

BRITISH STANDARDS INSTITUTION
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BS CECC 12 001-001
ISSUE 1 APRIL 1986



Specification available from:-
as shown in PD9002, BS CECC 00 200 and
ENGLISH ELECTRIC VALVE COMPANY LIMITED,
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ELECTRONIC COMPONENTS OF ASSESSED QUALITY
DETAIL SPECIFICATION IN ACCORDANCE WITH
CECC 12 000 1981

MANUFACTURER'S TYPE NUMBER P8079HP
See PD9002 and CECC 00 200
For ordering information see Clause 5.

Outline dimensions. First Angle Projection

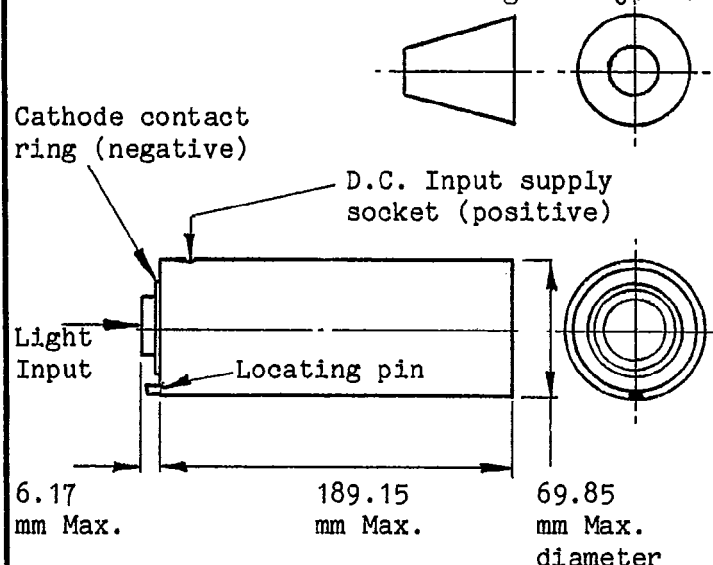


IMAGE INTENSIFIER: 3-STAGE CASCADE TUBE FOR
NIGHT VISION EQUIPMENT WITH ENHANCED MTF.

Integral power supply provides automatic output brightness control and specified minimum gain at high and low temperatures and at low input supply (battery) voltages. Internally protected against damage from short rise time high intensity flashes of light.

Windows : plano fibre-optics
Useful image diameters (nominal) -
Input (photocathode) : 25 mm.
Output (screen) : 25 mm.

For detail dimensions; see Appendix A
Marking information; see Clause 4

12 001 + ADDITIONAL REQUIREMENTS

1. REFERENCE DATA (not for inspection purposes)

OPTICAL

Input photocathode type	:	Extended red multialkali (S25)
Output phosphor type	:	Yellowish-green, medium short persistence (P20)
Luminance gain (typical)	:	80,000
Image magnification (typical)	:	(inverting) - 0.84
Limiting resolution (typical)	:	40 line pairs per mm

ELECTRICAL

Input power supply voltage (d.c.)	:	6.5 V
Input current (maximum at 6.5 V input):	:	40 mA

MECHANICAL

Mass (maximum)	:	0.930 kg
Mounting position	:	Any
Maximum force on bearing surfaces	:	100 N

ENVIRONMENTAL

Shock	:	half-sine, 6 ms duration, 735 m/s ²
Vibration	:	1.27 mm amplitude, 10-55 Hz (max acc. 150 m/s ²)

Refer to Qualified Products List PD9002 and/or CECC 00 200 for details of manufacturers approved to this specification.

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2. LIMITING VALUES. (absolute maximum rating system - IEC 134)

	Min.	Max.	Unit.
Instantaneous input supply voltage d.c., (see Note 1)	-7.0	+7.0	V
Continuous input supply voltage, d.c.	0.0	+6.8	V
Photocathode illuminance (see Note 2)	-	10	lx
Storage temperature (continuous)	-35	+35	°C
Storage temperature (2 hours max.)	-54	+68	°C
Operating temperature (continuous)	-35	+35	°C
Operating temperature (2 hours max.)	-54	+52	°C

3 OPERATING CONDITIONS AND CHARACTERISTICS.

Operating supply voltage : 6.50 ± 0.05 V Ambient temperature: 21 ± 3 °C

When the tube is operated under the conditions given above, unless others are specified, the characteristic values which follow are attainable:

	Min.	Max.	Unit.
Gain at photocathode illuminance of 0.1 to 0.3 mlx : and at 20 ± 1 °C or with a low input supply voltage of 5.50 ± 0.05 V and at 20 ± 1 °C	60,000 45,000	- -	- -
Photocathode luminous sensitivity	225	-	µA/lm
Photocathode radiant sensitivity, at wavelengths:- 800 nm 850 nm	20 10	- -	mA/W mA/W
Resolution (limiting),:- centre edge	32 32	- -	lp/mm lp/mm
Equivalent background illuminance (input) at 20 ± 1 °C	-	0.20	µlx
Magnification at centre	0.81	0.87	-
Output screen luminance over the input illuminance range 1.0 mlx to 1.0 lx and at 20 ± 1 °C	10	550	cd/m ²
Recovery time to restoration of visible image	-	1.5	s
Modulation transfer function, M.T.F., at spatial frequencies:- 2.5 cycles/mm 7.5 cycles/mm 15.0 cycles/mm	0.90 0.75 0.45	- - -	- - -

4. MARKING OF THE COMPONENT

- (i) Manufacturer's Type Number
- (ii) Date Code and Factory Identification Code
- (iii) NATO Stock Number (if required) - Subject to availability.

5. ORDERING INFORMATION.

Orders for components to this specification shall include the minimum information:-

- (i) Quantity
- (ii) Manufacturer's Type Number
- (iii) BS CECC Specification Number, Issue Number and Date
- (iv) Any special requirements, e.g. NATO Stock Number (NSN).

6. RELATED DOCUMENTS.

BS 2011 (IEC 68)	'Basic environmental testing procedures'.
BS 4727	'Part 4: Terms particular to lighting and colour Group 01, Radiation and Photometry; Group 02, Vision and Colour Terminology.'
BS 4779	'Recommendations for measurement of the optical transfer function of optical devices.'
BS 6001	'Sampling procedures and tables for inspection by attributes.'
BS 9000	'General requirements for a system for electronic components of assessed quality.'
BS CECC 12 000	'Harmonized System of Quality Assessment for Electronic Components. Generic Specification: Image Converter and Image Intensifier Tubes.'
IEC 134	'Rating systems for electronic tubes and valves and analogous semi- conductor devices.'
PD 9002	'BS 9000 and BS CECC Qualified Products List.'
CECC 00 200	'Harmonized System of Quality Assessment for Electronic Components: Qualified Product List.'

7. STRUCTURAL SIMILARITY.

Not applicable.

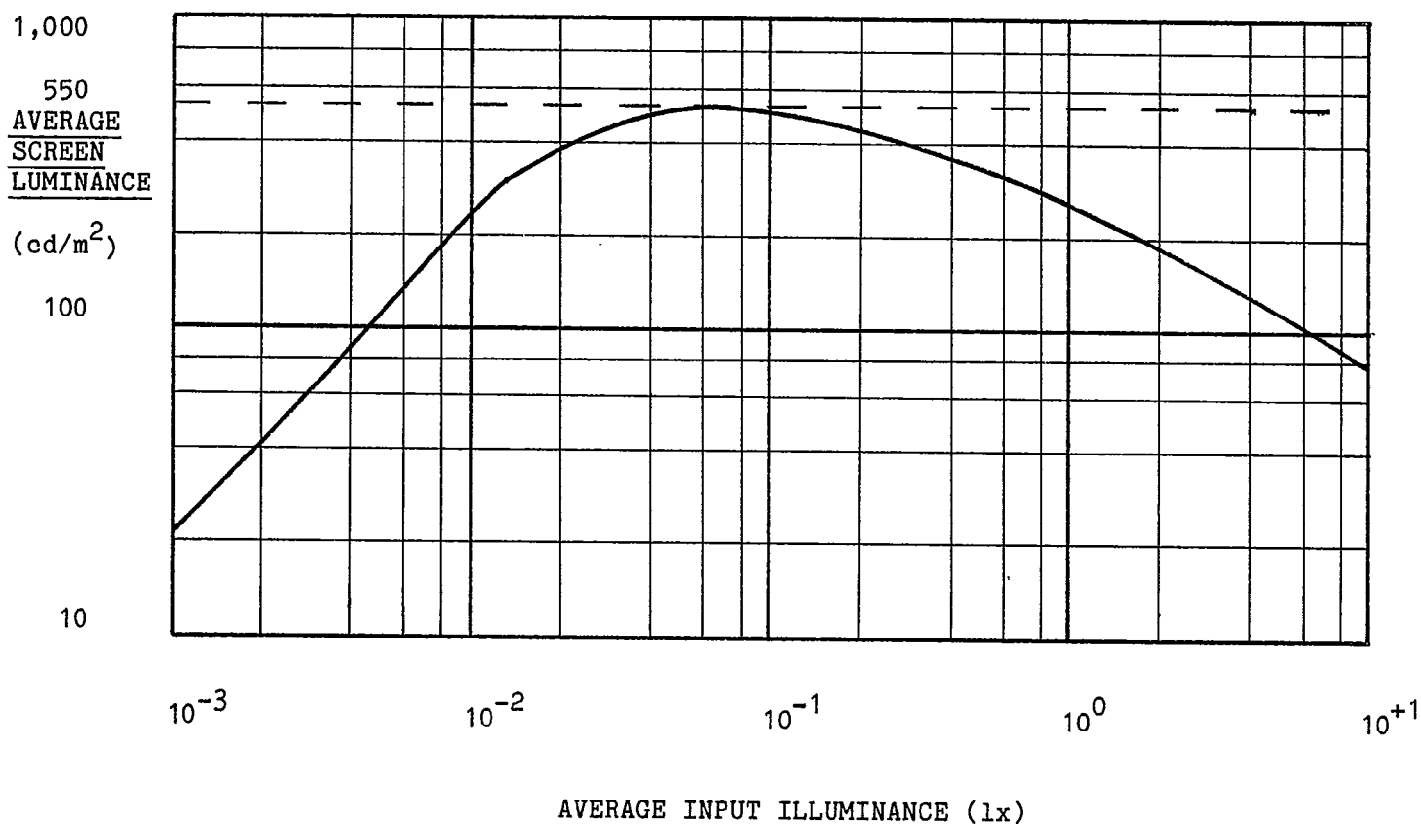
8. X-RADIATION.

Not applicable.

9. ADDITIONAL INFORMATION

- 9.1 It is recommended that for long term storage the tube should be kept in its "joint services approved" pack at a temperature which does not exceed 20 °C. However, the tube may be safely stored for long periods of time at temperatures in the range -35°C to +35°C. The photocathode should be kept covered, when not in use and should not be directly exposed continuously to bright light.
- 9.2 Care should be taken to prevent damage to the tube input window and to the convolutions at the screen end of the tube. These convolutions should not be used for withdrawing the tube from the equipment housing.
- 9.3 The axial force applied between the end face of the convolutions and the bearing surface at the photocathode end of the tube must not exceed 100 Newtons.
- 9.4 Discharging the tube power supply if the tube is to be removed from an equipment after any period of operation should be effected by the following procedure:
- 9.4.1 Ensure that the photocathode illuminance is less than 1.0 lux for at least 10 sec. before disconnecting the power supply to the tube.
- 9.4.2 Increase the photocathode illuminance to a level of at least 0.1 lux but not more than 1.0 lux until the output screen ceases to fluoresce. As a rough guide, an illuminance of at least 0.1 lux corresponds to the light from the full moon in a clear sky and an illuminance of 1.0 lux corresponds approximately to twilight about 30 minutes after sunset or before sunrise, when the sky is clear, or to that from a 15 watt light bulb (without lens or reflector) at a distance of 3 metres.
- 9.4.3 Wait at least 20 seconds, then remove the tube from the equipment
- 9.5 Limiting resolution at low input illumination shall be such that with a resolution bar pattern having a modulation of 0.35 ± 0.05 in contact with the photocathode window and an input illuminance of $25 \pm 5 \mu\text{lx}$, the limiting resolution using a X7 magnifier (NATO Stock Number 5855-99-964-8885) to observe the screen, should not be less than 7.0 line pairs/mm.
Modulation of the pattern is defined as $(T1 - T2)/(T1 + T2)$ where T1 and T2 are the optical transmissions of the lighter and darker bars (respectively) in the pattern.
- 9.6 To ensure that the specified tube performance is achieved in an equipment, the image intensifier tube must be operated in a non-magnetic and light proof housing (except for the input and output image apertures) designed to prevent the feedback of the output light flux to the input photocathode window.
The housing inner surface in contact with the outer cylindrical plastic shell of the intensifier tube shall also be electrically conducting and shall be electrically connected to the negative supply terminal.
The housing shall also be designed and manufactured to provide sufficiently accurate location of the tube via the bearing surfaces shown on the inspection drawing, see Appendix A.
- 9.7 The automatic brightness control performance of the tube is described by the typical signal transfer characteristic given in Figure 1.
- 9.8 The steady state signal transfer function describes the average screen luminance produced by an average input photocathode illuminance. This function is measured using spatially uniform illumination. The intra-scene contrast within the image is however reproduced linearly even at those light levels at which the average output screen luminance is not proportional to the average input illumination.

FIGURE 1.

TYPICAL SIGNAL TRANSFER FUNCTIONADDITIONAL INFORMATION (continued)

9.9 The (integral) image intensifier power supply reduces the gain of the tube at higher input illuminances in order to limit the average screen luminance and thus provide improved observer eye-comfort. This also prolongs the life of the tube by limiting the current loading to the screen, especially in the 2nd and 3rd stages of the tube. This feature of the integral power supply is termed AUTOMATIC BRIGHTNESS CONTROL or ABC.

Strictly the term ABC Characteristic only refers to the high illuminance part of the Signal Transfer Function, that is to the luminance limiting or non-linear part.

9.10 Image intensifier tubes meeting this specification are direct replacements for tubes meeting the requirements of the UK DEF STAN 59-60/90/107 and bearing the NATO STOCK NUMBER 5960-99-038-2689 but have an enhanced performance with respect to M.T.F. (and resolution), blemishes and the maintenance of gain over a wide range of battery voltages and ambient temperatures.

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10. TEST CONDITIONS AND INSPECTION REQUIREMENTS

Overall test conditions, except when modified under 'Conditions of Test'. A sample submitted to tests which are marked '(D)' shall not be accepted for release under BS CECC (see 20.2 of BS 9000 :Part 1).

Unless otherwise stated, all clause references are with respect to CECC 12 000.

All voltages are stated with respect to that of the (negative supply) cathode contact.

Supply voltage: 6.50 ± 0.05 V

Ambient temperature: 21 ± 3 °C

Test Equipment: See 4.3

See 4.3.1.

The test housing shall also provide electrostatic shielding and shall be fabricated from non-magnetic metal. The internal diameter of the test housing shall be $70.0 + 0.2, - 0.0$ mm.

Preferably the test pattern shall be placed immediately adjacent to the input photocathode window of the tube under test, otherwise it may be projected by an optical system of sufficient quality. A shutter to interrupt the incident illumination shall be provided.

See 4.3.4.

The light source shall be a tungsten (or tungsten-halogen) lamp operating at a correlated colour temperature of 2856 ± 20 K (CIE illuminant A) and the maximum divergence of the beam incident upon the photocathode shall be 5° off axis.

The photometer used on tests for Gain, Output Luminance, Signal Transfer Function, Bright Source Protection and Operational Life shall have the following characteristics:

where V_λ = photopic luminous efficiency of a CIE standard observer normalised to its maximum value

and E_λ = spectral radiance of the phosphor screen type used normalised to its maximum value

and S_λ = spectral sensitivity of the photodetector used for measurement of the output screen luminance normalised to its maximum value

and the wavelengths at the maximum values of V_λ and S_λ do not differ by more than 2.5 nm, then the integrals shown in figure 2 must not differ by more than 5 %.

Figure 2

$$\int_{400 \text{ nm}}^{700 \text{ nm}} V_\lambda E_\lambda d\lambda \quad \int_{400 \text{ nm}}^{700 \text{ nm}} S_\lambda E_\lambda d\lambda$$

The maximum acceptance angle of the photometer shall be 10° to the optical axis and its response shall be linear over the range of tube screen luminance from 1.0 to 1,000 candelas per square metre.

GROUP A - Lot by lot

All tests are non-destructive

AQL : given in %

INSPECTION OR TEST	REFERENCE CECC 12 000	CONDITIONS OF TEST	INSPECTION REQUIREMENTS				
			MIN.	MAX.	UNITS	IL	AQL
Subgroup A1						100%	-
Visual inspection	4.4						
Holding Period (or Non-operating endurance)	4.9.1	Duration: 24 hours minimum.					
Dimensions (major)	4.5	Inspection drawing: Appendix A.	See inspection drawing, subgroup A1 (APPENDIX A)				
Photocathode sensitivity	4.6.1	Photocathode aperture 19.0 $\pm$ 0.2mm dia.					
(Luminous)		Anode voltage: 150 to 400 V See Note 3.					
(Radiant)		Input luminous flux: not more than 5.0 mlm Maintain aperture and anode voltage. Input radiant power: not more than 0.1 mW	225	-	μ A/lm		
at λ = 800 nm		Filter characteristic Min. peak transmission 30% Bandwidth at 50% points 13.5 $\pm$ 3.5 nm Peak λ = 800 $\pm$ 2.5 nm Far infra red cut off to 4,000 nm	20	-	mA/W		
at λ = 850 nm		Filter characteristic as above except: Bandwidth at 50% points 14.5 $\pm$ 3.5 nm Peak λ = 850 $\pm$ 3.5 nm	10	-	mA/W		
Operating endurance (Short term)	4.9.2	No input illumination Supply voltage: 6.5 $\pm$ 0.1 V Duration: 16 hours min.					
Post Operating endurance tests		See Note 4 See Note 5.					

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GROUP A - Lot by lot

All tests are non-destructive

AQL: given in %

INSPECTION OR TEST	REFERENCE CECC 12 000	CONDITIONS OF TEST	INSPECTION REQUIREMENTS				
			MIN.	MAX.	UNITS	IL	AQL
Subgroup A1 continued						100%	-
Equivalent background input (EBI)	4.6.2	EBI Ambient temperature: 20 $\pm$ 1 °C. See Note 6. Stabilisation period: 10 min. maximum. Photocathode aperture: whole cathode area. Photocathode illuminance: 0.2 μ lx (or a convenient higher value within the range of linear response of the intensifier and photometer). Screen aperture: 14.0 $\pm$ 0.2mm diameter. Photometer readings used in the calculation shall exclude the photometer dark current.	-	0.20	μ lx		
Gain (luminance)	4.6.3	Ambient temperature: 20 $\pm$ 1 °C. See Note 6. Photocathode illuminance: 0.1 to 0.3 mlx. Screen aperture: 14.0 $\pm$ 0.2 mm diameter. Input Supply voltages: i) Standard at 6.50 $\pm$ 0.05 V ii) Low. at 5.50 $\pm$ 0.05 V	60,000 45,000	- -	- -		
Output luminance uniformity (ratio)	4.6.5	See Appendix C. Screen area to be examined: 20.0 mm diameter. Eyepiece magnification: X6 to X10. Light source: colour temperature 2,600 to 3,000 K. Photocathode illuminance: 0.1 to 0.3 mlx. If there is any doubt after visual assessment according to 4.6.5 use the luminance scanning method of Appendix C. Scanning aperture: 1.0 $\pm$ 0.1 mm diameter	-	5:1			

GROUP A - Lot by lot		AQL: given in %					
All tests are non-destructive							
INSPECTION OR TEST	REFERENCE CECC 12 000	CONDITIONS OF TEST	INSPECTION REQUIREMENTS				
			MIN.	MAX.	UNITS	IL	AQL
Subgroup A1 continued						100%	-
Resolution (limiting)	4.6.12	Dimensions of the test pattern: see Appendix R. Pattern position: concentric with the photocathode. Light source: colour temperature 2,600 to 3,000 K. Spectral transmission factor of the test pattern: in clear areas 90% min. and in dark areas 0.01% max. for wavelengths between 400 and 950 nm. Eyepiece magnification: X20					
Centre		Central element of test pattern observed.	32	-	lp/mm		
Edge		4 edge elements of test pattern observed	32	-	lp/mm		
Gas-test	4.6.14	Photocathode illuminance: 0.1 to 0.3 mlx. Light source: colour temperature 2,600 to 3,000 K. Eyepiece magnification: X6 to X10 Diameter of occluding disc on photocathode: 5.0 $\pm$ 0.2 mm. Diameter of circular aperture on the screen: 2.5 $\pm$ 0.1 mm.	See 4.6.14				
Spurious output	4.6.15	No illumination on photocathode Area of screen to be examined: 25 mm diameter Dark adapted observer using an eyepiece with magnification X6 to X10	See 4.6.15				
Blemishes	4.6.16	Eyepiece magnification: X6 to X10 Photocathode illuminance: 10 mlx maximum.	Blemish Specification: See Appendix B.				

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GROUP A - Lot by lot

All tests are non-destructive

AQL: given in %

INSPECTION OR TEST	REFERENCE CECC 12 000	CONDITIONS OF TEST	INSPECTION REQUIREMENTS				
			MIN.	MAX.	UNITS	IL	AQL
Subgroup A1 continued						100%	-
Signal Transfer Function (ABC Characteristic) and Maximum Screen Luminance	-	See Appendix D. and Fig. 1. Ambient temperature: 20 ± 1 °C. See Note 6. Screen aperture: 14.0 ± 0.2 mm diameter. Photocathode illuminance: 1.0 mlx to 1.0 lx. Light source: colour temperature 2,600 to 3,000 K. Measure the screen luminance at a minimum of 5 levels of input illuminance within the range specified above, to verify that the extreme values are within limits.	10	550	cd/m ²		
Supply Current	4.6.7	Photocathode illuminance 0.1 mlx to 1.0 lx Light source: colour temperature 2,600 to 3,000 K.	-	40	mA		
Excess Operating Voltage	4.6.6	No photocathode illumination. Supply voltage: $7.00 \pm 0.05 - 0.00$ V Duration of test: 120 s.					
<u>Post-conditioning tests</u>							
Examine for damage		See Appendix E. Supply voltage 6.5 ± 0.1 V	There shall be no damage				
Reverse Operating Voltage	4.6.4	No photocathode illumination. Supply voltage: $-7.00 \pm 0.00 - 0.05$ V Duration of test: 60 s. Recovery time: 60 s.					
<u>Post-conditioning tests</u>							
Examine for damage		See Appendix E. Supply voltage: 6.5 ± 0.1 V	There shall be no damage				

GROUP A - Lot by lot

All tests are non-destructive

AQL: given in %

INSPECTION OR TEST	REFERENCE CECC 12 000	CONDITIONS OF TEST	INSPECTION REQUIREMENTS				
			MIN.	MAX.	UNITS	IL	AQL
<u>Subgroup A2</u> Recovery from and resistance to light flashes. <u>Post-conditioning tests</u> Examine for damage		Recovery time. See Appendix F. Ambient temperature: 20 $\pm$ 1°C. See Note 6. Test patterns: See Figures 3a and 4a. Steady illuminance: 0.5 mlx max. Stabilisation period: 60 s. Eyepiece magnification: X20. Photocathode aperture. See Figures 3a and 4a. Light flash: See Figures 3b and 4b. See Appendix G. Photocathode illuminance range: 0.0 to 1.0 lx. Supply voltage range: 0 to 7.0 V	-	1.5	s	See Note 7	
<u>Subgroup A3</u> Image alignment	4.6.9	Spot dimensions: 0.030 mm max. either circular or square. Photocathode illuminance: 5 mlx.max. Light source: colour temperature 2,600 to 3,000 K.	-	0.75	mm	S-3	2.5