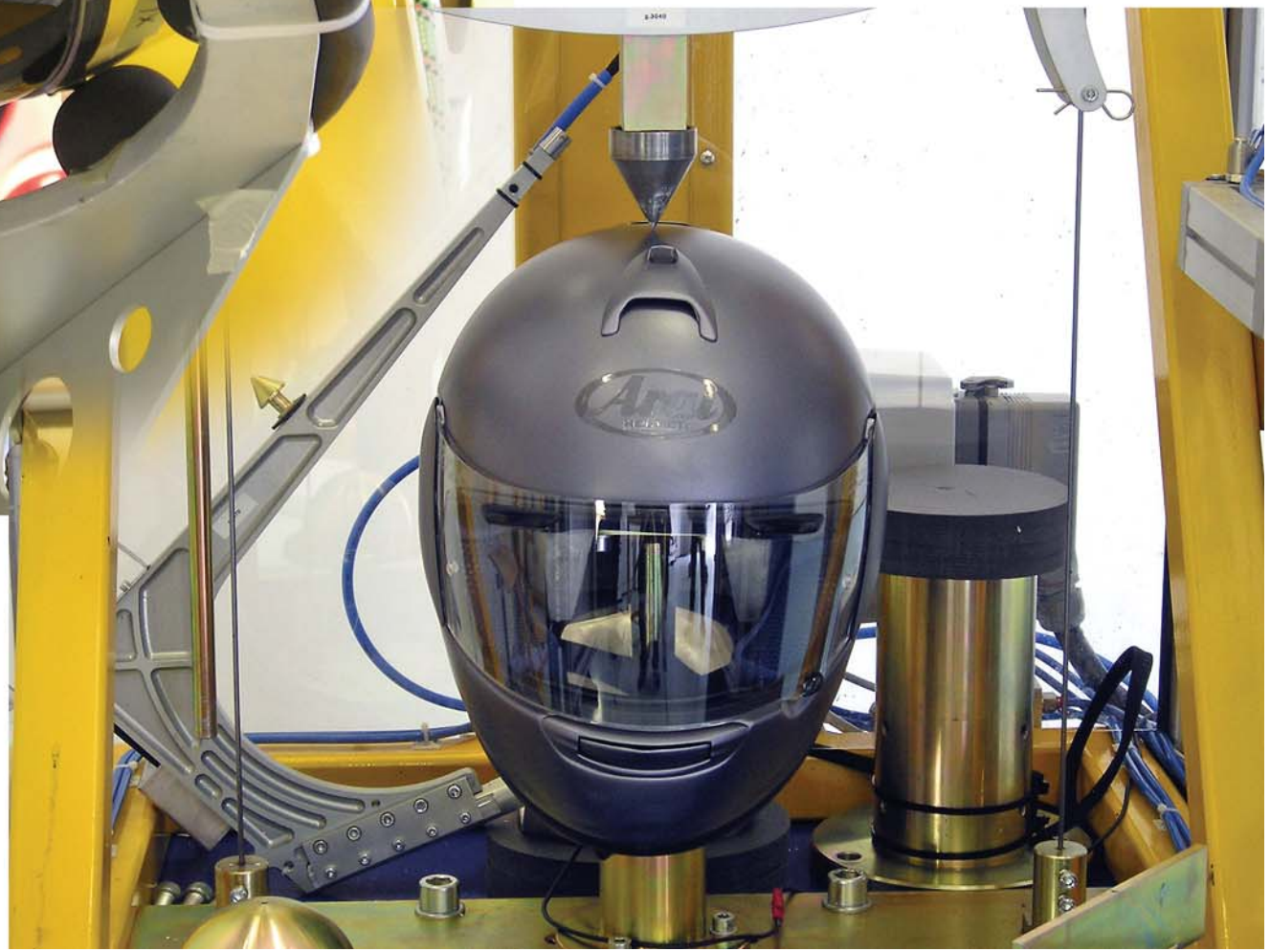
HELMET TESTING STANDARDS

Laser beam positioning of impact point

Positioning of penetration impact test striker (cone)



there is a difference

DISCLAIMER

This brochure does not represent a complete overview of any of the homologations, standards, approvals or certifications presented and is intended for general information on the subject only. All reasonable measures have been taken to ensure the quality, reliability, and accuracy of the information in this brochure. However Arai Helmet (Europe) BV is not responsible for any statement, opinion, view or procedure in relation to any person or organisation and the content of this brochure is intended to provide information only. If you are seeking advice of information on any matters relating to the information in this brochure please contact the approval or certifications authorities concerned.

This brochure presents a brief overview of the test procedures as used during the major international helmet homologation tests. Please note that this brochure does not represent the official procedures, laws and rules.

CONTENT

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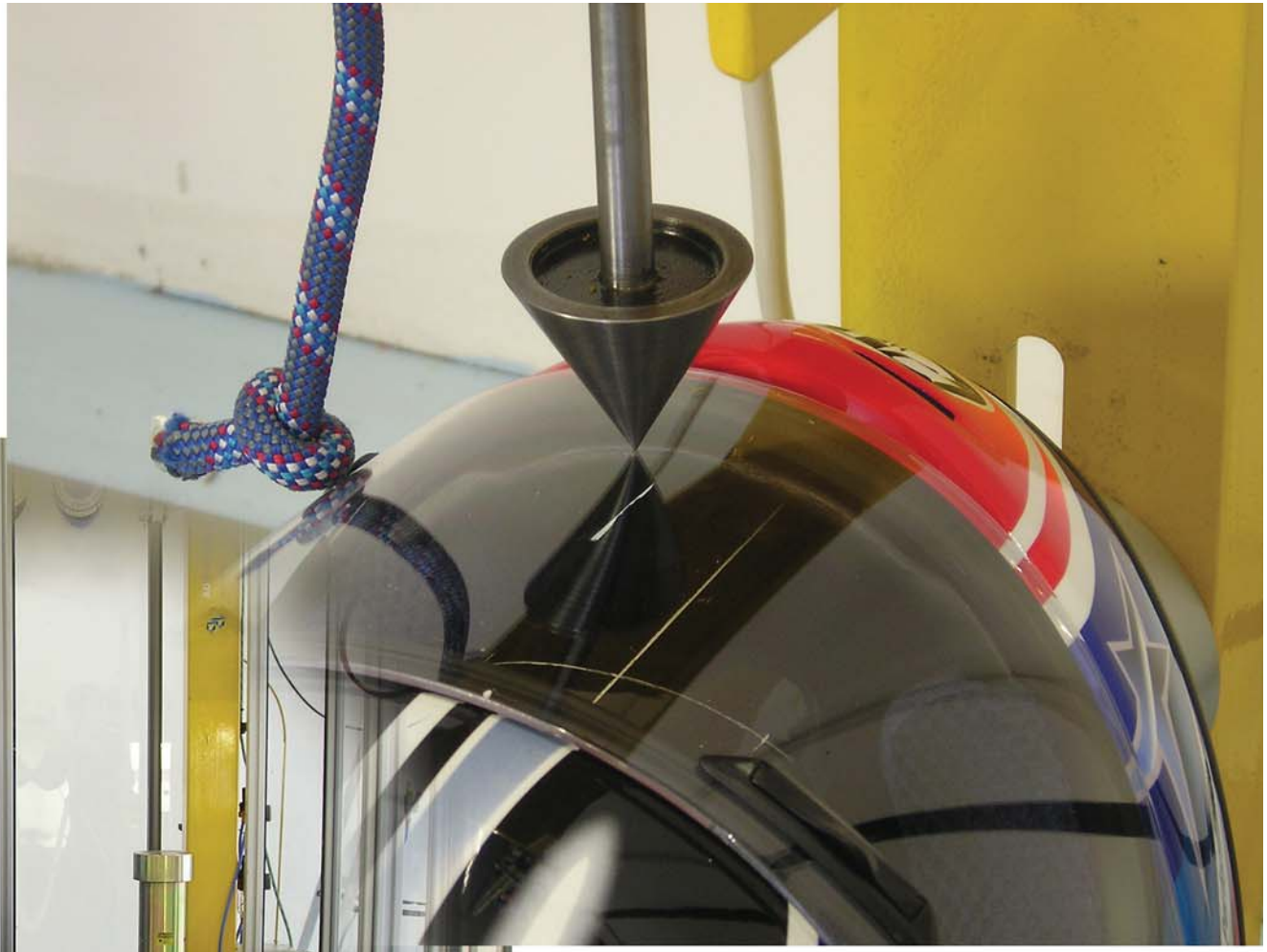
there is a difference



Visor penetration test

Read out of computer data

Helmet test ECE 22-05

Conditioning of the helmets

Prior to certain tests, the helmet must be ''conditioned''. This means that the helmet must be exposed to a certain temperature, relative humidity, UV radiation, water and solvent for a given amount of time before certain tests.

Heat conditioning = the helmet will be exposed to a temperature of 50° C (± 2 ° C) for not less than 4 hours and not more than 6 hours. (Used for shock absorption test with kerbstone anvil).

Low-temperature conditioning = the helmet will be exposed to a temperature of -20 ° C (± 2 ° C) for not less than 4 hours and not more than 6 hours. (Used for shock absorption test with flat anvil).

Ambient temperature conditioning = the helmet will be exposed to a temperature of 25 ° C (± 0,5 ° C) for at least 4 hours.

Hygrometry conditioning = the helmet will be exposed to a relative humidity of 65 % (± 5 %) for at least 4 hours.

UV (ultraviolet-radiation) conditioning = the outer surface of the helmet is will be exposed to ultraviolet irradiation by 125-watt xenon-filled quartz lamp for 48 hours at a range of 25 cm. (Used for shock absorption test with kerbstone and flat anvil).

Moisture conditioning = the outer surface of the helmet will be exposed to spraying for 4 tot 6 hours with water at ambient temperature at the rate of 1 litre per minute. (Used for shock absorption test with kerbstone and flat anvil).

Solvent conditioning = special solvent (liquid B/ISO 1817:1985 = 70% octane and 30% toluene) is applied with a cotton cloth to specified regions of the outer shell.

Dynamic test of retention system

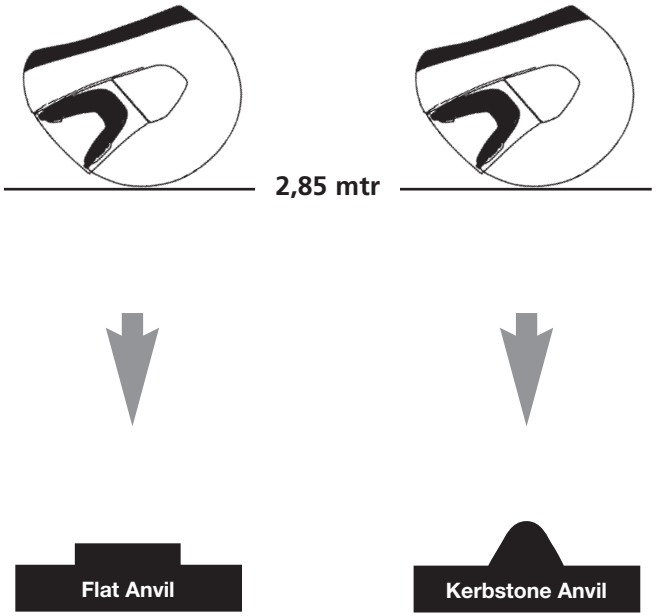
Preload	15 kg
Drop mass and height	10 kg x 0,75 mtr
Requirement	Allowance of dynamic displacement: less than 0,035 mtr Allowance of residual displacement: less than 0,025 mtr

Shock absorption test

Drop speed and height

Flat anvil	Kerbstone anvil
7.5 m/s (2,85 mtr) Point S 5.5 m/s	7.5 m/s (2,85 mtr) Point S 5.5 m/s

The maximum acceleration of the headform shall not exceed 275 G. De HIC value shall not exceed 2400. Each impact point is tested only once.



Visors

Visors are subject to:

1) Abrasion (scratch resistance) test
2) Light transmission/diffusion test
3) Penetration test
4) Mist retardant test (optional)

ECE 22-05

The ECE 22-05 describes the uniform provisions by the United Nations concerning the approval of protective helmets and their visors for riders and passengers of motor cycles and mopeds

HIC VALUE = HEAD INJURY CRITERION

The acceleration against time at the centre of gravity of the headform, is measured and recorded and from those figures the Head Injury Criterion or the HIC value is calculated. In general, a lower HIC value means a lower head in jury criterion and is therefore regarded as a ''better'' value. But please keep in mind that the HIC value is however a purely theoretical value and represents a low speed test, comparable with a speed of only 27 kilometres per hour (7,5 meter per second) and is therefore favourable to certain helmet construction types. As is true for all test values: they are never a guaranteed for the true performance of any helmet during actual crash conditions.

VISORS

- Abrasion test: 3 kg of abrasive material (natural quartz sand, grain size 0.50/0.7 mm) is allowed to drop through a gravity tube from a height of 1650 mm on the flattest part of the visor, that is fixed a on turntable. This turntable is situated on 45 degree angle to the direction of the sand. The speed of the turntable is 250 rpm. Afterwards the visor will be washed and cleaned and the luminous transmission shall be measured.
- Visors should have a minimum luminous (light) transmittance of Tv...80%
- If the visor is marked with the ''Daytime use only'' text or the appropriate ''sun'' symbol, a luminous transmittance of Tv...50% is permissible.

- (optional) If the visor is regarded as having a mist retardant facility, this may be indicated by the words ''MIST RETARDANT''

Helmet test ECE 22-05

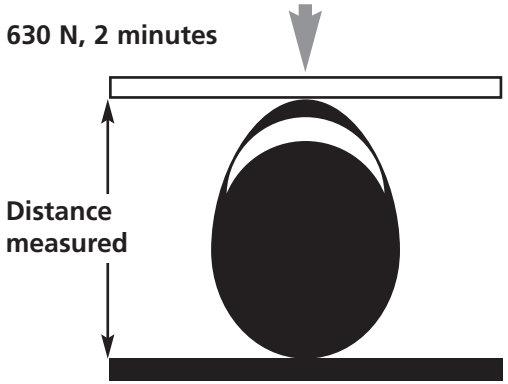
Rigidity test

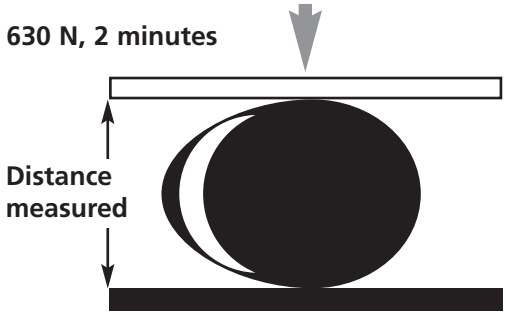
Preload: an initial load of 30 N shall be applied for 2 minutes.

The load shall be increased by 100 N every 2 minutes to a maximum of 630 N.

After 2 minutes of application of 630 N, the distance between the plates shall be measured.
Allowance: less than 0,04 mtr

After restoration of the 30 N load, the deformation shall be measured.
Allowance: less than 0,015 mtr



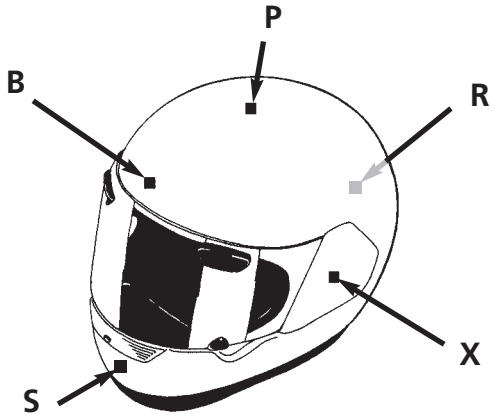


Resistance to penetration visor test

A 3 kg drop hammer falls from a height of 1 mtr on 0.3 kg punch (striker).

The punch must be stopped no less than 0,005 mtr above the headform.

Impact measuring points



APPROVAL NUMBERS AND SYMBOLS

The international approval mark (a circle surrounding the letter E followed by the country number : E4 for The Netherlands for instance) and one of the following letters:

J = Jet (if the helmet does not have a lower face cover)
P = Protective (if the helmet has a protective lower face cover)
NP = Non Protective (if the helmet has a non protective lower face cover)

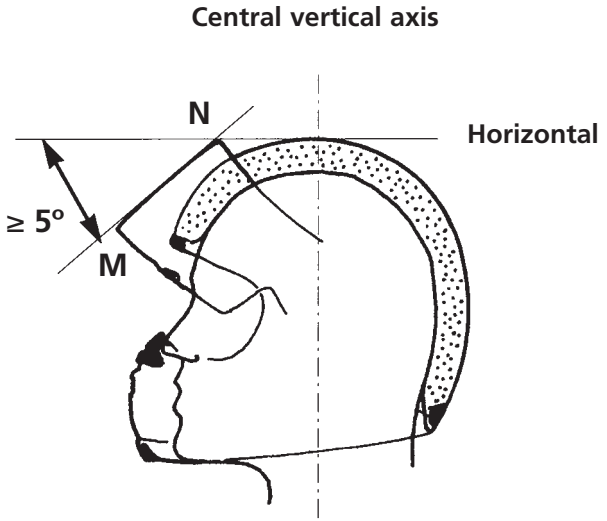
Example: **E4 P-0595011 0087340**

E4 = The Netherlands
P = protective lower face
05 = conform to the ECE 22-05 homologation
95011 = type approval of the medium-large sized RX-7 Corsair model
0087340 = unique continuous Arai serial number

If the helmet is fitted with a non protective lower face cover, the cover shall be marked with the text "DOES NOT PROTECT CHIN FROM IMPACTS" or the following symbol:

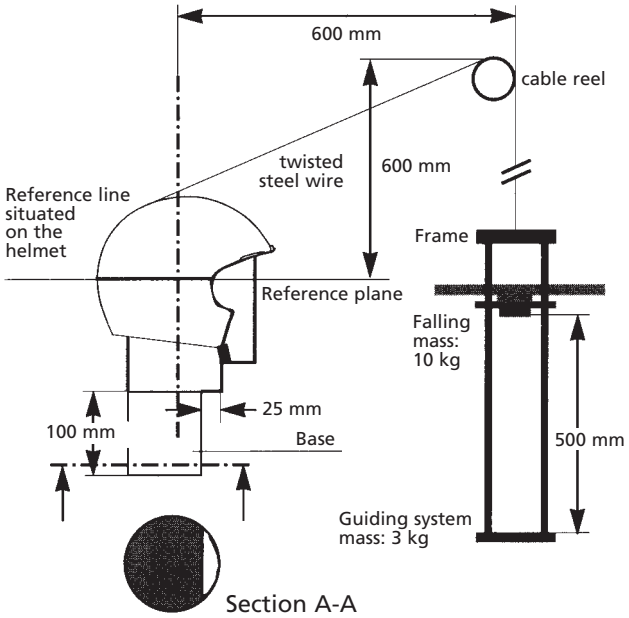
Visor opening

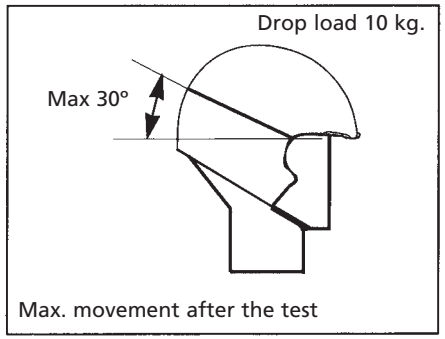
Testing the angel of visor opening



The MN line is the straight line joining the points of the upper and lower edges of the visor contained in the median vertical plane of the helmet.

Retention (roll –off) test





HEADFORMS

Five different headforms are used for testing:

Symbol	Size in cm.	Mass in kg
A	50	3.1
E	54	4.1
J	57	4.7
M	60	5.6
O	62	6.1

ECE headforms

Rentention (roll-of) test

Helmet test — Snell M 2005

Conditioning of the helmets

Prior to certain tests, the helmet must be ''conditioned''. This means that the helmet must be exposed to a certain temperature, relative humidity, UV radiation, water and solvent for a given amount of time before certain tests.

Special conditioning = a solvent mix (50% toluene and 50% isooctane) is applied to specified regions of the outer shell and at least 30 minutes shall elapse before further testing.

Cold-cycle = the helmet is exposed to a temperature of -20 ° C (± 2 ° C) or at the discretion of the Foundation's technicians a temperature of -30 ° C (± 2 ° C), for no less than 4 hours, but not more than 24 hours.

.

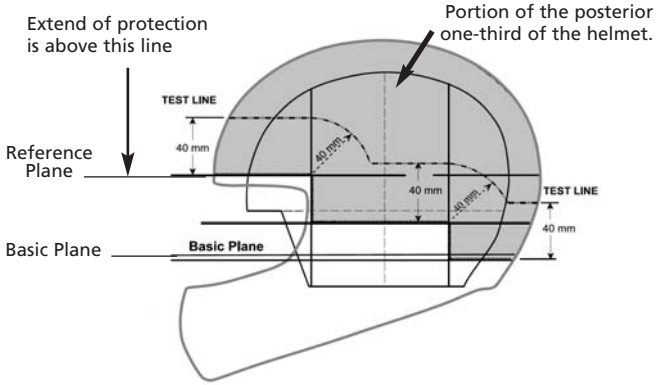
Hot-cycle = the helmet will be conditioned to a temperature of 50° C (± 2 ° C) for not less than 4 hours and not more than 24 hours.

Wet-cycle = the sample helmet shall be conditioned by continuously sprayed with water directed at the helmet's external surfaces at a temperature of 25 ° C (± 5 ° C) for a period of not less than 4 hours but not more than 24 hours.

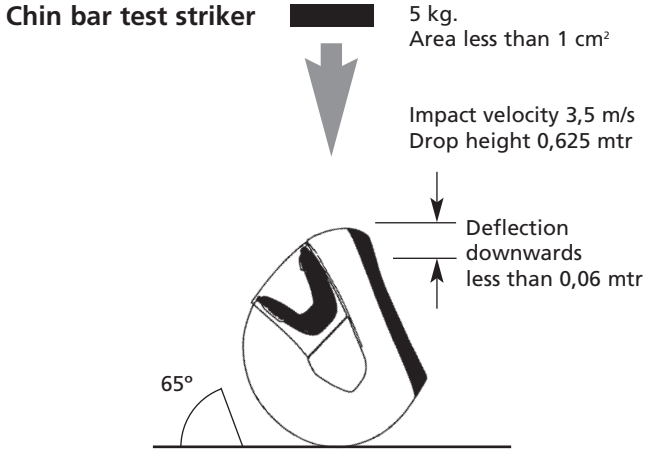
Ambient temperature = test samples may be kept at laboratory ambient temperature and humidity.

Extent of protection

The test area for shock absorption testing lies 40 mm above the reference line.

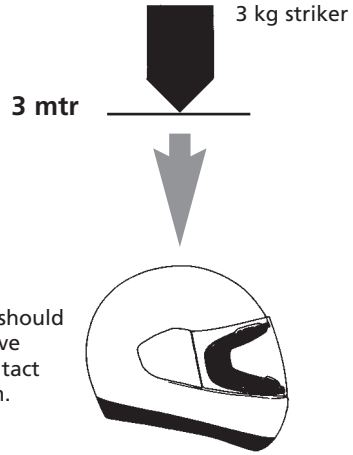


Chin bar test



Penetration test

A 3 kg striker with a 60 degree cone, falls from a height of 3 mtr on any site on or above the testline.



Allowance: the striker should not penetrate to achieve even momentaroly contact with the test headform.

Dynamic test of retention system

Preload	23 kg x 2 minutes
Dynamic test load	38 kg x 120 mm
Allowed Elongation	less than 0,03 mtr

SNELL M 2005

The Snell M 2005 standard for protective headgear for use with motorcycles and other motorized vehicles. Note: no ''flip-up'' chinguard helmet has ever been approved or certified by the Snell foundation.

Visor penetration test: a soft lead pellet weighing 1gramm with a diameter of 5,5 mm, travelling at a speed of 500 kilometers per hour strikes the visor. This test will take place on three different locations: in the centre line and 80 mm left and right of this line. The pellet must not penetrate to the interior of the helmet.

Removability: a technician must be able to remove the helmet form the largest headform with the help of simple, common hand tools in less than thirty seconds.

Penetration test: a test strike with a weight of 5 kg is dropped from 3 metres falls on any site on or above the test line. The striker must not achieve even momentary contact with the test headform.

Positional Stability (Roll-Off) Test
A head form is mounted on a stand so that it points face downward at an angle of 135 degrees. A wire rope is hooked to the rear edge of the helmet and brought forward so that its free end runs across the helmet and downward towards the floor. The free end of the rope has a mechanical stop with a 4 kg weight resting on the stop. The weight is raised to a 60 cm height and dropped onto the stop. The resulting shock places a rotational load on the helmet. The helmet may be shifted, but must not roll off the head form. Next the head form is repositioned, so that is facing upward. As in the first case, the helmet may be shifted but must not roll off the head form.


ISO headforms

Helmet test — Snell M 2005

Shock absorption test

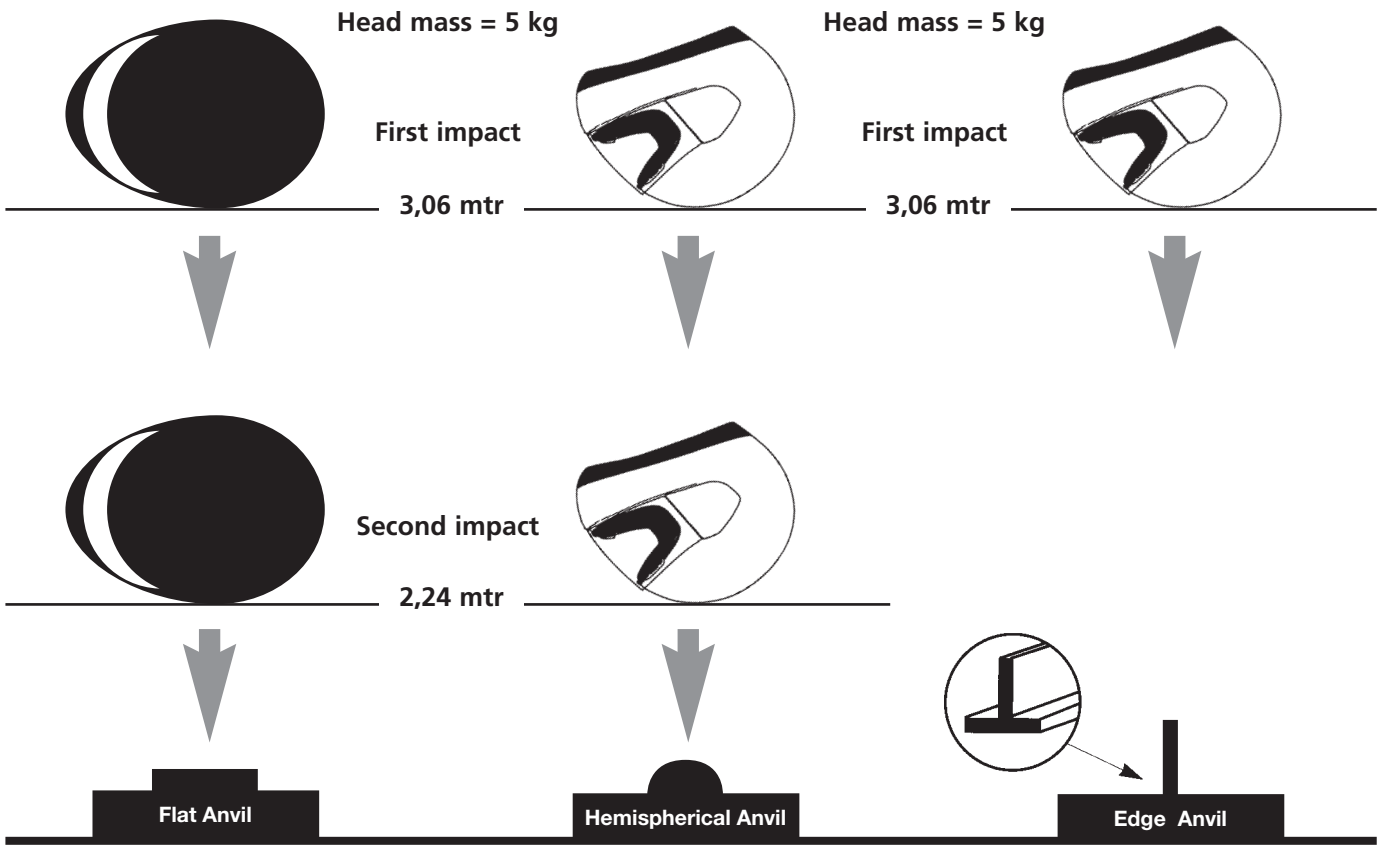
First impact

Flat Anvil	Hemispherical Anvil	Edge Anvil
150 J 3,06 mtr	150 J 3,06 mtr	150 J 3,06 mtr

Second impact

Flat Anvil	Hemispherical Anvil
110 J 2,24 mtr	110 J 2,24 mtr

Height depends on head mass. J = mass x dropheight x 9,8



Given an ideal frictionless mechanical test facility, this standard impact energy represents a exact 3,06 mtr drop (exact 2,24 mtr for the second impact) of a 5 kg headform and supporting assembly. With a dropping mass of 5 kg, maximum peak acceleration shall not exceed 300 G.

Penetration test

Helmet test — Snell SA/K 2005

Shock absorption test

First impact

Flat Anvil	Hemispherical Anvil	Edge Anvil
150 J 3,06 mtr	150 J 3,06 mtr	150 J 3,06 mtr

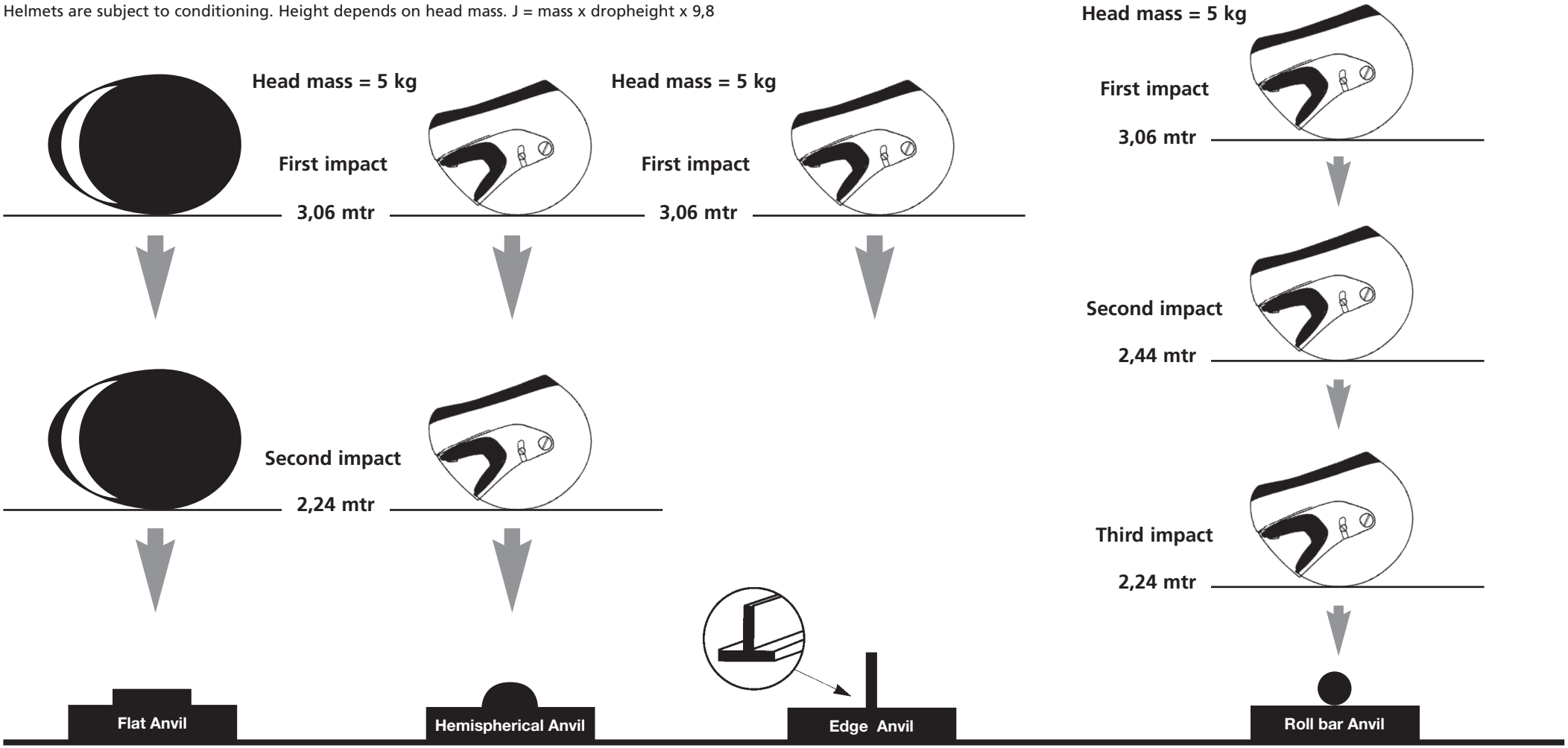
Second impact

Flat Anvil	Hemispherical Anvil
110 J 2,24 mtr	110 J 2,24 mtr

Roll bar Anvil

First impact	Second impact	Third impact
150 J 3,06 mtr	120 J 2,44 mtr	100 J 2,24 mtr

Helmets are subject to conditioning. Height depends on head mass. J = mass x dropheight x 9,8



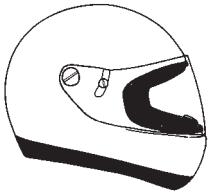
Given an ideal frictionless mechanical test facility, this standard impact energy represents a exact 3,06 mtr drop (exact 2,24 mtr for the second impact) of a 5 kg headform and supporting assembly. With a dropping mass of 5 kg, maximum peak acceleration shall not exceed 300 G.

Helmet test — Snell SA/K 2005

Penetration test

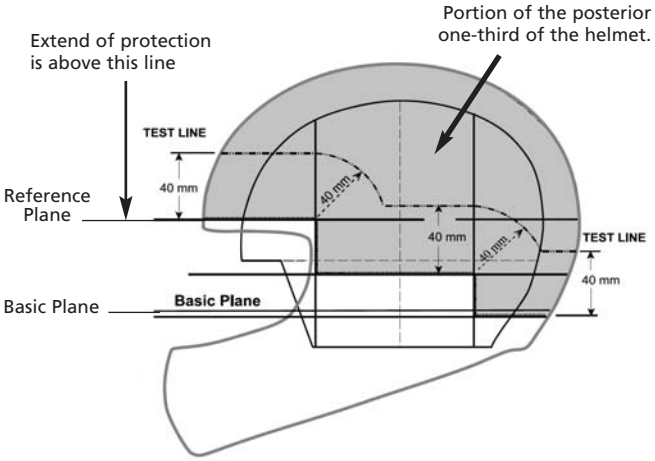
A 3 kg striker with a 60 degree cone, falls from a height of 3 mtr on any site on or above the testline.

Allowance: the striker should not penetrate to achieve even momentarily contact with the test headform.



Extent of protection

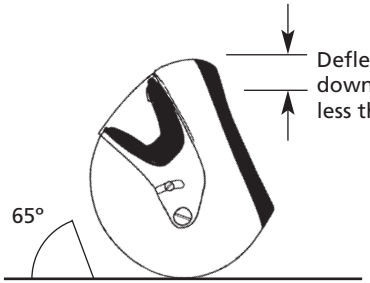
The test area for shock absorption testing lies 40 mm above the reference line.



Chin bar test

Chin bar test striker 5 kg.
Area less than 1 cm²

Impact velocity 3,5 m/s
Drop height 0,625 mtr



Dynamic test of retention system

Preload	23 kg x 2 minutes
Dynamic test load	38 kg x 120 mm
Allowed Elongation	less than 0,03 mtr

Conditioning of the helmets

According to Snell M 2005 regulations.

SNELL SA/K 2005

The Snell M 2005 standard for protective headgear for in competitive automotive sports or for use in kart racing.

Main differences with the M 2005 homologation:

4 instead of 3 anvil tests
Extra anvil = roll bar anvil

Roll bar anvil test: first 150 J, height 3,06 mtr, second 120 J, height 2,44 mtr, third 100 J, 2,24 mtr.

Visor penetration test: a soft lead pellet weighing 1gramm with a diameter of 5,5 mm, travelling at a speed of 500 kilometers per hour strikes the visor. This test will take place on three different locations: in the centre line and 80 mm left and right of this line. The pellet must not penetrate to the interior of the helmet or produce an indentation exceeding 2,5 mm as measured from the interior surface of the face shield.

Flame Resistance Tests -
Auto Racing (SA2005) Helmets Only
The helmet shall be self-extinguishing within 10 seconds of the removal of the propane test flame i.e., shall not continue to burn with the emission of a flame. The temperature of the padding and lining materials normally in contact at any point with the wearer's head shall not exceed 70°C during the test. The chin strap and, if present, the cover shall not melt and shall be self-extinguishing within 5 seconds of the removal of the thermal load. The face shield will be subjected to the same propane flame utilized in the shell test, but for a period of 45 seconds. The face shield shall not melt down during this period so as to allow the propane flame to penetrate the interior of the helmet. The shield shall be self-extinguishing in 20 seconds. The internal padding and lining materials will be subjected to the same propane flame utilized in the shell test, but for a period of 15 seconds. The lining shall be self-extinguishing within 5 seconds of the removal of the thermal load. This test shall only be applied to that part of the lining within 50 mm of the face or neck opening of the helmet.

Helmet test

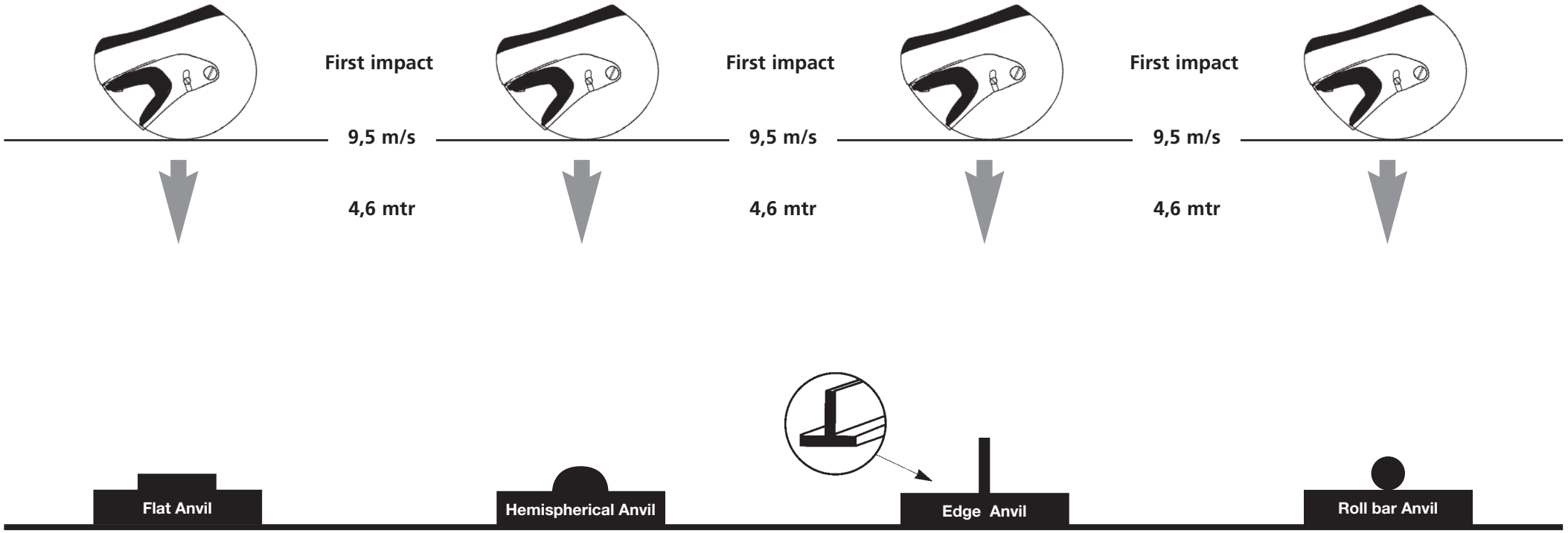
FIA 8860-2004
(Advanced Helmet Test Specification)

Shock absorption test

Helmets are subject to conditioning.

First impact

Flat anvil	Hemispherical Anvil	Edge anvil	Roll bar anvil
225 J 4,6 mtr	225 J 4,6 mtr	225 J 4,6 mtr	225 J 4,6 mtr



Given an ideal frictionless mechanical test facility, this standard impact energy represents a drop with a speed of 9,5 m/s for a 5 kg headform and supporting assembly. With a dropping mass of 5 kg, maximum peak acceleration shall not exceed 300 G and the HIC 36 shall not exceed 3.500.

Note 1: The FIA calls out impact test procedures almost precisely identical to SA2000 except, instead of two impacts at a particular site, FIA demands a single but much more severe impact for the 8860-2004 homologation.

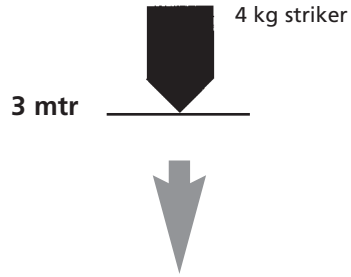
Note 2: The Snell double impacts are thought to have come about because there was limited ceiling space in the first Snell laboratories. The testers could not get all the impact severity they wanted from their test gear in one hit so they went for seconds. The dual impact regimen continued because it seemed serviceable and because most laboratory ceilings were not much higher than the minimum necessary for the first Snell impact.

Helmet test

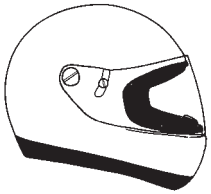
FIA 8860-2004
(Advanced Helmet Test Specification)

Penetration test

A 4 kg striker with a 60 degree cone, falls from a height of 3 mtr on any site on or above the testline.



Allowance: the striker should not penetrate to achieve even momentarily contact with the test headform.



HANS anchorage test

Preload	2 x 7000 N x 5 seconds
Tensile load	3500 N x 5 seconds

Flame resistance test

Car Racing Helmets Only

The test shall be conducted at ambient temperature between 10° C and 30° C, and utilize the thermal load of a propane flame at the flame location representing a measured temperature of 790° C ± 40° C.
The helmet shall be self-extinguishing within 10 seconds of the removal of the propane test flame i.e., shall not continue to burn with the emission of a flame. The temperature of the padding and lining materials normally in contact at any point with the wearer's head shall not exceed 70°C during the test. The chin strap and, if present, the cover shall not melt and shall be self-extinguishing within 5 seconds of the removal of the thermal load. The face shield will be subjected to the same propane flame utilized in the shell test, but for a period of 45 seconds. The face shield shall not melt down during this period so as to allow the propane flame to penetrate the interior of the helmet. The shield shall be self-extinguishing in 20 seconds. The internal padding and lining materials will be subjected to the same propane flame utilized in the shell test, but for a period of 15 seconds. The lining shall be self-extinguishing within 5 seconds of the removal of the thermal load. This test shall only be applied to that part of the lining within 50 mm of the face or neck opening of the helmet.

Conditioning of the helmets

According to ECE 22-05 regulations.

FIA 8860-2004

Drivers in the Formula One championship must wear helmets , which meet the FIA Standard 8860-2004 – Advanced Helmet Test Specification. The Arai GP-5 RC meets or exceeds all requirements of this specification.

The 8860-2004 tests will be conducted in accordance with Snell SA 2000, with the following inclusions or modifications:

- impact energy (one impact test only) increased to 225 J
- impact test sites shall be separated by at least 180 mm
- the peak acceleration shall not exceed 300g and the HIC36 shall not exceed 3.500
- an additional linear impact test will be conducted in accordance with ECE 22 chinguard impact test with 71 J, 5,5 m/s. The peak acceleration shall not exceed 275g and the HIC36 shall not exceed 2.400
- a penetration test will be conducted in accordance with Snell SA2000, but the mass of the striker shall be increased for 3 tot 4 kg, the drop height shall be 3 metres
- the HANS® anchorages shall be subjected to a combined load of 14 kN (2 x 7000N) for a period of no less than 5 seconds. One anchorage shall be subjected to a tensile load of 3500N for no less than 5 seconds
- The shell surface shall be subject to a Barcol hardness test ASTM DT2583, the average hardness shall not be less than 60

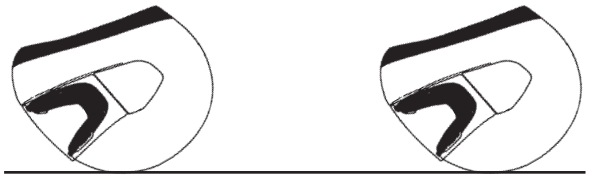
NOTE: Barcol hardness is a method that a hardness value obtained by measuring the resistance to penetration of a sharp steel point under a spring load. The instrument, called the Barcol impresser, gives a direct reading on a 0 to 100 scale. The hardness value is often used as a measure of the degree of cure of a plastic. ASTM D2583 Barcol Hardness test method is used to determine the hardness of both reinforced and non-reinforced rigid plastics. The specimen is placed under the indentor of the Barcol hardness tester and a uniform pressure is applied to the specimen until the dial indication reaches a maximum. The depth of the penetration is converted into absolute Barcol numbers. In general, polycarbonate offers a Barcol hardness of 30 to 40 and glasfiber 40 to 60 depending on the manufacturing process. As carbon fibre is "harder" with a Barcol hardness of 60 to 70, this material is (or must be) used for FIA 8860-2004 advanced specification helmets.

Helmet test Overview Arai - ECE - Snell Homologation

ECE 22-05

The maximum acceleration of the headform shall not exceed 275 G. Each impact point is tested only once.

Single impact:
Impact Velocity: 7,5 m/s



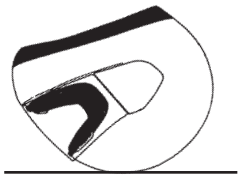
2,85 mtr

Maximum 300 G

Snell M 2005

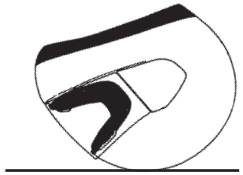
Double impact

First impact: 150 J



3,06 mtr

Second impact: 110 J



2,24 mtr

Maximum 300 G

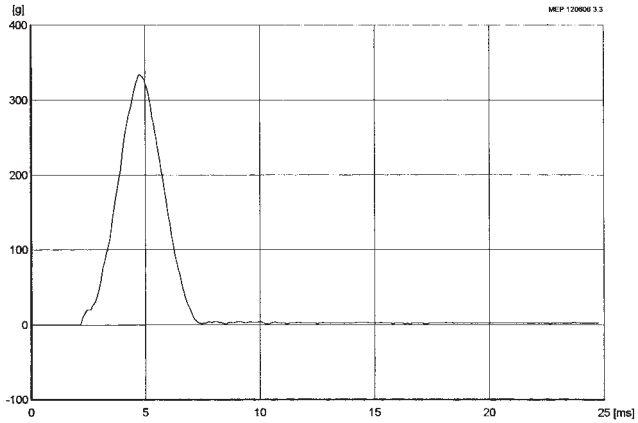
Arai Standard

Arai's in house standard exceed all global standards. This makes the Arai helmet so unique. In order to maintain this quality, it regrets us that for obvious reasons we cannot reveal these criteria. Besides (severe) impact testing , the Arai standard also includes penetration and rigidity tests.

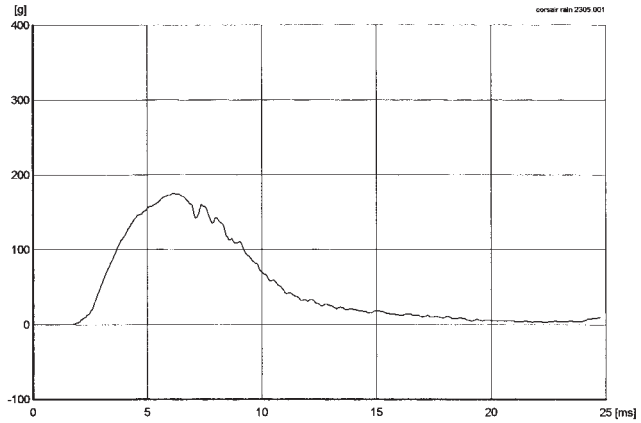
Helmet test

Impact Graphics of the Arai Standard

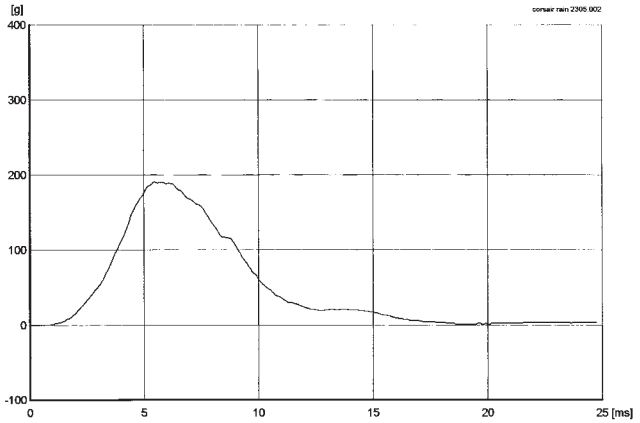
impact without protection



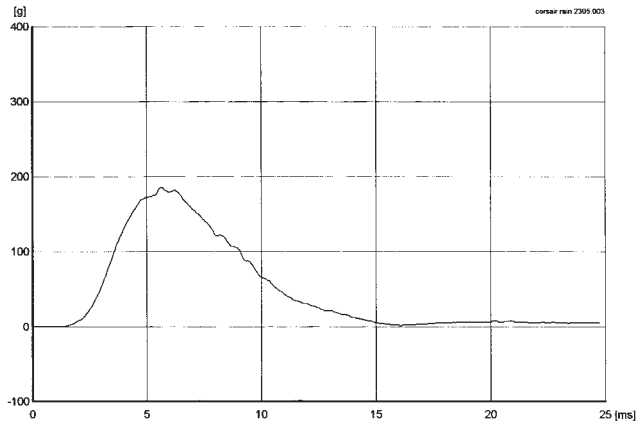
1st impact



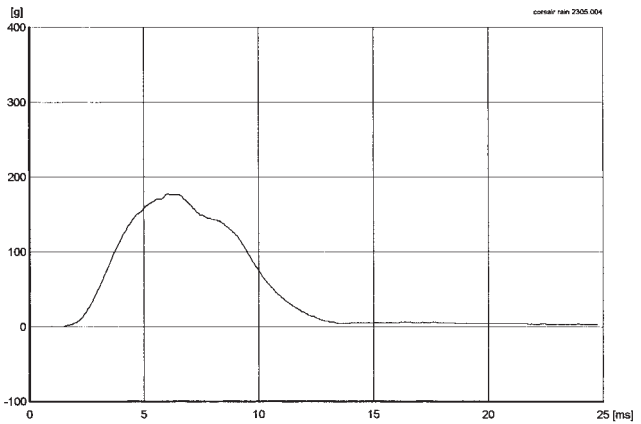
2nd impact



3rd impact



4th impact



this is the difference

there is a difference

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