



**STANDARD
FOR
PROTECTIVE
HEADGEAR**

1980

SNELL MEMORIAL FOUNDATION

DIRECTOR OF RESEARCH

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FOREWORD

THE 1980 STANDARD for protective headgear represents an expansion of the criteria first established by the Snell Memorial Foundation in 1959 for the design of racing crash helmets. Since the 1959 Standard was published, numerous consumer groups with activities unrelated to the sphere of automotive racing have evinced interest in the field of head protection. The common concern of all these groups is the hazard of exposure of the head to the transfer of impact energy. The ill effects of such transfer are independent of the way in which the impact energy is generated; the inadequately protected head cannot distinguish the kinetic energy of an impact against a rock, tree, car interior or ski pole from that of a falling object dropped from a height. As a consequence, the basic problems of head protection are common to most of these interested groups. Certain consumer groups may have specialized, unique additional requirements. In such cases the necessary test criteria may be developed and issued in appropriate appendix from time to time.

The performance standard utilized by the Snell Foundation was revised upward in 1962, 1968, 1970 and again in 1975, as the state of the art of helmet manufacture advanced; the 1980 Standard is even more demanding in the severity of its test requirements. It has been designed with the philosophy that where several test conditions might be employed for the same purpose, the most severe of such would be adopted on the premise that maximum possible protection should be the desired goal.

Several new aspects of testing for safety have been introduced in this 1980 standard. The test of retaining harness has been changed from static to dynamic in nature. A test of the chin piece used in full-face helmets has been developed. A multiple impact test against a cylindrical anvil has been added, both because of a need for assessing residual energy handling capacity not measured by the impact test previously used, and because of field accident data demonstrating multiple impacts against nonflat and nonrounded surfaces, e.g., linear rigid edges and tubular structures such as rollbars. Lastly, although testing to determine combustibility has been done by the Foundation

on new materials used in helmets, there now has been incorporated a standardized routine test of flammability. In keeping with the trend of usage on an international basis, the 1980 Standard utilizes the International System of Units. (SI units.)

This Standard is designed to establish, in so far as possible, performance characteristics rather than to set forth construction and material limitations upon the designer and manufacturer. The Foundation does not presume to recommend specific products or to impose its specifications upon either manufacturer or consumer. It offers its test facilities to bona fide manufacturers and makes available to any interested consumer group a means of identifying those products which have successfully met its Standard. The Foundation neither has nor will accept any power of enforcement for any consumer group. Snell Foundation certification of protective headgear requires specific contractual agreement between the primary manufacturer of the headgear and the Foundation. Information relative to the certification process may be obtained by interested manufacturers upon application to the Foundation.

It must be understood that the protection given by any protective headgear is necessarily less than complete, and that the wearing of such may not entirely prevent head injury or death in certain severe accidents. The best helmet is but one link in a long chain of safety which may include such factors as seat belts, restraining harnesses, proper training and conditioning, and most importantly, adequate safety education. The weakening of any one link in this chain tends to destroy the basic value of the entire chain.

The attention of the consumer must be called to the fact that of necessity helmets are constructed so that the energy of a severe blow is absorbed in the partial destruction of the helmet. This damage may not be readily apparent and it is strongly recommended by the Foundation that consumer groups require that any helmet involved in a significant accident be returned to the manufacturer for competent inspection. If such is not readily available, the helmet should be replaced.

CONSTRUCTION

A. GENERAL

The helmet shall consist of a hard, smooth shell lined with energy absorbing material or fitted with other means of energy absorption. It shall be strongly attached to a retention system designed to fasten under the wearer's chin. The assembled helmet shall have a smooth external surface without reinforcing ridges or other rigid external projections greater than 7 mm above the outer surface of the helmet, unless smoothly faired so as to offer no significant frictional resistance to tangential impact forces. A goggle clip may be used at the rear of the helmet if desired, and a ledge may be molded at the front edge to support a visor. Such ledge, if included, shall not project more than 10 mm from the outer surface of the shell, and shall not extend more than 120 mm from the midpoint in front towards either side.

B. SHELL

The shell of the helmet shall be as nearly uniform in thickness and strength as is possible using normal manufacturing methods. Ventilation holes, if used, shall not exceed 13 mm in diameter. The heads of rivets, if used, shall not project more than 2 mm above the outer surface of the helmet and shall show no sharp edges.

C. MATERIALS

The materials used in the manufacture of the various parts of the helmet shall be of durable quality, i.e., their characteristics shall not undergo appreciable alteration under the influence of aging or of the circumstances of use to which the helmet is normally subjected, such as exposure to sun, rain, cold, dust, vibration, solvents and cleaning agents, contact with skin, effect of sweat or of products applied to the skin or hair. Appropriate tests for durability under these circumstances may be instituted. Materials commonly known to cause skin irritation or disease shall not be used for those parts of the assembly which come into contact with the skin. Materials of new type must be shown not to be causative of skin irritation or disease.

D. FINISH

All edges of the shell shall be smooth and rounded and there shall be no metallic parts or other rigid projections on the inside of the shell which might injure the wearer's head in the event of impact. No part of the protective components of the helmet shall be inadvertently detachable, nor detach under test impact.

QUALIFICATION FOR CERTIFICATION

For qualification testing, helmets shall be taken in the condition as offered for sale. No helmet which has been subjected to any tests described in this Standard shall actually be offered for sale after testing. In qualification testing the helmets will be required to satisfy all of the safety performance criteria described in this Standard.

RANDOM SAMPLE TESTING

In addition to the initial testing prior to certification, random samples of certified models may be obtained by the Foundation from the open market. These will be tested by the Foundation in similar fashion, and must meet the performance requirements of this Standard. When it has been shown by qualification tests that the materials used are equally protective after exposure to temperature and moisture conditioning, thereafter consideration shall be given in routine random sample testing to possible relaxation of these requirements, provided there is no change in materials or manufacture.

LABELING AND MARKING

There shall be securely attached to each helmet offered for sale a label bearing an inscription to the following effect:

1. For maximum protection this helmet must be of good fit and the chin strap must be securely fastened.
2. This helmet is so constructed that the energy of a severe blow is absorbed through partial destruction of the shell and/or

lining, though damage may not be visible to the naked eye. If it suffers such an impact, it should either be returned to the manufacturer for competent inspection or destroyed and replaced by a new one.

Helmets which comply with the requirements of this Standard shall be marked as follows:

a. With the certification mark of the Snell Memorial Foundation, which may be used by the manufacturer only under license from the Snell Memorial Foundation. Particulars of the conditions under which licenses are granted may be obtained from the Foundation.

b. The manufacturer's name or trade mark and the month and year of manufacture must be indelibly marked in an agreed code in a visible position where this marking is protected from obliteration.

TESTING

1. *Conditioning for Testing*

a. In addition to testing at ambient temperature, a second helmet shall be conditioned by being exposed to a temperature of $-10\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for not less than 4 hours, nor more than 24 hours, in a mechanically cooled apparatus.

b. *Heat.* A third helmet shall be conditioned by being exposed to a temperature of $50\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for a period of not less than 4 hours, nor more than 24 hours.

c. *Water Immersion.* A fourth helmet may be conditioned by immersion in water at a temperature of $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for a period of not less than 4 hours, nor more than 24 hours.

d. All testing shall begin within two minutes from the time of removal from the conditioning equipment as indicated in a, b, and c.

2. *Extent of Protection*

The extent of protection and the areas of the helmet subject to test shall be referenced to the anatomical or basic plane de-

lineated on a standard head. This is defined as a plane at the level of the external auditory meatus and the inferior margin of the orbit. A test line shall be marked on the helmet subjected to tests. This test line shall be parallel to and 60 mm above the basic plane as above defined, save in the posterior one-third of the helmet it shall be the basic plane. All parts of the helmet above this test line shall attenuate shock transmission to at least the minimum requirements hereinafter specified under Shock Absorption Test.

3. *Dynamic Test of Retention System*

a. The helmet shall be placed on a suitable rigid fixture so that it is supported upright by the base of the shell, with the chin strap fastened over a device approximating the shape of the bony structure of the lower jaw. This shall consist of two metal rollers, each 12.7 mm in diameter, separated by 76.2 mm on center, which would serve to represent the jaw bone.

b. A 38 kg mass shall be dropped in vertical guided fall a distance of 120 mm so as to load abruptly the retaining system. The strap and its attachments must withstand this dynamic loading without parting and without greater than 30 mm increase in elongation.

c. A 23 kg preload shall be applied to the retention harness for 2 minutes before the dynamic loading takes place, arranged in such fashion so as to be removed from the loading system immediately prior to the dynamic test loading and, thus, not being additive to the test load. This removal of the preload mass shall occur as part of the test drop, and be completed before the test mass loads the retaining system.

4. *Penetration Test*

a. The complete helmet shall be placed on a rigidly mounted spherical head form which shall be covered with an electrically conductive material. If the helmet to be tested contains a "sling" or other adjustable sizing component, it shall be relaxed to its most extendable position.

The penetration test shall be conducted by dropping the penetration test striker onto the outer surface of the helmet

anywhere above the reference plane, in a direction essentially perpendicular to the outer surface of the helmet. At least the tip of the striker shall be electrically conductive.

When tested in the above fashion, the helmet shall be rejected if demonstrable electrical contact is made between the penetrator and the conducting surface of the head form.

b. Conditions of penetration test:

The weight of the penetration test striker shall be 3 kg $-0 +50$ gm.

The point of the striker shall have an included angle of 60 degrees ± 0.5 degree, and an altitude of 38 mm ± 0.38 mm.

The radius of the striking point shall be 0.5 mm ± 0.01 mm.

The hardness of the striking tip shall be 60 Rockwell (scale C) ± 3 points.

The height of the fall shall be 3 m ± 15 mm.

c. *Shell integrity test:* A randomly selected helmet from a test series may be conditioned at -30 °C ± 2 °C as described in 1.a and tested for penetration resistance within one minute after removal from the conditioning equipment, under the penetration test conditions described above.

5. Shock Absorption Test

a. Shock absorption shall be measured by determining imparted acceleration to an appropriately instrumented standard headform dropped in guided fall upon a fixed rigid steel anvil. Each helmet shall receive two impacts in each of four sites against the flat and the hemispherical anvil surfaces, and one helmet of each test series shall receive three consecutive impacts against the cylindrical anvil surface. The impact site shall be at any point above the test line, and the impacts separated from each other by a distance not less than one-sixth of the maximal circumference of the helmet.

b. Three anvil configurations shall be used, one flat, one hemispherical and one cylindrical. Paired impacts shall be applied with the flat and hemispherical configurations. The flat anvil shall have a minimum surface of 0.127 m², i.e., 127 mm diameter face; the hemispherical anvil shall have a 48 mm ± 0.5

mm radius. The cylindrical anvil shall have a diameter of 40 mm \pm 2 mm and shall be 130 mm \pm 4 mm in length. In use, it shall be positioned with its long axis parallel to the anvil base.

The test headform shall be of rigid, low resonance material such as a magnesium alloy (or a dynamic functionally equivalent material).

c. For each helmet, the calculated impact energy shall be established, utilizing the basic drop test mass of headform and supporting arm without helmet, and as confirmed by measured impact velocity.

At each test locus of impact against the flat or hemispherical anvil, the initial and second impacts under this requirement shall be 140 J and 110 J, respectively. Each of the three impacts against the cylindrical anvil shall be 140 J.

Appropriately sized headforms of similar configuration shall be used for helmets of differing sizes. The impact energy in all cases shall be as above noted, related to the test drop mass without helmet. With none of the several sizes of headforms shall the total mass of the supporting arm and test head, without helmet, exceed 6.5 kg.

Any recorded peak acceleration of the helmeted headform exceeding 300 g shall be cause for rejection of the helmet.

6. *Chin Bar Test*

Full-face helmets utilizing an integral extension of the shell anterior to the chin of the wearer shall be subjected to dynamic test of the chin bar.

The helmet shall be firmly mounted on a rigid base with the chin bar upwards and the helmet base 90° to the horizontal plane of the anvil.

A mass of 5 kg $-0 +0.2$ kg, having a flat striking face of 0.1 m² minimum area, shall be dropped in guided fall so as to impact the central portion of the chin bar, and the instantaneous maximum downwards deflection of the inner surface of the chin bar shall be recorded.

The drop distance of the test mass shall be 0.6 m $-0 +5$

mm. Downwards deflection exceeding 60 mm shall be cause for rejection of the helmet.

7. Flammability Test

The test will be conducted at ambient temperature, between 10 °C and 30 °C, and utilize the thermal load of a propane flame, at measured temperature of $790\text{ °C} \pm 40\text{ °C}$.

a. Shell: The flame shall impinge upon the external surface of the helmet shell for a period of 30 seconds. Simultaneous with the removal of the flame, a timing device shall be activated. The helmet shall be self-extinguishing within 5 seconds of the removal of the flame, i.e., shall not continue to burn with the emission of a flame.

The lining material normally in contact at any point with the wearer's head shall not exceed 70 °C during the test.

b. Trim: The trim and chin strap will be subjected to the same propane flame utilized in the shell test, but for a period of 10 seconds. The trim and chin strap shall be self-extinguishing within 5 seconds of the removal of the thermal load.