

JIS

JAPANESE INDUSTRIAL STANDARD

Light-exposure and light- and-water-exposure apparatus (Xenon-arc lamp type)

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1. Scope

This Japanese Industrial Standard specifies light-exposure and light-and-water-exposure apparatus (Xenon-arc lamp type) used for testing of light resistance ⁽¹⁾ and weather resistance ⁽²⁾ of industrial materials and products of all types (hereafter referred to as the "test apparatus").

Notes ⁽¹⁾ The property of resistance to variation under irradiation of light.

⁽²⁾ The property of resistance to variation to natural actions, such as outdoor sun-light, wind, rain, etc.

Remarks 1. Light-exposure apparatus means test apparatus capable of performing irradiation of an artificial light source closely resembling solar light for examining part of the properties of light resistance in a short time. Light-and-water exposure apparatus means test apparatus capable of performing irradiation of an artificial light source closely resembling solar light and of performing intermittent water spray for examining part of the properties of weather resistance in a short time.

2. The following Standards are cited in this Standard:

JIS C 1102 Electrical Indicating Instruments

JIS G 3442 Galvanized Steel Pipes for Water Service

JIS G 3459 Stainless Steel Pipes

JIS G 4305 Cold Rolled Stainless Steel Plates and Sheets

JIS G 4307 Cold Rolled Stainless Steel Strip

JIS H 3100 Copper and Copper Alloy-Sheets, Plates and Strips

JIS H 3250 Copper and Copper Alloy-Rods and Bars

JIS H 3300 Copper and Copper Alloy-Seamless Pipes and Tubes

JIS H 4000 Aluminium and Aluminium Alloy Sheets and Plates, Strip and Coiled Sheets

JIS H 5101 Brass Castings

JIS K 6742 Unplasticized Polyvinyl Chloride Pipes for Water Works

JIS K 6762 Polyethylene Pipes for Water Works Service

JIS Z 8703 Standard Atmospheric Conditions for Testing

JIS Z 8722 Methods of Measurement for Colour of Reflecting or Transmitting Objects

2. Definitions

For the purposes of this Standard the following definitions apply:

- (1) black panel temperature The temperature indicated by a black panel thermometer attached to a rack or rotary board, which is representative for the surface temperature.
- (2) xenon arc lamp An arc lamp which emits by xenon arc discharge.
- (3) emission part The part composed of a xenon arc lamp and a filter.

3. Classification

Test apparatuses shall be classified on the basis of whether or not a spray apparatus is provided, into the following two types:

- (1) Xenon arc lamp light-exposure apparatus (hereafter referred to as type XF).
- (2) Xenon arc lamp light-and-water-exposure apparatus (hereafter referred to as type XW).

The main specifications of apparatuses of these two types shall be in accordance with Table 1.

Table 1. Main specifications of test apparatuses

Class	Xenon arc lamp	Number of lamps	Test piece holding apparatus	Spray apparatus	Blower mechanism	Temperature adjustment	Humidity adjustment
Type XF	Water cooling or air cooling	1 or more than 2	Rack system or rotary board system	No	Intermittent or continuous blower type	Yes	Automatic control type or non-control type
Type XW	Water cooling or air cooling	1 or more than 2	Rack system or rotary board system	Yes	Continuous blower type	Yes	Automatic control type or none

4. Performance

4.1 Light irradiation The light irradiation of test apparatus shall be as follows:

- (1) Spectral characteristics of emission part The xenon arc lamp shall have a continuous spectrum at least over the wavelength range of 250 to 1200 nm, and shall irradiate light various rises according to the assembly of the filter. An example is shown in Informative Reference Fig. 3.

Informative Reference: The spectral transmissivities ⁽¹⁾ of filters (examples) are shown in Informative Reference Table 1 below.

Informative Reference Table 1

Class of filter	Spectral transmissivity %					
	275 nm	300 nm	320 nm	400 nm	700 nm	1000 nm
Quartz glass	Min. 90	Min. 90	Min. 90	Min. 90	Min. 90	Min. 85
Glass filter for insulating ultraviolet radiation (I)	Max. 2	Min. 35	Min. 75	Min. 90	Min. 90	Min. 90
Glass filter for insulating ultraviolet radiation (II)	0	0	Max. 20	Min. 90	Min. 90	Min. 90
Glass filter for insulating infrared radiation	Min. 0	Min. 20	Min. 50	Min. 80	Max. 75	Max. 7
Glass for insulating ultraviolet radiation and infrared radiation	0	0	Max. 20	Min. 80	Max. 70	Max. 5

Note ⁽¹⁾ The spectral transmissivity (at ordinary temperatures) before use is given.

- (2) Indication of irradiance ⁽⁴⁾ of test piece surface ⁽³⁾ For each type of test apparatus, indicate by a diagram the spectral irradiance of test piece surfaces in the wavelength range of at least 300 to 800 nm, and mark the irradiance in the wavelength of 300 to 400 nm.

Upon agreement between the parties concerned, the irradiance in other wavelength ranges or the spectral irradiance at a specific wavelength should also be marked.

The measuring method is to be in accordance with the annex.

Notes ⁽³⁾ Surface of the test piece holder.

⁽⁴⁾ Value (initial value) an assembly of a new xenon arc lamp and a filter aged for approx. 20 h.

- (3) Tolerance in irradiance during operation With automatic control, it shall be capable of maintaining $\pm 10 \%$ of the set irradiance. With manual adjustment, it shall be capable of being regulated to within $\pm 10 \%$ of the set irradiance.
- (4) Tolerance in irradiance of test piece surfaces The difference of irradiances of test piece surfaces due to the position must not exceed 10 % of the maximum value.
- (5) Light-and-dark cycles ⁽⁵⁾ It is capable of setting cycles of at least of 3.8 h irradiation (light) and 1 h quenching (dark). The temperature and humidity during irradiation shall be as given in 4.2, and the humidity during quenching shall be able to be set to $95 \pm 5 \%$ humidity. Spray apparatus for test piece surfaces shall not be used.

Note ⁽⁵⁾ This applies when provided with a light-and-dark cycle apparatus.

4.2 Temperature and humidity The temperature and humidity of the inside of the test tank shall be indicated by the adjustable black panel temperature and the relative humidity and, as follows:

- (1) Adjustable black panel temperature and its adjustable accuracy At least one of the following conditions must be satisfied:
 - (a) $63 \pm 3^\circ\text{C}$ (indicating temperature by type A black panel thermometer)
 - (b) $83 \pm 3^\circ\text{C}$ (indicating temperature by type A black panel thermometer)
 - (c) $50 \pm 3^\circ\text{C}$ (indicating temperature by type A black panel thermometer)
 - (d) $70 \pm 3^\circ\text{C}$ (indicating temperature by type B black panel thermometer)

Upon agreement between the parties concerned, the temperature and adjusting accuracy may be changed.

Remarks: The temperature differs with the type of xenon arc lamp and filter combination. The indicating temperature differs with the type of black panel thermometer used.

- (2) Adjustable relative humidity and adjusting accuracy ⁽⁶⁾ For each indicating temperature specified in (1), the relative humidity should be capable of being adjusted to $50 \pm 5 \%$. The measuring position of the relative humidity shall be near the air outlet in the test tank.

Upon agreement between the parties concerned, it may be a different relative humidity.

Note ⁽⁶⁾ Humidity adjusting apparatus applies to automatic control systems.

4.3 Spraying of the test piece surface Spraying of the test piece surface shall be as follows:

- (1) Methods of irradiation and spraying At least the following three classes shall be able to be set.
 - (a) 120 min cycle: Irradiation for 102 min, followed by irradiation and spraying for 18 min.
 - (b) 60 min cycle: Irradiation for 48 min, followed by irradiation and spraying for 12 min.
 - (c) No spraying: Irradiation only the time shall be to a precision of ± 0.5 min.
- (2) Range and tolerance of setting the spray water For a spray pressure of 0.1 MPa, this shall be either 0.53 ± 0.10 l/min or 0.08 ± 0.01 l/min per nozzle. This may be changed upon agreement between the parties concerned.

5. Construction, dimensions and materials

5.1 Construction Test apparatus shall be constructed of a test tank, emission part, xenon arc starting and stabilizing apparatus, irradiance adjusting apparatus, temperature adjusting apparatus, humidity adjusting apparatus ⁽⁷⁾, test piece holder, test piece surface sprayer ⁽⁸⁾, cooling apparatus, instrumentation apparatus, etc.

Notes ⁽⁷⁾ This applies to test apparatus provided with a humidity adjusting apparatus.

⁽⁸⁾ This applies to light-and-water-exposure apparatus.

5.2 Test tank The test tank shall have a chamber for carrying out irradiation of light to test pieces or, with type W, for also carrying out water spraying, with a built-in emission part, rotary frame, spray nozzle, etc., and, shall be so constructed that the temperature or temperature and humidity can be adjusted.

The material of the inside wall of test tank shall be SUS 304 specified in JIS G 4305 or A 1100 P specified in JIS H 4000 treated for corrosion resistance or materials equivalent or superior to these in quality.

The relative positions of the emission part, test piece holder, and spray nozzle are shown in Informative Reference Fig. 1.

5.3 Emission part The emission part shall be as follows:

- (1) Xenon arc lamp Xenon arc lamps are long arc lamps of a.c. burning in which electrodes are sealed-in both ends of a quartz tube and xenon gas is sealed-in inside, and are used with performing forced water cooling or forced air cooling.

- (2) Filter Filters are used for obtaining the required spectral characteristics and for cooling the xenon arc lamp. For insulating the ultraviolet part and the infrared part, glass filters for ultraviolet-radiation insulation, glass filters for infrared-radiation insulation, running water, etc., are used.
- (3) Other Based on the portion to be used, material superior in heat resistance, corrosion resistance, humidity resistance, or electric insulation shall be used.

A summary of the emission part is shown in Informative Reference Fig. 2.

5.4 Xenon arc starting and stabilizing apparatuses The xenon arc starting apparatus is used for starting the xenon arc lamp and shall be capable of generating the required high voltage pulses. The xenon arc stabilizing apparatus is for maintaining the stabilized xenon arc for a long time and shall be composed of a transformer, input voltage regulator, reactor, etc.

5.5 Irradiance adjusting apparatus The irradiance adjusting apparatus is an apparatus to correct the attenuation of radiation energy accompanying the use of a xenon arc lamp and filter, and shall be provided with one of the following conditions:

- (1) It shall be capable of manual adjustment of the lamp power stepwise according to the time of use.
- (2) It shall be capable of manual adjustment of the lamp power to make the irradiance constant by measuring the irradiance or radiant exposure quantity.
- (3) It shall be capable of automatic control of the lamp power to make the irradiance constant by detecting the fluctuation in irradiance.

5.6 Light-and-dark cycle apparatus The light-and-dark cycle apparatus shall be capable of setting the conditions of the specified black panel temperature and relative humidity by repeatedly burning and extinguishing at the specified time rate.

5.7 Temperature adjusting apparatus The temperature adjusting apparatus is for adjusting the air temperature in the test tank in order to make the indication of the black panel thermometer constant, and is constructed of a blowing mechanism, black panel thermometer, and temperature adjuster.

In order to regulate the air flow, it shall be provided with an air deflector or shall have equivalent performance.

The blowing mechanism, black panel thermometer, and temperature adjuster shall be as follows:

- (1) Blowing mechanism The blowing mechanism is for feeding air into the test tank, and is divided into intermittent and continuous blowing types.

The air inlet shall, as required, be provided with an air filter for preventing dust entry.

(2) Black panel thermometer

- (2.1) Classification Black panel thermometers are classified into the following two types.

Type A Type A is so structured that the heat sensitive body, bimetal, platinum resistor, thermistor, thermoelectric couple, etc., is attached coincident with the center of the metal plate and is adhered tightly to the heat sensitive body protecting tube.

Type B Type B is so structured that the heat sensitive body, platinum resistor, thermistor, etc., is attached coincident with the center of the back face (opposite side of the irradiation surface) of the metal plate, and is adhered tightly to the plastic insulating material to the metal face. A clearance of approx. 1 mm shall be provided between the heat-sensitive body and the heat insulating member.

- (2.2) The metal plate and heat-sensitive body protective tube used shall be SUS 304 specified in JIS G 4305 and shall be finished by painting baking type weather-proof black enamel.
- (2.3) The temperature indicating part may be dial type, digital type, etc.
- (2.4) The black panel thermometer is attached to the holder prepared for such attachment, and shall be attached to the rack or rotary board in parallel to the test piece.
- (2.5) The structure and dimensions of the black panel thermometer shall be in accordance with Attached Fig. 1.
- (2.6) The response performance, spectral reflectance, and scale of black panel thermometer shall be as follows:
- (a) Response performance ⁽⁹⁾ For the temperature rise, immerse all but the scale part of the black panel thermometer in water in a water tank regulated to $30 \pm 1^\circ\text{C}$, leave until the indication becomes stable at $30 \pm 1^\circ\text{C}$, quickly place in a water tank regulated to $70 \pm 1^\circ\text{C}$, and measure the time until the indication becomes 63°C . This value shall be not more than 10 s.

For the temperature drop, immerse all but scale part of black panel thermometer in water in a water tank regulated to $70 \pm 1^\circ\text{C}$, leave until the indication becomes stable at $70 \pm 1^\circ\text{C}$, quickly place in a water tank regulated to $30 \pm 1^\circ\text{C}$, and measure the time until the indication becomes 37°C . This value shall be not more than 10 s.

Note ⁽⁹⁾ This applies only to type A dial type.

- (b) Spectral reflectance When measured according to illumination and geometrical condition d of the receiving light specified in JIS Z 8722, the spectral reflectance (including positive reflected light) of the black panel in the wavelength range of 380 to 780 nm shall be not more than 5 %.
- (c) Scale A scale capable of indicating the specified temperature, with a scale interval within 1°C.
- (3) Temperature adjuster The temperature adjuster is used in combination with the blowing mechanism. There are two types, based on the detecting system, either of which can be used.
 - (a) Air temperature adjuster Air temperature adjusters can be liquid expansion type, electric type, etc., and the heat sensitive part should be attached near the test tank air outlet, avoiding direct light from the emission part.
 - (b) Black panel type temperature adjuster The black panel type temperature adjuster adjusts the air temperature in the test tank by detecting the black panel temperature. For the heat-sensitive part, there are the following two types:

Type AR This is so structured that the heat-sensitive body is attached to the center of the metal plate coincident with the center and adhered tightly to the heat sensitive body protecting tube.

Type BR This is so structured that the heat-sensitive body is attached to the center of the back face of the metal plate coincident with the center and adhered tightly to the insulating member made of plastic on the metal surface. A clearance of approx. 1 mm shall be provided between the heat-sensitive body and the heat-insulating member.

The structure of the heat-sensitive part shall be in accordance with Attached Fig. 2.

5.8 Humidity adjusting apparatus The humidity adjusting apparatus adjusts the humidity in the test tank, and shall be as follows:

- (1) Automatic control type apparatus detects the humidity near the air outlet in the test tank, avoiding direct light from light source, controls the humidifier by the signal of the set value, and adjusts the humidity in the test tank.
- (2) With wick type, immerse the wick (moisture-supply cloth) adhered to the frame into the water tank at the test tank bottom, and accelerate evaporation of the moisture content to humidify in test tank.