
**Road vehicles — Design and
performance specifications for the
WorldSID 50th percentile male side-
impact dummy —**

**Part 2:
Mechanical subsystems**

*Véhicules routiers — Conception et spécifications de performance
pour le mannequin mondial (WorldSID), 50e percentile homme, de
choc latéral —*

Partie 2: Sous-systèmes mécaniques





COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction	vii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Mechanical requirements for WorldSID	2
4.1 Head	2
4.1.1 General description	2
4.1.2 Specifications	2
4.1.3 Validation	3
4.2 Neck	3
4.2.1 General description	3
4.2.2 Specifications	3
4.2.3 Validation	3
4.3 Thorax/abdomen/shoulder	4
4.3.1 General description	4
4.3.2 Specifications	4
4.3.3 Validation	4
4.4 Arms	5
4.4.1 General description	5
4.4.2 Specifications	5
4.5 Lumbar spine and pelvis	6
4.5.1 General description	6
4.5.2 Specifications	6
4.5.3 Validation	6
4.6 Upper legs and knees	6
4.6.1 General description	6
4.6.2 Specifications	6
4.7 Lower legs, ankles, and feet	6
4.7.1 General description	6
4.7.2 Specifications	7
4.8 Clothing	7
4.8.1 General description	7
4.8.2 Specifications	7
4.9 Whole dummy	7
4.9.1 General description	7
4.9.2 Specifications	7
4.9.3 Validation	8
5 Validation test procedures	10
5.1 Head	10
5.1.1 Principle	10
5.1.2 Apparatus	10
5.1.3 Sensors	10
5.1.4 Preparation	10
5.1.5 Procedure	12
5.1.6 Calculation procedures and expression of results	13
5.1.7 Test reports	13
5.2 Neck	13
5.2.1 Lateral flexion	13
5.2.2 Torsion	17
5.3 Thorax/abdomen/shoulder/pelvis full body tests	20
5.3.1 Full body test setup	20

5.3.2	Shoulder test.....	24
5.3.3	Thorax test.....	26
5.3.4	Abdomen test.....	28
5.3.5	Pelvis test.....	31
5.4	Whole body dimensions.....	33
5.4.1	Principle.....	33
5.4.2	Apparatus.....	33
Annex A (informative) Optional WorldSID whole body dimension measurement procedure with mechanical tools		44
Annex B (informative) Single rib test		47

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 36, *Safety and impact testing*.

This third edition cancels and replaces the second edition (ISO 15830-2:2013), which has been technically revised.

The main changes are as follows:

- in [Figure 1](#) head CG location has been changed to head reference mark location;
- body segment assembly mass specifications have been changed;
- clothing mass specification has been changed;
- in [Table 1](#) specifications of head resultant acceleration have been changed for frontal and lateral drops;
- in [Table 3](#) new neck torsion specifications were added for new neck torsion validation test procedure;
- in [Table 4](#) new specification for decay time in shoulder validation test has been added;
- calculation procedure for neck validation has been changed;
- in [Table 5](#) thorax specifications have been changed and validation test procedure specifies a new pendulum face;
- thorax with arm specifications and validation test procedure have been removed;
- full arm description and specifications have been removed;
- in [Table 7](#) specifications for pelvis acceleration and pendulum force have been changed and a new specification for pubic force has been added;
- in [Table 9](#) specifications and CMM procedure for whole body dimensions have been added;

- drawing list has been removed;
- in [Annex B](#) new procedure for optional single rib test has been added.

A list of all parts in the ISO 15830 series can be found on the ISO website.

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

The purpose of the ISO 15830 series is to document the design and specifications of this side-impact dummy in a form suitable and intended for worldwide use.

In 1997, the WorldSID 50th percentile adult male dummy development was initiated, with the aims of defining a global-consensus side-impact dummy, with more humanlike anthropometry, improved biofidelity, and increased injury monitoring capabilities, suitable, for example, for regulatory use. Participating in the development were research institutes, dummy and instrumentation manufacturers, governments and vehicle manufacturers from around the world.

This document is intended to document information and design changes which have become available since the publication of the second edition of the ISO 15830 series (2013-05-15).

In order to apply the ISO 15830 series properly, it is important that all four parts be used together.

Road vehicles — Design and performance specifications for the WorldSID 50th percentile male side-impact dummy —

Part 2: Mechanical subsystems

1 Scope

This document specifies requirements for mechanical components, specifications and validation tests for the WorldSID 50th percentile side-impact dummy, a standardized anthropomorphic dummy for near-side-impact tests of road vehicles.

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 6487, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

ISO 15830-1, *Road vehicles — Design and performance specifications for the WorldSID 50th percentile male side-impact dummy — Part 1: Vocabulary and rationale*

ISO 15830-3:2022 *Road vehicles — Design and performance specifications for the WorldSID 50th percentile male side-impact dummy — Part 3: Mechanical requirements for electronic subsystems*

ISO 15830-4:2022 *Road vehicles — Design and performance specifications for the WorldSID 50th percentile male side impact dummy — Part 4: User's manual*

ISO/TS 21002, *Road vehicles — Multidimensional measurement and coordinate systems definition*

SAE J211-1, *Instrumentation for impact test — Part 1: Electronic instrumentation*

SAE J1733, *Sign convention for vehicle crash testing*

SAE J2570, *Performance specifications for anthropomorphic test device transducers*

SAE J2856, *User's manual for 50th percentile male Hybrid III dummy*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15830-1 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/>

4 Mechanical requirements for WorldSID

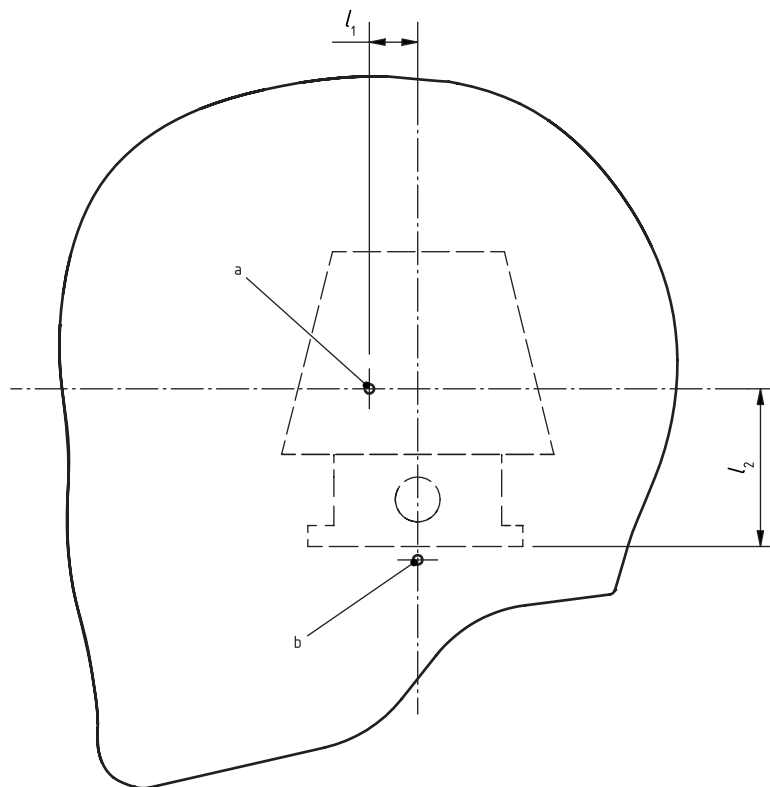
4.1 Head

4.1.1 General description

The head assembly shall consist of the components and assemblies shown in ISO 15830-4:2022, Clause A.1 excluding the neck shroud and five BHCS M4 × 0,7 × 10 LG.

4.1.2 Specifications

- The total assembly shall have a mass of 4,29 kg ± 0,05 kg.
- The head reference marks shall be located as indicated in [Figure 1](#).
- The materials used in the construction of the head assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.
- If present, cables exiting the head assembly shall exit at the rear and include a secure strain relief mechanism.



- l_1 (15,5 ± 2,5) mm
 l_2 (50,5 ± 2,5) mm
 a Head reference mark.
 b Occipital condyle.

Figure 1 — Head reference mark location

4.1.3 Validation

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in 5.1, the head assembly shall meet the specifications given in Table 1.

Table 1 — WorldSID head validation specifications

Frontal drop	
Variable	Absolute value
Peak resultant acceleration (g)	205 to 255
Peak lateral acceleration, a_y (g)	< 15
Maximum percentage, subsequent-to-main peak (%)	< 10
Lateral drop	
Variable	Absolute value
Peak resultant acceleration at CG (g)	104 to 123
Peak longitudinal acceleration, a_x (g)	< 15
Maximum percentage, subsequent-to-main peak (%)	< 10

4.2 Neck

4.2.1 General description

The neck assembly shall consist of the components shown in ISO 15830-4:2022, Clause A.2.

4.2.2 Specifications

- The total assembly shall have a mass of 2,86 kg $\pm$ 0,02 kg.
- The materials used in the construction of the neck assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.
- If present, cables exiting the neck assembly shall include a secure strain relief mechanism.

4.2.3 Validation

4.2.3.1 Lateral flexion

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in 5.2.1, the neck assembly shall meet the specifications given in Table 2.

Table 2 — WorldSID neck lateral flexion validation specifications

Variable	Absolute value
Maximum angular displacement of the head form relative to the pendulum, β (degrees)	50 to 61
Decay time of β to 0 degrees (ms) ^a	58 to 72
Peak moment at occipital condyle, M_{OCx} (N·m)	55 to 68
Peak moment decay time to 0 N·m (ms) ^a	71 to 87
Peak forward potentiometer angular displacement (degrees)	32 to 39
Time of peak forward potentiometer angular displacement, θ_F (ms) ^a	56 to 68
^a $T = 0$ ms is established following the procedure defined in 5.2.1.7.	

Table 2 (continued)

Variable	Absolute value
Peak rearward potentiometer angular displacement, θ_R (degrees)	30 to 37
Time of peak rearward potentiometer angular displacement, (ms) ^a	56 to 68
^a $T = 0$ ms is established following the procedure defined in 5.2.1.7 .	

4.2.3.2 Torsion

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in [5.2.2](#), the neck assembly shall meet the specifications given in [Table 3](#).

Table 3 — WorldSID neck torsion validation specifications

Variable	Absolute value
Peak torsion fixture rotation, z-axis (degrees)	41,9 to 51,2
Torsion fixture rotation decay time to 0 degrees (ms) ^a	37,3 to 45,6
First peak torsion fixture angular rate, ω_z (degrees/s) ^b	1 440 to 1 760
Peak lower neck moment, M_z (N·m)	34,6 to 42,9
^a $T = 0$ ms is established following the procedure defined in 5.2.2.7 .	
^b The angular rate is relative to the laboratory frame of reference, not the neck pendulum.	

4.3 Thorax/abdomen/shoulder

4.3.1 General description

The thorax/abdomen/shoulder assembly shall consist of the components and assemblies shown in ISO 15830-4:2022, Clause A.3.

4.3.2 Specifications

- The total assembly shall have a mass of 20,56 kg $\pm$ 0,35 kg.
- The materials used in the construction of the thorax/abdomen/shoulder assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.
- If present, cables exiting the thorax/abdomen/shoulder assembly shall include a secure strain relief mechanism.

4.3.3 Validation

4.3.3.1 Shoulders

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in [5.3.2](#), the shoulder assembly shall meet the specifications given in [Table 4](#).

Table 4 — WorldSID shoulder validation specifications

Variable	Absolute value
Peak pendulum force (kN)	2,6 to 3,3
Peak shoulder rib deflection (mm)	35 to 45

Table 4 (continued)

Variable	Absolute value
Delay time between peak pendulum force and peak shoulder rib deflection (ms)	> 15

4.3.3.2 Thorax

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in [5.3.3](#), the thorax assembly shall meet the specifications given in [Table 5](#).

Table 5 — WorldSID thorax validation specifications

Variable	Absolute value
Peak pendulum force (kN)	3,1 to 3,7
Peak T4 acceleration along y-axis (<i>g</i>)	14 to 20
Peak T12 acceleration along y-axis (<i>g</i>)	12 to 20
Peak thorax rib 1 deflection (mm)	35 to 45
Peak thorax rib 2 deflection (mm)	37 to 45
Peak thorax rib 3 deflection (mm)	33 to 41

4.3.3.3 Abdomen

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in [5.3.4](#), the abdomen assembly shall meet the specifications given in [Table 6](#).

Table 6 — WorldSID abdomen validation specifications

Variable	Absolute value
Peak pendulum force (kN)	2,7 to 3,1
Peak T12 acceleration along y-axis (<i>g</i>)	15 to 20
Peak abdomen rib 1 deflection (mm)	33 to 40
Peak abdomen rib 2 deflection (mm)	30 to 36

4.4 Arms

4.4.1 General description

The arm assembly shall consist of the components and assemblies shown in ISO 15830-4:2022, Clause A.4.

4.4.2 Specifications

- The total assembly shall have a mass of 1,76 kg ± 0,04 kg.
- The materials used in the construction of the arm assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.

4.5 Lumbar spine and pelvis

4.5.1 General description

The lumbar spine and pelvis assembly shall consist of the components and assemblies shown in ISO 15830-4: 2022, Clause A.5.

4.5.2 Specifications

- The total assembly shall have a mass of 19,30 kg $\pm$ 0,20 kg.
- The materials used in the construction of the pelvis assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.
- If present, cables exiting the pelvis assembly shall include a secure strain relief mechanism.

4.5.3 Validation

When assembled in accordance with ISO 15830-4 and tested using the procedure specified in [5.3.5](#), the pelvis assembly shall meet the specifications given in [Table 7](#).

Table 7 — WorldSID pelvis validation specifications

Variable	Absolute value
Peak pendulum force (kN)	6,8 to 8,2
Peak T12 acceleration along y-axis (<i>g</i>)	10 to 14
Peak pelvis acceleration along y-axis (<i>g</i>)	37 to 47
Peak pubic force (kN)	1,25 to 1,55

4.6 Upper legs and knees

4.6.1 General description

The upper leg assembly shall consist of the components and assemblies shown in ISO 15830-4:2022, Clause A.6 and Clause A.7.

4.6.2 Specifications

- The total assembly shall have a mass of 5,86 kg $\pm$ 0,04 kg.
- The materials used in the construction of the upper leg assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.
- If present, cables exiting the upper leg assembly shall include a secure strain relief mechanism.

4.7 Lower legs, ankles, and feet

4.7.1 General description

The lower leg, ankle, and foot assembly shall consist of the components and assemblies shown in ISO 15830-4:2022, Clause A.8.

4.7.2 Specifications

- The total assembly shall have a mass of 5,06 kg $\pm$ 0,07 kg.
- The materials used in the construction of the lower leg assembly shall not contain lead or lead alloys.
- The flesh material and/or external surface characteristics shall enable positive attachment of adhesive targets.
- If present, cables exiting the lower leg assembly shall include a secure strain relief mechanism.

4.8 Clothing

4.8.1 General description

The clothing shall consist of a form fitting polychloroprene suit covering from neck to ankle and stopping at the shoulder (sleeveless) as specified in ISO 15830-4:2022, Clause A.9.

4.8.2 Specifications

- The total assembly shall have a mass of 1,62 kg $\pm$ 0,16 kg.
- The materials used in the construction of the clothing shall not contain lead or lead alloys.
- The external surface characteristics shall enable positive attachment of adhesive targets.

4.9 Whole dummy

4.9.1 General description

The whole dummy assembly shall consist of the components and assemblies shown in ISO 15830-4:2022, Annex A.

4.9.2 Specifications

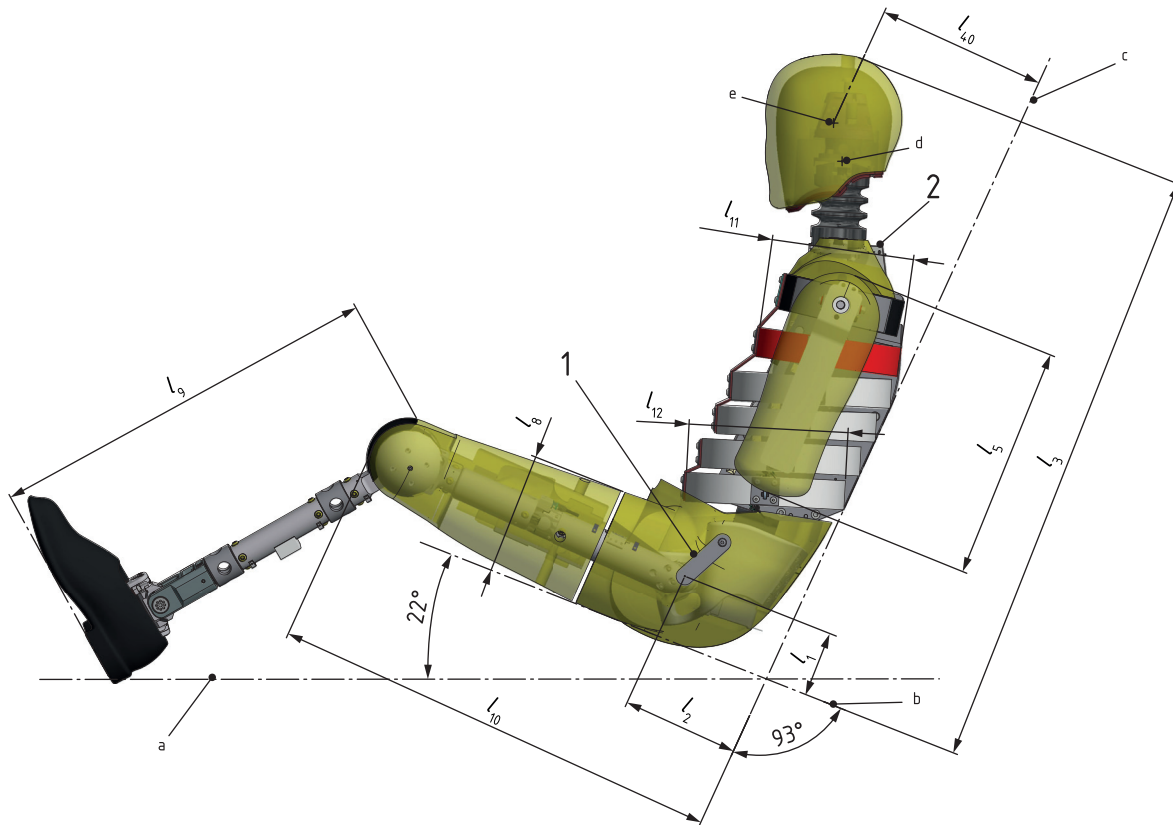
- The total dummy assembly with two half arms including clothing shall have a mass of 73,99 kg $\pm$ 1,08 kg.
- The body segment masses shall meet the specifications given in [Table 8](#).

Table 8 — WorldSID body segment mass specifications

Body segment	Mass [kg]
Head	4,29 $\pm$ 0,05
Neck	2,86 $\pm$ 0,02
Thorax/abdomen/shoulders	20,56 $\pm$ 0,35
Two half arms	3,52 $\pm$ 0,08
Lumbar spine and pelvis	19,30 $\pm$ 0,20
Two upper legs/knees	11,72 $\pm$ 0,08
Two lower legs/ankles/feet	10,12 $\pm$ 0,14
Clothing	1,62 $\pm$ 0,16
Total with clothing and half arms	73,99 $\pm$ 1,08

4.9.3 Validation

When assembled in accordance with ISO 15830-4:2022, Annex A, excluding the suit and moulded lower leg flesh, and measured using the procedure given in 5.4, the dummy shall meet the whole-body measurements shown in Figure 2 and Figure 3, and specified in Table 9.



Key

- 1 H-point tool
- 2 neck bracket
- a Horizontal.
- b Seat pan line.
- c Seat back line.
- d Occipital condyle.
- e Head reference mark.

Figure 2 — External dimensions, side view

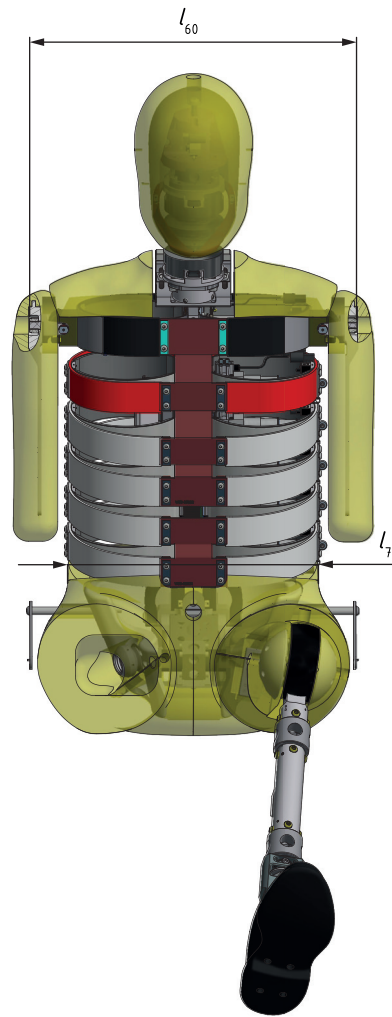


Figure 3 — External dimensions, front view

Table 9 — WorldSID linear dimension specifications

Dimensions in millimetres

Variable	Symbol	Value		
		Centre	Left	Right
Hip pivot height	l_1		85 ± 10	85 ± 10
Hip pivot to back line	l_2		175 ± 10	175 ± 10
Seated height	l_3	865 ± 20		
Head reference mark to seat back	l_{40}		250 ± 20	250 ± 20
Arm length	l_5		330 ± 10	330 ± 10
Width across shoulder attachment studs	l_{60}	435 ± 10		
Waist width	l_7	340 ± 10		
Thigh clearance	l_8		170 ± 10	170 ± 10
Knee to shoe height	l_9		580 ± 35	588 ± 35
Knee to back line	l_{10}		665 ± 15	665 ± 15
Thorax rib number 1 front to back	l_{11}		205 ± 10	205 ± 10

Table 9 (continued)

Variable	Symbol	Value		
		Centre	Left	Right
Abdomen rib number 2 front to back	l_{12}		225 ± 10	225 ± 10

5 Validation test procedures

5.1 Head

5.1.1 Principle

Certify the dynamic response of a head assembly by performing a 200 mm lateral drop on each side of the head and a 376 mm drop on the forehead.

5.1.2 Apparatus

The usual laboratory apparatus and, in particular, the following shall be used.

- horizontal head impact surface:
 - horizontal chrome-plated steel plate rigidly supported;
 - 50,8 mm × 610 mm × 610 mm minimum;
 - surface finish rms value of 8 µm/mm to 80 µm/mm.
- head drop tool assembly;
 - 120 g maximum.
- instrumented head assembly as described in ISO 15830-4:2022, Clause A.1, including the instrumentation insert and upper neck load cell or structural replacement, but excluding the neck shroud and five BHCS M4 × 0,7 × 10 LG.

5.1.3 Sensors

Use a triaxial linear accelerometer or three single-axis linear accelerometers as specified in ISO 15830-3:2022, 4.1.3.2.

5.1.4 Preparation

- Expose the head assembly to an environment with a temperature of 20,6 °C to 22,2 °C and a relative humidity between 10 % and 70 % for a period of at least four hours prior to a test.
- Clean the head skin surface and the surface of the impact plate with isopropyl alcohol or equivalent.
- Install the triaxial accelerometer or three single-axis linear accelerometers in the head assembly.
- Install the upper neck load cell, angular accelerometers, and dual-axis tilt sensor, or their structural or mass replacements.
- Suspend the head above the head impact surface using a quick release mechanism.
- For lateral tests, attach the head drop tool to the bottom of the upper neck load cell or its structural replacement with two SHCS M6 × 12 as shown in [Figure 4](#). The tool orients the midsagittal plane at an angle of 35,0° ± 1,0° with the impact surface and its anterior-posterior axis is horizontal to

within 1° as shown in Figure 5. Position the head so its lowest point is $200 \text{ mm} \pm 0,25 \text{ mm}$ above the impact surface.

- For a frontal test, attach the head drop tool to the bottom of the upper neck load cell or its structural replacement with two SHCS M6 $\times$ 12 as shown in Figure 6. The tool orients the frontal plane at an angle of $35,0^\circ \pm 1,0^\circ$ with the impact surface and its anterior-posterior axis is horizontal to within 1° as shown in Figure 7. Position the head so the lowest point on the forehead is $376 \text{ mm} \pm 0,25 \text{ mm}$ above the impact surface.

Dimensions in millimetres

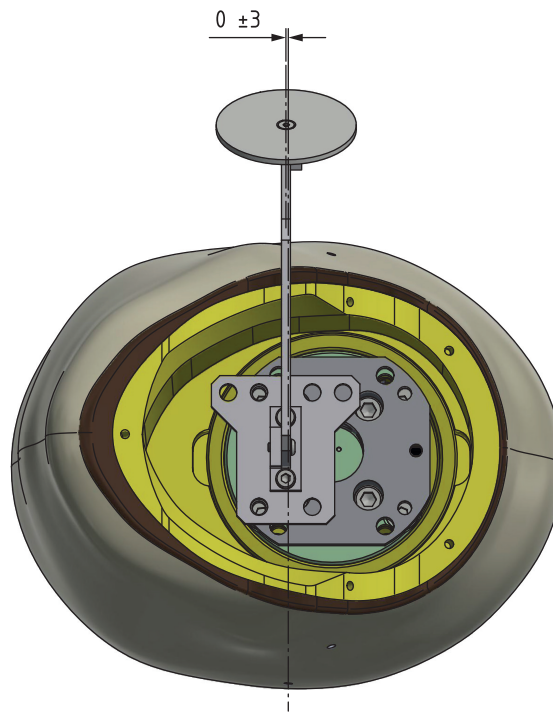


Figure 4 — Head drop tool installation for lateral drops

Dimensions in millimetres

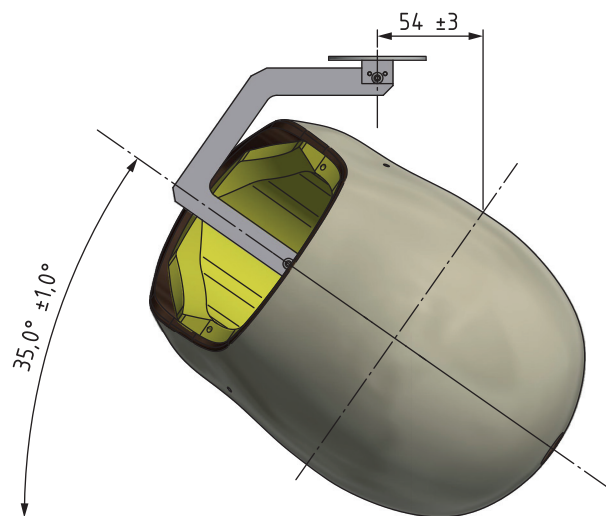


Figure 5 — Lateral head drop angle

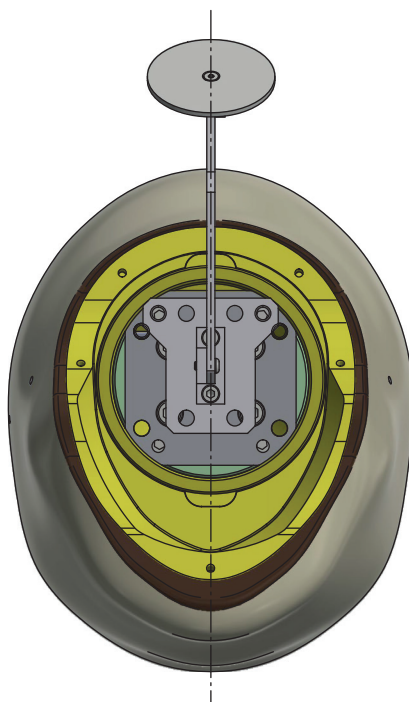


Figure 6 — Head drop tool installation for frontal drops

Dimensions in millimetres

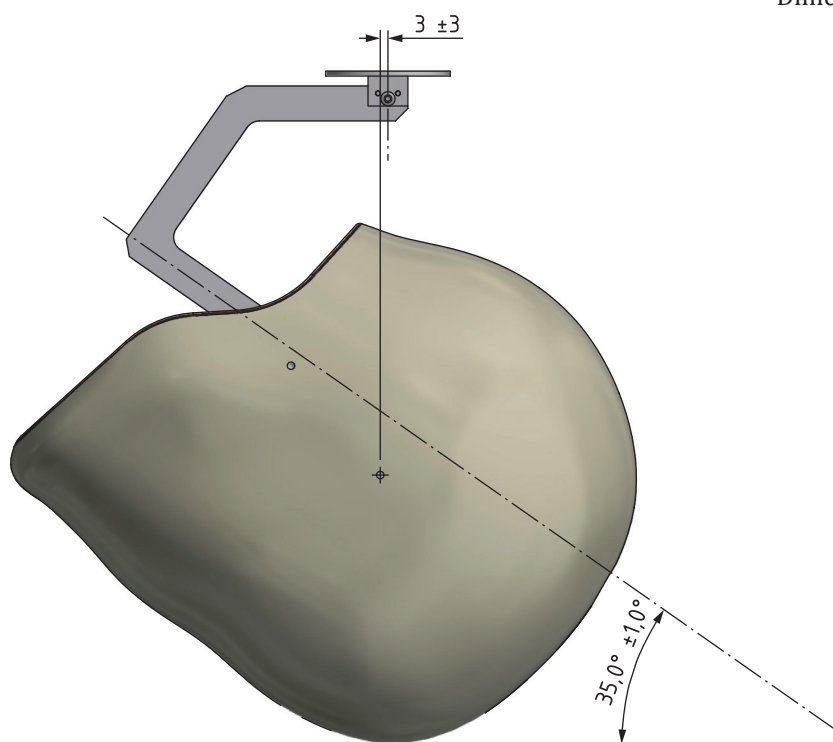


Figure 7 — Frontal head drop angle

5.1.5 Procedure

- Drop the head onto the rigid plate from the specified height by means that ensure quick release.