ELECTRONIC TUBE REFERENCE

1176

Rectifier - Half Wave electronic tube

CONSOLIDATED TECHNICAL DATA
1 SECTION
CONSTRUCTION
RECTIFIER

Directly heated Philips mercury-vapour or gas-filled industrial rectifier for heavy battery-charging installations up to about 110 lead-acid cells. Rated for approximately 850 V peak inverse voltage and 15 A output.

General characteristics

BASE DESIGNATION	SPECIAL	**BASE PINS**	–
NOMINAL HEATER	1.9 V / 28 A	**PARALLEL HEATER**	– / –
HEATING	Direct	**SERIES OPERATION**	Not specified
CATHODE ARRANGEMENT	Separate cathodes	**SECTION CONSTRUCTION**	Similar

Section ratings

SECTION1 Rectifier

PEAK INVERSE VOLTAGE	850 V
NOMINAL OUTPUT CURRENT	15 A
PEAK FORWARD CURRENT	75 A
FORWARD VOLTAGE DROP	12 V
WARM-UP TIME	120 s

Directly heated gas-filled rectifier with mercury-vapour/gas filling for industrial rectifier service up to 110 lead-acid cells.

1176 — Single-Anode Mercury-Vapour and Gas-Filled Rectifying Valve

The **1176** is an industrial, single-anode, mercury-vapour and gas-filled rectifying valve designed for high-current applications. It is primarily utilized in industrial rectifiers, such as those configured for charging

up to 110 lead-acid (Pb) accumulator cells. The valve features a directly heated, oxide-coated filament and incorporates an auxiliary ignition electrode to facilitate reliable starting.

Mechanical Construction and Physical Dimensions

The 1176 is constructed with a heavy glass envelope designed to withstand the thermal and electrical demands of industrial service. It must be operated strictly in a vertical position with the base down.

The physical dimensions and mechanical connections of the valve are as follows:

- **Maximum Bulb Diameter:** 92 mm
- **Maximum Overall Height:** 301 mm
- **Anode Connection:** Located at the top of the bulb, featuring an M8 screw terminal.
- **Base Connections:** Two heavy filament terminals (f, f) spaced 125 mm apart, with a total base width of 145 mm.
- **Auxiliary Ignition Connection:** An auxiliary ignition electrode (ah) terminal with an M4 screw thread located at the base.
- **Weight:** Net weight of approximately 600 g, with a shipping weight of 1190 g.

Filament and Heating Requirements

The valve utilizes a directly heated, oxide-coated filament. Because the tube contains mercury vapour and gas, the filament must be preheated to its proper operating temperature before anode voltage is applied. This preheating time (T_w) is critical to prevent damage to the cathode surface from ion bombardment.

- **Filament Voltage (V_f):** 1.9 V
- **Filament Current (I_f):** 28 A
- **Heating Supply:** Direct by A.C.

Filament Power Calculation

Using the nominal filament voltage and current, the electrical power consumed by the filament is calculated as: $\text{Power} = Vf \times If = 1.9\ \text{V} \times 28\ \text{A} = 53.2\ \text{W}$

Preheating Time (T_w) Requirements

- **Recommended Preheating Time:** 2 minutes under normal operating conditions.
- **Minimum Preheating Time:** May be reduced to 1 minute in urgent situations.
- **Extended Preheating Time:** A delay of 5 minutes is required after transport or after a long interruption of service to ensure proper mercury distribution.
- **Control:** A time-delay switch, such as type 4152, is recommended to automate and enforce this delay.

Typical and Operating Characteristics

The 1176 exhibits a low internal voltage drop during conduction, which is typical of gas and mercury-vapour rectifiers.

Ignition and Arc Characteristics

- **Arc Voltage (V_{arc}):** 12 V (typical)
- **Ignition Voltage (V_{ign}):** 22 V (typical)

To achieve the typical ignition voltage of 22 V, an auxiliary D.C. supply unit delivering a minimum of 40 V and 10 mA must be connected via a current-limiting resistor between the auxiliary ignition electrode (ah, positive) and the cathode (negative). The Philips Auxiliary Ignition Unit type 1289 is recommended for this purpose.

Rectifier Circuit Configurations

The valve can be operated in several standard rectifier circuit configurations (designated a through g). These configurations yield different output voltages (V_O) and currents (I_O) from specified transformer secondary voltages (V_{tr}):

Circuit Configuration	Transformer Voltage (V_{tr}, V_{eff})	Output Voltage (V_O, V)	Output Current (I_O, A)
a	275	230	30
b	540	440	30
c	220	240	45
d	210	440	45
e	205	240	60
f	200	240	90
g	220	240	90

Limiting Values (Absolute Limits)

The absolute maximum ratings of the 1176 are highly dependent on the operating temperature of both the ambient air (t_{amb}) and the condensed mercury (t_{Hg}). The manufacturer defines two distinct sets of absolute limits based on these temperature ranges:

Parameter	Temperature Range 1	Temperature Range 2
Ambient Temperature (t_{amb})	10 to 50 °C	10 to 45 °C
Mercury Temperature (t_{Hg})	30 to 80 °C	30 to 75 °C

Parameter	Temperature Range 1	Temperature Range 2
Max. Peak Inverse Anode Voltage (V_{ainv_p})	685 V	850 V
Max. Average Anode Current (I_a, $T_{\mathrm{av}} = \max.\ 5\ \mathrm{s}$)	15 A	15 A
Max. Peak Anode Current (I_{ap})	90 A	75 A
Max. Surge Anode Current (I_{surge}, $T = \max.\ 0.1\ \mathrm{s}$)	900 A	750 A
Min. Series Resistance (R_t)	0.2 Ω	0.2 Ω

These limits demonstrate that operating the valve at a slightly lower maximum ambient temperature (up to 45 °C instead of 50 °C) allows it to withstand a higher peak inverse voltage of 850 V, though the maximum peak anode current is conversely restricted to 75 A.

Technical Summary

The **1176** is a heavy-duty, single-anode, mercury-vapour and gas-filled rectifying valve designed for industrial power applications. It features a directly heated 1.9 V / 28 A filament requiring a calculated 53.2 W of heating power. To protect the oxide-coated cathode, a preheating delay of 2 minutes (or 5 minutes following transport) must be observed. The valve operates with a typical arc drop of 12 V and utilizes an auxiliary ignition electrode to initiate conduction at 22 V. Depending on the operating temperature, the 1176 supports peak inverse voltages up to 850 V and average anode currents up to 15 A, making it highly suitable for high-current industrial battery charging and rectification systems.

SOURCE OPERATING CONDITIONS

SOURCE PDF

1963 Philips Electron Tubes Handbook V3

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1963 PHILIPS ELECTRON TUBES HANDBOOK V3

Section 1 · Rectifier

CHARACTERISTIC		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Arc voltage drop	**12 V**	GasFilled

OTHER		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Maximum peak inverse anode voltage	**850 V**	—
Maximum average anode current	**15 A**	—
Maximum peak anode current	**75 A**	—
Maximum surge current	**750 A**	ShortDuration
Application	**industrial rectifier service up to 110 lead-acid cells**	—
Heater voltage	**1.9 V**	DirectAC
Heater current	**28 A**	DirectAC

SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

SOURCE PDF

1999 Philips 0-D

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1999 PHILIPS 0-D

Section 1 · Rectifier

CONSTRUCTION		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Filling	**Mercury vapour and gas**	—

CHARACTERISTICS		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Arc voltage	**12 V**	—
Ignition voltage	**22 V**	—

OTHER		
PARAMETER	**PUBLISHED VALUE**	**CONDITION / NOTE**
Peak inverse voltage	**850 V**	—

Tube Tinker

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