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Designation: F 1776 – 01

An American National Standard

Standard Specification for Eye Protective Devices for Paintball Sports[1]

This standard is issued under the fixed designation F 1776; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

This is the specification for eye protective devices, or EPD, to be used in the sport of paintball. Paintball is a sport that, like all sports, has intrinsic hazards. These hazards include being hit by paintballs. Protective equipment cannot eliminate all injuries but will substantially reduce their severity and frequency. Participation in this sport by a player implies acceptance of injury risk. The goal of protective equipment is to minimize the risk of injury.

Performance requirements are presented and are intended to minimize injury with minimal impairment of the form and appeal of the sport. This specification is subject to revision as indicated by subsequent injury statistics.

The impact requirements are designed to give eye and adnexal protection from paintball impacts likely to be encountered under game conditions. While the EPD also may protect the user from other potential impacts, such as running into tree branches, there are many conceivable impacts, including falls from heights, which could exceed the specification and result in eye injury despite the use of the EPD.

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1. Scope

1.1 This specification applies to eye protective devices, designed for use by players of the sport of paintball, that minimize or significantly reduce injury to the eye and adnexa due to impact and penetration of paintballs.

1.2 Eye protective devices meeting the requirements of this specification offer protection to the eyes and adnexa and not necessarily to any other parts of the head.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 This specification does not limit the wearing of eyeglasses or contact lenses when used in conjunction with the EPD.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics

F 803 Specification for Eye Protectors for Selected Sports

2.2 *ANSI Standards:*

Z80.3 Requirements for Nonprescription Sunglasses and Fashion Eyewear[3]

Z87.1 Practice for Occupational and Educational Eye and Face Protectors[3]

2.3 *Federal Standards:*[4]

No. 406

No. 3022

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *adnexa*, *n*—adjunct parts of the eye, including the orbit, orbital contents, eyelids, and the lacrimal apparatus.

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[1] This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment and Facilities and is the direct responsibility of Subcommittee F08.57 on Eye Safety for Sports.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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3.1.2 *astigmatism*, *n*—a condition in a lens that creates two axially separated line foci of each object point, the lines being mutually perpendicular. In other words, the lens has two different refractive powers in meridians that are 90° apart.

3.1.3 *base-in*, *adj*—relating to the type of prism imbalance that tends to cause parallel rays of light passing through a protector, spaced apart by the interpupillary distance, to converge.

3.1.4 *base-out*, *adj*—relating to the type of prism imbalance that tends to cause parallel rays of light passing through an EPD, spaced apart by the interpupillary distance, to diverge.

3.1.5 *binocular*, *adj*—relating to the field of view that is shared by both eyes simultaneously.

3.1.6 *central viewing zone*, *n*—that part of a lens that has its center in line with the wearer's line of sight when looking straight ahead. The zone is circular in shape. For the purpose of this specification, it shall be considered to be 38 mm in diameter. The center of the central viewing zone shall be the point of intersection of the line of sight with the lens as mounted on the CSA adult[5] headform, as specified by the manufacturer.

3.1.7 *cleanable*, *adj*—the ability of an EPD to be made readily free of dirt or grime without being damaged during an appropriate cleaning process, such as the use of soap and water.

3.1.8 *coverage*, *n*—a characteristic of an EPD that protects the eyes by obstructing straight line paths that are coincident with the wearer's eyes.

3.1.9 *definition, optical*, *n*—the characteristic of a lens that allows separate distinct points in close proximity to be discerned when looking through the lens.

3.1.10 *eye*, *n*—relating to the eye of the headform or the eye of a person wearing an EPD or that part of an EPD through which a wearer's eye would normally look.

3.1.11 *eye of the headform*, *n*—all structures contained within the orbital rim of the Alderson or CSA headform.

3.1.12 *eye protective device (or EPD)*, *n*— a device that provides protection to the wearer's eyes against specific hazards encountered in sports.

3.1.13 *haze*, *n*—the fraction of the total transmitted light from a normally incident beam that is not transmitted in a focused condition but scattered by inclusions or surface defects. Excessive haze will reduce contrast and visibility.

3.1.14 *headform optical parameters*, *n*—key dimensions for the headform as provided in Fig. 1.

3.1.15 *lens*, *n*—the transparent part of parts of an EPD through which the wearer normally sees.

3.1.16 *lens retention component(s)*, *n*—components, separate from the lens, that are designed to retain the lens in the frame or body of the EPD.

3.1.17 *luminous transmittance*, *n*—luminous transmittance is a function of the spectral transmittance of the lens weighted by the corresponding ordinates of the photopic luminous efficiency distribution of the CIE (1931) standard colorimetric observer and by the spectral intensity of standard Illumination C (see ANSI Z80.3).

3.1.18 *paintball fragment*, *n*—a part of the shell of the paintball that will not be surrounded completely by a 3 by 5-mm rectangle .

3.1.19 *orbital area*, *n*—the area contained in a circle *r* = 20-mm centered on the pupil of the headform.

3.1.20 *power imbalance*, *n*—a condition that exists when the refractive power created by the right lens of the EPD is different from that of the left lens.

3.1.21 *prism*, *n*—the angular deviation of a ray of light as it passes through a lens resulting from the angle at which the ray strikes each surface of the lens and the index of refraction of the material from which it is made.

3.1.22 *prism imbalance*:

3.1.22.1 *horizontal imbalance, n*—the difference in prismatic deviation of incident parallel light beams on the two eyes of an EPD in the horizontal meridian (see **base-in** and **base-out**).

3.1.22.2 *vertical imbalance, n*—the difference in prismatic deviation between parallel light beams incident on the two eyes of an EPD in the vertical meridian.

3.1.23 *refractive power*, *n*—the focusing effect of a lens expressed in diopters.

3.1.24 *spherical power*, *n*—the average of the maximum meridional astigmatic power and the minimum meridional astigmatic power of a lens.

4. Performance Requirements

4.1 *Optical Requirements*:

4.1.1 *Field of View*—When tested in accordance with 6.1, the EPD shall have a field of view equal to or exceeding the following:

4.1.1.1 *Temporal Field*—50°.

4.1.1.2 *Nasal Field*—30°.

4.1.1.3 *Superior Field*—30°.

4.1.1.4 *Inferior Field*—30°.

4.1.2 *Refractive Tolerances*—When tested in accordance with 6.6, the spherical power shall not be less than −0.37 diopters and shall not exceed +0.06 diopters.

4.1.3 *Astigmatism*—When tested in accordance with 6.6, the astigmatism shall not exceed 0.25 diopters.

4.1.4 *Power Imbalance*—When tested in accordance with 6.6, the power imbalance in corresponding meridians between the two eyes for straight ahead seeing shall not exceed 0.18 diopters.

4.1.5 *Prism*—When tested in accordance with 6.4 or 6.8, the primary viewing position of either eye of a shield shall not exceed 0.5 prism diopters.

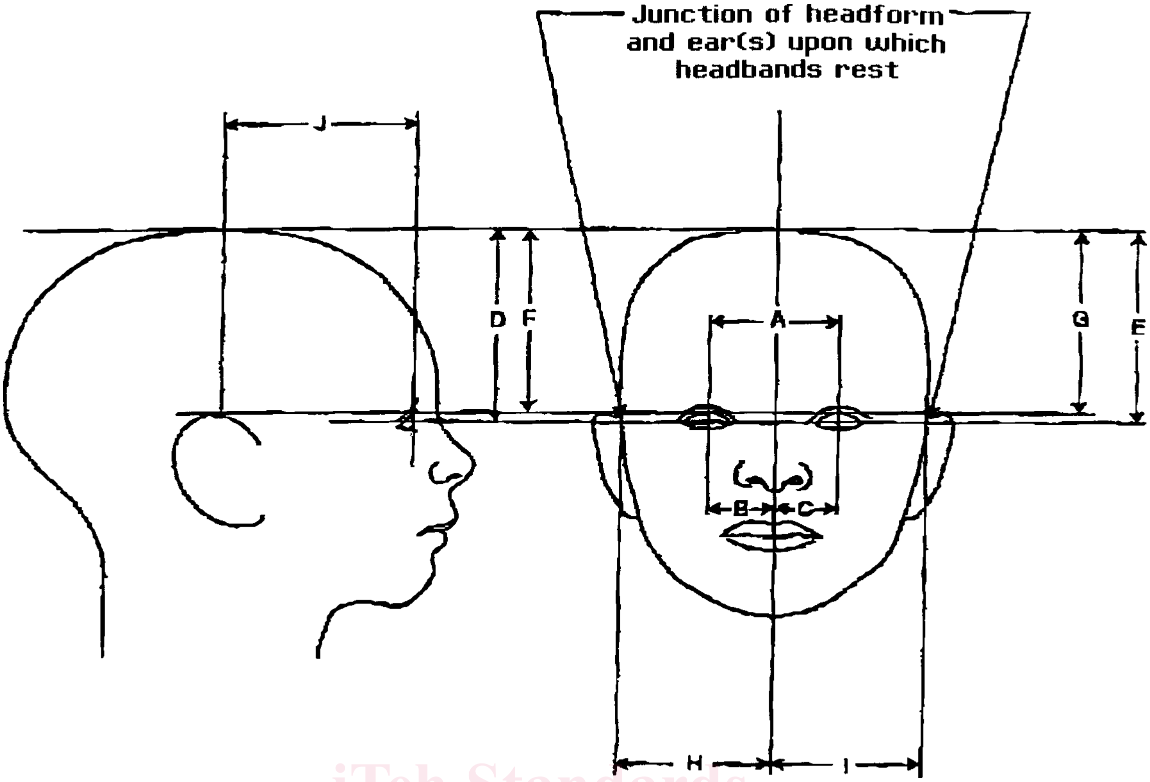
4.1.6 *Prism Imbalance*—When tested in accordance with 6.4 or 6.8, the prism imbalance shall meet the following criteria:

4.1.6.1 *Vertical Imbalance*, shall not exceed +0.25 diopters.

4.1.6.2 *Horizontal Imbalances*—Negative values (base-in) shall not be less than −0.25 prism diopters, and positive values (base-out) shall not be more than +1.0 prism diopters.

4.1.7 *Luminous Transmittance*—When tested in accordance with 6.3, the luminous transmittance shall not be less than 60 % for clear lenses and not less than 20 % for tinted lenses,

[5] Available from CSA, 178 Rexdale Blvd., Rexdale, Toronto, Canada, M9W1R3.



Dimensions, mm	
A	= 54.0 ± 2 %
B and C	= 27.0 ± 2 %
D and E	= 95.0 ± 2 %
F and G	= 93.0 ± 2 %
H and I	= 66.0 ± 2 %
J	= 80.0± 2 %

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NOTE 1—If headform is found to be symmetrical or is to be made symmetrical then B = C, D = E, F = G, and H = I.

A = Interpupillary distance.
B = Distance of right eye pupil from sagittal plane.
C = Distance of left eye pupil from sagittal plane.
D = Distance of right eye pupil from top of headform.
E = Distance of left eye pupil from top of headform.
F = Distance of top of right ear/headform junction from top of headform.
G = Distance of top of left ear/headform junction from top of headform.
H = Distance from right side of headform to sagittal plane.
I = Distance from left side of headform to sagittal plane.
J = Distance between front of pupil and top of ear/headform junction.

FIG. 1 CSA 8-Year Old Child

unless labeled **very dark** in which case the minimum transmittance shall be no less than 8 %. All tinted lenses shall be labeled **Not for use in low light conditions**.

4.1.8 *Haze*—When tested in accordance with 6.5, the haze of the EPD shall not exceed 3 %.

4.1.9 *Optical Quality*—Within the central viewing zone, striae, warpage, surface ripples, or other defects that are apparent under the optical inspection test conditions of 6.2 shall be considered a failure. An exception is when small specks or inclusions, which are not seen when the lens is held close to the eye in the as-worn position, shall not be a cause of rejection.

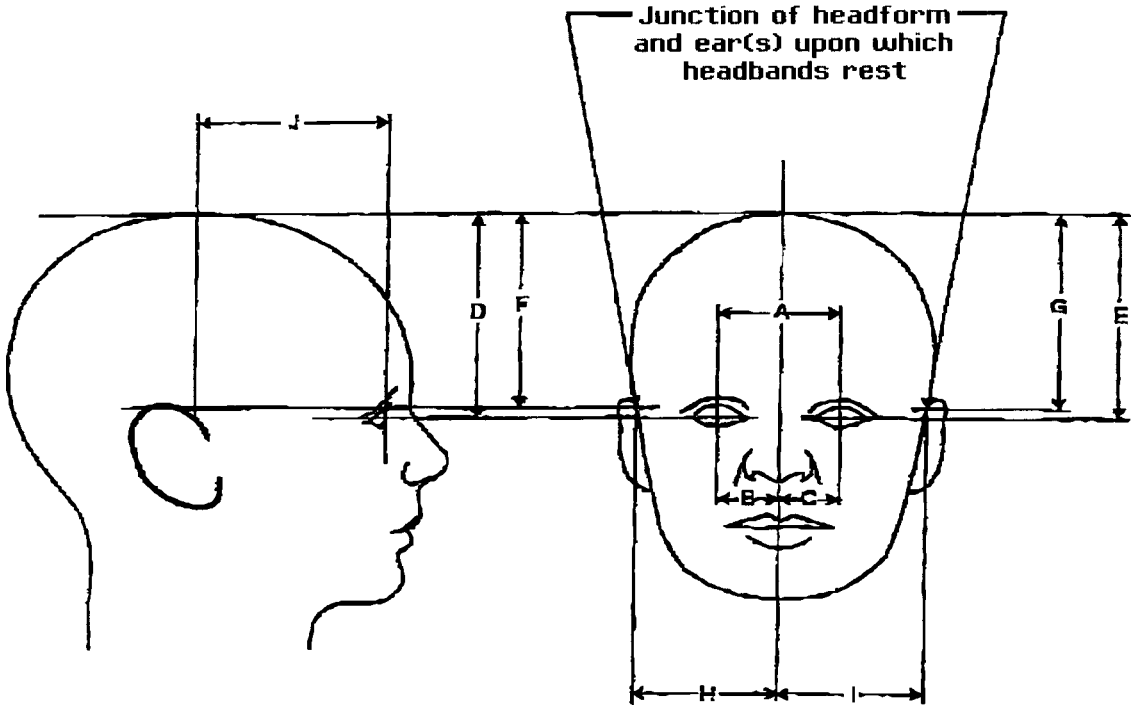
4.1.10 *Physical Lens Defects*—Within the central viewing zone, pits, scratches, grayness, bubbles, cracks, water marks, or other defects that are apparent under the visible inspection test conditions of 6.7 shall be considered a failure. An exception that small specks or inclusions, which are not seen when the lens is held close to the eye in the as-worn position, shall not be cause of rejection.

4.2 *Mechanical Requirements*:

4.2.1 No contact by components of the EPD or paintball fragments with the orbital area of the headform shall be permitted when tested in accordance with Section 7.

4.2.2 Any visible fracture of the lens or frame constitutes a failure.

4.2.3 Any dislodging of the lens from the frame constitutes a failure.



Dimensions, mm	
A	= 59.0 ± 2 %
B and C	= 29.5 ± 2 %
D and E	= 113.0 ± 2 %
F and G	= 108.0 ± 2 %
H and I	= 73.0 ± 2 %
J	= 85.0± 2 %

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H = Distance from right side of headform to sagittal plane.
I = Distance from left side of headform to sagittal plane.
J = Distance between front of pupil and top of ear/headform junction.

FIG. 1 CSA 13 Year-Old Male/Adult Female *(continued)*

4.2.4 Any dislodging of a lens retention component from the lens constitutes a failure.

4.2.5 Any dislodging of an EPD from the face protection component to which it is attached constitutes a failure.

4.2.6 Any rotation of the headgear system in the headform that would permit contact of a 15.9-mm (0.625-in.) diameter cylindrical probe to the orbital area of the headform constitutes failure.

5. Sample Preparation

5.1 *Eye Protective Devices*:

5.1.1 Only new and complete EPDs as offered for sale shall be tested.

5.1.2 EPDs shall be subjected to a single impact test.

5.1.3 The EPD shall be conditioned for a minimum of 4 h at the specified temperature prior to each test.

5.2 *Test Temperatures*:

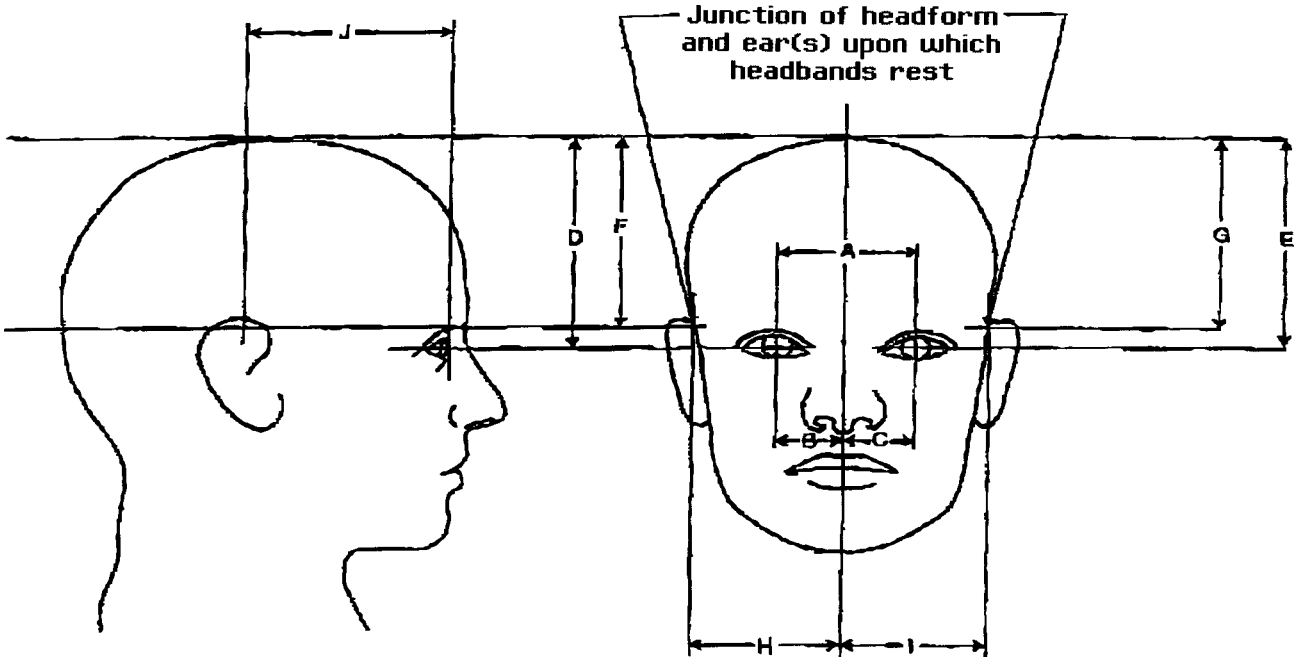
5.2.1 *Cold Test*, −12.2°C± 2°C (10°F ± 3.5°F).

5.2.2 *Room Temp*, 23°C± 2°C (73°F ± 3.5°F).

5.2.3 *Hot Test*, 37.8°C± 2°C (100°F ± 3.5°F).

5.3 *Paintballs*:

5.3.1 All impact testing shall be done using paintballs manufactured within the previous eight months. Paintballs shall be used for impact testing only after a sampling of paintballs taken from the bulk container fall within the parameters specified in 5.3.3 and 5.3.4. The paintball bulk container shall be resealed immediately after each group of paintballs is removed. Paintball storage and nontest handling shall be done



Dimensions, mm	
A	= 67.0 ± 2 %
B and C	= 33.5 ± 2 %
D and E	= 117.0 ± 2 %
F and G	= 108.0 ± 2 %
H and I	= 75.0 ± 2 %
J	= 92.0± 2 %

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FIG. 1 CSA Adult Male *(continued)*

at a relative humidity below 55 % and at a temperature between 12.7°C (55°F) and 29°C (85°F).

5.3.2 Paintballs used for impact testing shall be conditioned in a sealed packet (bag) for at least 4 h at the specified temperature for each test. Impact testing shall be completed within 3 min after removal of the paintballs from their temperature conditioning atmosphere.

5.3.3 *Weight and Dimension Test*—Measure a sampling of 25 paintballs. Their weight shall be at or between 3.1 and 3.3 g. Their diameter, measured both at the seam and polar, shall be at or between 16.89 and 17.78 mm (0.665 and 0.700 in.).

5.3.4 *Burst Strength Test*—Drop 100 paintballs, individually, from a height of 1.83 m (6 ft) onto a clean concrete floor. At least three but no more than 25 of the 100 paintballs shall break. Discard the unbroken paintballs.

TEST METHODS

6. Optical Test Methods

6.1 *Field of View (Angle of Vision)*:

6.1.1 *Purpose*—This test method is intended to determine the relative unobstructed angle visually available to the user. With the EPD mounted on the standard headform, the pole of the cornea shall be visible to an observer when sighted from the required field angles in accordance with 4.1.1. Any sighting method may be used. Paragraphs 6.1.2-6.1.4 give one method.

6.1.2 *Apparatus*—The concept is to mount a CSA headform, size specified by the manufacturer or chosen by the test lab, in a gimbal. Any gimbal that is sufficiently large and sturdy and properly inscribed with horizontal and vertical protractor markings is acceptable. Figs. 2-4 show front and side vertical

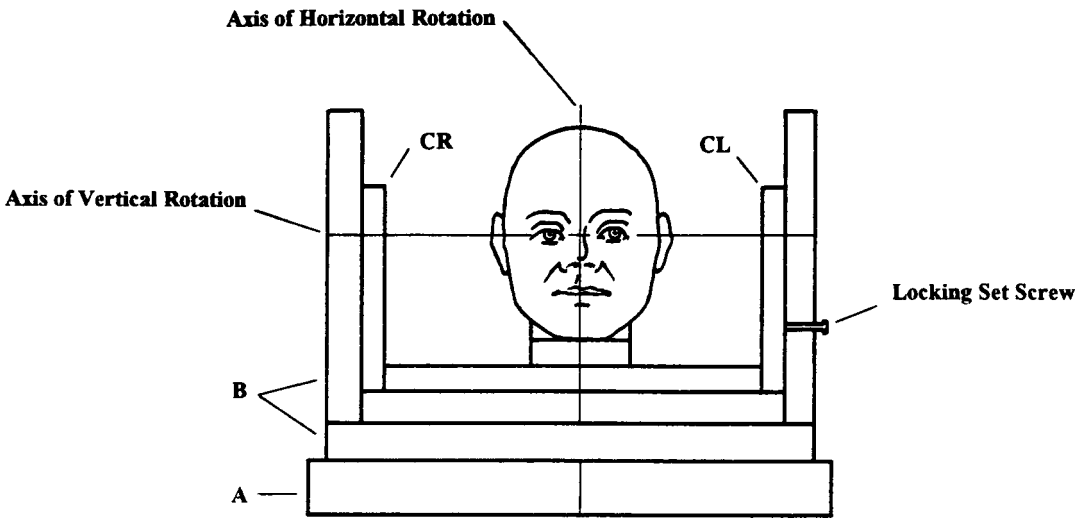

FIG. 2 Schematic of Gimbal for Supporting Standard Head

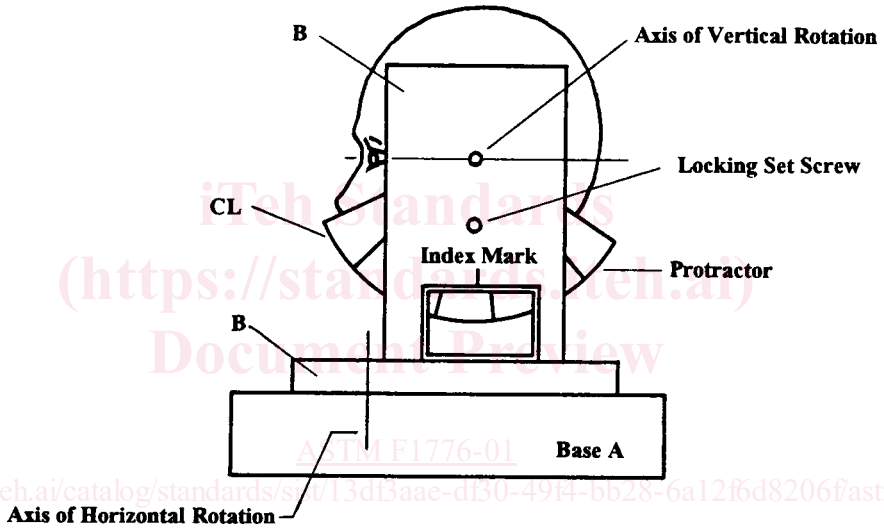

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FIG. 3 Side View of Gimbal

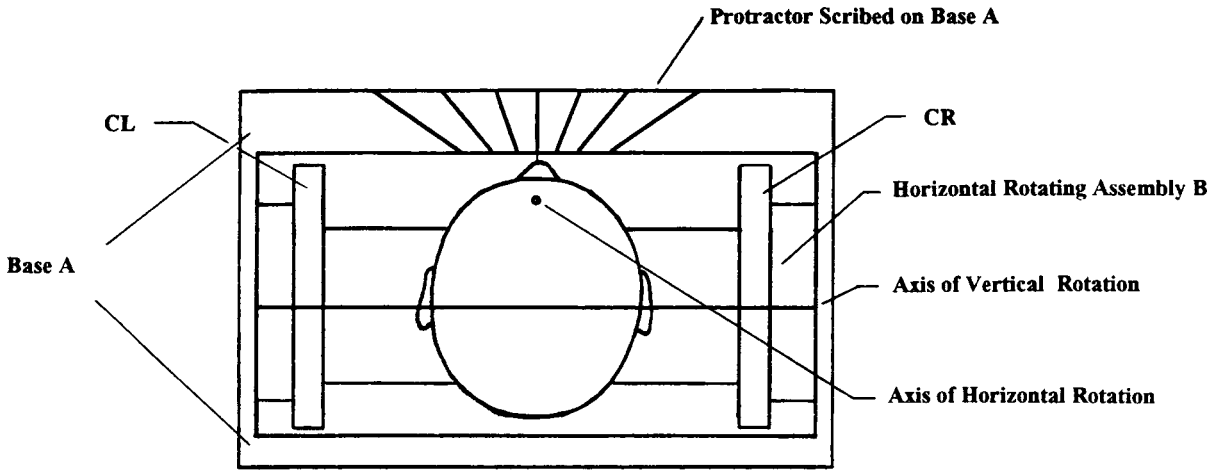

FIG. 4 Top View Showing Base for Horizontal Rotation

schematic views of a wooden gimbal that can be constructed with simple tools. Item A is the base and support for horizontal rotation. A protractor should be marked on the base with its center coincident with the axis of rotation. Base A should