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agenda item 15)

Proposal for revising para. 2.2.1 of Regulation ECE R112 Annex 6

Zhang Heng
P. R. China

Content

- What does “Resistance to atmospheric agents” mean?
- Proposal to revise four(4) sections of Annex 6 para. 2.2.1.

Background

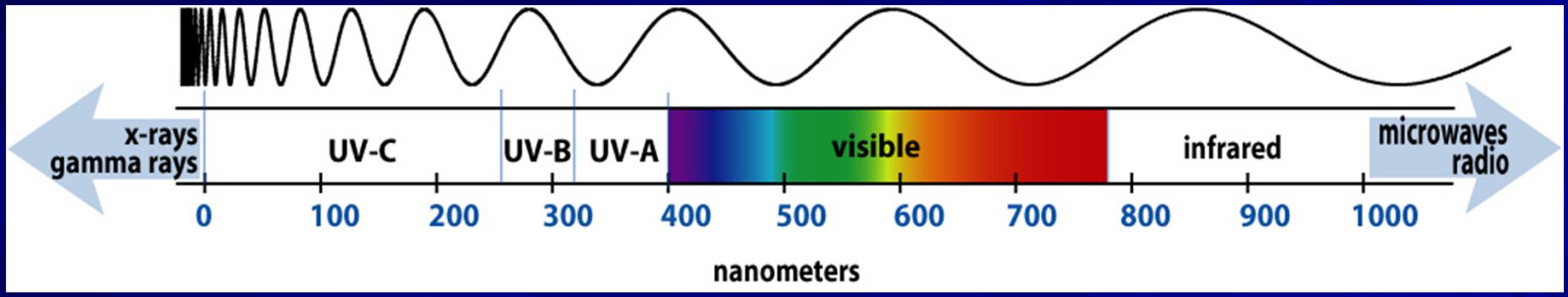
- Performance based
- We are not going to change the current testing
- We recommend describe it more accurate based on new technique development

- Example of ‘temperature of boiling water’ vs. ‘100 degree C’

What does “Resistance to atmospheric agents” mean?

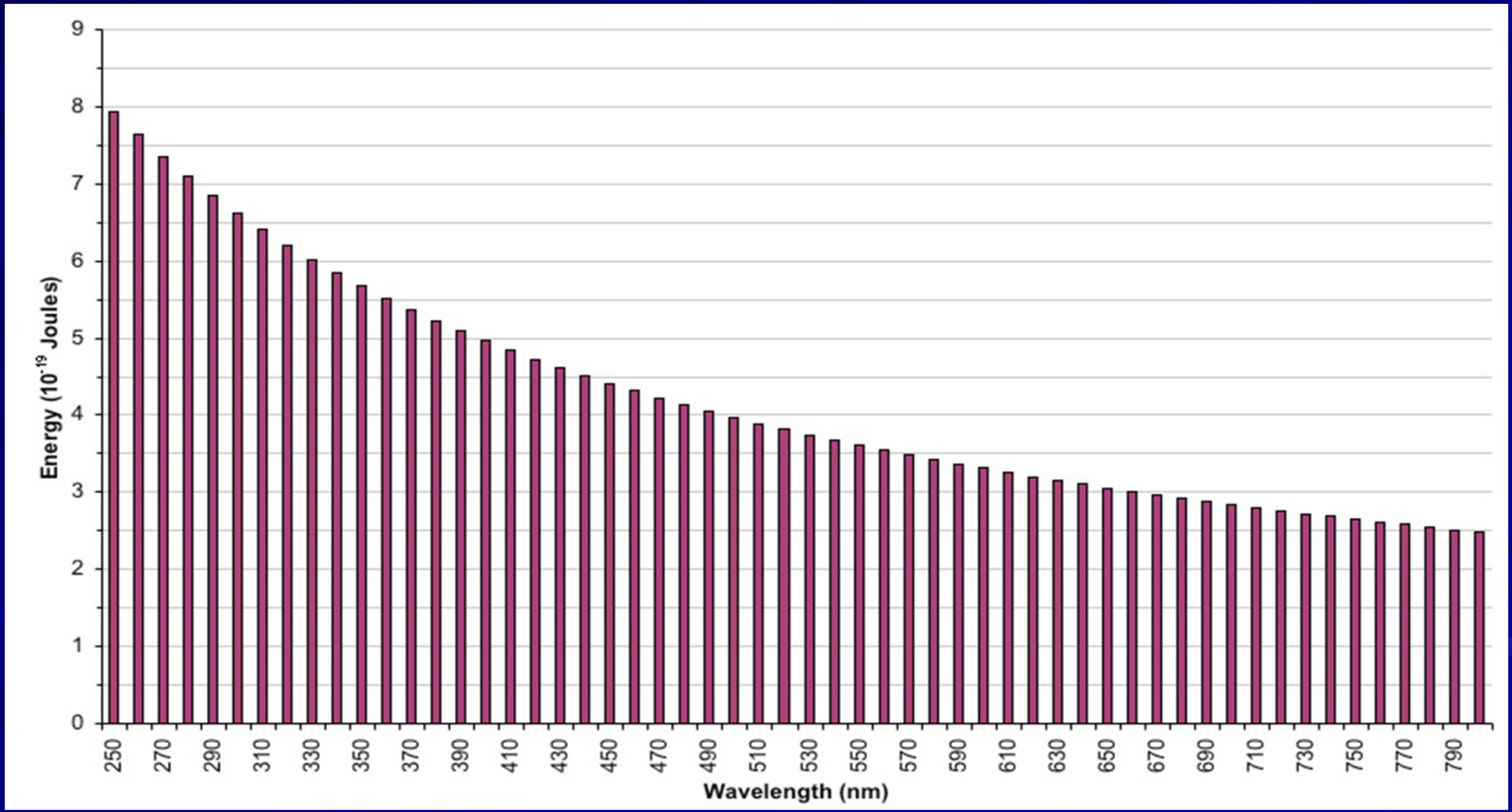
- Exposed to sunlight (especially UV radiation), temperature and moisture, automobile lenses may exhibit:
  - Cracking
  - Scratching
  - Chipping
  - Deformation
  - Optical transmission decrease
  - weathering

Electromagnetic Spectrum



The “size”of the photon is inversely proportionate to the wavelength

Shorter Wavelengths = Increased Chance of Degradation



Energy per Photon ($E=hc/\lambda$)

Problem #1 -- Current Wording

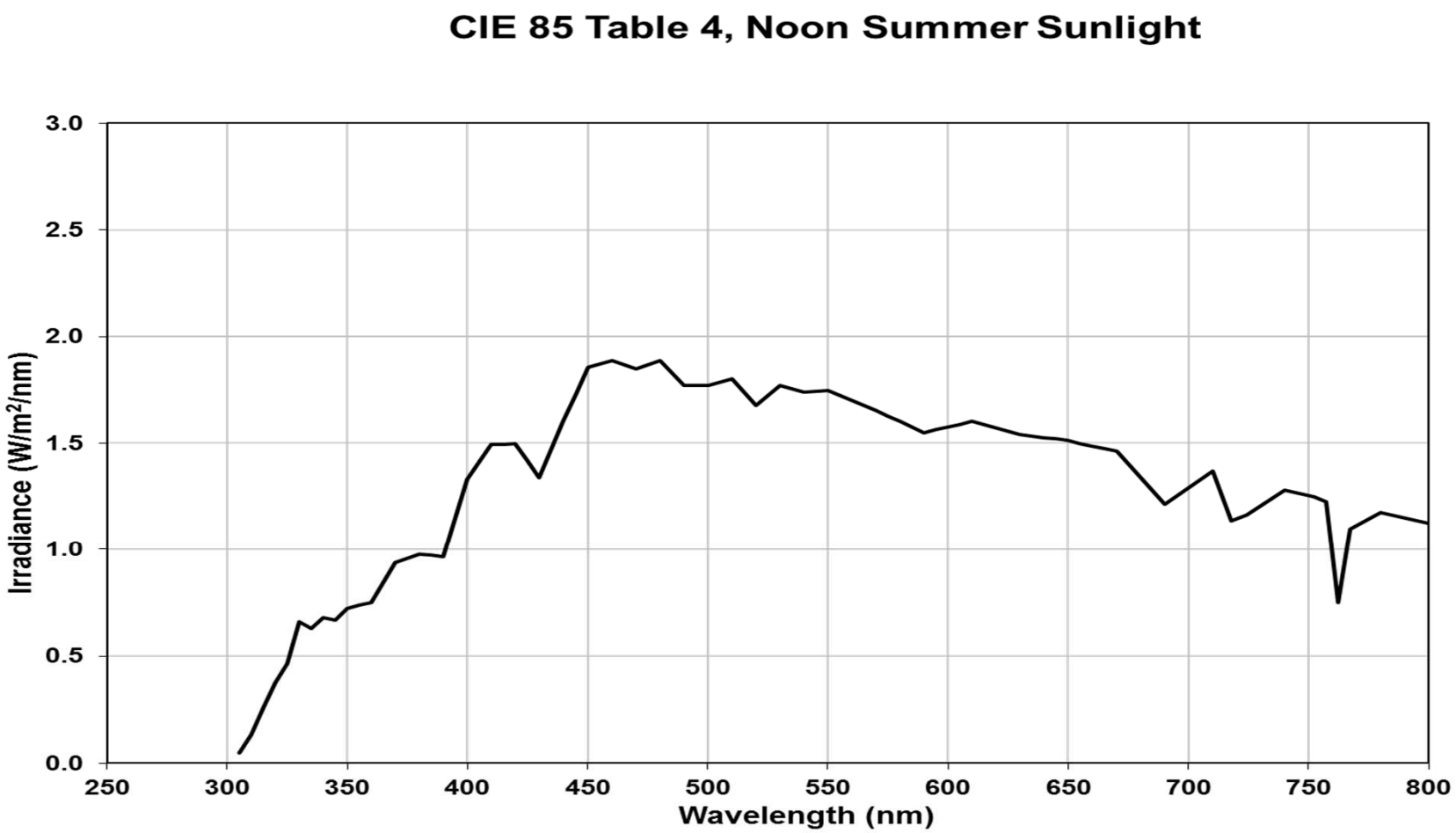
The spectral energy distribution of the light source is improperly described:

2.2.1. Resistance to atmospheric agents Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to that of a black body at a temperature between 5,500 K and 6,000 K. Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2,500 nm. The samples shall be exposed to an energetic illumination of 1,200 W/m2 + 200 W/m2 for a period such that the luminous energy that they receive is equal to 4,500 MJ/m2 + 200 MJ/m2. Within the enclosure, the temperature measured on the black panel placed on a level with the samples shall be 50 ° C + 5 ° C. In order to ensure a regular exposure, the samples shall revolve around the source of radiation at a speed between 1 and 5 1/min.

Problem #1: Justification

- Black body temperatures are useful for lighting sources and color matching, but do not accurately or sufficiently describe the sunlight spectrum
- Most current international weathering standards describe the spectral energy distribution of sunlight by referring to CIE Publication No. 85:1989, Table 4

Problem #1: Justification



Problem #1: Proposal

Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to that of a black body at a temperature between 5,500 K and 6,000 K.

Change to:

Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to **daylight spectral energy distribution described in CIE Publication No. 85:1989, Table 4.**

Problem #2 – Current Wording

The SPD of the light source is insufficiently defined

2.2.1. Resistance to atmospheric agents Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to that of a black body at a temperature between 5,500 K and 6,000 K. Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2,500 nm. The samples shall be exposed to an energetic illumination of 1,200 W/m2 ± 200 W/m2 for a period such that the luminous energy that they receive is equal to 4,500 MJ/m2 ± 200 MJ/m2. Within the enclosure, the temperature measured on the black panel placed on a level with the samples shall be 50 ° C ± 5 ° C. In order to ensure a regular exposure, the samples shall revolve around the source of radiation at a speed between 1 and 5 1/min.

Problem #2: Justification

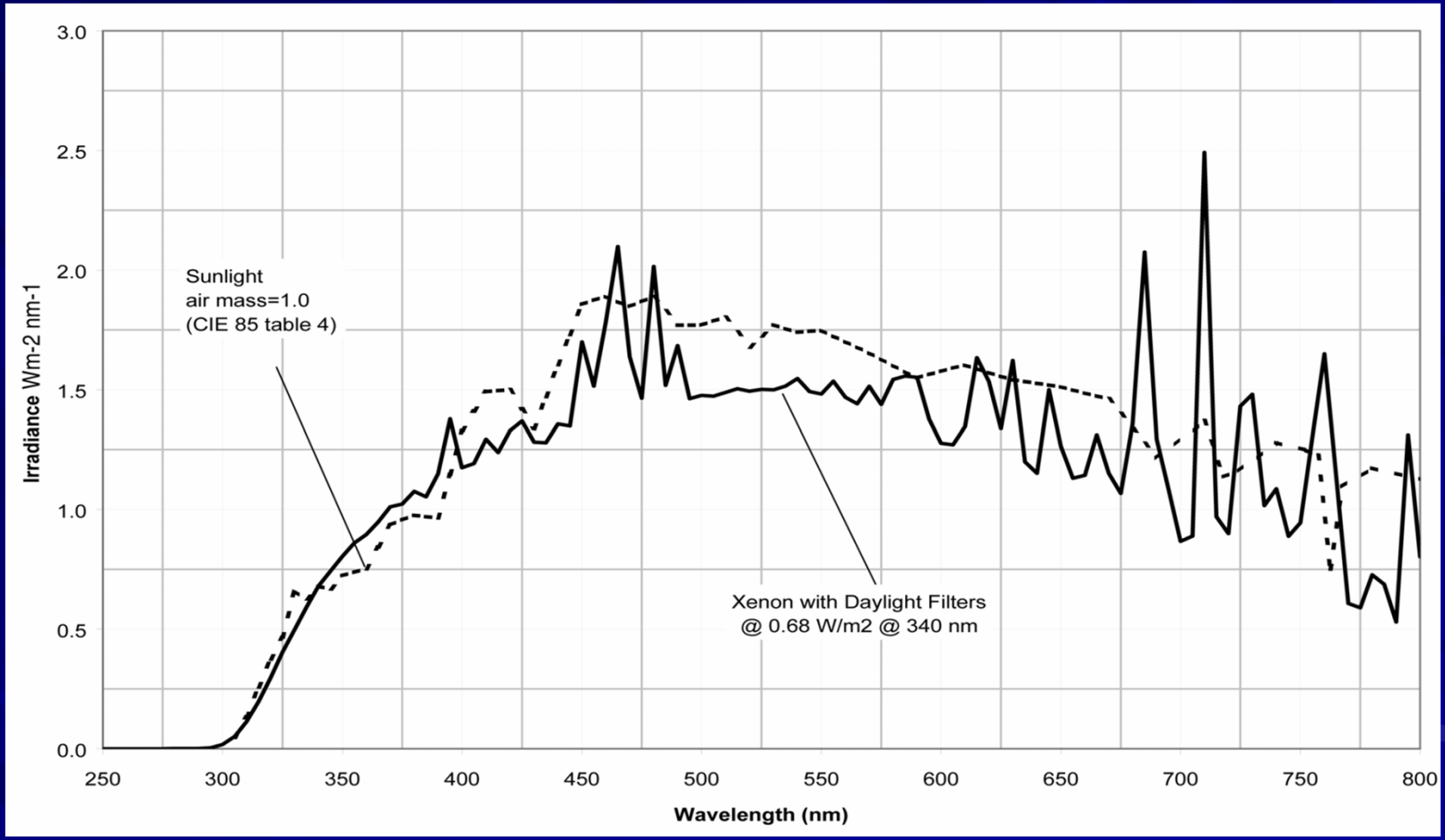
- Providing only the wavelength range does not sufficiently define the spectrum
  - It is important to accurately specify the proportions of wavelength ranges to match sunlight
  - If the proportions of UV radiation do not match sunlight, unrealistic degradation may occur
- This is accomplished by the use of appropriately designed “Daylight” optical filters

Problem #2: Justification

Spectral passband (λ=wavelength in nm)	Minimum %	CIE No. 85:1989, Table 4 %	Maximum %
λ<290			0.15
290≤λ≤320	2.6	5.4	7.9
320<λ≤360	28.2	38.2	39.8
360<λ≤400	54.2	56.4	67.5

Table 1 – Relative spectral irradiance of xenon-arc lamps with daylight filters (Ref. ISO 4892-2:2006)

Problem #2: Justification



SAE J2527-2004 FIGURE C2 (page 17)—DAYLIGHT FILTER VS. SUNLIGHT SPECTRAL POWER DISTRIBUTION

Problem #2: Proposal

Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2,500 nm, **and the minimum and maximum levels of the relative spectral irradiance in the UV wavelength range are given in Table 1.** (add the green font)

Problem #2: Proposal

Spectral passband (λ=wavelength in nm)	Minimum %	CIE No. 85:1989, Table 4 %	Maximum %
λ<290			0.15
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Table 1 – Relative spectral irradiance of xenon-arc lamps with daylight filters (Ref. ISO 4892-2:2006)

Problem #3: Current Wording

The irradiance specification is insufficiently defined and does not conform to international standards

2.2.1. Resistance to atmospheric agents Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to that of a black body at a temperature between 5,500 K and 6,000 K. Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2,500 nm. The samples shall be exposed to an energetic illumination of 1,200 W/m2 + 200 W/m2 for a period such that the luminous energy that they receive is equal to 4,500 MJ/m2 + 200 MJ/m2. Within the enclosure, the temperature measured on the black panel placed on a level with the samples shall be 50 ° C ± 5 ° C. In order to ensure a regular exposure, the samples shall revolve around the source of radiation at a speed between 1 and 5 1/min.

Problem #3: Justification

- UV radiation is the primary cause of degradation from sunlight
- Irradiance of the overall sunlight spectrum is irrelevant because it includes wavelengths that do not induce degradation
- International standards solved this by specifying irradiance and luminous energy dosage at a specific wavelength in the UV region
  - 0.68 W/m^2 irradiance at 340 nm more precisely represents the intended intensity of 1,200 W/m^2 wording
  - 2,550 kJ/m^2 at 340 nm more precisely represents the intended luminous energy of 4,500 MJ/m^2 wording

Problem #3: Proposal

The samples shall be exposed to an energetic illumination of 1,200 W/m^2 ± 200 W/m^2, for a period such that the luminous energy that they receive is equal to 4,500 MJ/m^2 ± 200 MJ/m^2.

Change to:

The samples shall be exposed to **an light source with irradiance of 0.68 ± 0.02 W/m^2 at 340nm**, for a period such that **the radiation energy that they receive is equal to 2,550 ± 75 kJ/m^2.**

Problem #4: Current Wording

Exposure uniformity is not defined and hardware specific current wording violates international standards guidelines (e.g. ISO, ASTM, SAE)

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Problem #4: Justification

- The terms “revolve” and “speed” are hardware based descriptions and do nothing to ensure exposure uniformity
- International standards (e.g. ISO 4892-2:2006) have solved this problem by specifying minimum uniformity

Problem #4: Justification

- Uniform requirements in ISO 4892-2-2006

4.1.4 Irradiance uniformity

The irradiance at any position in the area used for specimen exposure shall be at least 80 % of the maximum irradiance. Requirements for periodic repositioning of specimens when this requirement is not met are described in ISO 4892-1.

Problem #4: Justification

- Uniform requirements in ISO 11341-2004

6.2 Radiation source and filter system

The irradiance *E at any point over the area used for the test panels shall not vary by more than ± 10 % of the* arithmetic mean of the total irradiance for the whole area. Any ozone formed by the operation of the xenon-arc lamps shall not enter the test chamber but shall be vented separately. If this is not possible, specimens shall be periodically repositioned to provide equivalent exposure periods in each location.

Problem #4: Justification

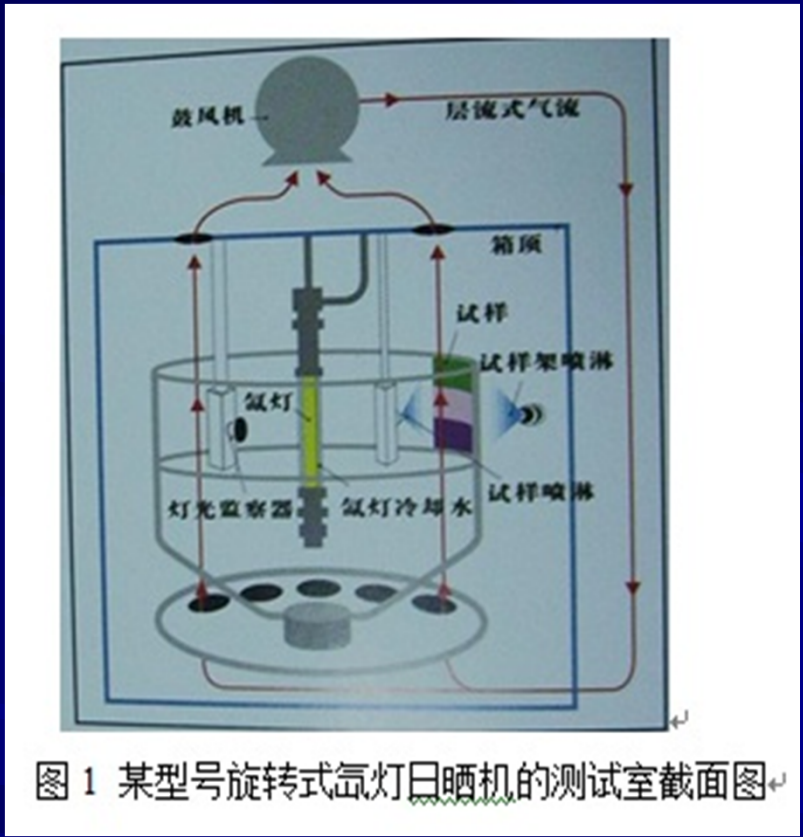

图 1 某型号旋转式氙灯日晒机的测试室截面图

Figure 1 Rotating Drum Xenon Arc Tester Cross Section

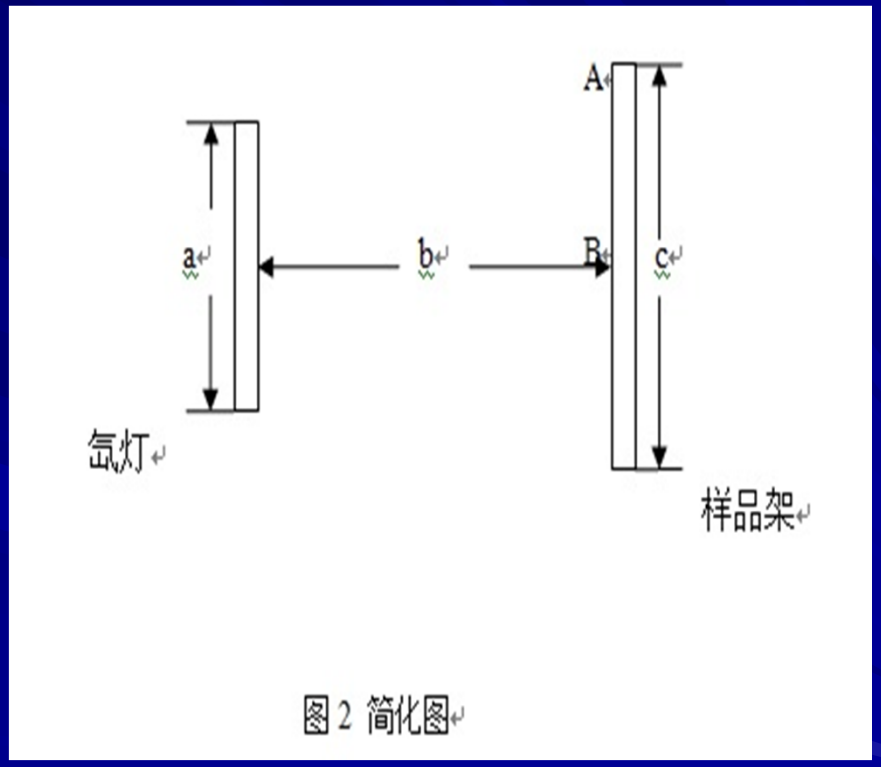

图 2 简化图

Figure 2 Simple diagram of Rotating Drum Xenon Tester chamber

a≈10 cm, b≈25 cm, c≈14 cm.

Problem #4: Justification

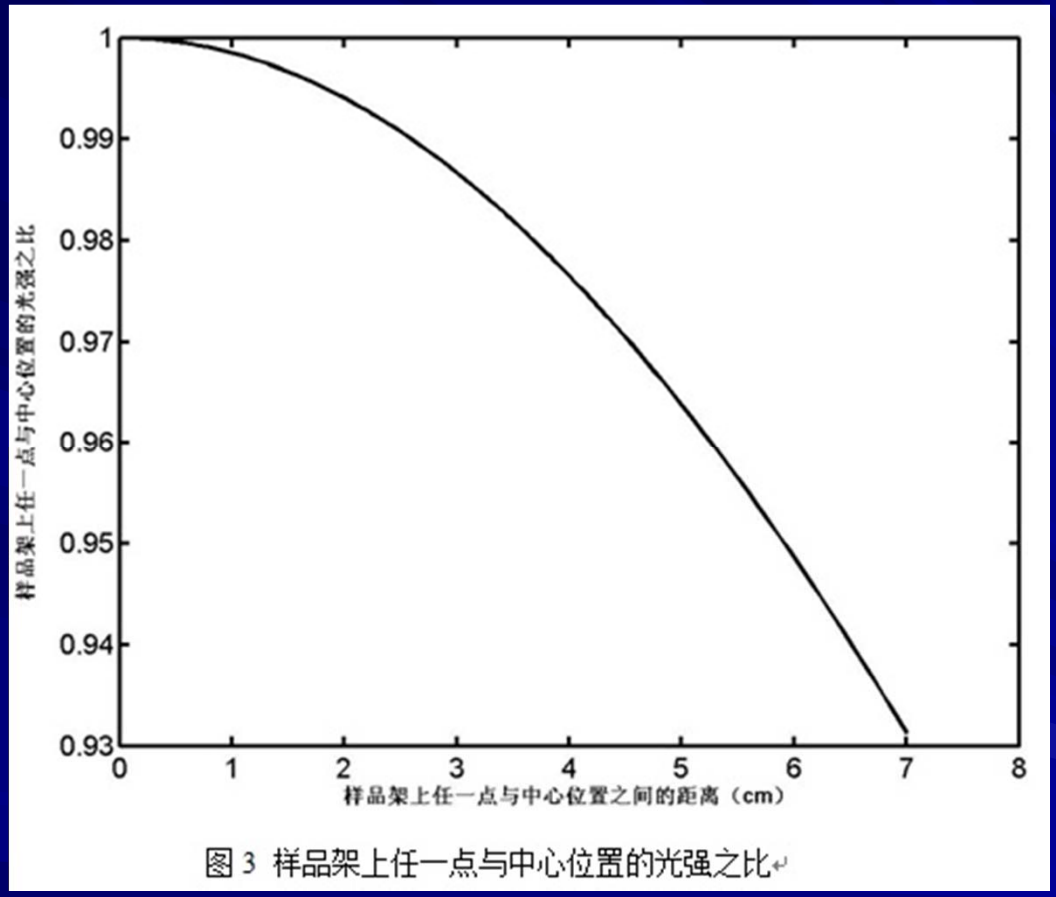

Figure 3 horizontal axis : Distance of point B to point A (middle)
vertical axis : Ratio of Irradiance B vs. Irradiance A (middle)

Note: the irradiance will be higher when the sample is closer to the middle.

Problem #4: Proposal

In order to ensure a regular exposure, the samples shall revolve around the source of radiation at a speed between 1 and 5 r/min

Change to

In order to ensure a regular exposure, **the irradiance at any position in the area used for specimen exposure shall be at least 80% of the maximum irradiance.**

Update of para. 2.2.1 of Annex 6

2.2.1 Three new samples (lenses or samples of material) shall be exposed to radiation from a source having a spectral energy distribution similar to **daylight spectral energy distribution described in CIE Publication No. 85:1989, Table 4** Appropriate filters shall be placed between the source and the samples so as to reduce as far as possible radiations with wave lengths smaller than 295 nm and greater than 2,500 nm, **and the minimum and maximum levels of the relative spectral irradiance in the UV wavelength range are given in Table 1.**

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Table 1 – Relative spectral irradiance of xenon-arc lamps with daylight filters (Ref. ISO 4892-2:2006)

The samples shall be exposed to **an light source with irradiance of 0.68±0.02 W/m2 at 340nm**, for a period such that **the radiation energy that they receive is equal to 2,550±75 kJ/m2.** In order to ensure a regular exposure, **the irradiance at any position in the area used for specimen exposure shall be at least 80 % of the maximum irradiance.**

Reference

- [1] CIE Publication No. 85:1989, Table 4
- [2] SAE J2527-2004 Performance based standard for accelerated exposure of automotive exterior materials using a controlled irradiance xenon-arc apparatus
- [3] ISO 4892-2:2006 Plastics - Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps

Questions?