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[Page 581-596]

TITLE 49--TRANSPORTATION

CHAPTER V--NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

PART 571--FEDERAL MOTOR VEHICLE SAFETY STANDARDS6--Table of Contents

Subpart B--Federal Motor Vehicle Safety Standards

Sec. 571.218 Standard No. 218; Motorcycle helmets.

S1. Scope. This standard establishes minimum performance

requirements for helmets designed for use by motorcyclists and other

motor vehicle users.

S2. Purpose. The purpose of this standard is to reduce deaths and

injuries to motorcyclists and other motor vehicle users resulting from

head impacts.

S3. Application. This standard applies to all helmets designed for

use by motorcyclists and other motor vehicle users.

S4. Definitions.

Basic plane means a plane through the centers of the right and left external ear openings and the lower edge of the eye sockets (Figure 1) of a reference headform (Figure 2) or test headform.

Helmet positioning index means the distance in inches, as specified by the manufacturer, from the lowest point of the brow opening at the lateral midpoint of the helmet to the basic plane of a reference headform, when the helmet is firmly and properly positioned on the reference headform.

Midsagittal plane means a longitudinal plane through the apex of a reference headform or test headform that is perpendicular to the basic plane (Figure 3).

Reference headform means a measuring device contoured to the dimensions of one of the three headforms described in Table 2 and Figures 5 through 8 with surface markings indicating the locations of the basic, mid-sagittal, and reference planes, and the centers of the external ear openings.

Reference plane means a plane above and parallel to the basic plane on a reference headform or test headform (Figure 2) at the distance

indicated in Table 2.

Retention system means the complete assembly by which the helmet is

retained in position on the head during use.

Test headform means a test device contoured to the dimensions of one

of the three headforms described in Table 2 and Figures 5 through 8 with

surface markings indicating the locations of the basic, mid-sagittal,

and reference planes.

S5. Requirements. Each helmet shall meet the requirements of S5.1,

S5.2, and S5.3 when subjected to any conditioning procedure specified in

S6.4, and tested in accordance with S7.1, S7.2, and S7.3.

S5.1 Impact attenuation. When an impact attenuation test is

conducted in accordance with S7.1, all of the following requirements

shall be met:

(a) Peak accelerations shall not exceed 400g;

(b) Accelerations in excess of 200g shall not exceed a cumulative

duration of 2.0 milliseconds; and

(c) Accelerations in excess of 150g shall not exceed a cumulative

duration of 4.0 milliseconds.

S5.2 Penetration. When a penetration test is conducted in accordance with S7.2, the striker shall not contact the surface of the test headform.

S5.3 Retention system.

S5.3.1 When tested in accordance with S7.3:

(a) The retention system or its components shall attain the loads specified without separation; and

(b) The adjustable portion of the retention system test device shall not move more than 1 inch (2.5 cm) measured between preliminary and test load positions.

S5.3.2 Where the retention system consists of components which can be independently fastened without securing the complete assembly, each such component shall independently meet the requirements of S5.3.1.

S5.4 Configuration. Each helmet shall have a protective surface of continuous contour at all points on or above the test line described in S6.2.3. The helmet shall provide peripheral vision clearance of at least 105 deg. to each side of the mid-sagittal plane, when the helmet is adjusted as specified in S6.3. The vertex of these angles, shown in

Figure 3, shall be at the point on the anterior surface of the reference

headform at the intersection of the mid-sagittal and basic planes. The

brow opening of the helmet shall be at least 1 inch (2.5 cm) above all

points in the basic plane that are within the angles of peripheral

vision (see Figure 3).

S5.5 Projections. A helmet shall not have any rigid projections

inside its shell. Rigid projections outside any

helmet's shell shall be limited to those required for operation of

essential accessories, and shall not protrude more than 0.20 inch (5

mm).

S5.6 Labeling.

S5.6.1 Each helmet shall be labeled permanently and legibly, in a

manner such that the label(s) can be read easily without removing

padding or any other permanent part, with the following:

(a) Manufacturer's name or identification.

(b) Precise model designation.

(c) Size.

(d) Month and year of manufacture. This may be spelled out (for

example, June 1988), or expressed in numerals (for example, 6/88).

(e) The symbol DOT, constituting the manufacturer's certification

that the helmet conforms to the applicable Federal motor vehicle safety

standards. This symbol shall appear on the outer surface, in a color

that contrasts with the background, in letters at least \3/8\ inch (1

cm) high, centered laterally with the horizontal centerline of the

symbol located a minimum of 1\1/8\ inches (2.9 cm) and a maximum of 1\3/

8\ inches (3.5 cm) from the bottom edge of the posterior portion of the

helmet.

(f) Instructions to the purchaser as follows:

(1) ``Shell and liner constructed of (identify type(s) of

materials).

(2) ``Helmet can be seriously damaged by some common substances

without damage being visible to the user. Apply only the following:

(Recommended cleaning agents, paints, adhesives, etc., as appropriate).

(3) ``Make no modifications. Fasten helmet securely. If helmet

experiences a severe blow, return it to the manufacturer for inspection,

or destory it and replace it."

(4) Any additional relevant safety information should be applied at the time of purchase by means of an attached tag, brochure, or other suitable means.

S5.7 Helmet positioning index. Each manufacturer of helmets shall establish a positioning index for each helmet he manufactures. This index shall be furnished immediately to any person who requests the information, with respect to a helmet identified by manufacturer, model designation, and size.

S6. Preliminary test procedures. Before subjecting a helmet to the testing sequence specified in S7., prepare it according to the procedures in S6.1, S6.2, and S6.3.

S6.1 Selection of appropriate headform.

S6.1.1 A helmet with a manufacturer's designated discrete size or size range which does not exceed 6\3/4\ (European size: 54) is tested on the small headform. A helmet with a manufacturer's designated discrete size or size range which exceeds 6\3/4\, but does not exceed 7\1/2\ (European size: 60) is tested on the medium headform. A helmet with a

manufacturer's designated discrete size or size range which exceeds 7\1/

2\ is tested on the large headform.

S6.1.2 A helmet with a manufacturer's designated size range which

includes sizes falling into two or all three size ranges described in

S6.1.1 is tested on each headform specified for each size range.

S6.2 Reference marking.

S6.2.1 Use a reference headform that is firmly seated with the basic

and reference planes horizontal. Place the complete helmet to be tested

on the appropriate reference headform, as specified in S6.1.1 and

S6.1.2.

S6.2.2 Apply a 10-pound (4.5 kg) static verticle load through the

helmet's apex. Center the helmet laterally and seat it firmly on the

reference headform according to its helmet positioning index.

S6.2.3 Maintaining the load and position described in S6.2.2, draw a

line (hereinafter referred to as ``test line'') on the outer surface of

the helmet coinciding with portions of the intersection of that service

with the following planes, as shown in Figure 2:

(a) A plane 1 inch (2.5 cm) above and parallel to the reference

plane in the anterior portion of the reference headform;

(b) A vertical transverse plane 2.5 inches (6.4 cm) behind the point on the anterior surface of the reference headform at the intersection of

the mid-sagittal and reference planes;

(c) The reference plane of the reference headform;

(d) A vertical transverse plane 2.5 inches (6.4. cm) behind the center of

[[Page 583]]

the external ear opening in a side view; and

(e) A plane 1 inch (2.5 cm) below and parallel to the reference plane in the posterior portion of the reference headform.

S6.3 Helmet positioning.

S6.3.1 Before each test, fix the helmet on a test headform in the position that conforms to its helmet positioning index. Secure the helmet so that it does not shift position before impact or before application of force during testing.

S6.3.2 In testing as specified in S7.1 and S7.2, place the retention system in a position such that it does not interfere with free fall, impact or penetration.

S6.4 Conditioning.

S6.4.1 Immediately before conducting the testing sequence specified

in S7, condition each test helmet in accordance with any one of the

following procedures:

(a) Ambient conditions. Expose to a temperature of

70 deg.F(21 deg.C) and a relative humidity of 50 percent for 12 hours.

(b) Low temperature. Expose to a temperature of 14 deg.F(-10 deg.C)

for 12 hours.

(c) High temperature. Expose to a temperature of 122 deg.F(50 deg.C)

for 12 hours.

(d) Water immersion. Immerse in water at a temperature of

77 deg.F(25 deg.C) for 12 hours.

S6.4.2 If during testing, as specified in S7.1.3 and S7.2.3, a

helmet is returned to the conditioning environment before the time out

of that environment exceeds 4 minutes, the helmet is kept in the

environment for a minimum of 3 minutes before resumption of testing with

that helmet. If the time out of the environment exceeds 4 minutes, the

helmet is returned to the environment for a minimum of 3 minutes for

each minute or portion of a minute that the helmet remained out of the

environment in excess of 4 minutes or for a maximum of 12 hours,

whichever is less, before the resumption of testing with that helmet.

S7. Test conditions.

S7.1 Impact attenuation test.

S7.1.1 Impact attenuation is measured by determining acceleration

imparted to an instrumented test headform on which a complete helmet is

mounted as specified in S6.3, when it is dropped in guided free fall

upon a fixed hemispherical anvil and a fixed flat steel anvil.

S7.1.2 Each helmet is impacted at four sites with two successive

identical impacts at each site. Two of these sites are impacted upon a

flat steel anvil and two upon a hemispherical steel anvil as specified

in S7.1.10 and S7.1.11. The impact sites are at any point on the area

above the test line described in paragraph S6.2.3, and separated by a

distance not less than one-sixth of the maximum circumference of the

helmet in the test area.

S7.1.3 Impact testing at each of the four sites, as specified in

S7.1.2, shall start at two minutes, and be completed by four minutes,

after removal of the helmet from the conditioning environment.

S7.1.4 (a) The guided free fall drop height for the helmet and test

headform combination onto the hemispherical anvil shall be such that the

minimum impact speed is 17.1 feet/second (5.2 m/sec). The minimum drop

height is 54.5 inches (138.4 cm). The drop height is adjusted upward

from the minimum to the extent necessary to compensate for friction

losses.

(b) The guided free fall drop height for the helmet and test

headform combination onto the flat anvil shall be such that the minimum

impact speed is 19.7 ft./sec (6.0 m/sec). The minimum drop height is 72

inches (182.9 cm). The drop height is adjusted upward from the minimum

to the extent necessary to compensate for friction losses.

S7.1.5 Test headforms for impact attenuation testing are constructed

of magnesium alloy (K-1A), and exhibit no resonant frequencies below

2,000 Hz.

S7.1.6 The monorail drop test system is used for impact attenuation

testing.

S7.1.7 The weight of the drop assembly, as specified in Table 1, is

the combined weight of the test headform and the supporting assembly for

the drop test. The weight of the supporting assembly is not less than

2.0 lbs. and not more than 2.4 lbs. (0.9 to 1.1 kg). The supporting

assembly weight for the monorail system is the drop assembly weight

minus the combined weight of the test headform, the headform's

clamp down ring, and its tie down screws.

S7.1.8 The center of gravity of the test headform is located at the

center of the mounting ball on the supporting assembly and lies within a

cone with its axis vertical and forming a 10 deg. included angle with

the vertex at the point of impact. The center of gravity of the drop

assembly lies within the rectangular volume bounded by x = -0.25 inch

(-0.64 cm), x = 0.85 inch (2.16 cm), y = 0.25 inch (0.64 cm), and y =

-0.25 inch (-0.64 cm) with the origin located at the center of gravity

of the test headform. The rectangular volume has no boundary along the

z-axis. The x-y-z axes are mutually perpendicular and have positive or

negative designations in accordance with the right-hand rule (See Figure

5). The origin of the coordinate axes also is located at the center of

the mounting ball on the supporting assembly (See Figures 6, 7, and 8).

The x-y-z axes of the test headform assembly on a monorail drop test

equipment are oriented as follows: From the origin, the x-axis is

horizontal with its positive direction going toward and passing through

the vertical centerline of the monorail. The positive z-axis is

downward. The y-axis also is horizontal and its direction can be decided

by the z- and x-axes, using the right-hand rule.

S7.1.9 The acceleration transducer is mounted at the center of

gravity of the test headform with the sensitive axis aligned to within

5 deg. of vertical when the test headform assembly is in the impact

position. The acceleration data channel complies with SAE Recommended

Practice J211 JUN 80, Instrumentation for Impact Tests, requirements for

channel class 1,000.

S7.1.10 The flat anvil is constructed of steel with a 5-inch (12.7 cm) minimum diameter impact face, and the hemispherical anvil is constructed of steel with a 1.9 inch (4.8 cm) radius impact face.

S7.1.11 The rigid mount for both of the anvils consists of a solid mass of at least 300 pounds (136.1 kg), the outer surface of which consists of a steel plate with minimum thickness of 1 inch (2.5 cm) and minimum surface area of 1 ft \2\ (929 cm \2\ ).

S7.1.12 The drop system restricts side movement during the impact attenuation test so that the sum of the areas bounded by the acceleration-time response curves for both the x- and y-axes (horizontal axes) is less than five percent of the area bounded by the acceleration-time response curve for the vertical axis.

S7.2 Penetration test.

S7.2.1 The penetration test is conducted by dropping the penetration test striker in guided free fall, with its axis aligned vertically, onto the outer surface of the complete helmet, when mounted as specified in S6.3, at any point above the test line, described in S6.2.3, except on a fastener or other rigid projection.

S7.2.2 Two penetration blows are applied at least 3 inches (7.6 cm)

apart, and at least 3 inches (7.6 cm) from the centers of any impacts

applied during the impact attenuation test.

S7.2.3 The application of the two penetration blows, specified in

S7.2.2, starts at two minutes and is completed by four minutes, after

removal of the helmet from the conditioning environment.

S7.2.4 The height of the guided free fall is 118.1 inches (3 m), as

measured from the striker point to the impact point on the outer surface

of the test helmet.

S7.2.5 The contactable surface of the penetration test headform is

constructed of a metal or metallic alloy having a Brinell hardness

number no greater than 55, which will permit ready detection should

contact by the striker occur. The surface is refinished if necessary

before each penetration test blow to permit detection of contact by the

striker.

S7.2.6 The weight of the penetration striker is 6 pounds, 10 ounces

(3 kg).

S7.2.7 The point of the striker has an included angle of 60 deg., a

cone height of 1.5 inches (3.8 cm), a tip radius of 0.02 inch (standard

0.5 millimeter radius) and a minimum hardness of 60 Rockwell, C-scale.

S7.2.8 The rigid mount for the penetration test headform is as

described in S7.1.11.

S7.3 Retention system test.

S7.3.1 The retention system test is conducted by applying a static

tensile

load to the retention assembly of a complete helmet, which is mounted,

as described in S6.3, on a stationary test headform as shown in Figure

4, and by measuring the movement of the adjustable portion of the

retention system test device under tension.

S7.3.2 The retention system test device consists of both an

adjustable loading mechanism by which a static tensile load is applied

to the helmet retention assembly and a means for holding the test

headform and helmet stationary. The retention assembly is fastened

around two freely moving rollers, both of which have a 0.5 inch (1.3 cm)

diameter and a 3-inch (7.6 cm) center-to-center separation, and which

are mounted on the adjustable portion of the tensile loading device

(Figure 4). The helmet is fixed on the test headform as necessary to

ensure that it does not move during the application of the test loads to

the retention assembly.

S7.3.3 A 50-pound (22.7 kg) preliminary test load is applied to the

retention assembly, normal to the basic plane of the test headform and

symmetrical with respect to the center of the retention assembly for 30

seconds, and the maximum distance from the extremity of the adjustable

portion of the retention system test device to the apex of the helmet is

measured.

S7.3.4 An additional 250-pound (113.4 kg) test load is applied to

the retention assembly, in the same manner and at the same location as

described in S7.3.3, for 120 seconds, and the maximum distance from the

extremity of the adjustable portion of the retention system test device

to the apex of the helmet is measured.

Appendix to Sec. 571.218

Table 1--Weights for Impact Attenuation Test Drop Assembly

Test headform size Weight \1\--1b(kg)

Small..... 7.8 (3.5 kg).

Medium..... 11.0 (5.0 kg).

Large..... 13.4 (6.1 kg).

\1\ Combined weight of instrumented test headform and supporting

assembly for drop test.

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[[Page 586]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.124

[[Page 587]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.125

[[Page 588]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.126

[[Page 589]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.127

[[Page 590]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.128

[[Page 591]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.129

[[Page 592]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.130

[[Page 593]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.131

[[Page 594]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.132

[[Page 595]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.133

[[Page 596]]

[GRAPHIC] [TIFF OMITTED] TC01AU91.134

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[[Page 597]]