HAMAMATSU

TECHNICAL DATA SHEET

DEUTERIUM LAMPS

UV LIGHT SOURCES FOR SPECTROSCOPY

Deuterium lamps are discharge lamps which use an arc discharge in deuterium gas at a pressure of several Torr. The resulting emitted light is in the region shorter than 400 nm in wavelength. Deuterium lamps are widely used in spectrophotometers as light sources emitting a continuous ultraviolet spectrum. Because of such applications, output variations in the order of 0.01% or even 0.001% become significant, placing quite severe conditions on operation to achieve the requied characteristics.

With their high intensity and stability, Hamamatsu deuterium lamps have become the choice for a wide range of analytical equipment, and depth of product line ensures that a deuterium lamp with the proper characteristics for your application will be available as a standard product.

APPLICATIONS

- **Spectrophotometers**
- **Fluorospectrophotometers**
- **Chromatographs**
- **Colorimeters**
- **Pollution analyzers**
- **Ultraviolet standard light source**
- **Excitation light source**
- **Background correction for AA analysis (Pulse-driven type)**

Deuterium Lamp Selection Guide

Power Consumption	Cathode Structure	Lighting Mode	Filament (Heater) Ratings	Lamp Type No.
30W	Super Quiet Indirectly-Heated	1 DC	10V	L1626, L1627, L1728
			2.5V	L1636, L1637, L1729
	Directly-Heated	2 DC	10V	L544, L1128, L591, L879
			2.5V	L625, L1403, L613, L879-01
		3 Pulse	10V	L544-20, L1128-20, L591-20
			2.5V	L625-20, L1403-20, L613-20
150W (Water-Cooled)	Indirectly-Heated	4 DC	10V	L1314, L1835

1. Super Quiet, Indirectly-Heated Lamps (DC Drive)

This type of lamp is characterized by a long operating life (1000 to 1500 hours), without instability caused by cathode fatigue. Rated heater voltages of 10V and 2.5V are available, as well as windows of synthetic silica, fused silica, and UV-transmitting glass. Both projecting and non-projecting window types are available.

2. Directly-Heated Lamps (DC Drive)

This type of Hamamatsu deuterium lamp is a widely used type. Fused silica, UV-transmitting and MgF_2 windows are available as well as three shapes, including a long-nose type, and two rated filament voltages.

3. Pulse-Driven, Directly-Heated Lamps

This type is chiefly used for background compensation in atomic absorption spectrophotometers, and represents a modification of the DC-type directly-heated lamp. Fused silica and UV-transmitting windows are available, as well as two types each of shapes and filament voltages.

4. Water-Cooled, High Intensity (150W) Lamps

This type of lamp provides approximately three to four times the intensity of standard 30W types, and is chiefly used as an excitation light source. This type lamp is housed in a special metal case allowing cooling-water to flow through it. The only type available is an indirectly-heated 10V filament voltage type with either a fused silica or MgF_2 window.

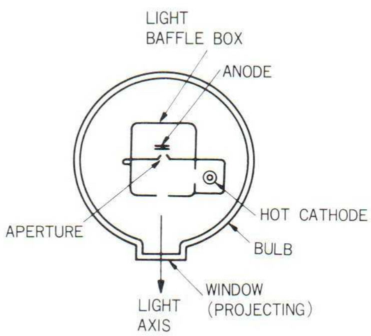
Construction and Basic Characteristics

CONSTRUCTION

Figure 1 below illustrates the internal electrode construction of the deuterium lamp as viewed from the top. Both the cathode and anode are enclosed in a metallic baffle box. Because the deuterium lamp uses the positive column light emitted from an arc discharge, the cathode is shifted to the side and an aperture is located directly in front of the anode to enable the emitted light to be output with high efficiency.

For pulse drive, the light baffle box itself may be used as an electrode, whereas for DC drive, it is kept floating.

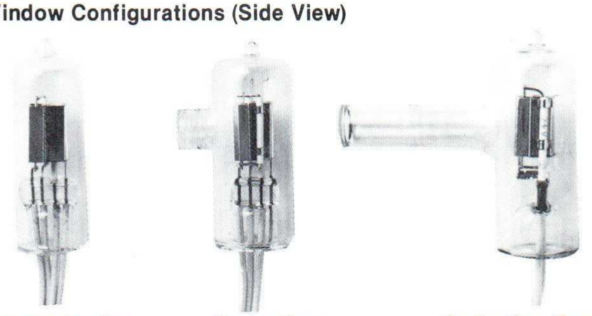
FIGURE 1
Electrode Construction of 30W Lamp (Top View)



WINDOW CONFIGURATIONS

A non-projecting type of window which uses the side of the cylindrical glass bulb as the window itself and a projecting-type of window which protrudes from the bulb side to form a flat glass window are used, as shown in Figure 2.

FIGURE 2
Window Configurations (Side View)

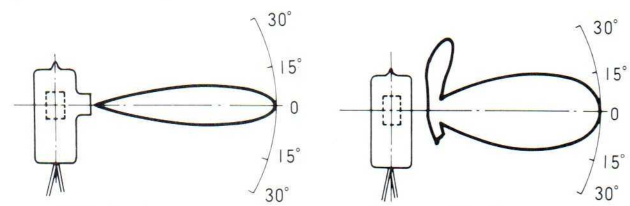


Non-projecting Type **Projecting Type** **Projecting Type (Long-nose)**

Because the projecting-type of window uses a flat glass surface, its transmittance is high and, since it is spatially removed from the discharge, it has the advantage of not being subjected to evaporated material from the discharge. In contrast to this, the non-projecting type does not have any troublesome projections and results in an improved space factor with a wide directionality pattern, resulting in easy adjustment of light axis.

The long-nose type of projecting window uses MgF_2 for the window material and is used for vacuum UV applications, with the nose end positioned within a vacuum device.

FIGURE 3
Spatial Intensity Distribution



Projecting type **Non-projecting type**

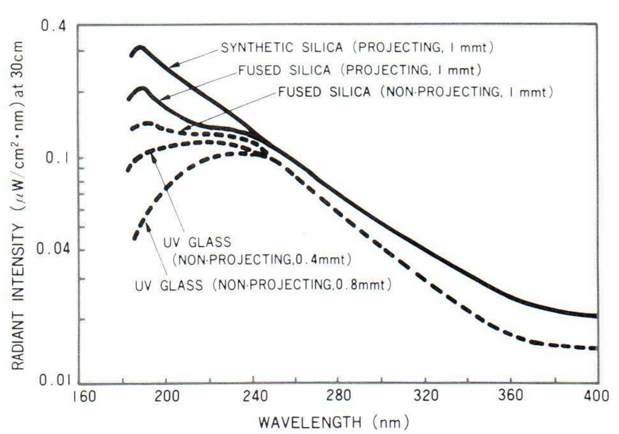
WINDOW MATERIALS

The following four types of window materials (glass) are used in deuterium lamps.

1) UV-transmitting glass (UV glass)
2) Fused silica
3) Synthetic silica
4) MgF_2 crystal

Figure 4 illustrates the spectral distributions of deuterium lamps using these various types of window materials. The difference in wavelengths longer than 280 nm can be attributed to differences in window configuration (flat or cylindrical) and differences in the region shorter than 240 nm are attributable to differences in window transmittance. (The measured curves were obtained in a normal atmosphere.)

FIGURE 4
Spectral Distributions of Deuterium Lamps



1) UV-transmitting glass (UV glass)
Of the above-listed four types of window materials, the limiting short wavelength of glass is the longest, being 185 nm. However, because of oxygen absorption, wavelengths below 187 nm are attenuated, so that for operation in normal atmospheres, this wavelength is the effective limiting wavelength. Two thicknesses (0.4 mm and 0.8 mm) of glass are provided, with the thinner variety having a higher transmittance (40 % higher at 200 nm).

2) Fused Silica
This glass is produced by crushing natural quartz and fusing it, and is used for both projecting and non-projecting type windows. The short wavelength limit is extended to 160 nm when used in a vacuum. The transmittance at 200 nm is approximately 20 % improved over that of UV glass of 0.4 mm thick. In order to make full use of the characteristics of this type of glass, however, it is necessary to eliminate the effects of oxygen absorption. For this reason, in far ultraviolet spectroscopy this lamp is used in spectrophotometers which are filled with nitrogen. Using this technique, the limiting wavelength can be extended to 170 nm

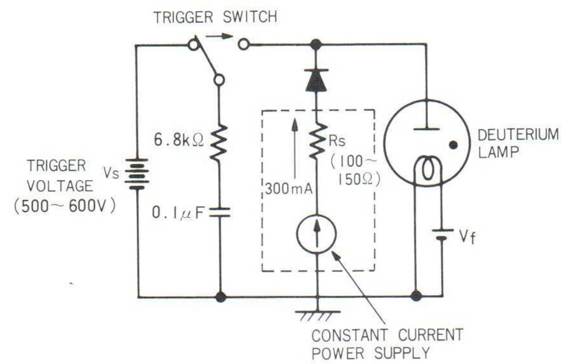
3) Synthetic Silica
This type of glass is fabricated by fusing synthetically grown quartz. The limiting wavelength is 160 nm and, compared with fused silica, levels of impurities are lower, resulting in a 50 % or greater improvement in transmittance at 200 nm. Because, at present, only flat-surfaced synthetic silica is available, it is only usable in projected-type window configurations.

4) MgF_2 Crystal
Crystals of alkali halide such as sodium chloride (NaCl), lithium fluoride (LiF), and magnesium fluoride (MgF_2) have excellent transmittance in the ultraviolet region, they present problems since they are subject to deliquescence. Of these materials, MgF_2 is least susceptible to this problem and is practical as a window material with extended short wavelength limits to 115 nm. The MgF_2 is sealed at the long-nose bulb with a special adhesive.

SOLARIZATION
UV glass and fused silica exhibit a drop in transmittance when used for long periods, caused by a loss of transparency of the glass itself due to the effect of UV radiation on glass crystals. In extreme cases, the glass may actually exhibit a white clouding. This phenomenon, known as solarization, results in significant loss of transmittance particularly in the short wavelength region. It is, however, virtually non-existent in synthetic silica.

POWER SUPPLY CIRCUITS
For use as a spectrophotometer light source, stable output is essential, thus making use of a current-regulated power supply as shown in Figure 5 required. This power supply has three major sections, the trigger power supply, main power supply and filament (heater) power supply. Hamamatsu deuterium lamp power supplies are shown on page 10.

FIGURE 5
Recommended Power Supply Circuit



CATHODE
To ensure reliable, stable arc discharge, deuterium lamps make use of a hot cathode, with this cathode being pre-heated with a power of approximately 10W for 10 to 60 seconds before discharge is started. Two filament voltages, 2.5V and 10V, are available to pre-heat the cathode.

After discharge begins, the cathode is heated by the discharge itself, and the power is reduced to 1 to 2W in directly-heated lamps and to 5 to 7W in indirectly-heated lamps.

DISCHARGE STARTING VOLTAGE
When the cathode has been sufficiently heated and the lamp is ready for arc discharge, a pulse trigger voltage is applied across the cathode and anode, thus starting the discharge. Although 30W deuterium lamps will start discharge at approximately 300V, to ensure stable triggering, a trigger voltage level of 500 to 600V is recommended. In no cases should the trigger voltage exceed the maximum allowable voltage of 650V.

OUTPUT STABILITY
The output stability of deuterium lamps can be represented by cause into the following two types.

1) Drift
Long-term output variations caused by the contamination and solarization of the window

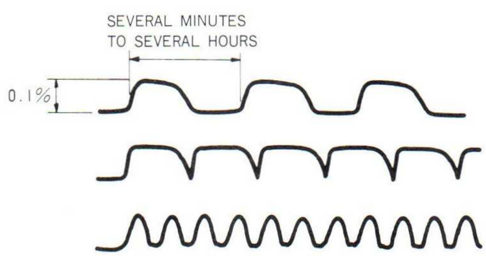
manifest themselves as drift. Since it takes from 10 to 15 minutes for internal thermal equilibrium to be reached in a deuterium lamp, a warm-up period of from 20 to 30 minutes is recommended before use.

2) Fluctuation

This term is formerly called noise in our brochure and further categorized to two phenomena.

- **Wavering:** This type of radiant intensity variation is caused by variations in lamp temperature caused by such effects as power supply variations and air current.
- **Shift:** Caused by changes in the position of the discharge due to cathode fatigue, this form of output variation is particularly prevalent in directly-heated lamps. Shifting occurs with a period of from several minutes to several hours, with a change in radiant intensity of approximately 0.1%. This type of variation is characterized by a simultaneous shift in position of the arc point. In contrast to drift or wavering variations of intensity which can be eliminated by using such techniques as the double-beam method, this becomes difficult with respect to shift-caused variations, so that shift is one of the determining factors of the life of a deuterium lamp.

FIGURE 6
Examples of Output Fluctuation (Shift)



LIFE

There are two major determining factors that limit deuterium lamp operating life.

1) Drop in Radiant Intensity

Hamamatsu deuterium lamps are considered to have reached the end of their useful life when their total radiant energy reaches 50% of the initial level. Since Super Quiet, indirectly-heated lamps exhibit virtually no radiant intensity fluctuations, their life is determined by this standard. For synthetic silica (projecting type) the minimum life is 1500 hours, while for fused silica (non-projecting type) it is 1000 hours.

2) Fluctuations in Radiant Intensity

Since the above-described wavering and shift effects are difficult to measure separately, Hamamatsu sets the life of a deuterium lamp at the point which the total of these two effects (fluctuations) exceeds 0.1% p-p for directly-heated lamps (0.05% p-p for SQ lamps).

Since such fluctuations are quite prevalent in directly-heated lamps and since they tend to appear before the 50% radiant intensity point is reached, the life of such lamps (500 hours) is mainly determined by these fluctuations.

For types L879, L879-01, and L1835 which use MgF_2 windows, the lamp life is determined by the life of the window material, and has been set at 300 hours.

PULSE DRIVE

For background compensation in atomic absorption spectrophotometers, the use of pulse-driven discharge is advantageous from an operational standpoint. This is done by applying a pulsed voltage to the anode. As the frequency increases, however, the S/N ratio is worsened. To ensure stable pulsed discharge, therefore, design consideration is required with regard to the bulb gas pressure and electrode construction.

The Hamamatsu deuterium lamp product line includes six types intended for pulse drive. As shown in Figure 7 below, these types use the light baffle box itself as an auxiliary electrode. By doing this, it is possible to lower the discharge triggering voltage to below 150V and trigger discharge with as low as 160 to 180V applied to the anode. Since, with pulse drive, the effective power is small, the operating filament voltage is not lowered as much as it would be for continuous-drive operation.

The pulse-driven lamps can also be operated in DC bias discharge mode as shown in Figure 8. This mode involves the continuous application of a DC component current (approx. 50 mAdc) in addition to the pulse current. The lamp's yellow lead should not be used in this mode.

FIGURE 7
Pulse Drive Circuit Using Auxilliary Electrode

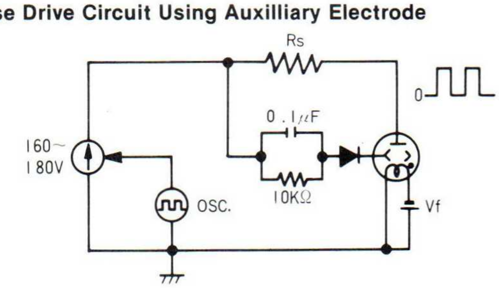
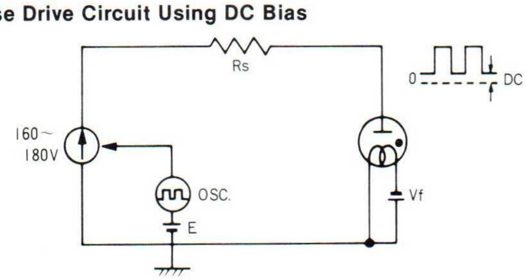


FIGURE 8
Pulse Drive Circuit Using DC Bias

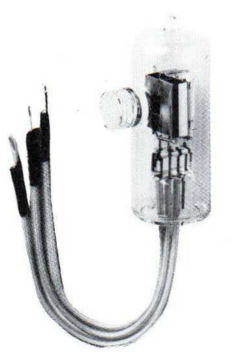


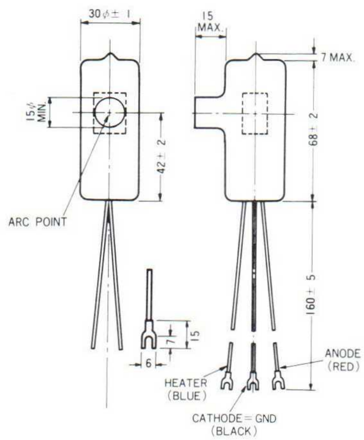
Super Quiet, Indirectly-Heated Lamps (30W)

Type No.	Outline	Window Material (E)	Spectral Distribution	Required Discharge Starting Voltage Min. (A)	Anode Current	Tube Drop Voltage	Stability (B)		Heater Ratings					Life Min. (C)
							Drift Max.	Fluctuation Max.	Warm-up			Operating		
									Voltage	Current	Time	Voltage	Current	
			(nm)	(Vdc)	(mAdc)	(Vdc)	(%/h)	(%p-p)	(Vdc,ac)	(Adc,ac)	(sec.)	(Vdc)	(Adc)	(h)
L1626	1	Synthetic silica	160～400	350	300 ± 30	80	± 0.5	0.05	10	1.2	20	7.0 ± 0.5	1	1500
L1627	2	Fused silica	160～400	350	300 ± 30	80	± 0.5	0.05	10	1.2	20	7.0 ± 0.5	1	1000
L1728	3	UV glass (0.4 mmt)	185～400	350	300 ± 30	80	± 0.5	0.05	10	1.2	20	7.0 ± 0.5	1	1000
L1636	1	Synthetic silica	160～400	350	300 ± 30	80	± 0.5	0.05	2.5	4	20	1.7 ± 0.2	3.3	1500
L1637	2	Fused silica	160～400	350	300 ± 30	80	± 0.5	0.05	2.5	4	20	1.7 ± 0.2	3.3	1000
L1729	3	UV glass (0.4 mmt)	185～400	350	300 ± 30	80	± 0.5	0.05	2.5	4	20	1.7 ± 0.2	3.3	1000

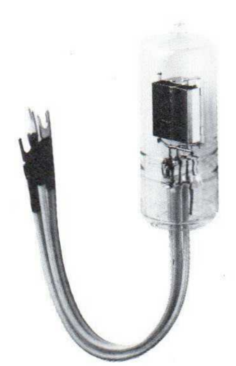
Unit: mm

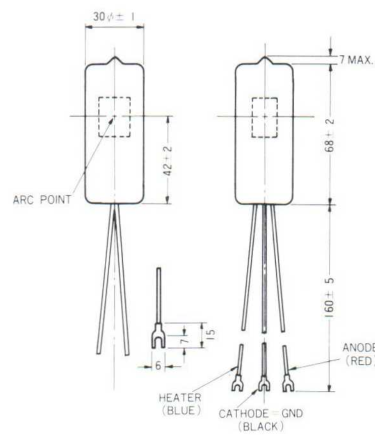
1 L1626, L1636



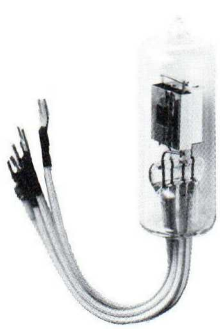


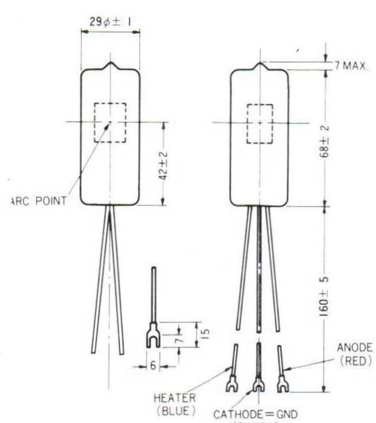
2 L1627, L1637





3 L1728, L1729





(A) A starting voltage of more than 350V is required to trigger discharge without fail. It is recommended that to provide a safety margin the power supply should be designed to deliver a voltage in the range 500 to 600V.

(B) Measured with a current-regulated power supply (Hamamatsu C1518) after 15 minute warm-up.

(C) The life end is defined when the ultraviolet region radiant intensity falls to 50% of its initial value or when stability exceeds values listed in the above table.

* Average life.

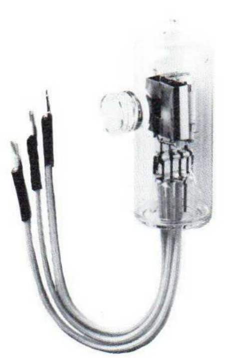
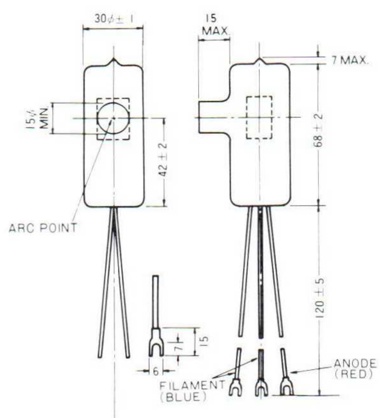
(E) Synthetic silica is better in UV transmittance below 240 nm than fused silica. (See page 3.)

Directly-Heated Lamps (30W)

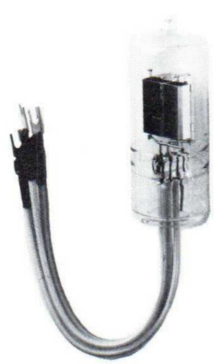
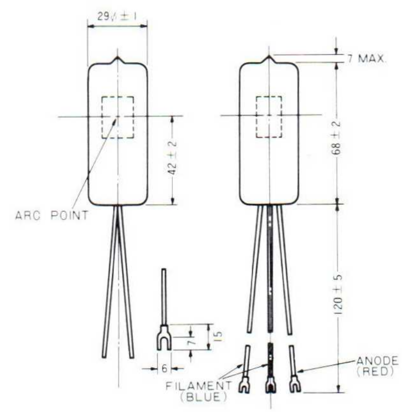
Type No.	Outline	Window Material	Spectral Distribution (nm)	Ⓐ Required Discharge Starting Voltage Min. (Vdc)	Anode Current (mAdc)	Tube Drop Voltage (Vdc)	Stability Ⓑ Drift Max. (%/h)	Stability Ⓑ Fluctuation Max. (%p-p)	Filament Ratings Warm-up Voltage (Vdc,ac)	Filament Ratings Warm-up Current (Adc,ac)	Filament Ratings Warm-up Time (sec.)	Filament Ratings Operating Voltage (Vdc)	Filament Ratings Operating Current (Adc)	Ⓒ Life Min. (h)
L544	1	Fused silica	160〜400	350	300 ± 30	80	± 0.5	0.1	10 ± 1	0.8	10〜60	3.5 ± 0.5	0.3	500
L1128	2	Fused silica	160〜400	350	300 ± 30	80	± 0.5	0.1	10 ± 1	0.8	10〜60	3.5 ± 0.5	0.3	500
L591	3	UV glass (0.8 mm t)	185〜400	350	300 ± 30	80	± 0.5	0.1	10 ± 1	0.8	10〜60	3.5 ± 0.5	0.3	500
L879	4	MgF_2	115〜400	350	300 ± 30	80	± 0.5	0.1	10 ± 1	0.8	10〜60	3.5 ± 0.5	0.3	300*
L625	1	Fused silica	160〜400	350	300 ± 30	80	± 0.5	0.1	2.5 ± 0.25	4	10〜60	1.0 ± 0.1	1.8	500
L1403	2	Fused silica	160〜400	350	300 ± 30	80	± 0.5	0.1	2.5 ± 0.25	4	10〜60	1.0 ± 0.1	1.8	500
L613	3	UV glass (0.8 mm t)	185〜400	350	300 ± 30	80	± 0.5	0.1	2.5 ± 0.25	4	10〜60	1.0 ± 0.1	1.8	500
L879-01	4	MgF_2	115〜400	350	300 ± 30	80	± 0.5	0.1	2.5 ± 0.25	4	10〜60	1.0 ± 0.1	1.8	300*

Unit: mm

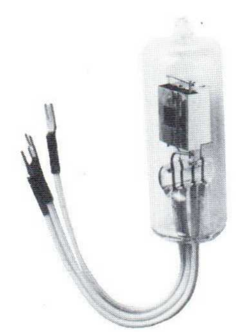
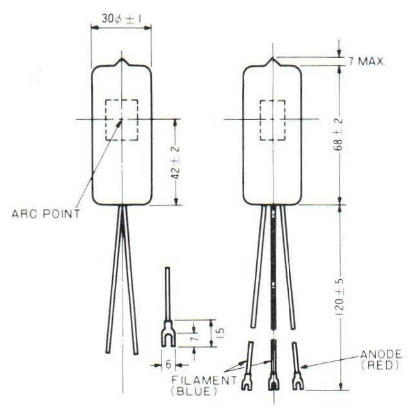
1 L544, L625

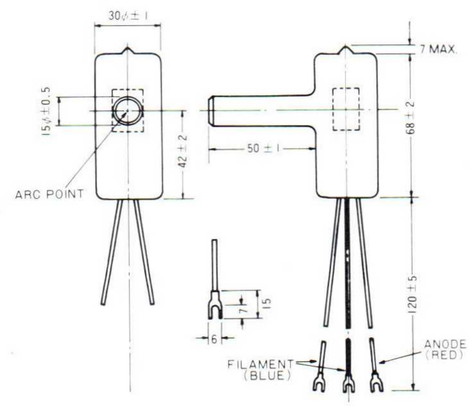
2 L1128, L1403

3 L591, L613

4 L879, L879-01

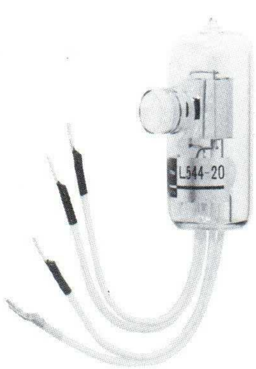



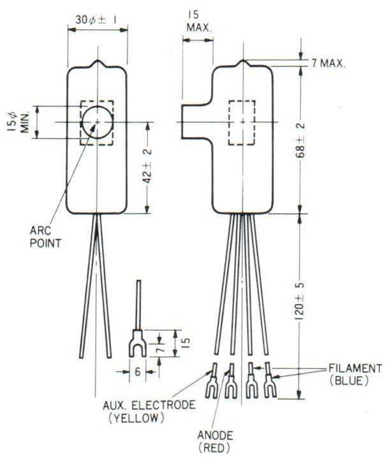
Pulse-Driven, Directly-Heated Lamps (30W)

Type No.	Outline	Window Material	Spectral Distribution (nm)	Ⓐ Required Discharge Starting Voltage Min. (Vdc)	Anode Current (mAp)	Tube Drop Voltage (Vdc)	Modulation Frequency (Hz)	Duty Ratio	Filament Ratings: Warm-up Voltage (Vdc,ac)	Warm-up Current (Adc,ac)	Warm-up Time (sec.)	Operating Voltage (Vdc)	Operating Current (Adc)	Ⓑ Life Min. (h)
L544-20	1	Fused silica	160～400	350	100～400	80	50～500	1:2～1:3	10 ± 1	0.8	10～60	8	0.5	500
L1128-20	2	Fused silica	160～400	350	100～400	80	50～500	1:2～1:3	10 ± 1	0.8	10～60	8	0.5	500
L591-20	3	UV glass (0.8 mm t)	185～400	350	100～400	80	50～500	1:2～1:3	10 ± 1	0.8	10～60	8	0.5	500
L625-20	1	Fused silica	160～400	350	100～400	80	50～500	1:2～1:3	2.5 ± 0.25	4	10～60	2.3	3.5	500
L1403-20	2	Fused silica	160～400	350	100～400	80	50～500	1:2～1:3	2.5 ± 0.25	4	10～60	2.3	3.5	500
L613-20	3	UV glass (0.8 mm t)	185～400	350	100～400	80	50～500	1:2～1:3	2.5 ± 0.25	4	10～60	2.3	3.5	500

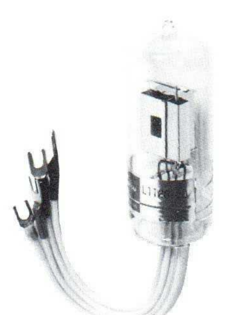
Unit: mm

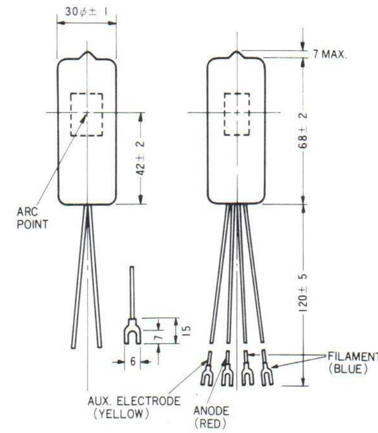
1 L544-20, L625-20



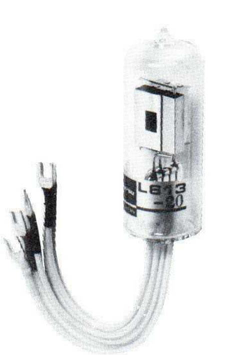


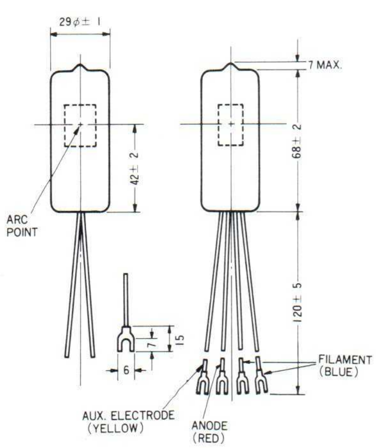
2 L1128-20, L1403-20





3 L591-20, L613-20





Ⓐ A starting voltage of more than 350V is required to trigger discharge without fail. It is recommended that to provide a safety margin the power supply should be designed to deliver a voltage in the range 500 to 600V. For pulse drive lamps, the starting voltage may be lowered according to the circuit (See page 5).

Ⓑ The life end is defined when the ultraviolet region radiant intensity falls to 50% of its initial value.

Water-Cooled, High Intensity Lamps (150W)

Type No.	Out-line	Window Material	Spectral Distri-bution	Required Discharge Starting Voltage Min.	Anode Current	Tube Drop Voltage	Water Flow Rate	Weight	Stability Ⓐ		Heater Ratings					Ⓑ
									Drift Max.	Fluctu-ation Max.	Warm-up			Operating		Life Min.
											Voltage	Current	Time	Voltage	Current	
			(nm)	(Vdc)	(Adc)	(Vdc)	(ℓ/min)	(g)	(%/h)	(%p-p)	(Vdc,ac)	(Adc,ac)	(sec.)	(Vdc)	(Adc)	(h)
L1314	1	Fused silica	160~400	500	1.2	120	1.5	600	± 1.0	0.5	10	1.2	20	5	1	300
L1835	2	MgF_2	115~400	500	1.2	120	1.5	950	± 1.0	0.5	10	1.2	20	5	1	300*

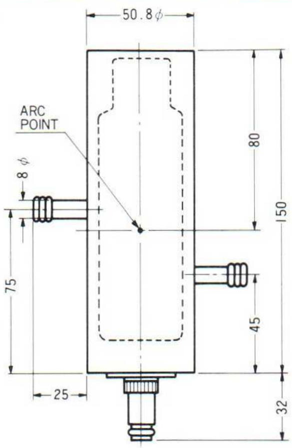
Ⓐ Measured with a current-regulated power supply (Hamamatsu C1316) after 15 minute warm-up.

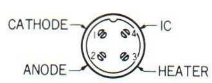
Ⓑ The life end is defined when the ultraviolet region radiant intensity falls to 50% of its initial value or when stability exceeds values listed in the above table.

* Average life.

Unit: mm

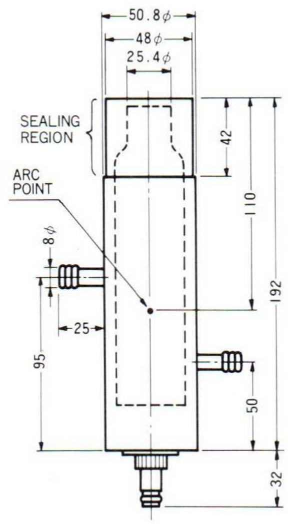
1 L1314



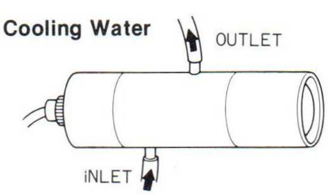


Pin Connection

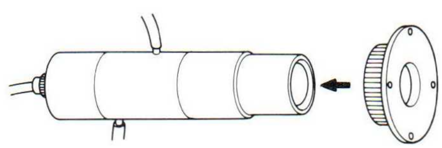
2 L1835



Flow of Cooling Water



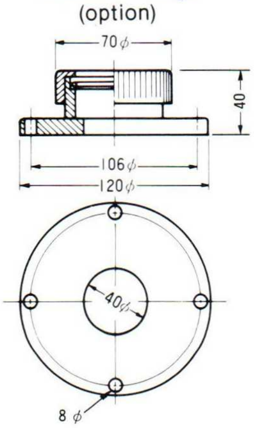
Types L1314 and L1835 cannot be operated without cooling water passing through them. Care should be taken that the lamp is positioned so that the two nozzles are aligned vertically, with the water flowing into the jacket at the bottom nozzle and leaving the jacket at the top nozzle. If this arrangement is not observed, there is a danger of damaging the lamp due to overheating.



Since the L1835 is often used inside a vacuum chamber, a special vacuum flange is provided. It is designed to be simply inserted over the lamp housing.

The pin connection of L1835 is identical with that of L1314.

Vacuum Flange
(option)



Deuterium Lamp Power Supplies

Because of the applications in which deuterium lamps are used, they require a power supply with extremely good regulation. To provide such a regulated power source, it is recommended that Hamamatsu deuterium lamps be used with one of the power supplies designed especially for these lamps.

The Hamamatsu deuterium lamp power supplies use a current-regulating circuit in the main output circuit and a voltage-regulating circuit in the filament supply output, thus ensuring stable, reliable lamp operation.

30 Watt Lamp Power Supply C1518

The C1518 power supply provides four switchable voltage outputs: 10V and 2.5V outputs for directly-heated lamps and outputs for 10V and 2.5V Super Quiet type lamps. It can be used with all types of Hamamatsu deuterium lamps with the exception of pulse-driven types. The C1518 uses an auto-starting technique to provide stable, reliable discharge without subjecting the lamp to undue stress. This starting method automatically turns the trigger voltage on approximately 20 seconds after the supply is turned on, and simultaneously switches the filament (heater) voltage to the proper operating voltage.

- **Highly stable regulation circuit**
- **Provides regulated filament (heater) voltage**
- **Auto-starting function**
- **Four filament voltages are available**

SPECIFICATIONS

Anode Circuit	
Output current	300 mAdc
Output voltage	80 ± 20 Vdc (in lamp operating) 160 Vdc (with no load)
Output trigger voltage	600 ± 50 Vp
Line regulation	± 0.05% Max. (for 10% change)
Load regulation	± 0.05% Max. (for 80 ± 20 Vdc)
Ripple	0.1% p-p
Drift (after 30 minutes warm-up)	± 0.1%/h Max.
Overload protection	0.5 A fuse
Filament (Heater) Circuit	
Output voltage for warm-up	10 ± Vdc or 2.5 ± 0.2 Vdc
Warm-up time	approx. 20 sec.
Output voltage for operation	
(for directly-heated lamps)	3.5 ± 0.5 Vdc or 1.0 ± 0.1 Vdc
(for SQ lamps)	7.0 ± 0.5 Vdc or 1.7 ± 0.2 Vdc
Line regulation	± 0.1% Max. (for 10% change)
Overload protection	
(10V side)	2A slow blow fuse
(2.5V side)	5A fuse
Line input	AC100/118/230V ± 10% 50/60Hz, 90VA
Operating temperature	0 to 40°C
Performance guaranteed temperature	5 to 35°C
Dimensions	200W x 107H x 240D mm
Weight	approx. 6.7 kg

150 Watt Lamp Power Supply C1316

The C1316 power supply is designed for use with water-cooled 200W lamps. Since loss of cooling water supply would result in certain damage to the lamp, the C1316 is provided with a water pressure operated relay as a safety feature. When the water pressure drops, the power supply is automatically shut down.

- **Built-in water pressure operated relay**
- **Highly stable regulation circuit**
- **Provides regulated filament (heater) voltage**
- **Wide current adjustment range (0.5 to 1.5A)**

SPECIFICATIONS

Anode Circuit	
Output current	0.5 to 1.5 Adc variable
Output voltage	70 to 170 Vdc (in lamp operating) 250 Vdc (with no load)
Output trigger voltage	700 Vp
Line regulation	
(at 1A output)	± 0.1% Max. (for 10% change)
Load regulation	
(at 1A output)	± 0.1% Max. (for 100 ± 20 Vdc)
Ripple (at 1A output)	0.1% p-p
Drift (at 1A output)	± 0.1%/h Max.
Overload protection	1.5 A fuse
Filament (Heater) Circuit	
Output voltage	2 to 10 Vdc adjustable
Output current	5 Adc Max.
Line regulation	± 0.5% Max. (for 10% change)
Overload protection	5A fuse and electronic circuitry
Line input	AC100/118/230V ± 10% 50/60Hz, 460VA Max.
Dimensions	303W x 194H x 410D mm
Weight	approx. 21.3 kg

Precautions for Use

1. Since the ultraviolet light output of the lamp is of high intensity, care should be taken not to observe the output directly, but to use only protective eyeglasses when working with deuterium lamps.
2. Care must be taken not to contact the bulb with the bare hands, as its temperature reaches over 200°C during the lamp is operating.
3. Do not subject the lamp to mechanical vibration or shock.
4. Before using the lamp, its window should be wiped with a liquid such as alcohol or acetone, as dirt on the window significantly reduces UV transmittance.
5. Since deuterium lamps use high operating voltages, extreme care is required to prevent electrical shocks.

Warranty

The period of the Hamamatsu deuterium lamp warranty is one year. The warranty is limited to replacement of the lamp. The warranty shall not apply, even within this one year period, in cases where the operating life of the lamp in hours has been exceeded, or in cases where trouble or failures has been encountered as a result of natural calamity, accident, or misuse.

HAMAMATSU

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