

# 90 and 100mm tubes S-11, S-13, Super S-11, Super S-13 cathodes

The EMI type 9531 is a unique design in which the front end geometry has been carefully optimised in order to give the best resolution with 75mm scintillation crystals. It should be noted, for the benefit of present users, that the focus element has been eliminated, resulting in a marked improvement in resolution. Standard 75mm photomultipliers have cathode diameters of only 65mm, whereas the 9531 has very closely a 75mm diameter cathode making a very good match with 75mm scintillators. The 9531 series have 11 CsSb venetian blind dynodes.

The 9531R is supplied with a "Super" S-11 cathode which has a typical peak quantum efficiency of 24% at 4000A. In addition the measured parameters are much more tightly grouped when compared with samples of standard grade tubes. Every 9531R is tested with our standard factory NaI-Tl crystal and must give a minimum peak to valley ratio for Co<sup>60</sup> of 7:1. This corresponds to a resolution for Cs<sup>137</sup> of ca. 7.8%.

For less stringent applications, the 9531B, which has an S-11 cathode, can be supplied at lower cost.

For those applications requiring an extension of the spectral response into the UV, or in those where radioactivity in the window or bulb might be objectionable, tubes can be supplied with quartz bulbs to special order, e.g. 9531QB.

Type 9711NB is electrically similar to the standard type, but is designed to be rugged enough to withstand environmental conditions encountered in rockets, satellites, etc. (see page 59).

A 100mm variant of the 9531, having 9 CsSb dynodes, is type 9732, and is available in grades "R" and "B".

## Notes

- Each tube is individually calibrated and the test ticket furnished with the tube specifies the cathode sensitivity in  $\mu\text{A}/\text{lm}$ , the overall voltage at 200 A/lm (9531) or 50 A/lm (9732) and the dark current at that overall sensitivity at 20°C.
    - Test data is obtained with cathode -D1 voltage held at 300V and a "Standard" dynode chain.
    - In general, when setting up experiments or designing for equipment, it is desirable to work at, or below, the ticket voltage of the individual tube.
    - For highest stability in d.c. conditions, mean anode current should not exceed 10  $\mu\text{A}$ .
  - Any material in contact with the glass envelope must be held at cathode potential. Failure to do so may result in erratic operation and high dark current.
  - Take great care in clamping tubes, particularly those with quartz bulbs. Excess pressure may fracture the glass in which case the warranty is void.
  - Photomultipliers are affected by magnetic fields and mu-metal shields should be used, (see page 64).
- \* For recommended dynode chains, refer to Groups H, I, J (9531) or Groups D, E, F (9732) on page 14.

## MECHANICAL CHARACTERISTICS

	9531	9732
Max. bulb dia.	91 mm (3.58 in)	102 mm (4.02 in)
Max. neck dia.	54 mm (2.13 in)	54 mm (2.13 in)
Min. cathode dia.	77 mm (3.03 in)	92 mm (3.62 in)
Cathode type	9732R 9732B	9531R 9531B "Super" S-11 S-11
Window material	All types borosilicate. Quartz to special order except 9732 types	
Dynodes	11VB (All CsSb secondary emitting surfaces)	9VB
Base	B15B	B19A
	Low loss pressed glass base furnished with appropriate high quality Teflon socket	



## ELECTRICAL RATINGS

	9531	9732		
Cathode to D1	350V Max.	350V Max.		
Recommended cathode to D1 voltage	300V	300V		
Cathode to anode (subject to not exceeding)	2350V Max. 2000A/lm	2100V Max. 200A/lm		
Overall sensitivity: Rated Max.	200A/lm 2000A/lm	50A/lm 200A/lm		
Max. anode current (mean)	1 mA	1 mA		
Max. anode dissipation	1W	1W		
Max. tolerable cathode current	1 $\mu\text{A}$	1 $\mu\text{A}$		
Max. operating temperature	60°C	60°C		
Min. operating temperature	-80°C	-80°C		
Anode pulse rise time	14 ns	12 ns		
Anode pulse f.w.h.m.	38 ns	30 ns		
Transit time	110 ns	85 ns		
Capacitance, anode to all dynodes	8 pF	8 pF		
Dark current shot noise Typical ( $\lambda$ peak)				
lumens:	9531R: $2.7 \times 10^{-13}$	9531B: $3.1 \times 10^{-13}$	9732R: $5.4 \times 10^{-13}$	9732B: $6.3 \times 10^{-13}$
watts:	$3.9 \times 10^{-16}$	$4.2 \times 10^{-16}$	$7.8 \times 10^{-16}$	$8.5 \times 10^{-16}$

Cathode Sensitivity $\mu\text{A}/\text{lm}$ Min. Typ.	Overall Sensitivity 200A/lm				Overall Sensitivity 2000A/lm					
	V Overall Typ.		Dark Current nA Typ. Max.		V Overall Typ.		Dark Current nA Typ. Max.			
	Max.	Max.	Max.	Max.	Max.	Max.	Max.			
9531R	80	110	1250	1600	5	100	1650	—	50	—
9531B	50	80	1300	1900	5	250	1750	—	50	—
			50A/lm				200A/lm			
9732R	80	110	1250	1500	5	40	1550	—	20	—
9732B	50	80	1250	1750	5	100	1550	—	20	—

Resolution: 9531R and 9732R must give better than 7:1 and 5:1 respectively peak/valley ratio for Co<sup>60</sup> with standard factory crystal.

