

DEUTERIUM LAMPS (D₂ LAMPS)



Hamamatsu deuterium lamps key features and the reasons

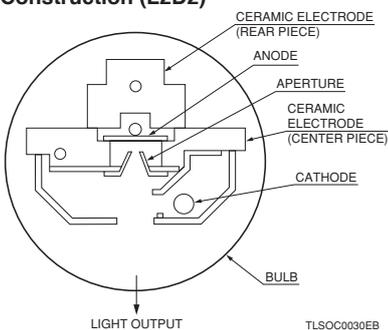
D₂ LAMPS

FOR HIGH PERFORMANCE DEVICES

Hamamatsu deuterium lamps (D₂ lamps) deliver a long lifetime, excellent stability, and high output to the highest levels to allow users to obtain the maximum performance characteristics from their equipment.



Construction (L2D2)



Long lifetime

1 UV-transmitting glass

Problems with prior lamps using quartz glass

Premature deterioration in transmittance cause by UV light

Quality variations due to production process and material inclusions

Troublesome ozone generation

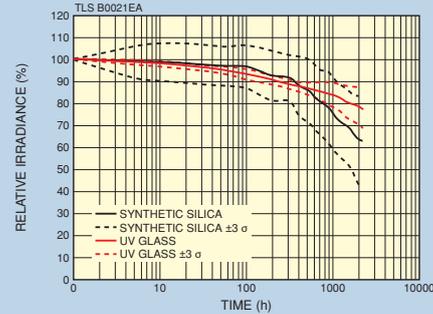
UV-transmitting glass solved these problems!

High resistance to UV light

High quality with less variations

No ozone generation

Life characteristics

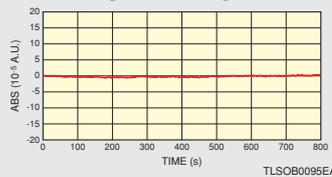


High stability

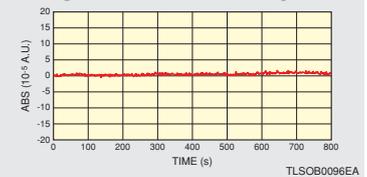
Light output stability

Maintains high stability until product lifetime end

Stability at initial operation



Stability after 2000 hours of operation



2 Ceramic electrode

Problems with prior lamps using (Metal electrode)

Low stability due to being susceptible to ambient conditions

Large variation in light output because electrode spacing is not uniform

Ceramic electrodes could solve these problems with its excellent temperature characteristics!

Excellent temperature characteristics ensure high stability

Uniform electrode spacing minimizes variations in characteristics

3 Cathode (Super quiet type)

Problems with conventional directly-heated type

Concentrated radiated heat damage applies a large load to the cathode

Vibration and operating time directly affect cathode deterioration

Using a super quiet cathode could solve the problems with the conventional lighting method!

Electron emission capability with minimal fluctuations

Lighting performance

4 Capacitor

Problems with D₂ lamp without auxiliary ignition

Fails to light up due to electrode deterioration during long-term operation

Fails to light up due to decrease of internal gas during long-term operation

Fails to light up when the lamp is hot and in case of re-igniting right after turning off

Auxiliary lighting method could solve the problems with the conventional lighting method!

Secured lighting even if the lamp is hot or at the end of lifetime

Deuterium lamps are light source lamps that utilize an arc discharge in deuterium (D₂) gas. They emit an intense spectrum in the UV region and have feature of unrivaled stability compared to other UV light sources.

PRODUCT LINE-UP / APPLICATION LIST

33 W
X2D2[®]
LAMPS
High brightness deuterium lamps
 High-end light sources that offer the world's highest luminance among the 30 W class * (twice that of L2D2 lamps)
P3

30 W
L2D2[®]
LAMPS
Long lifetime deuterium lamps
 Best-selling light sources that deliver the high quality and high performance required by chemical analysis instruments while keeping costs low
P5

5 W to 7 W
S2D2[®]
LAMPS
Compact deuterium lamps
 Compact yet high-performance light sources that were impossible to create up till now with conventional deuterium lamps
P11

110 W
H2D2[®]
LAMPS
High output deuterium lamps
 Next-generation light sources that have achieved the highest output in the history of deuterium lamps
P14

*As of Feb. 2016 according to our research

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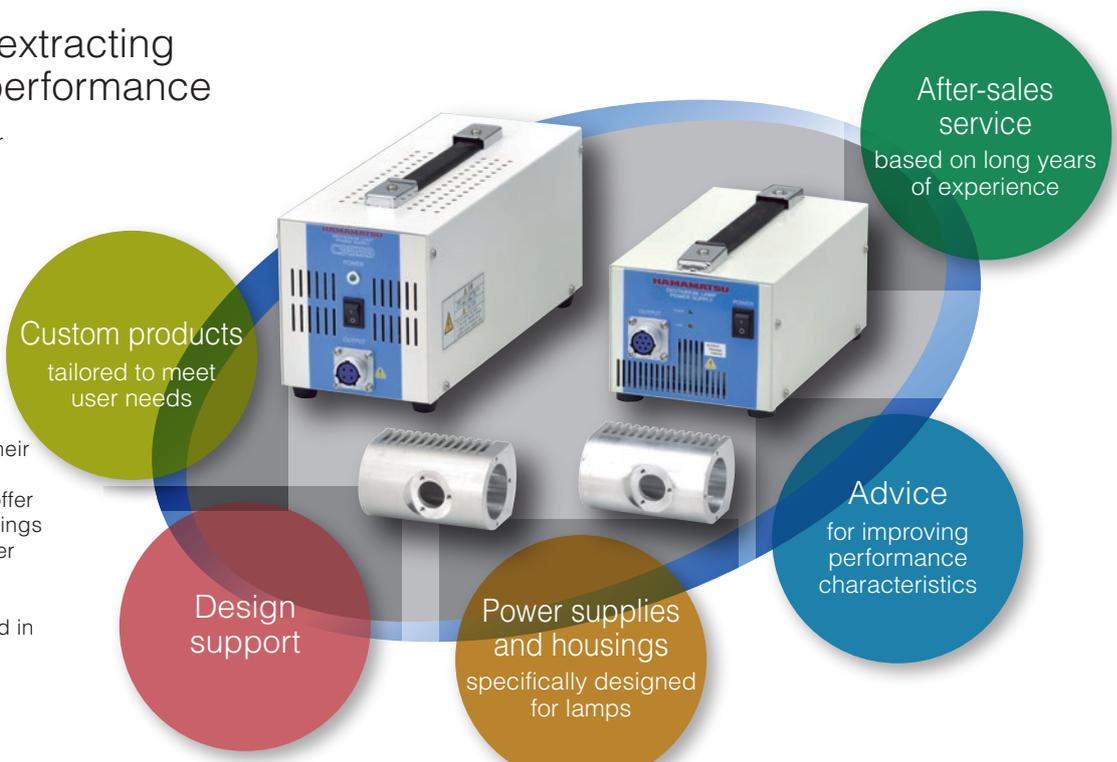
Applications	Window material	UV glass	Synthetic silica	MgF ₂
HPLC (High Performance Liquid Chromatography)		◎	○	×
UV-VIS Spectrophotometer		◎	○	○
CE (Capillary Electrophoresis)		◎	○	×
Atomic Absorption Spectrophotometer		◎	○	×
Thin Layer Chromatography		◎	○	×
Water Quality, Air Pollution and Other Environmental Analyzer		◎	○	×
Film Thickness Gauge		◎	◎	○
Semiconductor Testing Equipment		○	◎	◎
UV Resistance Evaluation of Materials		◎	◎	◎
Photoionization Light Source		×	×	◎
Static Electricity Removal by Vacuum UV Light		×	×	◎

◎: Optimum ○: Usable according to application ×: Not generally suitable

Peripheral devices that support high performance

Total support for extracting maximum lamp performance

To enable lamps to exhibit their maximum performance, it is important to design an optimum housing and power supply. We do not only sell deuterium lamps but also provide power supplies and housings specifically designed for deuterium lamps. Besides selling our own products, we provide technical support to help users design their own lamp housings and power supplies. We are also glad to offer advice on optimal electrical ratings and lamp shapes that meet user specifications. Please consult with us for specifications that are not listed in our product catalog.



X2D2[®] LAMPS

The X2D2[®] lamps (high brightness & long lifetime deuterium lamps) deliver unparalleled brightness twice that of L2D2 lamps (see page 5) while still maintaining the high stability and long lifetime offered by the conventional deuterium lamps. These characteristics will enhance sensitivity and throughput in various photometric instruments.

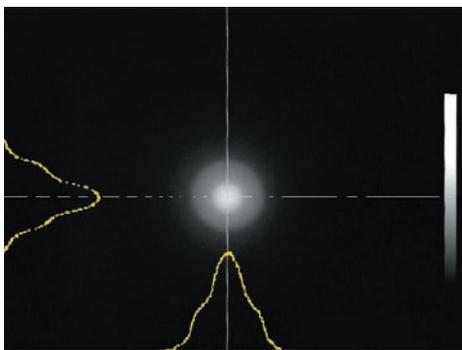


Features

- Long life: 2000 h
- High stability: 0.005 % (p-p) typ.
- High brightness: 2 times higher than L2D2 lamps

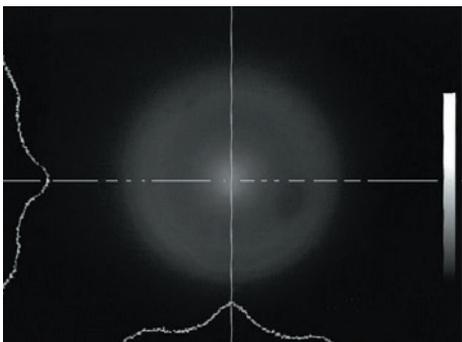
Arc distribution

- X2D2 lamp Aperture size: 0.5 mm



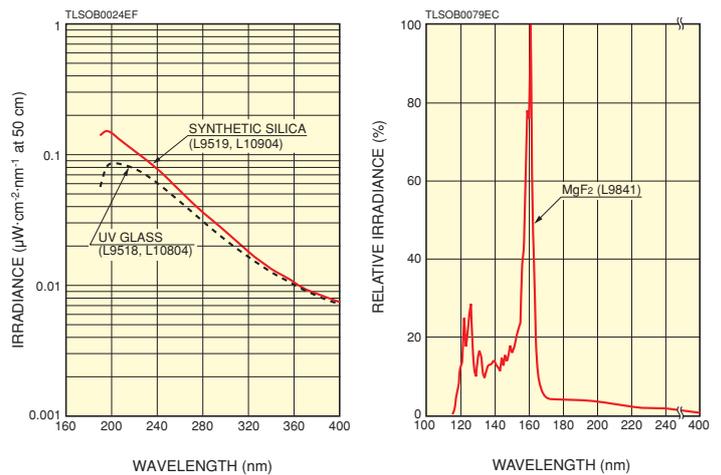
2 times
higher than
conventional type

- L2D2 lamp Aperture size: 0.5 mm



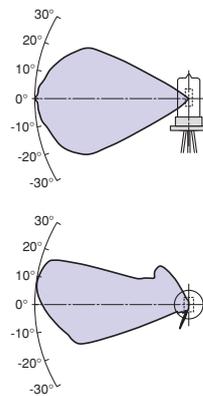
Characteristics

Spectral distribution

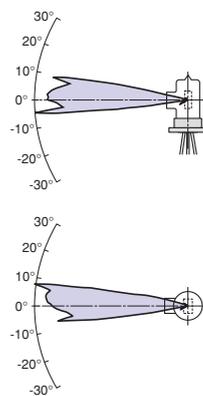


Directivity (Light distribution)

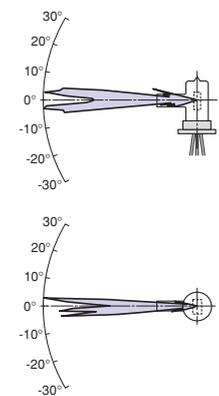
- ① UV glass
L9518, L10804



- ② Synthetic silica
L9519, L10904

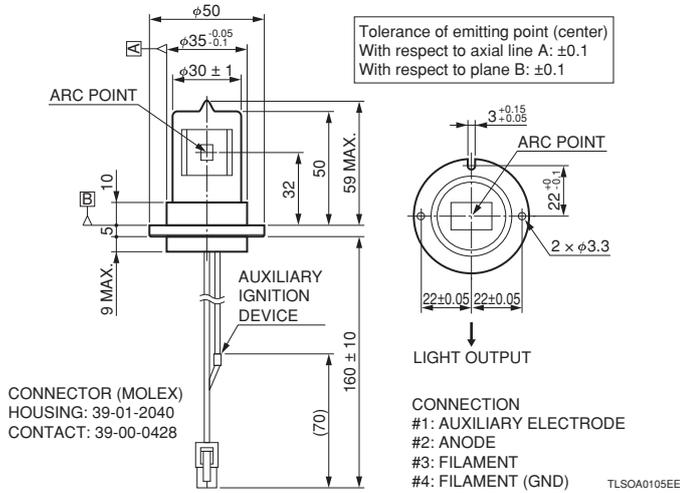


- ③ MgF₂
L9841

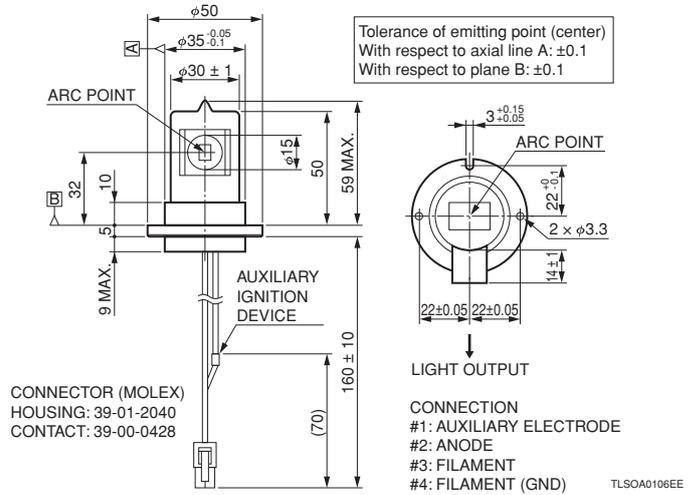


Dimensional outline (Unit: mm)

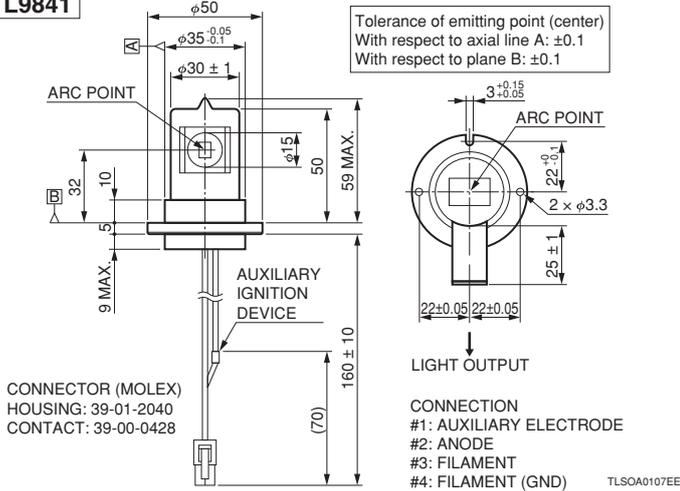
L9518, L10804



L9519, L10904

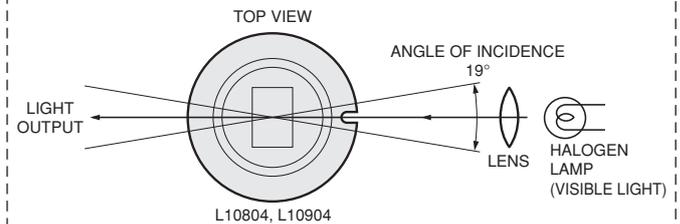


L9841



Example of optical system layout for visible light (X2D2 lamp)

The see-through structure allows easy use in combination with a visible light source.



TLSOC0053ED

Specifications

Parameter	L9518	L10804	L9519	L10904	L9841	Unit
Type	Standard	See-through	Standard	See-through	Standard	—
Window material	UVglass		Synthetic silica		MgF ₂	—
Spectral distribution	185 to 400		160 to 400		115 to 400 ^⑤	nm
Aperture diameter			0.5			mm
Output stability at 230 nm	Drift (Max.)		±0.3			%/h
	Fluctuation (p-p) Typ.		0.005			%
Guaranteed life at 230 nm ^④			2000			h
Discharge starting voltage (Max.) ^⑥			400			V dc
Anode current			300 ± 30			mA dc
Tube voltage (Typ.)	90				85	V dc
Filament ratings	Warm-up	Voltage	2.5 ± 0.25			V dc
		Current (Typ.)	4			A dc
	Operating	Voltage	1.7 ± 0.2			V dc
		Current (Typ.)	3.3			A dc
Filament warm-up time (Typ.)			20			s
Power supply ^③			C9559, M9521			—
Recommended operating temperature ^⑦			245 to 290			°C

④ Lamp life end is defined as the point when light output at 230 nm falls to 50 % of its initial value or when output fluctuations exceed 0.05 % (p-p).

⑥ A trigger voltage must be applied to the anode and auxiliary electrode. ③ The power supply for the L2D2 cannot be used to operate X2D2 lamps.

⑦ Recommended temperature for operating a lamp in the lamp housing. Consult us on how to measure the temperature.

⑤ Does not support vacuum evacuation and so should be used in nitrogen atmosphere.

* Custom lamps not listed above will be available on request. Please feel free to contact us.

L2D2[®] LAMPS

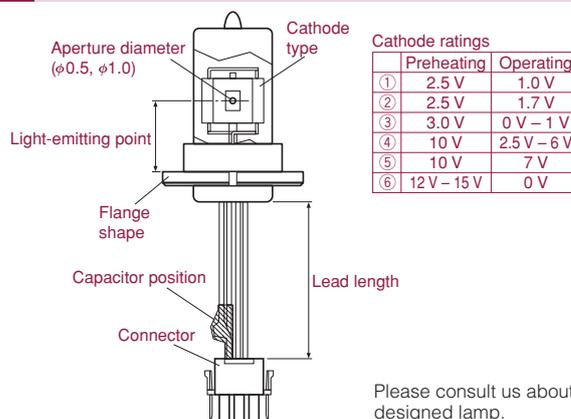
The L2D2[®] lamps are UV light sources with a long service lifetime and high stability. These L2D2 lamps have characteristics essential for light sources used in chemical analysis instruments and provide high measurement accuracy.



Features

- Long life: 4000 h (L6565-56)
- High stability: 0.005 % (p-p) typ.
- Small intensity variations
- Low cost
- Error-free lighting

Example of custom-designed lamp



Please consult us about custom designed lamp.

Specifications

Type No.	Type	Dimensional outline [Ⓐ]	Window material	Spectral distribution (nm)	Aperture diameter (mm)	Output stability at 230 nm		Guaranteed life at 230 nm (h) [Ⓑ]	Required discharge starting voltage [Ⓒ] Max. (V dc)	Anode current (mA dc)	Tube voltage Typ. (V dc)	
						Drift Max. (%/h)	Fluctuation (p-p) Typ. (%)					
L6565-56	Standard	⑧	UV glass	185 to 400	1.0	±0.3	0.005	4000	350	300 ± 30	80	
L6301		①										
L6301-50		⑧										
L6303		①										
L12313		③										
L12313-50		⑦										
L6307		②										
L6309		④	Synthetic silica	160 to 400	0.5							
L7296		⑥										
L7296-50		②										
L12307		⑤	UV glass	185 to 400	1.0			2000 [Ⓓ]	350			
L7293		⑤	MgF ₂	115 to 400								
L6999		See-through	①	UV glass	185 to 400			0.5	2000			400
L6999-50			⑧									
L9030	④		Synthetic silica	160 to 400								
L9030-50	⑥											

[Ⓐ] See pages 7 and 8.

[Ⓑ] Lamp life end is defined as the point when light output at 230 nm falls to 50 % of its initial value or when output fluctuations exceed 0.05 % (p-p).

[Ⓒ] A pulse voltage higher than this value must be supplied to start reliable lamp discharge.

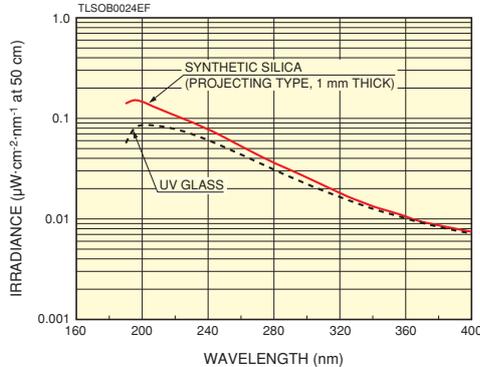
[Ⓓ] Operating life may vary depending on operating environmental conditions (vacuum atmosphere).

Characteristics

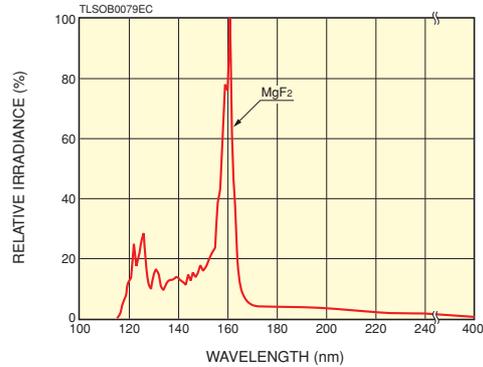
●Spectral distribution

Deuterium lamps emit high intensity light in the UV range at wavelengths shorter than 400 nm. Light intensity on the short wavelength side is determined by the window material used.

UV glass, Synthetic silica

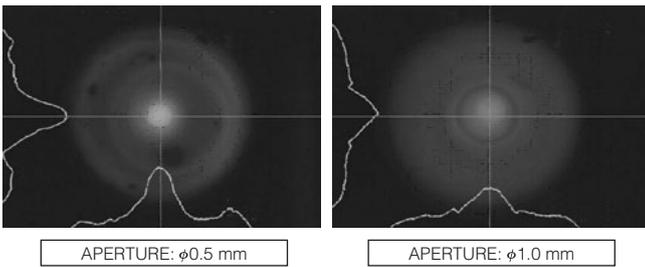


MgF₂

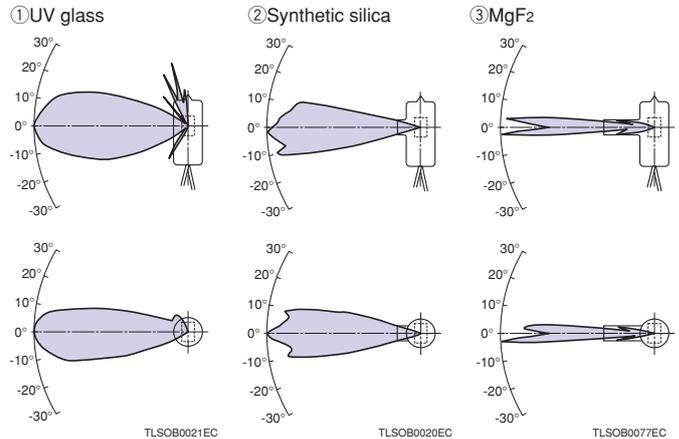


●Arc distribution

Arc distribution of deuterium lamps is determined by the aperture (light exit) size. At the same input current and voltage, lamps with a 0.5 mm aperture provide 1.4 times higher intensity than lamps with a 1.0 mm diameter aperture.



●Directivity (Light distribution)



Filament ratings				Filament warm-up time Typ. (s)	Applicable power supply ^(H)		Recommended operating temperature ^(I)	Type No.
Warm-up		Operating			AC input type	DC input time		
Voltage ^(E) (V dc, ac)	Current Typ. (A dc, ac)	Voltage (V dc)	Current Typ. (A dc)					
2.5 ± 0.25	4	1.0 ± 0.1	1.8	20	C9598-2510	M9596-2510	245 to 290	L6565-56
		1.7 ± 0.2	3.3					L6301
3	5	0 to 1	0 to 1.8		C9598-2517	M9596-2517		L6301-50
		2.5 to 6.0 ^(F)	0.3 to 0.6		C9598-3000	M9596-3000		L6303
10 ± 1	0.8	7.0 ± 0.5	1		C9598-1035	M9596-1035		L12313
	1.2				C9598-1070	M9596-1070		L12313-50
12 to 15	0.5 to 0.55	0 ^(G)	0 ^(G)		C9598-1555	M9596-1555		L6307
2.5 ± 0.25	4	1.0 ± 0.1	1.8		C9598-2510	M9596-2510		L6309
					L7296			
					L7296-50			
				L12307				
				L7293				
				L6999				
				L6999-50				
L9030								
L9030-50								

^(E)If the cable between the lamp and power supply is too long, a large filament voltage drop occurs in the cable that might make the lamp filament voltage too low.

The filament power supply should be designed to supply the specified voltage at the lamp input terminal.

^(F)Recommended operating voltage is 3.5 V ± 0.5 V.

^(G)During lamp operation a discharge current flows into the filament so no external power supply is needed to maintain the filament temperature.

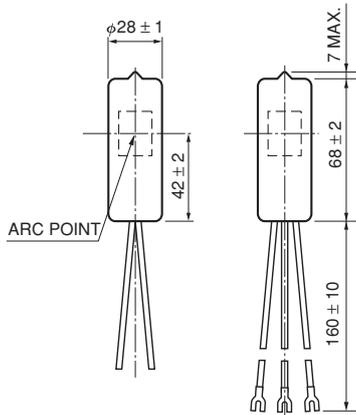
^(H)To extract full performance from our deuterium lamps we recommend using our dedicated power supplies.

^(I)Recommended temperature for operating a lamp in the lamp housing. Consult us on how to measure the temperature.

* Custom lamps not listed above will be available on request. Please feel free to contact us.

Dimensional outline (Unit: mm)

① L6301, L6303, L6999 See-through type



CONNECTION

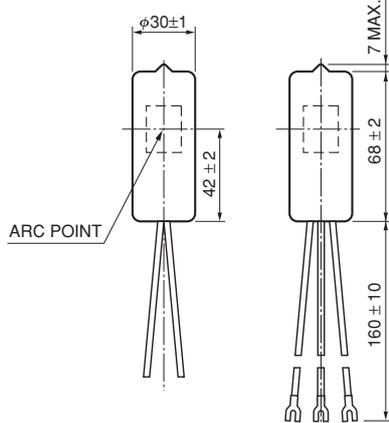
L6303	
FILAMENT	: BLUE
FILAMENT-GND	: BLACK
ANODE	: RED

L6301, L6999	
FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED



TLSOA0040ED

② L6307, L6309, L12307



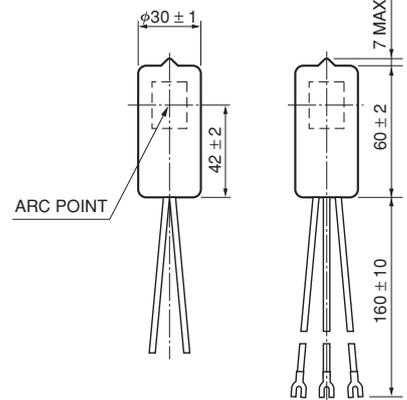
CONNECTION

FILAMENT	: BLUE
FILAMENT-GND	: BLACK
ANODE	: RED



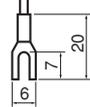
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③ L12313



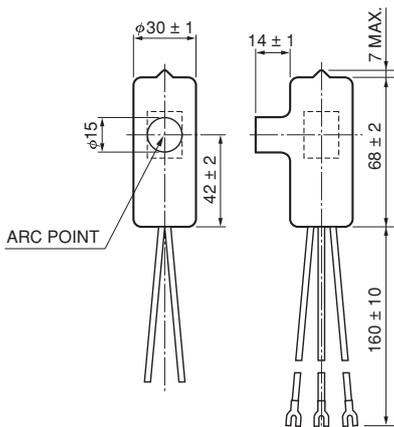
CONNECTION

FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED



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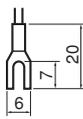
④ L7296, L9030 See-through type



CONNECTION

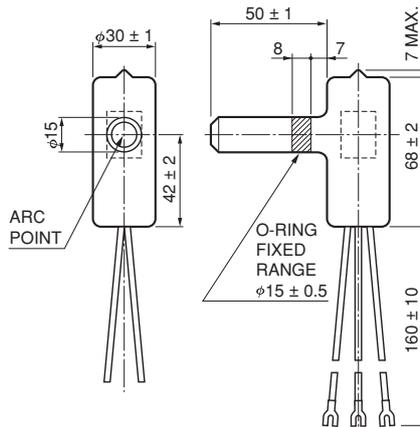
L7296	
FILAMENT	: BLUE
FILAMENT-GND	: BLACK
ANODE	: RED

L9030	
FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED



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⑤ L7293



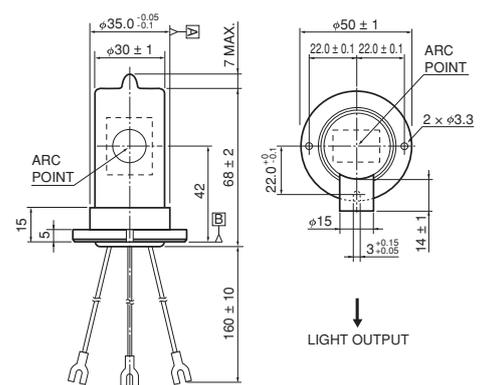
CONNECTION

L7293	
FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED



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⑥ L7296-50, L9030-50 See-through type



CONNECTION

L7296-50	
FILAMENT	: BLUE
FILAMENT-GND	: BLACK
ANODE	: RED

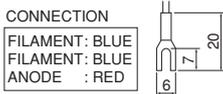
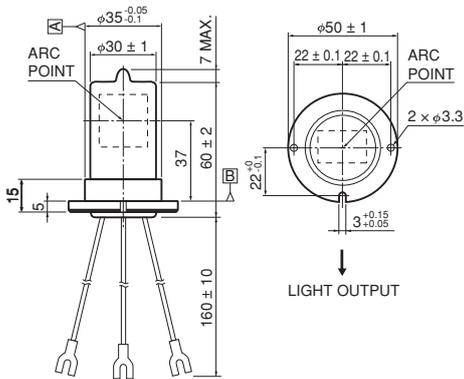
L9030-50	
FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED



Tolerance of emitting point (center)
With respect to axial line A: ±0.1
With respect to plane B: ±0.1

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⑦ L12313 -50

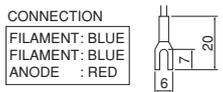
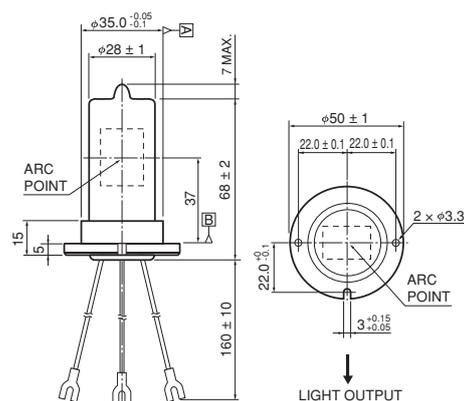


Tolerance of emitting point (center)
With respect to axial line A: ± 0.1
With respect to plane B: ± 0.1

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⑧ L6565-56, L6301-50, L6999-50

See-through type



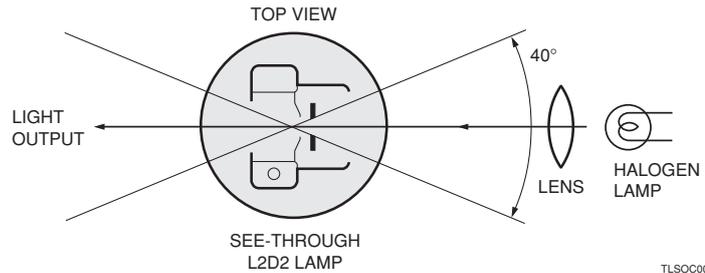
Tolerance of emitting point (center)
With respect to axial line A: ± 0.1
With respect to plane B: ± 0.1

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See-through type

The see-through type electrode structure enables straight-line arrangement of the halogen lamp, deuterium lamp, optical system and optical path. This simplifies optical design of UV-VIS spectrophotometer etc., and eliminates loss of light amount caused by the half mirror.

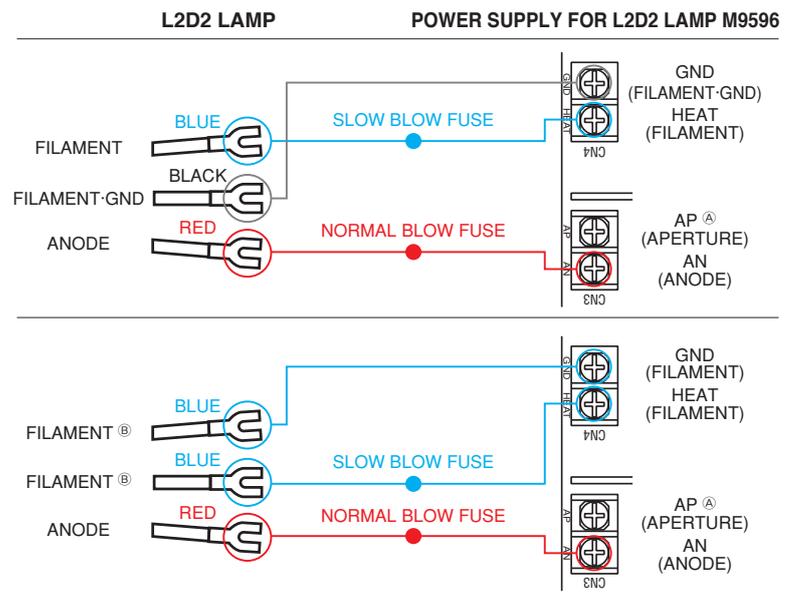
An example for optics of See-through type



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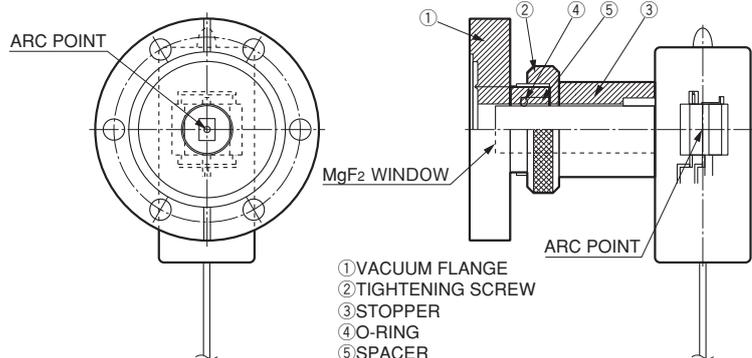
Target type No.: L6999, L6999-50, L9030, L9030-50

Power supply for lamp connection example



- Ⓐ It is not necessary to connect L2D2 lamp to the AP (aperture) terminal.
- Ⓑ There is no polarity for terminals without GND designation.

Mounting example on the vacuum system (L7293)



X2D2[®]
LAMPS

L2D2[®]
LAMPS

POWER SUPPLY FOR D₂ LAMPS LAMP HOUSE

Applications using deuterium lamps require very high stability of light output, so using a Hamamatsu dedicated power supply and lamp house is recommended to operate these lamps. When users are designing their own power supply and lamp housing, we provide technical support and follow-up to ensure an optimal optical design so please consult us when needed.

E9522-50: for L9518 E9558-50: for L9519
E9522: for L6565-56 and L6301-50 E9558: for L7296-50

* We welcome requests for custom products for see-through types (L10804, L6999-50, L6999-50 and L9030-50).

Power supply for X2D2[®] lamps / Lamp housing



▲Power supply Left: C9559, Right: M9521



▲Lamp housing Left: E9522-50, Right: E9558-50

Power supply for L2D2[®] lamps / Lamp housing



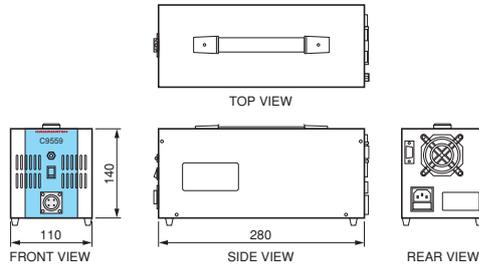
▲Power supply Left: C9598, Right: M9596



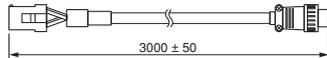
▲Lamp housing Left: E9522, Right: E9558

Dimensional outline (Unit: mm)

●C9559

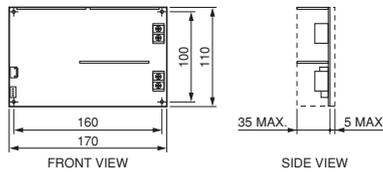


●Supplied lamp output cable



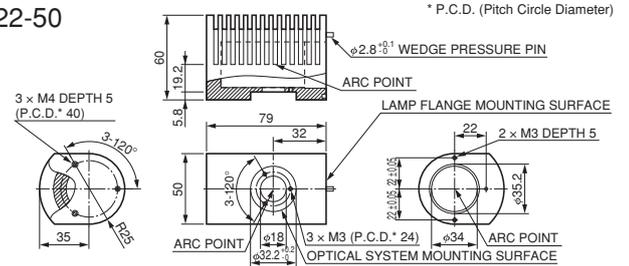
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●M9521



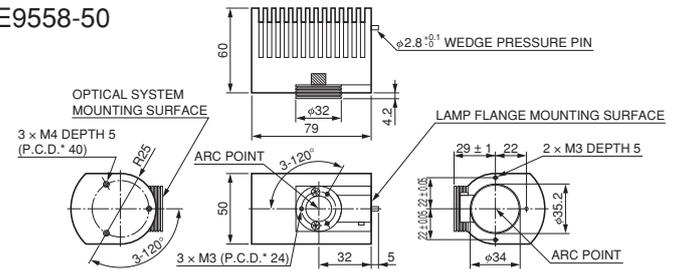
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●E9522-50



TLSOA0114EA

●E9558-50



TLSOA0115EA

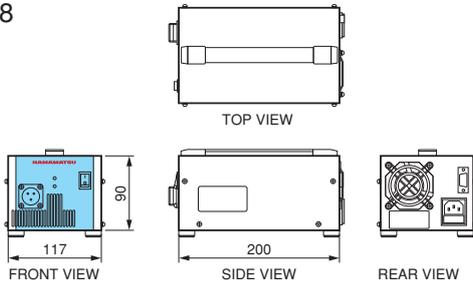
Power supply for X2D2 lamp specifications

Parameter		C9559	M9521	Unit	
Input	Input voltage	AC 100 V to AC 240 V (100 V/200 V Auto switching) Single phase 50 Hz / 60 Hz	DC 24 V ± 2.4 V	—	
	Input current (Max.)	1.4	3	A	
Output	Output voltage (DC)	With load (Typ.)	85 / 90	V dc	
		Without load (Min.)	200	V dc	
	Output current (DC)	300 ± 30		mA dc	
	Current fluctuation (p-p) (Typ.)	0.005		%	
	Current drift at 25 °C (Typ.)	±0.02		%/h	
	Filament ratings	Warm-up	Voltage	2.5 ± 0.2	V dc
			Current (Typ.)	4	A dc
		Operation	Voltage	1.7 ± 0.2	V dc
			Current (Typ.)	3.3	A dc
Filament warm-up time (Typ.)		20	s		
Trigger voltage	Anode	600		V peak	
	Auxiliary electrode	600		V peak	
Cooling method		—	Forced air cooling (0.3 m ³ /min)	—	
Operation ambient temperature		0 to +40		°C	
Storage temperature		-10 to +60		°C	
Operating and storage humidity		Below 80 % (No condensation)		—	
External control (Lamp ON/OFF, Lamp irradiation signal)		Yes	Yes	—	
Conformance standards	CE	Yes	Yes	—	
	UL (File No. E249677)	—	Yes	—	

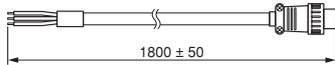
Dimensional outline (Unit: mm)

* P.C.D. (Pitch Circle Diameter)

●C9598

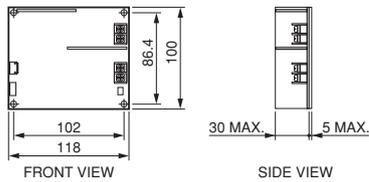


●Supplied lamp output cable



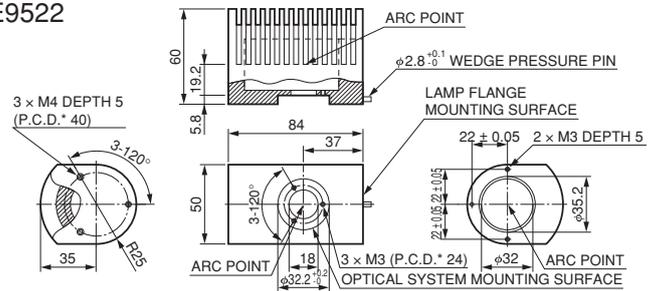
TLSOA0116EA

●M9596



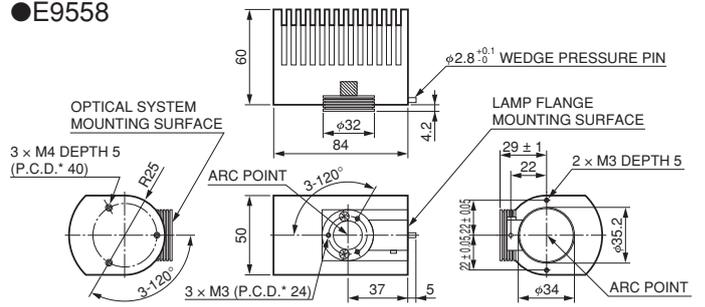
TLSOA0117EA

●E9522



TLSOA0118EA

●E9558



TLSOA0119EA

Power supply for L2D2 lamp specifications

Parameter		C9598	M9596	Unit
Input	Input voltage	AC 100 V to AC 240 V (100 V/200 V Auto switching) Single phase 50 Hz / 60 Hz	DC 24 V ± 2.4 V	—
	Input current (Max.)	0.9	2	A
Output	Output voltage (DC)	With load (Typ.)	80	V
		Without load (Min.)	200	V
	Output current (DC)	300 ± 30		mA
	Current Fluctuation (p-p) (Typ.)	0.005		%
	Current drift at +25 °C (Typ.)	±0.02		%/h
	Filament warm-up time (Typ.)	20		s
	Trigger voltage	Approx. 600		V peak
Cooling method		—	Forced air cooling (0.3 m ³ /min)	—
Operation ambient temperature		0 to +40		°C
Storage temperature		-10 to +60		°C
Operating and storage humidity		Below 80 % (No condensation)		—
External control (Lamp ON/OFF, Lamp irradiation signal)		Yes	Yes	—
Conformance standards	EN (CE marking)	Yes	Yes	—
	UL (File No. E249677)	—	Yes	—

Filament ratings

Type No.	Warm-up		Operation		Applicable lamp
	Voltage (V dc)	Current (A dc)(Typ.)	Voltage (V dc)	Current (A dc)(Typ.)	
C9598/M9596-2510	2.5 ± 0.2	4	1.0 ± 0.1	1.8	L6565-56, L7293, L6999, L6999-50 L6301, L6301-50, L9030, L9030-50
C9598/M9596-2517	2.5 ± 0.2	4	1.7 ± 0.2	3.3	L6303
C9598/M9596-3000	3 ± 0.2	5	0	0	L12313, L12313-50
C9598/M9596-1035	10 ± 0.5	0.8	3.5 ± 0.2	0.3	L6307
C9598/M9596-1070	10 ± 0.5	1.2	7 ± 0.4	1	L7296, L6309, L7296-50
C9598/M9596-1555	13.5 ± 0.7	0.5	5.25 ± 0.25	0.3	L12307

S2D2[®] LAMPS

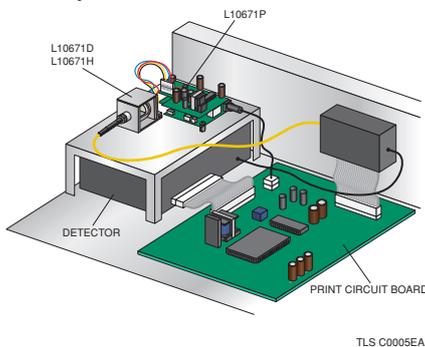
The S2D2[®] lamps are compact deuterium lamps with a drastically reduced size compared to ordinary deuterium lamps. Despite their compact body, the S2D2 lamps have the same high stability as conventional deuterium lamps and a unique electrode structure that delivers high brightness.



▲Left: L13301-01
Right: L10671D

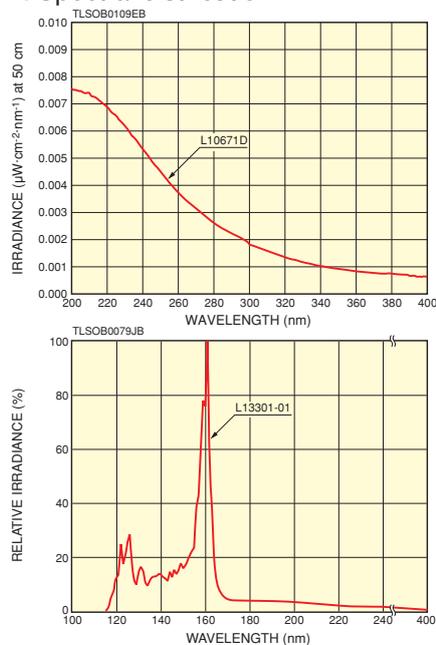
Features

- Long life: 1500 h (L10671D)
- Compact
- High stability: 0.005 % (p-p) typ.
- High output UV continuous spectrum
- Low power consumption
- Easy to use

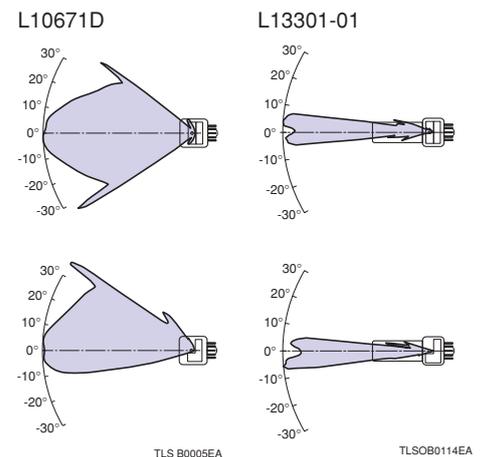


Characteristics

● Spectral distribution



● Directivity (Light distribution)



Specifications

Parameter		Description / Value		Unit	
Type No.		L10671D	L13301-01	—	
Window material		UV glass	MgF ₂	—	
Spectral distribution		185 to 400	115 to 400	nm	
Aperture diameter		1.1		mm	
Output stability at 230 nm	Drift (Max.)	±0.25		%/h	
	Fluctuation (p-p) (Typ.)	0.005		%	
Guaranteed life at 230 nm ^(A)		1500	1000 ^(D)	h	
Output current		30	50	mA	
Output voltage (Typ.)		Approx. 135		V	
Filament ratings	Warm-up	Voltage	4.2 ± 0.2		V
		Current (Typ.)	0.55		A dc
	Operating	Voltage	3.5 ± 0.2		V
		Current (Typ.)	0.5		A dc
Filament warm-up time (Typ.)		25		s	
Recommended operating temperature ^{(B)(C)}		+160 to +200	+200 to +240	°C	
Storage temperature		-10 to +60		°C	
Storage humidity		Below 85 % (No condensation)		—	

^(A)Lamp life end is defined as the point when light output at 230 nm falls to 50 % of its initial value or when output fluctuations exceed 0.05 % (p-p).

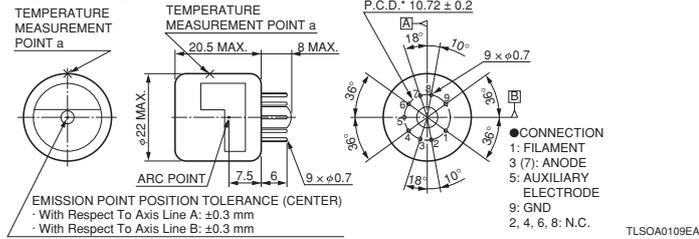
^(B) Position "a" in dimensional outline ^(C)Do not cool the lamp by direct air blow

^(D)Operating life may vary depending on operating environmental conditions (vacuum atmosphere).

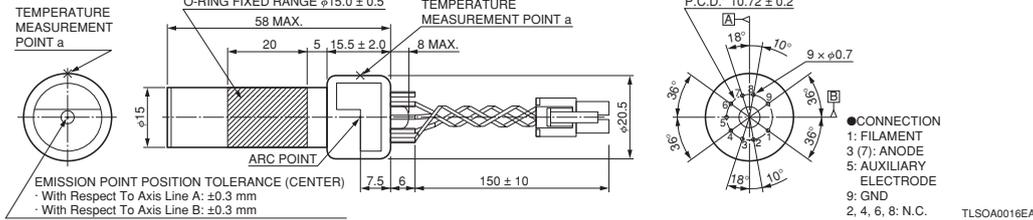
Dimensional outline (Unit: mm)

* PCD (Pitch Circle Diameter)

●L10671D



●L13301-01



Power supply

●L10671P (for L10671)

Parameter	Description / Value	Unit
Input voltage (DC)	12 *	V
Power consumption Max.	10	VA
External control	S2D2 lamp ON/OFF	—
	CN4 output ON/OFF	—
	CN5 output ON/OFF ^(A)	—
	Status signal (S2D2 lamp) CN4 Main power	—

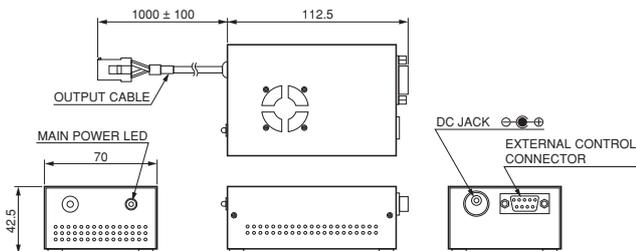
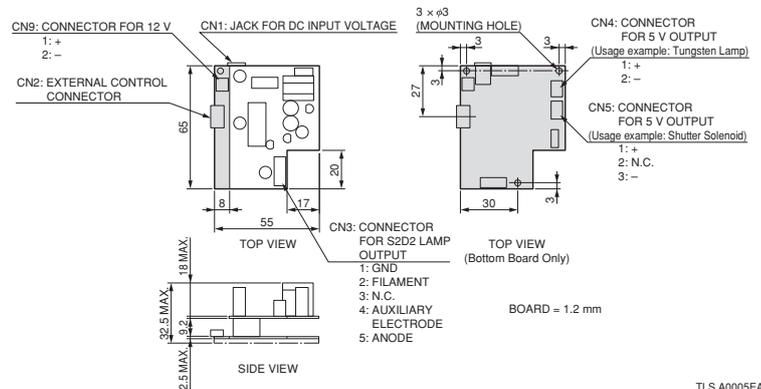
^(A) Each time a signal for external control is input across terminals 3 and 10, voltages +5 V and -5 V are alternately output at 200 ms intervals.

* Input voltage range is from 8.5 V dc to 13.2 V dc.

●C10707 (for L13301-01)

Parameter	Description / Value	Unit
Input voltage (DC) *	10.8 to 13.2	V
Power consumption Max.	17	VA
External control	Lamp ON/OFF	—
	Lamp status signal	—

* This power supply come with AC/DC adapter.



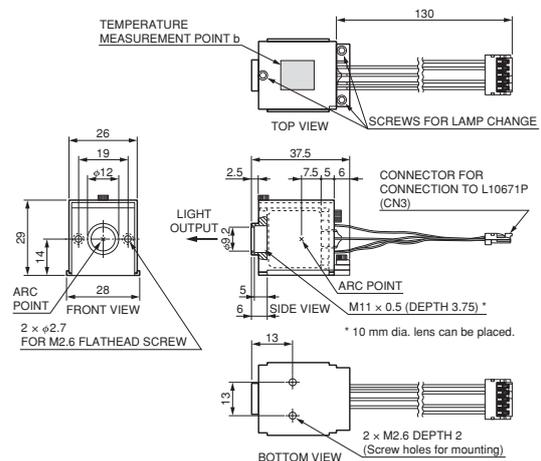
Lamp housing

●L10671H (for L10671D)

Parameter	Description / Value	Unit
Weight	320	g
Recommended operating temperature ^{(A)(B)}	+60 to +90	°C

^(A) At position "b" in the L10671H dimensional outline. (When this lamp housing is installed in equipment, thermal design specs must be considered to ensure the operating temperature will be within this range.)

^(B) Do not cool the lamp by direct air blow.



* Please consult us on the housing and vacuum flange for the L13301-01.

RELATED PRODUCTS

Vacuum UV light source unit L15094

The L15094 is a VUV light source unit that incorporates a high-performance deuterium lamp (H2D2 lamp). In addition to high stability and long life, the L15094 delivers high output. Its specially designed lamp housing allows air-cooled operation, significantly improving ease of use compared to water-cooled light sources. These features make the L15094 useful for various applications where high output of VUV light is required.



▲Left: Light source, Right: Power supply

Features

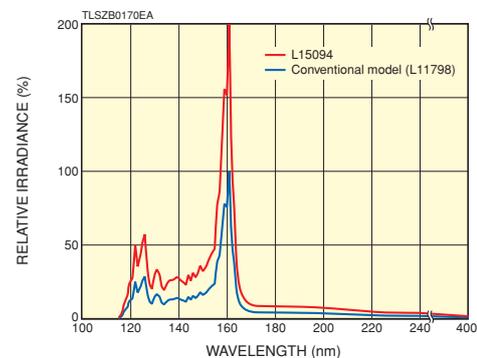
- High output: 2 times (compared to conventional model)
- High stability: Fluctuation 0.05 % p-p (Max.)
Drift ± 0.3 %/h (Max.)
- Long life: 1000 hours guaranteed
- Forced air cooling by fan (need no cooling water)
- External control

Applications

- Electrostatic charge removal
- Semiconductor inspection
- Film thickness measurement
- Photoionization
- Spectrophotometry
- Environmental measurement
- Material resistance evaluation

Characteristics

●Spectral distribution



Vacuum UV light source unit L10706

The L10706 is a vacuum UV light source unit that incorporates a compact deuterium lamp with an MgF₂ window. Equipped with a SUS flexible tube with a vacuum flange and a unique cooling mechanism, this light source unit allows irradiating objects or samples at a very close distance, and can be installed and operated under depressurized conditions. The compact lamp unit and SUS flexible tube offer greater flexibility in attaching the light source unit to various types of equipment.



▲Left: Light source, Right: Power supply

Features

- Enable proximity irradiation
- Compact
- Long life: 1000 hours guaranteed
- Forced air cooling by high-pressure air (need no cooling water)
- External control

Applications

- Electrostatic charge removal
- Photoionization
- Spectrophotometry
- Material resistance evaluation

Vacuum UV light source unit L12542

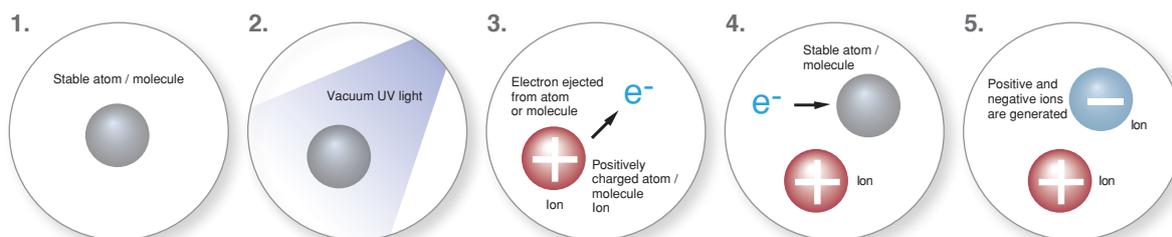
VUV Ionizers are electrostatic charge removers that use "photoionization" to apply vacuum UV light to remove static electricity. This innovative ionization method makes use of unique features of vacuum UV light to eliminate unwanted electrostatic charges in a vacuum (depressurized state) which has been impossible up to now. High-energy vacuum UV light at wavelengths shorter than 160 nm ensures highly efficient removal of electrostatic charges and in this way eliminates all types of static electricity problems that occur on production lines and a broad range of manufacturing processes.



▲Left: Light source, Right: Power supply

Principle of electrostatic charge removal: Photoionization mechanism

Irradiating vacuum UV light onto residual atoms and molecules in a vacuum (depressurized state) ejects the electrons from the atoms and molecules, leaving positively charged atoms and molecules (positive ions). These ejected electrons then combine with other residual atoms and molecules to produce negative ions. These electrons and ions are generated simultaneously over the entire space irradiated with vacuum UV light, and the electrons and ions generated near a target object are attracted to static electricity to remove electrostatic charges from the target object. Other electrons and ions generated during this process return to their original residual atoms and molecules.



Features

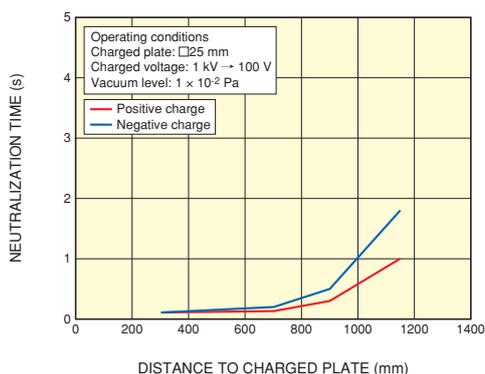
- High efficiency
- No overshoot
- No airflow
- No dust
- Long life
- Under low to high vacuum level

Applications

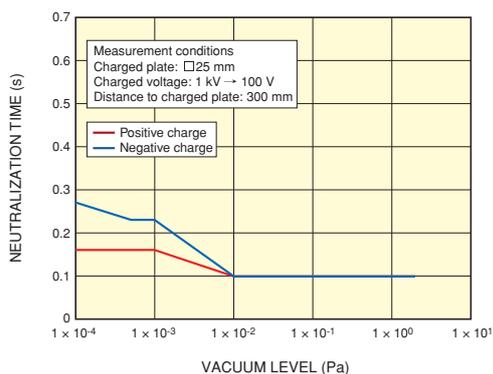
- Semiconductor manufacturing
- LCD panel and organic EL manufacturing
- Hard disk drive manufacturing
- Film manufacturing
- Electron beam application

Neutralization performance

●Neutralization time vs. distance



●Neutralization time vs. vacuum level



TECHNICAL INFORMATION

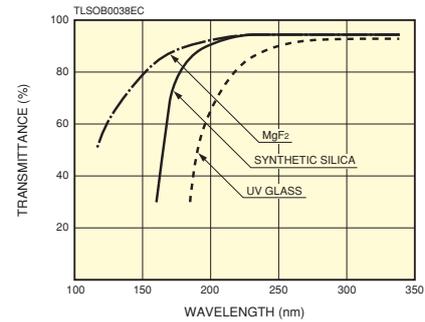
■Window material

The following three types of window material are available for deuterium lamps.

- ① UV glass ② Synthetic silica ③ MgF₂

UV light at wavelengths shorter than 190 nm attenuates greatly due to its absorption by oxygen. To obtain the fullest performance in window transmittance, it is recommended that light path of the equipment be filled with nitrogen or vacuum-evacuated to eliminate this absorption effect.

●Typical transmittance of various window materials



①UV glass

UV glass has a higher UV transmittance than normal optical glass (borosilicate glass). It has the cut off wavelength of 185 nm. So that there is little generation of ozone. Therefore, it is not necessary to have special anti-ozone treatments. Other features include a good transmittance that can be maintained over a long period of time.

②Synthetic silica

Synthetic silica is obtained by fusing a silica crystal that is artificially grown. Although its cut off wavelength is 160 nm, it contains less impurities than fused silica, and transmittance at 200 nm has been improved by approx. 50 %.

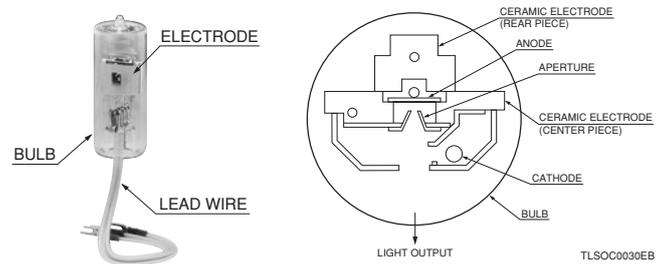
③MgF₂

MgF₂ is a crystallized form that has an excellent UV transmittance, a low deliquescence and is used as window material for vacuum UV applications. Its cut off wavelength is 115 nm.

■Construction

The anode is covered with ceramic to prevent abnormal discharge. The cathode is a highly durable electrode that ensures minimum wear over a long operating life. Since deuterium lamps utilize the positive column of arc discharge, the cathode is shifted sideways from the optical axis and an aperture is located in front of the anode to obtain high intensity. The aperture plate placed between the anode and cathode may be used as an auxiliary electrode for reliable lamp ignition.

●External view and electrode construction



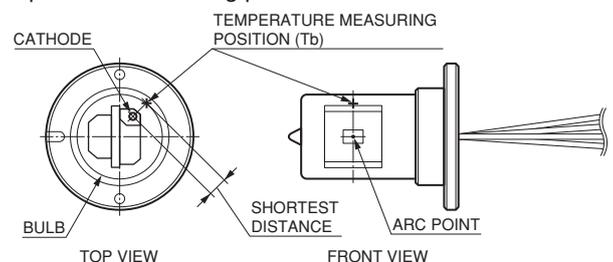
■Operating temperature

To obtain high stability and long operating life, adequate care must be paid to operating conditions including the lamp operating temperature. The bulb wall temperature (T_b) varies as the ambient temperature varies. The bulb wall temperature (T_b) also varies according to the lamp type, filament voltage, and the method of installing the lamp housing. Hamamatsu L2D2 lamps are designed to operate at an optimal lamp temperature when used at room temperatures. However, to maintain high stability over a long period of time, comply with the operating temperature range.

●Allowable operating temperature range for deuterium lamps

Bulb wall temperature: T _b	+245 °C to +290 °C
Maximum allowable bulb wall temperature: T _b	+300 °C Max.

●Temperature measuring position



If the lamp is used at a temperature exceeding the allowable operating temperature, the cathode temperature increases and results in evaporation of the cathode. If, on the other hand, the lamp is used at a temperature below the allowable operating temperature, the gas pressure inside the lamp bulb lowers and the kinetic energy of ions increases. This causes spattering of the cathode electron emitting materials. In both cases, the gas inside the bulb is rapidly consumed so that the lamp stability and radiant intensity drop, drastically shortening the operating life.

To ensure stable operation of the L2D2 lamps, care must also be taken with the lamp installation method. If using the lamps at a temperature outside the allowable operating range, please be sure to consult us.

Terminology

① Solarization

Transmittance through synthetic silica gradually decreases as it is used over a long period of time. This is caused by a drop in transparency of the glass resulting from contaminants adhering to the inner wall of the glass bulb and the effect of UV rays. The loss of transmittance of glass due to UV rays occurs more markedly in the shorter wavelength region. UV glass has significantly less deterioration than quartz.

Lamps with an MgF_2 emit strong UV light. If they are used in air, a thin film will be deposited on the window by CVD (chemical vapor deposition) that might reduce the transparency of the window. To avoid this problem, the lamps should be used in a vacuum or nitrogen atmosphere.

② Discharge starting voltage

When the cathode is sufficiently heated and ready for arc discharge, applying a pulse trigger across the anode and cathode will start discharge. This discharge starting voltage is typically 350 V (400 V at most) for 30 W lamps. However since the discharge starting voltage rises with the lamp operation time, applying a voltage of 500 V dc to 600 V dc is recommended for reliable trigger discharge each time.

The discharge starting voltage varies according to the trigger method and trigger constant.

③ Light output stability

● Drift

Drift refers to variations in light output over a long period of time that are caused by changes in thermal electron emission characteristics of the cathode, changes in gas pressure inside the bulb, and contaminants on the window. Drift is usually expressed in variation per hour. In the case of Hamamatsu L2D2 lamps, it takes at least 10 minutes to 15 minutes until the inside of the lamp reaches thermal equilibrium after discharge starts, so pre-heating for 20 minutes to 30 minutes is required.

● Fluctuation

Fluctuation refers to the peak-to-peak variation in light output over a short period of time. Hamamatsu L2D2 lamps deliver high stability with fluctuation down to 0.005 % (p-p).

Fluctuation greatly depends on changes in cathode electron emission capability that might be due to cathode deterioration and other factors. Hamamatsu L2D2 lamps maintain initial small fluctuations even near the end of the guaranteed lamp life.

④ Life

● Fluctuation in light output

Life end is defined as the point at which the fluctuation in light output exceeds 0.05 % (p-p).

● Drop in light output

Life end is defined as the point at which the total emitted energy drops to 50 % of the initial value.

Power supply

A deuterium lamp power supply usually includes the following three sections.

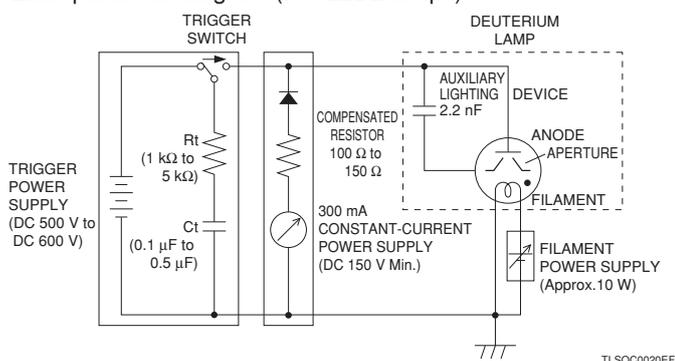
● Constant current power supply

● Trigger power supply

● Filament power supply

The aperture plate located between the anode and cathode can be used as an auxiliary electrode to make sure that discharge starts without fail.

● Example circuit diagram (For L2D2 lamps)



When using the above circuit to operate a deuterium lamp with a 0.5 mm aperture, setting the trigger resistance to 1 k Ω and the trigger capacitance to 0.5 μ F as the CR constant is recommended in order to ensure reliable lamp ignition.

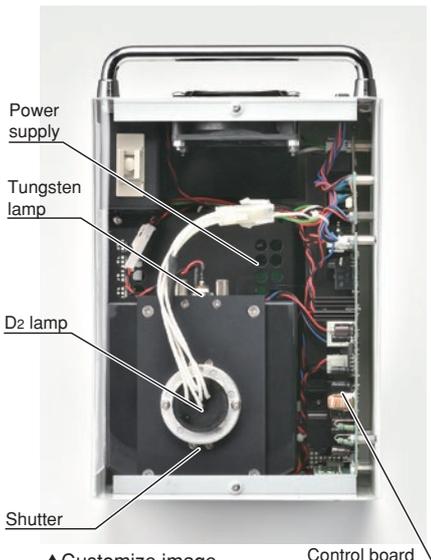
TECHNICAL INFORMATION

■ Customization

Hamamatsu can propose customized modules which meet your requests - application and other conditions of your concept - with best performance of our lamps.

The following are just examples of customization, so please contact us with the information of your request.

UV-VIS fiber light source high power type (X2D2 lamp)



▲Customize image

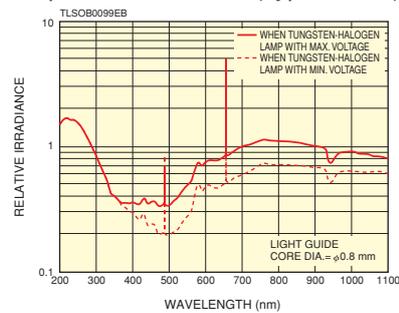
Reference dimension (W × H × D)
: 178 mm × 157 mm × 250 mm

Features

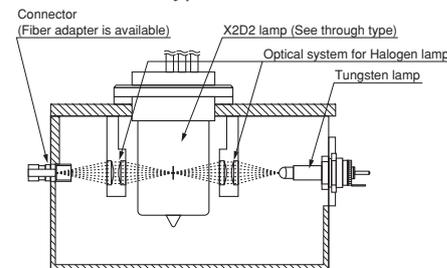
- Spectral distribution 200 nm to 1600 nm
- High power
- High stability: Fluctuation 0.004 % p-p (Typ.) (equivalent to 2×10^{-5} A.U.)
- Long life lamp: 2000 hours
- External control
- Shutter function
- Filter holder
- Fiber output

Characteristics

●Spectral distribution (Typical data)

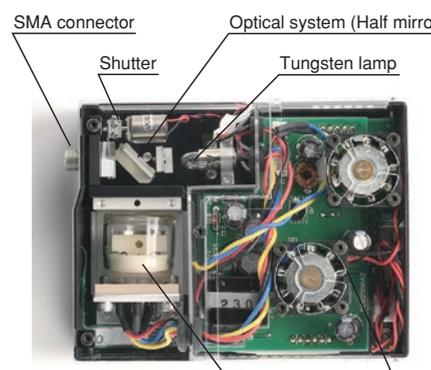


●UV-VIS fiber type module



* Power supply for lamp operation should be prepared.

UV-VIS fiber light source compact type (S2D2 lamp)



▲Customize image

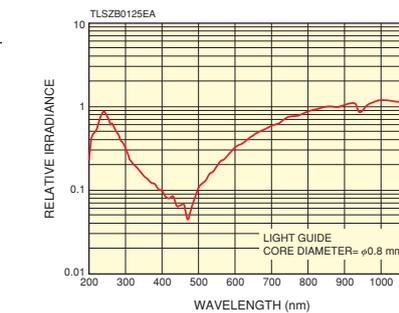
Reference dimension (W × H × D)
: 72 mm × 40 mm × 90 mm

Features

- Compact
- High stability: Fluctuation 0.004 % p-p (Typ.) (equivalent 2×10^{-5} A.U.)
- External control
- Shutter function
- Fiber output

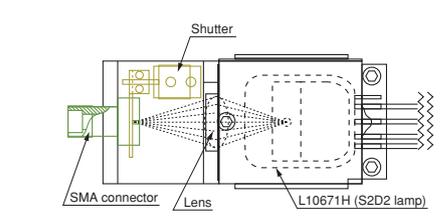
Characteristics

●Spectral distribution (Typical data)



Customize example

●UV fiber type module



* Power supply for lamp operation should be prepared.

■HANDLING PRECAUTION

1. Deuterium lamps emit UV rays which can be harmful to eyes and skin. Do not look directly at the emitted light or allow direct exposure to skin. Always wear protective glasses or goggles and clothing when operating the lamps. (Refer to JIS T 8141 or equivalent safety standards).
2. Since the bulb wall temperature reaches a high temperature (over 200 °C) during lamp operation, do not touch it with bare hands or bring inflammable objects near it.
3. Do not apply vibrations or mechanical shocks to the lamp. These might cause light output stability to deteriorate.
4. Graded sealing of synthetic silica and MgF₂ window:
On bulbs using synthetic silica or MgF₂ window, the window is formed by so-called "graded sealing" which connects different glasses with slightly different expansion rates. Since the mechanical strength of the seams of this graded sealing is low, use caution when securing the lamp so that no force is exerted on those seams during use.
5. Before turning on the lamp, wipe the bulb and window gently using alcohol or acetone. Do not handle the lamp with bare hands. Dirt or smears on the window will cause a significant drop in UV transmittance.
6. High voltage is used to operate these lamps. Use extreme caution to prevent electrical shock.
7. Be sure to avoid to store the lamp under high humidity and high temperature. Also, in case the lamp is not used for a long time, it with package in the place where shock or vibration is not applied.
8. Handling MgF₂ and synthetic quartz windows:
UV light generates ozone when it irradiates an atmosphere containing oxygen. The amount of the generated ozone is low and so does not affect the human body but does produce an ozone smell. So ventilate the room from time to time when using a lamp with an MgF₂ or synthetic quartz window in a closed room.
9. There might be a white substance that has fallen off inside the lamp bulb, but it is a part of the electrode components and basically has no effect on the characteristics. The electrodes wear out with use, and shedding may progress, but it can be used without problem.
However, this does not apply to cases where the product has been subjected to excessive shock or vibration, or when it has been handled in a way that we do not expect.

■WARRANTY

Lamps are warranted for a period of one year from the date of shipment. If a lamp is found to be defective within this warranty period, Hamamatsu will replace the defective lamp without charge. (This warranty is limited to replacement of the defective lamp.) Even if within the warranty period (one year), the warranty shall not apply to cases where the lamp operation time has exceeded the guaranteed life, or the trouble was caused by incorrect operation or natural or man-made disasters.

■DISPOSAL OF LAMPS

When disposing of the used lamp, take appropriate measures in compliance with applicable regulations regarding waste disposal and correctly dispose of it yourself, or entrust disposal to a licensed industrial waste disposal company. In any case, be sure to comply with the regulations in your country, state, region or province to ensure the used lamp is disposed of legally and correctly.

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OCT. 2021 IP