TECHNICAL REPORT

ISO/TR 12349-1

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Road vehicles — Dummies for restraint system testing —

Part 1: Adult dummies

Véhicules routiers — Mannequins pour essais de systèmes de retenue —

Partie 1: Mannequins adultes

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Foreword

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 36, *Safety aspects and impact test*.

This second edition cancels and replaces the first edition (ISO/TR 12349-1:1999), of which it constitutes a minor revision.

ISO/TR 12349 consists of the following parts, under the general title *Road vehicles — Dummies for restraint system tests*:

— *Part 1: Adult dummies*

— *Part 2: Child dummies*

Introduction

Some experts of ISO/TC 22/SC 36 reviewed the widely available adult crash test dummies on the basis of biofidelity, repeatability and reproducibility, durability, instrumentation capabilities, and ease of use. Implementation of a crash test dummy in a regulation or consumers' test is not a basis for recommendation in this Technical Report. Adult dummies whose designs were protected intellectual property at the time of review were not considered. Crash test dummies are continually being evaluated and those that are not currently recommended may be recommended in the next update of this Technical Report. This Technical Report represents the best recommendation of widely available adult crash test dummies at the time of publication.

The dummy instrumentation specified as required or optional in ISO test procedures for crash, sled, and OOP tests were reviewed. Adult dummy instrumentation recommended in this Technical Report consists of all instrumentation that are required by at least one test procedure. Some optional instrumentation and some instrumentation not specified in any ISO test procedure are also recommended in this Technical Report.

Road vehicles — Dummies for restraint system testing —

Part 1: Adult dummies

1 Scope

This Technical Report specifies the adult crash test dummies that are recommended by ISO for use in evaluating the occupant protection potential of restraint systems in frontal, side, and rear impact test procedures and out-of-position airbag test procedures.

2 Symbols and abbreviated terms

2.1 Symbols

A_x, A_y, A_z	linear acceleration along the positive x, y, and z axes of the dummy
α_x, α_y, α_z	rotational acceleration about the positive x, y, and z axes of the dummy
δ_x, δ_y, δ_z	deflection along the positive x, y, and z axes of the dummy
F_x, F_y, F_z	force along the positive x, y, and z axes of the dummy
M_x, M_y, M_z	moment about the positive x, y, and z axes of the dummy
ϕ_x, ϕ_y, ϕ_z	angle of rotation about the positive x, y, and z axes of the dummy
ω_x, ω_y, ω_z	rotational velocity about the positive x, y, and z axes of the dummy

2.2 Abbreviated terms

ASIS	anterior superior iliac spine
C.G.	centre of gravity
OOP	out-of-position

3 Recommended dummies

3.1 Adult dummies recommended for frontal impact tests

The following adult dummies are recommended for use in frontal impact crash and sled tests:

— Hybrid III small adult female with harmonized jacket (see Reference [10]) and without neck shield, unless a neck shield is specified by the test procedure;

— Hybrid III midsize adult male;

— Hybrid III large adult male.

3.2 Adult dummies recommended for side impact tests

The following adult dummies are recommended for use in side impact crash and sled tests:

— SID-IIs build level D small adult female (recommended on an interim basis);

— WorldSID midsize adult male.

3.3 Adult dummy recommended for high-severity rear impact tests

The Hybrid III midsize adult male is recommended for use in high-severity rear impact crash and sled tests.

3.4 Adult dummies recommended for out-of-position airbag tests

3.4.1 OOP tests with frontal impact airbags

The Hybrid III small adult female with harmonized jacket (see Reference [10]) is recommended for use in OOP tests with frontal impact airbags. Neck shield ABA-211 (see Reference [11]) is recommended, but should not be used if the test procedure does not specify the use of a neck shield. Instrumented arm(s) should be used, but no specific instrumented arm is recommended.

3.4.2 OOP tests with side torso or curtain airbags

The SID-IIs build level D small adult female is recommended for use in OOP tests with side torso or curtain airbags. Neck shield ABA-211 (see Reference [11]) is recommended, but should not be used if the test procedure does not specify the use of a neck shield. Instrumented arm(s) should be used, but no specific instrumented arm is recommended.

4 Recommended dummy instrumentation

4.1 Instrumentation recommended for adult dummies in frontal impact tests or OOP tests with frontal impact airbags

Table 1 gives the instrumentation that should be used with the recommended frontal impact dummies in ISO frontal impact test procedures (see Reference [1] and Reference [2]) and OOP test procedures with frontal impact airbags (see Reference [3], Reference [4], and Reference [5]).

Table 1 — Instrumentation recommended for adult frontal impact dummies

Dummy instrumentation	Hybrid III small female	Hybrid III midsize male	Hybrid III large male
Head			
Linear acceleration at C.G.	A_x, A_y, A_z	A_x, A_y, A_z	A_x, A_y, A_z
Angular acceleration	α_x, α_y, α_z	—	—
Angular rate	ω_x, ω_y, ω_z	ω_x, ω_y, ω_z	ω_x, ω_y, ω_z
Neck			
Upper neck loads and moments	F_x, F_y, F_z, M_x, M_y, M_z	F_x, F_y, F_z, M_x, M_y, M_z	F_x, F_y, F_z, M_x, M_y, M_z
Lower neck loads and moments	F_x, F_y, F_z, M_x, M_y, M_z	F_x, F_y, F_z, M_x, M_y, M_z	F_x, F_y, F_z, M_x, M_y, M_z
Thorax			
Spine acceleration[a]	A_x, A_y, A_z	A_x, A_y, A_z	A_x, A_y, A_z
Sternum acceleration	A_x	—	—

[a] At location specified by test procedure or injury criterion.

Table 1 *(continued)*

Dummy instrumentation	Hybrid III small female	Hybrid III midsize male	Hybrid III large male
Sternum deflection	δ_x	δ_x	δ_x
Lumbar			
Loads and moments	F_x, F_z, M_y	F_x, F_z, M_y	—
Pelvis			
Acceleration	A_x, A_y, A_z	A_x, A_y, A_z	A_x, A_y, A_z
ASIS loads and moments	F_x, M_y	F_x (upper and lower)	F_x (upper and lower)
Lower extremities (left and right)			
Femur load	F_z	F_z	F_z
Tibia/femur displacement	δ_x	δ_x	δ_x
Medial clevis load	F_z	F_z	F_z
Lateral clevis load	F_z	F_z	F_z
Upper tibia loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$	$F_x, F_y, F_z, M_x, M_y, M_z$	$F_x, F_y, F_z, M_x, M_y, M_z$
Lower tibia loads and moments	F_x, F_y, F_z, M_x, M_y	F_x, F_y, F_z, M_x, M_y	F_x, F_y, F_z, M_x, M_y

[a] At location specified by test procedure or injury criterion.

4.2 Instrumentation recommended for adult dummies in side impact tests or OOP tests with side torso or curtain airbags

Table 2 gives the instrumentation that should be used with the recommended side impact dummies in ISO side impact test procedures (see Reference [6] and Reference [7]) and OOP test procedures with side impact torso or curtain airbags (see Reference [4] and Reference [5]).

Table 2 — Instrumentation recommended for adult side impact dummies

Dummy instrumentation	SID-IIs small female	WorldSID midsize male
Head		
Linear acceleration at C.G.	A_x, A_y, A_z	A_x, A_y, A_z
Angular acceleration	$\alpha_x, \alpha_y, \alpha_z$	$\alpha_x, \alpha_y, \alpha_z$
Angular rate	$\omega_x, \omega_y, \omega_z$	$\omega_x, \omega_y, \omega_z$
Neck		
Upper neck loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$	$F_x, F_y, F_z, M_x, M_y, M_z$
Lower neck loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$	$F_x, F_y, F_z, M_x, M_y, M_z$
Shoulder		
Loads[a]	F_x, F_y, F_z	F_y
Rib acceleration[a]	A_y	A_x, A_y, A_z
Rib deflection[a]	δ_y	δ_y
Thorax		
Spine acceleration[a] [b]	A_x, A_y, A_z	A_x, A_y, A_z
Rib acceleration[a] (upper, middle, lower)	A_y	—
Rib deflection[a] (upper, middle, lower)	δ_y	δ_y
Abdomen		

[a] Left side or right side, depending on impact direction.

[b] At location specified by test procedure or injury criterion.

Table 2 *(continued)*

Dummy instrumentation	SID-IIs small female	WorldSID midsize male
Rib acceleration[a] (upper and lower)	A_y	—
Rib deflection[a] (upper and lower)	δ_y	δ_y
Lumbar		
Loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$	$F_x, F_y, F_z, M_x, M_y, M_z$
Pelvis		
Acceleration	A_x, A_y, A_z	A_x, A_y, A_z
Iliac wing load[a]	F_y	F_y
Sacro-iliac loads and moments[a]	—	$F_x, F_y, F_z, M_x, M_y, M_z$
Acetabulum load[a]	F_y	—
Pubic load	F_y	F_y[a]
Lower extremities (left and right)		
Femur neck load	—	F_x, F_y, F_z
Femur shaft loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$	$F_x, F_y, F_z, M_x, M_y, M_z$
Knee contact load (inner and outer)	—	F_y
Knee angular displacement	—	ϕ_y
Upper tibia loads and moments	F_x, F_z, M_x, M_y	F_x, F_y, F_z, M_x, M_y
Lower tibia loads and moments	F_x, F_z, M_x, M_y	F_x, F_y, F_z, M_x, M_y
Ankle angular displacement	—	ϕ_x, ϕ_y, ϕ_z

[a] Left side or right side, depending on impact direction.

[b] At location specified by test procedure or injury criterion.

4.3 Instrumentation recommended for adult dummy in high-severity rear impact tests

Table 3 gives the instrumentation that should be used with the recommended dummy for high-severity rear impact tests (see Reference [8] and Reference [9]).

Table 3 — Instrumentation recommended for adult dummy for high-severity rear impact tests

Dummy instrumentation	Hybrid III midsize male
Head Linear acceleration at C.G.	A_x, A_y, A_z
Neck Upper neck loads and moments Lower neck loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$ $F_x, F_y, F_z, M_x, M_y, M_z$
Thorax Spine acceleration[a]	A_x, A_y, A_z
Lumbar Loads and moments	$F_x, F_y, F_z, M_x, M_y, M_z$
Pelvis Acceleration	A_x, A_y, A_z

[a] At location specified by test procedure or injury criterion.

4.4 Instrumentation recommended for adult upper extremities for arm-airbag interaction tests

Table 4 gives the instrumentation that should be used with an instrumented adult arm in OOP airbag tests.

Table 4 — Instrumentation recommended for adult upper extremities for arm-airbag interaction tests

Location[a] and measurement	Channel
Upper arm loads and moments	F_x, F_y, F_z, M_x, M_y, M_z
Elbow moments	M_x, M_y
Elbow angular displacement	ϕ_y
Elbow acceleration	A_x, A_y, A_z
Forearm loads and moments	F_x, F_y, F_z, M_x, M_y, M_z
Wrist acceleration	A_x, A_y, A_z
[a] Left and/or right, depending on airbag location(s).	