

D.F

4.5 KG JNCAP/ECE Pedestrian Head Form Impactor

User Manual



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1. Introduction

The 4.5 KG JNCAP head form Impactor was developed in 2003 based upon the design of JARI-JAMA presented paper 443 “Development of JARI-JAMA Pedestrian Child and Adult Head-Form Impactors”, Yasuhore Matsui, et al..

Through the United Nation Economic Commission for Europe (UNECE) a proposal for a GTR (Global Technical Regulation)¹ has been issued. The Humanetics D.G and D.F head forms comply with all specifications set out in this GTR for the 3.5 and 4.5 kg pedestrian head forms.

The head form complies with the ISO adult head biofidelity requirements, as described in the document mentioned above, and is certified according to the standard HIII 50th percentile head drop test similar to the CFR 49, part 572, subpart E head drop test. A detailed description of the test procedure can be found in this manual.

An abstract of the Paper 443 “Development of JARI-JAMA Pedestrian Child and Adult Head- Form Impactors”, Yasuhore Matsui, et al. can be found below.

“Head injuries are the most common cause of pedestrian deaths in car-pedestrian accidents. To reduce the severity of such injuries, the International Organization for Standardization (ISO) has proposed subsystem tests in which child and adult head-form impactors are impacted upon a car bonnet top. The ISO designated the mass of the child head-form Impactor as 3.5 kg (i.e., the average mass of a 6-year old child’s head), and that of an adult as 4.5 kg. However, such head-form impactors have not been developed so far. In the study mentioned above the development of new child and adult head-form impactors according to the requirements of the ISO subsystem test procedures has been reported. “

¹ INF GR / PS / 161 Rev 1, Proposal For A Global Technical Regulation On Uniform Provisions Concerning The Approval Of Vehicles With Regard To Their Construction In Order To Improve The Protection And Mitigate The Severity Of Injuries To Pedestrians And Other Vulnerable Road Users In The Event Of A Collision

2. Description

2.1 Part Breakdown

The Impactor consists of an aluminum sphere covered by a PVC skin. This skin is clamped by an end plate mounted to the bottom of the sphere. The sphere and the end plate are bolted together using 8 hexagon socket head cap screws. Bolt holes are provided to mount three uni-axial accelerometer(s) to the inside of the end plate. The end plate is provided with threaded holes to mount the head form impactor during use and certification.

2.2 Mass and dimensions

The outer diameter of the Adult Head Form Impactor including the skin is 165 ± 1 mm. The thickness of the skin is 14 ± 0.5 mm.

The weight of a complete assembly including accelerometers is 4.50 ± 0.10 kg. The average weight of an array of three uni-axial accelerometers including the mount block is specified as approx. 10 grams.

Mass Moment of Inertia and Natural Frequency of the impactor are given in Table 1.

Table 1 Mass Moment of Inertia and Natural Frequency

Property	Requirement *	Specification
Mass Moment of Inertia around y-axis **	0.010 - 0.013kg*m ²	0.0111kg*m ²
First Natural frequency ***	> 5.0 kHz	10.8 kHz

* Requirements according Regulation EC 78-2009 and GTR-9

** The MMI is determined with CAD. More information is available on request.

*** The natural frequency was determined in a research program. More information is available on request.

3. Instrumentation

The head form Impactor is instrumented with accelerometers in three directions. Humanetics recommends the use of damped accelerometers with a damping ratio between 0.2 and 0.7 to avoid resonance with impacts against glass. However, damped accelerometers are not mandatory. JAMA-JARI specified the seismic mass location of accelerometer in direction of measurement axis within ± 10 mm from geometrical centre of the sphere, and in direction perpendicular to measurement axis within ± 1 mm from geometrical centre of the sphere.

The impactor's instrumentation options and mounts, including their seismic mass positions, are given in Table 2. Make sure to use the correct accelerometer and mount combination. Other instrumentation and mounts should not be used, and mounts intended for one accel type should not be used for another accel type, as it may not meet the specified seismic mass location.

The instrumentation Channel Frequency Class (CFC) response shall be 1000 Hz and Channel Amplitude Class (CAC) shall be 500 g as defined in ISO 6487:2002.

Table 2: Nominal location of Centre of Gravity and accelerometer seismic mass for 4.5 Kg head impactor* from centre of sphere;

Distance from geometrical centre of sphere		x	y	z
Centre of Gravity		0.0	0.0	-0.5
Meas-Spec Model 64 uni-axial (damped) on I.AG mounting block				
Seismic mass of accelerometer for direction of	x-axis measurement	5.8	0	0
	y-axis measurement	0	-5.8	0
	z-axis measurement	0	0	5.4
Kyowa uni-axial ASE-A (damped) on I.AW mounting block				
Seismic mass of accelerometer for direction of	x-axis measurement	7.8	0	0
	y-axis measurement	0	7.8	0
	z-axis measurement	0	0	9.2
Endevco 7264H (damped) and 7264C (undamped) uni-axial on I.AU mounting block				
Seismic mass of accelerometer for direction of	x-axis measurement	6.2	0.8	0
	y-axis measurement	0.8	-6.2	0
	z-axis measurement	0.6	0.6	4.3
Meas-Spec Model 68 (damped) and Endevco 7268C (undamped) tri-axial directly mounted				
Seismic mass of accelerometer for direction of	x-axis measurement	0	0	0
	y-axis measurement	0	-8.3	0
	z-axis measurement	0	0	-5.8
Meas-Spec EGCS-S425 (damped) on I.AU-E1 mount block				
Seismic mass of accelerometer for direction of	x-axis measurement	8.15	0	0
	y-axis measurement	0	-8.15	0
	z-axis measurement	0	0	3.6

* Coordinate system: Z-axis is perpendicular to end plate mounting face and positive in propulsion direction. Positive Y-axis is indicated by arrow on end plate.

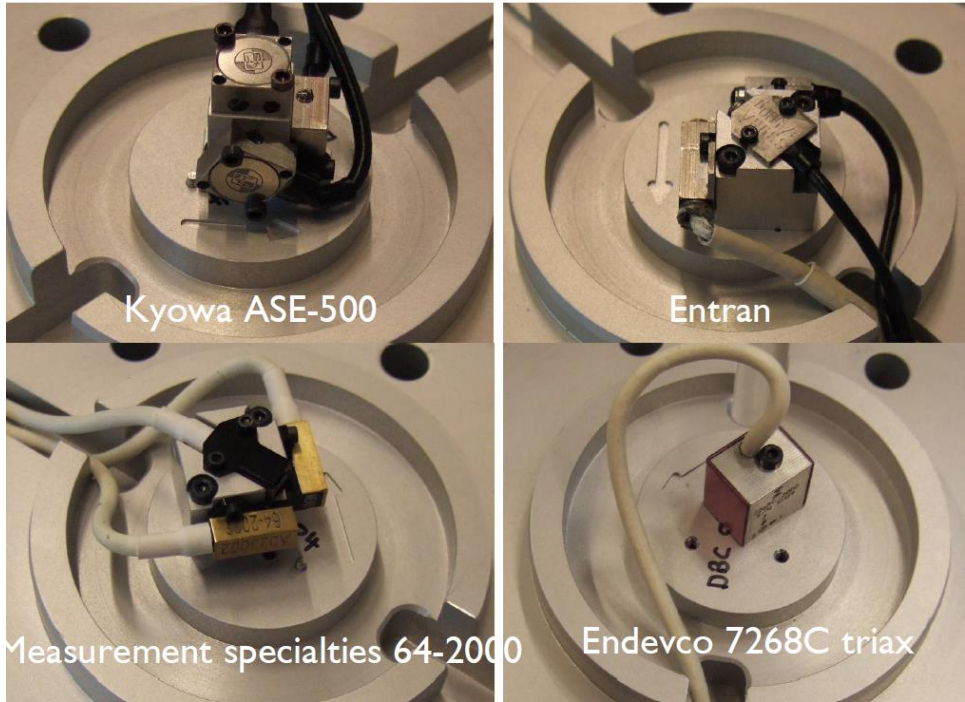


Figure 1 Pictures showing typical accelerometers and mounts assembled

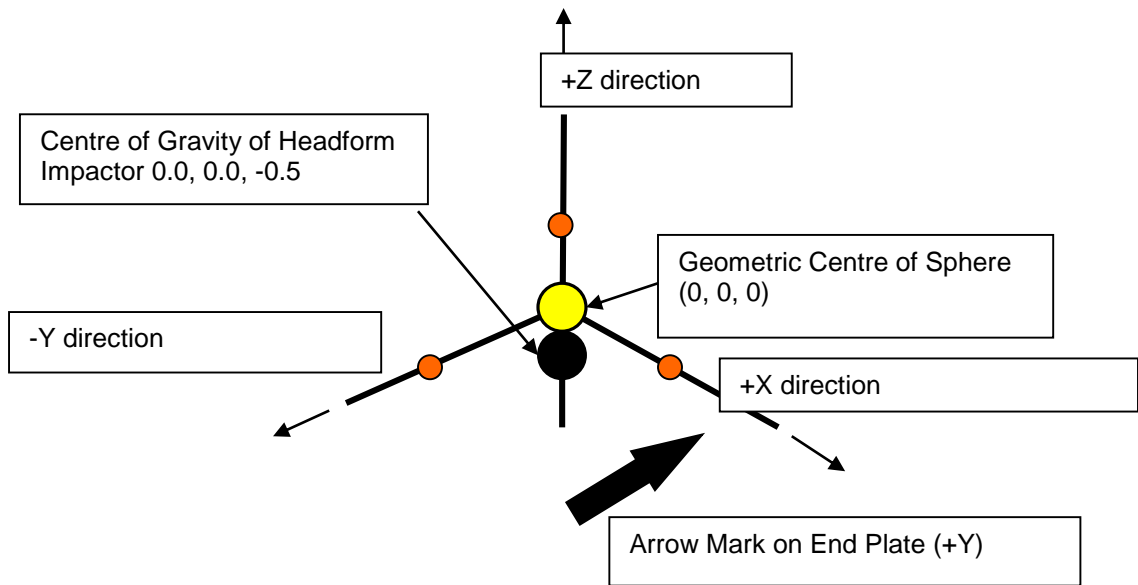


Figure 2: Seismic mass co-ordinate system

4. Assembly

Both adult and child head form impactors are assembled in the same way.

1. **Skin:** the skin is fitted over the sphere and positioned such that the lip of the skin is flush with the mating face.
2. **Accelerometers:** Accelerometer mounts listed above can be mounted to the inside of the back plate using two M2 screws.
3. **End plate:** The sphere and the end plate are bolted together using the M8 x 50 SHCS screws. To avoid damaging the cable make sure it is not clamped between sphere and end plate but routed through one of the recesses in the end plate.
4. **Magnet Plate:** The magnet plate is designed to accommodate the holding of the head form with an electro magnet.

Table 3: Parts list

Part No.	Part Name	Number Required	Material
D.FA	Sphere	1	Aluminum
D.FC	Back plate	1	Aluminum
D.BB	Skin Certified	1	PVC
D.FD	Magnet plate	1	Steel
5000325	M8 x 1.25 x 40 lg. SHCS	8	Steel
5000098	M3 x 0.5 x 6 lg. FHCS	6	Steel

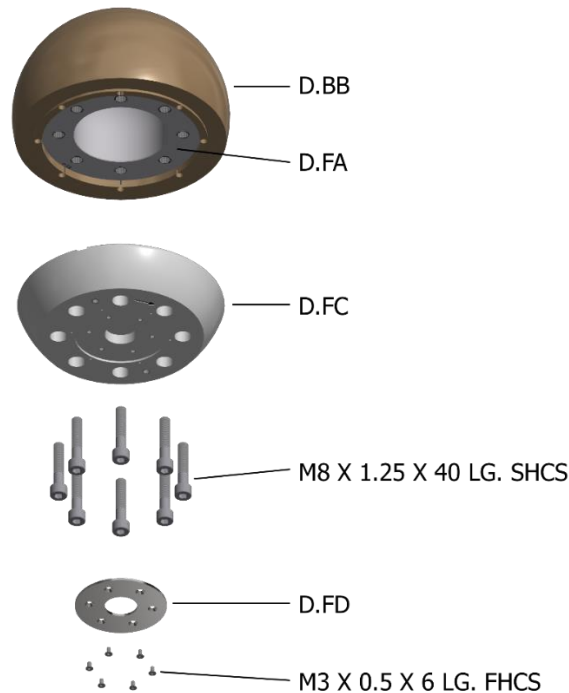


Figure 3: D.F 4.5 KG JNCAP/ECE Head form Impactor

5. Certification procedure

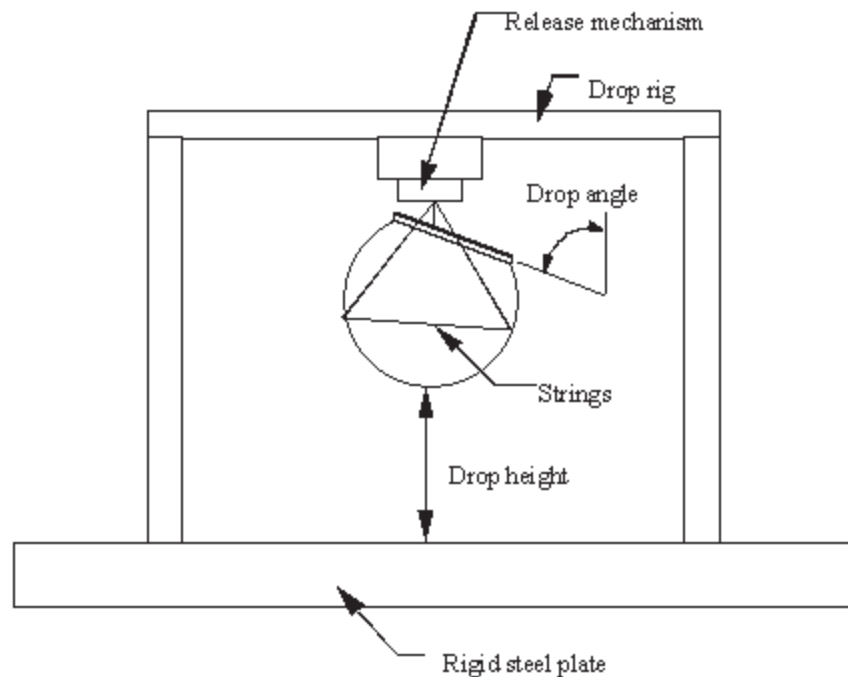


Figure 4: Certification test set-up.

Procedure below is equal to the procedure in the proposed Global Technical Regulation of the UNECE (ref.1). The certified impactor may be used for a maximum of 20 impacts before recertification. The impactor shall also be recertified if more than one year has expired.

1. In order to achieve reproducible results, the head form impactors have to be certified. Therefore, the following certification test is prescribed.
2. The head form is tested according to Head drop test procedure for the Hybrid III 50th percentile dummy head as described in the 49 CFR, part 572, subpart E.
3. The head form Impactor is suspended as shown in Figure 4. The drop height for the adult head form Impactor is 376 ± 1 mm. The flat face of the head form Impactor is set at a $65^\circ \pm 2^\circ$ to the vertical (or 25° to the horizontal).
4. The suspension of the head form Impactor should be such that the Impactor does not rotate during the drop.
5. The ambient temperature as well as the temperature of the Impactor has to be $20^\circ \pm 2^\circ \text{C}$. The relative humidity should be between 10 and 70%.

6. The head form Impactor is dropped onto a rigid steel surface and its resultant acceleration is measured during impact. The steel plate must conform to ECE R127 over 50 mm thick and more than 300 mm square with a surface finish of 0.2 to 2 micrometers (8 to 80 micro inch).
7. For the adult head form Impactor, the peak resultant acceleration has to be between/ or equal to 225 and 275 g.
8. This test has to be performed three times with the head form Impactor rotated by 120° along its symmetrical axis after each impact. By doing this the skull cap will be certified on three different positions on its circumference.
9. When all the peak resultant accelerations are within the specified corridors the head form Impactor is certified and ready for testing.

6. Attachment to propulsion system

There are two ways of fitting the head form Impactor to a propulsion system. The head form impactor is centrally located using a 24.8 mm diameter recess at the back of the end plate for both options and can be attached as described below. Users are free to apply any attachment and release system as desired. Two M5 threaded holes are also provided to fit a catch rope.

An electro magnet can be used to attach to the steel magnet holding plate at the back of the head form.

Or, attach the end plate to the propulsion system using two M2 nylon break screws. These provide enough strength to ensure the holding of the assembly prior to the shot and are designed to break just below the screw head, enabling the user to remove the remnants from the end plate with a set of pliers.

Nylon break screws can be purchased at Humanetics.

Manual Update Log

Rev. 1.2. – March 2006

Rev. 1.3 – October 2013

Manual changed from FTSS to Humanetics

Rev. A, Aug. 2015

Added user manual part number, D.F-9900

Page 1: Added picture

Page 2: Added lead material statement

Rev. B, March 2017

Moved parts list and assembly picture to assembly section. Added CFC and CAC requirements. Added JAMA-JARI seismic mass location requirements. Added additional accelerometers to Measurement-Specialties EGCS-S425 and their mounts including seismic mass position table. Updated to new Endevco 7264C and 7264 H seismic mass location specs. Added certification frequency. Added MMI and natural frequency specifications. Added photos of typical accel mounting. Added co-ordinate system figure. Defined tolerance for head drop height and drop angle. Defined impact plate and finish. Word magnetic was replaced with ferritic in attachment section.

Changed part number D.BB to D.BBO.

Rev. C, Sept. 2018

Updated Humanetics address; Table 3: D.BB was D.BBO and added certified to description, Removed 5000509; Updated Figure 3; Reworded 6. Attach to propulsion system