AUTOMOTIVE INDUSTRY STANDARD

Visors of Protective Helmets for Motorcycle Riders - Specification

Status chart of the Standard to be used by the purchaser for updating the record

Sr. No.	Corr-igenda.	Amend-ment	Revision	Date	Remark	Misc.

General remarks:

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the Ministry of Surface Transport (MOST) has constituted a permanent Automotive Industry Standard Committee (AISC) vide order No. RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the secretariat of the AIS Committee, has published this standard. For better dissemination of this information ARAI may publish this document on their Web site.

While preparing this Automotive Industry Standard (AIS) considerable assistance has been taken from:

- ECE – R – 22 : Uniform Provisions Concerning the Approval of Protective Helmet and of their Visors for Drivers and Passengers of Motorcycles and Mopeds.

- AIS-058 (Part – 1) Protective Helmets for Motorcycle Riders - Specification

- IS : 4151-1993 : Protective Helmets for Motorcycle Riders - Specification (Third Revision)

- IS : 9973 – 1981 : Specification for Visor for Scooter Helmet

The Part 1 on this standard talks about the specification of the helmets while, Part 2 is for specifications of the visor. The standard has been aligned to ECE – R – 22, Revisions – 3, Amendment –3, August 2001. While drafting the standard the committee felt that under Indian situation we should prescribe the maximum limit on the mass of the helmet and accordingly the maximum limit has been put as 1500g.

The Automotive Industry Standards Committee (AISC) responsible for preparation of this standard is given in Annexure : 10

Visors of Protective Helmets for Motorcycle Riders - Specification

1. SCOPE

1.1 This standard lays down the requirements regarding material, construction, workmanship, finish, mass and performance for visors fitted on protective helmets (with or without lower face cover) for everyday use by motorcycle riders.

1.2 The visors of helmets covered by this standard are not to be used on the helmets intended for high speed competitive events.

2.0 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

2.1 **Visor**

A transparent protective screen extending over the eyes and covering part of the face.

2.2 **Visor Screen**

The curved transparent plastic material intended for providing protection to the eyes and face.

2.3 **Goggles**

Transparent protectors that enclose and cover the eyes.

2.4 **Basic Plane of the Human Head**

A plane at the level of the opening of the external auditory meatus (external ear opening) and the lower edge of the orbits (lower edge of the eye sockets).

2.5 **Basic Plane of the Headform**

A plane, which corresponds to the basic plane of the human head.

2.6 **Central Vertical Axis**

The line relative to human head or headform or helmet that lies in the plane of symmetry, and that is normal to the basic plane at a point equidistant from the front and back of the head or the headform or (for helmet) of the headform that simulates the head that the helmet is intended to fit (Figure 2 of Annexure 1).

2.7 **Reference Plane**

A construction plane parallel to the basic plane of the headform at a distance from it which is a function of the size of the headform.

2.8 **Disposable Protective Film**

2.8.1 A removable plastic film may be applied to protect the visor prior to use. In this case the film has to be opaque or printed, so that it must be removed before use.

2.8.2 A protective film (tear-off) may be used for racing for example to reduce the level of luminous transmission. Such tear-off-films are not for use on the road and are not covered by this Standard.

2.9 **Ocular Areas** means two circles of minimum diameter 52 mm spaced symmetrically about the vertical centre line of the visor, the distance between the centers of the circles being 64 mm measured in the horizontal front plane of the visor as worn.

2.10 **Luminous Transmittance** τ_v

This is defined in Annexure 6 of this standard.

2.11 **Relative Visual Attenuation Quotient**

Means the relative visual quotient (Q) and is defined in Annexure 6.

2.12 **Visor Type**

Means a category of visors which do not differ substantially in such essential characteristics as;

2.12.1 The trade name or mark, or

2.12.2 The materials, dimensions, manufacturing processes (such as extrusion of moulding) colour, surface treatment, system of attachment to the helmet.

2.13 **Approval Test**

Means a test to determine the extent to which a protective helmet type and / or a visor type submitted for approval is capable of satisfying the requirements.

2.14 **The Field of Vision of the Visor**
(Figure 1, 2A, 2B, and 2C of Annexure 1)
The field of vision of the visor defined by;
a) A dihedron defined by the reference plane of the headform and a plane forming an angle of at least 7° upwards, its edge being the straight line $L_1 L_2$ with Points L_1 and L_2 representing the eyes.

b) Two segments of dihedral angles symmetrical to the median vertical longitudinal plane of the headform. Each of these dihedral angles is defined by the median vertical longitudinal plane of the headform and the vertical plane forming with this plane an angle of 90°, its edge being the straight line LK, and the lower edge of the visor.

3.0 MATERIALS

3.1 The plastic material for the visor screen shall be so chosen that it satisfy the requirements of this standard. The suitability of the proposed new material shall be established by the manufacturer. Any alternative materials may be used provided visor confirms the requirements of this standard

3.2 The bolts used for fixing of visor screen with the shell shall be either inherently corrosion resistant or shall have been treated for corrosion resistance. These bolts shall show no sign of corrosion when subjected to test as specified in IS 9844:1981.

4.0 VISOR REQUIREMENTS

4.1 General Requirements

4.1.1 The systems of attachment of a visor to a helmet shall be such that the visor is removable. It must be possible, to manoeuvre the visor out of the field of vision with a simple movement of one hand. However, the latter prescription may not be required for helmets which do not provide chin protection provided that a label is attached to the helmet to the effect of warning the purchaser that the visor cannot be manoeuvred.

4.1.2 Visors shall be free any significant defects likely to impair the vision, such as bubbles scratches, inclusions, dull spots, holes, mould marks, scratches or other defects originating from the manufacturing process in the field of vision. All edges shall be finished smooth and shall be free from burrs, protrusions and irregularities.

4.1.3 Angle Opening

4.1.3.1 **Requirement**
When the visor is in the raised position, the angle between the secant MN defined in Figure 1 of Annexure 3 and the horizontal shall be at least 5° with the point M situated below the horizontal plane passing through point N.

4.1.3.2 **Procedure**
The helmet, fitted with the visor being tested, shall be placed on a test headform of appropriate size, selected from those listed in Figure 1 of Annexure 1, in accordance with the Annexure 2, with the helmet tipped towards the rear as specified the visor placed in the closed position.

4.1.4   **Field of Vision (Figure 1, 2A, 2B and 2C of Annexure 1)**

4.1.4.1   When the visor is in the totally opened position, it shall not comprise any part liable to impair the user's peripheral vision in accordance with the paragraph 5.5 of the part 1 of this standard. Furthermore, when the visor is in closed position, the lower edge of the visor shall not be situated in the downward field of vision of the user in accordance with the paragraph 5.5 of the part 1 of this standard. The surface of the visor in the peripheral field of vision of the helmet may however include;

i.   The lower edge of the visor, provided that it is made of material with at least the same transmittance as the rest of the visor.

ii.   A device to allow the visor to be manoeuvred. However, if this device is situated within the field of vision of the visor defined in paragraph 2.14, below it shall be at the lower edge and present a maximum height (h) of 10 mm and its width (1) shall be such that the product (h x 1) at the most is equal to 1.5 cm^2. Moreover, it must be made of a material with at least the same transmittance as the visor and it must be free of any engraving, paint or other covering feature.

iii. Fixings and devices to allow the visor to be manoeuvred if they are situated outside of the field of vision of the visor and if the total surface of these parts, including devices, if any to allow the visor to be manoeuvred does not exceed 2 cm^2, possibly distributed on each side of the field of vision.

4.1.4.2   To determine the field of vision as defined in paragraph 2.14, the helmet fitted with the visor to be tested shall be placed on a test headform of suitable size from among those shown in Figure 1 of Annexure 1, in accordance with the provisions given in Annexure 2, the visor then being placed in a closed position.

4.1.5.   **Mass**
The mass of the complete visor shall not exceed 350 g. If the mass exceeds 350 g., this mass determined to the nearest 10 g. shall be shown on the label attached to the visor.

4.2 VISOR TESTS

4.2.1 Sampling and use of samples

The 7 (+ 3 if optional test) visors are used as follows,

Test	1	2	3	4	5	6	7	7	8	9	10	Total
								If Optional Test				
Field of vison	X											1
Luminance transmittance Light diffusion Recognition of signal lights Spectral transmittance	X	X	X									3
Refractive powers				X	X	X						3
Mist retardant (optional)								X	X	X		3
Mechanical characteristics				X	X	X						3
Optical quality &scratch resistance	X	X	X									3

Note : The test for recognition of signal lights may be dispensed with in the case of visors with luminance transmittance $\tau_v \geq 80\%$,

4.2.2   Prior to any type of further conditioning for mechanical or optical test, as specified in 4.2.1, each visor shall be subject to the ultraviolet conditioning in accordance with the provisions of paragraph 4.2.2.4.

4.2.2.1   **Ambient (temperature and humidity) conditioning -** The visor shall be exposed to a temperature of 30° ± 5°C and a relative humidity of 65 ± 5 percent for at least 4 hours in an oven.

4.2.2.2   **Heat conditioning -** The visor shall be exposed to a temperature of 50 ± 2°C for not less than 4 hours and not more than 6 hours in dry heat.

4.2.2.3   **Low-temperature conditioning** - The visor shall be exposed to a temperature of -20° ± 2°C for not less than 4 hours and not more than 6 hours in cold chamber.

4.2.2.4   **Ultraviolet-radiation conditioning and moisture conditioning** - The visor shall be exposed to ultraviolet radiation by a 125 watt zenon filled quartz lamp for 48 hours at a range of 25 cm subsequently spraying for 4 to 6 hours with water at ambient temperature at the rate of 1 litre per minute.

4.3   MECHANICAL REQUIREMENT

4.3.1   Impact Resistance Test

4.3.1.1   **Requirement**
When the drop hammer falls from a height of 1 + 0.005 m, measured between the top face of the punch and the lower face of the hammer, it shall be ascertained that, no sharp splinters are produced if the visor is shattered.
Any segment having an angle less than 60° shall be considered as a sharp splinter.

4.3.1.2   **Procedure**

4.3.1.2.1   The helmet, fitted with its visor and previously conditioned in accordance with the provisions of paragraph 4.2.2.2, shall be placed in accordance with Annexure : 2 on a test head form of suitable size. The test head form selected from among those shown in Figure 1 of Annexure : 1, shall be so placed that the basic plane is vertical.

4.3.1.2.2   The test apparatus used shall be as described below. The metal punch being placed in contact with the visor in the vertical symmetrical plane of the head form to the right of point K. The apparatus shall be designed in such a way that the punch is stopped not less than 5 mm above the head form.

4.3.1.2.3   The testing device mentioned above shall have the following characteristics:

Mass of punch	0.3 kg ± 10 g
Angle of cone forming punch head	60° ± 1°
Radius of rounded top of punch head	0.5 mm
Mass of the drop hammer	3 kg ± 25 g

4.4   OPTICAL REQUIREMENT

4.4.1   **Optical Requirements and Scratch Resistance**

4.4.1.1   **Requirements**

4.4.1.1.1   Three similar test pieces, each from a different visor and taken from the area specified in paragraph 4.1.4.1 shall meet the following requirements,

4.4.1.1.2   **The light diffusion shall not exceed the following values for each methods,**

Before Abrasion	After Abrasion
0.65cd/m^2/l$^{(a)(c)}$	5.0 cd/m^2/l$^{(a)(c)}$
2.5% $^{(b)}$	20% $^{(b)}$

$^{(a)}$measured according to Annexure 5,Method (a)
$^{(b)}$ measured according to Annexure 5,Method (b)
$^{(c)}$ measured according to Annexure 5,Method (c)

4.4.1.2   **Procedure**

4.4.1.2.1   The test piece shall be taken from the flattest part of the visor in the area specified in paragraph 4.1.4.1 and its minimum dimensions shall be 50 mm x 50 mm. The test shall be carried out on the face corresponding to the outside of the visor.

4.4.1.2.2   The test piece shall undergo ambient-temperature and hygrometry conditioning, in accordance with paragraph 4.2.2.1

4.4.1.2.3   The test shall comprise the following sequence of operations:

4.4.1.2.3.1   The surface of the test piece shall be washed in water containing 1 % detergent and rinsed with distilled of demineralized water, then carefully dried with a grease-free and dust-free linen cloth.

4.4.1.2.3.2   Immediately after drying, and before abrasion, the luminous transmittance and light diffusion is measured using the methods given in Annexure : 5.

4.4.1.2.3.3   The test piece shall then be subjected to the abrasion test described in Annexure :4, during which 3 kg of abrasive material shall be projected at the sample.

4.4.1.2.3.4   Following the test, the test piece shall again be cleaned in accordance with paragraph 4.4.1.2.3.1

4.4.1.2.3.5   Immediately after drying, the light diffusion after abrasion shall be measured by using again the same method used in accordance with paragraph 4.4.1.2.3.2 above.

4.4.2   **Luminous Transmiitance**

Visors shall have a luminous transmittance $\tau_v \geq 80\%$, relative to the standard illuminant D65. A luminous transmittance $80\% \geq \tau_v \geq 50\%$; measured by the method given in paragraph 4.4.3.2, is also permissible if the visor is marked with the symbol shown in Figure 1 below and/or with the English words "DAY TIME USE ONLY". The luminous transmittance shall be measured before the abrasion test. The luminous transmittance is measured as per Annexure : 5.
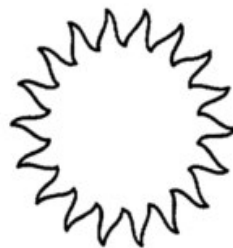
FOR DAY TIME USE ONLY
FIGURE 1

4.4.3   **Spectral Transmittance and the Relative Attenuation Quotient (Q)**

4.4.3.1   **Requirement**

In the range 500 nm to 650 nm, the spectral transmittance, measured by the method given in following paragraph 4.4.3.2 of the visor shall not be less than 0.2 τ. The spectral transmittance shall be measured before the abrasion test

Visors shall in addition be sufficiently transparent, shall not cause any noticeable distortion of object as seen through the visor, shall be resistant to abrasion, resistant to impact and shall not give rise to any confusion between the colour used in road traffic sign and signals. The relative visual attenuation quotient (Q) shall not be less than:
    0.80 for red and yellow signal lights;
    0.60 for green signal light;
    0.40 for blue signal light;
The relative attenuation quotient (Q) shall be measured by the method given in paragraph 4.3.3.2 before the abrasion test.

4.4.3.2   **Procedure**

In a parallel beam, with the test specimen being irradiated vertically, determine the spectral transmittance values between 380 nm and 780 nm and then the transmittance and the visual attenuation quotient in accordance with the equations given in Annexure : 7.

To calculate the luminous transmittance, the spectral distribution of standard illuminant D 65 and the spectral values of the colorimetric 2° standard observer CIE 1931 according to ISO/CIE 10526 shall be used. The product of the spectral distribution of standard illuminant D 65 and the spectral values of the colorimetric 2° standard observer CIE 1931 according to ISO/CIE 10526 is given in Annexure:7. Linear interpolation of these values for steps smaller than 10 nm is permissible.

4.4.4   TEST OF REFRACTIVE POWERS

The following Table contains the permissible refractive powers at the sight points . The sight points are located in the reference plane 32mm to the right and to the left of the longitudinal median plane (Figure 2B of Annexure :1)

Permissible Refractive Power Values for Visors

Spherical effect	Astigmatic effect	Prismatic effect difference		Vertical
$(D_1+D_2)/2$	(D_1-D_2)	Horizontal		
m^{-1}	m^{-1}	Base out cm/m	Base in cm/m	cm/m
± 0.12	0.12	1.00	0.25	0.25

D_1 , D_2 Refractive effect in two main sectors

The requirements for the prismatic effect apply to the difference between the values at the two sight points.

The refractive powers shall be measured according to method specified in Annexure :8.

4.4.5   **Mist Retardant Visor (Optional Requirements)**

The internal face of the visor is regarded as having a mist retardant facility if the square of the specular transmittance has not fallen below 80 % of the initial value without misting within 20 s when tested as described in Annexure:9. Such facility may be indicated by the English words "MIST RETARDANT".

5.0   **MARKINGS**

5.1   The visor submitted for the approval in conformity with paragraph 6, shall bear the following marking ;

    a)   Manufacturer's Trade Name or Mark
    b)   Model Name of the helmet for which the visor is approved
    c)   Batch No.
    d)   Month and year of manufacturing
    e)   If applicable Symbol or marking as described in paragraph 4.4.2

5.2   The marking shall be indelible, clearly legible and resistant to wear. The marking shall not be within the main field of vision.

5.3   Every visor placed on the market with or without a protective helmet, shall be accompanies by following information

5.3.1   Specific instructions for cleaning and their notice of use. These instructions shall include a warning regarding the dangers of using unsuitable agents for cleaning (such as solvents), especially if abrasion resistant coatings are to be preserved.

5.3.2   Advice to the suitability of the visor for use in conditions of poor visibility and during the hours of darkness. The following warning shall be included,

5.3.2.1   Visors with the marking indicating " daytime use only" are not suitable for use during the hours of darkness or in conditions of poor visibility.

5.3.2.2   If appropriate, the following warning shall also be included,

The fastening of this visor is such that it will not be possible to remove it instantly from the line of sight with one hand should an emergency (such as headlamp glare or misting) occur.

5.3.3   If the visor is MIST RETARDANT approved it may be indicated.

6.0   APPLICATION FOR APPROVAL

6.1   Application for Approval of a Protective Visor Type

6.1.1   The application for approval of a visor type shall be submitted by the manufacturer or by his duly accredited representative, and for each type the application shall be accompanied by the following:

6.1.2   Drawings in triplicate to a scale of 1:1, in sufficient detail to permit identification of the visor type, including its means of attachment to the helmet

6.1.3   A technical description of the visor stating the materials used, the manufacturing processes and, where appropriate, the surface treatment.

7.0   TEST REPORTS

Each technical service shall prepare reports on the results of the approval tests and keep such reports for two years.

8.0   MODIFICATION AND EXTENSION OF APPROVAL

Each modification of the visor type shall be informed by the manufacturer to the test agency, which approve the visor. The test agency may then either consider that,
i.   the extension can be given based on the documents or
ii. require further tests to be conducted before the issue of the extension, or
iii. require all tests to be conducted

9.0   CONFORMITY OF PRODUCTION

9.1   The helmet or visor approved (whether the visor is approved as such or as forming part of the helmet) shall be so manufactured as to conform to the type approved by complying with the requirements given in this standard.

9.2   The manufacturer is responsible for the conformity of production procedures and he must ensure the existence of effective procedures, availability of testing equipment and analysis tools. Records of the same must be maintained.

9.3   The test agency may carry out all of the tests prescribed in this standard. However at least tests for optical requirements must be performed;

9.4   The sampling plan and frequency of COP shall be as decided by MoSRT&H (DoRT&H) from time to time.

ANNEXURE : 1
HEADFORMS
(See para 2.14)
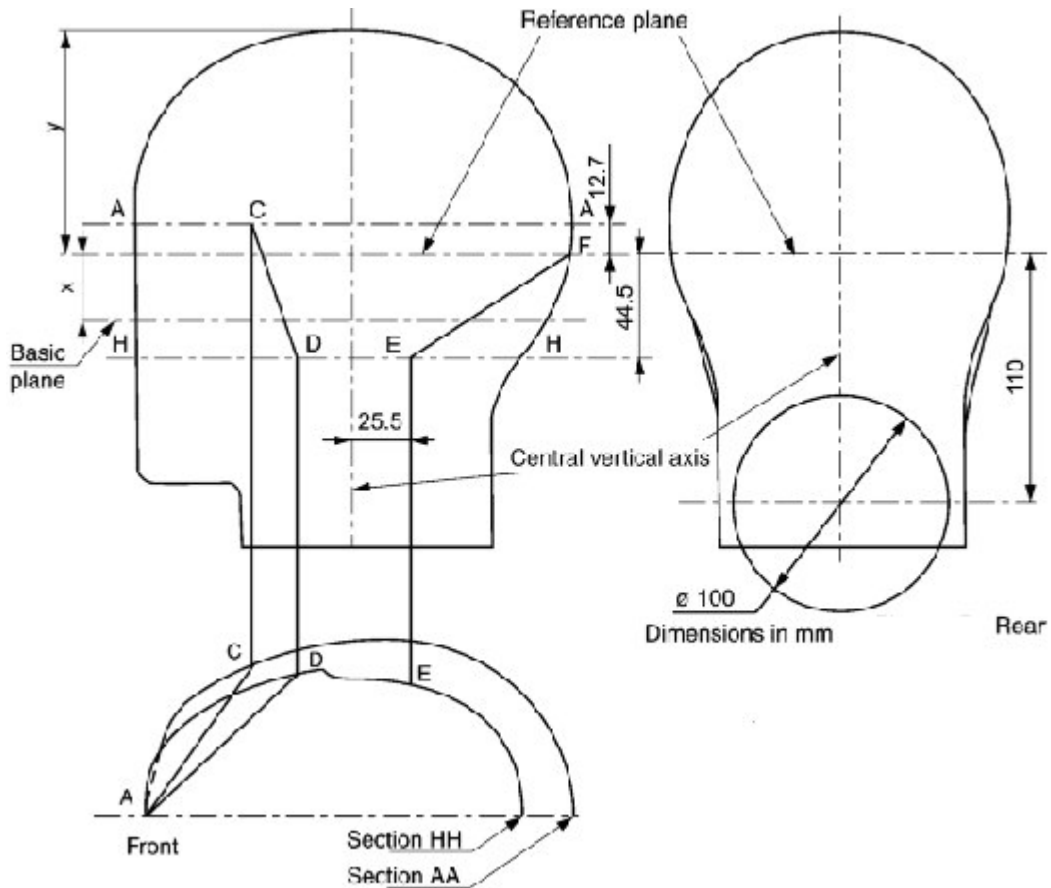
All dimensions are in millimeters

Headforms	Size	X	Y	AC	HD
A	500	24	89.5	80	88
C	520	25	93	82	90
E	540	26	96	84	92
G	530	27	99	86	94
J	570	27.5	102.5	87	95
K	580	28	104	88	96
M	600	29	107	90	98
O	620	30	110	92	100

Figure 1 - Headform Maximum extent of protection
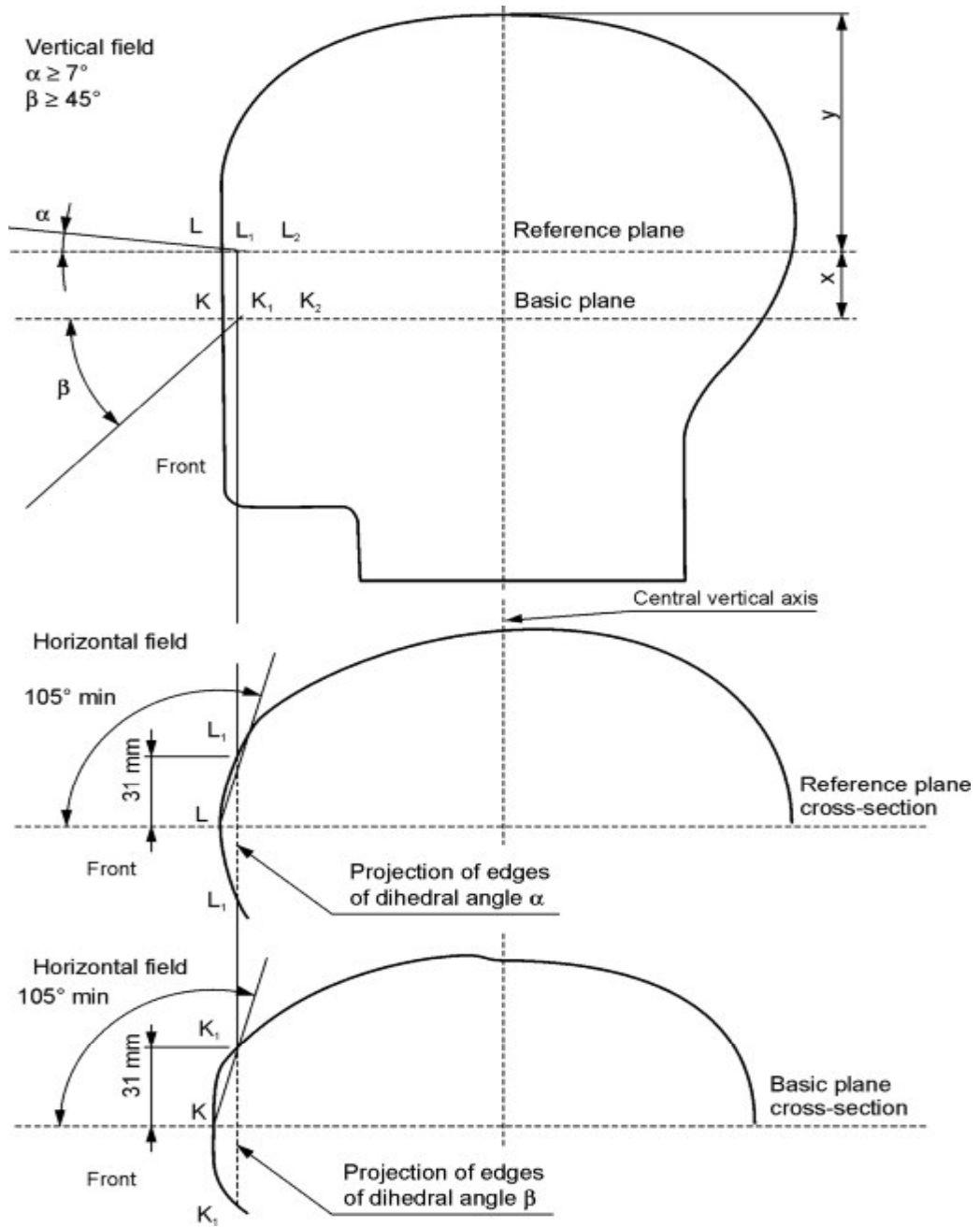
Figure – 2A Peripheral Vision

7°

Reference plane

Basic plane

45°

L_2 L L_1

K_2 K K_1

Central vertical axis

Vertical median plane
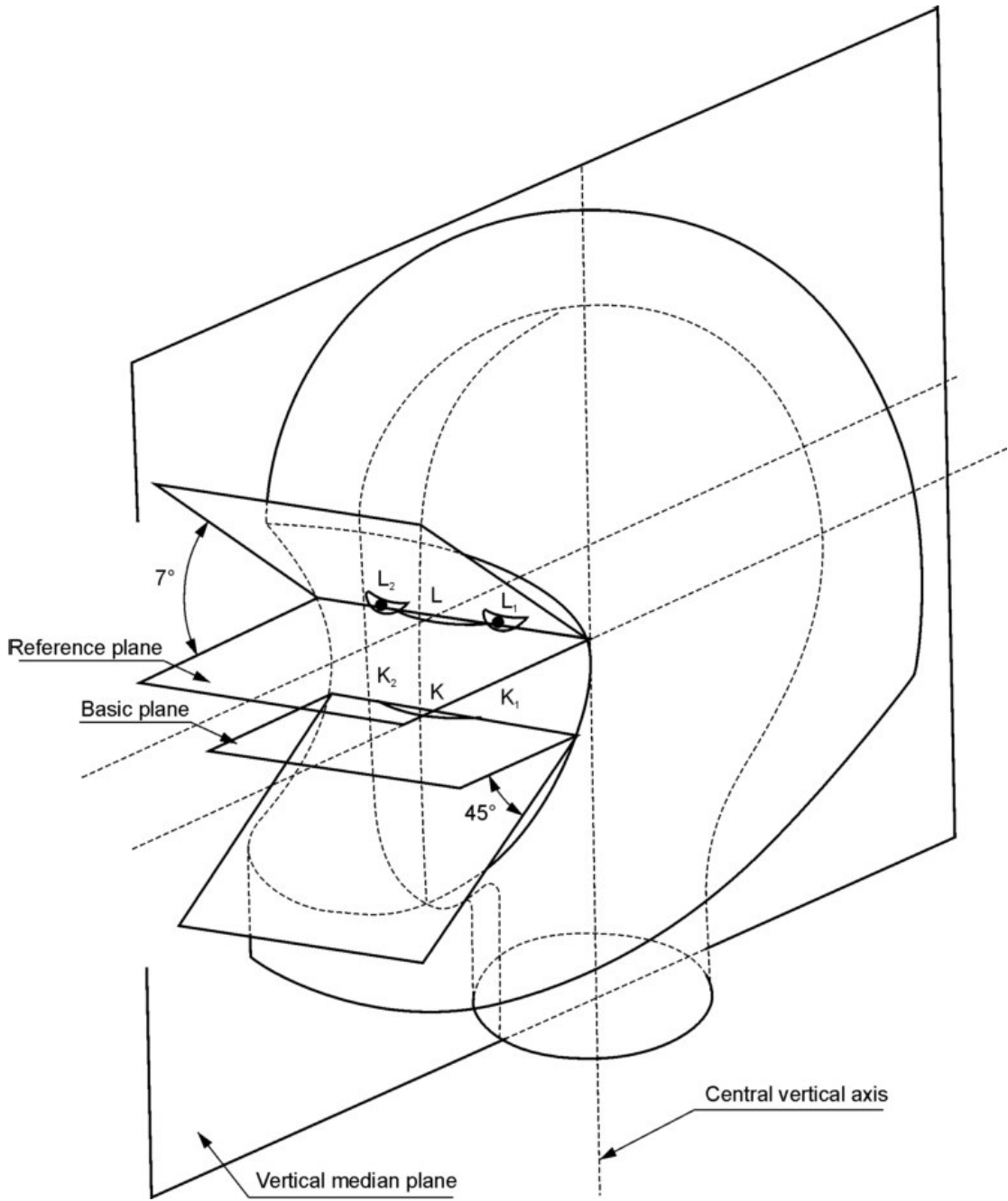
Figure– 2B Peripheral Vision – Vertical Field

105°

L

105°

Reference plane

Basic plane

K

Central vertical axis

Vertical median plane
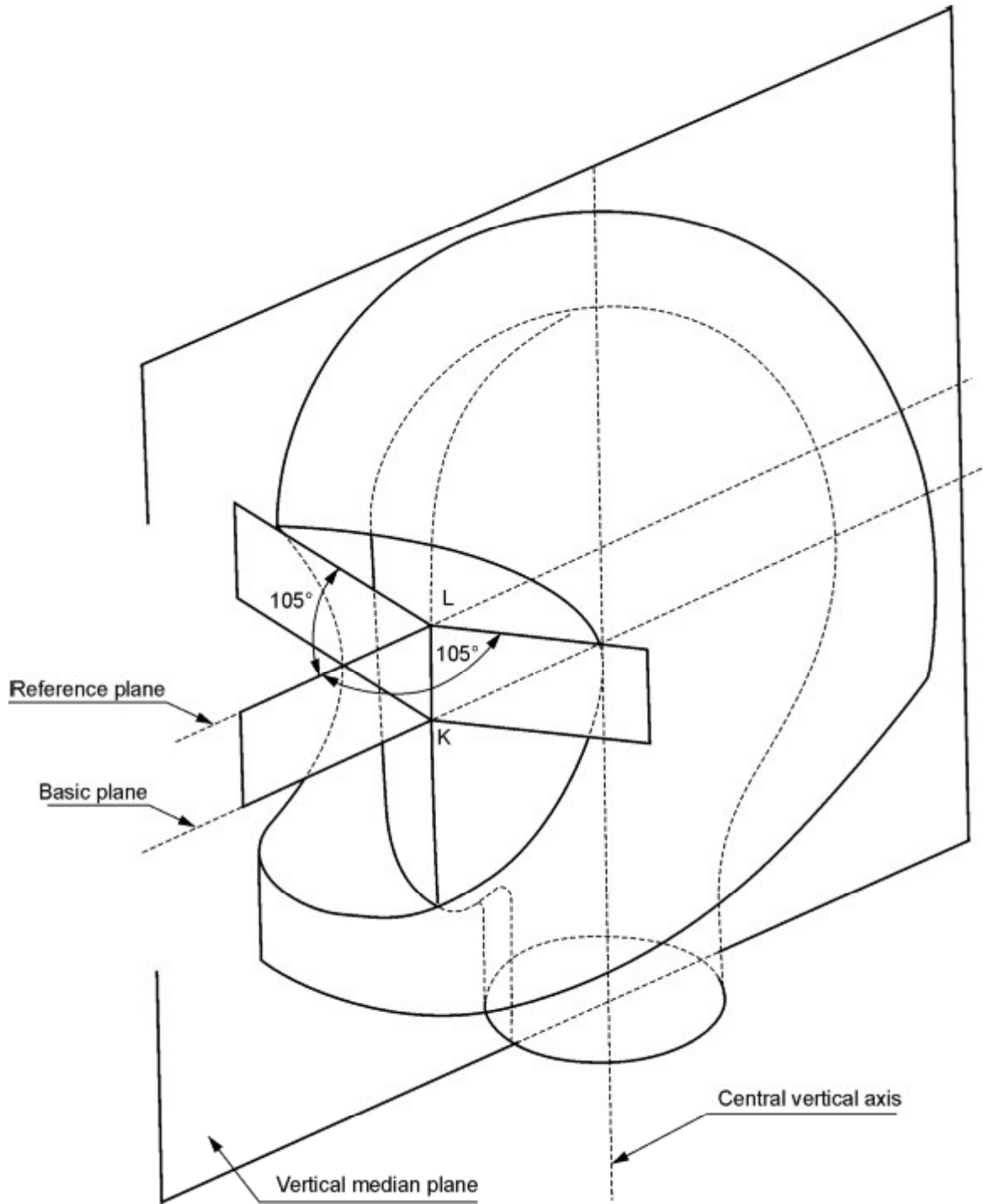
Figure– 2C Peripheral Vision – Horizontal Field

ANNEXURE : 2
(See para 4.1.3.2)

POSITIONING OF THE HELMET ON THE HEADFORM

1.0   The helmet is placed on a headform of appropriate size. A load of 50 N is applied on the crown of the helmet in order to adjust the helmet on the headform. It shall be ascertained that the vertical median plane of the helmet coincides with the median vertical plane of the headform.

2.0   The front edge of the helmet is placed against a gauge to check the minimum angle for the upward field of vision. The following points are then checked.

2.1   The line AC and the ACDEF zone are covered by the shell (see Figure 1)

2.2   That the requirements for the minimum downward angle and the horizontal field of vision are satisfied.

2.3   Requirements mentioned in paragraph 5.2.2 of Part 1of this standard, relating to the rear projection shall be respected.

3.0   If one of the above conditions is not met, the helmet is moved slightly from front to rear to seek a position where all the requirements are met. Once such a position is determined, a horizontal line is drawn on the shell at the level of the *AA'* plane. This horizontal line shall determine the reference plane for the positioning of the helmet during the tests.

ANNEXURE : 3
ANGLE OPENING TEST
(See para 4.1.3)
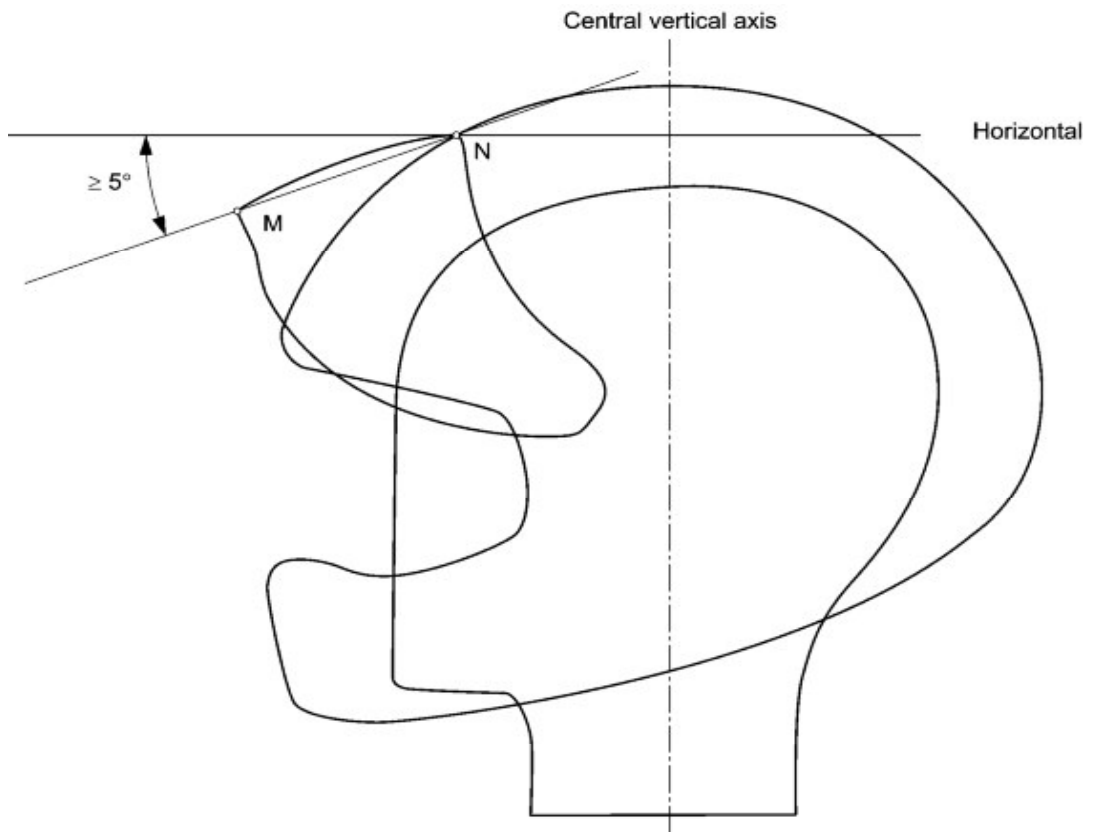
Figure 1 – Angle Opening (Visor) Test

ANNEXURE :4
(See para 4.4.1.2.3.3)

ABRASION TEST PROCEDURE

1. DESCRIPTION TEST PROCEDURE

The sand spray test equipment consists essentially of that illustrated in Figure 1 of this Annexure. The gravity tube consists of three separate rigid polyvinylchloride tubes (PVC hard) of the same diameter, with two polyamide sieves mounted in between. The sieves should have a mesh size of 1.6 mm. The speed of the turntable shall be 250 ± 10 rpm.
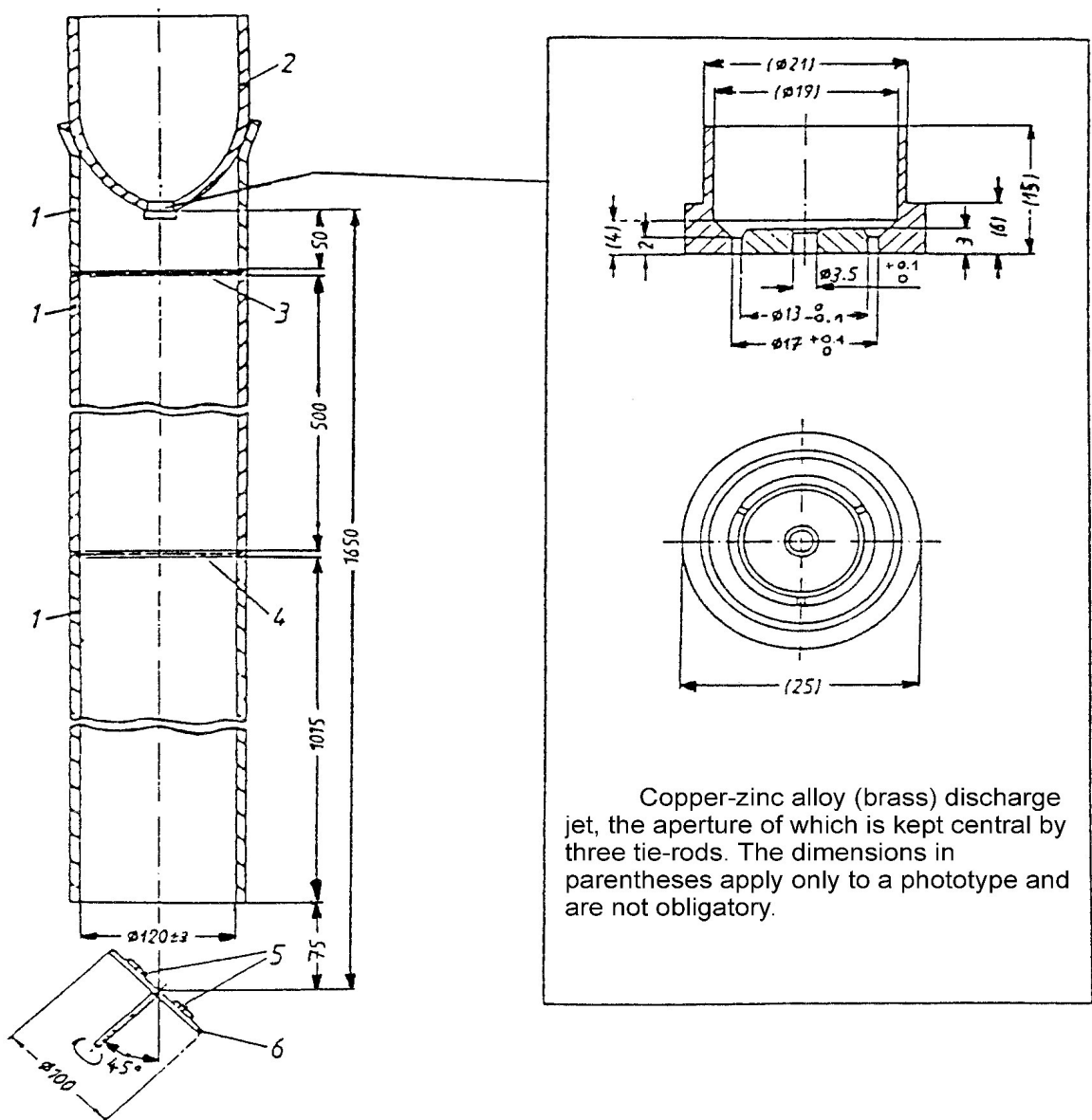
2. ABRASIVE MATERIAL

Natural quartz sand of a grain size of 0.50/0.7mm, with no oversize, obtained by sieving on wire sieves complying with ISO 565 with a mesh size if 0.50 mm and 0.7 mm. The sand may be used up to 10 times.

3. TEST PROCEDURE

Three kilograms of 0.50/0.7 mm grain size quartz sand is allowed to drop through a gravity tube from a height of 1.650 mm onto the sample to be tested. The test piece and, if necessary, a control-piece are mounted on a turntable, the axis of which is at a 45 degree angle to the direction of the sand.

The test pieces are mounted on the turntable in such a way that the area to be measured does not extend beyond the turntable. Whilst the turntable is rotating, 3 kg of sand are allowed to spray over the test pieces.

Copper-zinc alloy (brass) discharge jet, the aperture of which is kept central by three tie-rods. The dimensions in parentheses apply only to a phototype and are not obligatory.
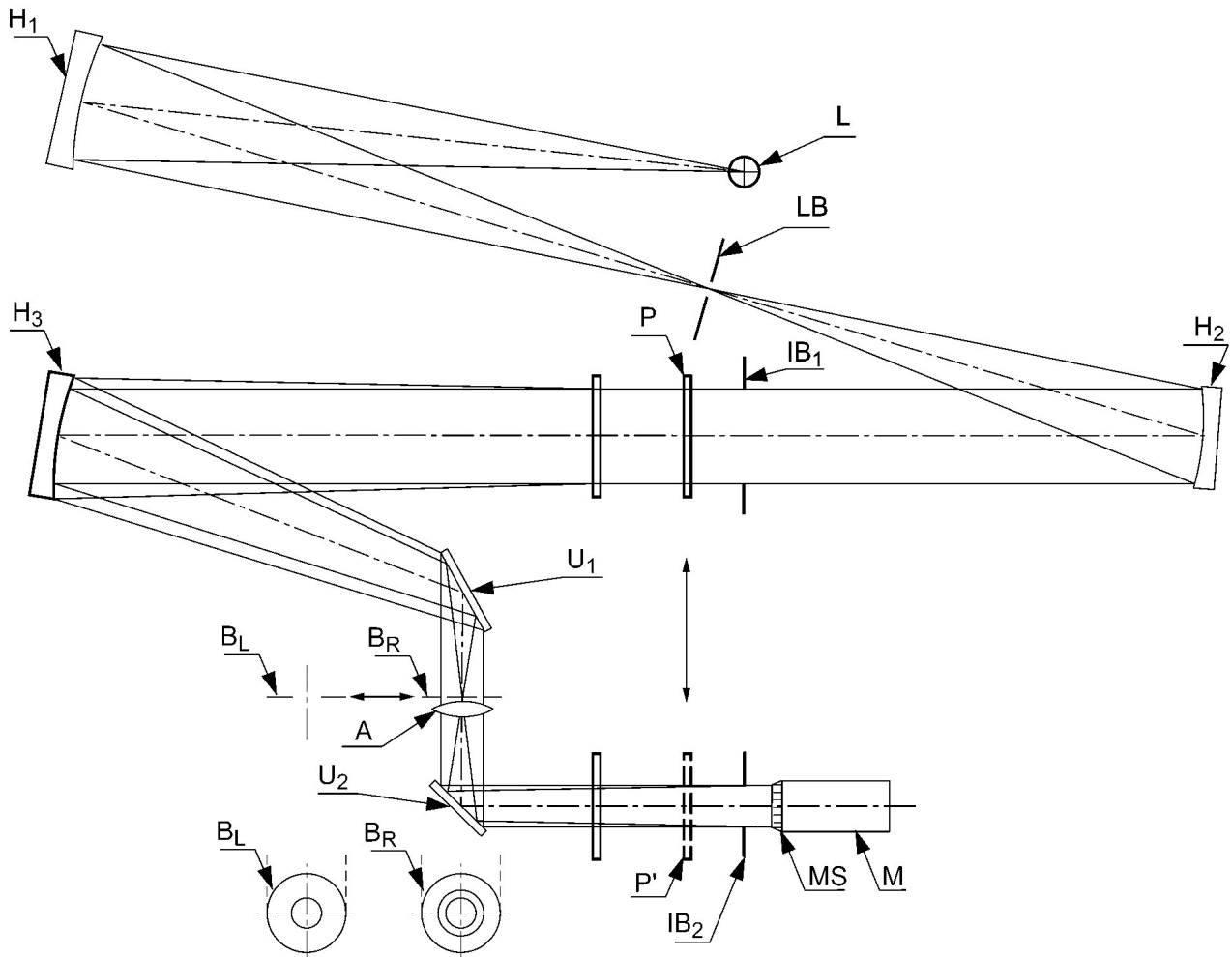
1. Parts of gravity tube
2. Container with discharge jet as figure 2, containing at least 3 kg sand
3. Upper sieve
4. Lower sieve
5. Test piece
6. Test piece holder (turnable)

Figure 1 – Sand Spray Equipment

ANNEXURE : 5
(See para 4.4.1.1.2)

**METHODS OF MEASURING LIGHT DIFFUSION AND
LIGHT TRANSMISSION COEFFICIENT**

1.   METHOD (a)

1.1   <u>Equipment</u>

Figure 1 – Test Equipment

This assembly collects all the unscattered light originating from the visor up to an angle of 0.72 degree (using diaphragm B_L) and all scattered light between the angles 1.5 degrees and 2 degrees in relation to the optical axis using diaphragm B_R. The angular area is important in the case of night riding, where a range in the immediate proximity of headlights has to be observed. The following dimensions are an information for the possible realization:

L	High-pressure xenon lamp (for example XBO 75W)
H_1	Spherical concave mirror: focal length 150 mm; diameter 40 mm
H_2	Spherical concave mirror: focal length 300 mm; diameter 40 mm
H_3	Spherical concave mirror: focal length 300 mm; diameter 70 mm
A	Achromatic lens: focal length 200 mm; diameter 30 mm
U_1U_2	Flat mirrors
B_R	Annular diaphragm: diameter of outer circle 21.00 mm; diameter of inner circle 15.75 mm
B_L	Circular diaphragm: diameter of aperture 7.5 mm
M	Silicon detector corrected according to curve V (λ) with diffusing screen MS
IB_1	Iris-diaphragm to adjust diameter of field of observation, diameter 40 mm
IB_2	Iris-diaphragm to eliminated edge effects from IB_1
LB	Circular diaphragm, diameter of aperture 1 mm
P,P'	Positions of visor.

Spherical mirror H_1 forms an image of light source L at Diaphragm LB which is in the focal plane of H_2. The concave mirror H_3 forms an image of Diaphragm LB in the plane of Diaphragms B_L and B_R. The achromatic Lens A is positioned immediately behind the diaphragm so that a reduced image of the test sample in position P appears on diffusing screen MS. The image of iris- Diaphragm IB_1 is simultaneously formed on IB_2.

1.2   Measurement

The visor is positioned in the parallel beam to position P, then Diaphragm B_L is set in place. The flux T_{1L} falling onto the detector corresponds to the undiffused light transmitted by the sample. Annular Diaphragm B_R then replaces diaphragm B_L; flux T_{1R} falling onto the detector corresponds to the total diffused light origination from the visor and from the apparatus. The visor is then placed at position P'. Flux T_{2R} falling onto the detector corresponds to the diffused light coming from the apparatus only. The visor is then brought out of the light beam (e.g. between P and P'). The flux T_{OL} falling on the detector with the Diaphragm BL in place corresponds to the total light.

1.3   **Optical Qualities; Definitions**

1.3.1   Luminous transmittance:

$\tau = T_{1L} / T_{OL} \text{ x } 1$

1.3.2   Lift diffusion before abrasion DB:

$DB = 597 \text{ x } (T_{1R} - T_{2R}) / T_{1L}$

1.3.3   Lift diffusion after abrasion:

$DA = 597 \text{ x } (T_{1R} - T_{2R}) / T_{1L}$

2.   **METHOD (b)**

2.1   **Equipment (See Figure 2)**

The beam of a collimator K of semi-divergence $\gamma/2 = 17.4 \text{ x } 10^{-4}$ rd is limited by a Diaphragm D_1 with an opening of 12 mm against which the sample holder is placed.

An achromatic convergent Lens L_2 corrected for spherical irregularities links the Diaphragm D_1 with the receiver R, the diameter of the Lens L_2 being such that it does not restrict the light diffused by the sample in a cone with a top half angle of $\beta/2 = 14°$.

An annular Diaphragm D_2 with extended angles $\alpha_0/2 = 1°$ and $\alpha_{max}/2 = 12°$ is placed in a focal image plane of the Lens L_2 (see Figure 2).

The non-transparent central part of the diaphragm is necessary to eliminate the light arriving directly from the light source. It must be possible to move the central part of the diaphragm away from the light beam in such a manner that it returns exactly to its original position.

The distance between the Lens L_2 and the Diaphragm D_1, and the focal length F_2 of the Lens L_2 are to be chosen so that the image of D_1 completely covers the receiver R.(For L_2 a focal diameter of about 80 mm is recommended)

For an initial incident flux of 1,000 units, the absolute precision of each reading shall be better than 1 unit.

2.2   Measurements

The following reading shall be taken:

Reading (T)	With sample	With central part of D_2	Quantity represented
T_1	No	no	Incident flux in initial reading
T_2	Yes (before abrasion)	no	Flux transmitted by the new material
T_{30}	No	yes	Incident light flux with central part of D_2
T_{31}	Yes (before abrasion)	yes	Flux diffused by the new material
T_4	Yes (After abrasion)	yes	Flux diffused by the abraded material

2.3   Optical Quantities Definitions

2.3.1   The luminous transmittance is given by:
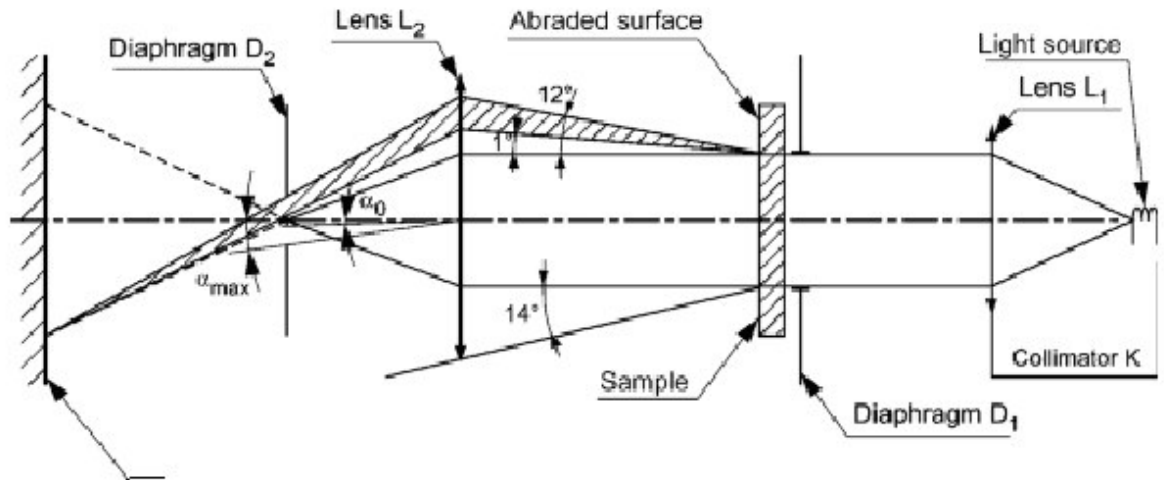
$(T_2/T_1) \times 100$

2.3.2   The light diffusion before abrasion is given by:

$$DB = \frac{(T_{31}-T_{30})}{T_2} \times 100$$

2.3.3   The light diffusion after abrasion is given by:

$DA = (T_4/T_2) \times 100$

Note : Markings DA and DB correspond to paragraph 1.3 of this Annexure.

**M = silicon detector corrected according to
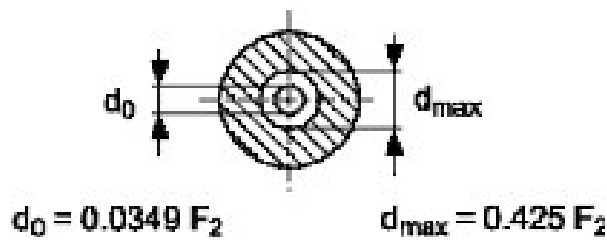curve V** (8) **with diffusing screen**

Figure 2 - Test equipment

$$d_0 = 0.0349\ F_2 \qquad d_{max} = 0.425\ F_2$$

Figure 2 - Annular diaphragm D_2

3.   METHOD (c)

3.1   Equipment

The test arrangement is shown in Figure 3.

Note 1 : The measurement principle is identical to the method (a), but the diameter of the measuring is smaller (approximately 2.5 mm) and the test arrangements is simplified.

The beam of the Laser (L) is expanded using the two Lenses L_1 and L_2 and is directed towards the measuring point of the ocular (P). Ocular (P) is positioned in such a way what it cant rotate around the axis of the beam.

The deviation of the beam is a function of the prismatic refractive power at the measuring point.

The annular or circular diaphragm, whichever is chosen, is at a distance of (400 ± 2) mm from the centre of the ocular. The Lens A then produces the image of the centre of the ocular on the photoreceptor S.

The part of the test arrangement, comprising the diaphragms, the lend and the receptor is designed to rotate about the vertical axis through the centre of the ocular.

The ocular and the detector part of the apparatus has to pivot in order to compensate for any prismatic refractive power of the ocular.

Note 2 : For oculars without corrective effect, it is not necessary, in most cases, for the ocular and the detector part to pivot.

3.2 Procedure

3.2.1 Calibration of the Apparatus

Set up the apparatus, the essential features of which are shown in Figure 3, without the ocular in place. Put the annular Diaphragm B_R in place. Rotate the detector part of the apparatus (consisting of a photoreceptor S, a Lens A and the annular Diaphragm B_R) horizontally about P so as to align the light beam from the beam expander (consisting of a Lens L_1, with a typical focal length of 10 mm, a Lens L_2 with a typical focal length of 30 mm and a circular Diaphragm B with a pinhole of sufficient size so as to provide a uniform beam) with the centre of the annular Diaphragm B_R. Measure the flux ϕ_{1R} falling onto the photoreceptor S, corresponding to the total non-diffused light. Replace the annular Diaphragm B_R by the circular Diaphragm B_L.

Measure the flux ϕ_{1L} falling onto the photoreceptor, corresponding to the total non-diffused light.

Obtain the reduced luminance factor for the apparatus, l_a^*, for the solid angle ω using the following equation.

$$l_a^* = \frac{1}{\omega} \cdot \frac{\phi_{1R}}{\phi_{1L}}$$

where ϕ_{1R} is the luminance flux without the visor in the parallel beam and with the annular Diaphragm B_R in place.

ϕ_{1L} is the luminance flux without the visor in the parallel beam and with the circular Diaphragm B_L in place.

ω is the solid angle defined by the annular Diaphragm B_R.

3.2.2 Testing of the Visor

Place the visor in the parallel beam at position P as shown in Figure 3. Repeat Paragraph 3.2.1 with the visor in place, and with the visor rotated about the axis of the beam to a position such that the prismatic deviation by the visor is horizontal. Rotate the detector part of the apparatus so that the light beam falls on the center of B_R. Obtain the reduced luminance factor for the apparatus factor for the apparatus including the visor, l_g*, for the solid angle ω using the following equation:

$$l_g* = \frac{1}{\omega} \cdot \frac{\phi_{2R}}{\phi_{2L}}$$

where

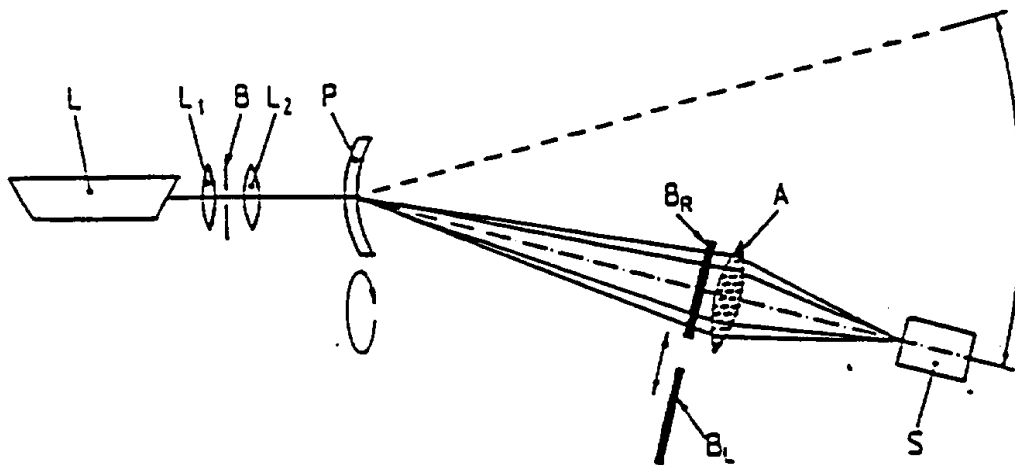ϕ_{2R} is the luminance flux with the visor in the parallel beam and with the annular Diaphragm B_R in place.

ϕ_{2L} is the luminance flux without the visor in the parallel beam and with the circular Diaphragm B_L in place.

ω is the solid angle defined by the annular Diaphragm B_R.

Then calculate the reduced luminance factor $l*$ of the ocular using the following equation:

$$l* = l*_g - l*_a$$

Figure 3 - Arrangement of Apparatus for Measurement of Light Diffusion - Method (c)

L	=	Laser with wavelength of (600 ± 70) nm.
		<u>Note</u>: Class 2 laser recommended.
		< 1mW. Diameter of beam between 0.6 and 1 mm
L_1	=	10 mm nominal focal length lens
L_2	=	30 mm nominal focal length lens
B	=	Circular diaphragm - (a hole of 0.1 mm approx produces a uniform light beam)
P	=	Visor sample
B_R	=	Annular diaphragm, the diameter of the external circle being (28.0 ± 0.1) mm and the inner circle (21.0 ± 0.1) mm. See Note 2 below.
B_L	=	Circular diaphragm of 10 mm nominal diameter
A	=	Lens, 200 mm nominal focal length and 30 mm nominal diameter
S	=	Photoreceptor

The distance between the annular/circular diaphragm and the centre of the ocular shall be (400 ± 2) mm.

Note 1: The focal lengths of the lenses are only given as a guide. Other focal lengths may be used, for example, if a wider beam is desired or a smaller image of the sample is to be formed on the receptor.

Note 2: The diameters of the annular diaphragm circles shall be measured to an uncertainty not exceeding 0.01 mm in order that the solid angle ω may be determined accurately; any deviation from the nominal diameters shall be taken into account by calculation.

ANNEXURE : 6
(See para 2.10, 2.11)

The luminous transmittance τ_v is defined as:

$$\tau_v = \frac{\int\limits_{380nm}^{780nm} S_{D65\lambda}(\lambda) \cdot V(\lambda) \cdot \tau_F(\lambda) \cdot d\lambda}{\int\limits_{380nm}^{780nm} S_{D65\lambda}(\lambda) \cdot V(\lambda) \cdot d\lambda}$$

The relative visual attenuation quotient Q is defined as:

$$Q = \frac{\tau_{sign}}{\tau_v}$$

where:

τ_v is the luminous transmittance of the visor relative to the standard illuminant D65

τ_{sign} is the luminous transmittance of the visor relative to the spectral power distribution of the traffic signal light and it is given by the following equation:

$$\tau_{sign} = \frac{\int\limits_{380nm}^{780nm} S_{A\lambda}(\lambda) \cdot V(\lambda) \cdot \tau_F(\lambda) \cdot \tau_S(\lambda) \cdot d\lambda}{\int\limits_{380nm}^{780nm} S_{A\lambda}(\lambda) \cdot V(\lambda) \cdot \tau_S(\lambda) \cdot d\lambda}$$

where:

$S_{A\lambda}(\lambda)$ is the spectral distribution of radiation of CIE standard illuminant A (or 3200 K light source for blue signal light). See: ISO/CIE 10526, "CIE standard colorimetric illuminants";

$S_{D65\lambda}(\lambda)$ is the spectral distribution of radiation of CIE standard illuminant D65. See: ISO/CIE 10526, "CIE standard colorimetric illuminants";

$V(\lambda)$ is the spectral visibility function for daylight vision. See: ISO/CIE 10527, "CIE standard colorimetric observers";

$\tau_S(\lambda)$ is the spectral transmittance of the traffic signal lens;

$\tau_V(\lambda)$ is the spectral transmittance of the visor.

     The spectral value of the product of the spectral distributions $\left(S_{A\lambda}(\lambda) \cdot S_{D65\lambda}(\lambda)\right)$ of the illuminant, the spectral visibility function $V(\lambda)$ of the eye and the spectral transmittance $\tau_S(\lambda)$ of the traffic signal lenses are given in Annexure :7.

ANNEXURE:7
(See para 4.4.3.2)

Products of the Spectral distribution of radiation of the signal lights and standard illuminant D65 as specified in ISO/CIE 10526 and the spectral visibility function of the average human eye for daylight vision as specified in ISO/CIE 10527

Table

Wavelength nm	$S_{A\lambda}(\lambda) \cdot V(\lambda) \cdot \tau_s(\lambda)$				$S_{D65\lambda}(\lambda) \cdot V(\lambda)$
	red	yellow	green	blue	
380	0	0	0	0.0001	0
390	0	0	0	0.0008	0.0005
400	0	0	0.0014	0.0042	0.0031
410	0	0	0.0047	0.0194	0.0104
420	0	0	0.0171	0.0887	0.0354
430	0	0	0.0569	0.3528	0.0952
440	0	0	0.1284	0.8671	0.2283
450	0	0	0.2522	1.5961	0.4207
460	0	0	0.4852	2.6380	0.6888
470	0	0	0.9021	4.0405	0.9894
480	0	0	1.6718	5.9025	1.5245
490	0	0	2.9976	7.8862	2.1415
500	0	0	5.3553	10.1566	3.3438
510	0	0	9.0832	13.0560	5.1311
520	0	0.1817	13.0180	12.8363	7.0412
530	0	0.9515	14.9085	9.6637	8.7851
540	0	3.2794	14.7624	7.2061	9.4248
550	0	7.5187	12.4687	5.7806	9.7922
560	0	10.7342	9.4061	3.2543	9.4156
570	0	12.0536	6.3281	1.3975	8.6754
580	0.4289	12.2634	3.8967	0.8489	7.8870
590	6.6289	11.6601	2.1640	1.0155	6.3540
600	18.2382	10.5217	1.1276	1.0020	5.3740
610	20.3826	8.9654	0.6194	0.6396	4.2648
620	17.6544	7.2549	0.2965	0.3253	3.1619

Wavelength nm	$S_{A\lambda}(\lambda) \bullet V(\lambda) \bullet \tau_s(\lambda)$				$S_{D65\lambda}(\lambda) \bullet V(\lambda)$
	red	**yellow**	**green**	**blue**	
600	18,2382	10,5217	1,1276	1,0020	5,3740
610	20,3826	8,9654	0,6194	0,6396	4,2648
620	17,6544	7,2549	0,2965	0,3253	3,1619
630	13,2919	5,3532	0,0481	0,3358	2,0889
640	9,3843	3,7352	0	0,9695	1,3861
650	6,0698	2,4064	0	0,2454	0,8100
660	3,6464	1,4418	0	1,3599	0,4629
670	2,0058	0,7892	0	0,6308	0,2492
680	1,1149	0,4376	0	1,2166	0,1260
690	0,5590	0,2191	0	1,1493	0,0541
700	0,2902	0,1137	0	0,7120	0,0278
710	0,1533	0,0601	0	0,3918	0,0148
720	0,0742	0,0290	0	0,2055	0,0058
730	0,0386	0,0152	0	0,1049	0,0033
740	0,0232	0,0089	0	0,0516	0,0014
750	0,0077	0,0030	0	0,0254	0,0006
760	0,0045	0,0017	0	0,0129	0,0004
770	0,0022	0,0009	0	0,0065	0
780	0,0010	0,0004	0	0,0033	0
Sum	100	100	100	100	100

ANNEXURE : 8
(See para 4.4.4)

TEST OF REFRACTIVE POWERS

1.0   Spherical and Astigmatic Refractive Powers

1.1.   Apparatus

1.1.1.   Telescope

A telescope with an aperture nominally 20 mm and a magnification between 10 and 30, fitted with an adjustable eyepiece incorporating a reticular.

1.1.2.   Illuminated target

A target, consisting of a black plate incorporating the cut-out pattern shown in Figure 1 given below, behind which is located a light source of adjustable luminance with a condenser, if necessary, to focus the magnified image of the light source on the telescope objective.

The large annulus of the target has an outer diameter of 23 ± 0.1 mm with an annular aperture of 0.6 ± 0.1 mm. The small annulus has an inner diameter of 11.0 ± 0.1 mm with annular aperture of 0.6 ± 0.1 mm. The central aperture has a diameter of 0.6 ± 0.1 mm. The bars are nominally 20 mm long and 2 mm wide with a nominal 2 mm separation.

Figure 1 - Telescope Target

1.1.3.   Filter

A filter with its maximum transmittance in the green part of the spectrum may be used to reduce chromatic aberrations.

1.1.4.   Calibration lenses

Lenses with positive and negative spherical refractive powers of 0.06 m^{-1}, 0.12 m^{-1} and 0.25 m^{-1} (tolerance $\pm 0.01 \text{ m}^{-1}$).

1.2   Arrangement and Calibration of Apparatus

The telescope and illuminated target are placed on the same optical axis 4.60 ± 0.02 apart. The observer focuses the reticule and the target and aligns the telescope to obtain a clear image of the pattern. This setting is regarded as the zero point of the focusing scale of the telescope.

The focusing adjustment of the telescope is calibrated with the calibration lenses (paragraph 1.1.4) so that a power of 0.01 m^{-1} may be measured. Any other calibration method may be used.

1.3   Procedure

The visor is mounted in front of the telescope as worn and measurements shall be taken at the sign points as specified in paragraph 4.4.4

1.3.1   Spherical and Astigmatic Refractive Powers

1.3.1.1   Visors without Astigmatic Refractive Powers

The telescope is adjusted until the image of the target is perfectly resolved. The spherical power of the visor is then read from the scale of the telescope.

1.3.1.2   Visor with Astigmatic Refractive Powers

The target, on the visor, is rotated in order to align the principle meridians of the visor with the bars on the target. The telescope is focused firstly on one set of bars (measurement D1) and then on the perpendicular bars (measurement D2). The spherical power is the mean, $(D_1 + D_2)/2$ astigmatic refractive power is the absolute difference, $|D_1 - D_2|$, of the two measurements.

2.   Determination of the Difference in Prismatic Refractive   Power

2.1   Apparatus
The arrangement of the reference method in shown in Figure 2 of this Annexure

2.2.1   Procedure
The Diaphragm LB_1, illuminated by the light source, is adjusted in such a way that it produces an image on the Plane B when the visor (P) is not in position. The visor is placed in front of the Lens L_2 so that the axis of the visor is parallel to the optical axis of the assembly.

Adjustable tilt visors are positioned with their ocular regions normal to the optical axis of the equipment.

Measure the vertical and horizontal distance between the two displaced images arising from the two ocular areas of the visor. These distances in cm are divided by 2 to give the horizontal and vertical prismatic difference in cm/m.

If the light paths which correspond to the two eye regions cross, the prismatic refractive power is 'base in' and if the light paths do not cross, it is 'base out'.
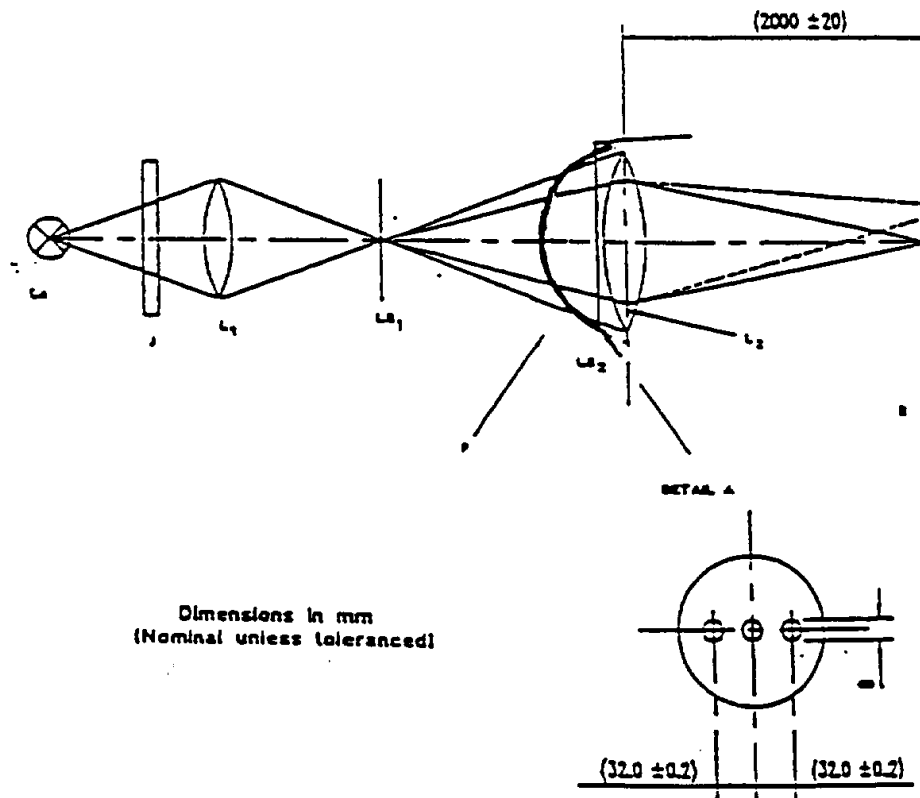
Figure 2 - Arrangement Apparatus for Measurement of Prismatic Difference

L_a = light source, for example, small filaments lamp, laser with wavelength of 600 ± 70 nm, etc.

J = interface filter, with peak transmittance in the green part of the spectrum (required only if a filament lamp is used as the light source).

L_1 = achromatic lens focal length between 20 and 50 mm.

LB_1 = diaphragm, diameter of aperture 1 mm nominal

P = visor

LB_2 = diaphragm as shown in detail A

L_2 = achromatic lens, 1,000 mm nominal focal length and 75 mm nominal diameter

B = image plane

ANNEXURE : 9

TEST FOR MIST RETARDANT VISOR

1.   **Apparatus**

Apparatus to determine the change in the non-diffused transmittance value, as shown in Figure 1 of this Annexure.

The nominal diameter of the parallel beam is 10 mm. The size of the beam divider, reflector R and lens L_3 shall be selected in such a way that diffused light is captured up to an angle of 0.75°. If a lens L_3 with a nominal focal length $f_3 = 400$ mm is used, the nominal diameter of a diaphragm is 10 mm. The plane of the diaphragm must lie within the focal plane of the lens L_3.

The following focal lengths f_1 of the lens L_1 are nominal examples and will not affect the test results:

$f_1 = 10$ mm and $f_2 = 100$ mm

The light source shall be a laser with a wavelength of 600 ± 70 nm.

The volume of air above the water bath is at least 4 litres. The seating ring has a nominal diameter of 35 mm and a nominal height of 24 mm is then measured to the highest point of the seating ring. A soft rubber ring, 3 mm thick and 3 mm wide (nominal dimensions), is inserted between the sample and the seating ring.

The water bath container also contains a ventilator to circulate the air. In addition, there must also be a device to stabilise the temperature on the water bath.

2.   **Samples**

At least 3 samples of the same type are to be tested. Before the test, the samples are conditioned for one hour in distilled water (at least 5 cm^3 water per cm^2 sample surface area) at $23° \pm 5$ °C, then dabbed dry and then conditioned in air for at least 12 hours at $23° \pm 5$ °C and 50 per cent nominal relative humidity.

3.   **Procedure and evaluation**

The ambient temperature during the measurement is $23° \pm 5$ °C.

The temperature of the water bath is set at $50° \pm 0.5$ °C. The air above the water bath is circulated using a ventilator, so that it becomes saturated with water vapour. During this time, the measurement opening is to be covered. The ventilator is switched off before the measurement.

To measure the change in the value of the transmittance τ_r the sample is placed on the seating ring and the time determined until the square of τ_r has dropped to less than 80 per cent of the initial value of the sample without fogging (time without fogging).

$$\tau_r^2 = \frac{\Phi b}{\Phi u}$$

where:

Φb is the luminous flux when there is fogging on the sample

Φu is the luminous flux before fogging

Initial fogging of maximum 0.5 s duration shall not be taken into consideration in the evaluation.

Note 1: Since the light beam passes through the samples twice, this measurement defines τ_r^2.

Note 2: The period until the start of the fogging can usually be determined visually. However, with some types of coating the formulation of the surface water causes diffusion to increase more slowly so that visual evaluation is difficult. The detection apparatus described in paragraph 1.0. should then be used.
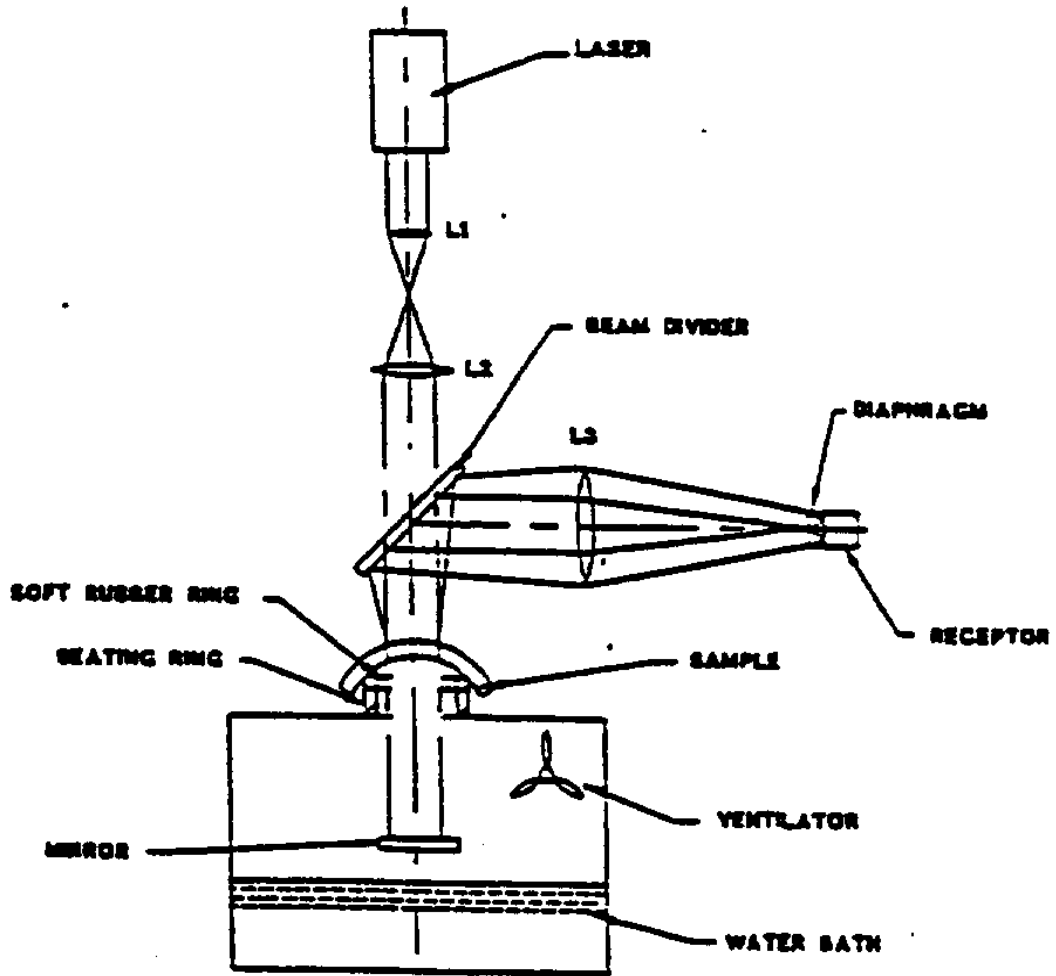
Figure 1 – Test Apparatus for Mist-Retardant Visor

ANNEXURE : 10
(See Introduction)
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