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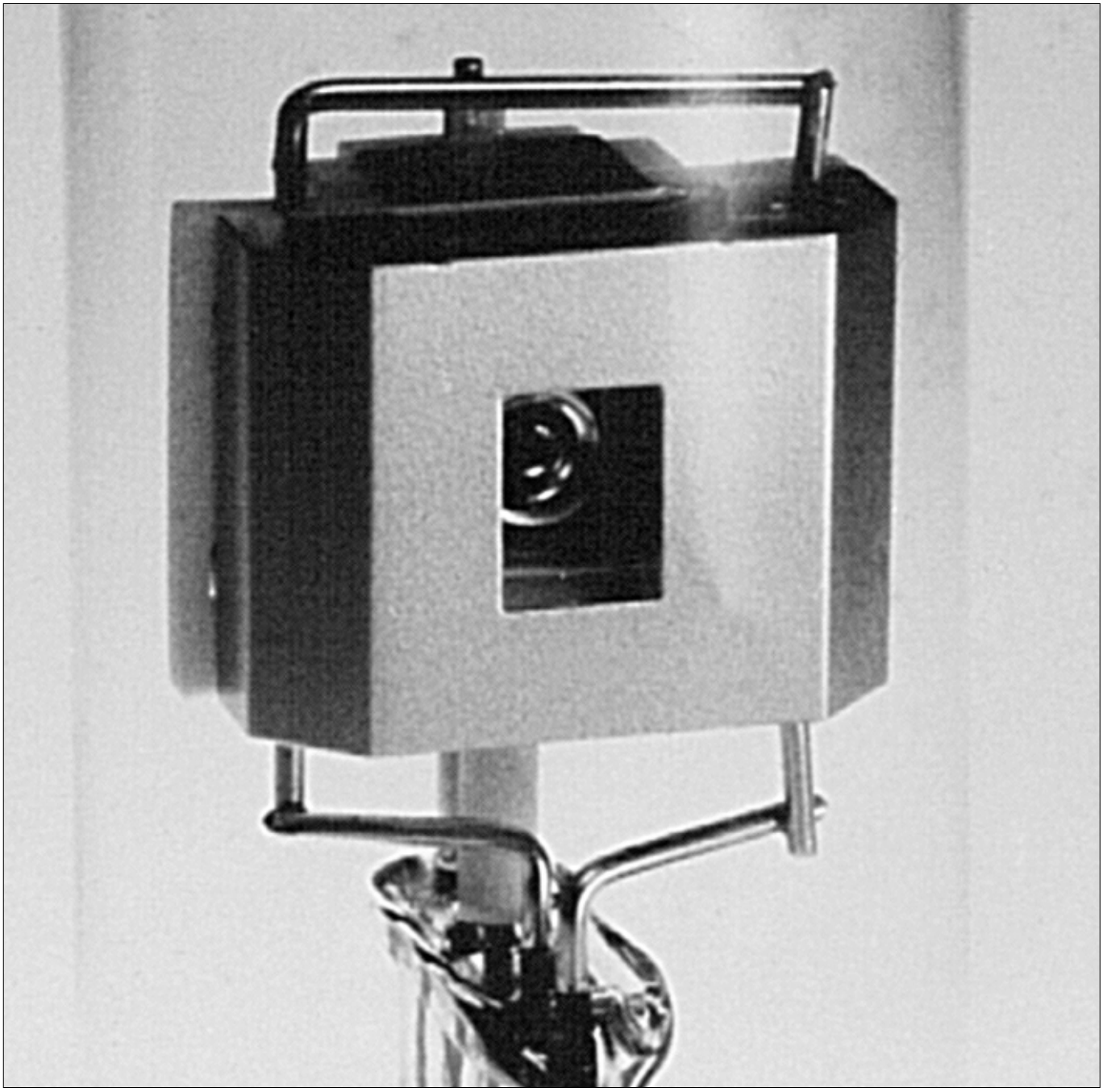
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PATENTS

L2D2 LAMPS

DEUTERIUM LAMPS

The best light source is supported by the best electrode technology.

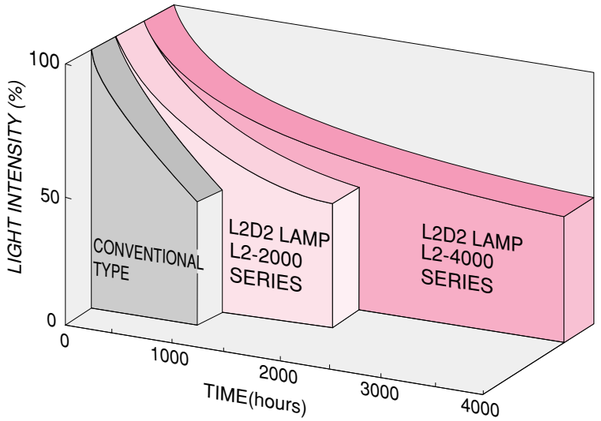


HAMAMATSU

LONG LIFE : 4000 HOURS

4 times longer guaranteed life

■ Life Characteristics



TLSOB0050EA

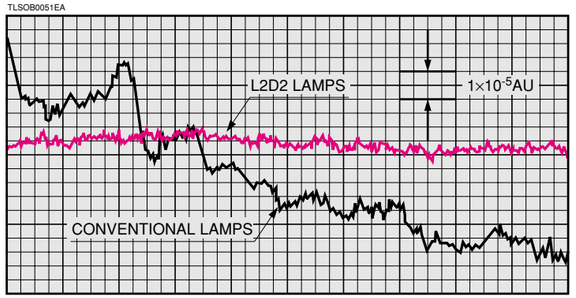
The L2-4000 series lamps assure an operating life of 4000 hours-4 times longer than conventional lamps. This is the longest operating life of any deuterium lamp.

HIGH STABILITY : 2 TIMES STABLE

Fluctuation: 0.05 %p-p, Drift: ±0.3 %/h

■ Light Output Stability

TLSOB0051EA



TIME (30 s/div.)

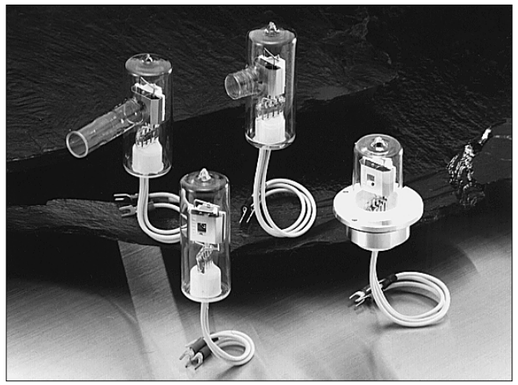
By using a newly developed ceramic structure, a uniform and optimum temperature distribution, which are the most important factor for stable operation, can be obtained. This results in fluctuations of only 0.05 %p-p in the light output, as well as a reduced drift of only ±0.3 %/h.

EXCELLENT TEMPERATURE CHARACTERISTICS

Use of a ceramic structure with excellent thermal stability ensures stable lamp operation even in the presence of ambient temperature variations.

Introducing the L2D2 lamps that open up a new generation of Deuterium lamps used in analytical instruments.
The Hamamatsu L2D2 lamps deliver high performance in all respects-operating life, stability and light output intensity.
You will find significant distinc tions from conventional lamps.

L2D2 LAMPS



TLSOF0138

APPLICATIONS

- UV-VIS Spectrophotometers
- CE(Capillary Electrophoresis)
- SOx/NOx Analyzers
- Film Thickness Measurement
- HPLC
- Atomic Absorption Spectrophotometers
- Thin Layer Chromatography

NOTE

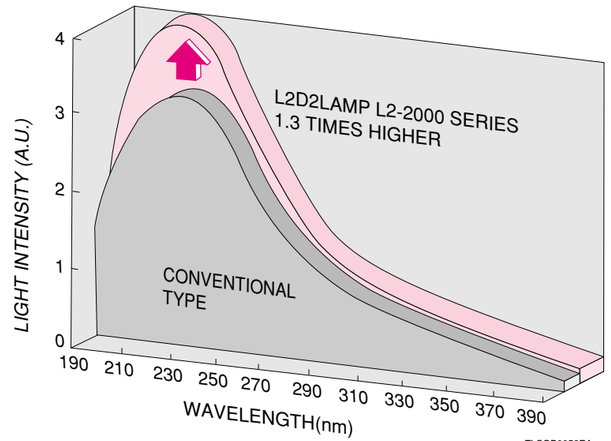
All of Hamamatsu deterium la mps will be L2D2 type in future. However, Hamamatsu agrees to provide conventional types before end of December,1998 upon your requests. Comparison table between L2 D2 type and conventional type is shown on page 3 and 4.

HIGH LIGHT OUTPUT : 1.3 TIMES HIGHER

1.1 times higher (L2-4000 series) (L2-2000 Series)

The L2-2000 series lamps produce 1.3 times higher light output than conventional lamps. The L2-4000 series lamps even offer light output 1.1 times higher than conventional lamps.

■ Radiant Output Intensity



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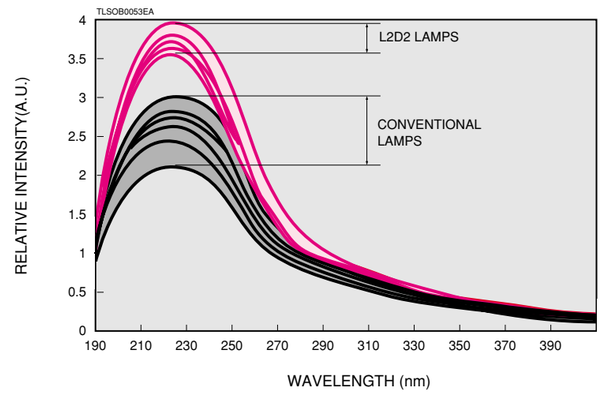
SMALL INTENSITY VARIATIONS : 1/2

Compared to our conventional lamps

The spacing between electrodes is kept fixed by a molded ceramic spacer. This reduces the lamp to lamp variations in the light output to one half of that obtained with our lamps having a conventional all metal structure.

■ Intensity Variation

TLSOB0053EA

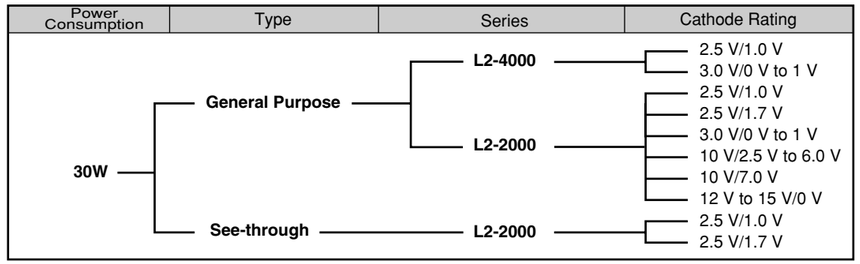


LESS MOVEMENT OF ARC EMISSION POINT

Since the ceramic structure has a small thermal expansion coefficient, there is virtually no movement of the arc emission point during operation.

SPECIFICATIONS FOR L2D2 LAMPS

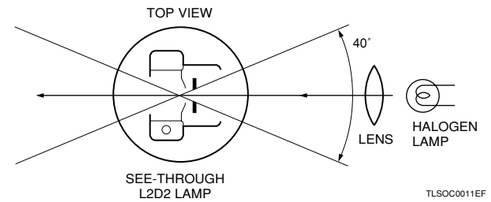
SELECTION GUIDE



SEE-THROUGH TYPE

The see-through type electrode structure enables straight-line arrangement of the halogen lamp, deuterium lamp, optical system and optical passage. 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



SPECIFICATIONS

GENERAL PURPOSE

Series	Type. No.	Dimensional outline	Window Material	Spectral Disiribution (nm)	Aperture Diameter Ⓐ (mm)	Required Discharge Starting Voltage Ⓑ Min. (V dc)	Anode Current (mA dc)	Tube Drop Voltage Typ. (V dc)
L2-4000	L6565	❶	UV glass	185 to 400	1.0	350	300±30	80
	L6566	❷			1.0	350		
L2-2000	L6301	❶	UV glass	185 to 400	0.5	400	300±30	80
	L6302	❶			1.0	350		
	L7298	❻	Synthetic silica	160 to 400	1.0	350		
	L6303	❹	UV glass	185 to 400	0.5	400		
	L6304	❹			1.0	350		
	L6305	❷	UV glass	185 to 400	0.5	400		
	L6306	❷			1.0	350		
	L6307	❸	UV glass	185 to 400	0.5	400		
	L6308	❸			1.0	350		
	L7296	❻	Synthetic silica	160 to 400	0.5	400		
	L7296-50	❽			0.5	400		
	L7295	❻			1.0	350		
	L6309	❸	UV glass	185 to 400	0.5	400		
	L6310	❸			1.0	350		
	L6311	❺	UV glass	185 to 400	0.5	400		85
	L6311-50	❾			0.5	400		
	L6312	❺			1.0	350		80
	L6312-50	❾			1.0	350		
	L7293	❼	MgF_2	115 to 400	1.0	350		
	L7292	❼			1.0	350		

Output Stability		Filament Ratings					Guaranteed Life Ⓓ	Conventional Lamps Ⓔ	Type. No.
Drift Max. (%/ h)	Fluctuation (p-p) Max. (%)	Warm-up			Operating				
		Voltage Ⓒ (V dc, ac)	Current Typ. (A dc, ac)	Time Min. (s)	Voltage (V dc)	Current Typ. (A dc)	(h)		
±0.3	0.05	2.5±0.25	4	20	1.0±0.1	1.8	4000	L613,L613-04	L6565
		3.0±0.3	5		0 to 1	0 to1.8		L3382-01	L6566
±0.3	0.05	2.5±0.25	4	20	1.0±0.1	1.8	2000	—	L6301
								L613,L613-04	L6302
					1.7±0.2	3.3		L1636	L7298
								—	L6303
								L1729	L6304
		3.0±0.3	5		0 to 1	0 to1.8		L3381-01	L6305
								L3382-01	L6306
		10±1	0.8		2.5 to 6.0 Ⓕ	0.3 to 0.6		—	L6307
								L591	L6308
		10±1	1.2		7.0±0.5	1		L2196	L7296
								—	L7296-50
								L1626	L7295
								L2541	L6309
								L2526	L6310
		12 to 15	0.5 to 0.55		Ⓖ 0	Ⓖ 0		L4505	L6311
								L4505-50	L6311-50
								L4510	L6312
								L4510-50	L6312-50
—	—	2.5±0.25	4		1.0±0.1	1.8	2000 Ⓗ	L879-01	L7293
		10±1	0.8		2.5 to 6.0 Ⓕ	0.3 to 0.6		L879	L7292

SEE-THROUGH TYPE

Series	Type. No.	Dimensional outline	Window Material	Spectral Disiribution (nm)	Aperture Diameter Ⓐ (mm)	Required Discharge Starting Voltage Ⓑ Min. (V dc)	Anode Current (mA dc)	Tube Drop Voltage Typ. (V dc)
L2-2000	L6999	❹	UV glass	185 to 400	0.5	400	300±30	80
	L6999-50	❿			0.5	400		
	L7307	❹			1.0	350		
	L7174	❿			1.0	350		
	L7306	❹			1.0	350		

Output Stability		Filament Ratings					Guaranteed Life Ⓓ	Conventional Lamps Ⓔ	Type. No.
Drift Max. (%/ h)	Fluctuation (p-p) Max. (%)	Warm-up			Operating				
		Voltage (V dc, ac)	Current Max. (A dc, ac)	Time Min. (s)	Voltage (V dc)	Current Max. (A dc)	(h)		
±0.3	0.05	2.5±0.25	4	20	1.0±0.1	1.8	2000	—	L6999
								—	L6999-50
								L1887	L7307
					1.7±0.2	3.3		—	L7174
								L1886	L7306

NOTE Ⓐ Lamps with an aperture of 0.5 mm diameter are high brightness types. These lamps provide 1.6 times higher brightness than standard lamps with an aperture of 1.0 mm diameter. (Refer to page 8.)
Ⓑ A trigger voltage higher than this value is required to start lamp discharge. For reliable lighting, an application of 500 V to 600 V is recommended. The maximum rated voltage that can be applied is 650 V.
Ⓒ The heater current during warming-up period is so high that the enough voltage may not be supplied to the lamp in case the cable between the lamp and the power supply is long because of voltage drop at the cable. The power supply for the heater should be designed so as to supply specified voltage at the lamp terminal.
Ⓓ The lamp life end is defined as the point when the light output falls to 50 % of its initial value or when output fluctuation (p-p) exceeds 0.05 %.
Ⓔ L2D2 lamp does not always have a direct replacement for conventional type from its dimensional outline point of view. Please refer to page 5 and 6. Please consult with our sales offices for further details.

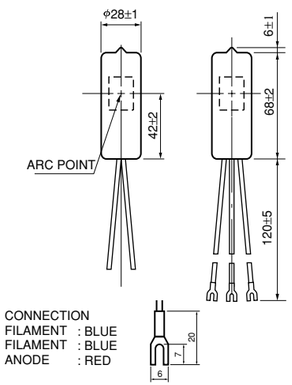
NOTE Ⓕ Recommended operating voltage is 3.5 V ± 0.5 V.
Ⓖ In these lamps, discharge current is allowed to flow into the filament during operation so that cathode temperature is maintained at an optimum level. So there is no need for input of external power to keep the filament heated.
Ⓗ Average operating life : Operating life depends on environmental conditions (vacuum atmosphere). It is recommended that these lamps be used in an oil-free environment.
*We recommend using Hamamatsu deuterium lamp power supplies in order to obtain the full performance from our lamps (Refer to page 7 and 9).

HAMAMATSU

DIMENSIONAL OUTLINES

(Unit : mm)

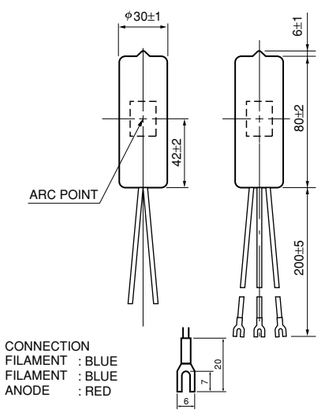
❶ L6301, L6302, L6565



CONNECTION
FILAMENT : BLUE
FILAMENT : BLUE
ANODE : RED

TLSOA0040EB

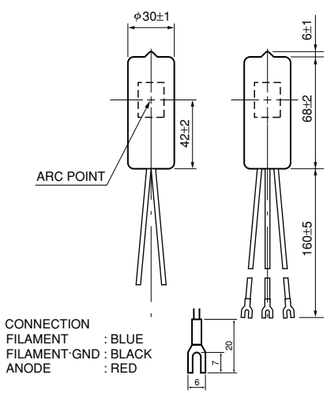
❷ L6305, L6306, L6566



CONNECTION
FILAMENT : BLUE
FILAMENT : BLUE
ANODE : RED

TLSOA0041EC

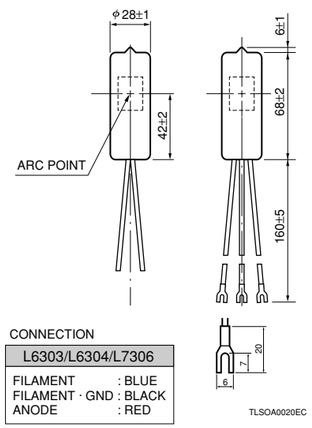
❸ L6307, L6308, L6309, L6310



CONNECTION
FILAMENT : BLUE
FILAMENT·GND : BLACK
ANODE : RED

TLSOA0018ED

❹ L6303, L6304, L6999 L7306, L7307



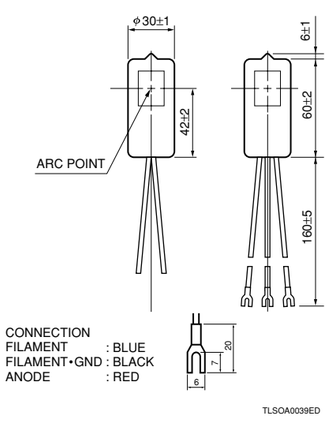
CONNECTION

L6303/L6304/L7306	
FILAMENT	: BLUE
FILAMENT · GND	: BLACK
ANODE	: RED

L6999/L7307	
FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED

TLSOA0020EC

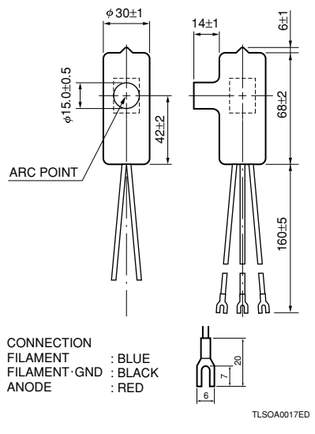
❺ L6311, L6312



CONNECTION
FILAMENT : BLUE
FILAMENT·GND : BLACK
ANODE : RED

TLSOA0039ED

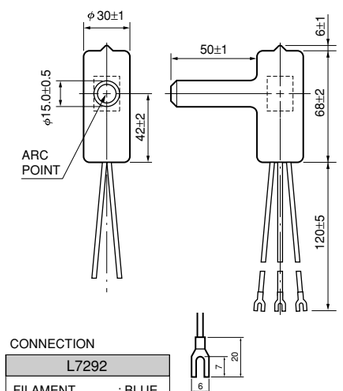
❻ L7295, L7296, L7298



CONNECTION
FILAMENT : BLUE
FILAMENT·GND : BLACK
ANODE : RED

TLSOA0017ED

❼ L7292, L7293



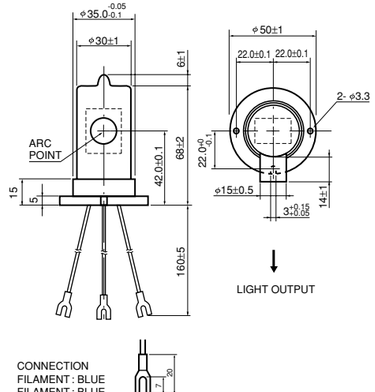
CONNECTION

L7292	
FILAMENT	: BLUE
FILAMENT·GND	: BLACK
ANODE	: RED

L7293	
FILAMENT	: BLUE
FILAMENT	: BLUE
ANODE	: RED

TLSOA0011EC

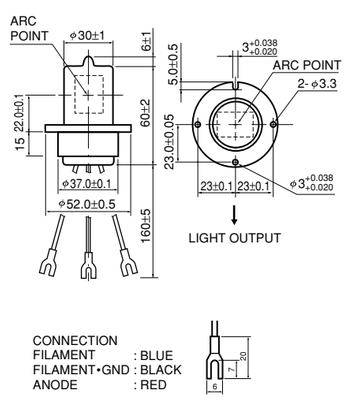
❽ L7296-50



CONNECTION
FILAMENT : BLUE
FILAMENT : BLUE
ANODE : RED

TLSOA0075EA

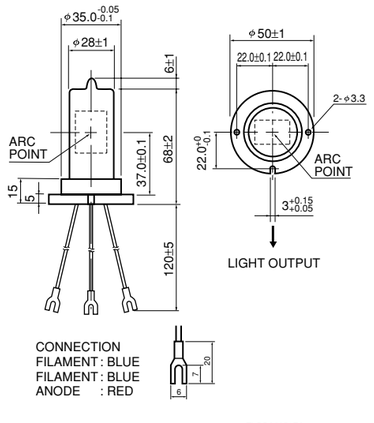
❾ L6311-50, L6312-50



CONNECTION
FILAMENT : BLUE
FILAMENT•GND : BLACK
ANODE : RED

TLSOA0050EA

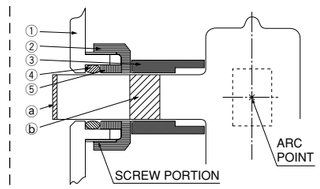
❿ L6999-50, L7174



CONNECTION
FILAMENT : BLUE
FILAMENT : BLUE
ANODE : RED

TLSOA0051EA

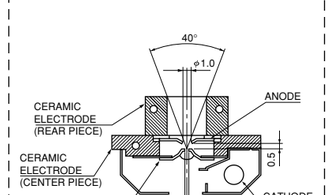
L7292, L7293 mounting example on the vacuum system



①VACUUM SIDE FLANGE
②TIGHTENING SXREW
③STORRER
④ORING (JIS B2401)
CALL No. V15
(15 mm I.D.
4 mm WIDTH)
⑤SPACER
ⓐMgF_2 WINDOW
ⓑGRADED SEAL

TLSOC0010EA

Cross section of see-through type



TLSOA0052EA

POWER SUPPLY

Extremely high stability of intensity is required for deuterium lamps because of their applications.
Therefore, use of a power supply designed to drive the lamps with stable operation is recommended.
Hamamatsu's power supply for deuterium lamps uses a constant-current circuit in the main power supply section and a constant-voltage circuit in the filament power supply section to assure a reliable operation.
Hamamatsu offers not only OEM power supplies specially designed for your applications, as well as the following types according to the operation mode of various lamps.

SPECIFICATIONS

Parameter				C1518	C7860	M7628	Unit
Control Methode				Dropper Type	Switching Type	Switching Type	—
Input		Input Voltage		(AC) 100/118/230 ±10 %	(AC) 90 to 115/180 to 250 (Automatic)	(DC) 24 ± 2.4	V
		Input Wattage		100	60	48	VA Max.
Output	Anode	Output Voltage	With Load	(DC) 80	(DC) 80	(DC) 80	V Typ.
			Without Load	(DC) 160	(DC) 160	(DC) 160	V Typ.
		Output Current		300	300	300	mA
		Trigger Voltage		600 ± 50	600 ± 50	600 ± 50	V peak
		Fluctuation (p-p)		0.1	0.5	0.5	% Max.
		Drift		±0.1	±0.1	±0.1	%/h Max.
	Heater	Output Voltage		See below	See below	See below	—
		Output Current		See below	See below	See below	—
		Warm-up Time		20	25	25	s Typ.
Ambient Temperature				0 to +40	0 to +40	0 to +40	°C
Cooling				Not required	Not required	20 CMF of forced air	—
Dimensions (W × H × D)				200 × 107 × 240	113 × 122 × 220	100 × 118 × 36.2	mm
Weight				6.7	2.7	0.17	kg
Certification				—	—	UL/CE	—

HEATER VOLTAGE AND CURRENT

Type No.	Warm-up		Operation		Applicable Lamps
	Voltage (V dc)	Current (A dc typ.)	Voltage (V dc)	Current (A dc typ.)	
C1518 (2.5 V)	2.5 ± 0.2	4	1.0 ± 0.1	1.8	L6565, L7293, L6999, L6999-50 L7307, L7174, L6301, L6302
C1518 (10 V)	10 ± 1	0.8	3.5 ± 0.5	0.3	L6307, L6308, L7292
C1518 (SQ2.5 V)	2.5 ± 0.2	4	1.7 ± 0.2	3.3	L7298, L6303, L6304, L7306
C1518 (SQ10 V)	10 ± 1	1.2	7.0 ± 0.5	1	L7296, L7295, L6309, L6310, L7296-50
C7860/M7628-2510	2.5 ± 0.15	4	1 ± 0.05	1.8	L6565, L7293, L6999, L6999-50 L7307, L7174, L6301, L6302
C7860/M7628-2517 Ⓐ	2.5 ± 0.15	4	1.7 ± 0.1	3.3	L7298, L6303, L6304, L7306
C7860/M7628-3000 Ⓐ	3 ± 0.15	5	0	0	L6566, L6305, L6306
C7860/M7628-1035 Ⓐ	10 ± 0.5	0.8	3.5 ± 0.2	0.3	L6307, L6308, L7292
C7860/M7628-1070	10 ± 0.5	1.2	7 ± 0.35	1	L7296, L7295, L6309, L6310, L7296-50
C7860/M7628-1555 Ⓐ	15 ± 0.75	0.5	5.5 ± 0.3	0.3	L6311, L6311-50, L6312, L6312-50

NOTE Ⓐ C7860 series are manufactured only when the order is placed.
* Characteristics are measured at 23±1 °C after 30 min of warming up.



TLSOF0068
C1518



TLSOF0150
C7860

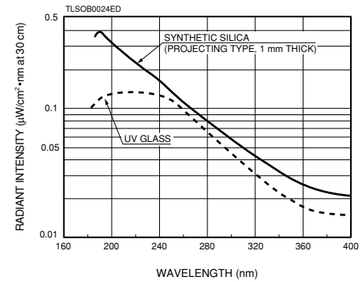

TLSOF0150
M7628

TECHNICAL INFORMATION

■ 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.

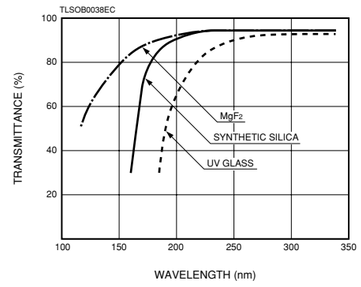
Figure 1: Spectral Distribution



■ Window Material

The following 4 types of window material are available for deuterium lamps.
(1) UV glass (2) Synthetic silica
(3) MgF_2
Figure 2 shows the transmittance of various window materials.
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 the inside of the equipment be filled with nitrogen or vacuum-evacuated to eliminate this absorption effect.

Figure 2: Typical Transmittance of Various Window Materials



●UV glass

UV glass has a higher ultraviolet transmittance than normal optical glass (borosilicate glass). It has the longest cut off wavelength of 185 nm among the four types. However the generation of ozone is lower than other window material types, it is not necessary to have special anti-ozone treatments.

●Synthetic 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 %.

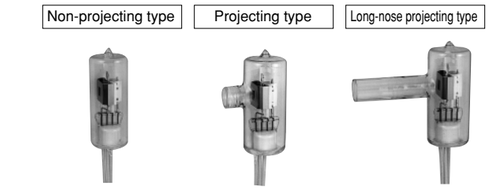
●MgF_2

MgF_2 is a crystallized form of alkali metal halide that has an excellent ultraviolet transmittance, a low deliquescence and is used as window material for vacuum ultraviolet applications. Its cut off wavelength is 115 nm.

■ Light Distribution

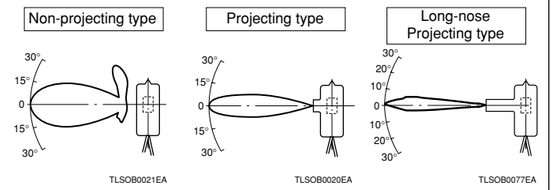
The non-projecting type uses the side of the cylindrical glass bulb as the emission window, whilst the projecting type uses a plane glass attached to a projection on the bulb.
The projecting type has a uniformed transmittance due to the plane glass. Since the window is located far from the discharge position, the amount of dirt produced by spattering from the electrodes is reduced resulting in low deterioration of light output. The non-projecting type requires less space and has a wider directivity since there is no projection, enabling effective use of emitted light. The long-nose projecting type uses an MgF_2 window and is suitable for vacuum ultraviolet applications. This type is used with the tip of the nose inserted into the vacuum equipment.

Figure 3: External View



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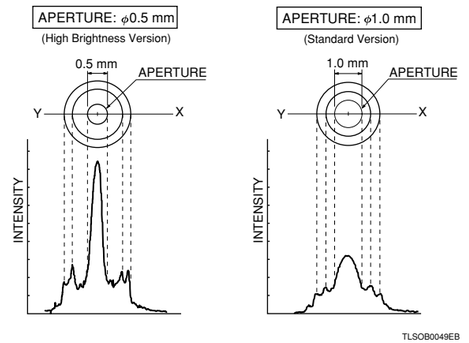
Figure 4: Directivity (Light Distribution)



■ Arc Distribution

Arc intensity is determined by the aperture (light exit) size. Figure 5 shows typical spectral distributions for lamps with different aperture sizes. At the same input current and voltage, lamps with an aperture of 0.5 mm diameter (high brightness type) provide 1.6 times higher brightness than lamps with an aperture of 1.0 mm diameter (standard type). The half width of spectral distribution also becomes narrower with a reduced aperture size. When higher intensity is required or the object to be irradiated is very small, the high brightness type is recommended.

Figure 5: Arc Distribution

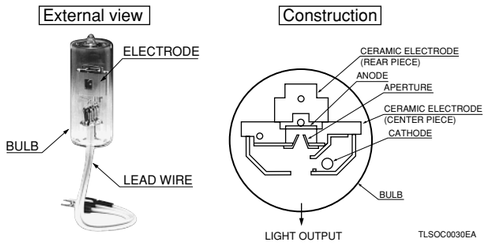


TECHNICAL INFORMATION

■ Construction

Figure 6 shows the external view and internal construction of a deuterium lamp. The anode has a unique structure covered with ceramic to prevent abnormal discharge, and the cathode has a highly durable electrode. Since a deuterium lamp uses the positive column flash of arc discharge, the cathode is shifted sideways and an aperture is located immediately in front of the anode so that high intensity is obtained. The aperture plate placed between anode and cathode may be used as an auxiliary electrode for lamps designed for low voltage lighting.

Figure 6: External View and Electrode Construction



■ Terminology

①Solarization

Transmittance of UV glass and fused silica drops when they are used over a long period. This is caused by a drop in transparency of the glass resulting from dirt on the glass and the influences of ultraviolet rays. In the worst case, the glass becomes cloudy and its life is shortened. This is called solarization, and transmittance drops, particularly in short wavelength region. This phenomenon is hardly ever seen with synthetic silica.

②Discharge starting voltage

When the cathode is sufficiently heated and ready for arc discharge, a pulse trigger voltage is applied between anode and cathode, and discharge starts. The discharge starting voltage of 30 W deuterium lamps is approx. 350 V (400 V max.). However, since the discharge starting voltage rises according to the prolongation of operation time, it is recommended that a voltage of approx. 500 V be applied to assure discharge. (The maximum applied voltage for trigger is 650 V.) The discharge starting voltage varies depending on the trigger method and trigger constant.

③Output stability

(1) Drift

Drift refers to variation of output over a long period caused as a result of the change in thermoelectron discharge characteristic of the cathode, change in gas pressure or dirt on the window. It is expressed in variation per hour. In the case of deuterium lamps, it takes 10 to 15 minutes until the inside of the lamp reaches thermal equilibrium after start of discharge, so a warm-up period of 20 to 30 minutes is required.

(2) Fluctuation

Fluctuation refers to variation of output caused by deterioration of the cathode or fluctuation of discharge position. Light output fluctuates approx. 0.05 % at intervals between a few minutes and a few hours. In addition, the position of the arc point also fluctuates.

④Life

(1)Fluctuation of light output

Life is determined by the point at which fluctuation combining fluctuation and shift exceeds 0.05 %p-p.

(2)Drop of light output

Life is determined by the point at which the total emitted energy drops to 50 % of the initial level. As described earlier, decrease in light output is caused mainly by solarization and dirt inside the window. The life specified is 2000 hours for L2-2000 series, and 4000 hours for L2-4000 series.

■ Discharging the L2D2 Lamps

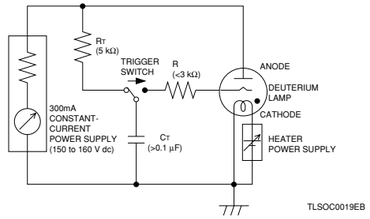
In deuterium lamps, an aperture electrode is placed between cathode and anode to compress the discharge, so that high light intensity is obtained. This required, a high voltage trigger discharge across cathode and anode.
In general, a typical power supply for deuterium lamps consists of the following three power supplies.

- Constant current power supply of 300 mA (open voltage about 150 V)
- Trigger power supply of 500 to 600 V peak
- Power supply for the heater (about 10 W)

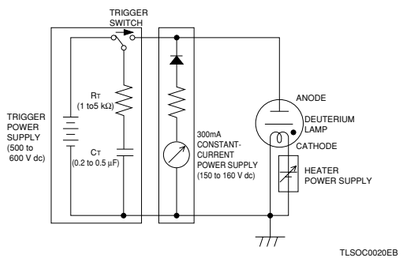
However, in view of the need for cost reduction, safety and downsizing, lamp manufactures are evaluating methods that eliminate the trigger power supply. One of these is the use of an auxiliary electrode. In this approach, the electrical energy from a constant current power supply of 150 V/300 mA (main power supply) is stored in a trigger capacitor and then is discharged between lamp shield box and cathode. This generates ions and momentarily reduces the impedance between anode and cathode, leading to the main discharge. However, because this trigger discharge occurs only at a restricted point near the cathode, it is a less reliable triggering method.
In the L2D2 lamp, ceramic insulators are used as part of the electrode support, so that the aperture potential is isolated from the shield box potential. Since this aperture electrode is used as an auxiliary electrode, the trigger discharge can be guided to the aperture, allowing operation at a voltage 40 to 50 V lower than that of a conventional lamp. This also results in higher reliability of the triggering operation. Thus, the greatest advantage of the auxiliary electrode is that no trigger power supply is necessary. The circuit shown on the below, resulting both a cost reduction and downsizing of the power supply.

Figure 7: Example Circuit Diagram

●Auxiliary electrode operation



●Conventional circuit



When the L2D2 lamp series with an aperture size of 0.5 mm diameter will be operated by the circuit as shown above, it is recommended to employ CR constant as R_T=1 kΩ and C_T=0.5 μF to obtain the reliable lamp ignition.

OPERATING TEMPERATURE

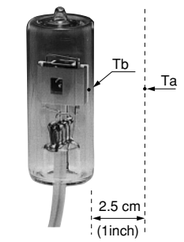
Optimum Operating Temperature

To obtain high stability and long operating life, adequate care must be paid to operating conditions including the operating temperature of the lamp.
Although the lamp's bulb wall temperature (Tb) rises as the ambient temperature (Ta) rises, the bulb wall temperature of conventional deuterium lamps normally rises to approx. +200 °C (direct-heated cathode type) to 240 °C (SQ cathode type) when the ambient temperature is +25 °C. Moreover, the bulb wall temperature of the L2D2 lamps rises even further by +50 °C reaching +280 °C due to the way in which the electrode is constructed. (Bulb wall temperature (Tb) also differs depending on the lamp type and heater voltage as well as lamp housing.) Although the operating temperature of Hamamatsu L2D2 lamps has been designed based on lamps operated under normal temperature, the temperature range given in the table below is recommended as the allowable operating temperature range enabling the use of the lamps over a long period of time with high stability.

Table1: Allowable Operating Temperature Range for Deuterium Lamps

Lamp Type	L2D2 Lamp
Cathode Type	All Cathode type
Ambient temperature: Ta	+10 °C to +50 °C (+20 °C to +30 °C)*
Bulb wall temperature: Tb	+245 °C to +280 °C
Maximum allowable bulb wall temperature: Tb Max.	+290 °C Max.

*Temperature enclosed by ( ) indicates the optimum ambient temperature.



Ta: Temperature measured at a position 2.5 cm (1 inch) away from the bulb wall

Tb: Temperature on the bulb wall (cathode side)

As the ambient temperature (Ta) rises, cathode temperature increases, resulting in evaporation of the cathode. If the ambient temperature (Ta) drops, the gas pressure inside the bulb is reduced increasing the kinetic energy of the gas and ions causing sputtering of the cathodes thermionic coating. In both cases, the gas inside the bulb is rapidly consumed. This deteriorates the stability and intensity. Thereby drastically shortening the operating life.
For stable operation of deuterium lamps, care should be paid to the installation of the lamps so that the bulb wall temperature (Tb) does not exceed +290 °C.

PRECAUTION AND WARRANTY

Precautions When Using Deuterium Lamps

1. Deuterium lamps emit ultraviolet rays which can be harmful to your eyes and skin. Never look directly at the emitted lights, nor should you allow it to come into contact with your skin. Always wear protective goggles and clothing when operating the lamps.
2. Since the bulb wall reaches a very high temperature (over +200 °C) when the lamp is on, do not touch it with bare hands or bring flammable objects near it.
3. Do not exert mechanical vibration or shock on the lamp, otherwise the stability will deteriorate.
4. Silica glass graded sealing.
   In the case of bulbs using silica glass, the window is formed by connecting different glass sections having slightly different expansion rates. Since the mechanical strength of these seams is low, the bulb fixing method should be so arranged that no force is exerted on these seams during fixing or operation.
5. Before turning on the lamp, wipe the bulb and window gently with alcohol or acetone. Dirt on the window will cause deterioration of the UV transmission, so always wear gloves when handling the lamp.
6. High voltage is used to operate the lamp. Use extreme caution to prevent electric shocks.

Warranty

The warranty period will be one year after our shipment to original purchaser or guaranteed life time whichever comes first. The warranty is limited to replacement of the faulty lamp. Faults resulting from natural disasters and incorrect usage will also be excluded from warranty.

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