Note to the user.

This Joint Service Specification K1001 contains over 400 pages.
For your convenience, a number of "navigation links" have been made.
Go to the Contents, pages 4 and 5 of this document.
A mouse-click on the Section or Appendix of interest, presents the top page of the selection.

From 1964 untill December 1975, 10 Amendments were released to keep this specification up to date.
The amendment sheets are retained and filed at the end of the specification.
Amendment 10 is found on top, page number 362.
Earlier amendments follow in sequence, 9, 8, 7, etc.
Superseded pages are filed with the amendment, containing the instruction for removal.

JOINT SERVICE SPECIFICATION

K1001

ISSUE No 6 JULY 1964

(SUPERSEDING ISSUE No.5 – DATED JUNE 1958)

ELECTRONIC VALVES

ISSUED ON BEHALF OF THE TECHNICAL VALVE COMMITTEE BY:-

MINISTRY OF AVIATION, T.L.5(b)
CASTLEWOOD HOUSE,
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THE APPROVING AUTHORITIES REFERRED TO IN THIS SPECIFICATION ARE:-

ADMIRALTY

The Captain Superintendent,
Admiralty Surface Weapons Establishment.

The Officer in Charge,
Services Valve Test Laboratories.

GENERAL POST OFFICE

The Engineer in Chief,
General Post Office.

MINISTRY OF AVIATION

The Director of Electronics Production (Air).

The Director,
Royal Aircraft Establishment.

The Director,
Royal Radar Establishment.

The Director,
Signals Research and Development Establishment.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

The Director,
Atomic Energy Research Establishment.

The Director,
Atomic Weapons Research Establishment.

WAR OFFICE

The Director,
Armament Research and Development Establishment.

AMENDMENT RECORD SHEET

Amdt. No.	Date of Amdt	Date Amended	Amdt. No.	Date
1	Nov 1964.			
2	June 1965	10 8/65		
3	June 1966	31 8/66		
4	october 1966	22 12/66		
5	Jan 1967	12 2/67		
6	April 1967	2 1/68		
7	Feb 1971	7 9/71		
8	Apr 1972	11 1/73		
9	Mar 1975	5 3/75		
10	Dec 1975	19/3/76		

JOINT SERVICE SPECIFICATION

K1001 ISSUE NO. 6

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JOINT SERVICE SPECIFICATION K.1001. ISSUE No. 6

ELECTRONIC VALVES

INTRODUCTORY NOTE

Joint Service Specification K1001, Issue No. 6 is essentially a reprint of Issue No.5 including amendments. All additional changes are indicated by vertical sidelines. The layout has been rearranged to facilitate insertion of future amendments.

Section 1. FOREWORD

This specification covers the requirements to be met by electronic valves supplied for the Navy, Army, Air Force, General Post Office and other Authorities. It contains requirements applicable to all valves, further requirements applicable to particular classes of valves, and appendices containing drawings, tables of data, and other information to which references are made in this general specification and in the associated Valve Test Specifications.

Section 2. VALVE TEST SPECIFICATIONS

2.1. Valves used by the British Services are identified by CV numbers, e.g. CV1, CV2. The additional acceptance tests for each CV type of valve are stated in an individual Test Specification which bears the CV number of the valve to which it refers and states where necessary any relevant exceptions or modifications to the requirements of this specification. In case of any conflicting requirements the individual Test Specification shall apply.

2.2. The test figures given in Test Specifications are absolute limits. Allowances shall be made for the inaccuracies of test apparatus and shall be subject to the approval of the Inspection Authority.

2.3. Except when otherwise stated all tests shall be performed by the manufacturer and to the satisfaction of the Inspecting Authority.

2.4. In the case of G.P.O. orders the manufacturer is not specifically required to perform these or other tests but is nevertheless required to ensure that the valves supplied to the G.P.O. are capable of passing all the relevant tests indicated in this specification. Further, notwithstanding any tests performed by the manufacturer, the G.P.O. Inspection Authority may subject any valve supplied by the manufacturer to any of the relevant tests and may determine the acceptability of individual valves or of consignments of valves in accordance with the results of such tests. The G.P.O. Inspection Authority may employ for this purpose sampling conditions other than those described in this specification but (unless otherwise agreed with the manufacturer) they shall not have a lower AQL (see Section 6) than as prescribed in this specification for the tests concerned.

Section 3. CONSTRUCTION AND MATERIALS

3.1. British Standard B.S.448 shall apply to all CV valves as far as it is applicable, but where any B.S. 448 requirement is not in accord with the corresponding requirement of K1001 the latter shall apply.

3.2. The manufacturer may use any form of construction for his valve, which, however, shall be subject to the approval of the Approving Authority (See Section 15, Qualification Approval).

3.3. Where materials, methods, or processes are required by this specification to be "approved" such approval must be obtained in writing from the Approval Authority.

3.4. The workmanship shall be of a high standard throughout and all materials used shall be of good quality and free from defects liable to affect adversely the operation or life of the valve.

3.5. External metal parts, including cans and shells, shall be of approved materials and finish preferably in accordance with Parts VI and VII of Specification DEF 5000. Sprayed metal coating shall be of silver, tin, or other approved material. Electro-tinning shall not be used for flexible leads which are required to be tinned for soldering into circuits.

3.5.1 When specified in the individual Test specification, gold plated pins and accessories shall be tested in accordance with Appendix XIX — Amdt 2

* 3.6. Radioactive valves are defined in ~~Section 19 and are discussed in T.V.C. Information Sheet No. 11, (See also Appendix XVI).~~ Appendix XX — Amdts 3 Addendum

3.7. Valves shall be constructed to withstand service requirements as regards vibration, shock and climatic conditions. Tests covering these requirements are given in subsequent sections of this specification.

3.8. When operation at high radio frequencies is of importance the Test Specification will state the highest frequency at which the valve shall operate, together with the corresponding ratings, or will describe the special conditions under which the valve will be used.

3.9. In any case of disagreement arising due to differences between gauges the article shall be accepted if it passes any gauge which is made within the tolerances defined in the original system of measures, the gauging procedure being carried out at 20° ± 5°C and at a maximum relative humidity of 75%.

3.10. Tolerances on Dimensions. The dimensions shewn on the drawings herein, in B.S.448 and in CV Valve Test Specifications normally include tolerances. Where no limits are specified the following tolerances shall apply for all materials except glass:-

(a) Machined Metal Parts

Up to 1 inch	± 0.005 inch
1 inch to 3 inches	± 0.010 inch
3 inches to 12 inches	± 0.015 inch

* 3.5.2 Valve bases having brass or bronze steel sleeves attached shall be tested in accordance with the requirements specified in Appendix IV, paragraph 3.5 — Amdt 6

(b) Castings

(i)	Machined parts and dimensions between machined surfaces	± 0.01 inch
(ii)	Unmachined parts	
	Thickness	± 1/64 inch
	Linear dimensions	
	Up to 6 inches	± 1/32 inch
	Above 6 inches	± 1/16 inch
(iii)	Die Castings	± 0.005 inch

(c) Hole Spacings

On true geometrical position	± 0.005 inch

(d) Framework made of Metal Angles, Tees, etc.

Up to 1 foot	± 0.03 inch
1 to 2 feet	± 0.05 inch

(e) Mouldings

(i) Taper on vertical surfaces

Up to 2 inches	± 0.015 inch per inch max.
2 to 3 inches	± 0.01 inch per inch max.

On double vertical surfaces such as walls, fins or similar projections, the total taper shall be as above, viz. up to 2 inches the taper on each side of the centre line shall not exceed 0.0075 inch per inch and from 2 to 3 inches it shall not exceed 0.005 inch per inch. These tolerances shall not be additional to any taper included in the design.

(ii)	Linear Dimensions	± 0.003 inch

When linear dimensions are affected by taper the tolerances on the base shall be $^{+\,0.005}_{-\,0.000}$ inch and the remainder shall be governed by the taper (i) above.

(iii)	Inserts, Geometrical position of	± 0.003 inch

Delete Section 4
See Amd 10

Section 4. MARKING

4.1. All marking shall be sufficiently durable to withstand fair usage.

4.1.1. The following symbols shall be shown in a frame in a suitable position on the valve:-

(a) The CV title.
(b) The Broad Arrow (Government Mark)
(c) The Date Code (See 4.1.2.)
(d) The letter K for a Valve made to specification K1001 or K1006, or J for a valve made to the JAN or MIL specification.
(e) The Qualification Approval letter as follows:-
    B when Approval has been given by a U.K. Authority.
    U when Approval has been given by or on behalf of both U.K. and U.S. Authorities.
    D when Approval has been given by the Australian Services.

NOTE:- When approval has been given for the use of a valve in MDAP equipment by the Director of Electronics Research and Development (Air) but that valve has not received Qualification Approval the letter X shall be marked on the valve as if it were the appropriate Qualification Approval letter.

(f) The Factory Identification Code (See Appendix VIII)
(g) Any other marking required by the Test Specification.

Items (d), (e) and (f) shall be arranged in that order with an oblique stroke between (e) and (f).

When a serial number is required by the Test Specification it may be put, if desired, on an internal component provided it is clearly visible.

When the Test Specification calls for a E.I.A. (or RETMA)[*] or other U.S. type designation to be marked on the valve, and a mineral filled base is used, the letter Y shall be included at the end of the name to indicate the use of a mineral filled base, e.g.

CV509 - 6V6GY

4.1.2. The Date Code shall shew when the marking was put on the valve and shall consist of four digits. The first two being the last two of the year and the second two being the calendar week of the year. When the calendar week consists of a single digit it shall be preceded by a zero

e.g. For Week February 9th to 15th 1964, the code shall read '6407'

Note. Week 1 is defined as the week when January 1st falls on or between Sunday and Friday. When January 1st falls on a Saturday, Week 1 commences on January 2nd.

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[*] Electronic Industries' Association (formerly Radio Electronic Television Manufacturers' Association of America).

(Paragraphs 4.1.1. (sub-clauses (a), (c), (d), (e) and (f) and 4.1.2. are requirements in accordance with N.A.T.O. Stanag No. 4012).

4.1.2.1. Alternative Date Code

Amdt 1

Until ~~January 1st 1965~~ further notice the following alternative Date Code shall be acceptable at the discretion of the manufacturer.

The Code shall consist of two block letters, the first representing the year beginning at A for 1945 and the second representing the month beginning at A for January, e.g.:-

AA = 1945 January
AB = 1945 February
NA = 1957 January
NF = 1957 June

The letters I and O shall not be used in the Code

4.1.3. Any marking additional to the above shall be subject to the approval of the Inspection Authority. Any such approved marking which involves periodic changes will not require approval for each individual change.

4.1.4. When it is impracticable, on account of physical limitations, to comply with paragraph 4.1.1. the approval of the Authority concerned should be sought for the omission of some of the symbols and/or frame. The order of preference for retention of the symbols is:-

i The CV number
ii The Factory Code
iii The Date Code
iv The Broad Arrow
v The Specification and Qualification Approval letters

4.1.5. Warning Marking for Radioactive Valves

Amdt 3 Addendum

See Appendix XX ~~(See Section 19 for definition of a Radioactive Valve)~~.

4.1.5.1. For British Manufactured Radioactive Valves

Additional to the general marking requirements at 4.1.1. to 4.1.4. above, all British manufactured Radioactive Valves shall be marked on the bulb or envelopes ~~as at Fig.4/1 with the three following items of Warning Marking:-~~ in accordance with the requirements specified in Appendix XX, according to the radioactive class to which the valve is assigned

Amdt 3 Addendum

Amdt 1

(i) the word "CAUTION" in positive lettering i.e. printed in the imprinting colour in the ordinary sense. ~~(This is opposite to American practice where the imprinting colour is used for a large surround and the cautionary word appears by absence of imprinting ink in the background colour.)~~

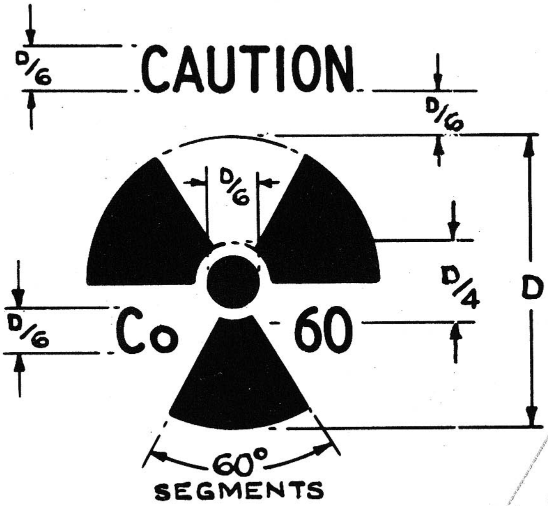
(ii) A three-bladed Radioactivity Symbol as illustrated.

CANCELLED

Amdt 2 Addendum

(iii) The Chemical Symbol(s) for the Radioactive substance(s) within the valve. As an example, the illustrations show the Chemical Symbol "Co 60" for Cobalt 60.

NOTE: For some years to come, stocks will exist of British made Radioactive Valves bearing the now superseded warning marking of an orange band ½-inch wide.



CANCELLED

Fig.4/1

Amdt 3
Addendum

Physical particulars for the Radioactive Warning Marking as above shall be as follows:-

(iv) Imprinting colour

796 Dark Violet to British Standard 381C,
or
47142 Magenta to American Standard FED-STD-595
or
Black (see Note)

Amdt 1

(v) Background Colour

Not specified for valves but the violet or magenta imprinting colour must be clearly visible against the background.

(vi) Size. Dimension D (see Fig.4/1) to be not less half the diameter of the bulb or envelope.

Note: In due course it is intended to align the requirements with those specified in British Standard Specification 3510 which will necessitate at least the following amendments.

Sub-paragraph (iv) Imprinting colour - deletion of 796 Dark Violet and 47142 Magenta

and

Sub-paragraph (v) Background colour - present paragraph to be deleted and replaced with "Yellow : Colour No. 309 of BS. 381C".

Amdt 1

4.1.5.2. For American Manufactured Radioactive Valves

Current American practice for Radioactive Warning Marking as in United States Military Specification MIL-M-19590B dated 17th June 1958 will be accepted.

4.1.5.3. For Radioactive Valves other than British or American

Radioactive Warning Marking shall be according to 4.1.5.1. above.

4.2. Valves accepted before Qualification Approval or under Concession

4.2.1. If a valve which has not met some particular electrical requirement is accepted under concession the letters to the left of the oblique stroke shall be replaced or cancelled by a yellow splash unless otherwise stated by the authority giving the concession. A document giving a concession which also states that the specification will be amended is to be treated as an amendment to the specification and the yellow splash requirement will not apply.

4.2.2. If a valve which has failed some physical requirement of the specification is accepted under concession the letters to the left of the oblique stroke shall be replaced or cancelled by a yellow splash when requested by the authority giving the concession.

4.2.3. If deliveries of a valve are required before Qualification Approval has been given, or when it has been withdrawn, the Qualification Approval letter is to be omitted or cancelled with a black, dark or neutral splash or stroke.

4.3. Valves accepted to Commercial Specifications in the absence of a CV Test Specification

Valves which have been allocated CV Numbers, but for which no Joint Service CV Test Specifications exists may be purchased to an agreed Commercial Specification. Such valves shall be marked in accordance with Para. 4.1.1.(a) and 4.1.1.(b).

4.4. Cancelled. See clause 4.1.5.

4.5. **Marking on Semiconductor Diodes.** See Section 5.C.

4.6. **Packaging.** Packaging shall be marked in accordance with Specification K.1005.

4.7. **Pin and Lead Protectors.** Details of Pin and Lead Protectors where relevant are contained in Appendix ~~VIII.~~ VII

Amdt 1

SECTION 5. ACCEPTANCE TESTS FOR ALL VALVES

(With certain exceptions stated in
Sections 5A to 5F)

5.1. General Inspection. A general inspection of the physical features of the valve shall be made and if it does not conform to the requirements of this specification and of the Valve Test Specification it shall be rejected.

5.2. Insulation Tests. The interelectrode insulation of valves of less than 750V anode rating shall be tested by one of the three methods described in paragraphs 5.2.1, 5.2.2 and 5.2.3. In these tests any metal soleplate or skirt or metal coating connected to a pin shall be regarded as an electrode; the heater shall be connected to the cathode.

5.2.1. Insulation Tests, Method 1

5.2.1.1. The following tests shall be applied with the cathode cold.

5.2.1.2. The insulation resistance between any two electrodes (excluding that between cathode and the adjacent grid in multi-electrode valves) shall exceed 100 megohms when measured at the maximum rated voltage of the valve or 500 volts whichever is the lower.

5.2.1.3. The insulation resistance between cathode and the adjacent grid shall be not less than 60 megohms when measured at not less than 20 volts.

5.2.2. Insulation Tests, Method 2

In this test the cathode (or filament) may be cold or heated at the rated voltage. The electrodes shall be strapped in two groups arranged in so many ways that the leakage path between any pair of electrodes may be tested by the application of a suitable voltage. The test voltage shall be applied through 10 megohms and shall be not less than 250 volts for indirectly heated valves and not less than 100 volts for battery valves.

If the valves are tested hot the leakage current shall not exceed 8 microamperes for indirectly heated valves and 2.5 microamperes for battery valves.

If the valves are tested cold the corresponding limits shall be 5 and 2 microamperes respectively.

5.2.3. Insulation Tests, Method 3

In this test the cathode shall not be heated and the insulation shall be measured between each individual electrode and all the other electrodes connected together. The insulation resistances C-all and G1-all shall each exceed 50 megohms when measured at not less than 200 volts.

5.2.4. Insulation Test Under Vibration

In some cases an insulation test under stated vibration conditions will be given in the Test Specification. This will normally be a Qualification Approval Test.

5.3. Heater-Cathode Leakage. The heater-cathode leakage current in indirectly heated valves wherein the heater is not internally connected to the cathode shall be measured with the rated heater voltage or current applied and with the heater both at negative and positive potentials with respect to the cathode, all other electrodes being unconnected. Notwithstanding the inclusion of any protective resistances the applied voltage shall be adjusted so that a potential of not less than 100 volts is maintained between the cathode and heater of the valve during this test. When the maximum permissible leakage current is not given in the Test specification it shall be 25 microamperes.

5.4. Tests of Characteristics

5.4.1. The valve characteristic tests given in the Test Specification need not be performed in the tabulated order unless required. Valves shall be preheated to obtain steady conditions of readings. The applied voltages shall be measured as follows:-

Cathode	Heating Supply	Voltage measured with respect to:
Indirectly heated	AC or DC	Cathode
Directly heated	DC	Negative filament terminal
	AC	Filament transformer secondary centre tap

5.5. Element and Electrode Connections. When the Test Specification requires that internal parts such as shields, beam plates, suppressor grids etc. be each connected to one or more base pins tests shall be made to ensure that they are properly connected.

5.6. Cancelled.

5.7. External Parts

5.7.1. Contact Potential. Where external metal parts such as sole plates, cans and shells are in contact the potential difference shall not exceed 0.25 volts (See DEF 5000, Part VII, Section 10).

5.7.2. Resistance. The resistance between any part of a sprayed metal coating and the base pin to which it is connected shall not exceed 1 ohm.

5.7.3. Clearance. The clearance between a cap and a sprayed metal coating shall be not less than 4 mm.

5.8. Noise. For the purposes of this specification the term noise shall include:-

(a) Noise Factor
(b) Hum
(c) Hiss
(d) Microphonic Noise
(e) Vibration Noise

When required by the Test Specification, test methods as stated in the following paragraphs, shall be used.

5.8.1. Noise Factor

The Noise Factor of a linear system at a selected input frequency is the ratio of (1) the total noise power per unit bandwidth (at a corresponding output frequency) available at the output terminals to (2) the portion thereof engendered at the input frequency by the input termination, whose noise temperature is standard (290°K) at all frequencies. The Noise Factor shall be measured under the conditions given in the Test Specification using the equipment described in Appendix XIII.

Note 1. The Noise Temperature at a pair of terminals, and at a specific frequency is the temperature of a passive system having an available noise power per unit bandwidth equal to that of the actual terminals.

Note 2. For heterodyne systems there will be, in principle, more than one output frequency corresponding to a single input frequency, and vice versa; for each pair of corresponding frequencies a noise factor is defined.

Note 3. The phrase "available at the output terminals" may be replaced by "delivered by the system into an output termination" without changing the sense of the definition.

5.8.2. Hum. Hum is defined as the mains frequency voltage introduced from the heater system in terms of an equivalent grid voltage. It shall be measured under the conditions given in the Test Specification using the equipment described in Appendix XII.

5.8.3. Hiss. Hiss is defined as all noise within a spectrum approximately 25 c/s to 10,000 c/s in the output referred back to the grid when the valve is operated with a D.C. voltage applied to the heater and the valve is not subjected to mechanical vibration and shock.

5.8.4. Microphonic Noise. Microphonic noise is defined as that noise developed when the valve is subjected to mechanical shock excitation, in terms of an equivalent grid voltage. It shall be measured under the conditions given in the Test Specification using the equipment described in Appendix XII. The valve shall be mounted and excited using the equipment described in Appendix X.

5.8.5. Vibration Noise. Vibration noise is defined as that noise which is generated when the valve is subjected to continuous mechanical vibration, expressed in terms of a r.m.s. noise output voltage. It shall be measured under the conditions given in the Test Specification. Suitable test equipment is described in Appendices X and XII.

5.9. Interelectrode Capacitance. See Appendix III.

5.10. Emission. See Appendix V.

5.11. Operational Tests. Operational tests may be carried out as a Qualification Approval feature by the Service to which the valves are supplied to ensure that they are satisfactory for use in the equipment for which they are required. Contract documents may require the manufacturer to do similar tests, if so, will state the apparatus or information to be supplied by the Approving Authority.

5.12. Lead Fragility Test. The following test shall be applied to subminiature valves and semiconductor devices with flexible leads. It shall also be applied to other valves with flexible leads when stated in the Test Specification. Unless otherwise stated the sampling procedure shall be as given in DEF.131 for an AQL of 6.5% and an Inspection Level 1A. Valves which are mechanically sound but failures on electrical tests may be used for this test.

The valve held vertically shall have a weight of not less than 1 lb. (or 8 ozs for semiconductor devices) freely suspended from each lead in turn. It shall then be inclined slowly so as to bend the lead through 45°, brought back and bent to 45° in the opposite direction and returned to the vertical, all bending being in the same vertical plane. Any damage which may permit the ingress of air or moisture or fracture or breakage of a lead, shall constitute a failure.

Valves subjected to the above test are not to be included in deliveries.

5.13. Test of Perpendicularity of B7G and B9A Valves. The major axis of the bulb of B7G and B9A valves shall not depart from the perpendicular to the sole by more than $3\frac{1}{2}^{\circ}$. The method of test shall be subject to the approval of the Inspecting Authority.

5.14. Inoperatives. Valves or semiconductor devices which have one or more of the following defects are termed "Inoperatives":

(a) Discontinuity
(b) Short circuit
(c) Air leak
(d) Broken pin or lead
(e) Loose base or cap

5.15. Destructive Tests. The following tests are destructive, and valves used for these tests will not be accepted for delivery:-

(a) Lead Fragility

(b) Glass Base Strain

(c) Life (other than Stability)

(d) Shock

(e) Vibration Fatigue

(f) Capacitance Tests and other tests on Flying Lead Valves which require the leads to be cut for the measurements.

5.16. Heater Supplies. Valves shall be designed to operate at discrete frequencies within the range 50-2500 c/s in addition to operation at 50 c/s or at D.C.

Usually their performances over this range will be checked as a Qualification Approval procedure. Unless otherwise specified the heater supply for acceptance tests shall be A.C. at 50 c/s.

Where additional or alternative supply frequencies are specified they shall be taken from the following list:-

(a) D.C.
(b) 60 c/s
(c) 400 c/s
(d) 500 c/s
(e) 1600 c/s
(f) 2400 c/s

All supply frequencies shall be within 5% of the nominal value. These conditions will also apply to valves having additional elements connected to the heater supply.

5.17. Cathode Interface Resistance. Measurement of Cathode Interface Resistance shall be carried out under the conditions specified in the Test Specification. Suitable test equipment is described in Appendix XVIII.

5A. ACCEPTANCE TESTS FOR CATHODE RAY TUBES

5.A.1. INTRODUCTION

This section refers to all types of Cathode Ray Tube supplied for Service use.

The general requirements, 5.A.3, shall apply to all tubes unless otherwise stated in the individual Test Specification. The test requirements given in sections other than 5.A.3. shall apply only when required by the individual Test Specification.

5.A.2 DEFINITIONS

(1) Cathode Ray Tube - An electron beam tube in which the beam can be focussed to a small cross-section on a surface and varied in position and intensity to produce a pattern either visible or otherwise detectable.

(2) Beam Current - The electron current of the beam arriving at the screen.

(3) Cathode Illumination - Illumination of the screen face of a tube caused by light from the heated cathode.

(4) Cut Off (Grid or Modulator) Voltage - The grid voltage which reduces the value of a dependent variable of the tube to a specified low value.

(5) Deflection - The displacement of the beam or spot on the screen under the action of the deflecting field.

5.1. Deflector plates - The electrodes used to produce the electric field for electric deflection.

5.2. Deflecting Voltage - Voltage applied between the deflector plates to create the deflecting electric field.

5.3. Electrostatic Deflection - Deflecting an electron beam by the action of an electric field.

5.4. Magnetic Deflection - Deflecting an electron beam by the action of a magnetic field.

5.5. Symmetrical Deflection - The application, to a pair of deflector plates, of a voltage such that, at every instant, the voltage between one plate and the final accelerator is numerically equal but opposite in sign to that of the other plate.

5.6. Asymmetrical Deflection - The application to a pair of deflector plates of a voltage such that one of the plates is maintained at a fixed voltage (usually zero) with respect to the final accelerator.

5.7. Deflection Sensitivity (Electrostatic) - The quotient of the spot displacement and the corresponding change in the deflecting voltage (usually expressed in millimetres per volt).

5.8. Deflection Sensitivity (Magnetic) - The quotient of the spot displacement and the corresponding change in deflecting magnetic induction.

5.9. Deflection Defocussing - An enlargement, usually non-uniform, of the deflected spot which becomes progressively greater as the deflection is increased.

(6) Face Plate - The (large) transparent end of the envelope through which the image is viewed or projected.

(7) Flashover - Arcing or discharge caused by voltage breakdown between two or more electrodes.

(8) Focussing - The process of controlling the convergence of the electron beam.

8.1. Electrostatic Focussing - Focussing of an electron beam by the action of an electrostatic electron lens.

8.2. Magnetic Focussing - Focussing of an electron beam by the action of a magnetic electron lens.

8.3. Deflection Defocussing - See 4.9.

(9) Line (Trace) - The path traced by a moving spot.

(10) Metallized Screen - A screen covered on its near side (with respect to the electron gun) with a metallic film, usually aluminium.

(11) Neck, The tubular part of the envelope near the base.

(12) Orthochromatic Candela - The actinic intensity (i.e. as related to the response of a specified photographic film) which, when measured by a combination of a photo-sensitor and colour filter of specified overall spectral response, will result in an electrical signal equal to that produced by light from a tungsten filament source of an intensity of one candela at a colour temperature of 2600 + 50°K.

(13) Persistence (Decay) Characteristic - The relation (usually shown by a graph) between the emitted radiant power and the time elapsing after the excitation has been removed.

(14) Raster - A pre-determined pattern of deflection lines which provides substantially uniform coverage of an area of the screen.

(15) Scan (Scanning Voltages) - See Deflection (4). The same definition is applicable.

(16) Screen (Luminescent Screen) - The surface of the tube upon which the visible pattern (usually luminescent) is produced.

(17) Spectral Characteristic (Spectral Response) - The relation (usually shown by a graph) between the wavelength and the emitted radiant power per unit wavelength interval.

(18) Spot - The small area of the screen surface instantaneously affected by the impact of the electron beam.

(19) Spot Displacement - Displacement of the undeflected spot from the geometric centre of the screen face caused by misalignment of the gun, leakage currents or magnetic effects.

(20) Stray or Spurious Emission - Emission from a source other than the cathode surface which causes unwanted or uncontrollable excitation of the screen.

(21) Trapezium Distortion - Variation of the sensitivity of the deflection parallel to one axis (vertical or horizontal) as a function of the deflection parallel to the other axis and having the effect of transforming an image which should be a rectangle into one which is a trapezium.

GENERAL REQUIREMENTS

5.A.3.1. General Inspection

A mechanical inspection of the tube shall be made to the requirements of Section 3 and Appendix XV of this Specification.

5.A.3.2. Loose Particles

5.A.3.2.1. Each tube shall be examined for loose particles. It shall be held with the neck axis at approximately 45° to the vertical with the screen downwards and shall be lightly tapped with the fingers on the maximum diameter. If any loose particles are present they shall be caused to traverse the screen a few times and if free screen material is produced the tube shall be rejected except when the screen is silicate or metallized (See para. 5.A.3.2.2.)

If free screen material is not produced the particles shall be examined for size and material and compared with the photographic standards and associated inspection table in Fig. 5.A/1. Loose particles shall be examined through the neck of the tube if not clearly visible when the tube is held as described above.

A tube shall be rejected if loose particles are present in amount and size in excess of the limiting quantities listed in Fig. 5.A/1 or if more than two of the materials in Groups 1, 2 and 3 be present.

5.A.3.2.2. Silicate or Metallized Screens

In cathode ray tubes with silicate or metallized screens the loose particles shall be observed as in 5.A.3.2.1. and shall be classed and assessed in Group 4 or Group 5 of Fig. 5.A/1 as appropriate.

5.A.3.3. Pre-heating

Prior to testing, cathode ray tubes shall be pre-heated for not less than 60 seconds with not less than the rated heater voltage.

5.A.3.4. Element and Electrode Connections

See Section 5.5.

5.A.3.5. Envelope, Face Plate and Screen Quality

See Appendix XV.

5.A.3.6. External Parts

See Section 5.7.

5.A.3.7. Holding Period

See Section 16.

5.A.3.8. Marking

See Section 4.

5.A.3.9. Tests for Qualification Approval Purposes Only.

Unless otherwise specified the following tests will apply for Qualification Approval purposes only.

5.A.3.9.1. Heater Modulation

No perceptible modulation or deflection of the spot shall be caused by the fields of the heater cathode or associated connections under normal operation.

5.A.3.9.2. Cathode Illumination

The tube shall be enclosed in a light proof container and the specified heater potential applied. After a period of at least 60 seconds, the light output at the face of the tube shall not be more than 0.154 milli-foot lamberts in any area of 2 inches in diameter.

5.A.3.9.3. Effects of Magnetisation

Following the line width measurements specified in 5.A.5.7. and the spot position and displacement measuremesnts specified in 5.A.6.4., the tube shall be de-magnetised. The line width and spot position shall then be re-measured immediately. The change in line width shall not exceed 20 per cent of the line width prior to de-magnetisation. The change in position of the undeflected spot shall not exceed 40 per cent of the specified maximum limit.

The tube shall then be exposed to a magnetic field of 500 gauss ± 10 per cent. The line width and the spot position shall be re-measured and shall be within the specified maximum limits.

For all these tests the tube shall be located in exactly the same position in the tube mount.

5.A.4. ELECTRICAL REQUIREMENTS

5.A.4.1. Insulation Tests

5.A.4.1.1. Insulation Tests Other than Grid Insulation and Heater Cathode Leakage Test

The grid, cathode and heater in indirectly heated tubes, and grid and filament in directly heated tubes shall be regarded as an electrode. A metal sole-plate if present shall be regarded as an electrode.

The insulation resistance shall be measured by one of the following methods with the cathode cold and at a voltage of not less than 250 volts unless otherwise stated in the Test Specification.

Method 1

The insulation resistance shall be measured between each and every two electrodes. The minimum insulation shall be 200 megohms.

Method 2

The insulation resistance shall be measured between each electrode in turn and all other electrodes connected together. Each measurement shall indicate a resistance of not less than $\frac{200}{n-1}$ megohms or greater than 50 megohms, "n" being the number of electrodes.

5.A.4.1.2. Grid Insulation

The test for insulation between grid and all other electrodes shall be done with normal electrode voltages applied and with the heater connected to the cathode. The test shall be performed by an approved method.

A recommended method of measuring grid insulation is as follows:-

Adjust the grid voltage to the value required for cut off. Insert a resistor of not less than the value stated in the Test Specification between the grid terminal and the voltage supply. Readjust the supply voltage to again cut off the beam current. Measure the increase in cut-off voltage.

5.A.4.1.3. Heater Cathode Leakage

The heater cathode leakage shall be measured with the rated heater voltage applied with the heater both at negative and positive potentials with respect to the cathode, all other electrodes being unconnected. A voltage of not less than 125 shall be applied between the heater and the cathode through a limiting resistor of 100,000 ohms.

5.A.4.2. Maximum Voltage Tests - Flashover and Stray Emission

5.A.4.2.1. The heater voltage shall be applied for 2 minutes before application of other potentials. The value of the limiting resistors or the impedance of the power supply shall be as specified. Unless otherwise specified the tube shall be adjusted to optimum focus with the maximum rated voltages on all electrodes (other than any focus electrode) and deflecting fields applied to scan the useful screen area for a period of at least 60 seconds.
There shall be no sign of breakdown.

Cathode ray tubes designed for asymmetrical deflection shall be tested as above with the scanning voltages applied as specified to the deflector plates.

5.A.4.2.2. Stray Emission (a)

With the tube operated as in 5.A.4.2.1. the grid voltage shall be adjusted to cut off and the deflecting fields reduced to zero. No stray emission shall cause visible excitation of the screen during a period of at least 2 minutes following the application of the anode voltage/s, the tube being viewed in darkened conditions.

5.A.4.2.3. Stray Emission (b)

The tube shall be operated as in 5.A.4.2.2. but with the screen uppermost and horizontal. The tube neck shall be tapped using an approved forked, rubber covered, wooden hammer at the specified rate of tapping (uaually 4 per second minimum) for a specified time.

The tube shall be rejected if flashover or stray emission cause visible excitation of the screen after the first five seconds.

5.A.4.3. Measurement of Grid Cut-off Voltage

The grid cut-off voltage shall be measured at the threshold of visibility of an undeflected focussed spot. The light intensity (room illumination) falling on the screen shall be at a low level. Alternatively the voltage shall be measured for a beam current of 0.1 microampere allowance being made for leakage currents.

Whichever method is used the same voltage shall be used in subsequent tests.

5.A.4.4. Grid Drive or Modulation (On Tubes for use at High Beam Currents)

The grid voltage required for a specified value of beam current shall be measured with the spot deflected off the useful screen area, or with the screen over-scanned.

The grid drive or modulation shall be obtained by subtracting the above voltage from the grid cut-off voltage (5.A.4.3.)

The beam current shall increase continuously from cut-off to the specified test condition.

5.A.4.5. Gas Test (Tetrode Tubes)

With no focus, ion trap or deflection fields applied the final anode and cathode currents shall be measured under the following conditions:-

Final Anode Voltage = -25V

First Anode Voltage = +300V

Heater Voltage = specified nominal

The Grid Voltage shall be adjusted for a cathode current of not less than 400 microamperes. The value of the gas ratio shall be computed from the following equation and shall not exceed 2×10^{-4} or a specified limit

$$\text{Gas Ratio} = \frac{\text{Final Anode Current (microamperes)}}{\text{Cathode Current (microamperes)}}$$

5.A.4.6. Inter-Electrode Capacitance

Capacitance measurements between the specified elecrodes shall be made at the tube contacts with the tube cold and by the methods described in Appendix III or other approved methods.

5.A.5. MEASUREMENT OF OPTICAL CHARACTERISTICS

5.A.5.1. Measurement of Light Intensity

5.A.5.1.1. The Light Intensity of a tube shall be measured on an optimum focussed raster of convenient size using a photo-electric device having an overall response approximating to the C.I.E. average eye. The grid voltage or beam current shall be adjusted to produce the specified light intensity. The grid voltage (and/or beam current when specified) shall be measured.

The Light Intensity is related to the average luminance of a raster by the formula:-

$$\text{Intensity} = \frac{\text{Luminance x Area}}{\pi}$$

Where Intensity is in Candelas, Luminance in Foot Lamberts and Area in square Feet

5.A.5.1.2. Tests of the intensity of a particular colour emitted by a screen shall be made using a specified colour filter in addition to a C.I.E. average eye correction filter and the filter/photocell combination calibrated against a light source of colour temperature of $2600 \pm 50^{\circ}$K.

The procedure of 5.A.5.1.1. shall then apply using the new calibration.

5.A.5.2. The light intensity or the beam current shall increase continuously when the grid voltage is varied from cut-off to the value corresponding to the specified light intensity or working beam current.

5.A.5.3. The specified light intensity or working beam current shall be attained at a grid/ cathode voltage not more positive than -1 volt.

5.A.5.4. Measurement of Actinic Intensity

The actinic intensity of the screen of a cathode ray tube intended for photographic recording shall be tested as in paragraph 5.A.5.1. but using a colour-filtered photocell having an overall response corresponding to that given in Fig. 5.A/2.

The actinic intensity will be specified in the Test Specification in "Orthochromatic Candela" a special unit introduced for the purposes of this test. (See 5.A.2.10)

5.A.5.5. Persistence

The persistence of a screen shall be tested using a defocussed linear raster pattern. Initial luminance and duration of excitation of the pattern will be specified by the Test Specification.

Persistence shall be measured as the time taken for the initial level of luminance to fall to specified values after removal of excitation.

A temperature correction factor shall be applied when specified.

5.A.5.5.1. Measurement of Screen Persistence

A convenient method of measuring the persistence of a Cathode Ray Tube may consist of an integrating photometer in conjunction with an indicating device or recorder.

The tube and photometer should be housed in a light-proof trunk with a distance between them of approximately ten times the radius of the raster being used.

The photometer, which must be corrected to the spectral response of the C.I.E. average eye, can be calibrated for intensity by locating a standard lamp in place of the tube. The axis of the photometer and tube neck will lie in the same plane so that the lamp should be placed at the same location as that for the centre of the tube screen. Once calibrated in this way, raster intensity can be measured.

The raster pattern should be formed by 50 c/s x 10 kc/s scanning voltages, the size being determined by the formula:

$$\text{Intensity} = \frac{\text{Raster Luminance} \times \text{Raster Area}}{\pi}$$

Where Intensity is in Candelas, Luminance in Foot Lamberts and Area in Square Feet.

The luminance will be specified in the test specification. By the same formula the final luminance can also be calculated.

The raster size should be measured at optimum focus but during the measurement of luminance it should be defocussed sufficiently to diffuse the line structure.

If no other period is specified, the screen must be excited to the specified luminance for at least thirty seconds. This permits the phosphor to build up to a steady state of excitation. On the expiration of this period the tube beam current should be cut-off and the phosphorescence of the screen can be measured. Timing by means of a stop-clock or other suitable device should commence at the instant of cut-off and be continued until the photometer indicates the specified lower luminance.

The ambient temperature close to the tube screen should be recorded during the measurement and if necessary the specified correction factor applied to the recorded time.

If a coloured filter is specified it should be interposed between the tube and photometer after the calibration procedure.

In older specifications where Test Set 331 has been specified as the method used for persistence measurements the following conditions can be applied using the above procedure.

Initial luminance measured through a C2 filter = 1.75 foot Lamberts

Time of Excitation = 30 seconds

Final luminance = 0.55% of initial luminance for N4 filter

or 2.2% of initial luminance for N3 filter.

5.A.5.6. Spectral Characteristic

When it is required to check the spectral characteristic of energy emitted from an excited screen the Test Specification will state the conditions of test.

5.A.5.7. Measurement of Focus

The focus quality shall be determined by a measurement of the width of a line using one of the following methods.

Unless otherwise specified the line width shall be considered as bounded by the region of 1/5th peak luminance as estimated by the eye when viewed through a microscope.

If necessary to prevent screen burning, the grid may be pulsed positively from cut off with pulses of specified duration and repetition rate.

Tubes utilising magnetic focus and/or deflection shall be tested in an approved Focus/Deflection coil unit.

5.A.5.7.1. Electrostatic Deflection

5.A.5.7.1.1. Expanded Raster

A raster formed by 10 kc/s x 50 c/s linear scanning shall be applied about the centre of the screen and the grid voltage adjusted to attain the specified light intensity or beam current.

The length of the high frequency lines will be specified. The low frequency lines shall be expanded to make the line structure clearly visible and to include the specified positions of measurement. The focus shall be adjusted to the optimum at the centre of the raster.

The line width shall be determined (a) at the screen centre and (b) as a measurement of deflection defocussing, at the specified distance along a radius at 45° to the axes of deflection.

This procedure shall then be repeated without adjustment of focus, with the high and low frequency scanning voltages interchanged and the raster size adjusted to give the same line lengths.

Unless otherwise specified symmetrical deflecting voltages shall be used.

5.A.5.7.1.2. Elliptical or Circular Trace

An elliptical or circular trace having major and minor axes of specified lengths and frequency shall be used and the grid voltage adjusted to attain the specified light intensity or beam current.

The tube shall be adjusted to optimum focus and the width of the trace measured at the point of poorest definition.

5.A.5.7.2. Magnetic Deflection

5.A.5.7.2.1. Expanded Raster

A raster as specified in 5.A.5.7.1.1. shall be applied about the centre of the screen and the grid voltage adjusted to give the specified light intensity or beam current.

The length of the high frequency lines will be specified. The low frequency lines shall be expanded to make the line structure clearly visible and the tube shall be adjusted to optimum focus at the centre of the raster.

The line width shall be measured at the centre of the screen.

The above procedure shall then be repeated without adjustment of focus with the high and low frequency scanning axes interchanged.

5.A.5.7.2.2. Pulsed Line

A 10 Kc/s line of specified length shall be applied and the grid voltage shall be adjusted to a value equivalent to that for the specified light intensity or beam current on a raster. The grid may be pulsed positively from cut off with 100 microsecond pulses at a specified repetition rate to attain the equivalent peak beam current or light intensity conditions.

The tube shall be adjusted to optimum focus and the line width measured at the centre of the trace.

With no further adjustment of focus the scanning axis shall be rotated 90° and a second measurement of line width made at the centre of the trace.

5.A.5.7.3. Unfocussed Spot Diameter

The diameter of the unfocussed spot shall be measured. The grid of the tube shall be pulsed as specified with no deflecting or focussing fields applied.

5.A.6. MEASUREMENT OF DEFLECTION AND SPOT POSITION

5.A.6.1. Deflection Sensitivity

A symmetrical (or asymmetrical if specified) deflection covering 75 per cent of the useful screen diameter shall be applied to each axis successively. The ratio of the deflection in millimetres to the instantaneous deflection voltage shall be measured for each axis.

5.A.6.2. Deflection Distortion

5.A.6.2.1. Trapezium Distortion

With the specified screen area scanned by symmetrical (or asymmetrical if specified) deflection voltages, the angles between adjacent sides of the raster shall be measured, the sides being averaged over their whole length.

5.A.6.2.2. Angle Between Axes

The angle between axes shall be measured counter clockwise from the horizontal trace at the centre of the screen.

5.A.6.3. Useful Screen Area

A raster shall be applied about the centre of the screen to excite not less than the specified minimum useful screen area. The intensity shall be that specified for the light intensity test and the focus shall be adjusted for optimum. The difference in intensity between any two parts of the useful screen area shall not exceed 2 : 1, allowance being made for any non-uniformity of writing speed. Visual estimation will usually satisfy this requirement.

5.A.6.4. Measurement of Spot Position and Displacement

5.A.6.4.1. Spot Position-Electrostatic Deflection

The spot position relative to the geometric centre of the screen shall be measured with all the deflecting plates connected directly to the final anode and any effects of external electrostatic and magnetic fields allowed for or eliminated.

For electrostatically focussed tubes the spot shall be adjusted to optimum focus.

For magnetically focussed tubes no focussing shall be present.

The grid voltage may be adjusted to any convenient value.

5.A.6.4.2. Spot Position-Magnetic Deflection

The spot position relative to the geometric centre of the screen shall be measured without deflecting fields applied and with any effects of external electrostatic or magnetic fields allowed for or eliminated.

For electrostatically focussed tubes the spot shall be adjusted to optimum focus.

For magnetically focussed tubes no focussing field shall be present.

The grid voltage may be adjusted to any convenient value.

5.A.6.5. Spot Displacement (Leakage)

With the spot adjusted to optimum focus and each deflecting plate connected to the final anode through a 10 megohm resistor, the short circuiting of each resistor in turn shall not produce a spot displacement in excess of the specified limit.

5.A.6.6. Spot Displacement (Beam Current Effects)

With the specified plate resistors and the deflector plates connected symmetrically the spot, line or raster shall be examined for shift of position when the grid voltage is changed from cut off to the voltage required for the specified light intensity.

When necessary the grid may be pulsed to prevent damage to the screen by excessive beam current.

5.A.7. MEASUREMENT OF MECHANICAL REQUIREMENTS

5.A.7.1. Alignment Tests

5.A.7.1.1. Mechanical Alignment

Mechanical features, such as those listed below shall be measured or checked by such gauges or dimensions as are specified.

(a) Alignment of side terminal to base reference

(b) Alignment of neck axis to bulb axis

(c) Degree of face tilt to major axis

(d) Neck straightness

(e) Perpendicularity of glass soleplate to neck.

5.A.7.1.2. Side Terminal Alignment

This shall be measured as the angle between a specified trace and a plane passing through the centre of the side terminal and the axis of the tube.

5.A.7.1.3. Base Alignment

This shall be measured as the angle between the trace produced by the specified deflection plates and the plane passing through a specified pin and the axis of the tube.

5.A.7.1.4. Electrostatic Deflection Direction

The spot shall be deflected in the direction of the specified base or other reference points when a positive potential is applied to the Y1 and X1 deflection plate successively.

5.A.7.2. Resistance to External Pressure

The completed tube shall be subjected to an external pressure of 45 lbs per square inch absolute for a period of not less than 60 seconds and not more than 90 seconds. This pressure shall be attained in not less than 20 seconds and not more than 60 seconds.

The appearance of any form of crack or fractire after this test shall constitute a failure. Tubes which are sound mechanically but failures in electrical tests may be used for this purpose.

5.A.8. LIFE TESTS

See Section 13.

5.A.9. SAMPLING INSPECTION

See Section 6.

LOOSE PARTICLES IN CATHODE RAY TUBES.

PARTICLE MATERIAL AND SIZE CLASSIFICATION

GROUP	MATERIAL	LIMIT QUANTITY	SIZE
1	Glass	1 piece	A
2	Ceramic	1 piece	A
3	Metal (assessed on linear dimensions, not on area)	1 piece	A
4	Graphite, Mica or Lead Sulphide	One of each	C
5	Dust (i.e. Any particle of size not greater than 1/5th of A)	25 square mm. max. area.	

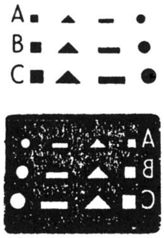


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FIG. 5A/1

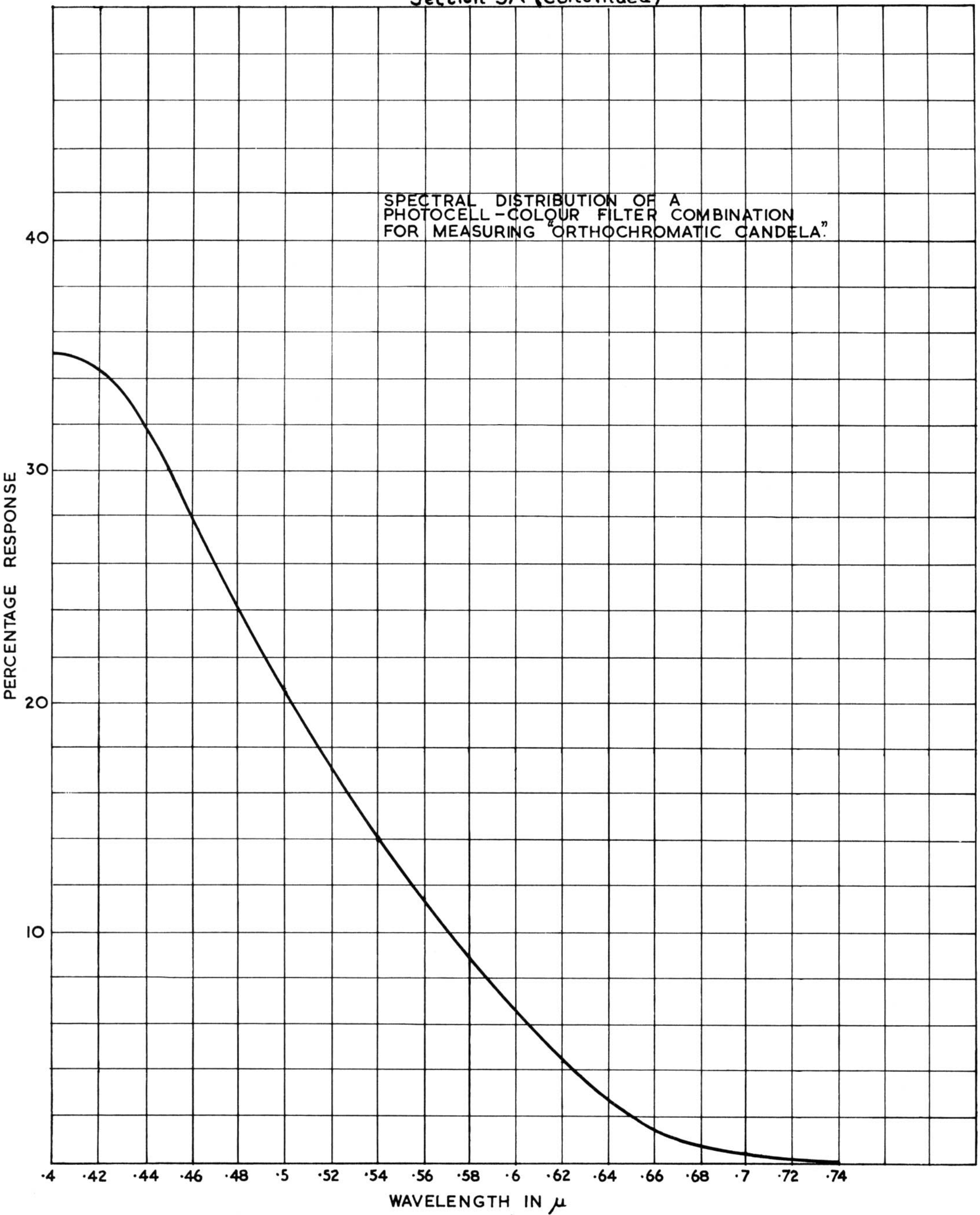
SPECTRAL DISTRIBUTION OF A PHOTOCELL-COLOUR FILTER COMBINATION FOR MEASURING "ORTHOCHROMATIC CANDELA."
40
30
20
10
PERCENTAGE RESPONSE
·4
·42
·44
·46
·48
·5
·52
·54
·56
·58
·6
·62
·64
·66
·68
·7
·72
·74
WAVELENGTH IN μ

FIG. 5A/2

SECTION 5B

V.M. VALVES (KLYSTRONS)

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- 5.B.4.7. Amplifier Gain Linearity
- 5.B.4.8. Amplifier Stability.

V.M. VALVES (KLYSTRONS)

This section refers to the requirements to be met by those velocity modulated valves designated "Klystrons" in the Test Specification which are supplied for Service use and whose mean power output does not exceed 10 watts.

The General Test conditions shall apply to all valves but the individual tests contained herein shall only apply when specified in the Test Specifications.

If differences occur between the test figures obtained by the manufacturer and those obtained at the Service Establishments the Approving Authority will provide an agreed correction for the guidance of the Inspecting Authority.

5.B.1. Definitions

5.B.1.1. Warm-up Times

5.B.1.1.1. Heater Warm-up Time is the period between the commencement of the application of heater voltage and the start of application of the H.T. voltage.

5.B.1.1.2. Oscillator Warm-up Time is the period between the start of application of H.T. voltage and the moment at which the operating frequency has reached a steady value within a specified tolerance (Δf) and/or where the R.F. power output has reached a specified minimum value.

5.B.1.1.3. Total Warm-up Time is the period between the start of application of heater voltage and the moment at which the operating frequency has reached a steady value within a specified tolerance (Δf) and/or the R.F. power output has reached a specified minimum value.

5.B.1.2. Optimum Power Output is the maximum power output which can be obtained by adjustment when the valve is operating under specified conditions.

5.B.1.3. Frequency

5.B.1.3.1. Frequency of Oscillation is the frequency at which the valve is operating after stability has been reached when looking into a load which shall be matched unless otherwise specified.

5.B.1.3.2. Pulsed Klystron. The frequency of oscillation is that value at which the power output is at the peak value.

5.B.1.3.3. Frequency Tuning Range

5.B.1.3.3.1. Oscillators is that maximum range over which the valve may be tuned with the optimum power output equal to or greater than, the specified minimum value.

5.B.1.3.3.2. Amplifiers - is that range over which the valve operating under specified conditions may be tuned to provide:-

(a) A minimum specified gain when a specified power input is applied.

and/or (b) A minimum specified power output when the power input is adjusted within a specified range for maximum power output at each frequency.

5.B.1.3.4. Frequency Tuning Rate is the rate of change of the Frequency of Oscillation which is obtained when maintaining optimum power output conditions the mechanical tuning control is adjusted as specified. The Tuning Rate is expressed as frequency units per unit change of mechanical tuning control position.

5.B.1.3.5. Mechanical Tuning Range is that continuous frequency range within two frequency points at which the R.F. power output delivered into a matched load is half the optimum power output when the specified operating conditions are changed from the optimum by the adjustment of the mechanical tuning control within the specified limits in either direction from a specified frequency point.

5.B.1.3.6. Mechanical Tuning Rate is the rate of change of the Frequency of Oscillation within the Frequency Tuning Range which is obtained when, under preset optimum operating conditions at a reference frequency, the mechanical tuning control is adjusted as specified. It is expressed as frequency units per unit of mechanical tuning control position.

5.B.1.3.7. Mechanical Tuning Hysteresis is the frequency difference obtained under preset operating conditions when a mechanical tuned frequency setting point is reached when approached from two different directions in a specified manner.

5.B.1.3.8. Electronic Tuning Range is that continuous frequency range within two frequency points at which the power output delivered into a matched load is half the optimum power output when the specified operating conditions are altered from the optimum by adjustment of the electronic tuning control within the specified limits.

5.B.1.3.9. Electronic Tuning Rate is the rate of change of the Frequency of Oscillation which is obtained when, under preset optimum operating conditions at a reference frequency the electronic tuning voltage is adjusted as specified and it is expressed as frequency units per unit voltage change.

5.B.1.3.10. Electronic Tuning Hysteresis is preset when, with the valve operating under specified conditions the power output or operating frequency can have more than one value for the same electronic control voltage. It is expressed as the percentage ratio of the power output at the onset of hysteresis to optimum power output.

5.B.1.3.11. Frequency Drift is the change in oscillation frequency caused by variation in temperature of the body of the valve. The temperature shall be measured at a specified point when the valve is operating under prescribed conditions.

5.B.1.3.11.1. Temperature Coefficient is the quotient of the Frequency Drift divided by its associated temperature variation and is expressed as frequency change per degree Centigrade.

5.B.1.3.12. Warm-up Frequency Drift is the total change in oscillation frequency which occurs in the valve.

(a) During the Oscillator Warm-up Time

or (b) Within a specified time interval after the application of H.T. voltage.

5.B.1.3.13. Frequency Pulling is the difference between the extremes of Frequency of Oscillation which occur when a specified load mismatch is varied through all phases.

5.B.1.3.14. Frequency Pushing

5.B.1.3.14.1. Current Pushing is the change in the frequency of Oscillation which is caused by the variation of electron beam current and is expressed as frequency per unit cathode current.

5.B.1.3.14.2. Voltage Pushing is the change in the Frequency of Oscillation which is caused by variation of the H.T. voltage applied to the valve and it is expressed as frequency units per unit volt change.

5.B.1.4. Electron Beam Efficiency (Multi-Cavity Valve) is the ratio of the electron beam current collected by the collector electrode to the total electron beam current.

5.B.1.5. Total Reflector Current is that current flowing in the reflector circuit which is composed of (a) leakage current, (b) Gas current and (c) Current caused by the electron bombardment of the reflector electrode.

5.B.1.6. Noise

5.B.1.6.1. Excess R.F. Noise is the sum of the R.F. noise powers contributed by the valve in two identical channels equally spaced on either side of the Frequency of Oscillation and spaced from each other by twice a specified I.F. frequency.

5.B.1.6.1.1. Noise Factor is the ratio of the excess R.F. Noise to the thermal noise power in the same two channels at 290^{o}K.

5.B.1.6.2. Noise Modulation is

(a) The amplitude modulated noise over a specified frequency band expressed as sideband noise power relative to the carrier frequency power and given in decibels.

and/or (b) The frequency modulated noise over a specified frequency band and is expressed as the root mean square value of frequency deviation in cycles per second which would provide sideband power equal to the noise power within the same specified frequency band.

5.B.1.7. Cold Impedance (Pulse Operation) is the impedance presented by a valve during the non-oscillating period between pulses to an applied C.W. signal whose frequency is equal to the Frequency of Oscillation.

5.B.1.8. Heater Modulation Effect is the modulation of the R.F. output caused by an a.c. heater supply or to a.c. ripples on a d.c. heater supply.

5.B.1.8.1. Heater Modulation Factor (Oscillators). The Heater Modulation Factor is expressed as

(a) The amplitude modulation depth at (n) cycles per second per ampere of heater ripple current.

and/or (b) The phase modulation index at (n) cycles per second per ampere of heater ripple current.

Where (n) is the frequency of the a.c. ripples or a.c. heater supply.

5.B.1.9. Amplifier Power Gain is the ratio of the R.F. Power out of the amplifier operating under given conditions into a matched load relative to the R.F. power input and is expressed in decibels.

5.B.1.10. Amplifier Gain Linearity is the constancy of the power gain with variation of drive input power when the valve is operating under specified conditions. The deviation of gain from a constant value is expressed in decibels.

5.B.1.11. Amplifier Stability is the ability of the amplifier valve to provide stability of output power within a specified power deviation limit for given operating and drive conditions after a prescribed interruption of H.T. Supply. The change in power output may be expressed as a percentage of power output or given as a change in power output expressed in decibels.

5.B.1.12. H.T. Voltage is that voltage which is applied to the appropriate valve electrode for the purpose of producing the flow of electron beam current.

5.B.1.13. Pulse Characteristics

5.B.1.13.1. Pulse Amplitude. The amplitude of a pulse waveform is the peak value of a curve drawn through the average of the deviations on the top of a pulse. Any spike on the leading edge of duration less than 10% of the pulse length shall be ignored.

5.B.1.13.2. Pulse Voltage. The pulse voltage is the amplitude of the voltage pulse.

5.B.1.13.3. Pulse Current. The pulse current is the amplitude of the current pulse.

5.B.1.13.4. Pulse Length

(a) The pulse length is the time during which the current exceeds 50% of the Pulse Current.

(b) Alternatively, when the Inspection Authority agrees, the pulse length may be defined and determined from the following expression.

$$\text{Pulse Length} = \frac{Im}{Ip \times \text{P.R.F.}}$$

where

Im = Indicated mean current

Ip = Pulse current

P.R.F.= Pulse Repetition Frequency

5.B.1.14. Pulse Repetition Frequency is the frequency at which a pulse is applied within a period of one second.

5.B.1.15. Duty Cycle. The Duty Cycle is the product of pulse length and the pulse repetition frequency.

5.B.1.16. Peak Output Power (Pulse Operation)

For the purposes of the tests contained in this section the following definition shall apply:-

$$\text{Peak Output Power} = \frac{\text{Mean Output Power}}{\text{Duty Cycle}}$$

5.B.1.17. R.F. Load is all that part of the circuit which receives R.F. power from and constitute the termination of the specified coupling device, mount, or section.

5.B.1.17.1. R.F. Load Mismatch. The mismatch of the R.F. Load at any frequency is either the voltage reflection co-efficient or the V.S.W.R. (greater than unity) which would occur in a test section consisting of a straight uniform length of transmission line or waveguide, whose cross section has dimensions equal to the nominal dimensions specified for the R.F. load, if it were fed with a C.W. Signal of that frequency from a matched source and terminated by the load.

Where the dimensions of the load waveguide are not specified, the dimensions of the test section shall be equal to the standard waveguide dimensions appropriate to the test frequency. (ref: RCL 351, Table I.)

5.B.2. General Test Conditions

5.B.2.1. Frequency and Wavelength

5.B.2.1.1. If frequencies are converted to wavelength for the convenience of testing, the value

$$C = 2.998 \times 10^{10} \text{ cm/sec.}$$ shall be used

5.B.2.1.2. Specified frequencies within the Frequency Tuning Range shall be within an accuracy of 0.2%. When required the end of the range frequency shall be within 0.2% of the specified value.

5.B.2.2. Tuning. The valve shall be capable of being tuned smoothly and without discontinuity over the specified Frequency Tuning Range.

Unless otherwise stated the frequency range shall be covered using the same oscillatory mode. Where a change in mode is permitted, the change shall not constitute a discontinuity.

5.B.2.3. Voltages and Currents. All specified voltages and currents shall be within the accuracy provided by a B.S. Grade 1 instrument. Applied d.c. values shall not have a superimposed ripple component greater than 0.1% of the specified value.

5.B.2.4. Matched Load. The matched load shall not present a maximum total R.F. loading impedance to the valve which shall give rise to a V.S.W.R. exceeding 1.1:1 at the Frequency of Oscillation.

5.B.2.5. Measurement of Power

5.B.2.5.1. Crystal Rectifiers. An approved method of calibrating the crystal response in terms of relative power levels shall be used when output power is measured by means of the output of a crystal rectifier.

5.B.2.5.2. Thermistors

5.B.2.5.2.1. When output is measured by means of a thermistor the condition of maximum thermistor output shall be used if this condition and that of best thermistor match do not coincide provided that precautions are taken to ensure the valve under test operates into a matched load.

5.B.2.5.2.2. Thermistors for use at wavelengths shorter than 5 cms shall have their output response in terms of relative R.F. power levels checked by an approved method. Appreciable error may be experienced due, for example, to the effect of the thermistor capacity causing a low impedance shunt across the measuring element.

5.B.2.6. External Cavities. (Plug-in Klystrons). All test cavities and assemblies shall be those specified and/or approved by the Approval Authority.

5.B.2.7. Mechanical Tuning Rate and Range Tests. If after setting the reference frequency the end stops limit the travel of the tuner spindle to values less than those specified, measurements shall be made between the limit point of the tuner and that position obtained with the spindle turned by the specified value towards the mid-band position from the limit point.

5.B.3. Electrode Voltage and Current Tests

5.B.3.1. Heater

5.B.3.1.1. Heater Current. The heater current shall be measured when it is substantially stable or following a specified time interval. Unless otherwise stated the H.T. voltage shall be applied.

5.B.3.1.2. Heater Power shall be within 4% of the specified value.

5.B.3.1.3. Heater Warm-up Time. The H.T. voltage shall be applied when the specified time period has elapsed. This time period shall not normally exceed 5 (five) minutes.

5.B.3.2. Grid Current. The total external resistance of the grid circuit shall not exceed 100,000 ohms, except when the maximum current value is 0.5/μA d.c. or less, in which case the resistance may be increased to 1.0 Megohm maximum.

The total grid current shall be measured under specified operating conditions by means of a series current meter after a period of at least five minutes unless otherwise specified. Readings shall be made when current stability has been achieved.

5.B.3.2.1. Grid Current (Pulsed Valves). In valves where the grid is pulsed positive the conditions shall be as in (5.B.3.2.) but the grid current shall be measured immediately after the grid has been biased to cut-off conditions from the steady state conditions specified.

5.B.3.3. Reflector Current

5.B.3.3.1. Total Reflector Current. The total reflector current shall be measured with the specified voltages applied to the valve by one of the following Methods. The specification shall state whether the valve shall be oscillating during this test.

Method I. The reflector current shall be measured using an approved current meter in the reflector circuit.

Method II. The frequency deviation caused by switching a specified high resistance into and out of the reflector circuit shall be observed. The value of reflector current may then be calculated:-

(a) From the reflector voltage change required to return the operating frequency to its original value.

or (b) From the frequency/reflector voltage characteristic if available.

5.B.3.3.2. Reflector Leakage Current. At the conclusion of the Total Reflector Current test (5.B.3.3.1.) the cathode connection shall be opened, or the resonator current reduced to zero by means of grid bias. The reflector current shall then be measured and considered as Leakage current.

5.B.3.3.3. Reflector Gas Current. The value of Current determined in the Reflector Leakage Current test (5.B.3.3.2.) shall be subtracted from the value of Total Reflector Current measured under non-oscillatory conditions. This difference shall be considered as the reflector gas current.

5.B.3.4. Emission. The valve shall not oscillate unless otherwise specified. When required to oscillate the valve shall operate at the reference frequency under optimum power output conditions, and under thermal equilibrium at the specified heater voltage. When steady state conditions are obtained the heater voltage shall then be increased or lowered as specified and after a period of at least 2 minutes, or as specified, the resonator current shall again be measured. The change in current shall be expressed as a percentage ratio taken against the value of current obtained with the lower heater voltage.

5.B.4. R.F. Tests

5.B.4.1. Power Output. The valve shall oscillate at the reference frequency and the tuning controls shall then be adjusted within the specified limits to provide optimum R.F. power into a matched load. The power output shall then be measured.

5.B.4.2. Tuning

See 5.B.2.2. and 5.B.2.7.

5.B.4.2.1. Frequency Tuning Range. The valve shall be adjusted to operate under optimum power output conditions when coupled to a matched load. Maintaining optimum power output conditions the valve shall be tuned within the specified limits and the frequency range measured.

5.B.4.2.2. Frequency Tuning Rate. The valve shall be adjusted to operate at the reference frequency under optimum power output conditions when coupled to a matched load. The mechanical tuning control shall be adjusted in either direction as specified, (5.B.2.7.) and the electronic tuning control adjusted to obtain optimum power output. The frequency shall then be measured and the Tuning Rate determined.

5.B.4.2.3. Mechanical Tuning Range. The valve shall be adjusted to operate at the reference frequency under optimum power output conditions when coupled into a matched load. The mechanical tuning control shall then be adjusted above and below the reference frequency setting point, in the specified manner, and the Mechanical Tuning Range measured.

5.B.4.2.4. Mechanical Tuning Rate. The test shall be performed as given in the Mechanical Tuning Range test (5.B.4.2.3.) and the Tuning Rate obtained.

5.B.4.2.5. Mechanical Tuning Hystereses. The valve shall operate at the reference frequency under optimum power output conditions when coupled to a matched load. The mechanical tuning shall be cycled over the complete frequency-tuning range three times, then returned to the original frequency setting point, and the frequency measured. The tuning spindle shall then continue to be tuned in the same direction to the end of the range and again returned to the original frequency setting point when a second measurement of frequency shall be made. The Mechanical Tuning Hysteresis may then be calculated.

5.B.4.2.6. Electronic Tuning Range. The valve shall operate at the specified frequency under optimum power output conditions when coupled to a matched load. The electronic tuning voltage shall then be varied above and below the value giving maximum power output to that value giving half the maximum Power obtained in this test. The frequencies at which the half power points are obtained shall be measured.

5.B.4.2.7. Electronic Tuning Rate. Since the electronic tuning rate is not constant over the electronic tuning range this measurement shall be made by a dynamic method or any approved alternative. In order to obtain an accurate measurement it is required that the change in electronic tuning control shall be small.

5.B.4.2.8. Electronic Tuning Hysteresis. The valve shall operate at the reference frequency under optimum power output conditions when coupled to a matched load. In addition to the direct voltage required for the specified mode of operation, a sweep voltage at 50 cycles, or some other approved frequency shall be applied between the controlling electrode and the cathode. The amplitude of the sweep voltage shall be sufficient to suppress oscillations in the valve on both positive and negative sweep voltage peaks. The power output of the valve shall be examined as a function of the sweep voltage in an approved manner. Observations for Electronic Tuning Hysteresis shall be made.

ALTERNATIVELY the d.c. controlling voltage may be manually operated to provide the sweep voltage in lieu of the applied a.c. voltage.

5.B.4.3. Frequency

5.B.4.3.1. Frequency Drift. The valve shall operate under optimum power output conditions at the reference frequency. The body temperatures shall be varied in an approved manner.

5.B.4.3.1.1. Temperature Coefficient shall be determined from the frequency/temperature characteristic obtained in the Frequency Drift test (5.B.4.3.1.).

5.B.4.3.2. Frequency Pulling. The valve shall operate under optimum power output conditions when coupled into the specified load mismatch. The Frequency Pulling value shall be determined by observation of the extremes of frequency obtained during the variation of mismatch through all phases.

5.B.4.3.3. Frequency Pushing. The valve shall operate under optimum power output conditions when coupled into a matched load. Variation of H.T. electrode supply as specified shall be effected in an approved manner and the Frequency Pushing value obtained.

5.B.4.4. Noise

5.B.4.4.1. Excess R.F. Noise. The valve shall be connected to a circuit as shown in Fig. 5.B.1. or its approved equivalent. Waveguide components used in the test valve circuit shall have negligible variation in their electrical parameters over a minimum frequency band of twice the specified IF amplifier bandwidth centred at the reference frequency to ensure constant loading of the valve over this range. The high Q cavity shall be required to suppress the relevant noise sidebands without attenuating the required output signal. The noise source to be of an approved type and shall be specified.

The local oscillator valve shall be adjusted to operate at the reference frequency under optimum power output conditions. The power into the receiver crystal shall be adjusted to the specified level as indicated by the crystal rectified current.

The noise power indicated on the output shall be noted. The specified noise generator shall then be switched on and the resulting increase in indicated noise output shall be adjusted to an arbitary level (say twice the noted receiver noise level) by means of the calibrated attenuator. The attenuator and meter readings shall be noted. The local oscillator valve shall then be switched off and the valve under test tuned in the specified mode to the reference frequency under optimum output power conditions. The power into the receiver crystal shall be adjusted to the same specified level as supplied originally by the local oscillator. The indicated noise level shall be returned to the value obtained using the local oscillator value by adjustment of the calibrated attenuator and the noise factor of the test valve determined.

Alternatively, the noise figure may be obtained using an accurately calibrated square law output meter.

By employing a R.F. phase bridge to enable an effective filter to be inserted or removed, the separate local oscillator may be dispensed with. The circuit is shown in Fig. 5.B.1(a).

5.B.4.4.2. Noise Modulation. The valve shall operate under the specified operating conditions and the output coupled into an appro ed noise measuring equipment. Recordings of amplitude modulated noise and/or frequency modulated noise against frequency shall be made within the specified bandwidth centred at the specified frequencies or within the specified frequency range off the carrier frequency. The noise modulation values obtained shall be expressed as defined.

5.B.4.5. Heater Modulation Effect. This effect is of importance in an oscillator type valve from the frequency stability point of view, whereas in an amplified type valve the significant effect may be one of amplitude and/or phase modulation.

The valve shall be coupled to a transmission system terminated by a matched mixer crystal coupled to a specified I.F. amplifier. The amplifier output shall be applied to a calibrated discriminator followed by a narrow band a.c. amplifier tuned to the required ripple frequency.

The valve shall be adjusted to operate at the reference frequency under optimum power output conditions within the specified test conditions. The control electrode voltages shall be supplied from an approved d.c. source having no significant ripple voltage superimposed. The heaters shall be d.c. heated and a known amount of a.c. ripple shall be superimposed at the specified frequency (n) cps. The amplitude of the a.c. amplifier output shall be measured, converted into terms of frequency deviation and expressed as R.M.S. frequency deviation at (n) cps. ($\sqrt{\Sigma\Delta f_0^2}$ cps) per ampere of heater ripple current where f_0 is the instantaneous frequency deviation.

Where the frequency deviation is small and may possibly be obscured by random effects it will be necessary to use a transmission line bridge system as shown in (Fig. 5.B.2.) or its approved equivalent. The bridge output and a reference signal shall each be applied to similar high gain linear amplifiers. After amplification the two signals shall be applied to a sign detector circuit and the output measured.

5.B.4.6. Amplifier Power Gain. The valve shall be connected to a transmission system which is coupled to an approved power measuring device and terminated by a matched load. The valve shall operate, within the specified limits, with the input drive and the output power adjusted for optimum conditions, at approved test frequencies within the specified frequency band. The relative input and output powers shall be measured at each test frequency and the input power/frequency and output power/frequency characteristics over the tuning range obtained.

There shall be no discontinuity of operation of the valve over the specified tuning range.

It is essential that all R.F. components are of adequate bandwidth, or to have been accurately calibrated, to ensure accuracy of measurement over the specified frequency band.

5.B.4.7. Amplifier Gain Linearity. The valve shall operate with optimum drive power at the reference frequency under optimum power output conditions when coupled to a matched load. The drive power shall be varied from the optimum value by the specified amount, and the output power from the valve under test measured.

5.B.4.8. Amplifier Stability. The valve shall operate with optimum drive input at the reference frequency under optimum power output conditions when coupled into a matched load. The output power shall be measured. The H.T. supply to the valve under test shall then be switched off. After a specified period of at least one minute the H.T. shall again be applied. The output shall then be monitored and the maximum power deviation recorded during the specified time interval.

5.B.5. Low Temperature (Operating).

Where tests are to be performed at a reduced temperature, the conditions specified in Section 10.4 shall apply.

5.B.5.1. During Qualification Approval testing, the valves shall, with the exception of any frequency tests, pass the primary and secondary electrical tests specified in the detail test specification.

5.B.5.2. During Production Acceptance testing, the valves shall pass certain primary electrical tests specified in the detail test specification.

5.B.5.3. Change in Output Power and Frequency During Temperature Rise

The output power and frequency shall be measured at specified times after the simultaneous application of all supplies. The maximum change in frequency and output power shall not exceed the limits specified in the detail test specification. The heat sink, cooling conditions and the impedance of the heater supply shall be specified.

5.B.6. High Temperature (Operating)

Where tests are required to be performed at a temperature of 150°C, the conditions specified in Section 10.5 shall apply.

5.B.6.1. During Qualification Approval testing, the valves shall, with the exception of any frequency tests, pass the primary and secondary electrical tests specified in the detail test specification.

5.B.6.2. During Production Acceptance testing, the valves shall, with the exception of any frequency tests, pass the primary electrical tests specified in the detail test specification.

5.B.7. Torque (Tuning Shaft) (Normally performed during Q.A. testing only).

Measurement of minimum and maximum starting torques shall be made with the valve either operating or non-operating as specified and at both the specified high and low temperatures. A suitable method of performing this test is to observe the positions of the maximum and minimum torques while the shaft is being rotated. The shaft shall then be set to these positions and the starting torques measured.

5.B.8. Operation Life. (Normally performed during Q.A. testing only).

Where an operation life test at high temperature is required, the conditions specified in Appendix VI/6.2 shall apply. On completion of the test the valve shall pass the high temperature test end points specified in the detail test specification.

5.B.9. High and Low Temperature Life (Non-Operating)

(Normally performed during Q.A. testing only).

5.B.9.1. Low Temperature

Where a test for low temperature storage is required the conditions specified in Appendix VI/6.1 shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.B.9.2. High Temperature

Where a test for high temperature storage is required, the conditions specified in Appendix VI/6.2 shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.B.10. Temperature Cycling

5.B.10.1. Temperature Cycling (1)

Where a temperature cycling test is required to be performed, the conditions specified in Section 10.6 shall apply. The valve shall be non-operating. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.B.10.2. Temperature Cycling (2). (Normally performed during Q.A. testing only).

The valve supplies shall be switched on simultaneously at normal ambient temperature, and the valve allowed to reach 100°C. The supplies shall then be switched off and the valve allowed to cool naturally to its original temperature. The valve shall be subjected to five of these cycles. The frequency shall be measured at the commencement of each cycle while the body reference temperature still corresponds to the initial temperature.

5.B.11. Air Pressure Tests (Normally performed during Q.A. testing only).

5.B.11.1. Low Pressure

Where a low pressure test is required, the conditions specified in Section 10.8.1 shall apply. The valves shall operate satisfactorily and there shall be no evidence of corona, voltage breakdown or over-heating. The frequency change (Δ f) caused by the change in pressure shall be measured. When specified the waveguide shall be pressurized.

5.B.11.2. High Pressure

Where a high pressure test is required, the conditions specified in Section 10.8.2. shall apply. On completion of the test the valve shall pass certain primary electrical tests specified in the detail test specification.

5.B.12. Moisture Resistance. (Normally performed during Q.A. testing only)

Where a test for moisture resistance is required, the conditions specified in Section 10.7 shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail specification.

5.B.13. Heater Resonance and Fatigue

Where a test for heater resonance and fatigue is required, the conditions specified in Section 11.6 shall apply. On completion of the test the valve shall pass the specified life test end points.

5.B.14. Functional Vibration

Where a functional vibration test is required, the conditions specified in Section 11.7 shall apply.

During the test, the changes in, frequency, (either frequency shift or frequency modulation), output power and reflector current, shall be monitored.

Method A. shall be used during Qualification Approval testing.

Method B. shall be used during Production Acceptance testing.

5.B.15. Vibration Life

Where a vibration life test is required, the conditions specified in Section 11.8 shall apply. During this test the changes in, frequency (either frequency shift or frequency modulation), output power and reflector current shall be monitored.

5.B.16. Fatigue Vibration

Where a vibration fatigue test is required, the conditions specified in Section 11.9 shall apply. On completion of the test, the valve shall pass the primary electrical tests specified in the detail test specification.

5.B.17. Functional Shock.

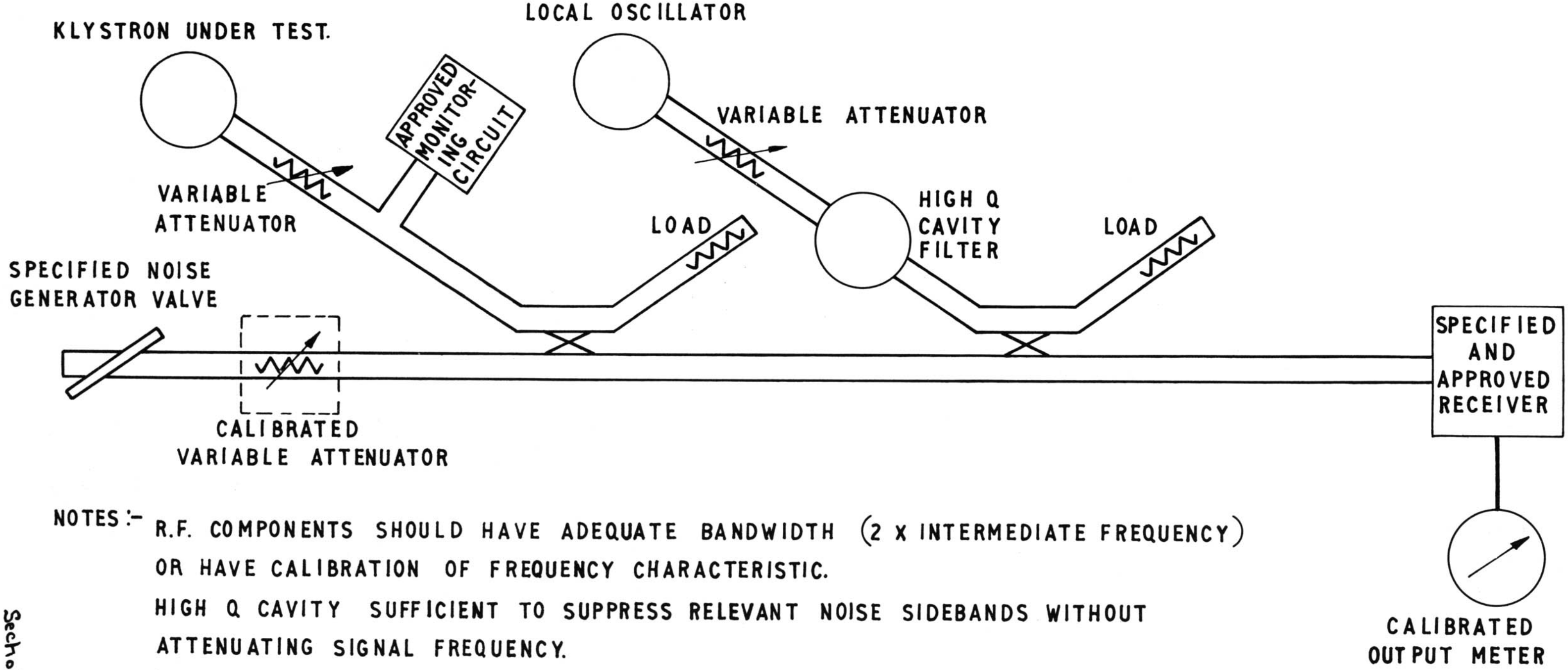
Where a shock test is required, the conditions specified in Section 11.10 shall apply. Frequency deviation and change in output power shall be measured immediately after completion of the test.

Method A. shall be used during Qualification Approval testing.

Method B. shall be used during Production Acceptance testing.

5.B.18. Tuner Side-thrust Test

A specified side thrust shall be applied to the top of the tuning shaft along each of two mutually perpendicular axes both of which are perpendicular to the shaft axis. The frequency deviation shall be measured.



NOTES :- R.F. COMPONENTS SHOULD HAVE ADEQUATE BANDWIDTH (2 x INTERMEDIATE FREQUENCY) OR HAVE CALIBRATION OF FREQUENCY CHARACTERISTIC.

HIGH Q CAVITY SUFFICIENT TO SUPPRESS RELEVANT NOISE SIDEBANDS WITHOUT ATTENUATING SIGNAL FREQUENCY.

IF APPROVED FOR LOW NOISE MEASUREMENTS INTRODUCTION OF FILTER TO AFFECT INCREASE IN NOISE TO SIGNAL RATIO MAY BE PERMITTED.

EXCESS NOISE MEASUREMENT.

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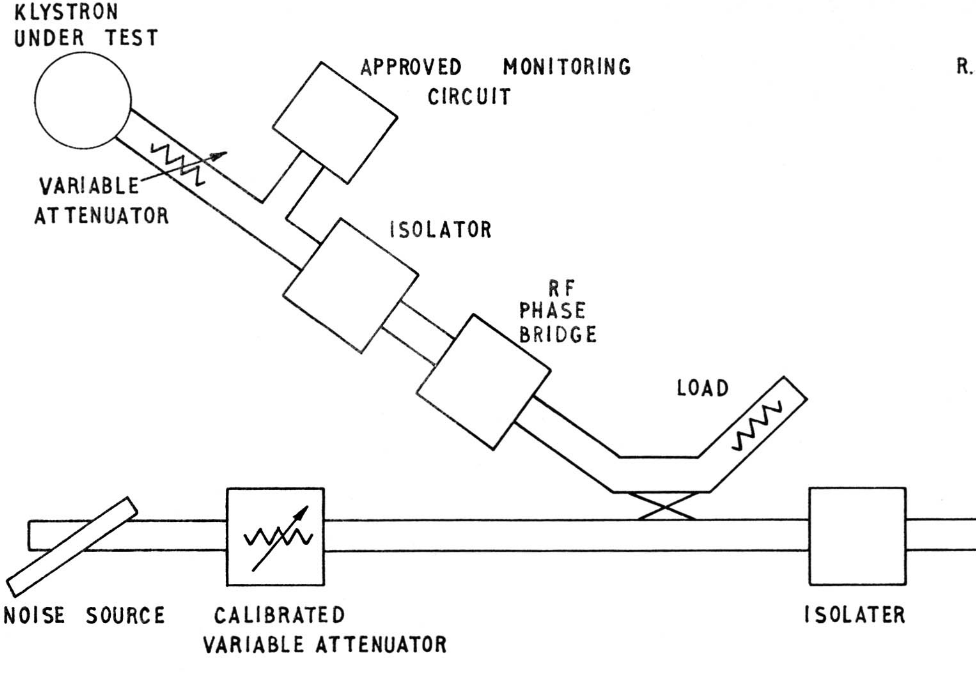
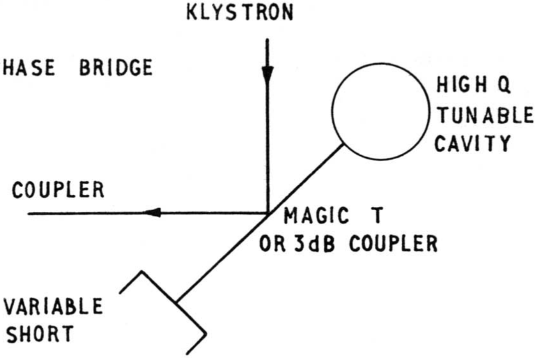


R.F. PHASE BRIDGE



OPERATION

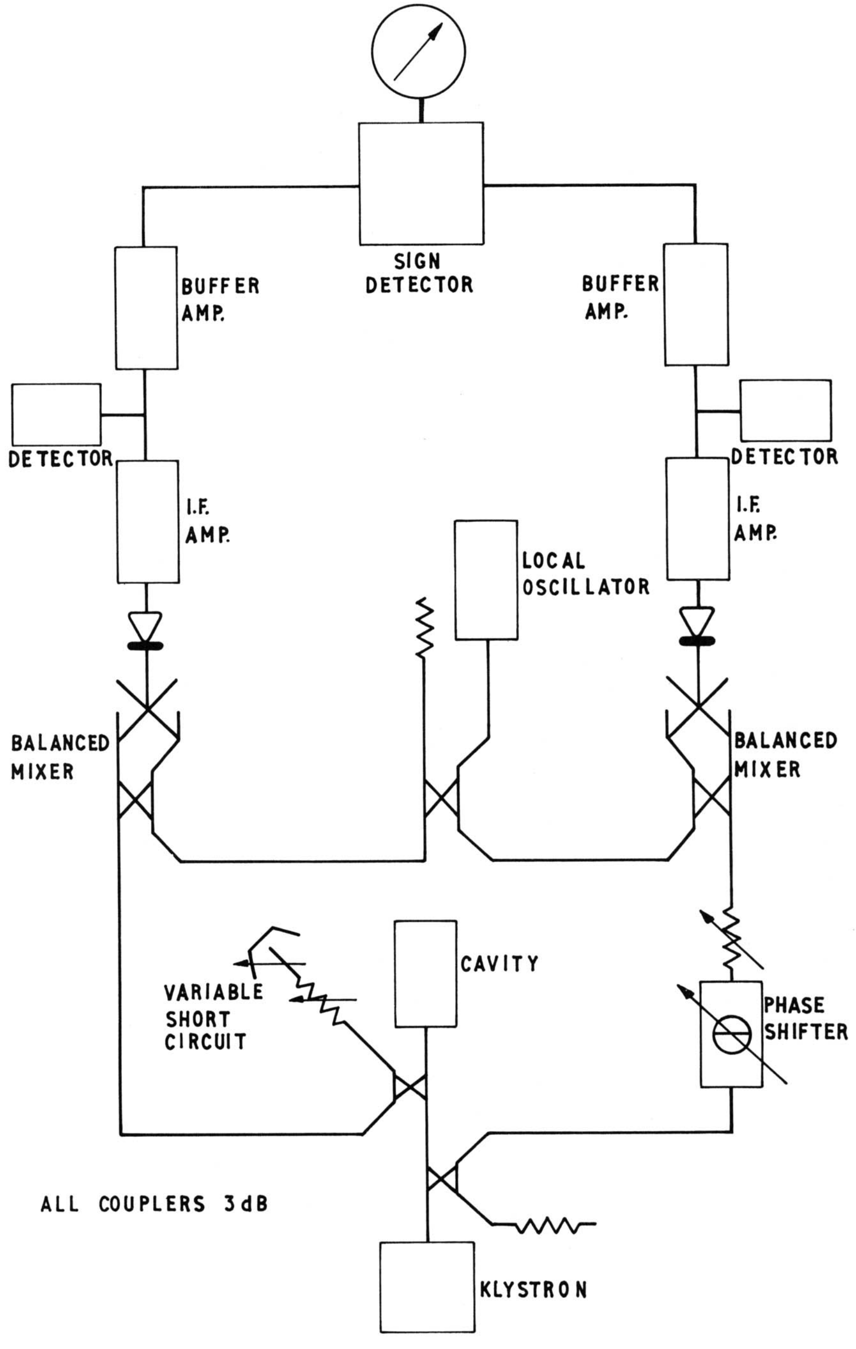
FILTER IN-SET VARIABLE SHORT FOR MINIMUM TRANSMISSION AND THEN TUNE CAVITY FOR MAXIMUM TRANSMISSION

FILTER OUT-DETUNE CAVITY AND ADJUST VARIABLE SHORT FOR MAXIMUM TRANSMISSION

NOTE:-

FOR OPTIMUM FILTER ACTION MATCH CAVITY TO WAVEGUIDE AT SIGNAL FREQUENCY

5B2



SCHEMATIC DIAGRAM FOR SENSITIVE FREQUENCY MODULATION MEASUREMENTS.

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Section 5C

ACCEPTANCE TESTS FOR SEMICONDUCTOR DIODES

5.C.1 Unless otherwise stated in the Test Specification, Semi-Conductor Diodes shall comply with all Sections of this specification except sections 5.2 to 5.10 inclusive, 5.13, 5A, 5B, 5D, 5E, 5F, 7, 12 and 13.

In addition, the following tests may be required and when specified they shall be applied on a Sampling Inspection basis in accordance with the procedure given in Appendix X1 Section 1 "Sampling Inspection by Attributes".

5.C.2 MECHANICAL TESTS

5.C.2.1 Fatigue Test. This test shall be applied in accordance with Section 11.3 except that the force shall be in two directions mutually at right angles. One of the directions shall be along the axis of the diode. For diodes having both connecting leads at one end, one of the directions shall be at right angles to the plane through the leads.

5.C.2.2 Shock Test. This test shall be applied in accordance with Section 11.4 except that the directions of shock shall be:-

(a) in the plane through the connecting leads.
(b) at right angles to the plane through the connecting leads.

For diodes having both connecting leads at one end the shock shall also be applied in the third mutually perpendicular plane both towards and away from the base.

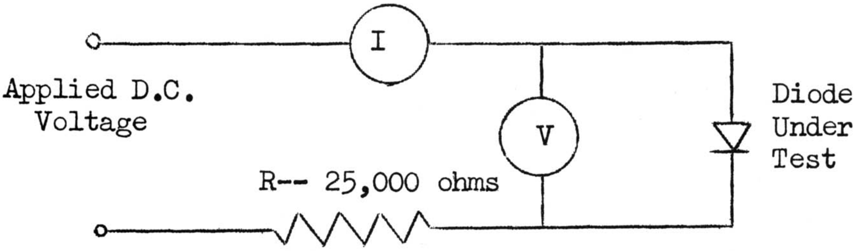
5.C.3 TEMPERATURE CYCLING TEST. The diodes shall be subjected to the specified number of complete cycles of temperature change. The specified extremes of temperature shall be maintained for at least 15 minutes. The time of changing from one temperature extreme to the other shall be not less than 15 minutes nor exceed 30 minutes. The test may start at any point in the cycle.

5.C.4 CLIMATIC CYCLING. This test shall comply with Section 10.1 except that the duration of the test shall be as given in the Test Specification. The Test Specification will also state the electrical tests to be applied during or after the Climatic treatment.

5.C.5 LIFE TESTS. When required by the Test Specification these shall be applied in accordance with the relevant sections of Appendix V1 and with the following additional requirements.

5.C.5.1 Storage Life Test. The diodes shall be stored under the temperature conditions and for the duration stated in the Test Specification. The Test Specification will also state the electrical tests to be applied after the Storage Life Tests.

5.C.6 PEAK INVERSE VOLTAGE TEST. Diodes shall be tested in a circuit equivalent to that shown below.



The applied voltage shall be adjusted until a condition is reached at which a further increase in the applied voltage shows no further increase in voltage across the diode. The voltage across the diode at which this condition occurs shall be considered to be the peak inverse voltage.

5.C.7 ADDITIONAL REQUIREMENTS FOR MIXER AND DETECTOR DIODES.

5.C.7.1 Marking. To avoid mechanical deformation by die marking after construction, single ended mixer and detector diodes shall be marked by means of an anodized aluminium or plastic disc inserted and secured into the end of the body. The disc shall be marked with the C.V. number, the factory code letters and the date code. It shall be coloured to indicate the polarity of the pin, viz. red when the pin corresponds to the cathode terminal of a thermionic diode and green when the pin corresponds to the anode terminal of a thermionic diode. The appropriate colour coding will be stated in the Test Specification.

5.C.7.2 Mechanical Stability. A sample of production diodes shall be subjected to a tension test in an approved test instrument in which an axial tensile force of not less than 15 lbs is applied between tip and cap. The diodes shall be tested to 1% AQL at Inspection Level 1A and any breakage shall be deemed to be a failure.

5.C.7.3 Resistance to Breakdown Voltages. The resistance of a diode to breakdown caused by pulse voltages shall be assessed by applying the process described below. The conditions for acceptance or rejection will be stated in the Test Specification.

The diode shall be subjected to 3,000 uni-directional voltage pulses derived from a section of concentric line giving a pulse length of 2.5×10^{-9} seconds, or from an 18 pF condenser at an energy level defined in the Test Specification. The specified energy shall be dissipated in the diode. The repetition rate shall not exceed 5,000 p.p.s. to ensure that the diode does not reach thermal equilibrium. The test equipment shall be subject to the approval of the Inspection Authority.

5.C.7.4 R.F. Properties (Noise Factor, Rectification efficiency, Admittance etc.)

When these tests are required by the Test Specification absolute methods of measurement shall be used where possible.

When applicable, measurements of admittance may be made using holders specified in terms of the RF normalised admittance at some chosen frequency. This shall be measured at an input reference plane when the diode is replaced by a resistive load which matches the feeder in which the diode is situated.

The input reference plane shall be at a position of voltage minimum in the input line when the diode is replaced by a short circuit at some other specified plane.

In these circumstances, the normalised admittance at the input reference plane is related to the normalised crystal admittance at the plane of the short circuit by the expression

$$y_1 = ay_c + jb$$

where a and jb are the real and imaginary parts of the normalised admittance defined above.

The normalised diode admittance to match the holder, measured at the plane of the short circuit is then

$$yc = \frac{y_1 - jb}{a}$$

In other cases, where the absolute accuracy of the measurements is deemed to be inadequate, appropriate approved transfer standards may be used. Standard diodes will not be used for this purpose.

5.C.8 ADDITIONAL REQUIREMENTS FOR GENERAL PURPOSE DIODES

5.C.8.1 Marking. General Purpose Diodes shall be marked with the CV number and other marking as required by the Test Specification. In addition the polarity shall be shown either by "+" and "-" signs or by marking the positive end or connection with red paint. The positive end or connection shall correspond to the cathode terminal of a thermionic diode.

5.C.8.2 Protective Sleeve. An approved protective sleeve shall be fitted to glass envelope diodes to prevent exposure of the diode element to light. The sleeve, when fitted, may carry the marking.

Section 5D

ACCEPTANCE TESTS FOR PHOTOCELLS

Unless otherwise stated in the Test Specification Photocells shall comply with the following requirements together with those given in the Test Specification and with all other sections in this specification except 5.2, 5.3, 5.4, 5.10, 5A, 5B, 5C, 5E, and 5F.

A general inspection of the physical features of the valve shall be made and if it does not comply with the requirements of this specification and of the Test Specification it shall be rejected.

The glass bulb shall be free from defects which may cause distortion of the light falling on the cathode surface.

5.D.1. General Test Requirements. The photocell to be tested shall be placed in an enclosure which screens it from all unwanted radiation. Arrangements shall be made to permit radiation to reach the cell as required by the subsequent clauses of this section and of the Test Specification. Suitable baffles shall, however, be provided to ensure that only direct radiation from the test lamp reaches the cell. The distance between the lamp and the cell shall be large compared with the greater dimension of the cathode (e.g. 20 times).

5.D.2. Light Sources for Test Purposes

5.D.2.1. The light source shall be an incandescent tungsten lamp controlled to operate at 2854°K. At least three lamps shall be certified for luminous intensity and colour temperature at a recognised photometric laboratory. One of these lamps shall be used for testing photocells and the others shall be used for the purpose of checking the calibration of the test lamp.

5.D.2.2. During the life of the test lamp frequent reassessment of calibration shall be made against the standard check lamps. Suitable adjustment shall be made to the position of the lamp to ensure that the light falling on the cell remains at a constant value. The use of any lamp shall be discontinued when the luminous intensity has fallen by 20% of the original value.

5.D.3. Dark Current. The photocell shall be shielded from all radiation and a voltage as specified in the Test Specification shall be applied to the anode. Under these conditions the anode current shall not exceed the specified limit.

5.D.4. Sensitivity Tests. Sensitivity tests shall be carried out with the photocell under test in a suitable enclosure provided with an aperture such that not less than half the cathode area is illuminated with a specified value of light flux.

5.D.5. Spectral Response. A filter, as required by the Test Specification, shall be interposed between the light source and the cell and the output voltage or anode current measured under specified conditions. A further measurement shall then be made without the filter. The ratio of the two readings of voltage or anode current shall be within the limits specified.

5.D.6. Gas Amplification Factor. Where the Test Specification requires a test for the gas amplification factor the conditions shall be as detailed in clause 5.D.4. The anode current shall be measured at the working value of voltage and at a fixed value of 25 volts. The ratio of the two anode current readings shall be within the limits specified.

5.D.7. Sensitivity of Photomultipliers

5.D.7.1. Cathode Photo Sensitivity. With the anode and multiplier dynodes strapped and with a specified voltage applied between them and the cathode the sensitivity shall be measured as for simple photo emissive cells and shall be within the limits specified.

5.D.7.2. Overall Sensitivity. With the specified voltages applied to the dynodes and anodes, the sensitivity shall be measured as for simple photo emissive cells and the overall sensitivity shall be within the limits specified.

SECTION 5E

ACCEPTANCE TESTS FOR G.M. COUNTER TUBES

Unless otherwise stated in the Test Specification Counter Tubes shall comply with the following requirements together with those given in the Test Specification and with all other sections in this specification except 5.2, 5.3, 5.4, 5.5, 5.8, 5.9, 5.10, 5A, 5B, 5C, 5D and 5F.

All Counter Tubes shall operate in the Geiger region and shall be capable of detecting alpha and/or beta electromagnetic radiations according to type, when used with suitable counting apparatus.

Unless otherwise stated in the Test Specification, all G.M. counter tubes shall be operated at a voltage approximating to the specified operating voltage Vw, for a time sufficient to obtain steady values of electrical characteristics, prior to electrical testing. (See 5.E.6).

Mechanical inspection shall be carried out before electrical tests.

5.E.1. General Inspection. A general inspection of the physical features of the counter tubes shall be made and any tubes which do not conform to the requirements specified shall be rejected; in particular, the anode wire shall be taut except where support is made at one end only, and the effective (unscreened) section of anode wire shall be symmetrically located about the line C_L as in individual drawings.

5.E.2. Loose Particles. The tube shall be rejected if it contains any loose particles which may have an adverse effect on its operation.

5.E.3. General Electrical Test Requirements. The counter tube to be tested shall be enclosed in a suitable light proof container unless the design of the tube is such that it is inherently insensitive to light.

The radioactive test source to be used shall, where necessary, be specified both in nature and strength in the Test Specification. Otherwise, any suitable type and strength of source may be used, provided that it shall not cause damage to the counter tube under test.

5.E.3.1. Self-Quenched Counter. All tests shall be carried out with an instrumental resolving time not greater than 350 microseconds, and an instrumental sensitivity as given in the Test Specification.

Test apparatus shall not supply any quenching pulse which may influence performance of the counter tube under test and shall be to the satisfaction of the Approving Authority.

5.E.3.2. Externally Quenched Counter. Test apparatus shall be to the satisfaction of the Approving Authority.

5.E.4. Methods of Plateau Measurement. The count rate/applied voltage characteristic shall be determined by measuring not less than 3000 counts at an average rate of not more than 6000 per minute, at intervals of 40 volts increase in applied voltage when the minimum acceptable plateau length, L_{min}, is 200 volts or greater. If L_{min} lies between 90 and 199 volts inclusive, the interval shall be 20 volts; if L_{min} is under 90 volts, the interval shall be 10 volts. The test shall not be carried on beyond the value of L_{min} + one interval, except where otherwise stated in the Test Specification.

5.E.5. Hysteresis Test. Immediately following completion of the plateau measurement, the count rate at the threshold voltage V_T shall be re-determined, if required by the Test Specification. This value shall not differ from the initial value by more than 10% disregarding statistical fluctuations.

5.E.6. Operating Voltage, Vw. For all tests where the counter tube is required to be operated at the operating voltage Vw, this shall be defined as $(V_T + \frac{1}{2} L_{min})$. The measured value shall be corrected to + 20°C using the average value of temperature coefficient as stated in the Test Specification.

5.E.7. Background Count. This test shall be carried out where required by the Test Specification. The location of the counter tube shall be to the satisfaction of the Approving Authority and measurements made over at least 1000 counts or a time of at least 5 minutes if this gives a lower total count.

Two separate tests are recognised viz.

5.E.7.1. Unshielded Background. This shall be measured with the counter tube screened from light but unshielded by lead or any other material of high atomic number.

5.E.7.2. Shielded Background. This shall be measured with the counter tube screened from light and entirely surrounded by material of sufficient thickness to ensure a weight of material of at least 40 gm per sq. cm (equivalent to 35 mm. of lead). An internal liner of thickness such that the weight is not greater than 1 gm per sq. cm. may be allowed.

5.E.8. Life Tests. For the purpose of Qualification Approval the useful life of a counter is the number of counts after which the plateau length is reduced to $\frac{1}{2} L_{min}$ and/or the plateau slope exceeds the maximum value stated in the Test Specification. The test will be carried out on not less than six tubes at a continuous rate of not greater than 30,000 counts per minute at the operating voltage as defined in 5.E.6 above. Qualification Approval will not be given if the useful life of any one counter tube in the batch is less than 50% of the average value for the batch, or if the average value for the batch is less than 80% of the value as stated in the Test Specification.

5.E.9. Temperature Coefficient. For the purpose of Qualification Approval this will be measured as an average change in threshold voltage (V_T), per degree centigrade change of temperature, over a range of temperature to be specified by the Approving Authority. The test will be carried out on not less than three tubes and Qualification Approval will not be given if the value for any one counter tube exceeds the maximum figure stated in the Test Specification.

5.E.10. Spurious Counts. For Qualification Approval the proportion of spurious counts generated by the counter tube due to any cause will be measured on a sample batch of three tubes using apparatus approved by the Approving Authority. These three tubes will be required in addition to those required for other Qualification Approval tests.

SECTION 5F

ACCEPTANCE TESTS FOR MAGNETRONS

Unless otherwise stated in the Test Specification, magnetrons shall comply with the following requirements together with those given in the Test Specification and with all other sections of this Specification except 5.2, 5.8, 5A, 5B, 5C, 5D, 5E and 7.

5.F.1. Definitions

5.F.1.1. Pulse Characteristics.

5.F.1.1.1. Pulse Amplitude. The amplitude of a pulse waveform is the peak value of a curve drawn through the average of the deviations on the top of a pulse. Any spike on the leading edge of duration less than 10% of the Pulse Length (5.F.1.1.4) shall be ignored. (See Fig. 5F/1).

5.F.1.1.2. Pulse Voltage. The Pulse Voltage is the Amplitude (5.F.1.1.1) of the voltage pulse.

5.F.1.1.3. Pulse Current. The Pulse Current is the Amplitude (5.F.1.1.1) of the current pulse.

5.F.1.1.4. Pulse Length.

(a) The pulse length is the time during which the current, excluding the effects of capacitance current, exceeds 50% of the Pulse Current (5.F.1.1.3).

(b) When the Inspection Authority agrees, the pulse length may be defined and determined by the following alternative method:-

$$\text{Pulse Length} = \frac{I_m}{I_p \times prf}$$

I_m = Mean Anode Current.

I_p = Pulse anode current (5.F.1.1.3)

prf = Pulse Repetition Frequency.

5.F.1.1.5. Time of Fall of Voltage. The time of fall of voltage is the time taken for the voltage to fall from 85% to 20% of the Pulse Voltage. (5.F.1.1.2).

5.F.1.2. Warming Up Time

(a) The Warming Up Time is the interval between the commencement of application of heater voltage and the commencement of application of H.T.

(b) For test purposes, it is the time within which the H.T. must be applied.

5.F.1.3. Magnetic Field Strength

The Field Strength is the value at the centre of the magnet gap.

5.F.1.4. Duty Cycle. The Duty Cycle is the proportion of time during which the instantaneous value of the anode current exceeds 50% of the Pulse Current. (5.F.1.1.3).

5.F.1.5. Peak Output Power. (Pulse Operation). The Peak Output Power is defined by the following formula:-

$$\text{Peak Output Power} = \frac{\text{Mean Output Power}}{\text{Duty Cycle (5.F.1.4)}}$$

5.F.1.6. Efficiency. The efficiency is the ratio of the R.F. output power to the anode input power.

5.F.1.7. Frequency of Oscillation. The Frequency of Oscillation of a magnetron is the value of the frequency at which the power output per unit frequency interval is a maximum.

5.F.1.8. R.F. Load. The R.F. load is all that part of the apparatus which receives R.F. power from and constitutes the termination of the specified coupling device or section.

5.F.1.8.1. R.F. Load Mismatch. The Mismatch of the R.F. Load (5.F.1.8) at any frequency is either the voltage reflection coefficient or the voltage standing wave ratio (greater than unity) which would occur in a test section consisting of a straight uniform length of transmission line or waveguide whose cross section has dimensions equal to the nominal dimensions specified for the R.F. Load if it were fed with a C.W. signal of that frequency and terminated at the other end by the Load. Where the dimensions of the load waveguide are not specified, the dimensions of the test section are equal to the nominal dimensions of the output end of the specified coupling device or section.

5.F.1.9. Frequency Pulling. The frequency Pulling is the difference between the extremes of Frequency of Oscillation (5.F.1.7) occurring when the phase of the Load Mismatch (5.F.1.8.1) is varied through 360°.

5.F.1.9.1. Frequency Pulling Figure. The Frequency Pulling Figure is the Frequency Pulling measured with a Load Mismatch of voltage reflection coefficient 0.2.

5.F.1.10. Frequency Pushing. The Frequency Pushing is the change in Frequency of Oscillation (5.F.1.7) per unit change in anode current, excluding the effects of thermal expansion of the electrodes.

5.F.1.10.1. Frequency Pushing Figure. The Frequency Pushing Figure is the Frequency Pushing measured at the specified current in megacycles per ampere.

5.F.1.11. Spectrum Width (R.F. Bandwidth). The Spectrum is the variation of power per unit frequency interval with frequency. The Spectrum Width is the difference in frequency between the most widely separated points at which the power per unit frequency is ½ of the highest value occurring in the spectrum.

5.F.1.12. Stability (Pulse Operation). Stability is the ratio of missing pulses to input pulses. A pulse is considered to be missing when its energy in the specified frequency band is less than some specified fraction of the energy of a normal putput pulse.

5.F.1.12.1. Starting Stability. The Starting Stability is the Stability measured during a specified period commencing with the first application of H.T. after the Holding Period.

5.F.1.13. Cold Impedance (Pulse Operation). The Cold Impedance of a magnetron is the impedance presented by the magnetron during the non-oscillating period between pulses to an applied C.W. signal whose frequency is equal to the Frequency of Oscillation (5.F.1.7).

5.F.1.13.1. Cold V.S.W.R. The Cold V.S.W.R. of a magnetron is the voltage standing wave ratio in a straight and uniform test section of transmission line or waveguide with cross-section having the nominal dimensions specified for the R.F. Load (5.F.1.8) terminated by the magnetron together with the specified coupling device or Section and fed with a signal as specified for Cold Impedance (5.F.1.13).

Where the dimensions of the load waveguide are not specified, the dimensions of the test section are equal to the nominal dimensions of the output end of the specified coupling device or section.

5.F.1.13.2. Position of Minimum. The Position of Minimum is the distance from a specified plane to the appropriate voltage minimum of the standing wave pattern in the test section specified under Cold V.S.W.R. (5.F.1.13.1) the distance being positive towards the magnetron.

Where the appropriate voltage minimum does not lie within the test section, its position is defined as the position of a voltage minimum within the test section plus or minus the appropriate integral number of half-wavelengths (in the test section).

5.F.2. Test Procedures for Magnetrons. The tolerances and limits specified in this section shall only apply where no tolerance or limit is given in the individual Test Specification.

5.F.2.1. Magnetic Field. Magnets used for testing magnetrons other than those with integral magnets shall satisfy the following requirements.

5.F.2.1.1. Magnetic Field Strength. The Magnetic Field Strength (5.F.1.3) shall be within ± 3% of the specified nominal value. When a permanent magnet is specified the field strnegth shall be within ± 5% of the specified nominal value.

5.F.2.1.2. Magnetic Field Polarity. Magnetrons shall be tested with the cathode connection nearest to the north pole of the magnet.

5.F.2.1.3. Magnetic Field Uniformity. Magnets shall have pole tips of soft magnetic material of thickness at least one quarter of the specified gap width, having plane faces parallel within 1° and coaxial within 3% of the gap width and of diameter at least equal to the gap width.

5.F.2.2. Cathode and Heater

5.F.2.2.1. Heater Voltage. For oscillation tests the Heater Voltage shall be within ± 3% of the specified value.

5.F.2.2.2. Heater Current Measurement. The heater current shall be measured when substantially stable, but not whilst anode voltage is applied.

5.F.2.2.3. Warming Up Time. The warming up time shall not exceed 5 minutes.

5.F.2.3. Cooling and Pressurising

5.F.2.3.1. Cooling liquid used during testing shall be clean and demineralised to the satisfaction of the Inspection Authority.

5.F.2.3.2. Cooling and Pressurising Air. Cooling air which may come into contact with components subjected to electric fields, including waveguide windows, output and input seals, shall be dry and clean to the satisfaction of the Inspection Authority.

5.F.2.3.3. Pressurising Test. Where an air-tight pressurising seal is required, the leakage shall not exceed that which gives a fall of pressure of 3 lbs/sq. in. per litre per hour when the appropriate part of the valve forms part of the wall of a vessel containing air at a pressure of 45 lbs. per sq. in. absolute, the other side of the valve being open to the atmosphere.

The minimum duration of the test shall be 10 minutes. Observation shall not commence until after 2 minutes.

NOTE:- The Air temperature must be kept constant during the test.

5.F.2.4. R.F. Load. The R.F. Load (5.F.1.8) or, where there is a Specified Load Mismatch (5.F.3.4.2), that part of the R.F. Load between its input end and the source of the specified mismatch, shall not have a reflection coefficient exceeding 0.2 at any frequency within the range + 20% to -5% of the Frequency of Oscillation (5.F.1.7).

The load shall not set up evanescent modes to a degree which, in the opinion of the Inspecting Authority, might significantly affect the behaviour of the valve.

5.F.2.4.1. Matched Load, Residual Mismatch. Where a Matched Load is specified, the Residual Load Mismatch (5.F.1.8.1) shall be such as to give a reflection coefficient not exceeding .05 at the Frequency of Oscillation (5.F.1.7).

5.F.2.4.2. Load of Specified Mismatch. Where an R.F. Load having a specified mismatch is called for, the load Mismatch (5.F.1.8.1) at the Frequency of Oscillation (5.F.1.7) must not be less than the value stated in the Test Specification at all phases of reflection:-

$$r_{min} = \frac{r_1}{r_o}$$

where: r_{min} = the minimum permissible value of the voltage standing wave ratio expressed as a ratio greater than unity,

r_1 = the specified value of Load Mismatch expressed as voltage standing wave ratio greater than unity,

and r_o = the specified maximum value of Residual Mismatch expressed as a voltage standing wave ratio greater than unity.

Alternatively:

$$k_{min} = \frac{k_1 - k_o}{1 - k_1 k_o}$$

where: k_{min} = the minimum permissible value of the modulus of the voltage reflection coefficient,

k_1 = the specified value of Load Mismatch expressed as the modulus of a voltage reflection coefficient,

and k_o = the specified maximum value of Residual Mismatch expressed as the modulus of a voltage reflection coefficient.

5.F.2.5. Pulse Characteristics. See Appendix XIV

5.F.2.5.1. Modulator Impedance. The output voltage of the test modulator on open circuit shall be not less than 1.3 times the operating voltage and the output current on short circuit shall be at least 1.5 times the operating current measured on isolated pulses.

5.F.2.5.2. Modulator Charging Characteristics. The available energy for every pulse in the period immediately following an arc in the magnetron under test shall not be less than the available energy when the magnetron is operating normally.

5.F.2.5.3. Anode Pulse Current. The Anode Pulse Current shall be within ± 5% of the specified value.

5.F.2.5.4. Anode Voltage. The Anode Pulse Voltage (5.F.1.1.2) shall be measured with the valve operating on Matched Load (5.F.2.4.1).

5.F.2.5.4.1. Anode Voltage Pulse Shape. At no instant shall the anode voltage exceed 1.5 times the Pulse Voltage.

5.F.2.5.5. Rate of Rise of Voltage.

A modulator will be accepted as having a suitable Rate of Rise of Voltage if it is demonstrated to the satisfaction of the Inspecting Authority that the maximum rate of rise of voltage measured lies within the specified limits.

During the measurement of rate of rise the modulator will be adjusted so that it would give the specified operating conditions if any otherwise acceptable magnetron were fitted. For the test the modulator shall be terminated by a capacitor of value equal to the nominal input capacitance of the magnetron. The measurements shall be made over the interval between the point when the voltage first equals 80% and the point where it first equals 100% of the pulse voltage of the magnetron. The value shall not fall after its maximum in this interval to less than 95% of the maximum value.

5.F.2.6. Pulse Repetition Frequency. The Pulse Repetition Frequency shall be within ± 5% of the specified value.

5.F.2.7. Mean Anode Current. The Mean Anode Current shall be within ± 2% of the value specified.

5.F.2.8. Nominal Frequency of Magnetron. The Nominal Frequency of a magnetron is the Frequency of Oscillation (5.F.1.7) measured with the magnetron operating under the specified conditions and with a Load of less than the specified Residual Mismatch (5.F.2.4.1) when the anode temperature, measured at the specified point, lies within the limits specified.

5.F.2.8.1. Frequency Grouping. When magnetrons of an identical type but for adjacent frequency bands are being submitted for acceptance tests under the same contract, a valve may be accepted even though the accuracy of frequency measurement does not enable it to be placed with certainty in any one of the specified frequency bands provided that the range of uncertainty lies entirely within two contiguous bands and that the inaccuracy of frequency measurement is not worse than 5 parts in 10^4.

If (due to the uncertainty arising from the tolerances implicit in the definition of Nominal Frequency (5.F.2.8) together with the inaccuracy of measurement) a valve on re-measurement falls within a different frequency band, action shall be taken according to the extent of the discrepancy of measured Nominal Frequency as follows:-

(a) If the discrepancy is less than 1 part in 10^3, the grouping remains unchanged.

(b) If the discrepancy is greater than 4 parts in 10^3, regroup accordingly.

(c) If the discrepancy is between 1 part and 4 parts in 10^3, take the mean of 3 further measurements, and if this mean shows a discrepancy in excess of 1 part in 10^3, regroup accordingly.

5.F.2.9. Calculation of Efficiency. The Efficiency (5.F.1.6) shall be calculated from measurements as follows:-

$$\text{Efficiency} = \frac{W_m}{Va \times I_m} \times 100\%$$

Where W_m = Mean Output Power.

Va = Pulse voltage (5.f.1.1.2); or D.C. anode voltage for C.W. operation.

I_m = Mean anode current

5.F.3. Low Temperature (Operating)

Where tests are required to be performed at a reduced temperature, the conditions specified in Section 10.4 shall apply.

5.F.3.1. During Qualification Approval testing, the valve shall pass the primary and secondary electrical tests specified in the detail test specification. Any measurement of frequency shall take into account thermal factor.

5.F.3.2. During Production Acceptance testing the valve shall pass the primary electrical tests specified in the detail test specification. Any measurement of frequency shall take into account thermal factor.

5.F.4. High Temperature (Operating)

Where tests are required to be performed at a temperature of 100°C the conditions specified in Section 10.5 shall apply.

5.F.4.1. During Qualification Approval testing, the valves shall pass the primary and secondary electrical tests specified in the detail test specification. Any measurement of frequency shall take into account thermal factor.

5.F.4.2. During Production Acceptance testing, the valves shall pass the primary electrical tests specified in the detail test specification. Any measurement of frequency shall take into account thermal factor.

5.F.5. Operation Life (Normally performed during Q.A. testing only)

When an operation life test at high ambient temperature is required, the conditions specified in Appendix VI/6.2 shall apply. On completion of the test, the valve shall pass the high temperature test end points specified in the detail test specification.

5.F.6. High and Low Temperature Life (Non-Operating) Normally performed during Q.A. testing only.

5.F.6.1. Low Temperature

Where a low temperature storage test is required, the conditions specified in Appendix VI/6.1.2. shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.F.6.2. High Temperature

Where a high temperature storage test is required, the conditions specified in Appendix VI/6.1.1. shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.F.7. Temperature Cycling

Where a temperature cycling test is required, the conditions specified in Section 10.6 shall apply. The valve shall be non-operating. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.F.8. Air Pressure Tests. (Normally performed during Q.A. testing only).

5.F.8.1. Low Pressure

Where a low pressure test is required, the conditions specified in Section 10.8.1 shall apply. Where specified the wave guide shall be pressurised. Throughout the test the valve shall pass the primary electrical tests specified in the detail test specification and there shall be no evidence of corona, voltage breakdown or overheating.

5.F.8.2. High Pressure

Where a high pressure test is required, the conditions specified in Section 10.8.2. shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.F.9. Moisture Resistance (Normally performed during Q.A. testing only).

Where a test for moisture resistance is required, the conditions specified in Section 10.7 shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.F.10. Heater Resonance and Fatigue

Where a test for heater resonance and fatigue is required, the conditions specified in Section 11.6 shall apply. On completion of the test the valve shall pass the specified life test end points.

5.F.11. Functional Vibration

Where a functional vibration test is required, the conditions specified in Section 11.7 shall apply. During the test, missed pulses, frequency shift, change in power output and frequency modulation shall be monitored at specified intervals. On completion of the test the valve shall satisfy the specified primary electrical tests.

Method A shall be used during Qualification Approval testing when the valve shall in addition satisfy the specified secondary electrical tests.

Method B shall be used during Production Acceptance testing.

5.F.12. Vibration Life

Where a vibration life test is required, the conditions specified in Section 11.8 shall apply. During this test, missed pulses, frequency shift and change in output power shall be monitored at specified intervals.

5.F.13. Fatigue Vibration

Where a vibration fatigue test is required, the conditions specified in Section 11.9 shall apply. On completion of the test the valve shall pass the primary electrical tests specified in the detail test specification.

5.F.14. Functional Shock

Where a shock test is required, the conditions specified in Section 11.10 shall apply. Frequency deviation and change in power output shall be measured immediately after completion of the test.

Method A shall be used during Qualification Approval testing.

Method B shall be used during Production Acceptance testing.

MAGNETRON PULSE WAVEFORM

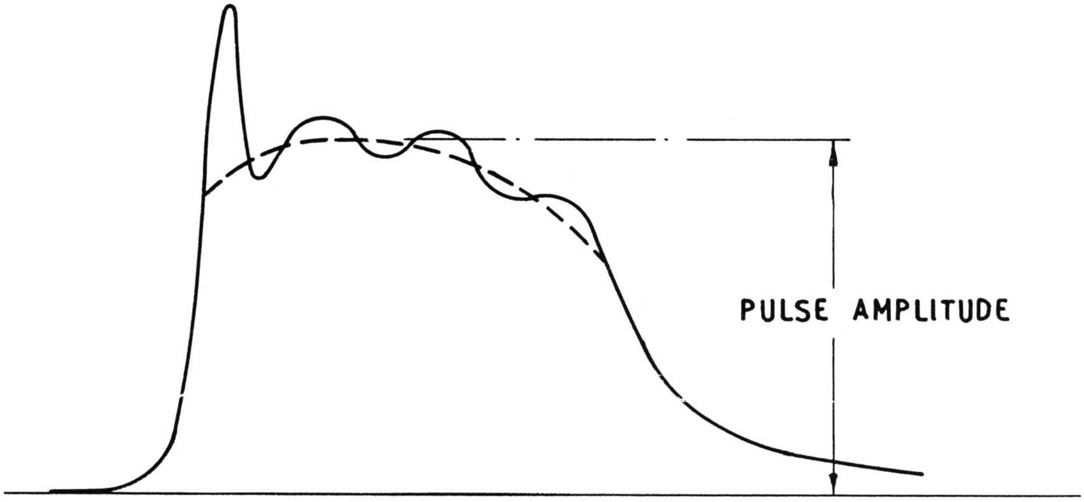


FIG. 5F/1

5G. ACCEPTANCE TESTS FOR GAS FILLED VOLTAGE STABILISERS AND REFERENCE TUBES

This section covers the requirements to be met by Gas Filled Voltage Stabilisers and Reference Tubes supplied for Services use. The tests contained in this section shall apply when specified in the Test Specification.

The load resistor will be specified on the Individual Test Specification.

5.G.1. STRIKING TESTS

Two methods are described but these are not to be used as alternatives unless permitted by the Test Specification.

The ripple content of the supply shall not exceed 0.25% for either method.

Unless otherwise specified, measurements are to be made with normal room illumination (5 to 50 lumen per square foot natural or artificial).

5.G.1.1. Striking Time

Following the specified inoperative period the specified direct voltage shall be applied between the anode and cathode in such a manner that this value is never exceeded. The device shall strike within the specified time measured from the initiation of the voltage. Unless otherwise specified, the time taken for the applied direct voltage to reach the specified maximum, shall not exceed 10% of the specified striking time.

5.G.1.2. Striking Voltage

Following the specified inoperative period a direct voltage shall be applied between anode and cathode. This shall be increased linearly, commencing at the specified maintaining voltage, at a rate not exceeding 25 volts per second until conduction occurs.

5.G.2. DARK STRIKING VOLTAGE

The valve shall be held inoperative in total darkness for at least 24 hours or a minimum period specified on the individual Test Specification. On conclusion of this period and before exposure to light, the specified striking test shall be applied.

5.G.3 MAINTAINING VOLTAGE

The voltage drop between anode and cathode shall be measured at the specified anode current. If a period of conduction is required prior to the measurement of the maintaining voltage this will be stated in the test specification.

5.G.4. REGULATION

This is to be derived by determining the difference between the maintaining voltages at the specified currents.

5.G.5. NEGATIVE IMPEDANCE

When required by the individual Test Specification the valve characteristics shall be examined for negative impedance. A suitable test method is described in the Appendix to Section 5G.

5.G.6. NOISE AND OSCILLATION

The valve shall be operated from a low impedance well filtered, adjustable d.c. supply, the output capacitance of which shall be at least 16 uF. The impedance of the power supply shall not be more than 1/5 of the impedance of the specified load resistor. The current through the valve shall be varied at a specified rate between the specified current values. Either direction of sweep may be used unless otherwise specified.

The anode of the valve shall be coupled by an 0.1 uF capacitor to a voltage amplifier with an input impedance of 100 K ohms. The frequency response of the amplifier shall be flat to within ± 0.5 dB of the response at 400 c/s over the frequency range from 50 c/s to 25 kc/s, not more than 3 dB down at 25 c/s and 100 kc/s, the fall off thereafter being 6 dB per octave.

The noise output of the valve under test which may be displayed on a cathode ray tube will be specified and shall be measured as a peak to peak voltage.

A voltage that exceeds the specified noise limit but which persists for less than a specified current range within the total current sweep shall be considered as a voltage jump.

Other indicating devices of a less subjective and more automatic nature may be used provided that the response can be shown to be in substantial agreement with that given by the Cathode Ray Tube display.

This measurement shall not include voltage jumps.

5.G.7. VOLTAGE JUMPS OR DISCONTINUITY

Using the equipment specified in 5.G.6. the current through the valve shall be varied at a specified rate between the specified values. The maximum amplitude of a voltage jump shall be measured as a peak voltage. The method of sweep i.e. one direction or both, shall be specified.

5.G.8. MICROPHONIC NOISE

With the current through the valve fixed at a specified value and using the equipment described in 5.G.6. the valve shall be tapped by an approved mechanical device, the direction and number of taps to be detailed in the individual Test Specification. Limits for Microphonic noise shall be specified as millivolts peak to peak.

5.G.9. RESONANCE SEARCH

Using the equipment described in 5.G.6 with the valve current fixed at a specified value the valve shall be mounted in an approved holder (see Drawing No.4 Appendix X) and vibrated as specified in Section 11.2. The limits of noise output shall be measured in millivolts peak to peak.

5.G.10. TEMPERATURE COEFFICIENT

Unless otherwise specified in the individual Test Specification the valve current shall be set at the specified value with the envelope immersed in a bath of high thermal capacity at a temperature of 25 ± 5°C and allowed to stabilise for three minutes. The Maintaining Voltage shall be recorded.

The valve envelope shall then be immersed in a bath of high thermal capacity for a specified period at temperature T1. and the Maintaining Voltage recorded at the end of this time.

The valve envelope shall then be re-immersed for a specified time in the bath at 25 ± 5°C and the Maintaining Voltage recorded.

The valve envelope shall then be immersed in a bath of high thermal capacity for a specified period at temperature T2 and the Maintaining Voltage recorded at the end of this time.

The temperature coefficient shall be computed in milli-volts per degree centigrade from the recorded changes of Maintaining Voltage from 25 ± 5°C to T1 and T2.

This test shall not be done more than once on any individual valve.

When the valve envelope is immersed in a bath of high thermal capacity maintained at the required temperature, the temperature of this bath measured close to the valve shall be considered to be temperature of the envelope.

This is not the temperature which the envelope would assume in air at 25°C and the results obtained must be interpreted accordingly.

5.g.11. LIFE TEST

Life test shall be done under specified conditions of envelope temperature, anode current and, when necessary, illumination.

5.G.12. SHELF LIFE TEST

The Striking and Maintaining Voltage shall be recorded and the valves stored for a specified period. The Striking and Maintaining Voltage shall again be measured at the end of this period.

Unless specified otherwise this test will be applied only for Type Approval purposes.

5.G.13. LEAKAGE CURRENT

With an ambient illumination of 5 to 50 lumen per square foot a specified voltage shall be applied to the valve in series with a specified resistor and the current through the valve/resistor combination measured.

APPENDIX TO SECTION 5G

THE MEASUREMENT OF NEGATIVE IMPEDANCE IN GAS-FILLED STABILISER VALVES

The presence of negative impedance or regulation in a stabiliser can be detected by plotting a static characteristic. A close approximation to this can be achieved conveniently be means of the basic circuit of Fig.1 enabling a dynamic characteristic to be displayed on a cathode ray tube.

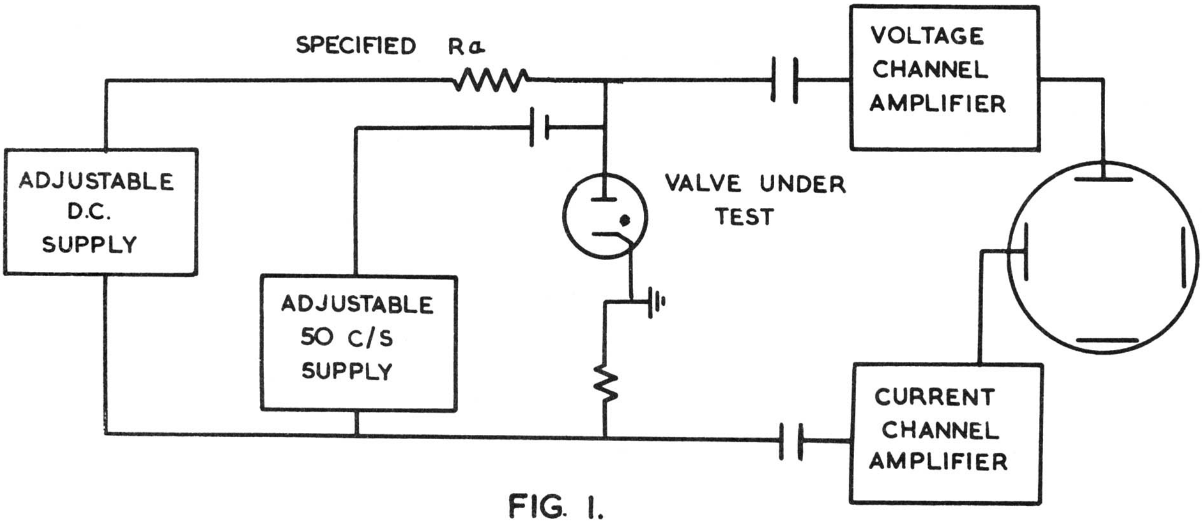


FIG. 1.

Prior to testing a valve in the above circuit, a resistor, of equivalent incremental resistance is substituted for the valve under test. The phase relationship of the amplifiers is then adjusted so that when a.c. is passed through the resistor a straight line is displayed on the cathode ray tube.

With the valve under test in the circuit and the a.c. supply disconnected the anode current of the stabiliser is set to the mid-point of its specified d.c. operating range. The 50 c/s sine wave voltage is then superimposed and adjusted to vary the stabiliser current between the limits of its current range. The voltages developed across the stabiliser and current monitoring resistor are then displayed on the C.R.T. as an Ia/Va curve.

The basic shape of any characteristic will be that of an ellipse the major axis of which represents the impedance of the stabiliser (Fig.2).

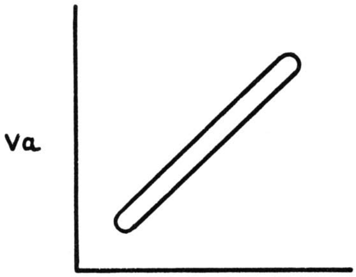


FIG. 2.

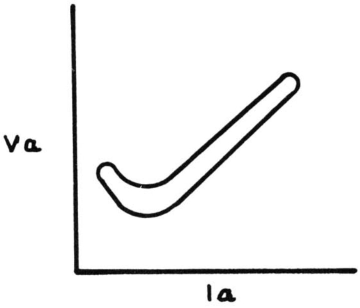


FIG. 3.

Negative impedance is indicated by a slope in the opposite direction Figure 3 shows a combination of negative and positive impedance. Voltage jumps of appreciable amplitude will appear as regions of high negative impedance.

Oscillations of appreciable amplitude can be detected, and the current range over which they occur can be noted. Regulation can be assessed by direct measurement of the display.

To facilitate correlation the frequency of the a.c. supply must be 50 c/s.

Section 5 H

MICROWAVE GAS DISCHARGE DEVICES

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MICROWAVE GAS DISCHARGE DEVICES

This section refers to microwave gas discharge devices such as Pre-T.R., T.R., and A.T.R. or T.B. cells.

The general test conditions shall apply to all cells but the individual tests contained herein shall apply as and when specified in the Test Specification. If significant differences occur between the test figures obtained by the manufacturers and those obtained at the Service Establishments, the Approving Authority will provide an agreed correction for the guidance of Inspecting Officers.

5.H.1. Definitions

5.H.1.1. Primer Ignition. The process of creating local ionisation by means of an applied primer voltage.

5.H.1.2. Firing. The ionisation of the cell which occurs due to the R.F.voltage.

5.H.1.3. Primer Current. The current which flows when a voltage is applied to the primer electrode for the purpose of increasing the electron density in the breakdown gap of the cell in order to facilitate the ionisation of the cell on the occurrence of high R.F. power.

5.H.1.4. Primer Interaction. The variations of the electrical parameters of the cell caused by primer current (5.H.1.3)

5.H.1.5. Excess Noise. Is that increase in noise power expressed in db which is indicated in the output of a double channel receiver due to Primer Ignition (5.H.1.1.)

5.H.1.6. Total Insertion Loss. The loss of power expressed in decibels incurred in a transmission system due to the insertion of the cell between a matched generator and a matched load, with the cell operating under normal primer conditions.

5.H.1.7. Centre Frequency. Defined as the geometric mean of the frequencies at which the measured V.S.W.R. values looking into the cell are equal and within a specified range.

5.H.1.8. Firing Power. The minimum applied R.F. power which causes the cell to fire, under specified operating conditions.

5.H.1.9. Firing Time. The time required for the cell to fire after the application of the high R.F. power.

5.H.1.10 Peak Attenuation. The Maximum additional attenuation obtained in a pulsed microwave attenuator by the application of the specified excitation pulse.

5.H.1.11 Minimum Breakdown Power. The level of incident power upon the cell causing electrical breakdown at or near the cell in a transmission system when that power is raised gradually from a low level.

5.H.1.12 Power Rating. The maximum R.F. power which may be applied to the cell without reduction of the specified life period of the cell.

5.H.1.13. Arc Loss. Defined as that attenuation change expressed in decibels obtained when the fired cell is replaced by a metallic short circuit.

5.H.1.14. Leakage Power.

5.H.1.14.1. Low Power Leakage. The maximum total leakage power through the cell which occurs as the incident power on the cell is gradually increased over a specified range extending from a point below to a point above that power level at which the cell fires.

5.H.1.14.2. Total Leakage Energy. The total energy expressed as ergs per pulse which is transmitted through the cell when a high power R.F. pulse is applied. The primer conditions shall be as specified.

5.H.1.14.3. Spike Leakage Energy. (Expressed as ergs per pulse) The initial high intensity pulse of energy composed of continuous frequency sidebands extending to approximately ± 100 Mc/s from the carrier frequency which is transmitted through the cell prior to the firing of the cell when a high power R.F. pulse is applied.

5.H.1.14.4. Flat Leakage Power. (expressed as peak watts). The power which is coupled through the cell during the period when the cell is fully fired.

5.H.1.14.5 Prepulsed Leakage Power. (T.R.cells) The leakage power measured when a specified current pulse is applied to the auxiliary electrode immediately prior to the R.F. pulse. The main primer operating as specified. In cells having no special prepulsing electrode the current pulse may be applied to the main primer superimposed on the specified steady primer conditions.

5.H.1.15. Recovery Time. That period of time following the instant at which the R.F. ionising pulse ceases which is required before the attenuation caused by the cell to a low power signal falls to a level removed from that existing immediately before the occurrence of the R.F. ionising pulse by 6 db or by the specified number of decibels.

5.H.1.16. Electrical Length. The length of specified waveguide which has the same effective electrical length as the cell.

5.H.1.17. Primer Leakage Resistance. The D.C. resistance between the primer electrode and the body of the cell when the cell is in a de-ionised state.

5.H.1.18. Pulse Characteristics. (Magnetron current and attenuator primer)

5.H.1.18.1. Pulse amplitude. The amplitude of a pulse waveform is the peak value of a curve drawn through the average of the deviations on the top of a pulse. Any spike on the leading edge of duration less than 10% of the pulse length (5.H.1.18.3.) shall be ignored.

5.H.1.18.2. Pulse Current. The pulse current is the amplitude (5.H.1.18.1) of the current pulse.

5.H.1.18.3. Pulse Length

(a) The pulse length is the time during which the current excluding the effects of capacitance current, exceeds 50% of the pulse current. (5.H.1.18.2)

(b) Alternatively, when the Inspection Authority agrees, the pulse length may be defined and determined from the following expression.

$$\text{Pulse length} = \frac{I_m}{I_p \times \text{P.R.F.}}$$

Where I_m = Indicated mean current

I_p = Pulse current (5.H.1.18.2)

PRF = Pulse Repetition Frequency

5.H.1.18.4. Duty Cycle. The duty cycle is the proportion of the time during which the instantaneous value of the current exceeds 50% of the Pulse Current (5.H.1.18.2)

5.H.1.19. R.F. Pulse Length. The period of time for which the amplitude of the pulse waveform as seen when using an approved detector and C.R.O. exceeds 10% of the indicated pulse amplitude (5.H.1.18.1)

5.H.1.20 R.F. Load. The R.F. load is all that part of the circuit which receives R.F. power from and constitutes the termination of the specified coupling device, mount or section.

5.H.1.20.1. R.F. Load Mismatch. The mismatch of the R.F. Load (5.H.1.20) at any frequency is either the voltage reflection coefficient or the V.S.W.R. (greater than unity) which would occur in a test section consisting of a straight uniform length of transmission line or waveguide, whose cross section has dimensions equal to the nominal dimensions specified for the R.F. load, if it were fed with a C.W. signal of that frequency and terminated by the load.

Where the dimensions of the load waveguide are not specified, the dimensions of the test section are equal to the nominal dimensions of the output end of the specified coupling device.

5.H.2. General Test Conditions

5.H.2.1. Frequency and Wavelength. If frequencies are converted to wavelength for the convenience of testing the value $c = 2.998 \times 10^{10}$ cm/sec shall be used.

5.H.2.2. Reference Point and Voltages. The polarity of all voltages applied to the electrodes shall be specified relative to the body of the cell.

5.H.2.3. Test Equipment

5.H.2.3.1. Test Mount. All external test cavities and test mounts shall be those specified and/or approved by the R. and D. Authority. The use of these cavities and mounts shall be implicit in all tests contained in this Section.

5.H.2.3.2. Test Circuit Equivalence. The tests contained in this section shall be made using the specified circuit or an approved equivalent.

5.H.2.3.3. Matched Termination and Generator V.S.W.R. Where cells have V.S.W.R. less than 1.17 : 1. the generator and detector V.S.W.R. values shall not exceed 1.1 : 1. This will in general, ensure an accuracy of ± 0.1 db. For higher values of cell V.S.W.R., tighter limits of generator and detector V.S.W.R. are necessary and will be specified. If a fixed padding attenuator is used immediately before the detector in order to improve the effective V.S.W.R., it shall be considered as part of the detector when interpreting the specified requirements.

5.H.2.4. Measurement of Power

5.H.2.4.1. Crystal Detectors. An approved method of calibrating the crystal response in terms of relative power levels shall be used when output power is examined by means of the output from a crystal rectifier.

5.H.2.4.2. Thermistors.

5.H.2.4.2.1. The calibration of the thermistor mount shall be referred to a specified standard power level. The direct calculation of power from D.C. considerations shall not be more than 10% less than the R.F. calibration figure.

5.H.2.4.2.2. The measured V.S.W.R. of the mount with the bridge at balance shall not exceed 1.1 : 1 for the specified frequency range when leakage power is measured by means of a thermistor.

5.H.2.4.2.3. In addition to 5.H.2.4.2.2. the V.S.W.R. with the bridge at balance shall not exceed 1.33 : 1 for a wider specified frequency range as and when required.

5.H.2.4.2.4. The efficiency of the thermistor shall be as specified.

$$\text{Eff} = \frac{\text{Indicated power}}{\text{Incident power}}$$

5.H.2.4.2.5. Thermistors for use at wavelengths shorter than 5 cms shall have their output response in terms of relative R.F. power levels checked by an approved method. Appreciable error may be experienced due to the effect of the thermistor capacity causing a low impedance shunt across the measuring element.

5.H.2.4.3. The mean power output from the magnetron used in any test contained herein shall be measured by means of a calibrated water load.

5.H.2.4.4. The peak power output shall be measured by any of the three following methods. It shall be within ± 10% of the specified power level.

5.H.2.4.4.1. By the measurement of mean power as in 5.H.2.4.3. and the ratio of peak to mean current through the magnetron.

$$\text{Peak power} = \text{mean power} \times \frac{\text{peak}}{\text{mean}}\ \text{current}$$

5.H.2.4.4.2. By the measurement of mean power as in 5.H.2.4.3. the P.R.F. and the pulse width at half amplitude.

$$\text{Peak Power} = \frac{\text{mean power}}{\text{P.R.F.} \times \text{pulse width}}$$

5.H.2.4.4.3. By means of a calibrated coaxial diode and measuring the voltage developed across it using a C.R.O. The measuring equipment shall initially be set up using one of the methods contained in 5.H.2.4.4.1. and 5.H.2.4.4.2., and the values obtained shall correlate within ± 4%.

5.H.2.4.5. Directional Couplers. Errors due to the modified coupling obtained with the presence of standing waves in the line, or errors due to insufficient directivity in the coupler permitting coupling of reflected power may occur when using directional couplers for the purpose of measuring incident line power. These errors may be eliminated by the insertion of an approved calibrated attenuator immediately after the coupler.

5.H.2.5. D.C. Primer Supply. The D.C. primer supply voltage shall be within ± 2% of the specified value, and the total resistance of the supply source shall be within ± 5% of the specified value. Not less than 0.5 Megohm of this source resistance shall be connected directly to the primer electrode of the cell under test. Primer resistors which are built into the cell shall be considered as part of the source resistance. The D.C. primer voltage shall not have a superimposed ripple component greater than 1% peak to peak and the regulation over the current range from zero to the operating current should be better than 1%.

5.H.2.6. Tunable Cells. The tuning of the cells shall be effected smoothly and without discontinuities over the specified frequency range. No cell shall require less than the specified number of complete turns of the tuning screw to cover this range. The tuning screw shall be fully cycled before electrical tests are performed.
Where the tuning of the cell involves the movement of the breakdown cones of the cell, a test shall be made using an electrical continuity tester to ensure that the cones do not touch when the tuning control is cycled through its entire range.

5.H.2.7. Pre-Test Holding Period. Test cells shall be stored in darkness for a period of not less than seven days before any tests contained in this section are performed.

5.H.2.8. High Power R.F. Load Characteristics. The high power R.F. load (5.H.1.18) shall not have a V.S.W.R. exceeding 1.1 : 1 at the reference frequency of test nor shall it have a V.S.W.R. greater than 1.5 : 1 at any frequency within the range + 20% to - 5% of the frequency of oscillation. The load shall not set up evanescent modes to a degree which, in the opinion of the approval or Inspection Authority might significantly affect the test results.

5.H.2.9. Pulse Repetition Frequency (P.R.F.) The P.R.F. shall be within ± 10% of the specified value and shall be measured to an accuracy of ± 1%.

5.H.2.10 High Level Firing Test (T.B. cells) The test contained in section 5.H.4.2.1. shall be performed before any other High Level test.

5.H.2.11 Resonance Tuning Tuning to the resonance frequency of a cell shall, where possible, be indicated by the minimum value of V.S.W.R. Where the V.S.W.R. method is not convenient resonance may be obtained by tuning for a pronounced peak in the observed output power.

5.H.2.12. Frequency of Test. (Reference frequency) Specified frequencies shall be accurate within

(a) for High Power tests - a 2% bandwidth centred at the reference frequency.
and
(b) for Low Power measurements - a 0.2% bandwidth centred at the reference frequency.

5.H.2.13 Leakage Measurements. Where the specified test conditions introduce difficulties into the performance of the Leakage Tests as given in 5.H.4.2.4. the alternative method known as flat-cancellation may be used if approved.

5.H.2.14 The R.F. power level at which the Low Level Tests (5.H.4.1) are made shall be specified and shall normally be of that order at which the cell will operate when in functional use.

5.H.3 Electrical Tests

5.H.3.1. Primer Tests (keep alive)

5.H.3.1.1. Ignition Test. The cell shall be connected as shown in Fig.(5H/1) and the specified D.C. voltage shall be applied to the primer electrode or electrodes via a specified series resistor. The time required for the cell to ignite shall be measured. This test shall be performed with the cell in darkness. Each primer shall be tested individually when the cell has more than one primer electrode.

5.H.3.1.2. Primer Current. The cell shall be connected as in Fig.(5H/1) and the specified D.C. voltage applied to the primer electrode or electrodes via the specified series resistance. The resultant current shall be measured.

5.H.3.1.3. Oscillations. The cell shall be tested in the circuit shown in Fig.(5H/2). The specified D.C. voltage shall be applied and the primer current adjusted by means of a variable resistance in series with the primer electrode. The minimum current which prevents relaxation oscillations shall be measured. Relaxation oscillations are indicated on the oscilloscope trace.

5.H.3.1.4. Primer Leakage Resistance. Primer Leakage Resistance as defined in 5.H.1.17, shall be measured using any approved method capable of determining high order resistances. Care must be taken to ensure that the applied voltage is not sufficient to cause ignition.

5.H.4. R.F.Tests

5.H.4.1. Low Level Tests

5.H.4.1.1. Insertion Loss. The loss shall be measured by a transmission method in a circuit as shown in Fig.(5H/3) in which the cell is inserted between a matched generator and matched load.

5.H.4.1.1.1. Total Insertion Loss. The specified voltage shall be applied to the primer electrodes and the value of insertion loss measured by adjustment of the calibrated attenuator or by an approved method on replacing the cell by a section of waveguide of equal physical length.

5.H.4.1.1.2. Insertion Loss. No D.C. Primer Voltage shall be applied to the primer electrodes, and the value of insertion loss measured as given in 5.H.4.1.1.1.

5.H.4.1.1.3. Primer Interaction. This shall be obtained by subtracting the value of loss obtained in 5.H.4.1.1.2. from that value obtained in 5.H.4.1.1.1.

ALTERNATIVELY - The specified voltage shall be applied to the primer electrodes and the value of the insertion loss obtained as an arbitrary reading of the calibrated attenuator. The primer voltage shall then be removed and the change in attenuation recorded.

5.H.4.1.1.4. Integral Tunable Cavity Type Cell. The loss shall be measured in a circuit as given in 5.H.4.1.1. The frequency and power output of the signal generator shall be adjusted to the specified values. The cell shall then be tuned to resonance. The cell shall be rejected if in addition to more than one peak of output power being observed as the tuning screw is tuned over its complete range, either :

(a) more than 20° movement of the tuning control is required to tune from the top of the seconday peak to a position nearest to that secondary peak on the main curve of the tuning characteristic where the same output power is obtained.

or (b) the difference in amplitude between the secondary peak power and the output power in the bottom of the valley connecting the secondary peak to the main is greater than 10 per cent of the main peak output. See fig. (5H/4).

5.H.4.1.1.5. Fixed Tune. The signal generator shall be adjusted to the reference frequency and the loss measured as in 5.H.4.1.1.1.

5.H.4.1.1.6. External Cavity Type Cell. The signal generator shall be adjusted to the reference frequency and the output power measured. The cell shall then be replaced by an approved cavity calibrator (dummy cell) and the change in output recorded in decibels as indicated on the calibrated attenuator.

5.H.4.1.2. Excess Noise. The cell shall be connected to the input of a receiver having a specified noise factor. The increase of noise factor obtained on the application of the specified primer current through the cell shall be recorded. The application of primer current shall not cause the cell V.S.W.R. value to change by an amount exceeding 0.05. V.S.W.R. changes exceeding this amount may be cancelled by the use of a variable mismatch unit.

5.H.4.1.3. Voltage Standing Wave Ratio.

5.H.4.1.3.1. T.R. Cells. The cell shall be inserted in an approved low level transmission circuit equivalent to that shown in Fig. (5H/5) between a matched signal source and matched load. The signal generator shall be tuned to the reference frequency, and adjusted to give the specified power output. The standing wave ratio shall be measured. This test shall be performed with the specified primer current applied to primer electrode/s.

5.H.4.1.3.2. Pre T.R. Cells. The cell shall be inserted in the specified duplexing mount and connected in an approved transmission circuit equivalent to that shown in Fig. (5H/5). The V.S.W.R. looking from any arm of the duplexing mount shall not exceed 1.2 : 1. The signal generator shall be tuned to the reference frequency, and adjusted to give the specified incident power onto the duplexing mount. The V.S.W.R. shall be measured. If specified the transmitter arm of the duplexing mount shall be terminated by a variable short circuit plunger to simulate a quiescent transmitting valve. In this case the V.S.W.R. shall be measured with the plunger adjusted through all phases and the worst value recorded.
The V.S.W.R. under all given conditions shall be measured with the cell position in the duplexing mount being varied to include all positions where the operating region of the cell couples into both channels of the duplexer.

5.H.4.1.4. Tuning Range. In this test the load shall not introduce a mismatch greater than one tenth of that specified for the cell - (e.g. Cell V.S.W.R. 1.2 : 1 therefore load V.S.W.R. 1.02:1). The cell shall cover the minimum frequency range specified when tested in a circuit as in Fig.(5H/5). Resonance of the cell is indicated by the minimum value of V.S.W.R.

5.H.4.1.5. Tuning - Fixed. The cell shall be inserted between a matched signal generator and matched detector. The signal generator frequency shall be varied to obtain the resonant frequency of the cell and its cavity. The resonant frequency shall be measured.

5.H.4.1.6. Centre Frequency. The cell shall be inserted in the specified mount and connected in the circuit shown in Fig.(5H/5), between a matched signal generator and matched load. The power output from the signal generator shall be adjusted to the specified value and maintained constant. The frequency shall be varied over the specified band and a number of V.S.W.R. values corresponding to frequencies within that band shall be obtained. From the resulting V.S.W.R/frequency characteristic curve the centre frequency shall be computed as the geometric mean of the frequencies at which the V.S.W.R. values are equal and within the specified limits.

5.H.4.1.7. Conductance and Susceptance (T.B. Cells) The cell shall be fitted in the specified series mount and inserted in a transmission line circuit as shown in Fig.(5H/5) with the matched termination replaced by a variable short circuit plunger. The operating conditions shall be adjusted to those specified. Measurements of the V.S.W.R. shall be made over the required frequency band, with the variable short circuit plunger adjusted at each test frequency to produce a minimum value of V.S.W.R. From the resultant V.S.W.R./Frequency characteristic curve the Conductance and Susceptance values may be derived as follows:

(a) Conductance (G) $= \dfrac{1}{r_0}$

where r_0 = The maximum value of V.S.W.R. indicated on the V.S.W.R/Frequency curve. The maximum value of the V.S.W.R/ Frequency curve will occur at the resonant frequency of the cell (fo)

(b) Susceptance (B) $= \pm \sqrt{\dfrac{G}{\text{V.S.W.R.}} - G^2}$

$$= \pm \sqrt{\frac{1}{r_0}\left(\frac{1}{r} - \frac{1}{r_0}\right)}$$

where r = V.S.W.R. at any frequency.

5.H.4.1.7.1. Equivalent Conductance. Shall be measured by one of the following methods using the circuit shown in Fig.(5H/5).

Method I. The cell shall be fitted in the specified T-junction mount between a matched signal generator and matched load. The V.S.W.R(r) shall be measured over a narrow band of frequencies centred around the specified frequency, and a V.S.W.R/Frequency curve obtained. The maximum value of V.S.W.R.(r_0) occurs at the resonant frequency of the cell when the susceptance (b) is zero. The equivalent conductance may then be obtained from

$$g = \frac{1}{r_0 - 1}$$

Method II. The cell shall be fitted as in Method I with the load replaced by a matched power reading detector. The equivalent conductance shall be obtained by the measurement of the incident power (P_i) upon the cell, and the power which is transmitted to the matched detector (P_t) when the frequency of the signal generator is adjusted to the resonant frequency of the cell. The value of equivalent conductance may be obtained from:

$$g = \frac{1}{2\ (K - 1)}$$

where $k = \frac{P_i}{Pt}$

The difference in attenuator reading on replacing a dummy metallic short inserted in the mount by the cell will given the ratio $\frac{P_i}{Pt}$. It is essential that the power output from the signal generator remains constant during the period of the test.

Method III (Relative) The cell shall be fitted in the specified mount and inserted in a circuit as shown in Fig.(5H/6). Operating at the reference frequency the short circuit plunger shall be adjusted for minimum reading on the matched power detector. This reading shall be recorded as a conductance value.
The cell shall be tested on a relative basis by comparison of the reading of the matched detector obtained during the test with the calibration curve of the detector output obtained when using cells which had previously been tested by Method I or Method II. The calibration curve shall be checked at intervals not exceeding 30 days.

5.H.4.1.7.2. Tuning Susceptance. The cell shall be inserted in the specified T. junction mount between a matched generator and matched load as indicated in Fig.(5H/5). The susceptance shall be measured by one of the following methods.

Method I. The susceptance shall be measured by comparing the phase of the standing wave in front of the cell with the phase obtained using a standard cell chosen to be resonant at the reference frequency. The susceptance shall be computed from

$$b = \frac{(1 + 2g)}{2} \tan \frac{4\pi \Delta \ell}{\lambda gR}$$

where $b = \frac{B}{Y_R}$ = normalised susceptance of the cell

$g = \frac{G}{Y_R}$ = normalised conductance of the cell (see 5.H.4.1.7.1.)

Δl = phase shift of voltage standing wave from sample to standard.

$\lambda g R$ = Guide wavelength (same units as for Δl) at reference frequency

For small values of Δl the expression may be written

$$b = (1 + 2g) \frac{2\pi \Delta l}{\lambda gR}$$

Alternatively the circuit may be equivalent to that shown in Fig. (5H/6) and Δl obtained from the adjustment of short circuit plunger.

Method II This method requies the determination of the ratio of the power incident on the cell (Pi) and the power transmitted through the cell to the load (Pt) when measured at the reference frequency. The susceptance of the cell may then be computed from

$$b^2 = \frac{K(1 + 2g)^2 - 4g^2}{(4 - 4K)}$$

where g = normalised conductance of the cell (obtained from 5.H.4.1.7.1.)

$$K = \frac{P_t}{P_i}$$

The reflected power from the cell is comparable in magnitude to the incident power and hence if a directional coupler is used for measurement of P_i care must be exercised. (See 5.H.2.4.5.)

5.H.4.1.8. Q. Measurements

5.H.4.1.8-1. Loaded Q

5.H.4.1.8.1.1. T.R. Cells. The cell shall be inserted in a transmission circuit (5H/5) between a matched signal generator and a matched detector. There should be sufficient attenuation between the signal generator and the cell to prevent frequency or power changes in the signal generator due to the tuning of the cell. The loaded Q shall be measured by one of the following two methods.

Method I The cell shall be tuned to resonance (f_0) with the signal generator operating at the reference frequency. The power output shall be measured. The frequency of the signal generator shall then be tuned to points above and below resonance where the measured output power is reduced to half the peak value. The two frequencies f_1 and f_2 where half power readings are obtained shall be recorded. The value of loaded Q is derived from

$$Q = \frac{f_0}{f_1 - f_2}$$

It is essential that the output power of the signal generator is stable in amplitude to better than 1% over the frequency band f_1 to f_2. If this is not obtainable the frequency/power output characteristic of the signal generator must be determined and the necessary corrections applied.

Method II Measurements shall be made of the input V.S.W.R. when the cell under test is tuned to resonance at the reference frequency and the frequency of the signal generator is varied over a narrow band centred about the specified reference frequency. A V.S.W.R/frequency characteristic curve shall then be drawn. The cell resonant frequency shall be determined from the V.S.W.R/frequency curve. Resonant frequency occurs where the V.S.W.R. (r_0) is a minimum and the half power transmission frequencies may be obtained from V.S.W.R/frequency curve by locating those frequencies where the half power V.S.W.R. value occur. The half power V.S.W.R. (r) shall be computed from

(a) High Q: $$r = \frac{r_0 + 1 + \sqrt{r_0^2 + 1}}{r_0 + 1 - \sqrt{r_0^2 + 1}}$$

or

(b) Low Q: $$r = \frac{\sqrt{(r_0 + 1)^2 + 0.1} + \sqrt{(r_0 - 1)^2 + 0.1}}{\sqrt{(r_0 + 1)^2 + 0.1} - \sqrt{(r_0 - 1)^2 + 0.1}}$$

where V.S.W.R. value < 1. In this test it is assumed that the V.S.W.R. is high at frequencies remote from resonance, and is not less than 25 db.

ALTERNATIVELY. Values of V.S.W.R. shall be obtained from the V.S.W.R/frequency characteristic at the resonant point (f_0) and also at two frequencies on either side and equally displaced from the resonant frequency where the V.S.W.R. is within the range 0.5 to 0.6. The value of loaded Q shall be obtained from:

$$Q_L = \frac{fo}{\delta f} \frac{\sqrt{(1 - r_0 r) \quad (r_0 - r)}}{(1 + r_0) \quad \sqrt{r}}$$

where $r = \text{V.S.W.R.} \pm \frac{\delta f}{2}$ from f_0

5.H.4.1.8.1.2. T.B. Cells The loaded Q can be defined in terms of rate of change of susceptance with frequency, and may be expressed as

$$Q_L = \frac{fo \, \frac{\frac{dB}{Yo}}{df}}{2 \, (1 + \frac{G}{Yo})} = \frac{fo \, \frac{db}{df}}{2 \, (1 + g)}$$

where fo = resonant frequency.

$df = f_1 - f_2$

$\frac{B}{Yo} = b =$ normalised susceptance of cell.

$\frac{G}{Yo} = g =$ normalised conductance of cell.

Since fo should be within the tolerance limits of the reference frequency, the reference frequency shall always be employed in place of fo in the above equation. The quantity $\frac{db}{df}$ (rate of change of susceptance with frequency) in the vicinity of fo can be determined by the measurement of b at two frequencies near fo and a linear relationship assumed between b and f. The linear relationship may be assumed for any frequencies within 1 per cent of fo. If the conductance and susceptance of the cell has been determined as given in section 5.H.4.1.7. $\frac{db}{df}$ may be computed from the V.S.W.R/frequency characteristic. An alternative method for the determination of $\frac{db}{df}$ involves the measurement in front of the cell of the rate of change of the phase of the standing wave minimum with frequency; then

$$\frac{db}{df} = \frac{2\pi}{2g} \, (1 + 2g) \, \frac{d\Theta}{df}$$

where λg = guide wavelength at reference frequency.

g = normalised conductance of the cell.

$\frac{d\Theta}{df}$ = rate of change of phase of voltage standing wave before the cell with frequency.

$\frac{d\Theta}{df}$ must be determined at the voltage maximum close to the plane of symmetry of the cell. Since it is not usually possible to take measurements at this point, the impedances obtained at a remote point must be transformed to the correct position. The correct values can be determined from

$$\frac{d\Theta}{df} = \frac{d\Theta'}{df} - \frac{m}{4} \cdot \frac{d\lambda g}{df}$$

where $\frac{d\Theta'}{df}$ = measured slope of the line obtained by plotting the observed position of a voltage minimum as a function of frequency.

m = odd number of quarter wavelengths measured, at resonance, from the reference minimum to the plane of symmetry of the cell. For the determination of $\frac{d\Theta}{df}$, frequencies within 1 per cent of fo should be used.
During this test the R.F. signal source and the terminating load shall be matched.

5.H.4.1.8.2. Unloaded Q.

5.H.4.1.8.2.1. High Q External Cavity

The cell shall be inserted in a transmission circuit between a matched signal generator and matched detector. The signal generator shall be tuned to the resonant frequency. The resonant wavelength (λR) and relative value of power received by the detector (Pd) shall be measured.
The frequency of the signal generator shall then be varied above and below the resonant frequency until in each case the transmitted power indicated by the detector is reduced to the half power points. The wavelengths at which the lower levels are obtained are recorded (λ_1, λ_2). The power available at the detector (P_a) is found by removing the cell and associated cavity from the circuit. The unloaded Q of the cell and cavity can be obtained from

$$Q = \frac{\lambda R}{(\lambda_1 - \lambda_2)(1 - \sqrt{T})} \quad \text{where } T = \frac{Pd}{Pa}$$

The equation assumes that the input and output coupling of the cavity are identical. This may be checked by measuring the V.S.W.R. with the cavity reversed in position so that the former output coupling is used as an input coupling. If the V.S.W.R. in the original position is denoted r_1 and the V.S.W.R. in the reversed position as r_2, then $r_1 = r_2$ if coupling identical. Otherwise the expression for Q becomes.

$$Q = \frac{\lambda R}{(\lambda_1 - \lambda_2)} \cdot \frac{1 + r_1 r_2 + r_1 + r_2}{r_1 r_2 - 1}$$

Alternatively. The unloaded Q may be obtained using the V.S.W.R. obtained at resonance. If the cavity is under-coupled, i.e. the shunt conductance is greater than unity, then

$$Q = Q_L \frac{1 + 2}{r_R} = \frac{\lambda_R}{(\lambda_1 - \lambda_2)} \cdot \frac{1 + 2}{r_R}$$

or if the cavity is overcoupled, i.e. when the shunt conductance is then less than unity.

$$Q = Q_L (1 + 2r_R) = \frac{\lambda_R (1 + 2r_R)}{(\lambda_1 - \lambda_2)}$$

5.H.4.1.8.2.2. Relative Method. The cell shall be tested on a relative basis by comparing the reading of the output indicator at resonance with the reading for a cell whose unloaded Q is known. There shall be at least 10 db attenuation between the test cavity and the signal generator. The equipment used in this method shall be calibrated at intervals, not to exceed 30 (thirty) days by means of cells which have passed the unloaded Q as measured in 5.H.4.8.2.1.

5.H.4.1.8.2.3. Primer Interaction (ΔQ). The primer discharge causes an increase in the effective shunt conductance across a T.R. cavity. Since the unloaded Q is a function of the power loss in the cavity, primer interaction can be interpreted as the change in unloaded Q due to primer discharge. The primer current shall be adjusted to the specified value and the change in unloaded Q as measured in 5.H.4.1.8.2.2. shall be obtained.

5.H.4.1.9. Mode Purity (T.B. Cell) Spurious modes can be excited due to the differences between the dimensions of T.B. cell and its mount, and the dimensions of the waveguide. These modes result in low values of V.S.W.R. being obtained at those frequencies. The cell shall be inserted in the specified T. junction mount and connected as shown in Fig.(5H/5) between a matched signal generator and a matched load. No appreciable energy shall be excited in the cell cavity other than the desired mode. The V.S.W.R. looking into the cell shall be measured over the specified frequency band. The standing wave measurements shall be made using the variable calibrated attenuator.

5.H.4.1.10 Electrical Length (T.R. Cell) The electrical length shall be measured by one of the two following methods.

Method I. The cell shall be inserted in a circuit as shown in Fig. (5H/6a) or in an equivalent approved circuit. The signal generator shall be tuned to the specified frequency and the amplitude of the two signals incident upon the slotted line adjusted to be equal. A minimum in the standing wave pattern shall be located. The cell shall then be replaced by a section of waveguide having the same physical length. The change in position of the minimum ($\Delta\ell$) in the standing wave pattern shall be measured. The electrical length is given by $L + 2\Delta\ell$, where L is the electrical length of the substituted waveguide of similar physical length.

Method II The cell shall be inserted in a circuit as shown in Fig.(5H/6) with the matched load behind the cell replaced by a metallic short circuit at the output flange of the cell. The signal generator shall be tuned to the reference frequency and the short circuit plunger adjusted to give minimum output indication in the detector. The change in position ($\Delta\ell$) of the variable short circuit plunger to give a minimum output in the detector on replacing the cell by a section of specified waveguide having the same physical length and short circuited at its output flange, shall be measured. The electrical length of the cell is given by $L + \Delta\ell$ where L is the electrical length of the dummy waveguide having the same physical length.

5.H.4.2. High Level Tests

5.H.4.2.1. Firing Time (T.B. Cell). This test shall be done before any other high level test. The cell shall be inserted in the specified mount and connected to the main transmission line which shall be terminated by an approved load. The R.F. power shall be adjusted to the specified test conditions and the time required for the cell to fire after the application of the R.F. power shall be measured.

5.H.4.2.2. Arc Loss (T.B.Cells). The cell shall be inserted in the specified mount and connected in the circuit shown in Fig. (5H/7). The R.F. power (Ps) shall be adjusted to the specified test conditions and the power output indicated on the detector shall be measured. The cell shall then be replaced by a metallic short circuit and the power output (P_t) again recorded. The arc loss in dB is then given as

$$10 \log \frac{P_s}{P_t}$$

5.H.4.2.3. High Level V.S.W.R. (T.B.Cell) The cell shall be fitted in the specified mount and connected in a circuit equivalent to that shown in Fig. (5H/8). The R.F. power in the main line shall be adjusted to the conditions specified. With a load whose V.S.W.R. is better than or equal to the specified value, the V.S.W.R. immediately before the cell shall be measured.

5.H.4.2.4. Leakage Measurements (See 5.H.2.13)

5.H.4.2.4.1. Total Leakage Power. The cell shall be fitted in the specified mount and connected as shown in the circuit given in (Fig. 5H/9). The cell operating conditions shall be as specified. The R.F. power in the main line shall be adjusted to the specified conditions and the leakage power shall be measured on the matched power detector. For the purpose of this test the leakage pulse shall be deemed to have the same pulse width as the R.F. power pulse and the peak leakage power shall be computed from

$$\text{Peak Leakage Power} = \frac{\text{Average Leakage Power}}{\text{P.R.F.} \times \text{R.F. pulse width}}$$

5.H.4.2.4.2. Spike Leakage energy

5.H.4.2.4.2.1. Narrow Band Cell. The cell shall be fitted in the specified mount and connected as in 5.H.4.2.4. The specified primer current shall be applied and the R.F. power in the main line adjusted for the specified test conditions. The average leakage power shall be measured at each of the two specified pulse widths Tp1 and Tp2. The spike leakage energy (W_s) shall be calculated from

$$W_s = \frac{10^7}{\text{P.R.F.}} \left(P_1 - \frac{(P_1 - P_2)\,\text{Tp1}}{(\text{Tp1} - \text{Tp2})} \right)$$

Where W_s = Spike leakage energy in ergs per pulse.

P_1 = Average power reading at Tp1 (watts)

and P_2 = Average power reading at Tp2 (watts)

5.H.4.2.4.2.2. Broad band cell. The test contained in 5.H.4.2.4.2.1. may provide an inaccurate value for spike leakage due to the possible occurrence of a region of very low coupled power between the spike and flat leakage areas. The cell shall be connected as given in 5.H.4.2.4.2.1. and the shorter pulse reduced in width to between 0.05 μ sec and 0.15 μ sec. duration or as specified. The leakage energy shall be measured during the reduced short pulse only. This measured value shall be considered to be solely spike energy.

$$\text{Thus } W_s = \frac{10^7}{\text{P.R.F.}} P.$$

Where W_s = Spike leakage energy in ergs per pulse.

P = Average measured leakage power in watts.

5.H.4.2.4.3. Flat Leakage Power. The flat leakage power (P_f) shall be determined from the power readings obtained in the spike leakage test (5.H.4.2.4.2.) and calculated from

$$P_f = \frac{(P_1 - P_2)}{\text{P.R.F.}\,(\text{Tp1} - \text{Tp2})} \text{ Peak Watts}$$

In the case of broad band cells the flat leakage power obtained as above will be inaccurate unless the shorter pulse is increased in width to include the beginning of the flat region of the leakage characteristic.

5.H.4.2.4.4. Low Power Leakage. (Broad band T.R.Cells) The cell shall be fitted in an approved mount and connected in the circuit shown in Fig.(5H/10). The operating conditions shall be adjusted as specified. Commencing at the lower specified power level the power shall be raised to the higher specified power level. The maximum value of leakage power indicated shall be recorded.

5.H.4.2.5. Recovery Time. Care must be exercised to ensure that R.F. break-through power does not saturate the amplifier and so introduce possible error in the measurement of recovery time due to the recovery period of the amplifier circuits.

5.H.4.2.5.1. Constant Attenuation. The cell shall be fitted in an approved mount and connected as shown in the circuit of Fig.(5H/11). The cell shall be tuned to the reference frequency and the primer current adjusted to the specified value. The R.F. power in the main line shall be adjusted as specified. A low level pulse modulated signal (simulating received echo at the reference R.F. frequency) which is synchronised with the high power R.F. transmitted pulse via a variable delay trigger unit, shall be introduced into the main line through a suitable coupling device. The power transmitted through the cell shall be amplified and the output applied to the vertical deflection plates of a suitable monitor whose horizontal sweep is synchronised with the transmitter modulator. As the low level signal is varied in time with respect to the transmitted pulse, the variation of low level signal amplitude indicated on the monitor shall be observed. Comparison of attenuation shall be made with respect to the amplitude of the low level signal obtained when the time delay after the R.F. high power pulse is of such a large proportion of the pulse repetition period that the cell can be considered as completely recovered to the state which existed prior to the transmitter pulse. Alternatively by using the fixed delay in the transmitter modulator trigger circuit the low level signal shall be made to appear before the transmitter pulse.

The recovery time shall be measured from the trailing edge of the transmitted pulse to the front edge of the low level pulse. This measurement may for convenience be made by measuring the time delay from the front edge of the transmitter pulse and subtracting the transmitter pulse width period. The measurement of time may be made by the use of a calibrated variable delay or by the superimposition of a suitable frequency signal on the time base of the monitor.

In addition, as the low level pulse shape may be modified due to the frequency response of the amplifier the measurements concerning amplitude of pulse shall be made at the centre of the low level simulating pulse.

Alternatively. The low level simulating pulse may be replaced by a C.W. signal. This has the effect of tracing out the recovery characteristic of the cell from which measurements may be extracted and will be particularly useful in the case of cells having short recovery times.

5.H.4.2.5.2. Constant Delay. The cell shall be tested as specified in the Constant Attenuation test (5.H.4.2.5.1.) and the low level signal attenuation of the cell at the specified time following the occurrence of the transmitted pulse shall be recorded.

5.H.4.2.5.3. Pre T.R.Cells. The measurement of recovery time for the pre T.R. cell shall be made as given in the Constant Attenuation test (5.H.4.2.5.1.) If a T.R. cell is used following the pre T.R.cell, the low level signal must see a match looking into the T.R. cavity (i.e. tuned to resonance and properly loaded). If the loading cannot be adjusted, resisting padding can be used between the cells. Precautions shall be taken to ensure that the T.R. cell recovery characteristic will not effect the measurement of the pre T.R. cells recovery time. Care must be exercised to prevent crystal detector burnout by ensuring adequate attenuation is provided.

5.H.4.2.6. Attenuation Characteristic. The attenuation shall be measured as in the Recovery Time-Constant attenuation test (5.H.4.2.5.1.) Owing to the high level of this attenuation it will be necessary to use a high gain linear amplifier system having a detector output to indicate the relative power output level.

The cell shall be included in a transmission system between a matched C.W. signal generator (or square wave modulated signal generator) and a matched crystal mixer. The output from this mixer shall be amplified and passed through a calibrated attenuator to an indicator. The signal generator shall be tuned to the reference frequency and the specified operating conditions obtained. The cell shall then be tuned to resonance and the output recorded. The attenuator electrode current shall then be set to the specified value and the calibrated attenuator adjusted until the output indication returns to the original value. The db change in attenuator reading, which is equal to the signal attenuation caused by the attenuator electrode current shall be recorded.

5.H.4.2.7. Position of short. The test equipment shall be connected as shown in Fig. (5H/12). The R.F. power output from the source shall be adjusted to the specified test conditions. The cell shall be fitted into the specified mount and connected to one of the balanced arms of the magic Tee. The calibrated variable short circuit plunger shall be adjusted to give minimum reflected power in the line as indicated by a minimum in the power detector. The cell shall then be replaced by a reference short circuit and the short circuit plunger readjusted for minimum reflected power. The difference in the short circuit settings corresponds to the distance between the plane of the reference short and the effective short produced by the fired cell.

It is recommended that the position of the adjustable short circuit plunger which gives the minimum reflected power when using the reference short shall be located prior to this test using a low power source.

5.H.4.2.8. Firing Power. The cell shall be inserted in the specified mount and connected in the circuit shown in Fig.(5H/7). With all operating conditions adjusted as specified, the R.F. power incident upon the cell shall be raised from the specified low level until the cell fires. The firing of the cell will be indicated by a rapid decrease in the power recorded by the power detector in front of the load. The incident power which just causes the cell to fire shall be measured.

5.H.4.2.9. Minimum Breakdown Power. The cell shall be inserted in the specified mount and connected in the circuit given in Fig.(5H/7). With all operating conditions adjusted as specified, the R.F. power incident upon the cell shall be raised until sparks occur at the cell, in the waveguide. The power at which the sparking commences shall be recorded.

5.H.5. Environmental Tests. Tests contained in this section shall, when required by the Test Specification, be made on a statistical basis, and shall be in accordance with an approved sampling procedure. Where applicable and approved, devices which are functional rejects may be used for tests contained herein.

Cells which have been subjected to those tests considered and specified as destructive tests will not be accepted for delivery. The degree and duration of mechanical vibration, shock etc. on cells whose proposed functional use make it appropriate shall be performed in accordance with those specified in Specification SP.24 (DES.1)

5.H.5.1. Mechanical Tests. When the tests contained in this section are to be performed extreme care must be exercised in the mounting of the cell as some dimensions are critical. It is essential that sufficient clearance for projections be allowed and that the input flange is connected in the correct direction.

5.H.5.1.1. Pressure operation. The specified air pressure shall be applied to one or both windows of the cell as required for a period of 30 minutes. The pressure shall then be reduced to atmospheric pressure. After five such cycles the cell shall pass the primer ignition test (5.H.3.1.1.)

5.H.5.1.2. Vibration/Frequency Deviation. (Tuneable cells) The cell shall be tuned to resonance at the reference frequency and shall then be vibrated in the direction of the tuner axis as specified. After vibration, the tuning shall be checked and any change shall be recorded. At the conclusion of this test, the cell shall pass the specified electrical tests.

5.H.5.1.3. Vibration. The cell shall be vibrated in a plane perpendicular to the primer axis under the specified test conditions. During the test no shorting, as indicated by a continuity tester, shall be observed between the primer electrode and the adjacent cone.

5.H.5.2. Temperature Tests

5.H.5.2.1. Primer Current Temperature Drift. Using a constant voltage source, the primer current shall be adjusted to the specified value at 25°C. The ambient temperature shall be raised to 100°C in not less than 15 minutes, and the change in primer current shall be measured.

5.H.5.2.2. Frequency - Temperature Coefficient. The frequency drift of the cell over the specified temperature range shall be determined and expressed as frequency per degree centigrade. One of the following methods shall be used.

Method I The cell shall be placed in a temperature controlled chamber at room temperature and connected in a transmission circuit between a matched signal generator and matched detector. With the signal generator at the reference frequency the cell shall be tuned to resonance. The temperature shall then be reduced to 0°C and the cell allowed to come into thermal equilibrium. The new resonant frequency shall beobtained by retuning the signal generator. The temperature shall then be raised to 100°C in not less than 15 minutes nor exceeding 30 minutes. The cell shall be allowed to come into thermal equilibrium and the new resonant frequency determined.

Method II External Cavity. Using the signal generator to determine the resonant frequency of the cell and cavity, and the frequency-temperature coefficient shall be obtained as in Method I.

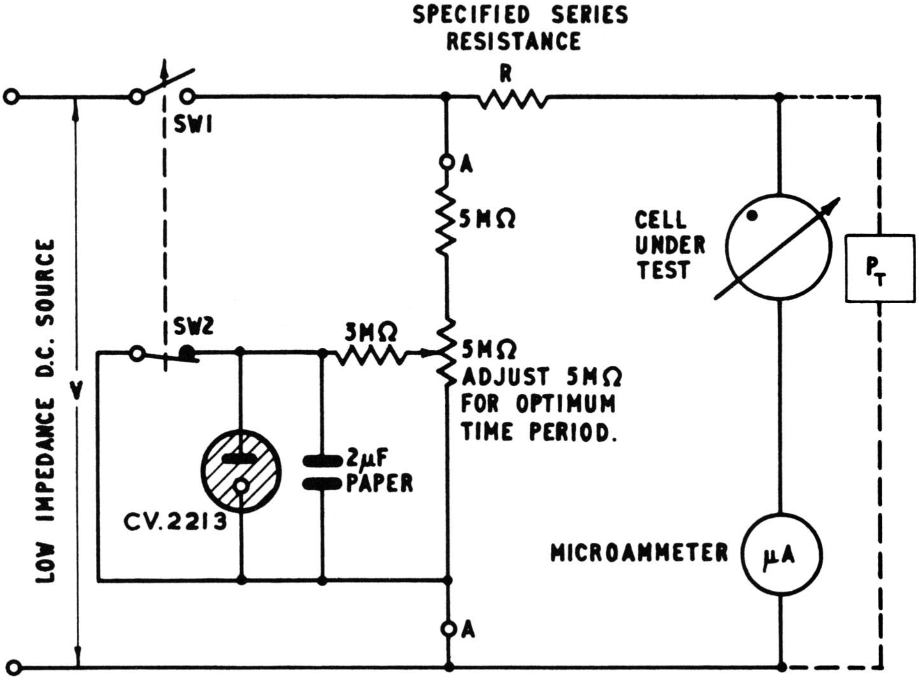
5.H.5.2.3. Temperature Cycling.

5.H.5.2.3.1. General. The cell shall be exposed to one cycle of gradual temperature variation. The specified extremes of temperature shall be maintained for not less than 15 minutes. The time of changing from one temperature extreme to the other shall not be less than 15 minutes nor exceed 30 minutes. The temperature may be allowed to come to equilibrium at room temperature on changing from one temperature to the other. At the conclusion of this temperature cycle the cell shall pass the Primer ignition time test (5.H.3.1.1.) This test may be performed before the final finishing operation.

5.H.5.2.3.2. Holding Period Test. (T.R.Cells) At the conclusion of the general temperature cycling test (5.H.5.2.3.1.) the cell shall pass the primer ignition test (5.H.3.1.1.) Not less than twenty four hours after the temperature cycling test, the cell shall again pass the primer ignition time test (5.H.3.1.1.)

5.H.5.2.3.3. Holding Period Test (T.B.Cells) After the completion of the general temperature test (5.H.5.2.3.1) the cell shall pass a firing time test (5.H.4.2.1.) The cell shall again pass the firing time test not less than twenty four hours after the general temperature cycling test.

5.H.5.3. Life Tests. The cell shall be fitted to a transmission line system and the specified R.F. power applied. Where a number of cells are being tested simultaneously, the power shall be measured immediately before the cell in front of the load. It is permitted to interchange the position of the cells if required. The primer current (if applicable) on each cell shall be as specified and no adjustment of primer current shall be made during the life test. Life test end points shall be deemed to have been reached when the cell fails to pass the specified test conditions or when the specified life period has been reached. Cells for this test shall be taken at random. Any cell which when selected fails to pass the specified test conditions for life test end point shall be excluded from the test and replaced by a good cell chosen at random.



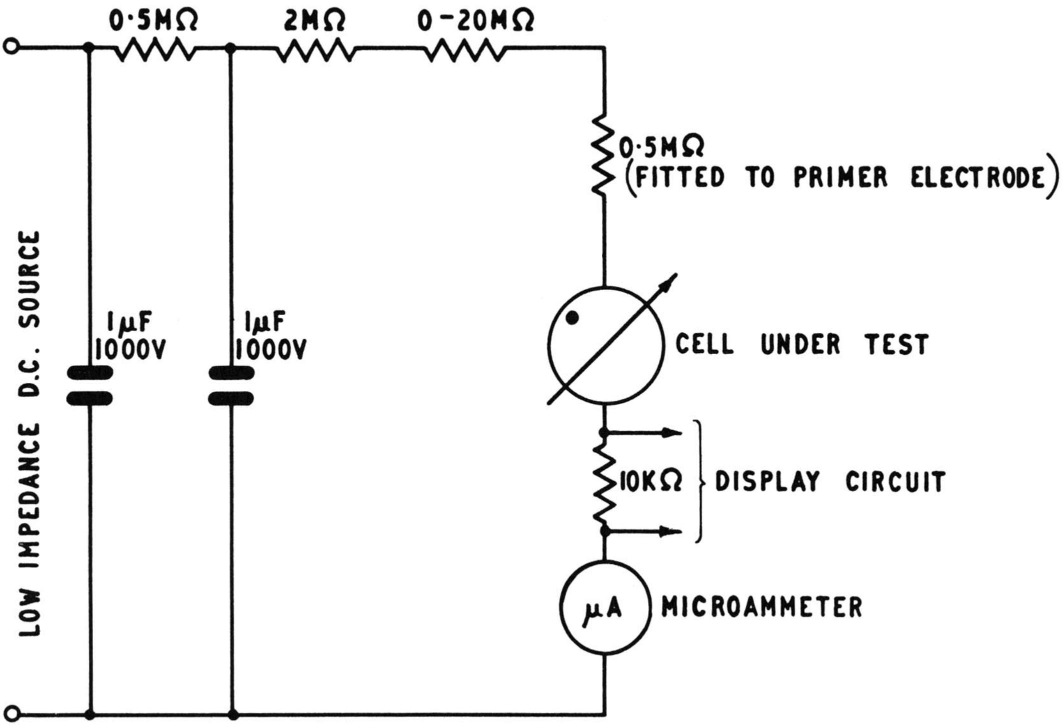
PRIMER CURRENT AND IGNITION TEST CIRCUIT

NOTE:- COUNTING CIRCUIT (BETWEEN POINTS A) MAY BE OMITTED IF ALTERNATIVE TIME MEASUREMENT IS USED.

MEASUREMENT OF PRIMER VOLTAGE

METHOD A	BY EXTERNAL POTENTIOMETER P_T CONNECTED AS DOTTED AND ADJUSTED SO THAT NO CURRENT FLOWS TO OR FROM THE PRIMER.
METHOD B	CONNECTION OF VOLTMETER ACROSS POINTS (A) AND SUBTRACTING VOLTAGE DROP ACROSS THE SERIES RESISTANCE (R x MEASURED CURRENT) FROM THE VOLTAGE READING.

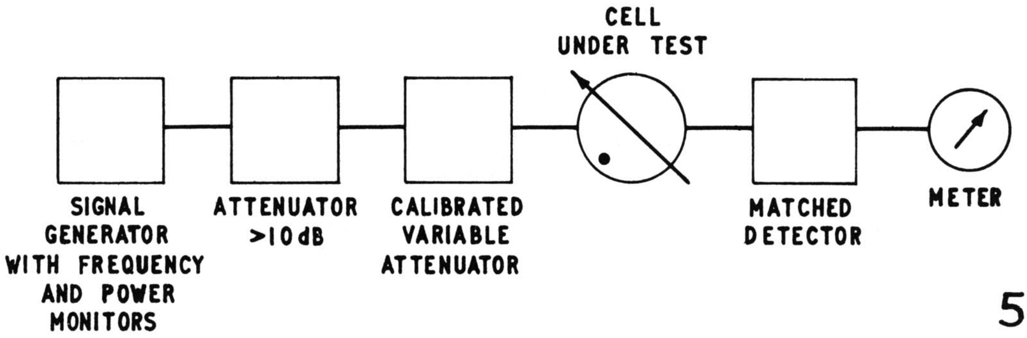
5H/1



PRIMER RELAXATION TEST CIRCUIT

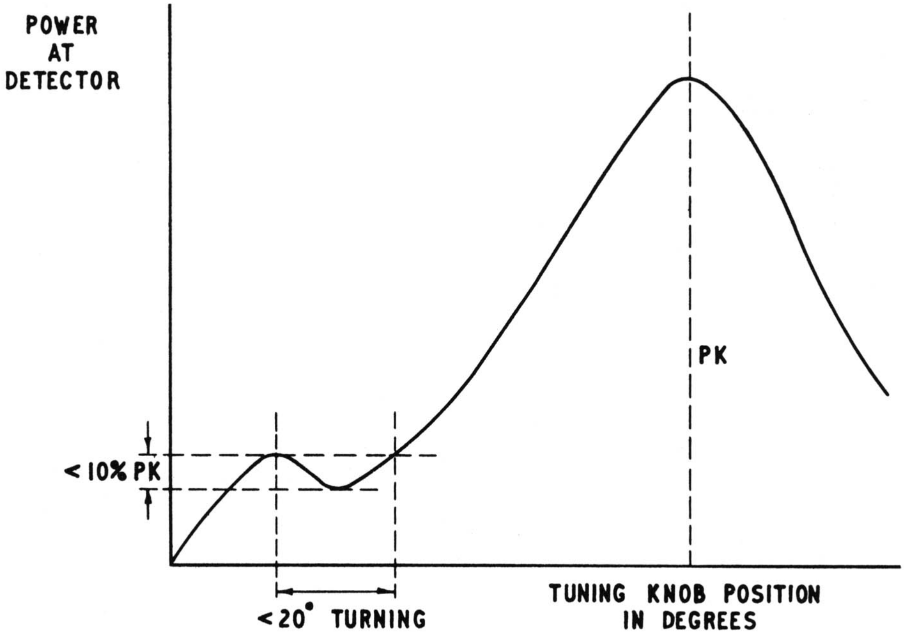
NOTE:- IF AMPLIFIER USED TO GIVE FULL SCREEN DEFLECTION OF OSCILLOSCOPE, THE BANDWIDTH OF SYSTEM TO 3dB POINTS SHOULD NOT BE LESS THAN 50c/s—500Kc/s WITH A SOURCE IMPEDANCE OF 10KΩ CONNECTED ACROSS THE 10KΩ MONITOR RESISTANCE.

5H/2

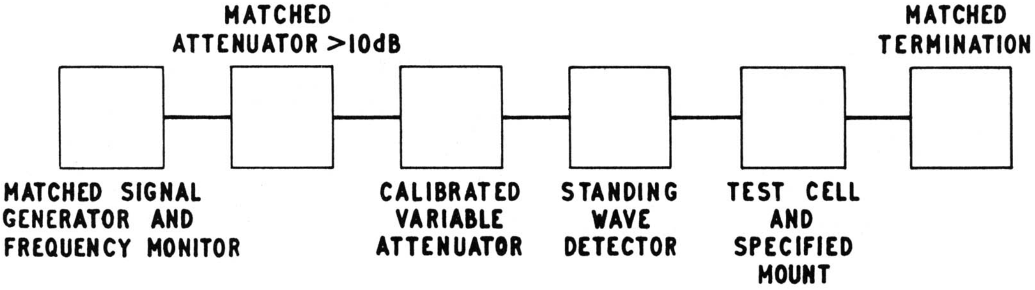


5H/3

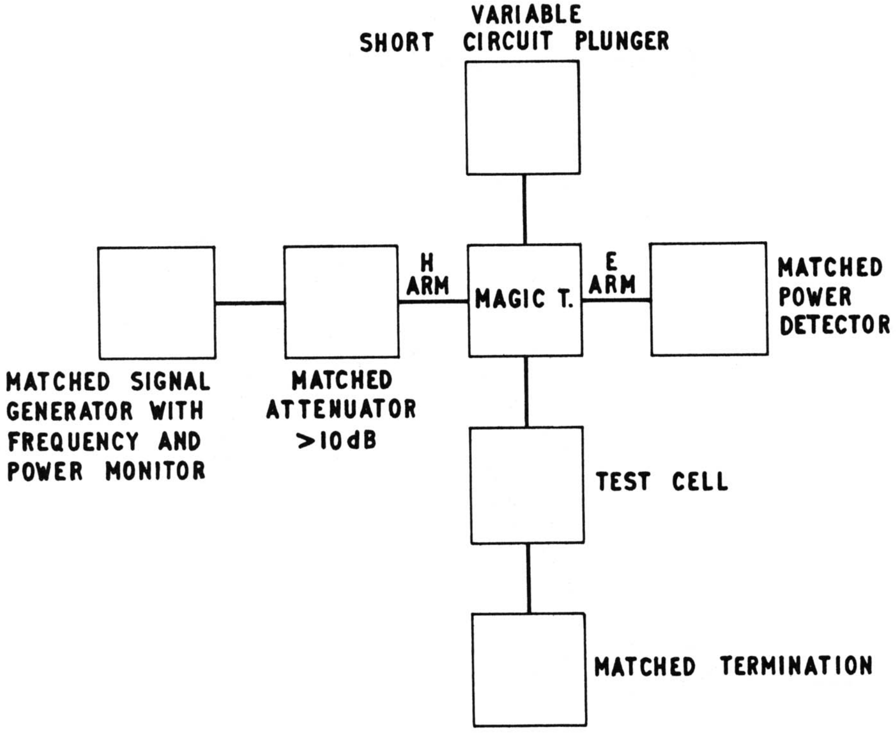
SCHEMATIC DIAGRAM FOR TRANSMISSION SYSTEM MEASUREMENTS



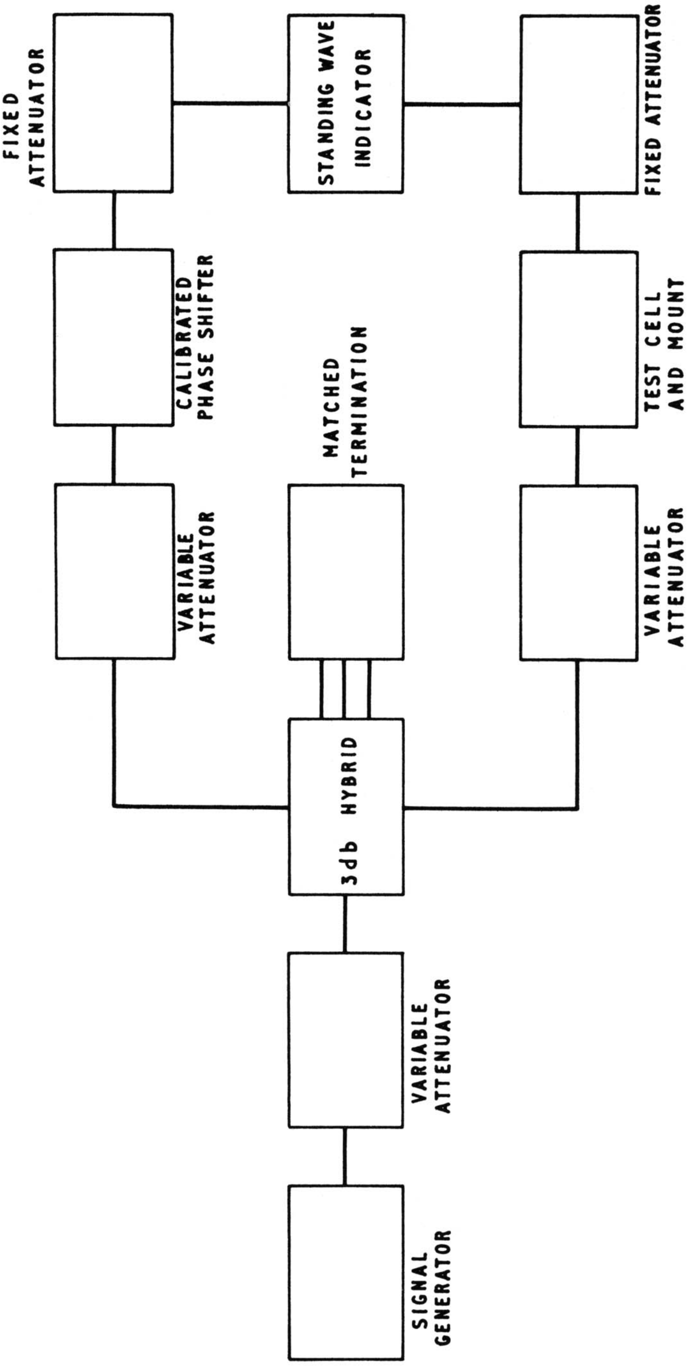
5H/4


MATCHED ATTENUATOR >10dB
MATCHED TERMINATION
MATCHED SIGNAL GENERATOR AND FREQUENCY MONITOR
CALIBRATED VARIABLE ATTENUATOR
STANDING WAVE DETECTOR
TEST CELL AND SPECIFIED MOUNT

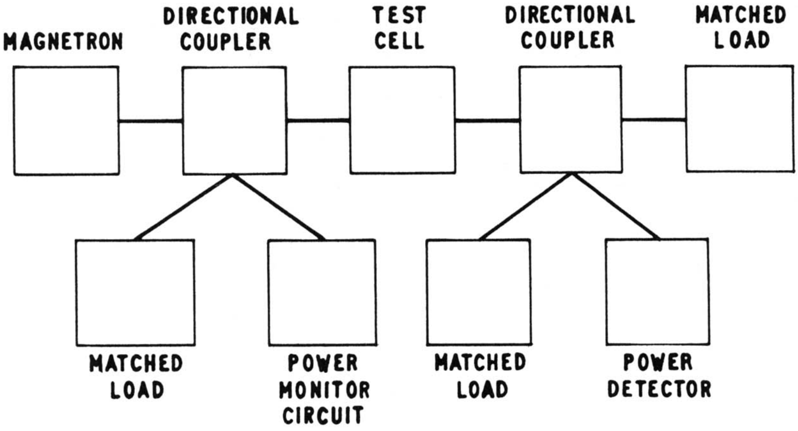
5H/5


SHORT VARIABLE CIRCUIT PLUNGER
H ARM
MAGIC T.
E ARM
MATCHED POWER DETECTOR
MATCHED SIGNAL GENERATOR WITH FREQUENCY AND POWER MONITOR
MATCHED ATTENUATOR >10dB
TEST CELL
MATCHED TERMINATION

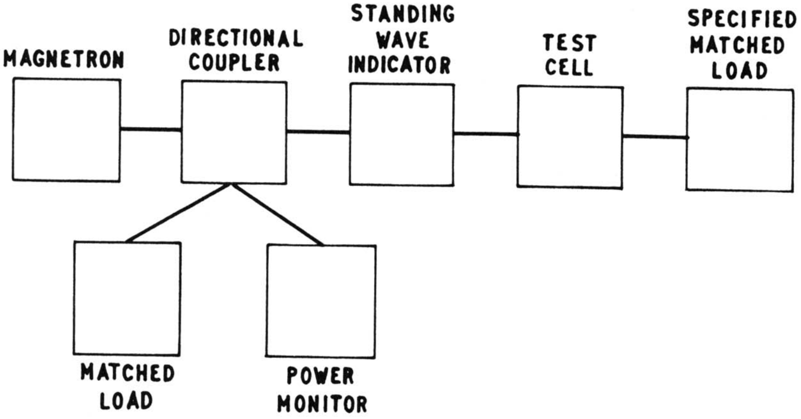
5H/6


SIGNAL GENERATOR
VARIABLE ATTENUATOR
3db HYBRID
MATCHED TERMINATION
VARIABLE ATTENUATOR
CALIBRATED PHASE SHIFTER
FIXED ATTENUATOR
VARIABLE ATTENUATOR
TEST CELL AND MOUNT
FIXED ATTENUATOR
STANDING WAVE INDICATOR

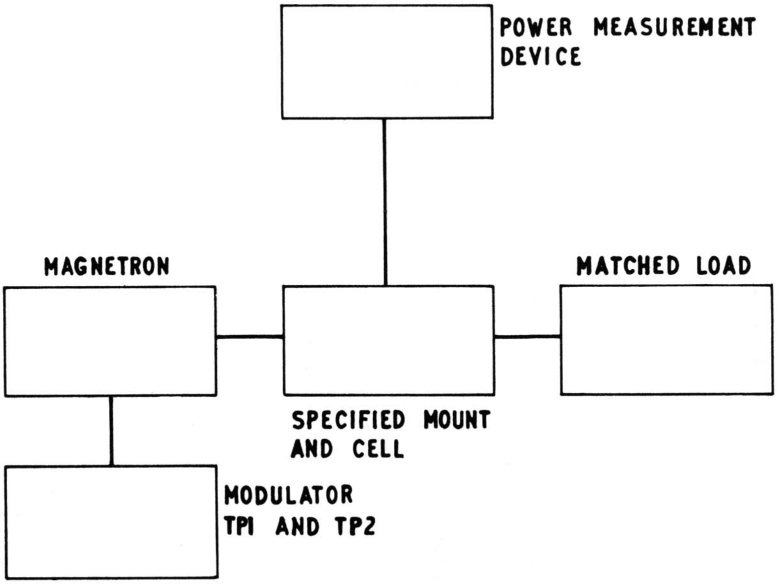
5H/6A


MAGNETRON
DIRECTIONAL COUPLER
TEST CELL
DIRECTIONAL COUPLER
MATCHED LOAD
MATCHED LOAD
POWER MONITOR CIRCUIT
MATCHED LOAD
POWER DETECTOR

5H/7

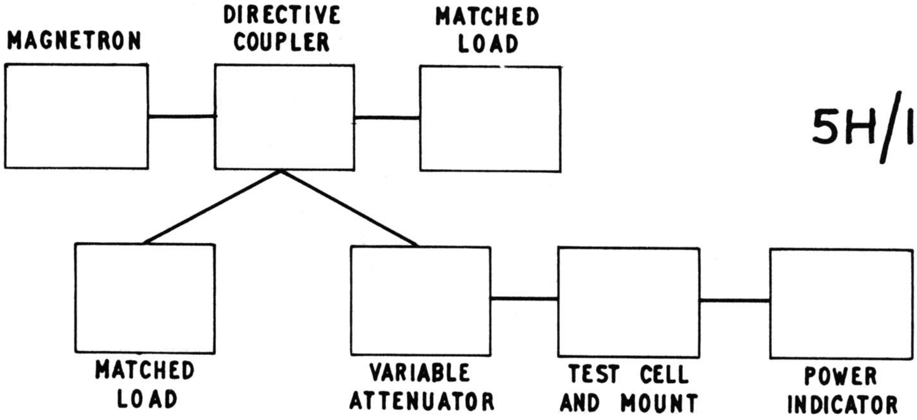

MAGNETRON
DIRECTIONAL COUPLER
STANDING WAVE INDICATOR
TEST CELL
SPECIFIED MATCHED LOAD
MATCHED LOAD
POWER MONITOR

5H/8

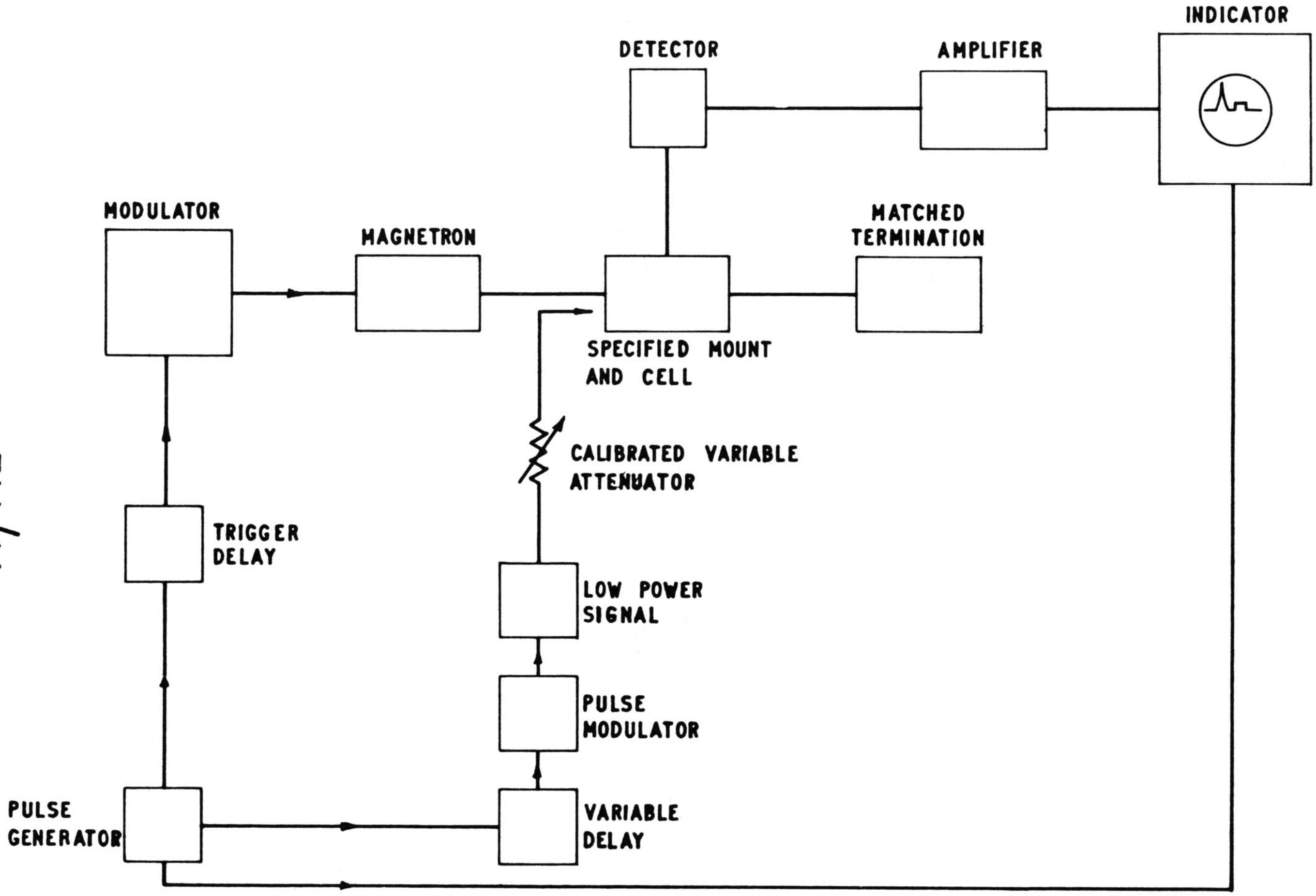


5H/9

SCHEMATIC DIAGRAM FOR LEAKAGE POWER MEASUREMENTS.

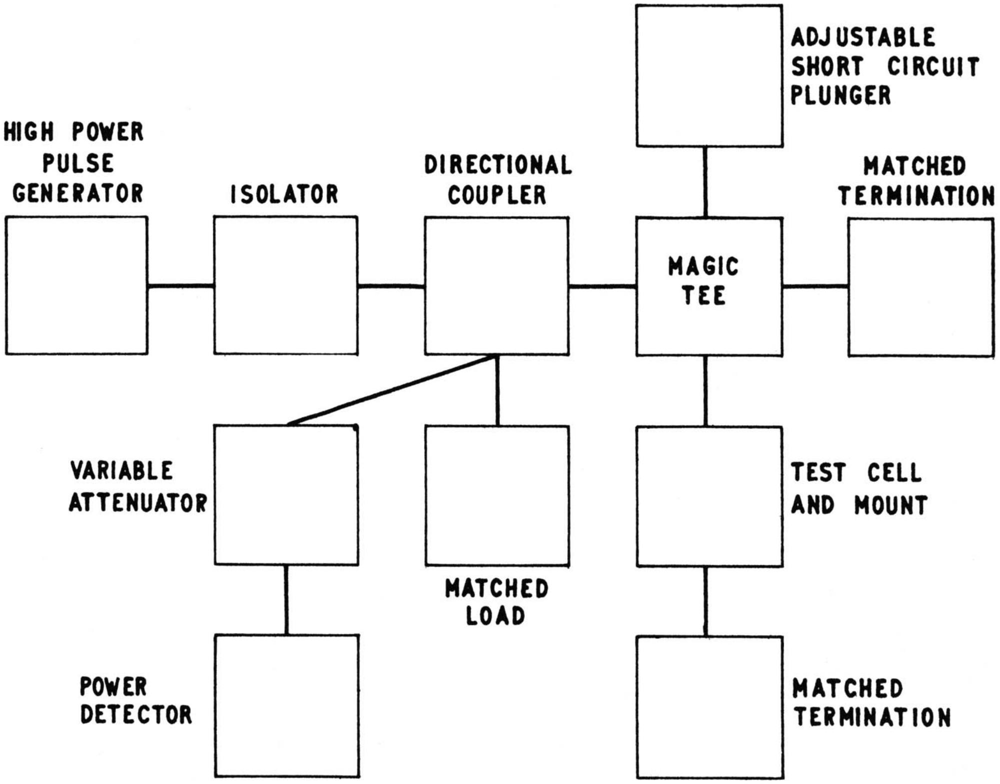


5H/10



SCHEMATIC DIAGRAM FOR RECOVERY TIME MEASUREMENTS

5H/11


HIGH POWER PULSE GENERATOR
ISOLATOR
DIRECTIONAL COUPLER
ADJUSTABLE SHORT CIRCUIT PLUNGER
MAGIC TEE
MATCHED TERMINATION
VARIABLE ATTENUATOR
MATCHED LOAD
TEST CELL AND MOUNT
POWER DETECTOR
MATCHED TERMINATION

5H/12

Section 5J

TRAVELLING WAVE TUBES

This section refers to forward wave, O type, travelling wave signal or power amplifiers (of output power not exceeding 100 watts, for c.w. or pulsed operation where applicable) having either permanent magnet, electromagnetic or electrostatic focussing.

The general test conditions shall apply to all valves unless otherwise specified in the test specification, but the individual tests (Section 6) contained herein shall apply as and when specified in the Test Specification. If significant differences occur between the test figures obtained by the manufacturers and those obtained at appropriate Service Establishments, the Approving Authority will provide an agreed correction for the guidance of Inspecting Officers.

1. Definitions

1.1 Valve For the purpose of this section the term "valve" in the test clauses, relates to the travelling wave tube as supplied by the manufacturer to meet the appropriate test specification.

1.1.1 Packaged. A term used to describe a valve permanently incorporating the focussing system and r.f. terminals (see Paragraph 1.13).

1.1.2 Encapsulated. A valve having an outer sleeve (capsule) integral with the travelling wave tube to protect the inner envelope from mechanical damage. This may or may not include the r.f. terminals (See Paragraph 1.13).

1.1.3 Mount. The additional focussing equipment and/or r.f. terminals necessary to operate the valve as a travelling wave amplifier but excluding the requisite power supplies.

1.2 R.F. Power Input The r.f. power that would be delivered into a matched load substituted for the r.f. input terminal (see Paragraph 1.13 below).

1.3 R.F. Power Output The r.f. power, having the same frequency as the power input, which is delivered into a matched load at the r.f. output terminal (see Paragraph 1.13 below).

1.4 Gain The ratio of r.f. power output to r.f. power input.

1.5 Small Signal Gain The gain obtained as the input level tends to zero. Unless otherwise specified this is understood to be the gain when the r.f. power output is at least 10 dB down on the specified saturated power output.

1.6 Synchronous Helix Potential The Helix potential giving maximum small signal gain at a given frequency.

1.7 Saturated Power The first maximum value of r.f. power output as the r.f. power input is increased.

1.7.1 Synchronous Saturated Power. The saturated power obtained at synchronous helix potential.

1.7.2 Working Saturated Power. The saturated power obtained either at a specified absolute value of helix potential other than synchronous or at a specified difference from synchronous helix potential, in the specified working conditions.

1.7.3 Maximum Saturated Power. The largest value of saturated power obtained by adjustment of both helix potential and power input at a given frequency.

1.8 Phase Sensitivity The change of phase of the output signal with reference to the input signal, for a specified change in electrode potentials or input signal level.

1.9 Spurious Oscillations Unwanted coherent oscillations occurring under the specified conditions.

1.10 Cold Tests Tests in which electrode voltages are not applied. (The heater may be left on unless otherwise specified).

1.11 Hot Tests Tests in which the valve is operating under specified conditions.

1.12 Cathode Pre-Heating Time The time which must elapse after the application of full heater voltage before the commencement of application of electrode voltages which result in a flow of current from the cathode.

1.13 R.F. Terminals The specified input and output connectors which may be either integral with the valve or the approved mount.

1.14 Input and Output Match The measured voltage reflection coefficient or the voltage standing wave ratio which would occur in a test section fed by a c.w. signal at a reference frequency, and terminated by the r.f. terminal (as defined in Paragraph 1.13). The test section shall consist of a straight uniform length of transmission line or waveguide, whose cross section has the dimensions specified for the r.f. terminal. Where the dimensions of the r.f. terminal are not specified the dimensions of the test section shall be equal to the nominal dimensions of the input/output of the specified waveguide coupling. In the case of an r.f. plug or socket input/output, the test section shall be terminated by an appropriate mating plug or socket.

Precautionary Note: In certain cases the reflected wave may be equal to or greater than the incident wave from the c.w. source owing to amplified reflections from within the valve. V.S.W.R. measurements are then ambiguous. The measurement of voltage reflection coefficient is, therefore, preferred and in this case the value will be equal to or greater than unity.

2. Electrode Numbering

With the exception of the Helix Collector and Cathode, all electrodes are termed grids and are numbered 1, 2, 3 according to their position relative to the cathode, the lowest number being closest to the cathode. Where two helices are equidistant from the cathode, the lower voltage helix is assigned the lower number.

3. Abbreviations and Symbols

Noise Factor (dB)	F
Gain (dB)	G
Helix Voltage	V hel
Helix Current	I hel
Collector Voltage	V col
Collector Current	I col
Grid Voltages	Vg1, Vg2, etc.
Grid Currents	Ig1, Ig2, etc.

4. Colour Code

The following code is to be used with travelling wave tubes equipped with flying leads.

Body Colour	Tracer Colour	T.W.T. Element
Black	None	Earth, or earthed elements
Yellow	None	Cathode also heater cathode lead if common
Brown	None	Heaters or filament off cathode
Brown	Yellow	Heater internally connected to cathode, if additional to cathode lead
Red	None	Collector
Orange	None	Helix 1
Orange	Green	Helix 2
Orange	Blue	Helix 3
Orange	Grey	Helix 4
Green	None	Grid 1
Blue	None	Grid 2
Grey	None	Grid 3
White	None	Grid 4
Green	Black	Grid 5
Blue	Black	Grid 6
Grey	Black	Grid 7
White	Black	Grid 8

(See Paragraph 2 for electrode numbering)

5. General Test Conditions

5.1. Frequency and Wavelength Where it is desired to convert frequency to wavelength, the value $c = 2.998 \times 10^{10}$ cm/sec. shall be used.

All frequencies shall be within 0.5% of the specified value.

5.2. Reference Point and Polarity of Voltages All voltages (except heaters) shall be specified relative to the cathode.

5.3. Test Equipment

5.3.1. Test Solenoid or Permanent Magnet Assembly. All mounts (see Paragraph 1.1.3.) shall be those specified and/or approved by the Design Authority. The use of these mounts is implicit in all tests contained in this section.

5.3.2. Mismatch. Except where a mismatch is specified, the voltage reflection coefficient of all test equipment shall not normally exceed 0.1 at the specified frequency. Where this is not practicable, the Approving Authority will provide an agreed correction for the guidance of Inspecting Officers.

5.4 Power Supplies

5.4.1. Supply Voltages. Where d.c. h.t. supply voltages are specified these shall be within ± 2% of the specified value.

5.4.2 Stability (long term variation) and Ripple (short term variation) Unless otherwise specified the various test voltages and currents shall not exceed the following:-

Helix Voltage	) Stability better than ± 0.5%) Peak to peak ripple less than 0.5%
Collector Voltage	) Stability better than ± 2%) Peak to peak ripple less than 1%
Other Grid Voltages	) Stability better than ± 1%) Peak to peak ripple less than 0.1%
Solenoid Current	) Stability better than ± 5%) Peak to peak ripple less than 2%

6. Electrical Tests

6.1 Small Signal Gain (1.5) The power gain shall be measured using one of the following methods:-

Method I. The valve shall be operated under the specified conditions in a circuit equivalent to that shown in FIGURE 1A. The switches shall provide an isolation of at least 20 dB more than the gain of the valve under test (e.g. if gain is 20 dB the cross talk ratio shall be at least -40 dB). The switches shall be turned to Position 1 and the level adjusted to give a convenient reading on the indicator. The switches shall then be turned to Position 2 and attenuation introduced to give the previous reading on the indicator. The value of attenuation introduced gives the gain of the valve under test.

NOTE: Where 2nd harmonics may affect the result the necessary precautions shall be taken.

Method II The Valve shall be operated in a circuit equivalent to that shown in FIGURE 1B. The directional couplers shall together have a coupling ratio approximately equal to the gain of the valve under test. The signal generator shall be tuned to the specified frequency or the frequency swept in time over the specified frequency band. The ratiometer output shall be monitored by means of a calibrated recorder or indicator.

Method III The valve shall be operated in a circuit equivalent to that shown in FIGURE 1C. The calibrated attenuator and the phase shifter shall be adjusted to provide a null reading on the indicator. The valve shall then be replaced by a section of transmission line and the attenuator and phase shifter re-adjusted for a null reading on the indicator. The value of attenuation introduced gives the gain of the valve under test.

6.2 High Level Gain. The valve shall be operated under the specified conditions in a circuit equivalent to FIGURE 2. The gain of the valve under test shall be calculated from the readings of input and output power monitors, and the value recorded.

6.3 Spurious Oscillations. The valve shall be operated under the specified conditions in a circuit equivalent to Figure 3.

The Directional couplers shall couple less than 10% of the power in the main arm and the receiving system shall have the specified sensitivity and bandwidth. The helix potential shall be swept over the specified range.

One of the shorting plungers shall be adjusted in fixed steps and the noise output observed whilst varying the other shorting plunger. The onset of oscillations will be observed as a marked change in noise level.

6.4 Noise Factor. The Noise Factor shall be measured by one of the following methods, using the Noise Source specified. Methods I and II may be used for noise factors up to 25 dB, but for greater accuracy Methods III and IV are recommended for noise factors greater than 15 dB. The v.s.w.r. of the noise source shall be not greater than 1.2 with noise source on or off. The bandwidth of the receiver shall be less than 10% of the operating bandwidth of the valve under test. Double sideband may be used provided the intermediate frequency does not exceed 2% of the operating frequency. The symbols used in the equations contained in 6.4.1 are as follows:-

n = Excess noise power of the noise source expressed as a power ratio $\frac{T - T_o}{T_o}$

Where T = effective absolute temperature of noise source

$T_o = 290^{o}K$

x = Reading of Attenuator A expressed as a power ratio greater than 1

y = Reading of Attenuator B expressed as a power ratio greater than 1

f = Noise Factor of valve under test expressed as a power ratio greater than 1

f' = Noise Factor of receiver expressed as a power ratio greater than 1

g = Gain of Valve under test expressed as a power ratio.

6.4.1 Noise Factor Methods of Measurement

Method I The valve shall be operated in a circuit equivalent to Figure 4(A). The noise source shall be switched off and the receiver output noted with attenuator B set to 0 dB. The noise source shall then be switched on, attenuator B set to give 3 dB attenuation and attenuator A adjusted to keep the receiver output constant. The reading of attenuator A shall be recorded. Then

$$f = \frac{n}{x} \qquad (1)$$

For the measurement of noise factors greater than n, attenuator B shall be set to a value lower than 3 dB.

Then $$f = \frac{n}{x(y - 1)} \qquad (2)$$

Alternatively, attenuator A may be omitted. The noise source shall be switched off and the receiver output noted with attenuator B set to 0 dB. The noise source shall then be switched on and attenuator B adjusted to keep the receiver output constant. The reading of attenuator B shall be recorded. Then

$$f = \frac{n}{y - 1} \qquad (3)$$

Method II This is basically Method I but using an I.F. attenuator.

The valve shall be operated in a circuit equivalent to Figure 4(B). The appropriate procedure stated in Method I shall then be followed.

The general equation, equivalent to equation 2 above is then:-

$$f = \frac{n}{x(y - 1)} - \frac{f' - 1}{g} \qquad (4)$$

Method III The valve shall be operated under the specified conditions in a circuit equivalent to Figure 4(C). With the noise source on, the switch shall be turned to Position 1 and the receiver output noted. The switch shall then be turned to Position 2 and the attenuator A adjusted to keep the receiver output constant. The reading of attenuator A shall be recorded. Then

$$f = \frac{nx + 1}{g} \qquad (5)$$

Method IV Alternatively, the low noise methods specified in Methods I and II may be used in conjunction with a suitable amplifier to increase the output of the noise source. In this case the excess noise, corresponding to n of equation (5) is $n' = g'(n + f'') - 1$ where g' is the gain of the amplifier used to increase the noise power and f'' its noise factor.

6.5. Cold Attenuation (1.10) The insertion loss shall be measured in a circuit equivalent to Figure 5. The electrode voltages shall not be applied. The switches shall be turned to Position 1 and the input level adjusted to give a convenient reading on the indicator. The switches shall then be turned to Position 2 and attenuation introduced to give the previous reading on the indicator. The value of attenuation introduced gives the cold attenuation of the valve under test.

NOTE: Where 2nd harmonics may affect the result the necessary precautions shall be taken.

6.6 Hot Cut-off Loss (1.11) The valve shall be operated under the specified "cut-off" conditions, and procedure of measurement stated in Paragraph 6.5 shall be applied. The maximum input shall be specified.

6.7 Cold Input Match, Cold Output Match and Hot Input Match These measurements shall be made with the valve in a circuit equivalent to Figure 6. The second harmonic filter may be required only in the case of the hot match tests. The directional couplers may be replaced by a standing wave indicator.

6.8 Hot Output Match With the valve operating under the specified conditions the hot output match shall be measured using one of the following methods as applicable. Method I usually measures the hot match at small signal conditions, while Method II can be used to measure the hot match under power conditions.

Method I This is the reflectometer method as specified for the Hot Input Match Test in Paragraph 6.7 above.

Method II This is a "ripple" pipe method. The valve shall be operated under the specified conditions in a circuit equivalent to Figure 7.

The height of the fine structure ripple observed on an oscilloscope shall be used to obtain the reflection coefficient.

A correction factor shall be applied to the reflection co-efficient to account for:-

(i) The loss in the ripple pipe (two directions)

(ii) The loss in power which occurs through the directional coupler (two directions).

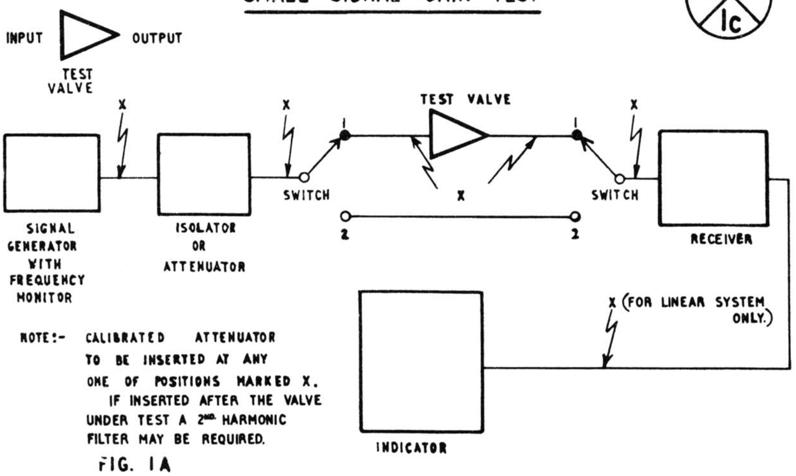
The ripple pipe shall be of sufficient length to ensure that its "ripple" is distinguishable from variations in reflection. The directional coupler shall have a coupling ratio not less than 10 dB down.

Alternatively, calibration of the oscilloscope shall be effected by introducing a known mis-match at the output of the valve under test.

SCHEMATIC DIAGRAMS FOR R.F. MEASUREMENTS

SMALL SIGNAL GAIN TEST

1a 1b 1c



NOTE:- CALIBRATED ATTENUATOR TO BE INSERTED AT ANY ONE OF POSITIONS MARKED X.
IF INSERTED AFTER THE VALVE UNDER TEST A 2nd HARMONIC FILTER MAY BE REQUIRED.

FIG. 1A

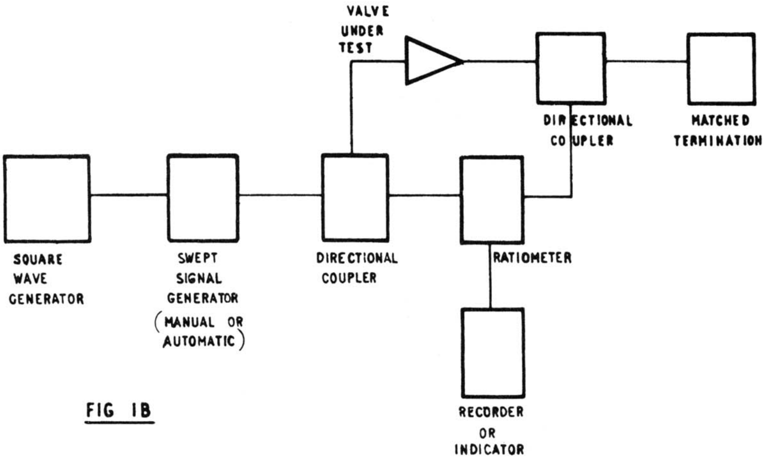


FIG 1B

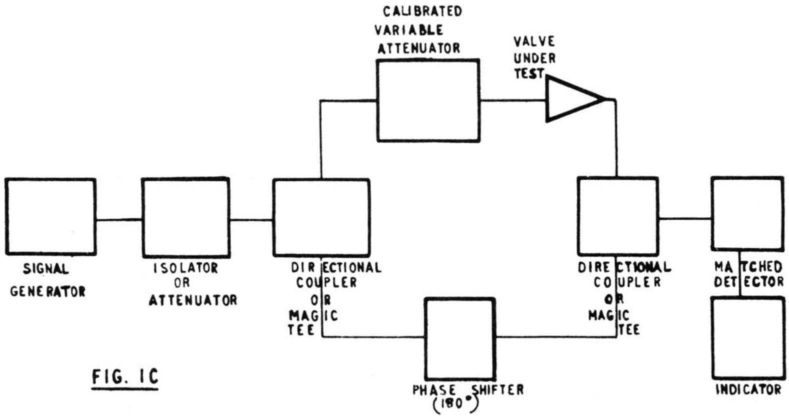


FIG. 1C

SCHEMATIC DIAGRAMS FOR R.F. MEASUREMENTS

2 3 4

HIGH LEVEL GAIN TEST

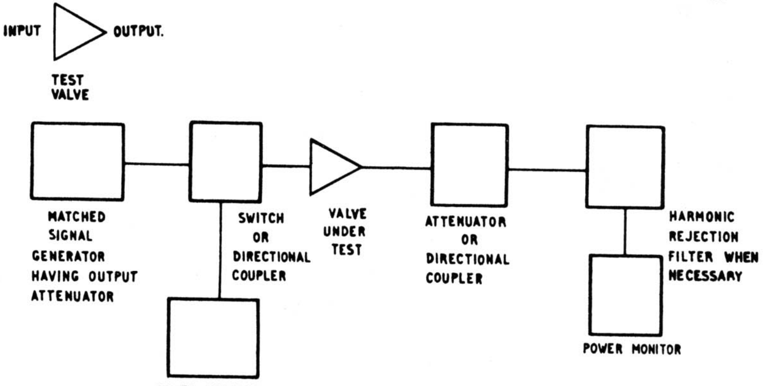


FIG.2.

SPURIOUS OSCILLATIONS TEST

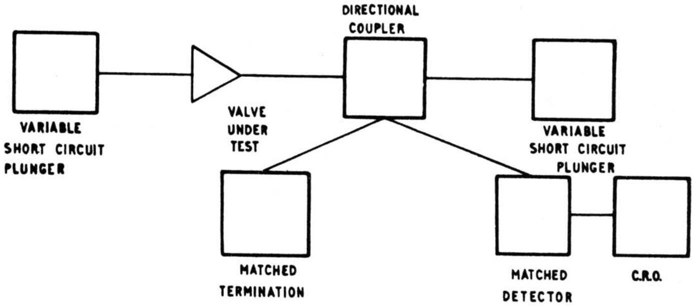
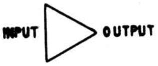


FIG. 3.

SCHEMATIC DIAGRAMS FOR R.F. MEASUREMENTS
LOW NOISE FACTOR TESTS

4a 4b 4c



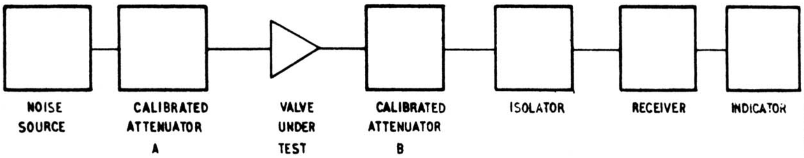


FIG. 4A

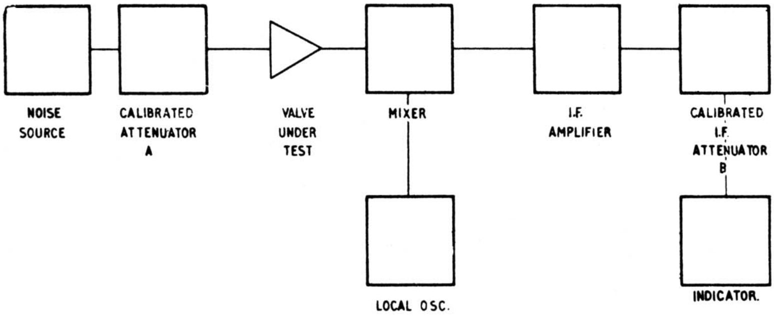


FIG. 4B

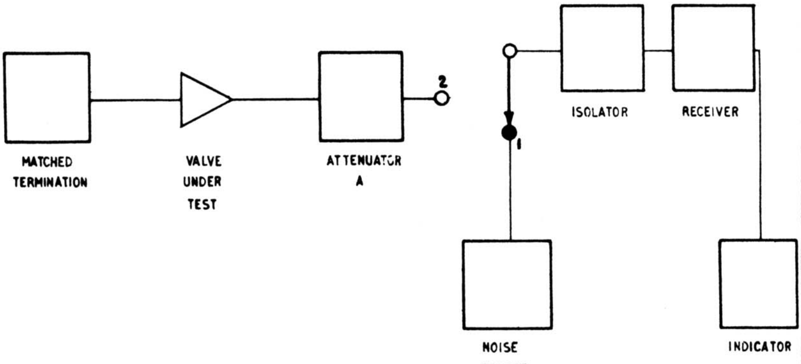
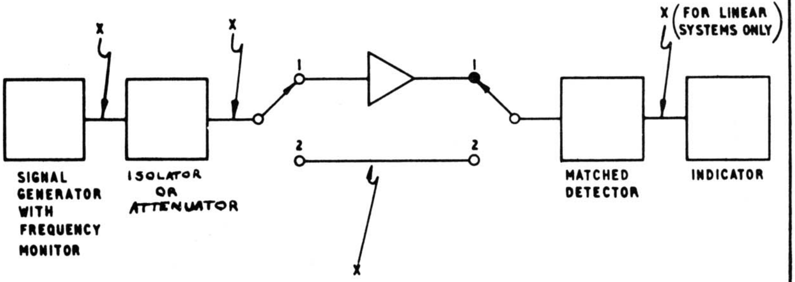


FIG. 4C

SCHEMATIC DIAGRAM FOR R.F. MEASUREMENTS.

INSERTION LOSS TEST MEASUREMENTS.

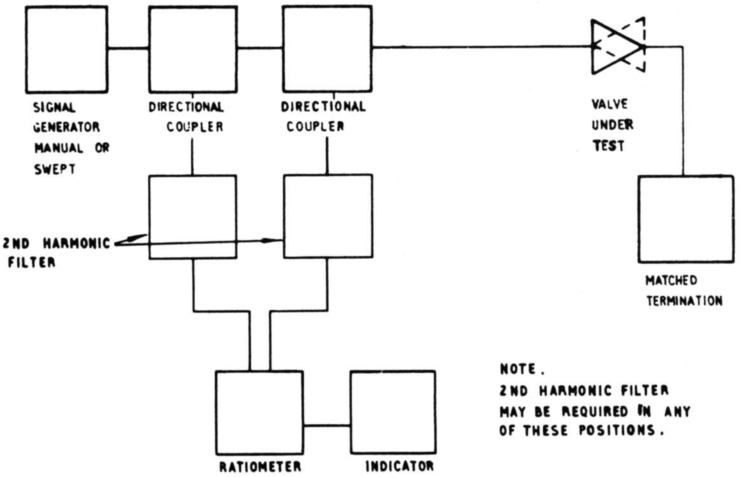
5
6



NOTE.
CALIBRATED ATTENUATOR TO BE INSERTED AT ANY ONE OF POSITIONS MARKED X.
IF INSERTED AFTER THE VALVE UNDER TEST A 2ND HARMONIC FILTER MAY BE REQUIRED.

FIG. 5.

COLD INPUT MATCH, COLD OUTPUT MATCH AND HOT INPUT MATCH TESTS.



NOTE.
2ND HARMONIC FILTER MAY BE REQUIRED IN ANY OF THESE POSITIONS.

FIG. 6.

7

SCHEMATIC DIAGRAMS FOR R.F. MEASUREMENTS
HOT OUTPUT MATCH TEST

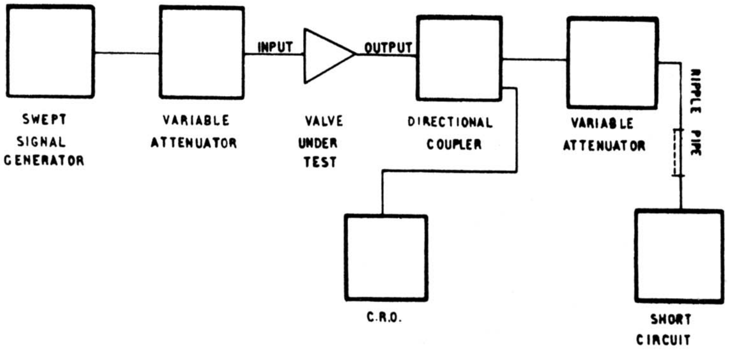


FIG. 7

Section 6

SAMPLING AND STATISTICAL TESTS

Where a Test Specification requires that inspection and acceptance for any test or group of tests shall be on a statistical basis the sampling procedure shall be in accordance with Appendix XI. Sampling Inspection will be indicated by the inclusion of an Inspection Level and an Acceptable Quality Level (AQL) in the Test Specification.

Where a manufacturer has in operation a system of quality control covering the characteristics detailed in the relevant specification, and his system and records are considered to be adequate by the Inspection Authority after consultation with the Approval Authority, these records may be accepted in lieu of all or part of the Acceptance Tests.

6.1 Test Specifications issued prior to Issue 5 of this specification or subsequently re-issued. In some Test Specifications issued before the publication of Issue 5 of K.1001 it was shewn that 100% inspection was not essential for certain tests. This was indicated by one of the following methods:-

(a) A percentage of each quantity of valves to be submitted to the Inspecting Officer, with an overriding minimum; e.g. 1% (20).

This shall now be interpreted as Inspection Level IB and AQL 6.5%. (See Appendix XI).

(b) A fixed quantity to be tested per week or month; e.g. 6 per week.

This shall now be interpreted as Inspection Level IC and AQL 6.5%. (See Appendix XI).

(c) 100% or S.

This shall now be interpreted as giving the manufacturer permission to use a Sampling Inspection plan instead of 100%. The following procedure shall apply:-

(i) Characteristic tests for Ih, Ih-k, Ia and gm

Inspection Level = II. AQL = 1.5%. (See Appendix XI)

(ii) Other characteristics

Inspection Level = I. AQL = 4.0%. (See Appendix XI)

6.2 Test Specifications for Normal Quality General Purpose Receiving Valves

6.2.1. Test specifications for normal quality general purpose receiving valves often specify tests to be performed at an Inspection Level of 100%. In these cases the manufacturer may with the agreement of the Inspecting and Approving Authority, apply Sampling and Statistical Testing in accordance with Appendix XI.

The tests shall be grouped (see also Appendix IX clause 2.4.1.1.) as follows:-

(a) Group A.

Reverse Grid Current and Electrode Insulation Tests. Inspection Level = 100% (alternatively these may be submitted to Group B testing).

(b) Group B.

Major Electrical Parameters. (These will be those tests not already covered in either clauses 6.1. or 6.2.(a) above. Inspection Level = II. A.Q.L. = 0.65%. A combined A.Q.L. of 1% shall also be applied to each set of four tests parameters, (or less as necessary), taken in the sequence in which they are specified.

(c) Group C.

Secondary Electrical Parameters. The Sampling specified in clause 6.1. above, applies as appropriate.

Section 7

GLASS STRAIN TESTS

(Note:- Where in Specifications dated prior to 1st January, 1954, mention is made of K1001/7.1 or K1001/7.2 these references should now be amended to read K1001/6.1).

Where the Test Specification requires that Glass Strain Tests shall be performed on valves, either at Qualification Approval or during acceptance testing, they shall be performed in accordance with one or other of the methods below:-

Sampling procedure shall be as specified in the individual specification.

7.1. Glass Envelope Strain Test

The glass bulb, but not the base, shall be immersed in boiling water at a temperature between 97°C and 100° C for 15 seconds and then immediately plunged into ice-cold water for 5 seconds. The volume of water shall be large enough to ensure that the temperature of the water shall not be appreciably affected by the test. The glass bulb shall not crack or break. For all-glass valves the entire valve shall be submerged.

7.2. Base Strain Test for Pinned Miniature Valves

This test shall be performed on a sampling basis. The test shall consist of forcing the pins of the valve over the specified cone and then completely submerging the valve and cone in boiling water for a specified time. Any defects resulting from glass strain shall be noted and classified separately into groups as follows:

Group	Defect
A	Bulb and/or tip cracks
B	Base cracks
C	Seal cracks

7.2.1. Equipment

7.2.1.1. Holders

The holders for the valves shall be spaced so that the valves do not touch one another. A minimum of six holes of three-eighths inch diameter shall be drilled in the plate for the holders

7.2.1.2. Container for Boiling Water

The container shall be sufficiently large so that, while the test is being made, no valve is within three-quarters inch of the retaining wall of the vessel. The container shall have a minimum capacity of two litres per fifteen valves and shall be at least three quarters full for every strain test.

7.2.1.3. Boiling Water

The boiling water shall be at a temperature between 97°C and 100°C.

7.2.1.4. Deflection Cones

The deflection cones used for the mechanical loading of the pins by uniform deflection of the pins, shall be in accordance with Appendix X, Drawing No.1.

7.2.2. Procedure

7.2.2.1. Sampling

Unless otherwise stated in the Test Specification, the sample shall consist of thirty (30) valves taken at random from each production lot.

7.2.2.2. Testing

All valves shall be at room temperature and shall have been submitted to approved pin straightening.

(a) Align the axis of the valve with the axis of the specified deflection cone and carefully push the small end of the cone into the circle formed by the valve pins until the cone lies firmly against the valve bottom.

Note: If observation after the removal of the cone shows some pins are bent more than others, the test is being made improperly.

(b) Place the holder of valves into boiling water so that the valves and cones are completely submerged for a period of ten seconds.

(c) After the ten seconds submersion period, remove the valves from the water and allow to cool to room temperature on a wooden support.

(d) Examine the valves visually for each class of strain test failure.

7.2.3. Acceptance Requirements

A lot shall be

(a) Accepted if not more than three defectives for "A", "B" or "C" group defects respectively, or if not more that a total of four defectives are found in the sample;

or (b) Rejected if four or more defectives for "A", "B" or "C" group defects respectively, or if a total of five or more defectives are found in the sample.

Section 8

ALTERNATIVE METHODS OF TEST

Contractors may seek approval for the use of alternative methods for the tests in this specification and in the Valve Test Specifications. Such requests must demonstrate the equivalence of the proposed and the specified methods to the satisfaction of the approving Authority in consultation with the Inspection Authority.

Section 9

TEST EQUIPMENT

When the Test Specification requires tests which involves the use of equipment which has no value other than for this purpose, application may be made to the appropriate Procurement Authority for the loan of the necessary apparatus.

Section 10. CLIMATIC TESTS

Climatic Tests for electronic valves are Qualification Approval tests only, unless otherwise stated in the Test Specification.

10.1. Test Chamber. The chamber conditions in any region where valves may be placed shall be varied cyclically between 35 ± 2°C and 20 ± 5°C.

The upper temperature shall be maintained for 12 hours and the lower for a minimum of 5 hours each cycle.

The relative humidity in the chamber shall be not less than 95% at any stage of the test.

The atmosphere in the chamber shall not saturate during the 35°C period.

Saturation of the atmosphere shall take place during the cooling period and throughout the 20°C period.

10.2. Test Procedure. Valves shall be introduced into the chamber at Normal Atmospheric Conditions for test, i.e. Temperature 15°C to 35°C; Air Pressure 600 mm to 800 mm of mercury. The conditions within the chamber shall then be brought to 35°C.

One complete cycle shall be of 24 hours duration and shall consist of 12 hours at 35°C and at least 5 hours at 20°C.

These conditions will be maintained for a period of 42 days after which the valves will be removed from the chamber, have surface moisture removed and will be subjected to the following tests under Normal Atmospheric Conditions.

10.3. Tests

10.3.1. Corrosion. The valve pins and any other external metal parts shall not show corrosion such as would cause unsatisfactory operation of the valve.

10.3.2. Metal Coating. Any metal coating on the valve shall comply with Clauses 5.7.1. and 5.7.2. of this specification.

10.3.3. Insulation Resistance.

(a) Valves with Glass bases shall comply with Clause 5.2.1. or 5.2.2. of this specification. This test will be completed after one hour recovery under Normal Atmospheric Conditions.

(b) Valves other than those with glass bases shall have an insulation resistance not less than 1/10 of the value stated in Clauses 5.2.1., 5.2.2., 5.A.3.1. or the relevant Test Specification.

This test will be carried out after two hours recovery under Normal Atmospheric Conditions.

10.3.4. Electrical Characteristics. Electrical characteristics other than those detailed in Clauses 10.3.1., 10.3.2. and 10.3.3. shall not show any significant deterioration.

10.3.5 Torque and Pull Tests on Bases, Caps and Wafer Inserts. Valves fitted with cemented bases, caps, etc., shall comply with the requirements of Section 12 of this specification.

10.4 Low Temperature (Operating)

The temperature of the valve shall be reduced to a specified temperature (-40°C ± 5°C or -55°C ± 5°C), measured at the mounting flange or other specified point. The valve shall be maintained at this temperature for a specified period before any voltages are applied. The Test Specification will specify the duration of the test after switching on.

10.5 High Temperature (Operating)

The temperature of the valve shall be elevated to a specified temperature (100°C ± 5°C or 150° ± 5°C), measured at the mounting flange or other specified point. The valve shall be maintained at this temperature for a specified period before any voltages are applied. The Test Specification will specify the duration of the test after switching on. During the test the temperature shall not fall below that specified.

10.6. Temperature Cycling

The valve shall be subjected to ten cycles of temperature variation over the range -55°C ± 5°C to + 85°C, ± 5°C, measured at the mounting flange or other specified point. The time taken in changing from one temperature extreme to the other shall not be less than one hour and the extremes of temperature shall be maintained for a minimum period of five minutes. The test may commence at any point in the cycle.

10.7 Moisture Resistance (Humidity Test)

The valve non-operating shall be subjected to the cycle shown in Fig.10.1. The duration of the test shall be ten continuous cycles.

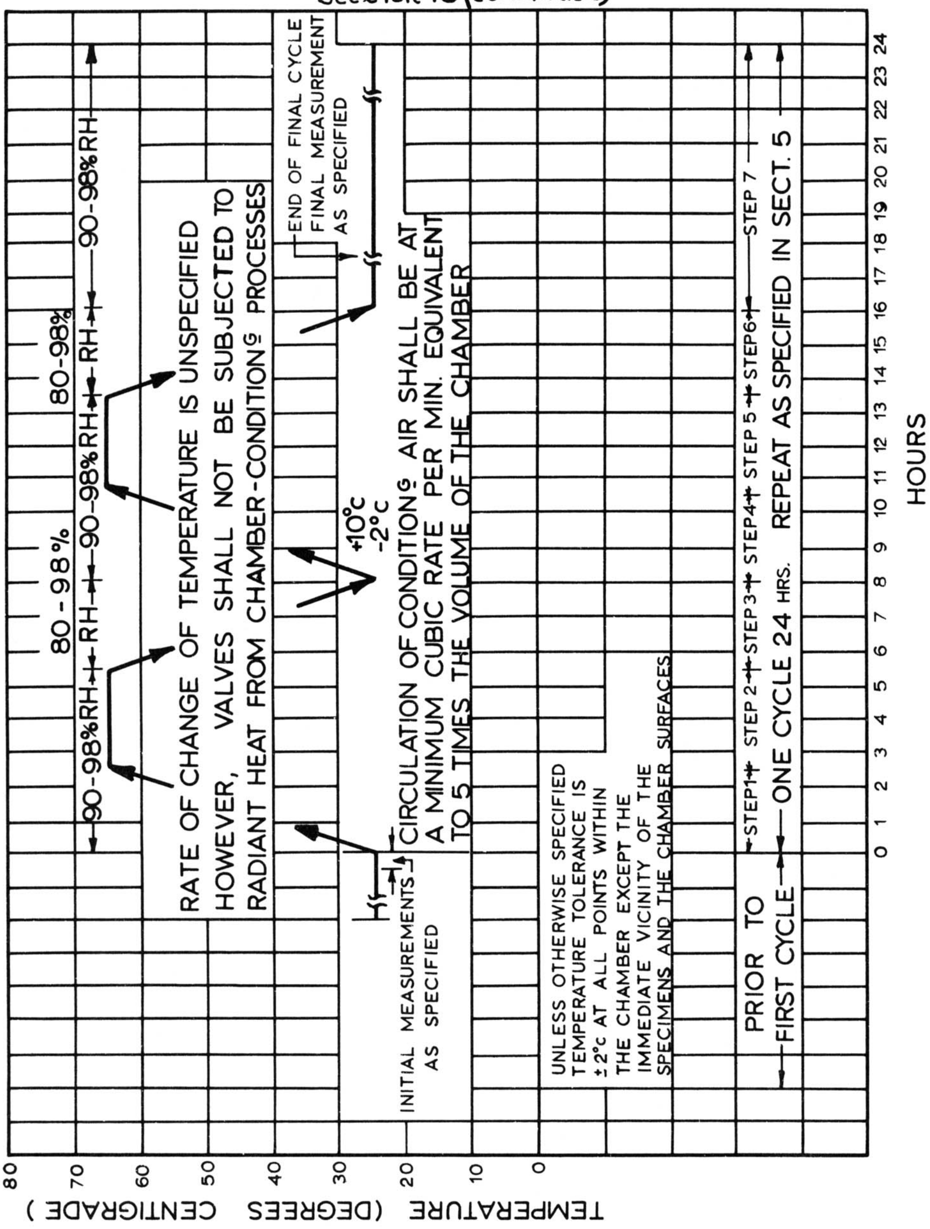
10.8. Air Pressure Tests

10.8.1. Low Pressure

The valve shall be operated under the specified conditions in a chamber at normal room temperature. The pressure shall then be reduced to the specified value in a time not greater than three minutes, and then further reduced as specified and maintained at this pressure for a period of not less than five minutes.

10.8.2. High Pressure

A pressure of not less than 45 lbs. per sq. inch shall be applied to the valve and/or waveguide for not less than five minutes. The leakage rate shall be specified.



RATE OF CHANGE OF TEMPERATURE IS UNSPECIFIED HOWEVER, VALVES SHALL NOT BE SUBJECTED TO RADIANT HEAT FROM CHAMBER-CONDITIONG PROCESSES

CIRCULATION OF CONDITIONG AIR SHALL BE AT A MINIMUM CUBIC RATE PER MIN. EQUIVALENT TO 5 TIMES THE VOLUME OF THE CHAMBER

INITIAL MEASUREMENTS AS SPECIFIED

END OF FINAL CYCLE FINAL MEASUREMENT AS SPECIFIED

UNLESS OTHERWISE SPECIFIED TEMPERATURE TOLERANCE IS ±2°c AT ALL POINTS WITHIN THE CHAMBER EXCEPT THE IMMEDIATE VICINITY OF THE SPECIMENS AND THE CHAMBER SURFACES

REPEAT AS SPECIFIED IN SECT. 5

GRAPHICAL REPRESENTATION OF HUMIDITY TEST.

Fig. 10. 1

Section 11

VIBRATION, RESONANCE SEARCH, FATIGUE AND SHOCK TESTS

When required by the Test Specification tests for Vibration, Resonance Search, Fatigue and Shock shall be as follows:-

11.1. Vibration. This test shall be at a frequency of 50 c/s with a minimum acceleration of 2 g for not less than 2 minutes. Tests for Noise and Microphony may be required during or after this treatment (see Section 5, paragraph 5.8.5.). Valves which develop mechanical faults or fail the noise and microphony test shall be rejected.

11.2. Resonance Search Test. This test shall be on a sampling basis.

The valves shall be rigidly mounted on a vibration machine and vibrated at a continuously variable frequency to the limits stated in the Test Specification. The rate of change of frequency shall be:-

(i) Not exceeding one octave per minute from 25 c/s to 200 c/s

(ii) Not exceeding 100 c/s per minute between 200 c/s and 500 c/s

and (iii) Not exceeding 250 c/s per minute between 500 c/s and 2500 c/s.

Where approved high sensitivity recording equipment is being used the rate of sweep shall be not greater than 15 seconds per octave up to 200 c/s and not greater than 45 seconds per octave above 200 c/s and up to 2.5 kc/s.

The time of rise of the indicator to full scale deflection shall be not greater than one fiftieth (1/50) of the sweep time per octave up to 200 c/s and not greater than one hundred and fiftieth (1/150) of the sweep time per octave above 200 c/s and up to 2.5 kc/s.

The acceleration shall be not less than 2 g. The waveform shall be sinusoidal and have not more than 5% harmonic distortion.

The valves shall be vibrated in three mutually perpendicular planes or in a direction at approximately 45° to the three main axes of the valve.

The Test Specification will state, as required:-

(a) The limits of vibration frequency.

(b) The electrical operating conditions.

(c) The limits of noise output in each of the specified frequency bands.

and (d) The Inspection Level and AQL.

11.3. Fatigue Test. This test shall be on a sampling basis.

The valves shall be rigidly mounted on a vibration machine and shall be vibrated at a frequency not less than 100 c/s. The waveform shall be sinusoidal with not more than 5% harmonic distortion. The valves shall be vibrated in three mutually perpendicular directions successively, one of which shall be along the major axis of the valve. The Test Specification will state the minimum total time of vibration in each direction and the times during each vibration period at which the required test measurements shall be made. If desired for practical convenience the duration of vibration and the stages at which test measurements are made may exceed those specified but for the purpose of acceptance the number of rejects found at these test periods shall count as being found at the specified times.

When required the test specification will state:-

(a) The acceleration.

(b) The minimum duration of treatment.

(c) The electrical operating conditions.

(d) The tests to be performed after the fatigue treatment has been completed.

and (e) The Inspection Level and the overall AQL values.

11.4. Shock Test. This test shall be done on a sampling basis using a machine designed in accordance with Drawing No. 2, Appendix X, or other approved alternative.

11.4.1. The valve shall be mounted so that the whole of it receives the shock but the shock must not be transmitted via the base pins. Recommended methods of mounting are:-

(a) In an approved holder; see Drawing No. 3, Appendix X.

or (b) Moulded in wax contained in a strong metal container rigidly fixed to the shock table.

11.4.2. The valve shall be subjected to five blows in each of the following directions:-

(a) Across the major axis of the electrodes.

(b) Across the Minor axis of the electrodes.

(c) Towards the base.

and (d) Away from the base.

11.4.3. Valves not constructed with pinned bases shall be tested in both directions along the major axis and in two other mutually perpendicular directions.

11.4.4. The Test Specification will state:-

(a) Either the hammer angle or the minimum peak acceleration and minimum shock duration.

(b) The post shock tests.

and (c) The Inspection Level and AQL values.

11.5. Vibration Test for Cathode Ray Tubes. When the Test Specification requires that tubes be tested for the effects of vibration the test shall be done with a circular motion of 0.008 inch total amplitude applied to the base of the tube and at right angles to the major axis of the tube. The frequency shall be varied over the range 0 to 100 cycles per second. The centre of the screen of the tube shall be prevented from appreciable movement, e.g. by clamping the edge of the faceplate in suitable resilient material. The tube shall be operated at the specified electrode voltages with a circular scan pattern having a diameter not less than 75% of the screen diameter and with the focus control adjusted to give optimum line width. The tube shall be rejected if at any time during the test the apparent line width exceeds twice its initial value.

The tubes under test shall be examined visually and tested in accordance with the relevant Test Specification both before and after the vibration test and will be rejected if, after vibration, any objectionable defect is found or if any of the electrical characteristics have changed by more than a specified amount.

11.6. Heater Resonance and Fatigue. The heater supply frequency which shall be sinusoidal with a distortion not exceeding 10% shall be swept from 40 c.p.s. to 2.7 k/c.p.s. at a rate not exceeding one octave per three minutes. Mechanical resonances are defined as occurring when the output from a detector exceeds the general mean level by three times. They shall be determined with the aid of a piezo-electric transducer, the output from which shall be displayed on a C.R.O. such that the spot displacement is directly proportional to the output of the transducer. The transducer shall be screwed or clamped to the body under test and so placed as to measure maximum response and to cause minimum damping of the resonances. The frequencies of all mechanical resonances shall be noted.

The heater supply frequency shall be held at each resonance within any of the following bands for 250 hours:-

(i) 45 to 65 c.p.s.

(ii) 360 to 550 c.p.s.

(iii) 1440 to 1760 c.p.s.

(iv) 2160 to 2640 c.p.s.

(v) 700 to 900 c.p.s.

Any heater supply frequencies shall be replaced by square waves when specified.

11.7. Functional Vibration

11.7.1. Method A

The valve shall be operated under the specified conditions and mounted in an approved clamp, and subjected to vibration in each of three mutually perpendicular directions. The waveform shall be sinusoidal with less than 5% total harmonic distortion. The frequency shall be swept once up and down between the specified limits at a rate not exceeding one octave, per minute. The peak acceleration at each frequency shall not be less than that given by one of the envelope curves obtained by plotting the points in the table below on log. log. paper, and joining the points with straight lines as in Fig. 11.1 of this section:-

(i)	f.c.p.s.	10	30	5000	10000
	g.	1	10	10	5

(ii)	f.c.p.s.	10	30	50	5000	10000
	g.	1	10	10	20	10

(iii)	f.c.p.s.	10	30	50	100	5000	10000
	g.	1	10	20	30	30	15

11.7.2. Method B

The test conditions as specified in clause 11.7.1. shall apply except that the envelope curve shall be determined by plotting the points in the table below on log. log. paper, and joining the points with straight lines as in Fig. 11.2 of this section:-

(iv)	f.c.p.s.	30	5000
	g.	10	10

(v)	f.c.p.s.	30	50	5000
	g.	10	20	20

(vi)	f.c.p.s.	30	50	100	5000
	g.	10	20	30	30

11.8. Vibration Life

The test conditions as specified in clause 11.7.1. shall apply. The duration of the test shall be not less than 15 hours.

11.9. Fatigue Vibration

The valve shall be subjected to a sinusoidal vibration having a peak acceleration of not less than 3(g) at 30 c.p.s., rising to 10(g) at 100 c.p.s., and remaining at 10(g) up to 2 k c.p.s. The frequency range 30 c/s to 2000 c/s shall be swept continuously and in each direction at a rate of one octave per minute ± 10 secs. The duration of the test shall not be less than 100 hours, of which at least 30 hours shall be in each of three mutually perpendicular directions. One direction of vibration shall be along the axis to the cathode. During the test the valve shall be operated intermittently with not less than 12 interruptions in each 24 hours. A minimum 'on' period of 1 hour with an 'off' period of 15 minutes shall elapse between each interruption and the cumulative 'on time' shall be at least 20 hours out of each 24 hour period. The 'on' and 'off' periods shall consist of the immediate application and removal of the heater voltage.

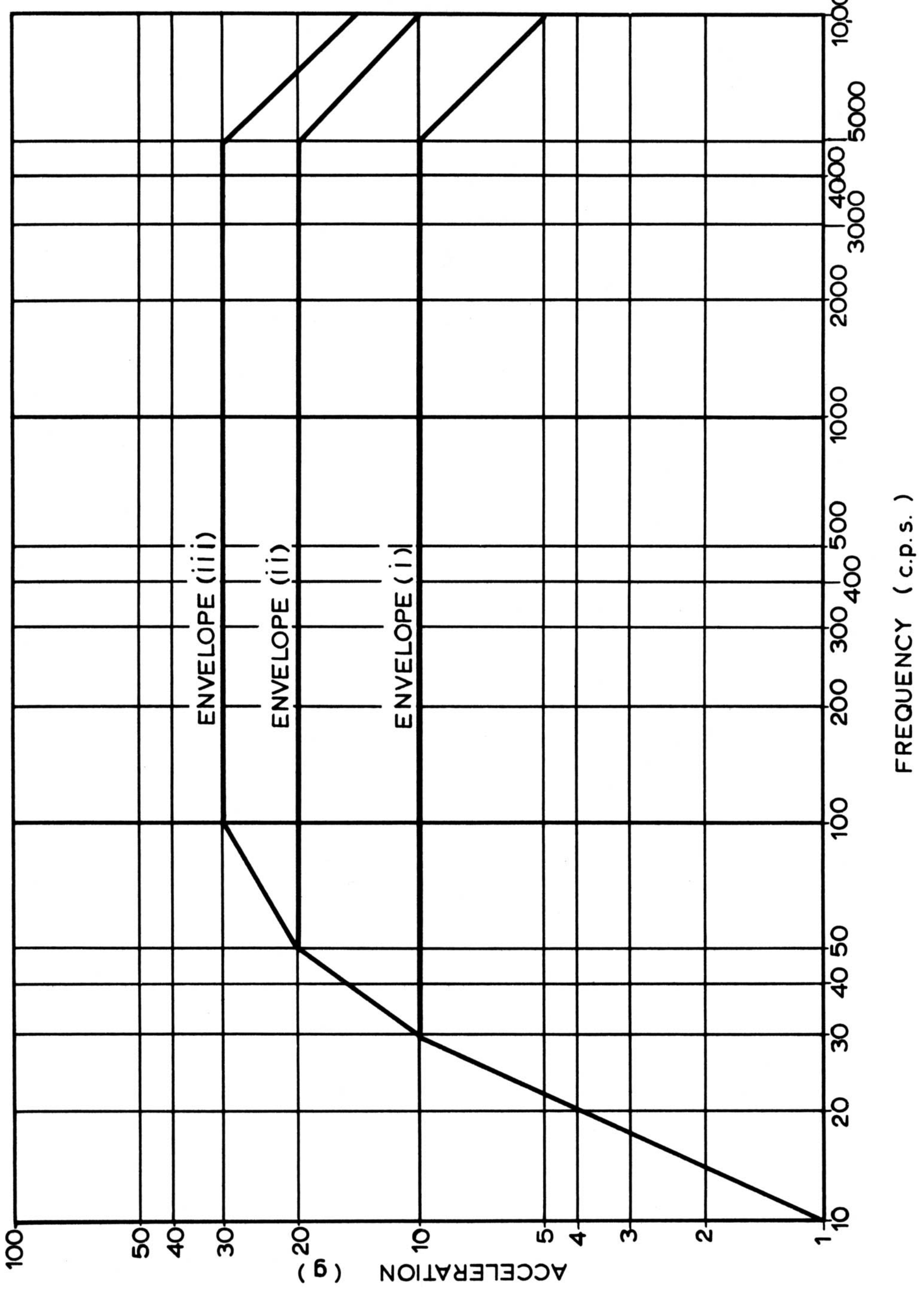
11.10 Functional Shock

11.10.1. Method A

The valve shall be operated under the specified conditions and subjected to shock along each of three mutually perpendicular axes. Each shock shall have a duration of 6 to 12 milliseconds and a peak acceleration, defined such that the product of the duration in milliseconds and the acceleration in 'g' units shall not exceed 600. The rise time shall be between 0.5 and 1.0 millisecond. The valve shall receive three shocks in each of six directions.

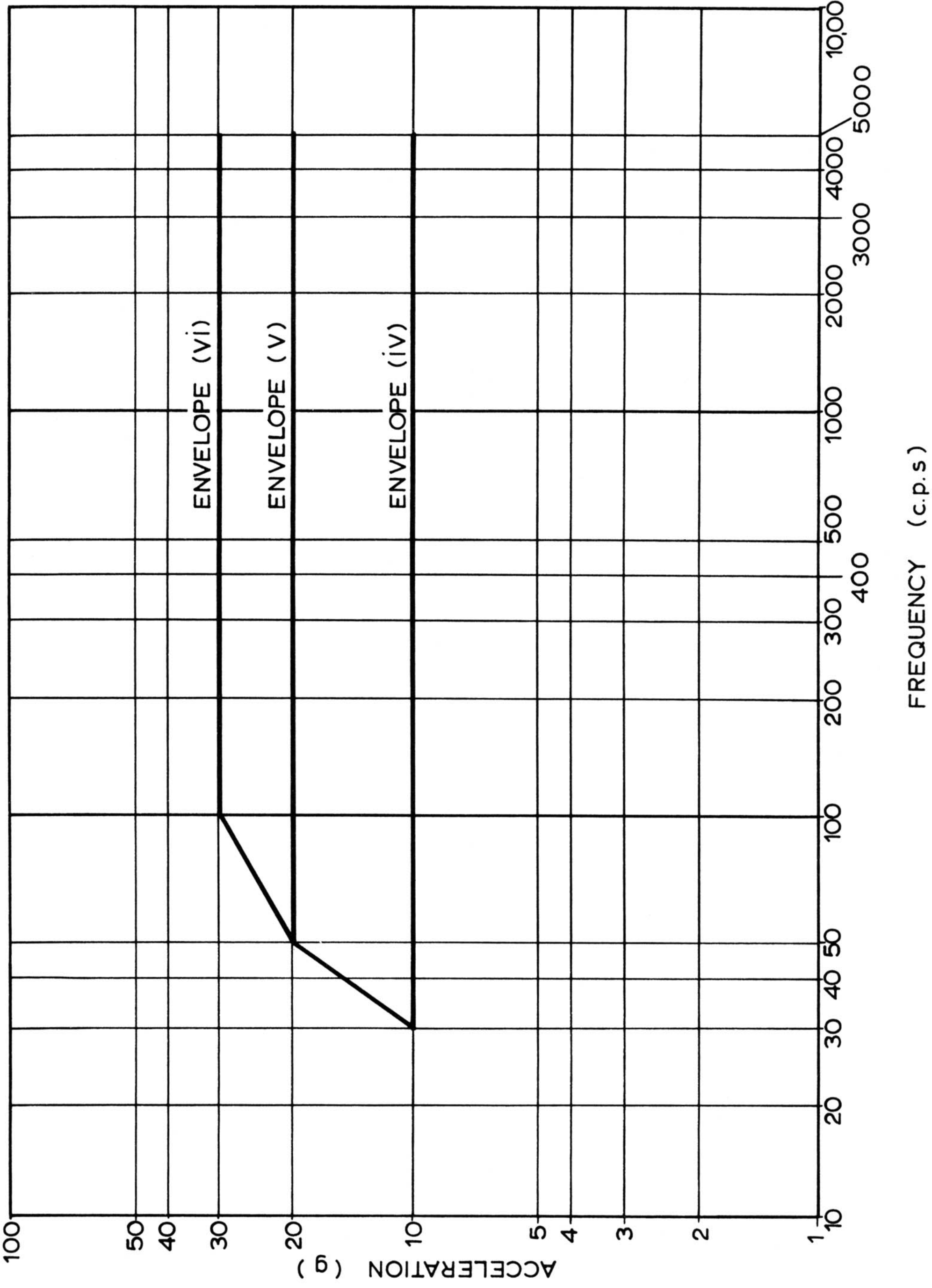
11.10.2. Method B

The valve shall be subjected to shock in the most sensitive direction as determined by the test specified in clause 11.10.1. The test conditions specified in clause 11.10.1 shall apply, the valve shall receive three shocks.



GRAPHICAL REPRESENTATION OF FUNCTIONAL VIBRATION TEST. (Para. 11.7.1)

Fig. 11.1



GRAPHICAL REPRESENTATION OF FUNCTIONAL VIBRATION TEST. (Para. 11.7.2)

Fig. 11. 2

Section 12

BASE AND CAP ADHESION TESTS

12.1. Assembled valves with bases or caps shall be tested for adhesion of bases, caps and inserts as specified below. At intervals of two months, ten samples, selec at random by the Inspectorate from the types listed below, shall be subjected to the following tests in the order as specified.

12.2. Torque and Pull Torque shall be applied gradually between the elements specified in accordance with Table 1. After application of torque and pull, there shall be no loosening of cemented joints or loosening by more than 1/32" movement of mechanical joints.

12.3. The valves shall be subjected to the Climatic Test, Section 10.1 and 10.2.

12.4. Torque and Pull shall be repeated after the Climatic Test.

12.5. Valves may be selected from the following types and should be mechanically sound, but failures on electrical tests may be used for this test. In the case of cathode ray tubes, necks only may be accepted for testing.

Base Only

CV 391
CV 394
CV 420 (CRT)
CV 429 (CRT)
CV 1530
CV 2175 (CRT)
CV 2244 (CRT)
CV 2253
CV 2296
CV 2415 (CRT)
CV 2464 (CRT)
CV 1868
CV 2162
CV 2108

Base and Cap

CV 265
CV 375
CV 2109
CV 2125
CV 2180
CV 2520
CV 2659
CV 2904 (CRT)
CV 254 (CRT)
CV 262 (CRT)
CV 464 (CRT)
CV 2328 (CRT)

12.6. These tests will normally be carried out by the manufacturer but where facilities do not exist reference should be made to the relevant Inspection Authority.

12.7. After completion of all tests the results shall be examined and details of any failures reported to the Qualification Approval Authority.

TABLE 1

Element Size	Torque	Pull
Bases having maximum overall diameter not greater than 16.5 mm	12 in. lb	
Bases having maximum overall diameter between 16.5 mm and 38 mm	20 in. lb	
Bases having maximum overall diameter greater than 38mm	40 in. lb	
Caps having maximum overall diameter not greater than 15 mm	1.5 in. lb	
Caps having maximum overall diameter greater than 15 mm	3 in. lb.	
B8G and B9G	-	35 lbs

Section 13

LIFE TESTS

13.1. Life Tests will usually be called up in individual Valve Test Specifications. Where for older specifications this is not done, it is the responsibility of the manufacturer to control the quality of his product by adequate testing whenever practicable.

However, when such life tests are not practicable the life performance shall be maintained to an agreed standard by joint Services/Manufacturer negotiation. All relevant records of life tests performed shall be available for the information of the Manufacturing, Approving and Inspection Authorities when required.

Section 14

PACKAGING

Valves shall be packed according to the requirements of Joint Service Specification K1005. The following acceptance tests shall be performed as required during packaging tests (See K1005, Section 7.)

14.1. Test for Inoperatives (see paragraph 5.14):-

(1) Discontinuities
(2) Shorts
(3) Air leaks
(4) Broken pins
(5) Loose base or caps

The methods of test for (1), (2), (3) and (5) shall be those normally used by the Manufacturer subject to the approval of the Inspection Authority.

14.2. Electrical Tests

14.2.1. Receiving Valves

TESTS

1. Anode Current

2. Screen Current and Diode Current where applicable.

3. Anode Current Cut-off. (Where this is stated in the Test Specification it is to be measured as the average change in grid voltage for a fixed current).

LIMITS

When minimum and maximum values only are given in the Test Specification, the average value of change of the referenced parameter shall not exceed ± 10% of the difference between the maximum and minimum limits.

When a bogey value is given in the Test Specification, the average value of change of the referenced parameter shall not exceed ± 20% of the difference between the bogey value and the wider limit.

When a single sided limit is given in the Test Specification, the average value of the change shall not exceed ± 10% of this limit.

14.2.2. Rectifiers

TESTS

All rectifiers shall be subjected to the Load Test as specified. On gas filled rectifiers this test shall be made at least 24 hours after the drop test.

LIMITS

Load Test: ± 5% of existing specification limit.

NOTE: Where the Peak Inverse Voltage rating exceeds 10 kV, the tolerances shall be raised from 5% to 7½%.

14.2.3. Cathode Ray Tubes

TESTS

1. Spot Centrality

2. Beam (or Anode) Current at a fixed point or alternatively - Visual Cut-off

3. Useful screen area to be fully scanned

LIMITS

1. Spot Centrality: The geometrical position of the spot shall not change by more than 50% of the total tolerance.

2. Beam (or Anode) Current, or, alternatively, Cut-off. When minimum and maximum limits are given in the Test Specification, the average value f the change shall not exceed ± 20% of the difference between the maximum and minimum values.

When a single sided limit is given in the Test Specification, the average value of change shall not exceed ± 10% of this limit.

3. Deflection Sensitivity. (Electrostatically deflected tubes only): 50% of the total tolerance.

14.2.4. Small or Medium Power Transmitting Valves

TESTS

1. Any Functional Test given in the Test Specification (ignoring the time clause).
2. If no functional test is specified, test as for receiving valves in Section 14.2.1 above.

LIMITS

1. Functional Test e.g. Power Output: ± 10% of existing specification limit.
2. As in Section 14.2.1 above.

14.2.5. Magnetrons

TESTS

1. Power Output Test
2. Frequency Pulling
3. Peak Anode Voltage
4. Frequency.

LIMITS

1. Power Output: ± 10% of existing specification limit.
2. Frequency Pulling: ± 10% of maxumum limit.
3. Peak Anode Voltage: ± 10% of existing specification limit.
4. Frequency: ± 10% of the difference between the specification limits or ± 20% of the difference between the bogey value and the wider limit.

14.2.6. Reflex Klystrons

TESTS

1. Power Output
2. Reflector Voltage
3. Tuning Range

LIMITS

1. Power Output: ± 20% of existing specification limit.
2. Reflector Voltage: ± 10% of the difference between the specification limits.
3. Tuning Range: As in the Test Specification.

14.2.7. Gas Filled Tubes

All tests to be made not less than 24 hours after the drop test.

TESTS

1. Load Test as for rectifiers
2. Striking Voltage

LIMITS

1. Load Test: as for rectifiers (See 14.2.2.)
2. Striking Voltage: ± 10% of the difference between the existing specification limits.

14.2.8. All other valves. Where the specification requires a functional test to be made this test shall be the package acceptance test.

Where no functional test is given life test conditions shall be used.

Where neither functional nor life test conditions are stated selected specification tests may be used in agreement with the Inspection Authority.

SECTION 15

QUALIFICATION APPROVAL

15.1. Before valves can be accepted to a contract for supply to the Services it is necessary for the manufacturer to obtain Qualification Approval of the design of the valve to be supplied. This condition does not apply to the valves listed in Appendix XVII. The name of the Approving Authority is given in the Test Specification. Qualification Approval given by that Authority will apply to contracts for any Service unless otherwise stated.

15.1.1. If Qualification Approval is required in connection with any particular contract the appropriate Authority is to be informed of the despatch of the sample valves and reference made to the contract concerned. However, it is not necessary for a manufacturer to wait until he has received a contract before submitting valves for Qualification Approval.

15.1.2. Sample valves submitted for Qualification Approval shall be accompanied by Form S.S.C.238 duly completed by the manufacturer. (Specimen forms may be obtained from the T.V.C. Office, Ministry of Aviation, Castlewood House. 77, New Oxford Street, London, W.C.1.).

15.1.3. The specified marking need not appear on sample valves submitted for Qualification Approval but the valves and packages must be clearly marked to provide safe means of identification.

15.1.4. One hundred sample valves will be required for Qualification Approval of a Reliable Valve, twelve of a Semiconductor Diode and six of all other types except when otherwise directed by the Approving Authority.

15.1.5. When valves are submitted for Qualification Approval two sample valves will be sealed and held for reference, one by the Approving Authority and one by the manufacturer, to enable comparison to be made later with valves purporting to be in accordance with approved samples. When this is impracticable adequate information (including drawings and photographs) to the satisfaction of the Authority will be accepted in lieu of a sample valve.

15.1.6. Valves submitted for Approval will be tested to this Specification and to the appropriate Test Specification. They may also be tested in equipment typical of that in which they are intended to be used.

15.1.7. Bulk deliveries are not to be made by a manufacturer until he has received notification of Qualification Approval from the Authority, except when delivery under a concession has been approved. (See Clause 4.2), or when Approval has been given for the use of the valve in MDAP equipment.

15.2. Production Approval. When valves are produced in accordance with Appendix IX a further stage of approval may be demanded. The number of valves required will be determined by the Inspection Levels and Acceptable Quality Levels stated in the Test Specification and shall be not less than the minimum number which will allow the specified Acceptable Quality Levels to be assessed.

Valves supplied for this stage of approval shall be selected at random from the production lot and shall be accompanied by full test results obtained on a similar sample from the same production lot.

15.3. Manufacturers shall submit new samples of valves for Qualification Approval if:-

(a) changes in design (as compared with previously approved valves) likely to affect the performance of the valve are introduced,

or (b) the interval since the type was last manufactured to Government order exceeds five years.

15.4. When a subsidiary factory is required to manufacture a valve, of a type and design for which Qualification Approval has already been granted to the parent factory, the following procedure shall apply:-

(a) Samples shall be submitted for Qualification Approval.

(b) The Approving Authority will make a preliminary inspection of the samples. If they appear to conform to the design already approved for the parent factory the manufacturer will be informed so that delivery of valves may proceed while full Qualification Approval tests are being completed.

When changes in design have been approved for the parent factory a separate submission of samples by a subsidiary factory will not always be necessary. At the time of the submission of samples the parent factory shall state whether it is intended to introduce the modification into valves manufactured by a subsidiary factory. The Approving Authority will then state whether a separate submission by the subsidiary factory will be required.

15.5. Qualification Approval granted in respect of a sample batch of valves shall not be taken to approve any departure from the specified requirements for that type of valve that may have existed in the samples submitted. Any such departure from the requirements of this specification must be specifically mentioned in the covering correspondence if a concession approving it is desired by the manufacturer.

15.6. Correspondence granting Qualification Approval will refer to the valves only and will not include packing unless this is expressly stated.

15.7. Maintenance of Qualification Approval Tests

15.7.1. When required by contract documents Maintenance of Qualification Approval Tests will be performed at suitable intervals (normally not more than once in six months) during the course of manufacture of the valves ordered.

When requested by the Inspection Authority the contractor shall provide the Testing Authority[x] with the necessary samples at the appropriate intervals and shall certify that such samples are typical of the bulk supply.

The Testing Authority will report the results of the tests to the Inspection Authority, Qualification Approval Authority, Production Departments and the Contractor.

Failure to pass Maintenance of Qualification Approval Tests will at once be notified by the Testing Authority to the Inspection Authority, Qualification Approval Authority, Production Departments and the Contractor, and acceptance may be suspended.

15.7.2. In circumstances which indicate that valves may fail to meet the Qualification Approval requirements, the Inspection Authority may propose that the tests described in 15.7.1. be exceptionally applied. On so doing, the Inspection Authority shall formally notify the Contractor to this effect and may suspend acceptance as from the date of the notice, pending the outcome of the test.

[x] Director E.I.D. "Aquila", Golf Road, Bromley, Kent.

Section 16

HOLDING PERIOD

Part I. MANDATORY

Amdt 2

16.1. All valves intended for delivery on contract shall, after completion of manufacture, be held in store for a specified holding period and shall then be tested or retested prior to despatch. Valves shall not be operated during the holding period.

16.2. The Test Specification will normally specify the minimum duration of the holding period together with the tests which are to be performed after completion of the holding period. Any valve failing to pass the specified tests shall be deemed a failure and removed from the lot.

16.3. Where in Test Specifications no mention of holding period is made the following Clauses appropriate to the class of valve shall apply.

16.3.1. The manufacturer may at his discretion perform any of the other tests specified in the test specification either prior to or after, completion of the holding period.

16.3.1. Air, Water and Radiation Cooled Valves excluding General Purpose Receiving Valves.

16.3.1.1. Duration of the Holding Period

The minimum duration of the holding period shall be fourteen days.

16.3.1.2. Post Holding Period Tests

Inspection for inoperatives together with a measurement of reverse grid current shall be performed. The maximum limit of -Igl shall not be more than 10% above the limit specified for this test in the test Specification.

16.3.2. Cathode Ray Tubes

16.3.2.1. Duration of the Holding Period

Minimum duration of the holding period shall be seven days.

16.3.2.2. Post Holding Period Tests

The tests to be performed after the holding period shall be agreed with the Specification Authority.

16.3.3. Gas or Vapour Filled Valves (Cold Cathode)

16.3.3.1. Scaling Tubes (including Vacuum Counter Tubes) (G.M. tubes etc.)

16.3.3.1.1. Duration of the Holding Period and Post Holding Period Tests

The minimum duration of the holding period and the tests to be performed after the holding period shall be agreed with the Specification Authority.

16.3.3.2. Spark Gaps, Arc Discharge, Trigger and Display Tubes

16.3.3.2.1. Duration of the Holding Period

Minimum duration of the holding period shall be fourteen days.

16.3.3.2.2. Post Holding Period Tests

Inspection for inoperatives together with specified measurement of eigher ignition or trigger voltage, as appropriate. The limits in the Test Specification shall apply.

16.3.3.3. Stabilisers (Glow Discharge and Reference Tubes)

16.3.3.3.1. Duration of the Holding Period

Minimum duration of the holding period shall be fourteen days.

16.3.3.3.2. Post Holding Period Tests

Inspection for inoperatives together with specified measurement of maintaining voltage. The limits in the Test Specification shall apply.

16.3.4. Gas or Vapour Filled Valves (Hot Cathode)

16.3.4.1. Ignitrons, Excitrons Rectifiers and Hydrogen Thyratrons

16.3.4.1.1. Duration of the Holding Period

Minimum duration of the holding period shall be fourteen days.

16.3.4.1.2. Post Holding Period Tests

Inspection for inoperatives together with a high voltage test. The limits in the Test Specification shall apply.

16.3.4.2. Thyratrons (other than Hydrogen)

16.3.4.2.1. Duration of the Holding Period

Minimum duration of holding period shall be fourteen days.

16.3.4.2.2. Post Holding Period Tests

Inspection for inoperatives together with ignition and high voltage tests. The limits in the Test Specification shall apply.

16.3.5. Klystrons (High Power)

16.3.5.1. Duration of the Holding Period

Minimum duration of holding period shall be twenty-eight days.

16.3.5.2. Post Holding Period Tests

The tests to be performed after the holding period shall be agreed with the Specification Authority.

16.3.6. Klystrons (Low Power)

16.3.6.1. Duration of the Holding Period

Minimum duration of the holding period shall be fourteen days.

16.3.6.2. Post Holding Period Tests

The tests to be performed after the holding period shall be agreed with the Specification Authority.

16.3.7. Magnetrons

16.3.7.1. Duration of the Holding Period

Minimum duration of the holding period shall be fourteen days.

16.3.7.2. Post Holding Period Tests

Where a test for stability is included in the test specification it shall be repeated, otherwise, the tests to be performed shall be agreed with the Specification Authority.

16.4.. Repeat Tests

The manufacturer may, in addition to the relevant tests specified in Clause 16.3 elect to repeat certain of the remaining tests detailed in the Test Specification.

16.5. Double Holding Period

Where a Double Holding Period is required, the Test Specification will state the details of the tests which are to be recorded.

16.6. Changes in Characteristics

In certain cases it may be necessary to specify in test specifications, allowed changes in characteristics for individual valves during the Holding Period.

Part 2 DELAYED SHIPMENT OF INSPECTED VALVES

16.7 Valves which have passed inspection and have subsequently been held in storage for a period in excess of twelve months shall prior to delivery be re-tested for inoperatives. Amdt 2

Section 17

GROUPED TESTING OF STRUCTURALLY SIMILAR VALVES

When two or more types of valves with identical electrode designs are being tested they may be considered as one for the purposes of certain individual tests, subject to the approval of the Inspection Authority.

17.1. Examples of such similar types are:-

(a) A pinned miniature valve and its flying lead version, and

(b) The double diodes CV4007 and CV4025.

17.2. Examples of tests suitable for group testing are:-

(a) Life tests

(b) Certain Capacitance Tests, and

(c) Noise Factor Measurements

Section 18

CONTINUOUS PRODUCTION AND TESTING PROCEDURE

Certain testing procedures in this specification (e.g. Reduced Inspection in Section 7 of Appendix XI) are contingent upon production being continuous. For such purposes Continuous Production is defined as prevailing when:-

(a) There has not been any change of design or place of manufacture, and

(b) There has not been a break in production exceeding one month (or a longer period if approved by the Inspection Authority.)

Section 19

RADIOACTIVE VALVE

19.1. Definition. A radioactive Valve for Joint Service use is defined as one into whose manufacture a radioactive substance or composition has deliberately been introduced. In this context a radioactive substance or composition means one having radioactivity in excess of 0.002 microcuries per gram,

except (a) that any one substance listed in the Table below may be introduced at the indicated level without the valve coming into the Radioactive Class.

and (b) that more than one substance listed in the Table below may be introduced without the valve coming into the Radioactive class provided that the sum of the fractions of the permitted Quantities in Column 2 of the Tables does not exceed unity.

e.g. - a valve containing 0.8 microcuries of Krypton 85 would have 8/10 of the permitted quantity of that material. If it also contained 0.02 microcuries of Caesium 137, this would, represent 2/10 of the permitted quantity of that material, making the sum of the fraction 8/10 + 2/10 = 1.0"

TABLE

OF RADIOACTIVE SUBSTANCES SHOWING QUANTITIES PERMITTED WHEN ONE SUBSTANCE ONLY IS USED WITHOUT THAT VALVE COMING INTO THE RADIOACTIVE CLASS

Column 1 Substance	Column 2 Quantity Allowed per Valve in Microcuries	Column 3 Radiation Dose Rate Allowed at Surface of Valve in Millirads per Hour
Hydrogen 3 (H3)	1.0	0.01
Carbon 14 (C14)	1.0	0.01
Chlorine 36 (Cl36)	1.0	0.01
Cobalt 60 (Co60)	0.1	0.01
Nickel 63 (Ni63)	0.1	0.01
Krypton 85 (Kr. 85)	1.0	0.01
Caesium 137 (Cs 137)	0.1	0.01
Thorium Natural	0.1	0.01
Thallium 204 (Tl 204)	0.1	0.01
Lead 210	0.1	0.01
Radium 226	0.1	0.01
Uranium Natural (U 238)	0.1	0.01

19.2. Radioactivity Declaration by Manufacturer

When radioactive material is incorporated into any valve whatever, the radioactive substance(s) and quantity(ies) concerned must be declared to the Qualification Approval Authority at the time of submitting samples for Approval.

19.2.1. Ministry of Aviation T.L.5b (T.V.C. Office) shall be informed for those valves having C.V. numbers but without C.V. Specifications.

19.3. Radioactivity Declaration by Approval Authority

The Qualification Approval Authority (or M.O.A./T.L.5b as appropriate) shall supply to other Specification and Qualification Approval Authorities and to the Inspectorates details of the Radioactive content of valves whether or not these valves fall within the definition of a Radioactive Valve. This information shall also be inserted on the Qualification Approval Certificate.

19.3.1. The Specification Authority shall endorse the relevant C.V. Specification, "This Valve may be Radioactive".

19.4. Further information on Services Radioactive Valves and their problems is given in T.V.C. Information Sheet No. 11.

19.5. Sources of further information on general radioactivity matters and Codes of Practice are listed in Appendix XVI.

Radioactive valves shall conform to the requirements specified in Appendix XX

Amdt 3 Addendum

JOINT SERVICE SPECIFICATION K1001

APPENDIX I

VALVE DIMENSIONS

1. GENERAL

This appendix contains general outline drawings of various types of valves. Wherever possible, Test Specifications will define dimensional requirements by reference to B.S.448.

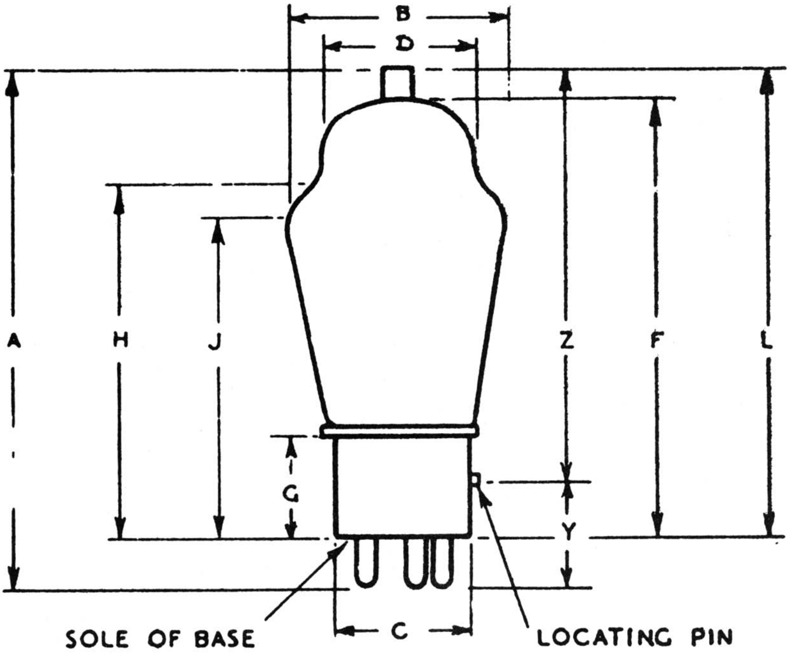
2. INDEX OF DRAWINGS

The Drawings comprising Appendix I are:-

Drawing No.	Drawing Title
1	Conventional Glass Valves
2	Valves fitted with B9G Glass Base
3	Double Ended Glass Valves (Transmitting Type without Base).
4	Outline Dimensions of Valves B7G and B9A.
5	Top Caps
6	Anti-Corona Connector
7	B8B and B8G Glass Base Valves
8	Cartridge Crystal Valves, Dimensions
8A	Concentricity Gauge for Cartridge Crystal Valves
9	Shielded Co-axial Crystal Valves, Dimensions
9A	Concentricity Gauge for Shielded Co-axial Crystal Valves
10	Outline Dimensions of Miniature Valves B5A/F, B5B/F and B8D/F.
11	Outline Dimensions of Miniature Valves Type B7G/F and B9A/F.

DRAWING N°1

CONVENTIONAL GLASS VALVES



A. OVERALL LENGTH OF VALVE INCLUDING PINS, SPIGOT AND TOP CAP OR TERMINAL (SCREWED DOWN) IF PRESENT

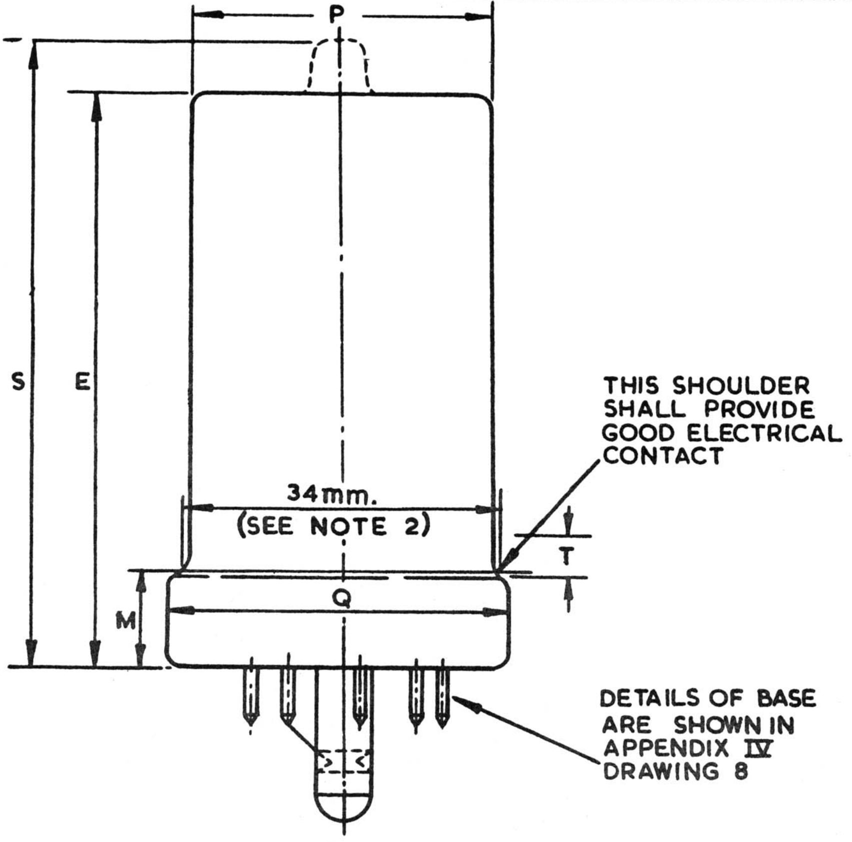
B. DIAMETER OF VALVE AT PART OF MAXIMUM DIAMETER.

C. DIAMETER OF VALVE BASE AT PART OF MAXIMUM DIAMETER, EXCLUDING LIP IF ANY.

D. DIAMETER OF DOME OF VALVE
F. LENGTH, EXCLUDING PINS AND TOP CAP.
G. HEIGHT OF BASE FROM SOLE OVER WHICH DIMENSION "C" APPLIES
H. HEIGHT FROM SOLE TO PART WHERE DIMENSION "D" APPLIES
J. HEIGHT FROM SOLE TO PART OF MAXIMUM DIAMETER.
L. HEIGHT FROM SOLE TO TOP OF VALVE, INCLUDING TOP CAP, IF ANY
Y. HEIGHT OF LOCATING PIN FROM END OF CONTACT PINS
Z. HEIGHT FROM LOCATING PIN TO TOP OF VALVE, INCLUDING TOP CAP IF ANY.

DRAWING No. 2.

VALVES FITTED WITH B9G GLASS BASE

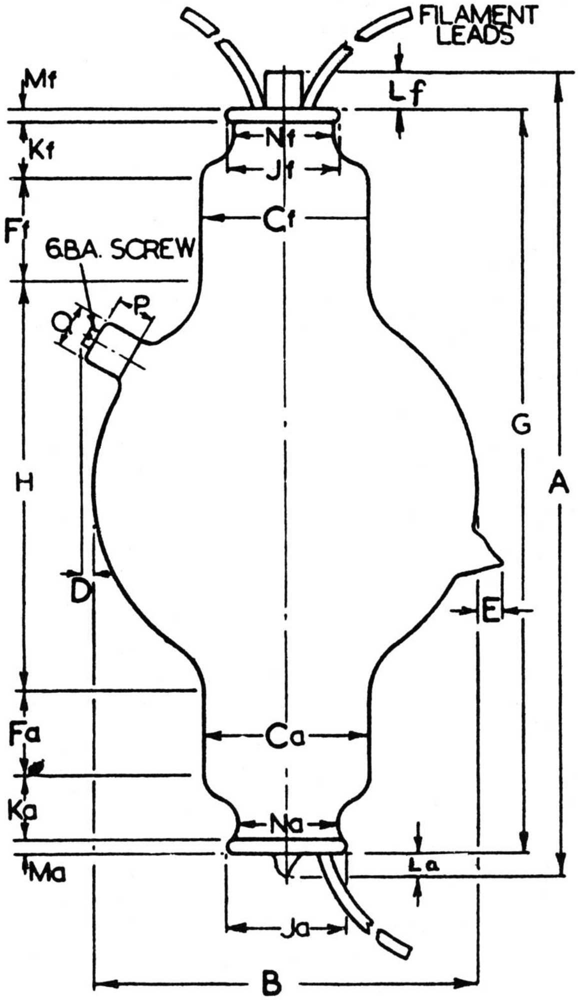


DIMENSION	LIMITS IN mm. (SEE NOTE 1)		
	MIN.	MAX.	NOTES
E	56.5	62	
M	8.5	11.5	2
P		34	
Q	36.1	37.2	
T		9.5	3
S	-	-	4

1. The dimensions stated above are mandatory unless the test specification for an individual valve states otherwise.
2. A 34 mm. ring gauge may be used.
3. Extent of metal in valves not completely canned.
4. This dimension will be specified, where applicable, on an individual test specification.

DRAWING No. 3

DOUBLE ENDED GLASS VALVES
(TRANSMITTING TYPE WITHOUT BASE)



DIMENSIONS (SEE NOTES)

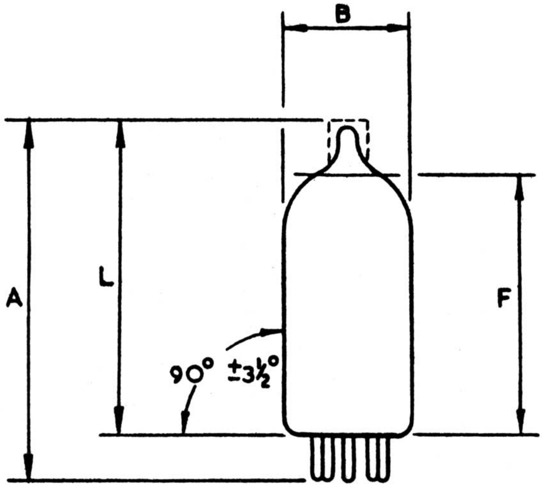
A	OVERALL LENGTH OF VALVE INCLUDING ANY PROJECTIONS SUCH AS SEALING-OFF PIP.
B	DIAMETER OF VALVE AT WIDEST PART, EXCLUDING ANY PROJECTIONS SUCH AS SEALING-OFF PIP OR CAP.
C	DIAMETER OF MAIN PARALLEL SIDED PORTION.
D	GREATEST PROJECTION OF CAP BEYOND BULB.
E	GREATEST PROJECTION OF PIP BEYOND BULB.
F	LENGH OF MAIN PARALLEL SIDED PORTION.
G	LENTH OF VALVE FROM FLANGE TO FLANGE, EXCLUDING ANY PROJECTIONS FROM THE FLANGE.
H	LENGTH OF CENTRE CURVED PORTION OF VALVE.
J	WIDTH OF FLANGE, IF DIFFERENT FROM C.
K	LENGTH OF END NON-PARALLEL PORTION, LESS THICKNESS OF FLANGE.
L	LENGTH OF PROJECTION FROM FLANGE OF PIP ETC.
M	THICKNESS OF FLANGE.
N	DIAMETER OF NARROWEST PARALLEL SIDED PORTION.
P	LENGTH OF METAL CONNECTING CAP.
Q	DIAMETER OF METAL CONNECTING CAP.

NOTES:

1. THE DIMENSIONS 'A' TO 'F' ARE THOSE RECOMMENDED AS CONSTITUTING TOGETHER A SUFFICIENT SPECIFICATION OF BULB SIZE. IT IS OBVIOUS WHERE MAXIMA, MINIMA OR BOTH SHOULD BE SPECIFIED. THE DIMENSIONS 'G' TO 'Q' SHOULD IF POSSIBLE, BE LEFT UNSPECIFIED.
2. THE END OF THE VALVE WHERE THE FILAMENT LEADS EMERGE IS CALLED "f". THE OTHER END IS "a". DIMENSIONS PROBABLY SYMMETRICAL CAN IF NECESSARY BE DISTINGUISHED BY SUFFIX "a" OR "f" ACCORDINGLY, E.G. Da, Df. IF NO SUFFIX IS GIVEN THE DIMENSION SHALL APPLY TO BOTH ENDS.
3. THE TEST SPECIFICATION FOR AN INDIVIDUAL VALVE WILL STATE WHETHER THE ANODE LEAD IS TO BE BROUGHT OUT THROUGH A PINCH OR AT THE SIDE OF THE BULB AND WILL STATE ANY REQUIREMENTS CONCERNING THE TYING BACK OF LEADS.

DRAWING No. 4.

OUTLINE DIMENSIONS OF VALVES B7G AND B9A



A	Normal overall length of valve including pins and top cap where applicable.
B	Max. diameter of bulb.
L	Seated height including top cap if fitted.
F	Seated height (retainer reference position)

NOTE

For details of bases and valve outlines see Appendix IV and B.S. 448, Sections B7G and B9A.

DRAWING No. 5.

TOP CAPS

FIG. 1.

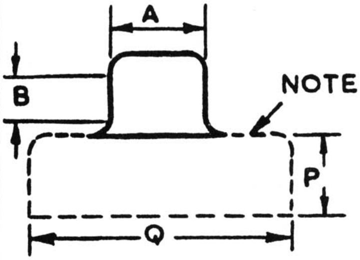


FIG. 2.

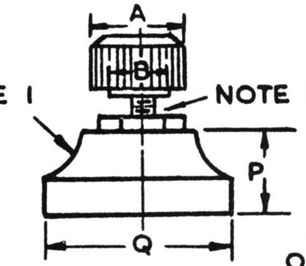
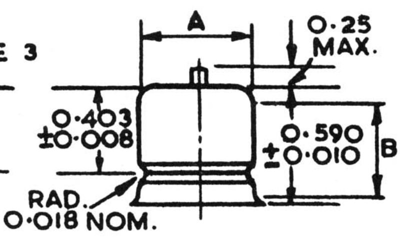


FIG. 3.



DIMENSIONS

(In inches except where otherwise stated)

B.S.448 REF.	TEST SPEC. REF.	FIG	A		B
			MIN	MAX	MIN
CT2	5.1	1	0.355	0.365	0.30
CT1	5.2	1	0.245	0.255	0.21
	5.3	2		9mm.	
CT6	5.4	2		0.47	0.30
CT3	5.5	1	0.559	0.573	0.38
CT4	5.6	1	0.740	0.760	0.63
CT9	5.7	1	0.373	0.377	0.50
	5.8	1	20.3mm.	20.6mm.	19.5mm.
	5.9	1	15.5mm.	16.2mm.	20.0mm.
	5.10	1	14.9mm.	15.1mm.	12.5mm.
CT5	5.11	3	0.585	0.595	0.47

NOTES

1. Caps may be fitted either with or without a skirt. The skirt may be of any convenient shape or material but the dimensions 'P'and 'Q' will be specified when necessary.

2. Dimension 'B' represents the length of the contact surface. It must be substantially cylindrical for Caps Fig. 1 and Fig.3.

3. The screw for Cap 5.3 is 4mm. metric thread. The screw for Cap CT6 is 6BA thread, formally 5BA.

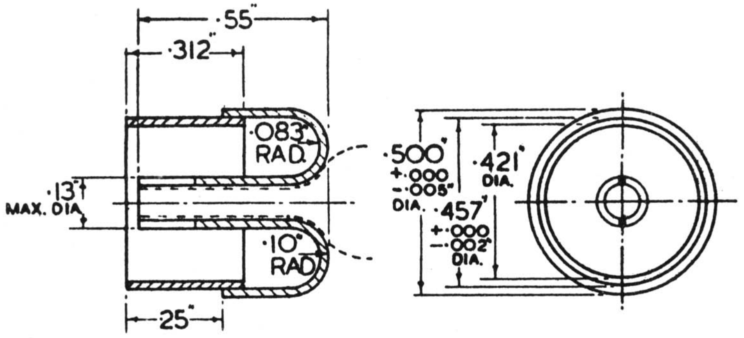
4. Specification B.S.448 shall apply where shewn in the table of dimensions.

DRAWING No. 6.

ANTI-CORONA CONNECTOR.

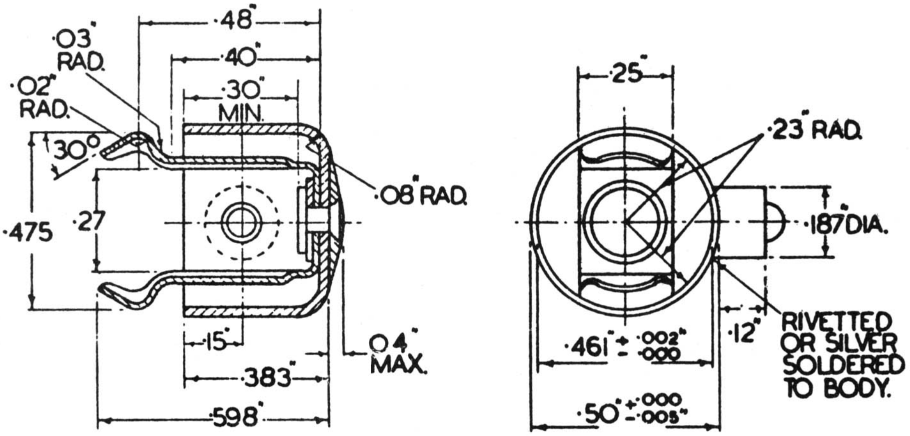
6·1

(THIS PART IS FIXED TO THE VALVE).



6·2

(THIS PART WHICH FITS 6·1 ABOVE, IS SHEWN FOR INFORMATION ONLY).

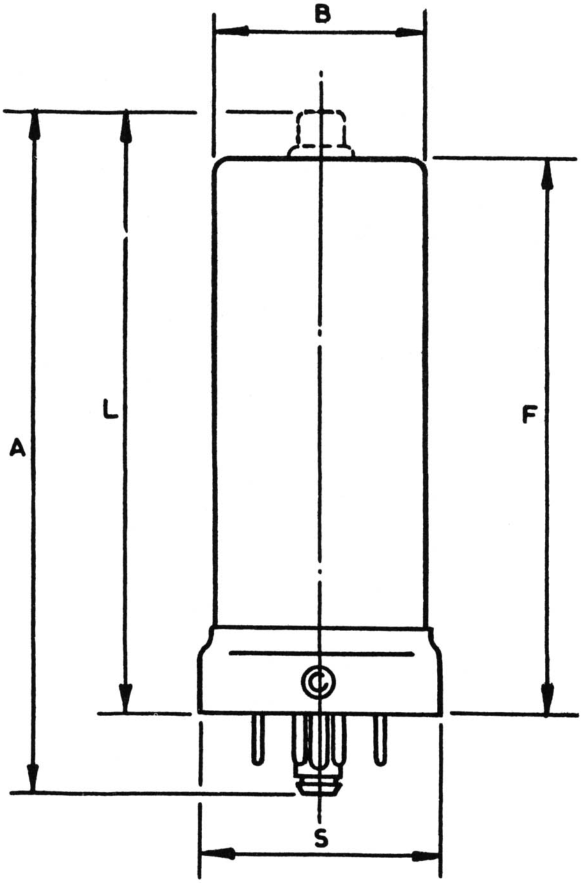


NOTES:-

1. ALL SHARP EDGES AND BURRS TO BE REMOVED
2. ALL PARTS ARE TO BE SILVER PLATED.
3. UNLESS OTHERWISE STATED TOLERANCES ON DIMENSIONS ARE TO BE WITHIN THE LIMITS ±0·005"

DRAWING No. 7.

B8B & B8G GLASS BASE VALVES

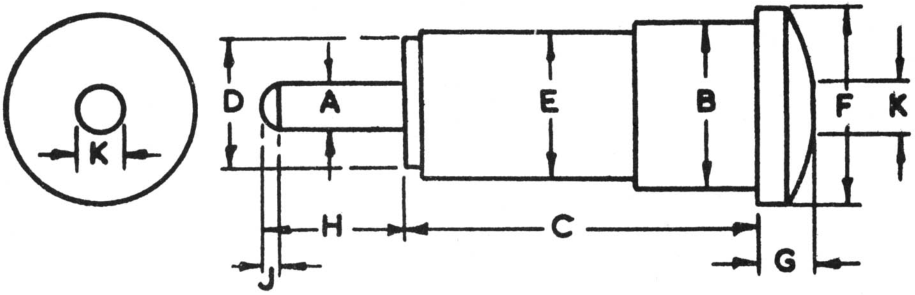


A	Normal overall length of valve including pins and spigot and top cap when applicable.
B	Diameter of bulb or can if fitted.
F	Seated-height excluding top cap.
L	Seated height including top cap when applicable.
S	Diameter of shell.

For further details see Drawing No.12, Appendix IV and B.S.448.

DRAWING No. 8.

CARTRIDGE CRYSTAL VALVES.
DIMENSIONS.



DIMENSION	INCHES.		NOTE
	MIN.	MAX.	
A	0·093	0·096	
B	0·247	0·250	
C	0·535	0·575	
D	0·210	0·226	
E	–	0·240	
F	0·285	0·315	
G	0·050	0·060	
H	0·195	0·205	
J	0·015 NOMINAL		(III)
K	0·125		(I)
OVERALL LENGTH WITH ABOVE TOLERANCES	0·780	0·840	

NOTES (i) K IS THE APPROX. MIN. DIAMETER OF A CIRCULAR FLAT ON THE ASSEMBLY. THERE MUST BE SOME CHAMFER AROUND THIS FLAT, AS SHEWN.

(ii) A HOLE IS TO BE MADE IN THE CENTRE OF THE FLAT, AS SHEWN, (WITH 1/16 IN. DRILL OR 12 B.A. TAP) OF APPROX.

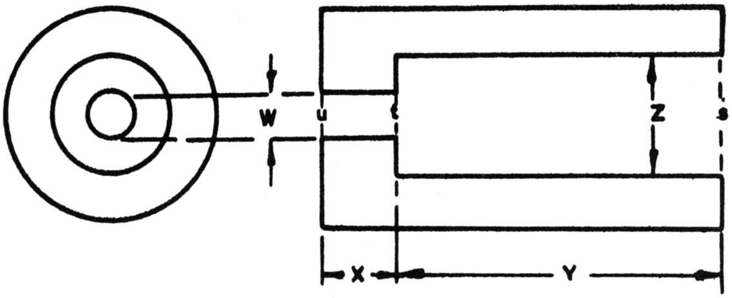
DIAMETER — — — — — — — — — 0·06 IN.
AND NOMINAL DEPTH — — — — — — 0·01 IN.

(iii) J IS THE NOMINAL LENGTH OF THE CHAMFERED PORTION.

(iv) CONCENTRICITY MUST BE CHECKED BY USE OF GAUGE AS DETAILED IN DRAWING No. 8A.

DRAWING No. 8A

CONCENTRICITY GAUGE FOR CRYSTAL VALVES



MATERIAL.

HARDENED
STEEL

DIMENSIONS (INCHES.)

W	0·136
X	0·205
Y	0·575
Z	0·251

TOLERANCES.

0·001 IN. MAX. ON DIAMETERS.
0·005 IN. MAX. ON LENGTHS.

FINISH :- EDGES, SLIGHTLY CHAMFERED.

OPERATION :- INSERT CRYSTAL VALVE INTO GAUGE.

(a) PART OF DIMENSION A (TIP) MUST FIT EASILY INTO PART "tu" OF GAUGE.

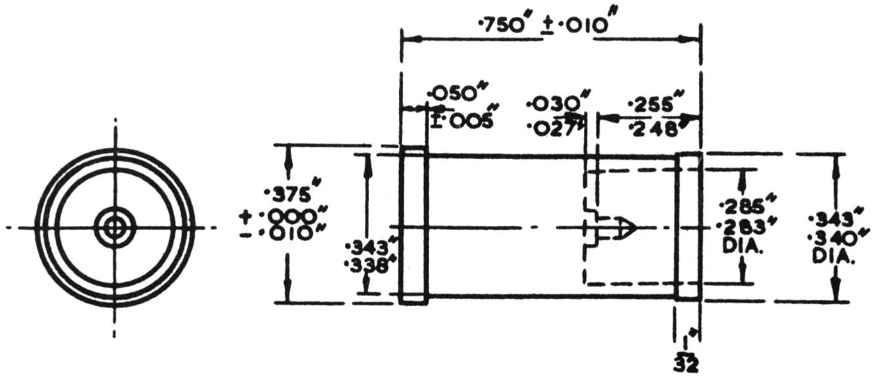
(b) PART OF DIMENSION B MUST FIT EASILY INTO PART "st" OF GAUGE.

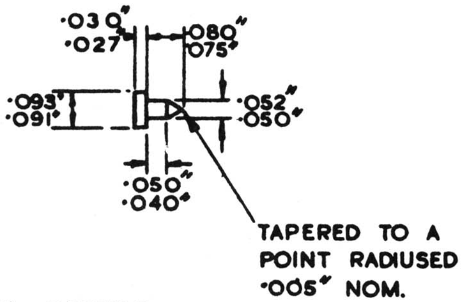
(c) PART OF DIMENSION F MUST BUTT AGAINST SURFACE "s" OF GAUGE.

DRAWING No. 9.

SHIELDED COAXIAL CRYSTAL VALVES

DIMENSIONS.



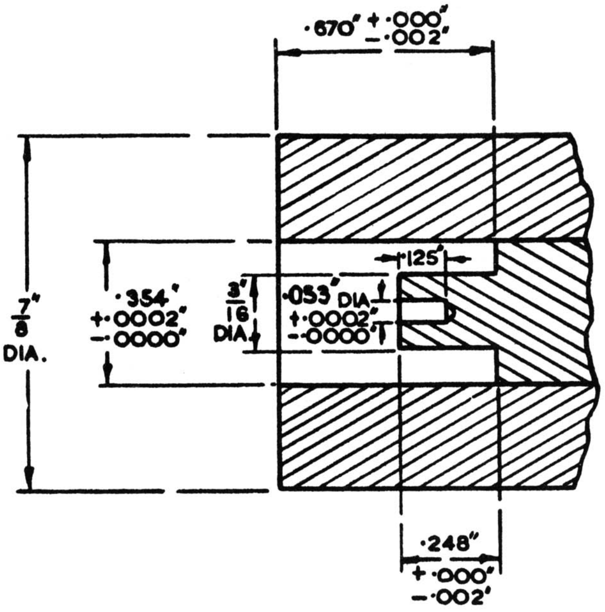


PIN DETAILS

NOTE :- CONCENTRICITY SHALL BE CHECKED BY THE USE OF A GAUGE AS DETAILED IN DRAWING No. 9A.

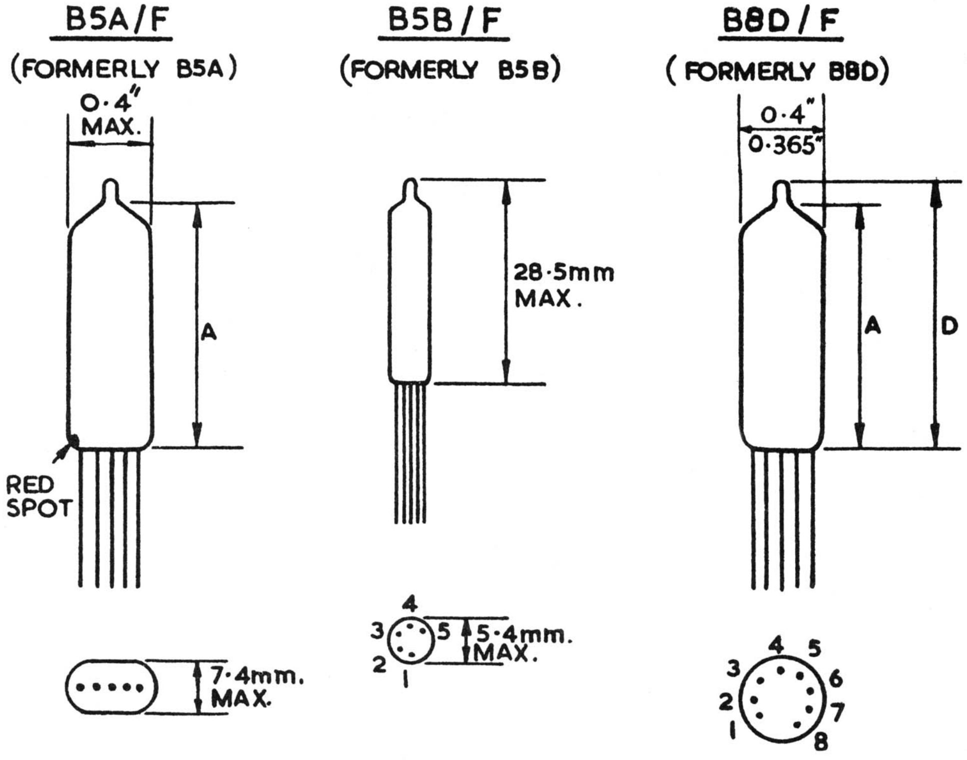
DRAWING No.9A.

CONCENTRICITY GAUGE FOR SHIELDED COAXIAL CRYSTAL VALVES.



DRAWING No. 10.

OUTLINE DIMENSIONS OF SUB-MINIATURE VALVES

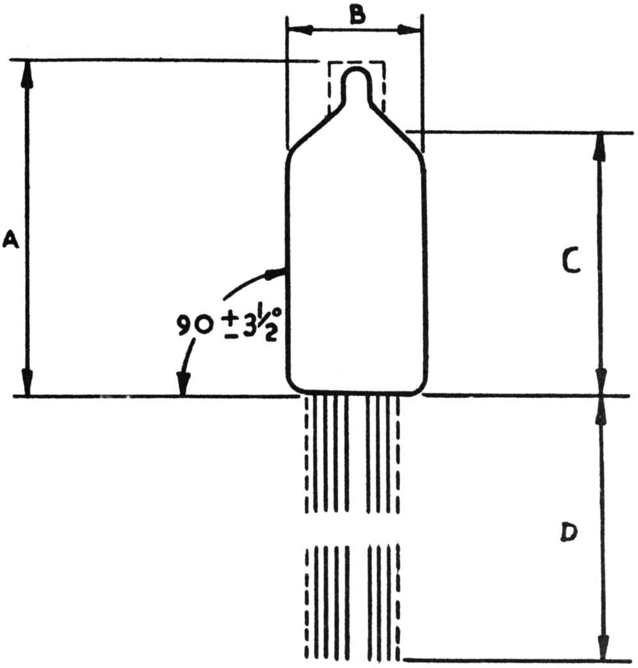


NOTES

1. The leads shall be flexible tinned wire, 0.017 inch nom. dia. Electrotinning shall not be used.
2. The minimum length of all leads shall be 1.5 inches.
3. The dimension A is measured from the sole to the retainer reference position as determined by ring gauges.
4. The names B5A, B5B and B8D are now reserved for the valves when the leads are cut short to fit in holders.
5. For further details see B.S.448.

DRAWING No. 11.

OUTLINE DIMENSIONS OF MINIATURE VALVES TYPE B7G/F & B9A/F



A Seated height, including top cap if fitted.

B The maximum diameter of B7G/F is 19 mm and of B9A/F is 22 mm.

C Measured from the sole to the retainer reference position as determined by a ring gauge 7/16 inch int. dia.

D The leads shall be flexible tinned wire 0.017 inch nominal diameter and 1.5 inch minimum length.
Electrotinning shall not be used.

For further details see B.S.448.

JOINT SERVICE SPECIFICATION K1001

APPENDIX II

ABBREVIATIONS AND SYMBOLS

1. The symbols given in British Standard 1409 :1950 "Letter Symbols for Electronic Valves" are used in K.1001 Test Specifications as far as possible but they do not cover all the requirements of those specifications. Many additional abbreviations and symbols are used and these are given in this Appendix together with those of B.S.1409.

2. Many K 1001 Test Specifications were issued before B.S.1409 was published and they contain a number of abbreviations which conflict with the meanings given in the British Standard. Although appropriate changes are made, if practicable, when these specifications are revised it is unlikely that the amendment of conflicting symbols will be complete in the foreseeable future. The alternative meanings will be found in this Appendix and the correct ones should be easily understood from the context in the Test documents.

3. The symbolic names for valve bases are in general those given by the British Radio Valve Manufacturers' Association.

4. Subscripts in printed documents such as B.S.1509 and manufacturers' catalogues are usually printed slightly below the line of the print. This "dropping" of subscripts cannot be readily done with a typewriter; therefore, as Test Specifications are generally reproductions of typed papers, the symbols in this appendix are given with the subscripts on the same line as the main lettering.

ABBREVIATIONS AND SYMBOLS

B.S.1409	K1001 (prior to adoption of BS 1409)	
	A	Ampere. Anode
a		Anode
	A1 etc.	First anode etc. (See Note 1, Page 8)
	Aa,Ab	Anodes in a multiple valve (See Note 2, Page 9)
	AC	Alternating current
	Ad	Diode anode
	AF	Audio frequency
Ag		Gas amplification in phototubes
	Ao	Oscillator anode (See Note 3, Page 9)
ASE		Overall amplification in secondary emission amplifiers
	B	Beam forming plates. Energy bandwidth of a receiver
B		Brightness in cathode-ray tubes
b		(Used as a subscript) Battery or other source
	B2A	2-pin base used on G.M. Counter tubes
	B2B	2-pin base for photo-conductive cells
	B3A	American Pee-Wee 3-pin base (See App. IV, Drawing No. 28)
	B3B/A	
	B3D	
	B3D/F	Transistor base with flying in-line leads
	B3G	3-pin in-line lead glass base (See App. IV, Drawing No.10)
	B4	Original British 4-pin base (See App. IV. Drawing No. 5)
	B4A	American 4-pin base used on CV398, CV2752, CV2814 etc. (See App. IV, Drawing No. 29)
	B4B	4-pin base for phototubes (See App. IV, Drawing No. 30)
	B4D	American Super Jumbo 4-pin base with bayonet (See App. IV, Drawing No. 22)
	B4E	4-clip base for cathode-ray tubes
	B4F	American Jumbo 4-pin base (See App. IV, Drawing Bo. 23)
	Bc4	4-pin base with bayonet (See App. IV, Drawing No. 41)
	B5	British 5-pin base (See App. IV, Drawing No. 5)
	B5A	B5A/F base with leads cut short for insertion in a valveholder
	B5A/F	5-lead, in-line, subminiature base with flying leads (See App. I, Drawing No. 10) (Mullard and M.O.V.)
	B5B	B5B/F base with leads cut short for insertion in a valveholder
	B5B/F	5-lead button base with flying leads for subminiature valves (See App. I, Drawing No. 10)
	B5D	American Giant 5-pin base (See App. IV, Drawing No. 33)
	B5E	Alternative version of B5D (with metal shell) (Eimac and R.C.A., See App. IV, Drawing No. 34)
	B5F	Alternative version of B5D (Mullard and Phillips, See App. IV, Drawing No. 35)
	B5G	B5G/F base with leads cut short for insertion in a valveholder.
	B5G/F	American 5-lead, in-line, subminiature base with flying leads
	B5H	
	B5H/F	5-lead, in-line, flat miniature base (Hivac)
	B5J	
	B5J/F	Pressed glass electrometer base (Mullard)

B.S.1409	K1001 (prior to adoption of BS1409)	
	B5K	5-pin Super Giant Base (Philips)
	B7	British 7-pin base (See App. IV, Drawing No. 5)
	B7A	American Septar 7-pin base (See App. IV,Drawing No. 24)
	B7B	7-pin CRT base (E.M.I.) (See App. IV, Drawing No. 54)
	B7D	American Medium Shell Giant 7-pin base with bayonet (See App. IV, Drawing No. 25)
	B7E/F	American 7-lead, in-line, flat subminiature base
	B7G	Small button miniature 7-pin base (See App.IV,Drawing No. 9)
	B7G/A	Welded lead version of B7G base (S.T.C.)
	B7G/B	Welded lead version of B7G base (G.P.O.)
	B7G/F	B7G base with flying leads instead of pins
	B8A	Rimlock 8-pin base with location boss
	B8B	8-pin glass base
	B8D	B8D/F base with leads cut short for insertion in a valveholder.
	B8D/F	8-lead circular subminiature base with flying leads (See App. I, Drawing No. 10)
	B8E	8-pin CRT base (Formerly E.M.8, See App. IV,Drawing No. 17)
	B8F	American 8-pin base used on CV2519 (4X150 A)(See MIL-E-1 spec.)
	B8G	8-pin locking-in base (See App. IV,Drawing No. 12)
	B8G/F	B8G base with flying leads
	B9	British 9-pin base (See App. IV, Drawing No. 5)
	B9A	9-pin Noval base (See App. IV, Drawing No. 26)
	B9A/B	Welded lead version of B9A base (G.P.O.)
	B9A/D	B9 base with central exhaust tubulation (Mullard)
	B9A/F	B9A base with flying leads
	B9B	9-pin base for vibrators
	B9G	9-pin glass base (See App. IV,Drawing No. 8)
	B9G/B	Welded lead version of B9G base (G.P.O.)
	B10A	
	B10A/A	10-pin glass base with welded leads (S.T.C.)
	B11A	American 11-pin Sub-Magnal base (See App. IV,Drawing No.27)
	B12A	American 12-pin Duodecal base (See App. IV,Drawing No. 39)
	B12B	12-pin spigot base (See App. IV, Drawing No. 16)
	B12D	12-pin side contact CRT base with key (See App. IV, Drawing No. 15)
	B12E	B12A base with cap on spigot (See App. IV,Drawing No. 47)
	B12F	12-pin glass base for CRT (Electronic Tubes Ltd.)
	B12G	12-pin glass base for CRT (E.M.I. Ltd.)
	B14A	American Diheptal 14-pin base (See App.IV,Drawing No.40)
	B14B	14-pin pressed glass base for CRT (E.M.I. Ltd.)
	B15A3	3-pin base (formerly 3-pin Quindecal) used on CV339 (See App. IV, Drawing No. 21)
	B15B	15-pin glass base (E.M.I., used on photomultipliers)
	B22	Bayonet Lamp Cap (See App. IV, Drawing No. 14)
	BC4	Medium 4-pin bayonet base (See App. IV, Drawing No. 41)
bp		Beam forming plate
C		Capacitance (for associated circuits)
c		Capacitance (for valve)
C in	(Input Cap.)	Grid to all electrodes except anode
C out	(Output Cap.)	Anode to all electrodes except grid

B.S.1409	K1001 (prior to adoption of BS 1409)	
	C	Capacitance, cathode, centigrade (°C)
	C-all	Capacitance between cathode and all other electrodes
	Ca-all	Capacitance between anode and all other electrodes
	Cac	Anode to cathode capacitance (See Note 5, Page 9)
	Cae	Capacitance between anode and all other electrodes except the grid
	Cag	Anode to grid capacitance
	CC	Internal conductive coating
	Cgc	Grid to anode capacitance
	Cge	Capacitance between grid and all other electrodes except the anode
	CK12	See B12D
cf		Switch, fixed contact
	CL3	3-clip base (See App. IV, Drawing No. 11)
	CL6	6-clip base (See App. IV, Drawing No. 18)
	CL7	7-clip base (See App. IV, Drawing No. 19)
cm	cm	Switch, moving contact. Centimetre
C.M.F.		Cross-modulation factor
CRT	CRT	Cathode Ray Tube
	c/s	Cycles per second
cw		Capacitance, working
	Cx-all	Capacitance between one X plate and all other electrodes
	Cxy	Capacitance between one X plate and one Y plate
	Cy-all	Capacitance between one Y plate and all other electrodes
D	D	Distortion. Diode anode.
d	d	(Used as a subscript) Diode. Deci-
	db	Decibel
	DC	Direct current
Δf		Bandwidth
D.F.		Duty factor
	dia	Diameter
	Dy	Dynode
	EFC	Equivalent foot candles
	E	Earth
	EL4B	Large-4-pin base
	EM8	8-pin base, now B8E (See App. IV, Drawing No. 17)
eq		(Used as a subscript) Equivalent
	ES	Medium Edison Screw Base (See App. IV, Drawing No. 13)
ESD	ESD	Electrostatic deflection
ESF	ESF	Electrostatic focus
ext		(Used as a subscript) (Extinction (Voltage)
	F	Farad. Filament
f(-)	F-	Filament terminal connected to negative side of supply
f(+)	F+	Filament terminal connected to positive side of supply
f	f	Filament (emitting). Frequency
f max		Frequency limit, maximum
f min		Frequency limit, minimum
	G	Grid (See Note 4, Page 9)
	G1 etc.	First grid etc. (See Note 4, page 9)
	G1-all	Capacitance between G1 and all other electrodes
	Gla etc.	See Note 2, page 9
g		Grid
gc	gc	Conversion conductance

B.S.1409	K1001 (prior to adoption of BS1409)	
	GES	Goliath Edison Screw base (See App. IV, Drawing No. 13)
gm	gm	Mutual conductance. Slope
	Go	Oscillator grid (See Note 3, page 9)
	H	Henry, Oersted. Heater
h		Heater. (Used as a subscript) Hexode. Heptode. etc.
	HCT	Heater centre tap
het		(Used as a subscript) Heterodyne
	HF	High Frequency
	Hg	Mercury
H.M.F.		Hum-modulation factor
	hr	Hour
	HT	High tension
I		Direct current
	Ia	Anode current
	Ia peak	Peak anode current
Iav		Average value of the direct component of a complex current wave
	Ib	Beam current (Cathode Ray Tube)
IC		Pin with an unspecified internal connection which must not be used for an external connection
	Ic	Total cathode current
	Ie	Cathode emission current
	IF	Intermediate frequency
	If	Filament current
	Ig, Ig1 etc.	Grid Current (See Note 4, page 9)
ign		(Used as a subscript) Ignition (Voltage)
	Ih	Heater current
	Ihc	Heater-cathode current
in		(Used as a subscript) Input.
inv		(Used as a subscript) Inverse (voltage or current)
	Ins	Insulation
	IO	International Octal base. Now known as the Octal base with the symbol O or B8-O (See App. IV, Drawing No. 2)
Io		No-signal current
ipk		Peak current
I r.m.s.		Alternating current (r.m.s.)
	Ish	Internal shield or coating current
	K	Kelvin. Boltzmann's constant
k	k	Cathode. Kilo-
k1		Primary cathode
k2 etc.		Secondary cathodes of secondary emission valves
	kc/s	Kilocycles per second
	kW	Kilowatt
L	L	(Used as a subscript) Total effective working load Inductance. Conversion loss in decibels
	L4	4-pin low loss base(See App. IV, Drawing No. 6)
	LF	Low frequency
	LO	Local oscillator
	λ	Wavelength
M	M	External conductive coating forming an integral part of the valve (e.g. metallizing, metal shell or can). Mega-. Meg-. Magnetic. Mutual inductance of circuit.

B.S. 1409	**K1001** (prior to adoption of BS 1409)	
m	m	Internal conducting coating. Mutual inductance of valve. Metra. Milli-
μ	μ	Amplification factor. Micro-
	μS	Microsecond
	mA	Milliampere
	max	Maximum
	Mc/s	Megacycles per second
MD	MD	Magnetic deflection
	MES	Miniature Edison Screw base (See App. IV. Drawing No. 13)
MF	MF	Magnetic focus
	mm	millimetres
	min.	Minimum. Minute
	MO	Mazda Octal base (See App. IV, Drawing No. 3)
mod		(Used as a subscript) Modulation
	MΩ	Megohm
NC		Pin with no internal connection
	NIF	Noise factor of I.F. Amplifier
	Nom	Nominal
NP		No pin
NR		Noise factor of receiver
NSE		Secondary emission ratio, in S.E. Amplifiers
	O	Octal base. Formerly International Octal with the symbol I.O. (See App. IV, Drawing No. 2)
	Ω	ohm
out		(Used as a subscript) Output
P		Power (for associated circuit)
p		Power. (Used as a subscript) Pentode. Pico-
	PB8	8-pin Bayonet base (See App. IV, Drawing No. 20)
	PEC	Photoelectric cell. Photocell
pdr		Driving power
	pF	Picofarad
P.I.V.	PIV	Peak inverse voltage
P.R.F.	PRF	Pulse recurrence or repetition frequency
	PS10	Spigot base (See B12B)
	PS12	Spigot base (See B12B)
q		(Used as a subscript) Tetrode
R	R	Resistance of associated circuit
r		Resistance of valve. (Used as a subscript) Rectifier
	Ra	Anode AC resistance or impedance
	Rad	Radius
	Ref	Reflector
Res	Res	Resonator
	RF	Radio Frequency
	Rl	Load resistance
r.m.s.	RMS	Root mean square
	RO	I.F. Impedance of a mixer
S	S	Sensitivity of cathode ray tube or photocell.
s		Internal shield
SC	SC	Pin connection for the shell of certain metal valves. Side contact
	SC8	8-pin side contact base

B.S. 1409	K1001 (prior to adoption of BS1409)	
	Sec	Second
	SES	Small Edison Screw base (See App. IV,Drawing No. 13)
	Sh	Internal Shield
sig		(Used as a subscript) Signal
	Sp	Special
stab		(Used as a subscript) Stabilized
sur		(Used as a subscript) Surge voltage or current
	SWR	Standing wave ratio
	Sx	Deflection sensitivity of C.R. tube X-plates
	Sy	Deflection sensitivity of C.R. tube Y-plates
	T	Temperature. Target
t		(Used as a subscript) Triode. Fluorescent screen or other target. Noise temperature ratio
T bulb		Bulb temperature
THg		Condensed mercury temperature
T pin		Pin temperature
Trad		Radiator temperature
Tseal		Seal temperature
tap		(Used as a subscript) Tapping on filament or heater
td		Deionization time
thk		Cathode heating time
ti		Ionization time
tp		pulse duration
tsd		Switching delay time
tc	TC	Top contact. Top cap
	Tp	Pulse duration
	T4	4-pin metal shell base (See App. IV,Drawing No. 7)
	UHF	Ultra high frequency
	USD12) USD14)	American Diheptal base. Now B14A (See App. IV, Drawing No. 40)
	USG5	American Giant 5-pin base with bayonet. Now B5D (See App. IV, Drawing No. 33)
	USG7	American Giant 7-pin base with bayonet. Now B7D (See App. IV, Drawing No. 25)
	USL4	American Large 4-pin base, (See CV1506 specification)
	USM4	American Medium 4-pin base, No. A4-9 (See App. IV, Drawing No. 48)
	USM4B	American Medium 4-pin bayonet base. No. A4-10 (See App. IV, Drawing No. 49)
	USM5	American Medium 5-pin base, No. A5-11 (See App. IV, Drawing No. 50)
	USM5B	American USM5 base with bayonet pin (See CV2595 specification)
	USM6	American Medium 6-pin base. No. A6-12 (See App. IV, Drawing No. 51)
	USM7	American Medium 7-pin base. No. A7-13 (See App. IV, Drawing No. 52)
	USM11	American Magnal 11-pin base, Nos. B11 - 33 and B11 - 66 (See App. IV, Drawing No. 45)
	USS4	American Small 4-pin base, No. A4 - 5 (See App. IV, Drawing No. 48)

B.S.1409	K1001 (prior to adoption of BS1409)	
	USS5	American Small 5-pin base, No. A5-6 (See App. IV, Drawing No. 50)
	USS6	American Small 6-pin base, No. A6-7 (See App. IV, Drawing No. 51)
	USS7	American Small 7-pin base, No. A7-18 (See App. IV, Drawing No. 52)
	USSM11	American Sub-Magnal base. Now B11A (See App. IV, Drawing No. 27)
V	V	Direct Voltage. Volt
	Va	Anode Voltage
	Vao	Oscillator anode voltage
	Val etc.	First anode voltage, etc.
Vav		Average value of the direct component of complex voltage wave
	Vcc	Internal conductive coating voltage
	Vf	Filament voltage
	Vg	Grid voltage
	Vg1 etc.	First grid voltage, etc, (See Note 4, page 9)
	Vh	Heater voltage
	Vhc	Voltage between heater and cathode
	VHF	Very high frequency
	Vht	H.T. supply voltage
	VM	Velocity modulated
	Vr	Reflector voltage
Vr.m.s.		Alternating voltage (r.m.s.)
	Vsh	Internal shield voltage
	Vt	Target voltage
Vpk		Peak voltage
	W	Watts
	Wa	Anode dissipation, anode wattage
	Wg	Grid dissipation
	Wgl etc.	First grid dissipation (See Note 4, page 9)
wr		Wave retardation electrode
X		Reactance of associated circuit
x		Reactance of valve. Deflector electrode
	X1, X2	X-plates of cathode ray tube
	Y1, Y2	Y-plates of cathode ray tube
Y		Admittance of associated circuit
y		Admittance of valve. Deflector electrode
Z		Impedance of associated circuit
z		Impedance of valve

NOTES

1. Anodes are numbered sequentially along the direction of electron flow. When a C.R.T. specification allows for a given number of anodes and a design of tube is accepted which has no separate A1 connection, the anodes will always be numbered as if, in fact, there were an A1. For example if a tube without a separate A1 connection be accepted to a specification for a three anode tube, the final anode will be known as A3 and the focussing anode as A2.

2. When similar electrodes are equidistance from the filament, or occur in two or more identical structures they are differentiated by the addition of the letters "a" and "b". This rule applies to all electrodes, but does not hold for frequency changers. (See Note 3).

3. In a self oscillating frequency changer valve which employs an independent grid and anode in the oscillator section, these are designated by the suffix o.

4. Where a valve contains more than one grid, they are numbered G1, G2, G3, etc., commencing with the grid nearest the filament or cathode.

5. Cag, Cge, Cac are "direct" capacitances with the unmentioned electrodes earthed.

JOINT SERVICE SPECIFICATION K1001

APPENDIX III

THE MEASUREMENT OF INTER-ELECTRODE CAPACITANCES

Section 1. FOREWORD

The capacitances referred to in the individual specifications for valves are the direct capacitances between two electrodes or between groups of electrodes excluding the capacitances between external base pins or connectors. Full details appear in Section II.

The individual valve specifications usually specify the pin connection arrangements to be used for measuring the capacitances required. These connections will usually be referred to the three terminals of the bridge and will be designated HP, LP and E. These correspond to points B, C and D respectively on the diagram FIG. 1 in Section 2, Para. 2.1.4.1.

1. The Bridge

1.1. When the Radio frequency bridge described in Section 2 is used, the accuracy of measurement shall conform to the limits stated below.

Capacitance Range	Max. Error
0.001 pf - 0.005 pf	±0.0001 pf
0.005 pf - 0.01 pf	±0.0002 pf
0.01 pf - 0.05 pf	±0.001 pf
0.05 pf - 0.10 pf	±0.002 pf
0.01 pf - 0.5 pf	±0.01 pf
0.5 pf - 1.0 pf	±0.02 pf
1 pf - 10 pf	±0.1 pf
10 pf - 20 pf	±0.2 pf
20 pf - 100 pf	±1 pf

1.2 Discrimination

This shall be at least five times better than the accuracy of measurement on all ranges.

1.3 Side Capacitance

Side capacitance of up to 300 pf between either HP or LP terminal to earth shall not cause the accuracy of measurement to exceed the limits specified.

1.4 Set Zero adjustment - This shall allow correction for at least 30% of each range without causing any change in the accuracy or discrimination as required by 1.1 and 1.2.

1.5 Approved reference standard capacitances may be used for checking the calibration of the bridge as and when necessary.

2. Valve Bases Adaptors Sockets Shields and Top Caps

These shall conform to the requirements of Section 2, Clauses 2.2, 2.3 and 2.4.

SECTION 2

MEASUREMENT OF DIRECT INTERELECTRODE CAPACITANCES OF ELECTRONIC VALVES

Table of Contents

SCOPE

This document covers the measurement of direct interelectrode capacitances of valves in the following classes: Receiving Valves, Cathode Ray Tubes, Gas-filled Valves, Photocells, Photomultipliers and High Power Valves.

2.1 Methods of Tests

2.1.1. Definitions

In this document the following definitions will apply:-

Element (of an Electronic valve). Any integral part of the valve that contributes to its operation and to which external connections can be made.

Electrode (of an Electronic valve). A conducting element that performs one or more of the functions of emitting, collecting, or controlling by an electric field the movement of electrons or ions.

Filament (of an Electronic valve). A hot cathode (usually in the form of a wire or ribbon) which is heated directly by current flowing in it.

2.1.2. Measurement of interelectrode capacitances of valves

The specified interelectrode capacitance shall be measured directly rather than derived from combinations of two or more individual capacitance measurements.
In the measurement, elements to be excluded are connected to the reference ground.
This is not to be confused with grounding or earthing in circuit applications.
Valve elements shall be connected as follows unless otherwise specified:-

Group of Valves	Electrode Connections	Parts left Floating, Capacity to other objects being kept at a minimum.	Connections of Elements other than Electrodes	Metal Parts
General Types	Connect as specified in table of connections.	-	Connect to cathode.	Connect to cathode (External shields, base sleeves which have internal connection, unused pins or leads)
Cathode Ray Tubes	ditto	Post deflection accelerators (Intensifier electrodes)	Ground those elements not common to unit under test.	ditto.

Table Continued Overleaf

Group of Valves	Electrode Connections	Parts left Floating, Capacity to other objects being kept at a minimum	Connections of Elements other than Electrodes	Metal Parts
Multiple Unit Valves such as Diode-Triodes, Triode-Pentodes, multi-gun cathode ray tubes etc.	Connect as specified in table of connections	-	Ground those elements not common to unit under test.	Connect to cathode (External shields, base sleeves which have internal connection, unused pins or leads)
Valves with metal sleeve not connected internally	ditto	Metal base sleeve	ditto	ditto

In all cases when stating capacitance values, it shall be made clear which electrodes and elements are connected to the active terminals of the measuring equipment, and which are connected to the ground. This may be done either in words or symbols. Certain descriptive terms are used with the meanings assigned in the following tables.

On all types, for elements terminated in two or more pins or leads, all such pins or leads shall be connected together.

In those cases where two or more elements are internally connected, the combination shall be treated as the major element of the combination. For example, a suppressor grid internally connected to the cathode shall be considered the cathode in the tables of connections. For directly-heated filament types, the filament is the cathode electrode.

TABLES OF CONNECTIONS OF ELECTRODES FOR MEASURING

DIRECT INTERELECTRODE CAPACITANCE

Table I - Receiving Valves

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
Indirectly heated cathode	Heater-cathode	Heater	Cathode	All other elements, shields, metal parts, etc.
Diode	Diode anode-all			
	(a)	Anode	Cathode + heater + shields + metal parts, etc.	Other units
	(b)	Anode	Cathode + heater + shields + metal parts + other Units, etc.	
	Diode anode-earth	Diode-anode	Cathode + heater + shields + metal parts, etc.	Other diode anode
	Diode cathode-anode	Cathode	Diode anode + heater + shields + metal parts etc.	Other unit(s).
	Coupling (between units)	Diode anode	Anode of other unit(s)	All other elements, shields, metal parts, etc.
	Coupling (between units)	Diode anode	Grid of other unit(s)	All other elements, shields, metal parts, etc.
Triode, tetrode pentode	Inter-electrode (General)	First specified electrode	Second specified electrode of same unit	All other elements, shields, metal parts, etc.
	Grid-Anode	Grid	Anode	All other elements, shields, metal parts, etc.
	Input	Grid	Cathode + heater + screen + suppressor + shields + metal parts, etc.	Anode, diode, inactive unit(s).

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
	Output	Anode	Cathode + heater + screen + suppressor + shields + metal parts, etc.	Grid, diode, inactive unit(s).
	Anode-Earth	Anode	Cathode + heater + screen + suppressor + shields + metal parts + diode anodes + inactive units, etc.	Grid
	Grid$_n$ -earth (4)	Grid$_n$	Cathode + heater + screen + suppressor + shields + metal parts + diode anodes + inactive units, etc.	Anode$_m$
	Coupling (between units)	Grid of one unit	Anode of other unit	All other elements, shields, metal parts, etc.
	Coupling (between units)	Anode of one unit	Anode of other unit	All other elements, shields, metal parts, etc.
	Coupling (General)	Specified electrode of one unit	Specified electrode of other unit	All other elements, shields, metal parts, etc.
	Electrode (1)	Electrode	All other elements shields, metal parts, etc. connected to ground.	
Grounded-Grid Types	Cathode-Anode (heater grounded)	Cathode	Anode	All other elements, shields, metal parts, etc.
Grounded-Grid Types	Input (heater grounded)	Cathode	Grid + heater + screen + suppressor + shields + metal parts, etc.	Anode, diodes, inactive unit(s).

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
Grounded-Grid Types	Output (heater grounded)	Anode	Grid + heater + screen + suppressor + shields + metal parts, etc.	Cathode, diodes, inactive unit(s).
Grounded Grid Types	Cathode-anode (heater live) (2)	Cathode + Heater	Anode	All other elements, shields, metal parts, etc.
Grounded Grid Types	Input (heater live) (2)	Cathode + Heater	Grid + screen + suppressor + shields + metal parts, etc.	Anode, diodes, inactive unit(s).
	Output (heater live)(2)	Anode	Grid + screen + suppressor + shields + metal parts, etc.	Cathode + heater, diodes, inactive unit(s).
Mixer	Signal grid(1) - anode	Signal grid(1)	Anode	All other elements, shields, metal parts, etc.
	Signal grid(2)-anode	Signal grid(2)	Anode	All other elements, shields, metal parts, etc.
	Input (1)	Signal grid(1)	All other elements, shields, metal parts, etc.	
	Input (2)	Signal grid(2)	All other elements, shields, metal parts, etc.	
	Grid$_n$ -anode (4)	Grid$_n$	Anode	All other elements, shields, metal parts, etc.
	Grid$_n$ -All (4)	Grid$_n$	All other elements, shields, metal parts, etc.	
	Output	Anode	All other elements, shields, metal parts, etc.	

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
	Coupling	Signal grid (1)	Signal grid (2)	All other elements, shields, metal parts, etc.
	Electrode (1)	Electrode	All other elements metal parts, shields, etc. connected to ground.	
Converter	Signal grid-mixer anode	Signal grid	Mixer Anode	All other elements, shields, metal parts, etc.
	R.F. Input	Signal grid	All other elements, shields, metal parts, etc.	
	Mixer Output	Mixer anode	All other elements, shields, metal parts, etc.	
	Osc. grid-Osc. anode	Osc. grid	Osc. anode	All other elements, shields, metal parts, etc.
	Osc. Input	Osc. grid	Cathode + heater + mixer anode + signal grid + shields + metal parts, etc.	Osc. anode
	Osc. Output	Osc. anode	Cathode + heater + mixer anode + signal grid + shields + metal parts, etc.	Osc. grid
	Grid_n $-\text{anode}_m$ (4)	Grid_n	Anode_m	All other elements, shields, metal parts, etc.
	Grid_n-All (4)	Grid_n	All other elements, shields, metal parts, etc.	
	Osc. Input (3)	Osc. grid	All other elements, shields, metal parts, etc.	

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
	Osc. Output (3)	Cathode	Heater + mixer anode + Signal grid + osc. anode + shields + metal parts, etc.	Osc. grid
	Osc. grid-cathode (3)			
	(a)	Osc. grid	Cathode	All other elements, shields, metal parts, etc.
	(b)	Osc. grid	Cathode + heater	All other elements, shields, metal parts, etc.
	Osc. Grid-mixer anode (3)	Osc. grid	Mixer anode	All other elements, shields, metal parts, etc.
	Osc. Grid-All except Cathode (3)	Osc. grid	Mixer anode + signal grid + osc. anode + heater + shields + metal parts, etc.	Cathode
	Coupling	Osc. grid	Signal grid	All other elements, shields, metal parts, etc.
	Coupling	Osc. Anode	Signal grid	All other elements, shields, metal parts, etc.
	Electrode(1)	Electrode	All other elements, shields, metal parts, etc. connected to ground.	
	Grid$_n$-earth (4)	Grid$_n$	Cathode, filament shields and all other elements etc.	Anode$_m$
	Anode$_m$-earth (4)	Anode$_m$	Cathode, filament shields and all other elements etc.	Grid$_n$

See notes overleaf.

NOTES

(1) The capacitance of an electrode is defined as the capacitance between one electrode and all other electrodes and metal parts connected to ground.

(2) Measurements apply to grounded-grid types normally operating with radio frequency voltage between heater and earth in circuit applications.

(3) Applies to converters normally operated with radio frequency voltage between cathode and earth.

(4) The subscripts n or m identify the number of the grid or anode respectively.

Table II - Cathode Ray Tubes

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
Magnetic deflection and focus, or magnetic deflection, electrostatic focus	Cathode-All	Cathode	All other elements, shields, metal parts, etc.	
	Grid-All	Grid	All other elements, shields, metal parts, etc.	
	Anode 1-All	Anode 1	All other elements, shields, metal parts, etc.	
	External conductive coating	External conductive coating	Final anode	All other elements, shields, metal parts, etc.
Electrostatic deflection and focus; symmetric deflection	Cathode-All	Cathode	All other elements, shields, metal parts, etc.	
	Grid-All	Grid	All other elements, shields, metal parts, etc.	

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
	X1 - X2	X1	X2	All other elements, shields, metal parts, etc.
	Y1 - Y2	Y1	Y2	All other elements, shields, metal parts, etc.
	X1 - All	X1	All other elements, shields, metal parts, etc.	
	X2 - All	X2	All other elements, shields, metal parts, etc.	
	Y1 - All	Y1	All other elements, Shields, metal parts, etc.	
	Y2 - All	Y2	All other elements, shields, metal parts, etc.	
	X1 - All except X2	X1	All other elements, shields, metal parts, etc.	X2
	X2 - All except X1	X2	All other elements, shields, metal parts, etc.	X1
	Y1 - All except Y2	Y1	All other elements, shields, metal parts, etc.	Y2
	Y2 - All except Y1	Y2	All other elements, shields, metal parts, etc.	Y1
Electrostatic deflection and focus; asymmetric deflection	Grid-All	Grid	All other elements, shields, metal parts, etc.	
	X1 - All	X1	All other elements, shields, metal parts, etc.	

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
	Y1 - All	Y1	All other elements, shields, metal parts, etc.	

NOTES

(1) For cathode ray tubes the post-deflection accelerator(s) (intensifier electrode(s)) if present, shall float for all measurements, unless otherwise indicated.

(2) The inter-gun shield shall be considered an element of the gun being measured. When measuring the capacitance of any one gun of a multigun tube, all elements of the other gun shall be earth.

(3) (a) The grid (or modulator electrode) is called "Grid 1" in U.S.A..

(b) The anode 1 is called "Grid 2" in U.S.A., and so on.

(c) The U.K. symbols X1, X2, Y1, Y2 are equivalent to the U.S. symbols for deflectors (D1, D2, D3, D4) but do not relate to particular electrodes as do the U.S. symbols.

Table III - Gas Filled Valves

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
All Valves	Grid-anode	Grid	Anode	All other elements, shield, metal parts, etc.
	Grid-earth	Grid	Cathode + heater + shield grid + shields + metal parts, etc.	Anode
	Anode-earth	Anode	Cathode + heater + shield grid + shields + metal parts, etc.	Control grid
	Shield grid - Anode	Shield Grid	Anode	All other elements, shields, metal parts, etc.
	Shield grid - Earth	Shield Grid	Cathode + heater + shields + metal parts, etc.	Anode

Table IV - Photocells and Photomultipliers

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
Gas and Vacuum Types	Anode-cathode	Anode	Cathode + shields + metal parts, etc.	
Gas and Vacuum Twin Types	Anode-cathode (each unit)	Anode	Cathode + shields + metal parts, etc.	Anode and cathode of unit not under test.
	Coupling between units (cathode to cathode)	Cathode of one unit	Cathode of other unit	All other elements, shields, metal parts, etc.
	Coupling between units (anode to anode)	Anode of one unit	Anode of other unit	All other elements, shields, metal parts, etc.
Multiplier Types	Anode-All	Anode	All other elements, shields, metal parts, etc.	
	Anode-Last Dynode	Anode	Last Dynode	All other elements, shields, metal parts, etc.
	Electrode (1)	Electrode	All other elements, shields, metal parts, etc. connected to ground.	

NOTE

(1) The capacitance of an electrode is defined as the capacitance between one electrode and all other electrodes and metal parts connected to ground.

Table V - High Power Valves

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
Indirectly heated cathode types	Heater-cathode	Heater	Cathode	All other elements, shields, metal parts, etc. (2)
Diode	Anode-All	Anode	Cathode + heater + shields + metal parts	

Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
Triode, Tetrode, Pentode	Grid-anode	Grid	Anode	All other elements, shields, metal parts, etc. (2)
	Input	Grid	Cathode + heater + screen + suppressor + shields + metal parts, etc. (2)	Anode
	Output	Anode	Cathode + heater + screen + suppressor + shields + metal parts, etc. (2)	Grid
	Electrode (1)	Electrode	All other elements, shields, metal parts, etc. connected to ground (2)	
	Cathode-anode (grounded-grid)			
	(a)	Anode	Cathode + heater	All other elements, shields, metal parts, etc. (2)
	(b)	Anode	Cathode	All other elements, shields, metal parts, etc. (2)
	Input (grounded-grid)	Cathode + heater	Grid + screen + suppressor + shields + metal parts, etc. (2)	Anode
	Output (grounded-grid)	Anode	Grid + screen + suppressor + shields + metal parts, etc. (2)	Cathode, heater
Twin triode Tetrode, Pentode	Coupling between units (grid to anode)	Grid of one unit	Anode of other unit	All other elements, shields, metal parts, etc. (2)

/Table Continued Overleaf

Type of Valve	Capacitance	Measure Between		Connect to Reference Ground
	Coupling between units (anode to anode)	Anode of one unit	Anode of other unit	All other elements, shields, metal parts, etc. (2)
	Coupling between units (general)	Specified electrode of one unit	Specified electrode of other unit	All other elements, shields, metal parts, etc. (2)

NOTES

(1) The capacitance of an electrode is defined as the capacitance between one electrode and all other elements and metal parts connected to ground.

(2) For high-power vacuum types employing metal sleeve-type bases with the sleeves not connected internally to any base pin or electrode, the sleeve shall float for all measurements and shall not be connected to any measurement circuit as are other metal parts.

2.1.3. Conditions of Tests

2.1.3.1 For all valves, interelectrode capacitances shall be measured with the cathode cold and with no direct voltages present unless otherwise specified.

2.1.3.2 For all valves, interelectrode capacitances shall be measured using the standard capacitance sockets and standard cap connectors described in Clauses 2.2 and 2.4. The socket face plate on the standard socket shall be earthed. In those cases where the terminals do not fit the standard sockets or cap connectors, connections shall be made directly to such terminals by using flexible shielded leads. Shielding on the connecting leads shall be carried as close to the terminals as possible. Shielding between terminals shall be used, where necessary, in order to have the capacitance measurement exclude the capacitance between terminals outside the base or bulb, just as is done in the case of standard shielded sockets and cap connectors.

Standard shields shall be used where specified.

When used, cylindrical shields shall sit squarely on, and concentric with the capacitance socket. When both a shield and a cap connector are used, the cap connector shall be concentric with the opening of the shield.

The dimensions and shapes of the standard shields have been selected to provide for maximum repeatability of measurement, ease of use, use on largest number of valve types to keep number of standard shields at minimum, and simple shield shapes that allow for maximum allowable variation in bulb dimensions. The standard shields do not necessarily provide therefore, the most perfect shielding for an individual outline.

2.1.3.3. All metallic objects and/or dielectric materials having a dielectric constant appreciably greater than air should be at such a distance from the valve under test that a change in the relative position between the object and the valve does not affect the capacity reading. This requirement does not apply to the use of the specified sockets and shields described in Clause 2.2 and Clause 2.3.

2.1.3.4. For cathode ray tubes, in the measurement of capacitance between the internal and external conductive bulb coatings, connection shall be made to the external coating by means of a conductive ring, such as braided bare wire, wrapped around the bulb at a point approximately at the coating centre. If the external coating has been applied in a patch so that it does not extend around the entire bulb wall, connection will then be made by means of a finger contact located at the approximate centre of the coating.

2.1.4. Capacitance Measuring Circuits

The radio frequency bridge method and the transmission method as shown in Paragraphs 2.1.4.1 and 2.1.4.2 shall be the standard methods of measuring interelectrode capacitances with the exceptions that for the measurement of the "capacitance of an electrode", the substitution method, Clause 2.1.4.3. and for the measurement of cathode ray tube capacitances, the measurement on an impedance bridge operating at 1000 c/s shall also be considered a standard method.

The first mentioned two methods are applicable throughout the usual range of valve capacitance, i.e. 0.0001 to 100 picofarads. In using these methods, the operating frequency shall be $0.4-5.0 \times 10^6$ cycles per second. The third method is applicable from 1-100 picofarads.

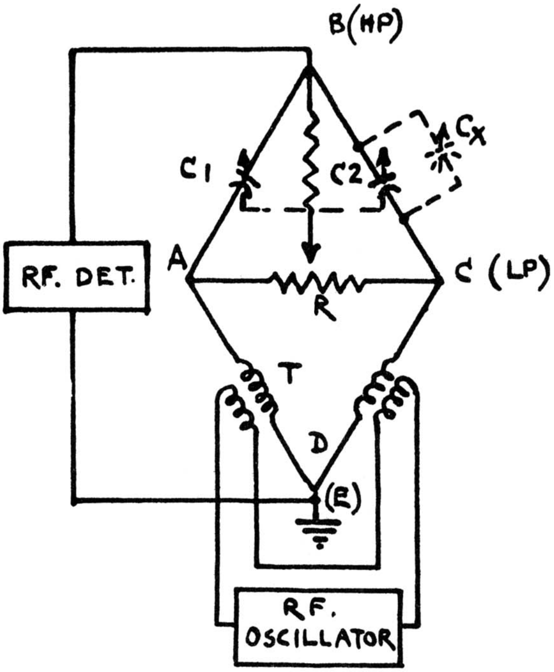
2.1.4.1. Radio-frequency Bridge Method

A bridge circuit for the measurement of direct interelectrode capacitances of a valve is shown by way of example in Figure 1. A stable oscillator, such as a crystal-controlled oscillator, supplies radio-frequency power through a closely coupled balanced transformer (T). Balance is indicated by a null-indicating device. For convenience the capacitors are ganged differentially so that increase of one capacitance is accompanied by an equal decrease of the other. Balance may then be effected by varying the two capacitance branches of the bridge until they are equal (when $C_X = C_1 - C_2$). Then at balance

$$C_x = 2\Delta C_1 = 2\Delta C_2$$

An advantage of the bridge over the transmission method is that the conductive components of the valve admittance due to insulation losses, getter deposits or other leakages, can be measured and balanced out independently of the capacitance reading.

The effect of capacitance to ground is negligible as Point B is at a centre location in the bridge, where capacitance does not influence balance, and the capacitance from C to ground is across a closely coupled low-impedance winding which does not affect the capacitance balance or the voltage applied to the bridge.



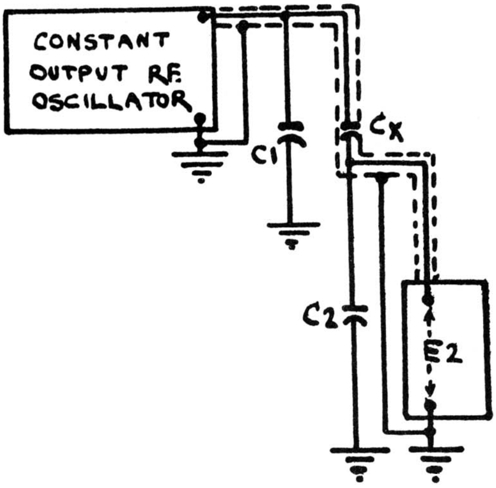


Fig. 1 (Radio Frequency Bridge)

Fig. 2 (Transmission)

2.1.4.2 Transmission Method

A circuit for measuring the direct interelectrode capacitance of a valve is shown schematically by way of example in Figure 2. The radio frequency oscillator voltage is attenuated according to the range desired. The current in the unknown valve capacitance is amplified and measured by a valve voltmeter or is measured by a compensation method.

The amplifier input is attenuated in conjunction with the oscillator output so that the various ranges may be obtained. The oscillator-output and amplifier-input attenuators may be operated from a common control and calibrated in convenient decade steps. It is to be noted that large capacitances are required across the input and output so that the effects of the valve capacitances shunted across the input and output is negligible.
The device is calibrated by using a known standard capacitance or a resistor of negligible shunt capacitance which may be calibrated in position. It is necessary to shield the parts from one another to eliminate stray capacitances because there is no way of balancing them out with this method. (Errors may be introduced as a result of conductance in shunt with the capacitance being measured).

2.1.4.3. Substitution Method

This method is only to be used for measuring the "capacitances of an electrode" (See Note 1, page 10). Fig. 3 gives a circuit for the substitution method.

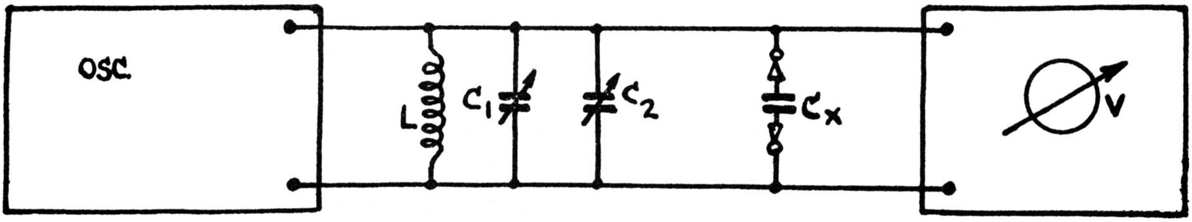


Fig. 3 (Substitution)

A stable oscillator "OSC", supplies radio-frequency power to the tuning circuit consisting of the coil L, the variable capacitor C_1 and the calibrated variable capacitor C_2. The circuit is tuned with capacitor C_1 as indicated by the maximum reading of the voltmeter V.

The capacitance Cx which is to be measured is then inserted in the circuit, and the circuit is again tuned for resonance, this time with the calibrated variable capacitor C_2. The difference between the readings of C_2 gives the capacitance value of Cx. With this measurement great care should be taken that stray capacitances to earth of the circuit proper are not altered by inserting the capacitance to be measured. Standard capacitance sockets mentioned as in Clause 2.2 will therefore be used.

2.2 Standard Capacitance Sockets

2.2.1 R.F. Bridge and Transmission Method Sockets

The following specifications shall be standard for capacitance sockets for the radio frequency bridge method and the transmission method for valves having bases indicated in Table VI.

(a) The construction and shielding of capacitance sockets and leads shall be such that when the holes for the insertion of the base pins and the spigots or locating lugs are covered with a grounded, flat metal plate, the capacitance between any one socket terminal and all other socket terminals tied together does not exceed 0.00010 picofarad for receiving valves, 0.0050 picofarad for cathode ray tubes, and 0.0005 picofarad for all other types. A spigot or locating lug contact (where present) shall be considered as an additional socket terminal.

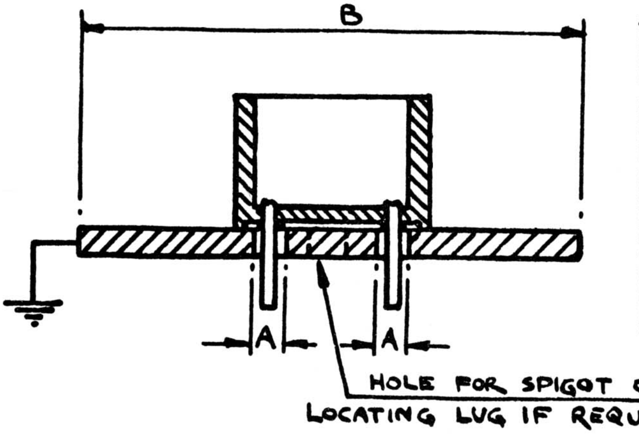
(b) Holes for the accommodation of spigots or locating lugs shall have a maximum diameter stated in Table VI.

(c) The diameter of the holes for the insertion of the base pins (See Fig.4) shall be limited to the values shown in Table VI. The socket face plate shall be flat and shall have a minimum diameter provided complementary screening is present, so that when the holes in the socket face plate are covered with a grounded flat metal plate, the capacitance between all socket terminals tied together and an object simulating the inserted valve, shall be less than the capacitance values mentioned in Clause 2.2.1(a).

(d) A thin insulating film with a maximum thickness of 0.010" (0.254 mm) may be permanently attached to the face plate of capacitance sockets to provide insulation for ungrounded shielding members.

(e) The socket shall be constructed so that the base of the valve under test will seat on the face plate.

(f) Where a recess is specified on the standard drawing of a valve base, provision may be made for a projecting boss on the earth plate. When this modified socket is used it shall be stated. The boss shall have dimensions compatible with the minimum size recess specified for the valve. (For the B7G type of base, the boss dimensions shall be 0.200" (5.080 mm) diameter maximum and 0.018" (0.457 mm) height maximum).



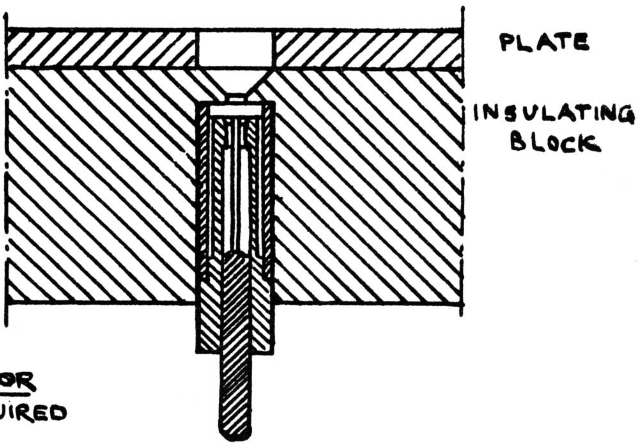


Fig. 4

Fig. 5

2.2.2. Substitution Method Sockets (Fig. 5)

The following specifications shall be standard for capacitance sockets for the substitution method.

(a) The socket face plate shall be flat and have a minimum diameter of 200 mm (7.87").

(b) The diameter of the hole provided for the passage of the pin of which the capacitance will be measured is twice the diameter of the holes for the other pins as mentioned under (c).

(c) The diameter of holes provided for the pins of which the capacitance is not measured, corresponds with the maximum hole diameter as given in Table VI except for the B7G and B9A and B8A types for which the diameter is 2.0 mm (0.078"). These dimensions are toleranced plus and minus 5%.

(d) The contact for the pin of which the capacitance will be measured will have a construction as shown in Fig.5 to diminish the alteration of the capacitance of the socket due to the insertion of the valve.

TABLE VI

Diameter of holes for insertion of base pins and diameter of socket face plate of capacitance sockets for various valve bases.

Symbolic Name	Base Description	Maximum diameter (A) of holes for the insertion of base pins. Inches	Minimum diameter (B) of socket face plate Inches	Maximum diameter of holes for spigots or location lugs Inches
USM4	Medium 4-pin base	0.250	3	
USM4B	Medium 4-pin base with bayonet	0.250	3	
USM5	Medium 5-pin base	0.250	3	
B8-O	Ootal base	0.175	3	0.500
B9G	9-pin glass base	0.093	3	0.500
B8G	8-pin glass base	0.093	3	0.500
B7G	7-pin miniature base	0.075	2 1/2	
B8A	8-pin miniature base	0.075	2 3/4	0.375
B9A	9-pin miniature base	0.075	2 3/4	
B12B	12-pin spigot base	0.250	3 1/2	0.700
-	Magnal 11-pin base	0.175	3	0.500
B14A	Diheptal 14-pin base	0.175	4	1.0
B12A	Duodecal 12-pin base	0.175	3	0.813
B11A	Submagnal 11-pin base	0.175	3	0.500
B3A	Pee Wee 3-pin base	0.175	2 1/2	
B7A	Septar 7-pin base			
	For thin pins	0.093		
	For thick pins	0.250		
B5D	Medium shell giant 5-pin base with bayonet	0.325	3	
B5E	Giant 5-pin base with metal skirt	0.325	3	
B5F	Giant 5-pin base	0.325	3	
B4F	Jumbo 4-pin base	0.375	3	
B4D	Super Jumbo 4-pin base with bayonet	0.375	3	

2.3 Standard Shields

Standard shields or cans shall be made as shown in Table VII. Material shall be copper, brass or an equivalent metal and shall have sufficient thickness to maintain shape under conditions of use.

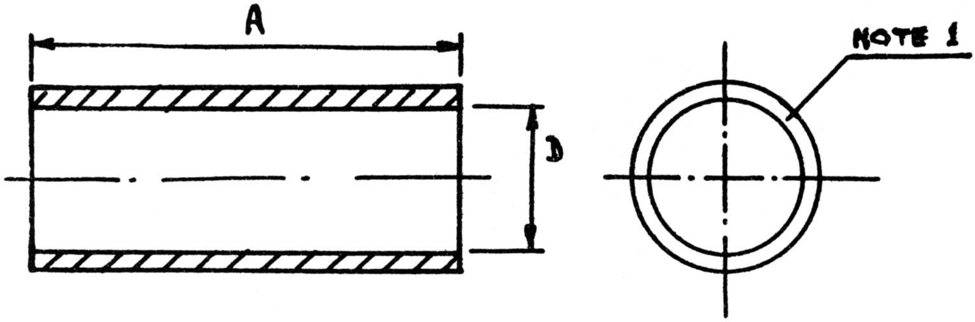
In using the receiving valve shields, the shielded top cap connector shall slide inside the shield.

It is recommended that in future for any new receiving valves with parallel sided bulbs, the internal diameter of the shielding can shall be equal to the maximum diameter of the base or bulb and the length shall not be less than the overall seated height of the valve including tip or top cap.

TABLE VII

Recommended shields for use in the measurement of valve capacitances.

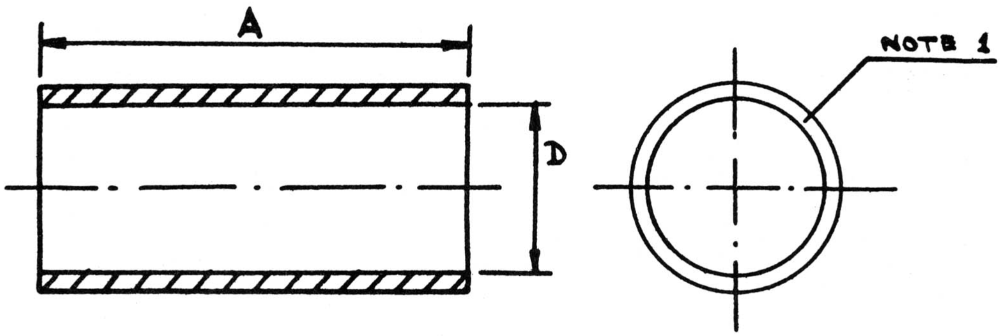
Figure No.	Shield No.	Applicable Valve Description
6	1	Valves with B7G base
7	2	Valves with B9A base (Medium and short bulb)
8	3	Valves with B9A base (long bulb)
9	4	Valves with B8A base
10	5	Valves with B5G/F and B7E/F base (T2X3)
11	6	Valves with B8D and B8D/F base
12	7	Valves with B5B/F base



ref.	inches			millimetres		
	min.	nom.	max.	min.	nom.	max.
A	2 15/64	2 ¼	2 17/64	56.76	57.15	57.54
D	¾	¾	49/64	19.05	19.05	19.44

Note 1. A maximum radius of 3/32" (2.3 mm) is allowable on all internal edges.

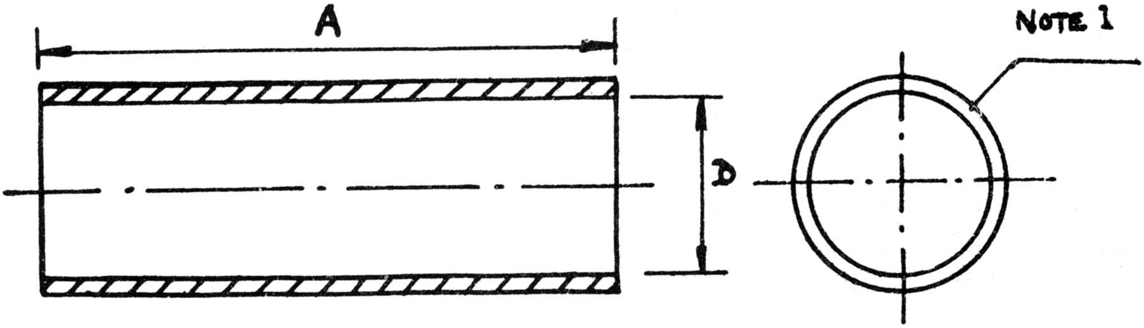
Fig.6 Shield No.1



Ref.	inches			millimetres		
	min.		max.	min.	nom.	max.
A	2 15/64	2 ¼	2 17/64	56.76	57.15	57.54
D	7/8	7/8	57/64	22.22	22.22	22.62

Note 1. A maximum radius of 3/32" (2.3 mm) is allowable on all internal edges.

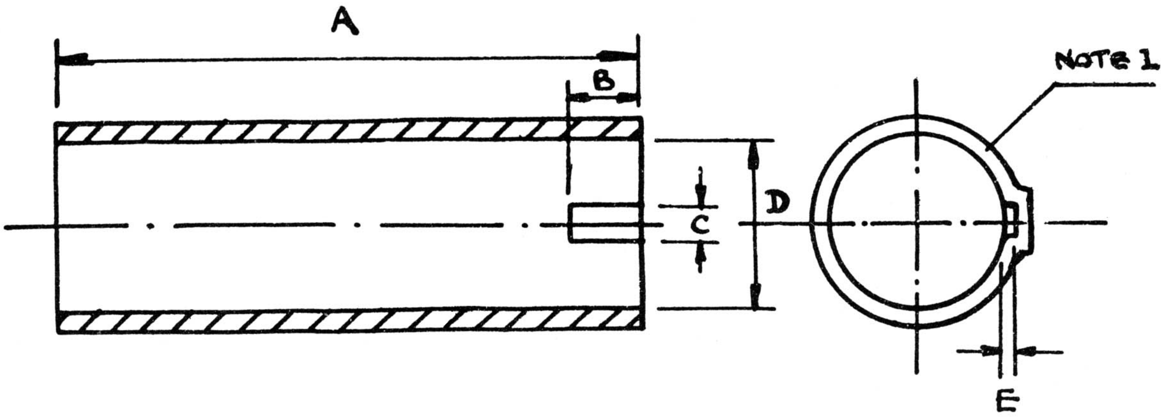
Fig.7 Shield No.2



Ref.	inches			millimetres		
	min.	nom.	max.	min.	nom.	max.
A	2 63/64	3	3 1/64	75.81	76.20	76.59
D	7/8	7/8	57/64	22.22	22.22	22.62

Note 1. A maximum radius of 3/32" (2.3 mm) is allowable on all internal edges.

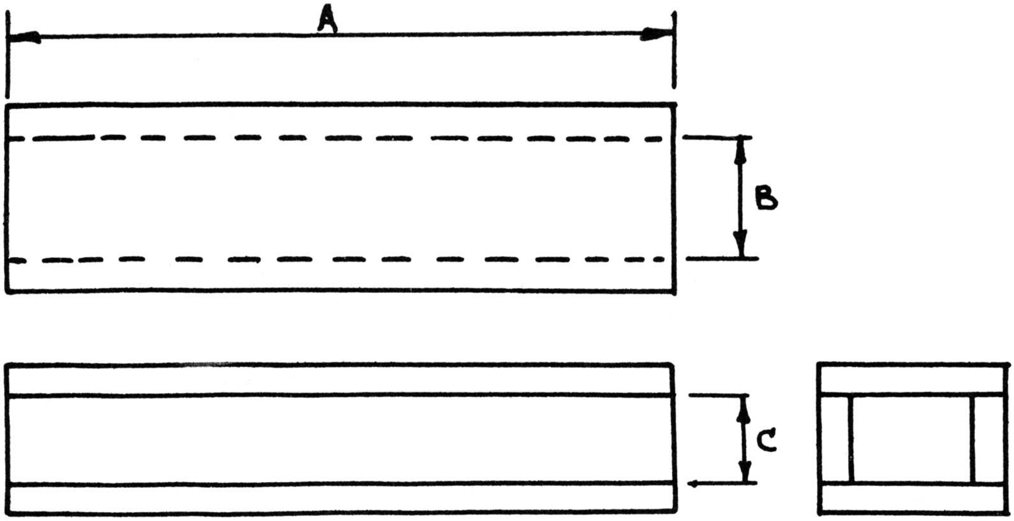
Fig.8 Shield No. 3



Ref.	millimetres			inches		
	min.	nom.	max.	min.	nom.	max.
A	77.5	78.0	78.5	3.052	3.071	3.090
B	9.5	10.0	10.5	0.375	0.394	0.413
C	4.0	4.5	5.0	0.158	0.177	0.196
D	22.5	22.5	23.0	0.886	0.886	0.905
E	2.0	-	2.5	0.079	-	0.098

Note 1 A maximum radius of 3/32" (2.3 mm) is allowable on all internal edges.

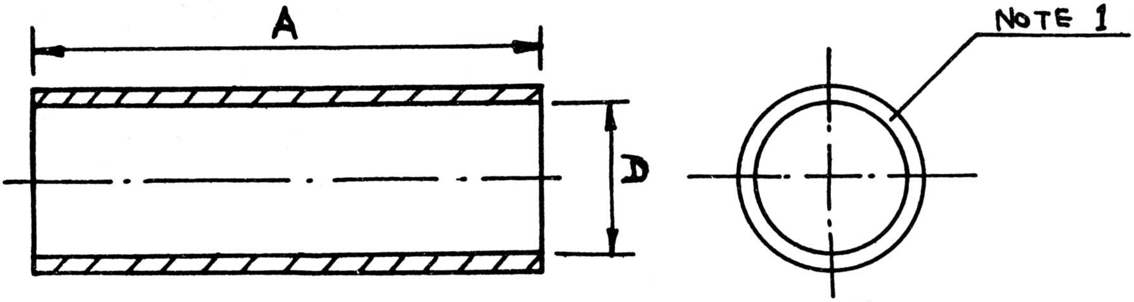
Fig.9 Shield No.4



Ref	inches			millimetres		
	min	nom	max	min	nom	max
A		1.1750			44.450	
B	0.415		0.418	10.541		10.617
C	0.286		0.288	7.265		7.315

NOTE

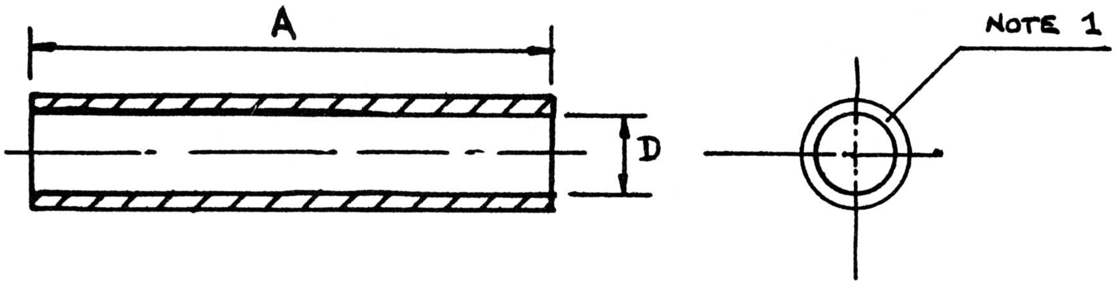
1 A maximum radius of $^3/_{32}''$ (2.3m.m.) is allowable on all internal edges.



Ref.	inches			millimetres		
	min.	nom.	max.	min.	nom.	max.
A	1 23/64	1 3/8	1 25/64	34.53	34.93	35.32
D	0.402	0.405	0.408	10.211	10.287	10.363

Note 1. A maximum radius of 3/32" (2.3 mm) is allowable on all internal edges.

Fig. 11 Shield No. 6



Ref.	millimetres			inches		
	min.	nom.	max.	min.	nom.	max.
A	34.0	-	35.0	1.339	-	1.377
D	5.45	-	5.55	0.2146	-	0.2185

Note 1. A maximum radius of 3/32" (2.3 mm) is allowable on all internal edges.

Fig. 12 Shield No. 7

2.4. Standard Cap Connectors. Standard Cap Connectors shall be made as shown in Fig. 13.

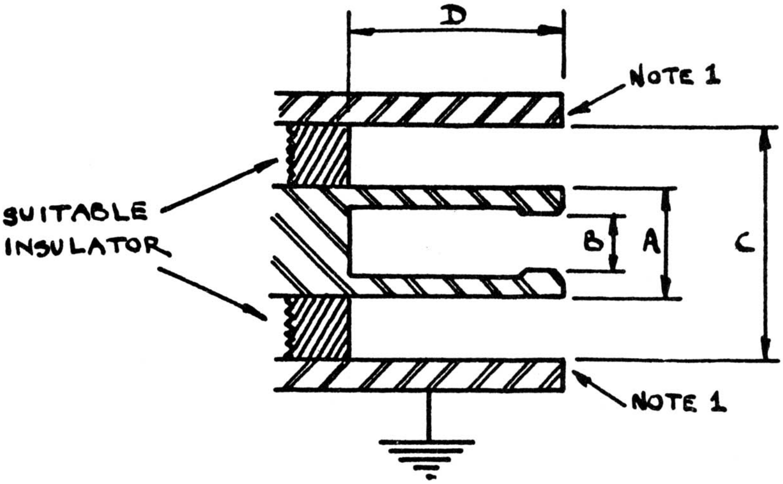


Fig.13. Standard Cap Connectors.

CT3 (U.S. Medium Cap Connector)						
inches				mm		
ref.	min.	nom.	max.	min.	nom.	max.
A	41/64	21/32	43/64	16.28	16.67	17.06
B		0.556			14.122	
C	0.845	0.850	0.855	21.463	21.590	21.717
D	1/2			12.7		
CT2 (U.S. Small Cap Connector)						
ref.	min.	nom.	max.	min.	nom.	max.
A	7/16	29/64	15/32	11.12	11.51	11.90
B		0.352			8.941	
C	0.745	0.750	0.755	18.923	19.050	19.177
D	1/2			12.7		

/Table Continued Overleaf

CT1 (U.S. Miniature Cap Connector)						
ref.	min.	nom.	max.	min.	nom.	max.
A	5/16	21/64	11/32	7.94	8.33	8.73
B		0.242			6.147	
C	0.745	0.750	0.755	18.923	19.050	19.177
D	1/2			12.7		

Note 1. A thin insulating film may be placed on the surface indicated.

Note 2. For 7 pin miniature valves with top caps, the standard cap connectors cannot always be used.

N JOINT SERVICE SPECIFICATION K1001

APPENDIX IV

VALVE BASES AND CAPS

1. GENERAL

The Test Specification for a valve will state the type of base employed and will refer, as appropriate, to the relevant drawing in this Appendix.

1.1. The drawings herein are marked "Illustrative" or "Mandatory".

Illustrative Drawings are for bases which are in British Standard Specification BS448 and except where otherwise stated such bases shall satisfy the requirements of that Standard. The "Illustrative" drawings are given in this Appendix solely to assist in the recognition of types.

Mandatory Drawings give the information to which the bases shall be tested for the valves concerned.

1.2. Pins. In all cases dimensions for the positions of pins refer to the fixed ends. When the corresponding gauges are specified these dimensions are for information only and the pin dispositions shall be tested by using the specified gauges and not by any other methods of measurement.

1.3. The inspection of base dimensions shall be made on a sampling basis (See Section 6) at Inspection Level IB and AQL = 6.5%.

1.4. Certain mandatory outline dimensions may be given in the Test Specifications by reference to Appendix I.

2. PIN CONNECTIONS

The Pin Connections will be given in tabular form in the individual test specification by showing pin numbers against electrodes. The numbers corresponding to the pins or contacts in each type of base will be given either in the Base Pin Numbering Drawing in this Appendix or in the individual test specification. As from the date of this issue of Appendix IV the symbols used will be those given in BS.1409: "Letter symbols for Electronic Valves". Test Specifications of earlier date may have other symbols. (See Appendix II)

3. MATERIALS

3.1. Moulded Bases and Caps shall be of approved materials (see below). The material shall be stable and posses a high surface resistivity and resistance to voltage breakdown. Bases and caps shall be capable of withstanding the treatment specified in paragraph 10.1 of this specification without injurious effect. The insulation resistance after this treatment shall be in accordance with the requirements of Section 10.

3.2. A list of approved moulding materials for bases and caps is given in Table I below. In addition to these materials ceramics are approved for incorporation in certain other bases, e.g. B4A, B4D and B4F. Contractors wishing to use other materials should submit samples to The Director, S.R.D.E. for test. In cases where the valve rating permits a voltage of 1.0 kV or higher to appear between any two base contacts, the Approving Authority must be consulted before any change of base materials is made, even if the change is to another material in the list of approved moulding materials.

3.3. Soldered connections shall be mechanically and electrically sound after withstanding the treatment specified in paragraph 10.1 of this specification.

3.4. The contact surfaces of pins or side contacts etc. shall be of approved material. In the case of fabricated or moulded bases, the contacts, normally brass, shall be nickel plated to B.S. 1224 or silver plated to DTD.919 unless the finish is otherwise specified in the individual test specification.

TABLE I

LIST OF APPROVED MOULDING MATERIALS

Approved Moulding Materials		Manufacturer
Grade	Colour	
X262/2)	Natural	Bakelite Ltd., 12 Hobart Place, London, S.W.1.
X5283/3)	Natural	
X5337)	Natural and Black	
X5418	Natural	
A803	Natural	James Ferguson & Co. Ltd., Lee Park Works, Prince George's Road, Merton Abbey, S.W.19
3920	Natural	British Resin Products Ltd., 21 St. James Square, London, S.W.1.
Philite 437 (Spec. NLN-K 437)	Yellow-brown or black	N.V. Philips Gloeilampenfabricken Eindhoven, Holland

Amdt 9

Amdt 3

3.5 Season Cracking in Brass or Bronze Base Sleeves

The test shall be applied to three unplated specimens.

The specimen shall be cleaned from oil and grease and immersed in a nitric acid solution consisting of 40 volumes of nitric acid, S.G. 1.42 made up to 100 volumes with distilled water, until a clean, well pickled surface is obtained. On removal from the pickling bath, the specimen shall be washed in water avoiding staining. It shall then be completely immersed while wet in a 0.5% mercurious solution, maintained at 15 to 25°C, for 10 minutes, and then washed in water followed by alcohol or acetone.

During this treatment the specimen shall not be subject to any rubbing or unnecessary pressure.

It shall then be allowed to stand for 24 hours, after which the specimen shall be visually examined when there shall be no evidence of cracking.

NOTE A stock of mercurious solution may be made from 100 c.c. of nitric acid, S.G.1.42 with 100g of mercurious nitrate crystals with distilled water added to make up one litre. One volume of this stock solution made up to 20 volumes with distilled water will give a 0.5% solution. The solution must be fresh for each specimen, and in quantity equivalent to one litre per pound of brass or bronze in the specimen.

4. CEMENT FOR BASING AND CAPPING

The cement used for securing the bases and or cap to the bulb shall be of approved material (see Table 2) and the method of basing shall be such that the completed valve satisfies the requirements of Section 12 of this Specification.

A list of approved cements for bases and caps and the method of use is given below. Contractors wishing to use other materials should submit samples to the Approving Authority for test.

The cements in Table 2 cannot be used for certain photo tubes and a few other electronic valves as the requisite heat treatment would damage the tubes. For such valves other materials and processes may be used subject to approval. Special precautions will be required in the packaging to prevent moisture from affecting the cement joints.

TABLE 2

LIST OF APPROVED CEMENTS FOR BASING AND CAPPING

Approved Cements	Composed of:-	Manufacturer
G17146 keyed with Bostic 1775	G1746 Bostic 1775	Bakelite Ltd., 12 Hobart Place, S.W.1. B.B. Chemical Co. Ltd. Ulverscroft Rd., Leics.
Footscray	JK5176	British Resin Products Devonshire House, Mayfair Place, W.1.
	PR1221	British Paints Ltd., Crew House, Curzon St., W.1.
	MS996	Midland Silicones Ltd., 19, Upper Brook St., London, W.1.
Resin Capping Paste 2656 (Spec. RV-X 004 18(E)) (used in conjunction with RV-X 004 22(E) or RV-X 019 95(E))	Resin Capping Paste 26 (Spec. RV-X 004 18/02(E)) Ethanol (Spec. NLN-X 000 06) Silicone Resin (Spec. RN-X 020 87(E))	N.V. Philips Gloeilampenfabrieken, Eindhoven, Holland.
Resin Capping Paste 29. (Spec. RV-X 004 18/01)	As for Resin Capping Paste 2656, except that more Ethanol is used to make the paste thinner for hand application. When baked, both pastes are the same.	
Resin Capping Paste 8 (Spec. RV-X 004 22(E)) (used in conjunction with RV-X 004 18(E))	Shellac (Spec. NLN-X 007 74/02) Levigated Chalk Dried (Spec. RV-X 004 92/09(E)) Dried Calcite (Spec. RN-X 004 92/15)) Diphenylenepropane Resin (Spec. LT-X 017 13/01) Methyl Ethyl Hetone (Spec. NLN-X 006 09)	
Cellodammar Capping Paste (Spec. RV-X 019 95(E)) (used in conjunction with RV-X 004 18(E))	Cellodammar Resin Capping Paste (Spec. RV-X 019 94(E)) Isopropanol (Spec. NLN-X 016 00)) Silicone Resin (Spec. RN-X 020 87(E))	
Stopper Paste, Black R99 (Spec. RV-Z 600 41(E)) Used as a finishing filler between edge of base and wall of tube.	Nitrosynthetic Paint R67, Black (Spec. RV-Z 051 12(E)) Kaolin (Spec. RN-X 004 97(E))	

METHOD OF USE

G17146 Keyed with Bostic 1775

The Bostic 1775 should be applied with a brush to the glass envelope of the valve before basing and the G17146 to the base. The valve is then based in the normal manner for G17146 cement.

Footscray Cement

(a) Mixing

To make 1 lb. of Footscray Cement:-

- (i) Mix 440 cubic centimetres (360 grammes) of JX5176 to a tacky solution with addition of 68 o.p. methylated spirit.
- (ii) Add to the above 22 cubic centimetres (18 grammes) of prepared PR1221 rubber additive and mix.
- (iii) Add to the above 24 cubic centimetres (20 grammes) of silicon varnish* MS996.

(b) Curing Time

Approximately 10 minutes at 120°C cement temperature (not necessarily baking oven temperature).

(c) Working Life

It is recommended that this cement is mixed daily and used for a period not exceeding 10 hours after mixing.

Philips Pastes

Instructions for capping of bases and bottom outer screens for oscilloscope tubes are contained in N.V. Philips Specification RV-5-3-55/411(E) dated 26th May 1964.

5 INDEX OF DRAWINGS

The Drawings in Appendix IV are:-

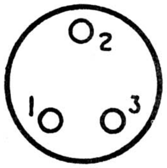
Drawing No.	Drawing Title
1.1, 1.2, 1.3, 1.4	Valve Base Pin Numbering.
2	The Octal Base B8-O (Illustrative)
3	The Mazda Octal Base B8-MO (Illustrative)
4	
5	British 4, 5, 7 and 9 Pin Bases (Illustrative)
6	Special 4-Pin Low Loss Base (L4) (Mandatory)
7	Transmitting Valve Base, 4-Pin Metal Shell (T4), (Mandatory)
8	B9G Base. (Illustrative)
9	B7G Base. (Illustrative)
10.	Valves with B3G Base. (Illustrative)
11.	3 Clip Base (CL3). (Mandatory)
12	B8G Base. (Illustrative)
13	Edison-Type Screw Lamp Caps. (Illustrative)
14	Bayonet Lamp Caps. (Illustrative)
15	B12D Base. (Illustrative)
16	B12B Base. (Illustrative)
17	B8E Base. (Formerly EM8). (Mandatory)
18	6 Clip Base (CL6). (Mandatory)
19	7 Clip Base (CL7). (Mandatory)
20	8 Pin Bayonet Base (PB8). (Mandatory)
21	B15A3 Base (Formerly 3-Pin Quindecal), (Mandatory)
22	B4D Base. (Mandatory)
22A	B4D Base Pin and Bayonet Position Gauge,(Mandatory)
23	B4F Base. (Illustrative)

24	B7A Base. (Illustrative)
25	B7D Valve Base. (Illustrative)
26	B9A Base. (Illustrative)
26A	B9A Pin Straightening Tool. (Mandatory)
26B	B9A Pin Position Gauge. (Mandatory)
27	B11A Base. (Illustrative)
28	B3A Base. (Illustrative)
29	B4A Base. (Mandatory)
30	B4B Base. (Illustrative)
31	B5A and B5A/F Bases. (Illustrative)
32	B5B and B5B/F Bases. (Illustrative)
33	B5D Base. (Illustrative)
34	B5E Base. (Illustrative)
35	B5F Base. (Illustrative)
36	B8A Base. (Illustrative)
37	
38	
39	B12A Base. (Illustrative)
40	B14A Base. (Illustrative)
41	BC4 Base. (Mandatory)
42	C11 Base. (Mandatory)
43	SC8 Base. (Mandatory)
44	
45	Magnal Base. (Mandatory)
46	B8F Base. (Mandatory)
47	B12E Base. (Mandatory)

48	American A4-5 and A4-9. (Mandatory)
49	American A4-10. (Mandatory)
50	American A5-6 and A5-11. (Mandatory)
51	American A6-7 and A6-12. (Mandatory)
52	American A7-8 and A7-13. (Mandatory)
53	American A7-14. (Mandatory)
54	B7B Base (Mandatory)
54A	B7B Pin Position Gauge (Mandatory)

DRAWING No.1·1

VALVE BASE PIN NUMBERING.



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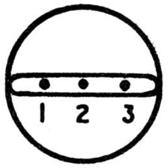

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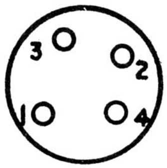

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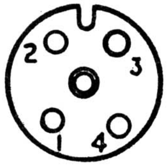

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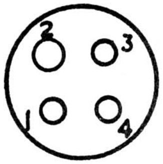

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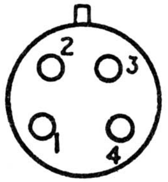

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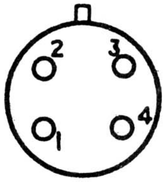
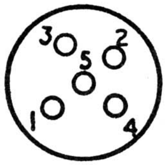


B4F & T4
AMERICAN A4-28



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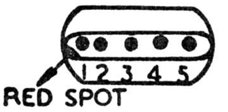

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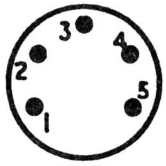

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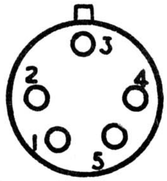

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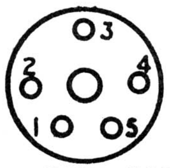
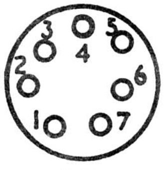
AMERICAN A5-19



B5E & B5F



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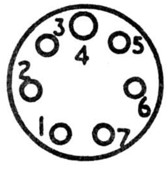

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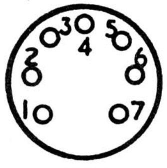

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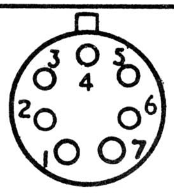
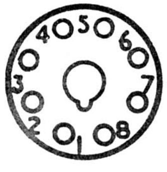


B7D

B7G

B8A



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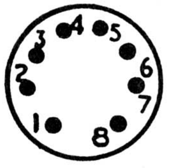
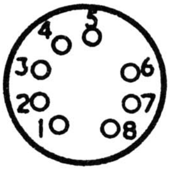
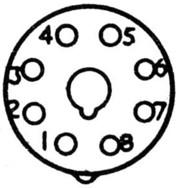
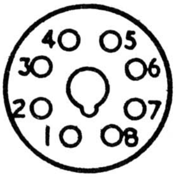
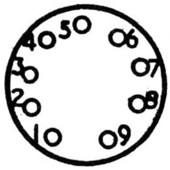
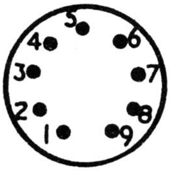
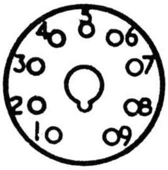
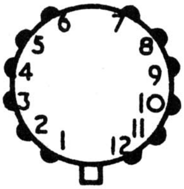
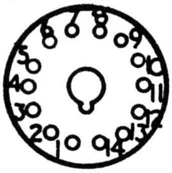
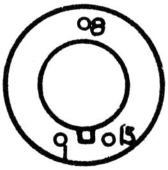


B8D

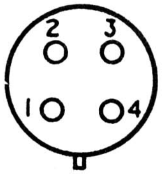
DRAWING No1·2

VALVE BASE PIN NUMBERING

 B8 E	 B8 G	 B8 -O & B8-MO	 B9
 B9A	 B9G	 B11A & MAGNAL	 B12A & B12B
 B12D	 B14A	 B15A3	

DRAWING No1·3

VALVE BASE PIN NUMBERING



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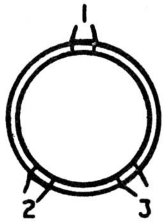

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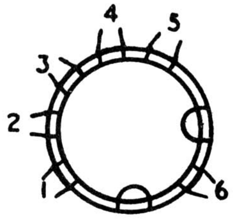

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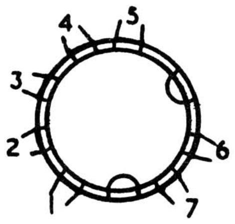

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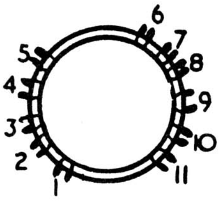

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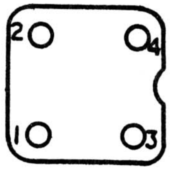

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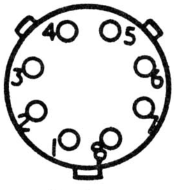
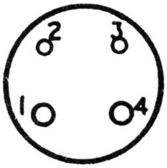


PB8

DRAWING No 1·4

VALVE BASE PIN NUMBERING



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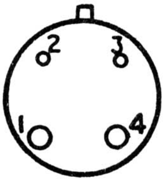
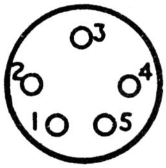


AMERICAN A4-10



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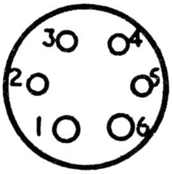

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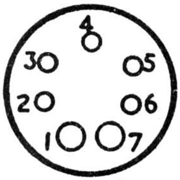

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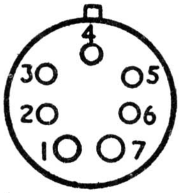
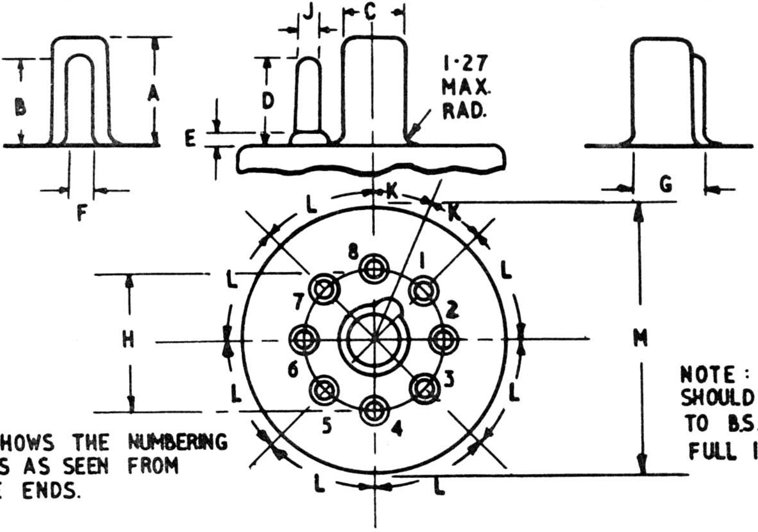


AMERICAN A7-14

DRAWING. No. 2.

THE OCTAL BASE B8-0

ILLUSTRATIVE



DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.

NOTE: REFERENCE SHOULD BE MADE TO B.S. 448 FOR FULL INFORMATION

	A	B	C	D	E	F	G	H	J	K	L
NOMINAL DIMENSIONS IN MM. EXCEPT WHERE OTHER-WISE STATED.	14·22	12·70	7·88	11·10	1·20 MAX.	2·16	9·10	17·45	2·362	22·5°	45°

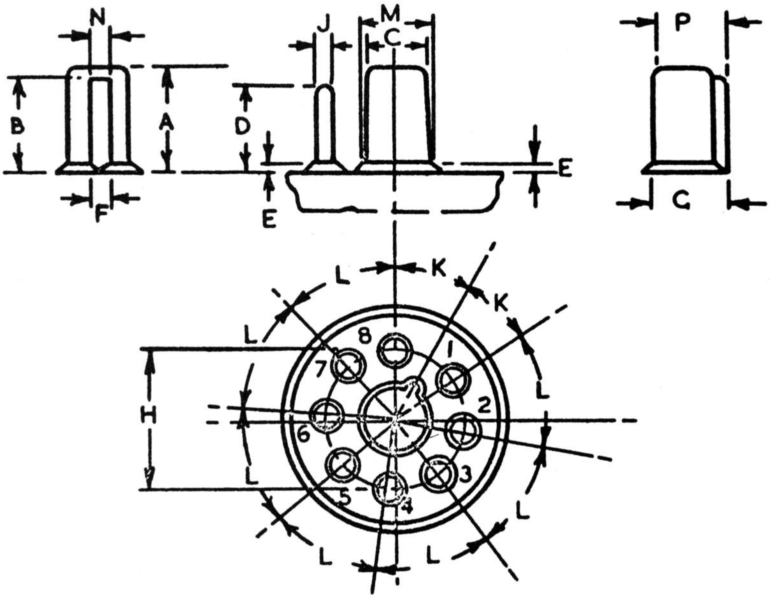
	"M" DIMENSIONS TO BE ONE OF THE MAXIMUM SHOWN BELOW					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
DIAMETER "M" WILL BE ONE OF THE SIX LIMIT DIAMETERS SHOWN ON THE RIGHT. THIS DIMENSION IS THE MAXIMUM SHELL DIAMETER OF FINISHED VALVES AND IS TO ALLOW FOR DISTORTIONS, TOLERANCES ETC. THE RELEVANT MAXIMUM DIMENSION IS QUOTED IN THE INDEX TO ELECTRONIC VALVES SPECIFICATIONS, THE AMENDMENT TO OCTAL-BASED VALVE SPECIFICATIONS AND THE APPROPRIATE INDIVIDUAL VALVE SPECIFICATIONS WHERE THESE EXIST.	1·062"	1·187"	1·281"	1·313"	1·406"	1·720"

(40626)

DRAWING No 3

THE MAZDA OCTAL BASE B8–MO

ILLUSTRATIVE



DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS

NOMINAL DIMENSIONS IN MM EXCEPT WHERE OTHERWISE STATED	A	B	C	D	E	F	G	H	J	K	L	M	N	P
	14·25	12·70	8·80	11·10	1·20 MAX	2·30	10·20	18·50	2·36	27·75	43·50	8·90	2·0	10·0

NOTE

REFERENCE SHOULD BE MADE TO B.S. 448 FOR FULL INFORMATION

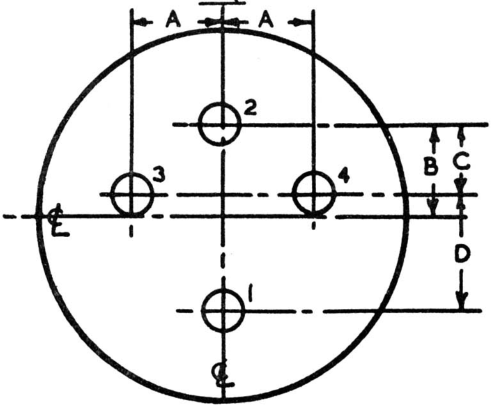
DRAWING No.5

BRITISH 4,5,7 & 9. PIN BASES

ILLUSTRATIVE

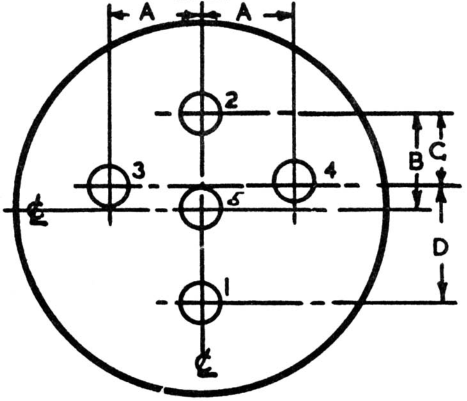
DRG 5·1

B4



DRG 5·2

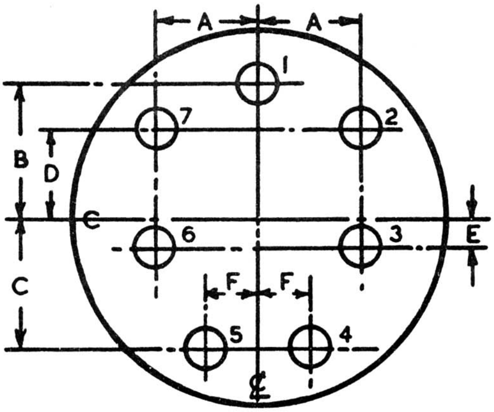
B5



NOMINAL DIMENSIONS	A	B	C	D
DRG. 5·1	8·00	8·125	6·10	10·15
DRG. 5·2	8·00	8·125	6·10	10·15

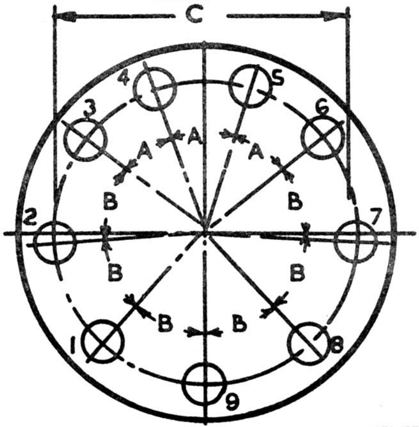
DRG 5·3

B7



DRG 5·4

B9



NOMINAL DIMENSIONS	A	B	C	D	E	F
DRG. 5·3	9·10	12·0	11·12	7·94	2·19	4·5

NOMINAL DIMENSIONS	A	B	C
DRG. 5·4	34°	43°	26·0

NOTES 1. DRAWINGS SHOW NUMBERING OF PINS AS SEEN FROM THEIR FREE ENDS AND THEIR NOMINAL SPACINGS.

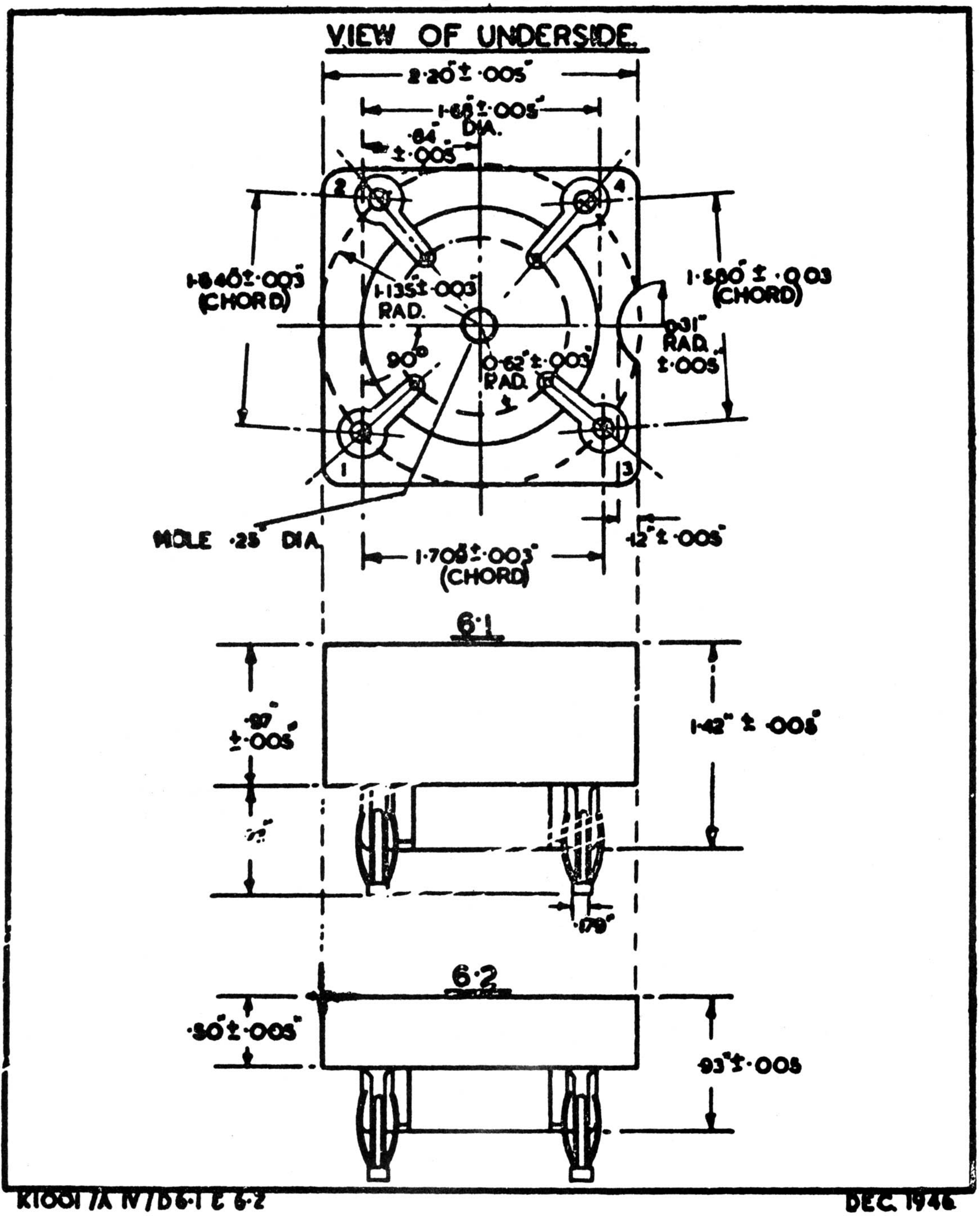
2. REFERENCE SHOULD BE MADE TO B.S. 448 FOR FULL INFORMATION.

3. DIMENSIONS IN MM EXCEPT WHERE OTHERWISE STATED.

DRAWING No 6.

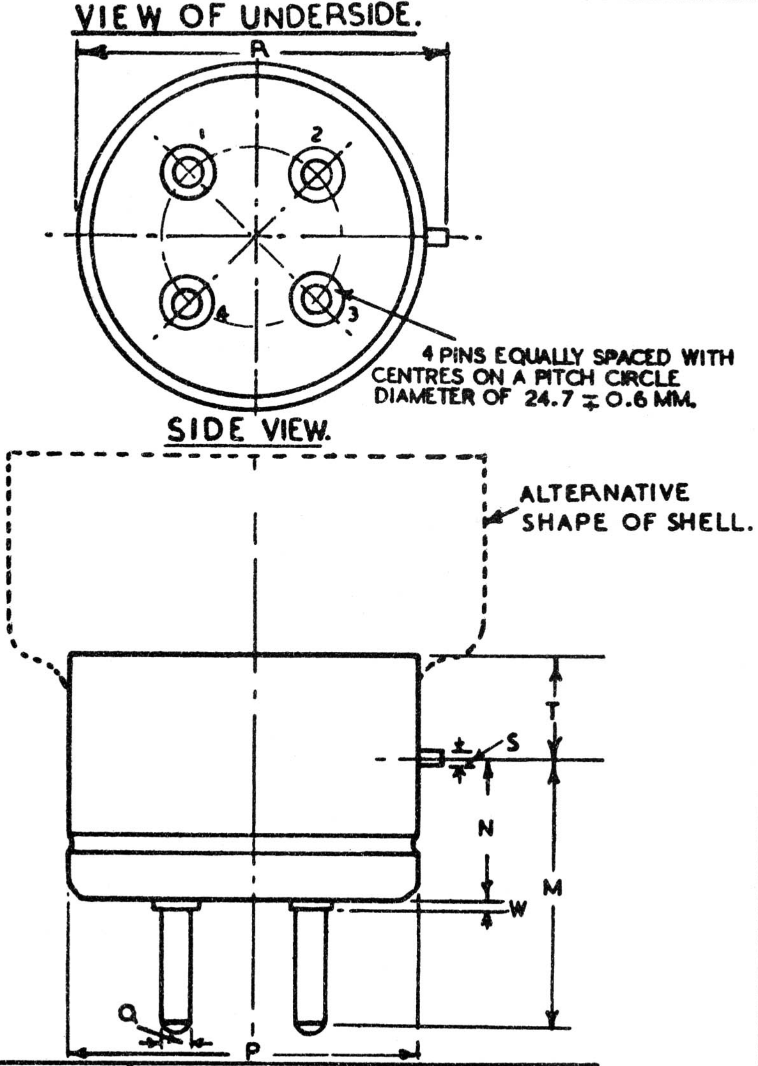
SPECIAL 4-PIN LOW LOSS BASE. (L4)

MANDATORY.



DRAWING No 7.

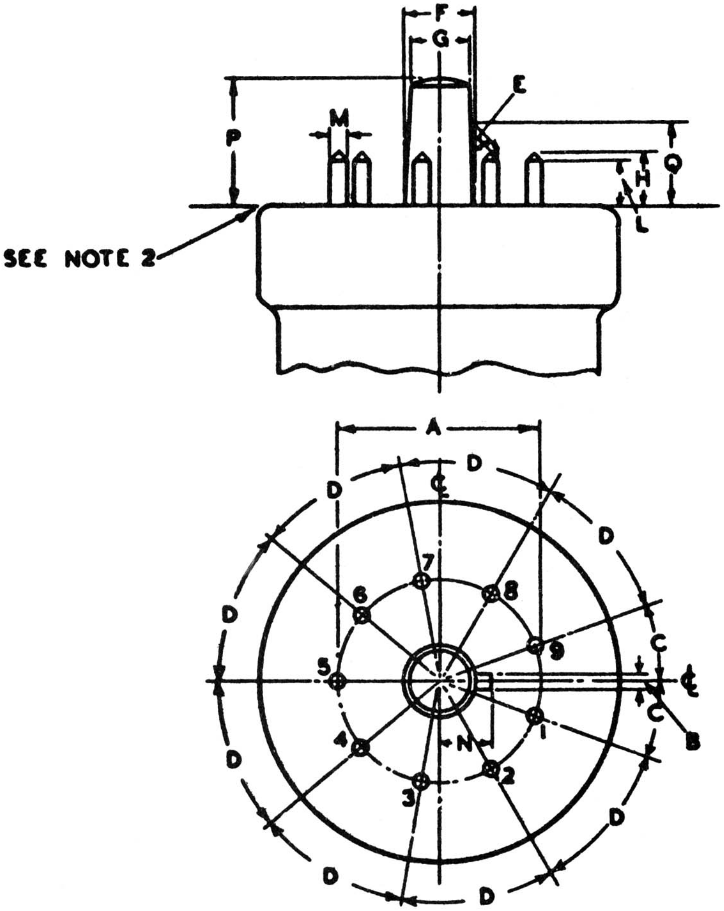
TRANSMITTING VALVE BASE, 4-PIN METAL SHELL (T4) MANDATORY.



DIMENSIONS.	LIMITS IN MILLIMETRES	
	MIN.	MAX.
M	28	35
N	15	—
N+W	—	22
P	46	47·5
Q	3·9	4·9
R	48·5	50
S	1·0	2·2
T	9·5	—
W	—	1·5

DRAWING Nº 8

B9G BASE
ILLUSTRATIVE



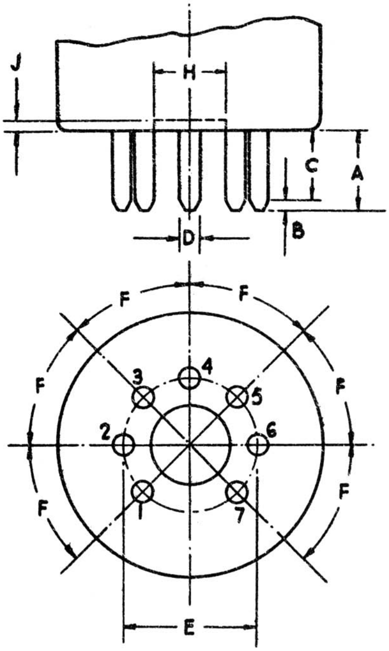
THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.

NOMINAL DIMENSIONS IN MM. EXCEPT WHERE OTHERWISE STATED.	A	B	C	D	E	F	G	H	L	M	N	P	Q
	21·0	2·0	20°	40°	45°	6·5	6·4	6·0 MAX.	4·5	1·1	6·0	14·3	8·3 MIN.

NOTES:—

1. THE SPIGOT MAY BE TAPERED OR PARALLEL WITHIN THE LIMITS GIVEN.
2. DIMENSIONS MEASURED FROM THE UNDER SURFACE OF THE BASE OR FROM THE TURNED—OVER SHOULDER IF PRESENT.
3. IT IS PREFERABLE THAT THE ENDS OF THE PINS SHALL BE TAPERED AND/OR ROUNDED.
4. REFERENCE SHOULD BE MADE TO B.S.S. 448—1947 FOR FULL INFORMATION.

DRAWING No. 9
B7G BASE
ILLUSTRATIVE.



DIMENSIONS	
A	O·28 IN. MAX.
B	O·O15 IN. MIN.
C	O·187 IN. MIN.
D	O·O4O IN. NOM.
E	O·375 IN. NOM.
F	45° NOM.
H	O·222 IN. NOM.
J	O·O18 IN. MIN.

NOTES

NOTE 1. THE DIMENSIONS FIXING THE POSITION OF THE PINS REFER TO THE FIXED ENDS OF THE PINS. THE PIN DISPOSITION SHALL BE CHECKED BY MEANS OF A GAUGE AS SHOWN IN FIG. B7G/1.2., B.S.448

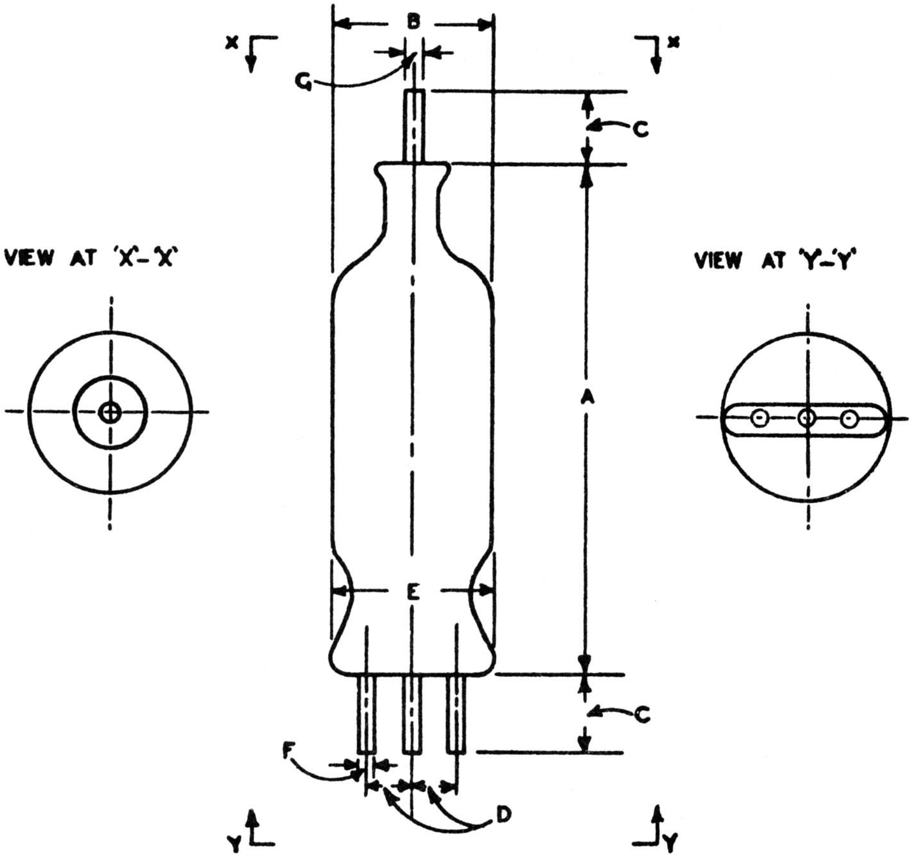
NOTE 2. THE TIPS OF THE PINS SHALL BE TAPERED OR ROUNDED.

NOTE 3. REFERENCE SHOULD BE MADE TO BS 448 FOR FULL INFORMATION.

DRAWING No 10

VALVES WITH B3G BASE

ILLUSTRATIVE



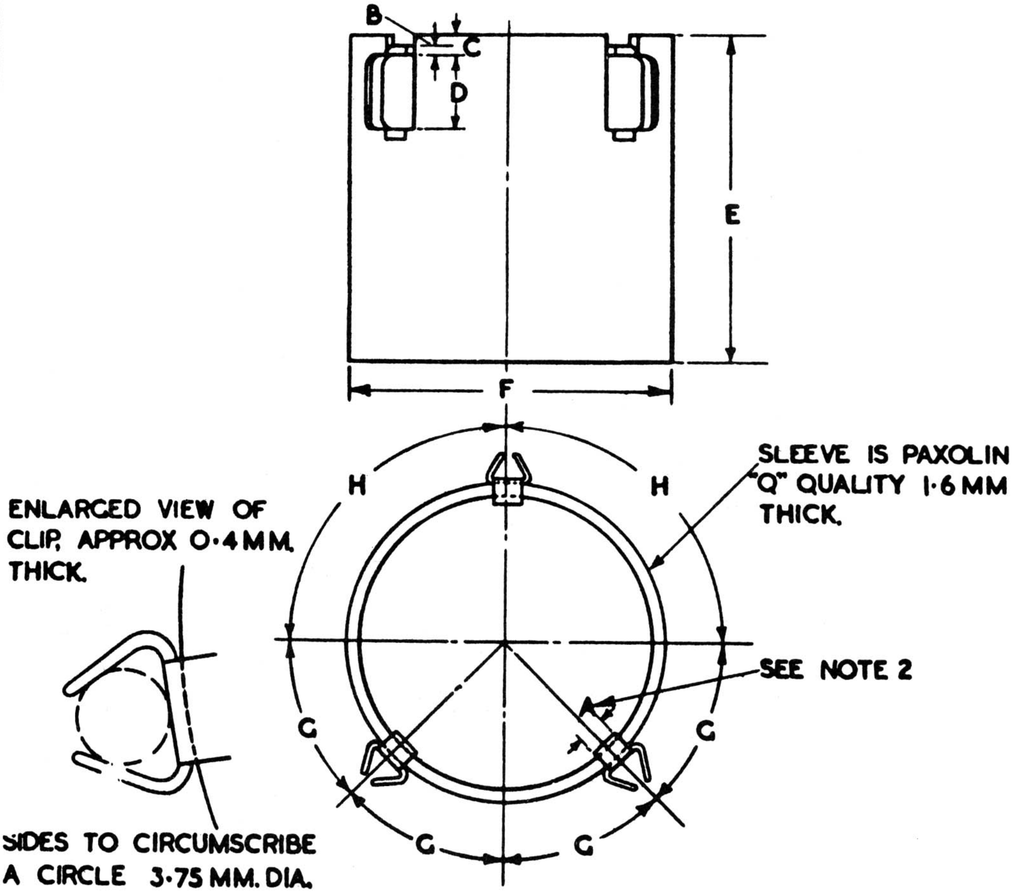
THE DIMENSIONS ON THE DRAWING FIXING THE POSITION OF THE PINS REFER TO THE FIXED ENDS OF THE PINS.

NOM. DIM. IN MM EXCEPT WHERE OTHERWISE STATED.	A	B	C	D	E	F	G
	36·0	12·0 MAX.	5·5	3·0	12·0 MAX.	1·0	0·8

NOTE:-

REFERENCE SHOULD BE MADE TO BS 448–1947 FOR FULL INFORMATION.

DRAWING No. 11.
3 CLIP BASE (CL3)
MANDATORY



ENLARGED VIEW OF CLIP, APPROX 0·4 MM. THICK.

SLEEVE IS PAXOLIN "Q" QUALITY 1·6 MM THICK.

SEE NOTE 2

SIDES TO CIRCUMSCRIBE A CIRCLE 3·75 MM. DIA.

DIMENSIONS IN MM EXCEPT WHERE OTHERWISE STATED	A	B	C	D	E	F	G	H
	5·5±0·13	1·5 MAX	4·0 MAX	11·0±0·2	38·0±1·0	55·5±0·3	45°±0·75	90°±0·75

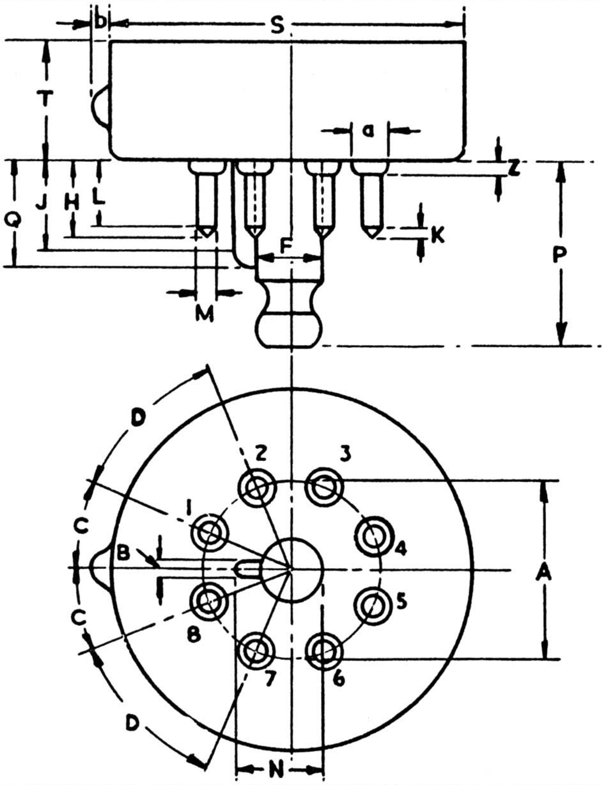
NOTES

1. THIS BASE IS DESIGNED FOR USE WITH PINS OF 4·2 MM. DIA. ON A P.C.D. OF 60·6 ± 0·25 MM.
2. DIMENSION "A" REFERS TO THE SLOT IN THE PAXOLIN INTO WHICH THE CLIP IS FITTED.

DRAWING No. 12.

B8G BASE.

ILLUSTRATIVE.



NOMINAL DIMENSIONS IN INCHES
EXCEPT WHERE OTHERWISE STATED.

A	0·687	J	0·235 MIN.	Q	0·274
B	0·080	K	0·015 MIN.	S	1·179
C	22½°	L	0·156 MIN.	T	0·50
D	45°	M	0·050	Z	0·030 MAX.
F	0·262	N	0·307	a	0·075 MAX.
H	0·220 MAX.	P	0·534	b	0·040 MAX.

NOTES.

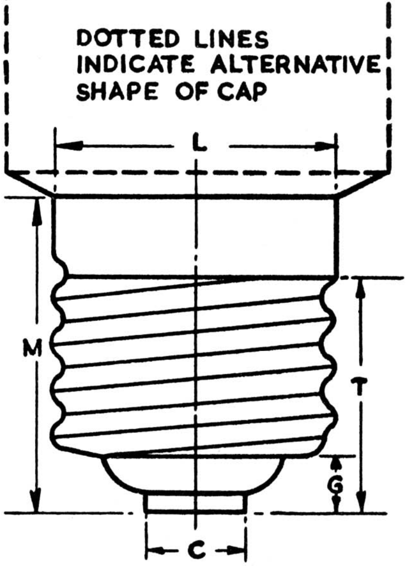
1. DIMENSIONS HJLPQZ ARE MEASURED FROM THE SOLE OF THE BASE, OR THE TURNED OVER SHOULDER IF PRESENT.
2. THE ENDS OF THE PINS MAY BE TAPERED OR ROUNDED.
3. DIMENSIONS FIXING PIN POSITIONS REFER TO THE FIXED ENDS OF THE PINS.
4. THE BOSS (DIMENSION b) IS OPTIONAL.
5. REFERENCE SHOULD BE MADE TO B.S. 448 FOR FULL INFORMATION.

DRAWING No. 13

EDISON-TYPE SCREW LAMP CAPS

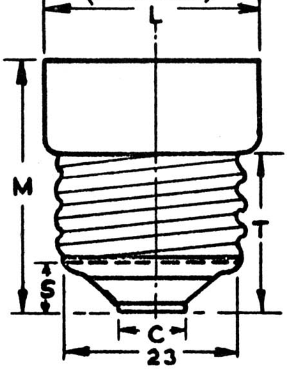
ILLUSTRATIVE

13·1
E.40/45
(GOLIATH)

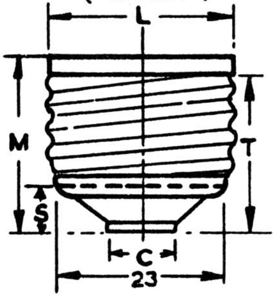


DOTTED LINES INDICATE ALTERNATIVE SHAPE OF CAP

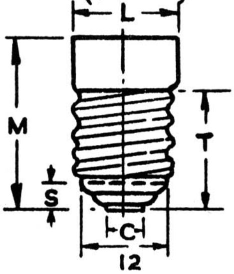
13·2
E.27/35X30
(MEDIUM)



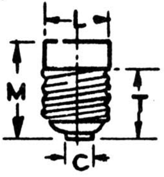
13·3
E.27/28
(MEDIUM)



13·4
E.14/23X15
(SMALL)



13·5
E 10/13
(MINIATURE)



DRAWING	L	M	C	T	G	S
	NOM	NOM	NOM	MIN.	NOM.	NOM.
13·1	39	45	16	34·0	8·5	—
13·2	30	35	10·5	22·0	—	7·5
13·3	26	25·5	10·5	22·0	—	7·5
13·4	15	23·5	6	16·0	—	4
13·5	9·3	13·5	3·75	9·5	—	—

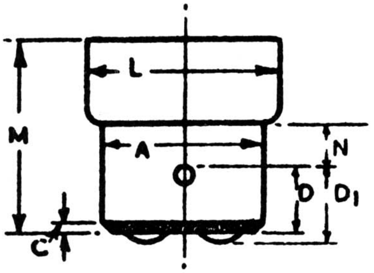
NOTES:-

1. REFERENCE SHOULD BE MADE TO B.S. 98 1934 FOR FULL INFORMATION.
2. DIMENSIONS IN MM.

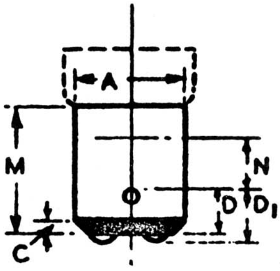
DRAWING Nº 14

BAYONET LAMP CAPS
ILLUSTRATIVE

14·1
B22
(NORMAL)



14·2
B15d
(SMALL-DOUBLE CONTACT)



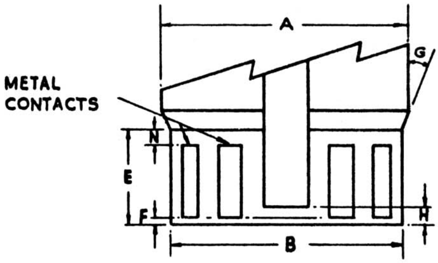
NOMINAL DIMENSIONS IN MM.	DRG. Nº	A	C	D	D_1	L	M	N
	14·1	21·95	1·5	6·5	8·0	26·2	25·5	8·0
	14·2	15·14	1·5	6·25	7·51	—	17·5	7·0

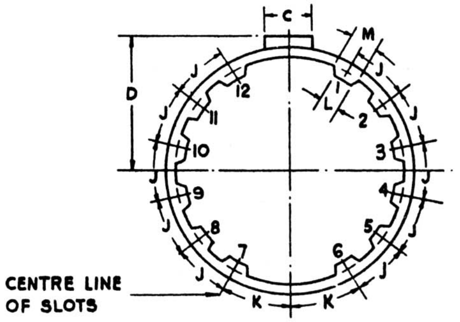
NOTE:- REFERENCE SHOULD BE MADE TO B.S. 52-1941 FOR FULL INFORMATION.

DEC 1947

DRAWING No. 15

B12D BASE
ILLUSTRATIVE.





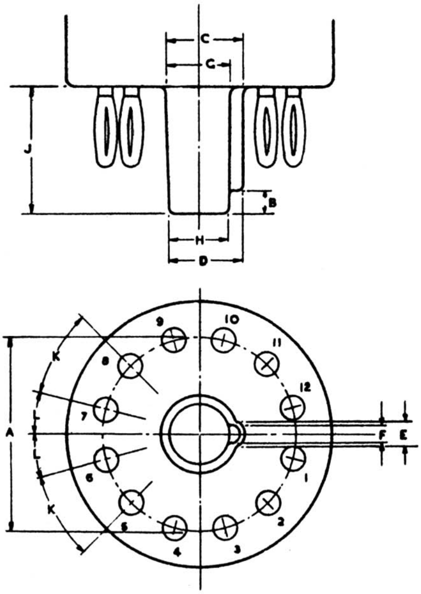
DIMENSIONS			
	INCHES		
	MIN.	MAX.	NOM.
A	2·751	2·822	—
B	2·579	2·630	—
C	0·495	0·535	—
D	1·501	1·560	—
E	1·031	1·093	—
F	0·043	0·250	—
G	—	—	30°
H	0·125	0·187	—
J	—	—	24°
K	—	—	30°
L	0·325	—	—
M	0·22	0·26	—
N	—	0·125	—

NOTE 1. THE FACES OF THE METAL CONTACTS SHALL NOT LIE MORE THAN 0·02 IN. BELOW THE ADJACENT SURFACES OF THE MOULDING.

NOTE 2. REFERENCE SHOULD BE MADE TO B.S. 448 FOR FULL INFORMATION.

DRAWING No. 16

B12B. BASE ILLUSTRATIVE.



THIRD ANGLE PROJECTION

NOMINAL DIMENSIONS IN MILLIMETRES EXCEPT WHERE OTHERWISE STATED.			
A	35·00	G	12·00
B	3·00	H	11·85
C	14·00	J	22·00
D	13·73	K	30°
E	2·00	L	15°
F	1·78		

NOTES.

NOTE 1. FOR THE 10 PIN VARIANT, PINS 6 AND 12 ARE OMMITTED.

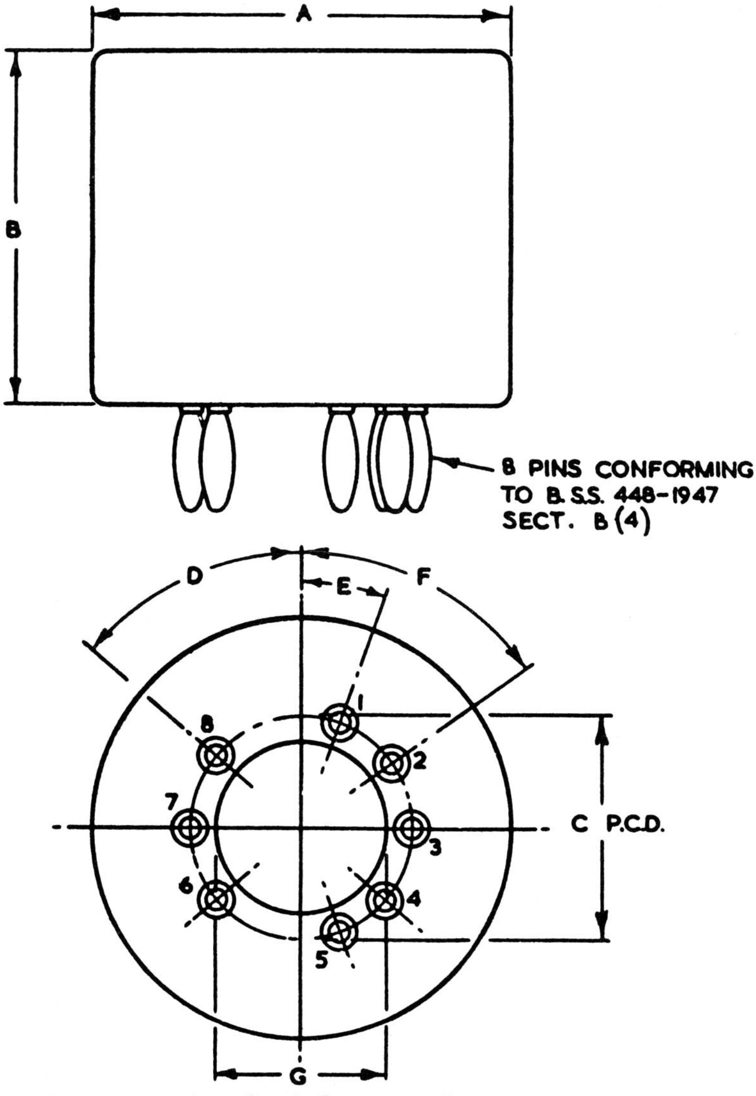
NOTE 2. THE DIMENSIONS FIXING THE POSITIONS OF PINS REFER TO THE FIXED ENDS OF PINS. THE PIN DISPOSITION SHALL BE CHECKED BY MEANS OF A GAUGE AS SHOWN IN FIG. B12B/1.2. B.S.448

NOTE 3. DIMENSIONS AND GAUGES FOR PINS ARE SPECIFIED IN SECTION 5, B.S. 448.

NOTE 4. REFERENCE TO BE MADE TO BS. 448 FOR FULL INFORMATION.

DRAWING No. 17

B8E BASE (FORMERLY EM8)
MANDATORY



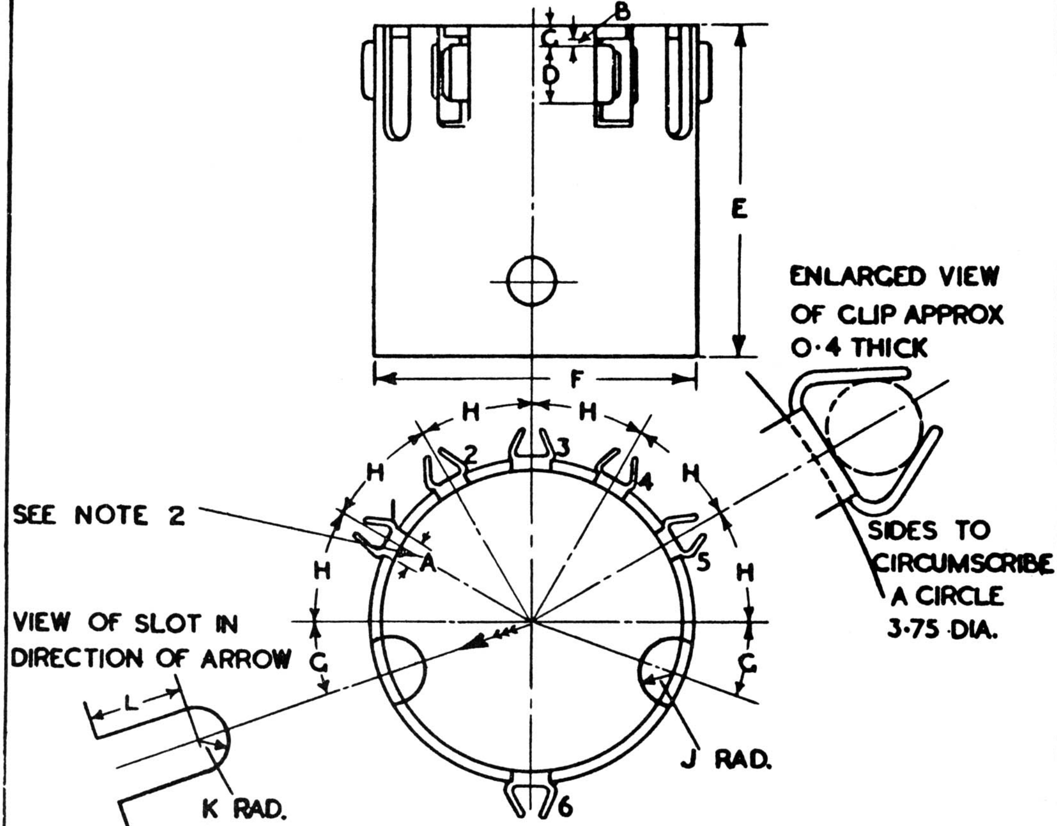
VIEW OF BASE FROM UNDERSIDE SHOWING THE PIN NUMBERINGS.

DIMENSIONS		A	B	C	D	E	F	G
LIMITS IN INCHES	MIN.	2·360	1·85	1·3105	50°	20°	55°	1·0
	MAX.	2·390	2·15	1·3145				

DRAWING No.18

6 CLIP BASE (CL6)

MANDATORY



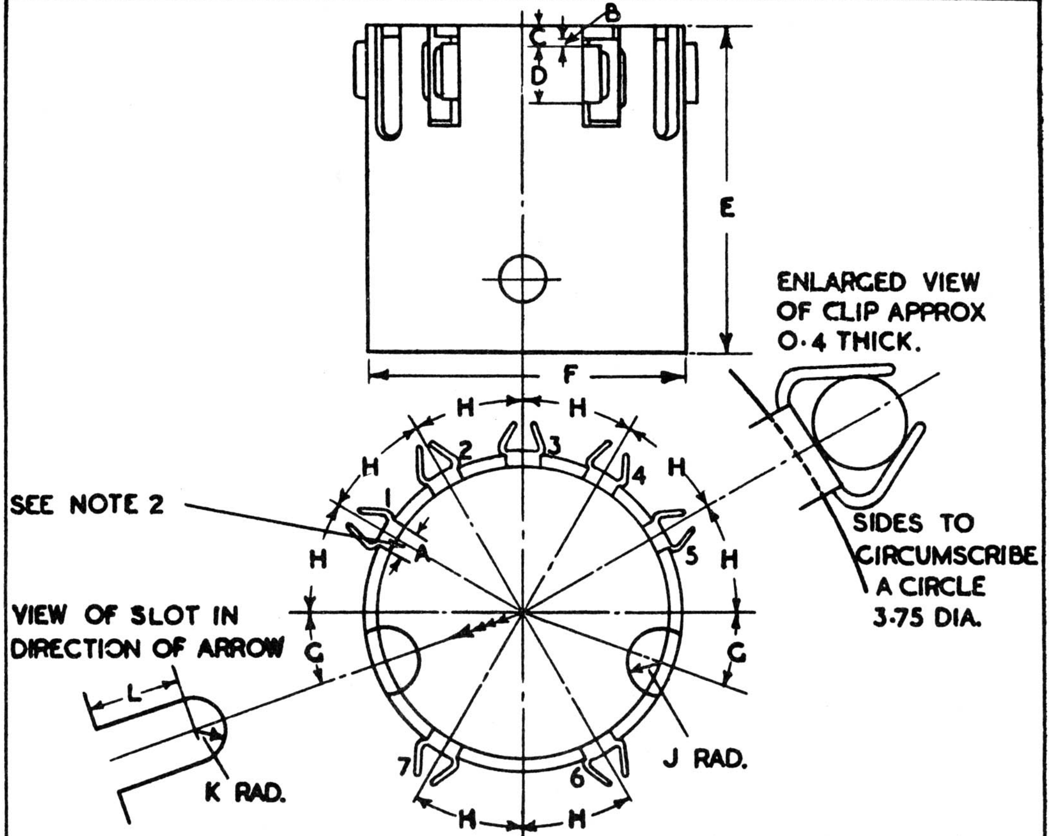
SLEEVE AND END PLATE PAXOLIN "Q" QUALITY 1·6 THICK.

DIMENSIONS IN MM EXCEPT WHERE OTHERWISE STATED	A	B	C	D	E	F	G	H	J	K	L
	5·5 ±0·13	1·5 MAX	4·0 MAX	11·0 ±0·2	57·0 ±0·5	55·5 ±0·3	20° ±0·75	30° ±0·75	4·75 ±0·25	4·75 ±0·25	16·35 ±0·6

NOTES

1. THIS BASE IS DESIGNED FOR USE WITH PINS OF 4·2 MM. DIA. ON A P.C.D. OF 60·6 ± 0·25 MM.
2. DIMENSION "A" REFERS TO THE SLOT IN THE PAXOLIN INTO WHICH THE CLIP IS FITTED.
3. DRAWING SHOWS THE NUMBERING OF THE CONTACTS WITH THE BASE VIEWED FROM THE UNDERSIDE.

DRAWING No.19
7 CLIP BASE (CL7)
MANDATORY



SLEEVE AND END PLATE PAXOLIN "Q" QUALITY 1·6 THICK

DIMENSIONS IN MM EXCEPT WHERE OTHERWISE STATED.	A	B	C	D	E	F	G	H	J	K	L
	5·5 ±0·13	1·5 MAX.	4·0 MAX.	11·0 ±0·2	57·0 ±0·5	55·5 ±0·3	20° ±0·75	30° ±0·75	4·75 ±0·25	4·75 ±0·25	16·35 ±0·6

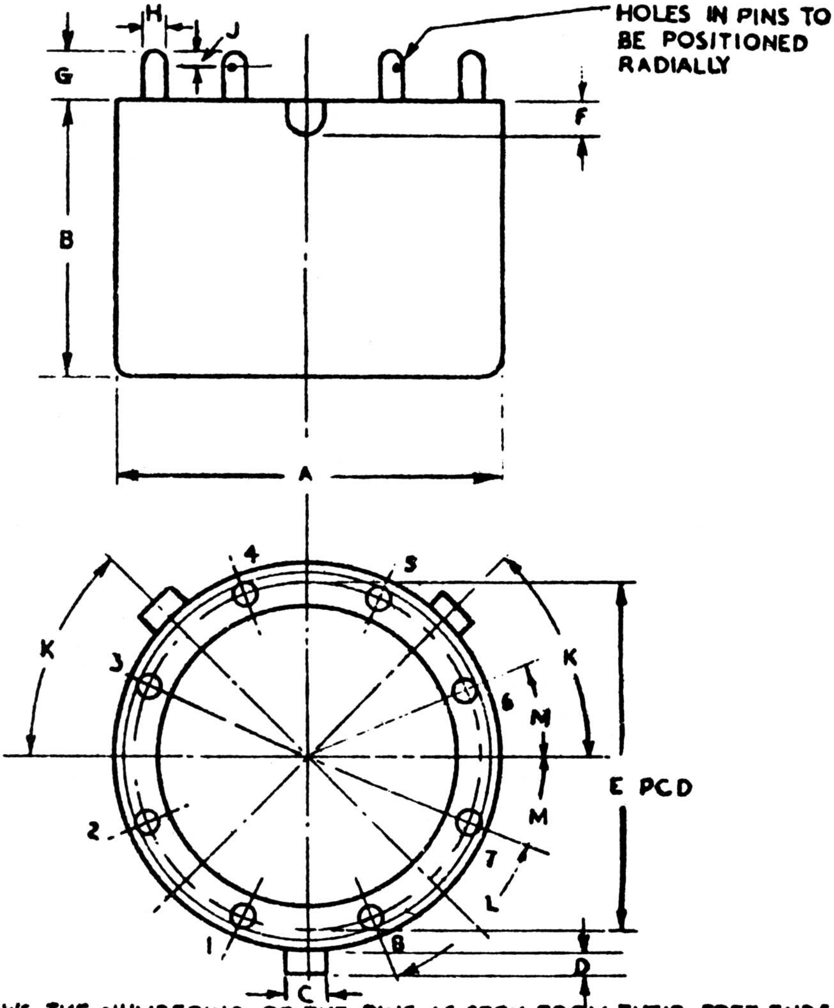
NOTES

1. THIS BASE IS DESIGNED FOR USE WITH PINS OF 4·2 MM DIA ON A P.C.D. OF 60·6±0·25MM.
2. DIMENSION "A" REFERS TO THE SLOT IN THE PAXOLIN INTO WHICH THE CLIP IS FITTED.
3. DRAWING SHOWS THE NUMBERING OF THE CONTACTS WITH THE BASE VIEWED FROM THE UNDERSIDE.

DRAWING Nº 20

8 PIN BAYONET BASE (PB8)

MANDATORY



HOLES IN PINS TO BE POSITIONED RADIALLY

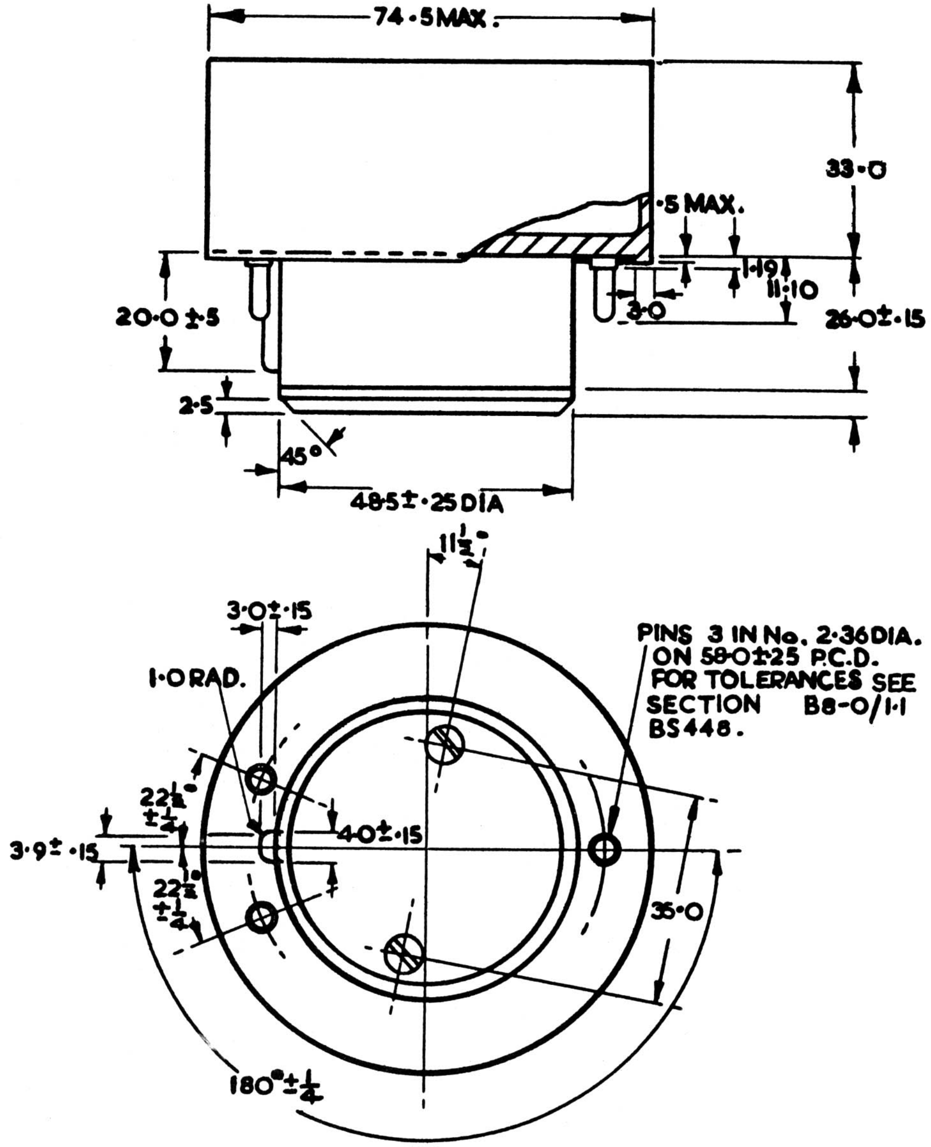
DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.

DIMENSIONS		A	B	C	D	E	F	G	H	J	K	L	M
LIMITS IN MM.	MIN.	50·3	37·9	3·87	2·28	44·44	4·66	6·25	3·07	3·07	45°	45°	22½°
	MAX	50·5	38·1	4·07	2·48		4·86	6·45	3·27	3·27			

DEC 1947

DRAWING No 21

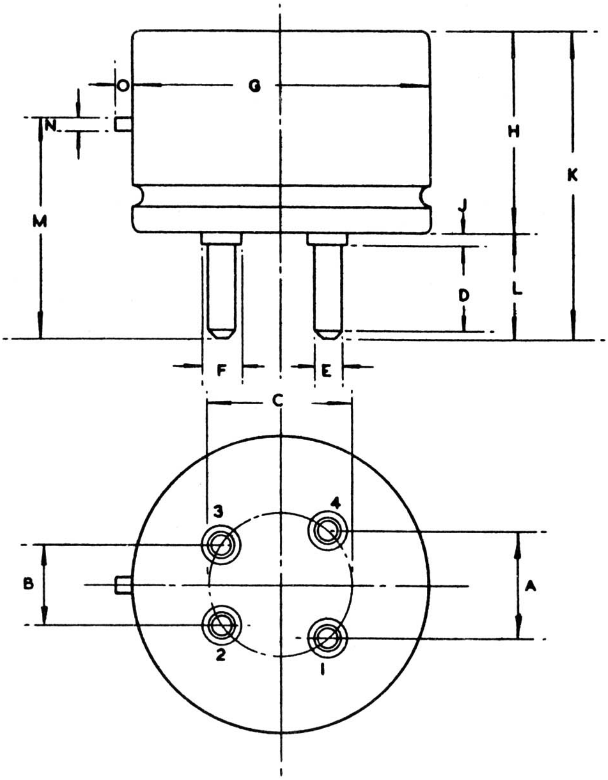
B15A3 BASE (FORMERLY 3-PIN QUINDECAL)
MANDATORY.



ALL DIMENSIONS IN MILLIMETERS.

DRAWING No. 22
B4D BASE
MANDATORY.

THIRD ANGLE PROJECTION



THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS

DIMENSIONS								
REF	INCHES			DEGREES	MILLIMETRES			NOTES
	MIN	NOM	MAX	NOM	MIN	NOM	MAX	
A	—	·750	—	—	—	19·05	—	2
B	—	·562	—	—	—	14·274	—	2
C	—	1·000	—	—	—	25·40	—	2
D	0·575	—	—	—	14·61	—	—	
E	0·184	0·187	0·190	—	4·68	4·75	4·82	
F	—	—	0·260	—	—	—	6·60	
G	2·177	2·198	2·219	—	55·30	55·83	56·35	
H	—	1·438	—	—	—	36·53	—	
J	—	—	0·073	—	—	—	1·85	
K	—	2·125	—	—	—	53·98	—	1
L	—	—	0·718	—	—	—	18·23	1
M	1·526	1·546	1·566	—	38·8	39·25	39·75	1
N	—	—	0·082	—	—	—	2·08	
O	0·079	0·094	0·109	—	2·05	2·4	2·75	

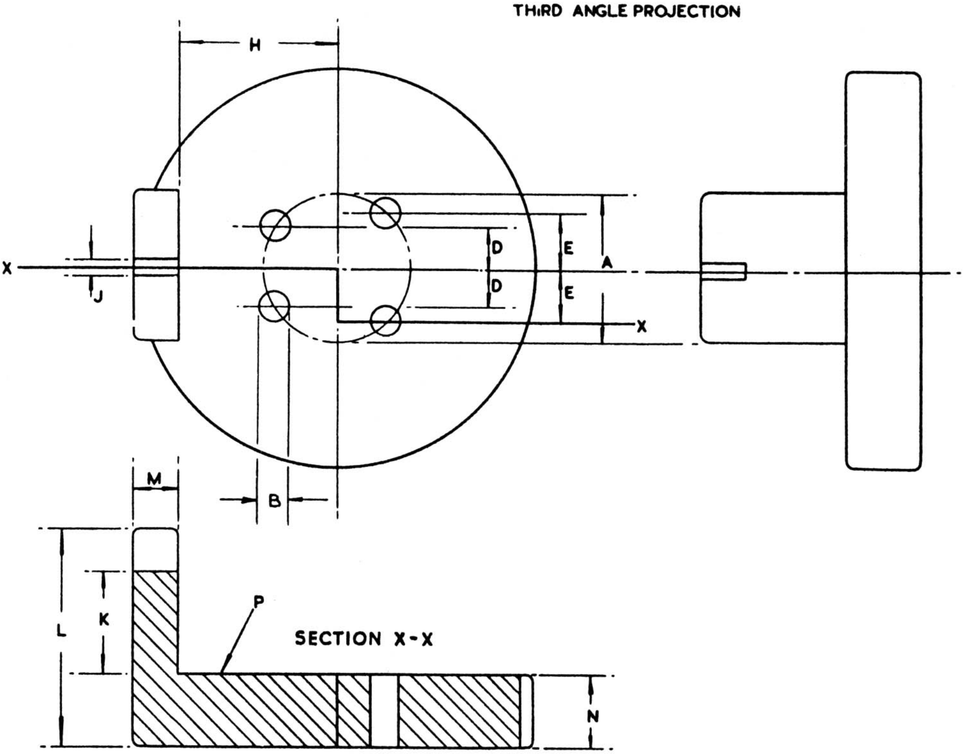
NOTES

1. THE DIMENSIONS K, L, AND M MAY BE INCREASED BY 0·060 IN. (1·52 m.m.) MAX FOR SOLDER.
2. THE DIMENSION FIXING THE POSITIONS OF PINS REFER TO THE FIXED ENDS OF THE PINS, AND ARE GIVEN FOR INFORMATION ONLY. THE PIN DISPOSITION SHOULD BE CHECKED BY MEANS OF THE GAUGE SHOWN ON DRG No. 22 A
3. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.
4. THIS BASE IS THE AMERICAN SUPER JUMBO, JETEC TYPE A4-18.

DRAWING No.22 A

B 4 D BASE PIN & BAYONET POSITION GAUGE

MANDATORY.



THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS

DIMENSIONS								
REF	INCHES			DEGREES	MILLIMETRES			NOTES
	MIN	NOM	MAX	NOM	MIN	NOM	MAX	
A	—	1·000	—	—	—	25·40	—	
B	0·206	0·2065	0·207	—	5·234	5·244	5·256	1
D	—	0·281	—	—	—	7·137	—	
E	—	0·375	—	—	—	9·525	—	
H	1·110	1·110	1·115	—	28·195	28·195	28·320	
J	0·087	0·0875	0·088	—	2·210	2·222	2·234	1
K	—	0·687	—	—	—	17·45	—	
L	—	1·5	—	—	—	38·1	—	
M	—	0·312	—	—	—	7·92	—	
N	—	0·5	—	—	—	12·7	—	

NOTES

1. HOLES B AND SLOT J HAVE POSITIONAL TOLERANCE ZONES 0·001 IN. (0·025 mm) DIAMETER AND 0·001 IN. (0·025 m.m.) WIDE RESPECTIVELY. DATUM-FACE P.

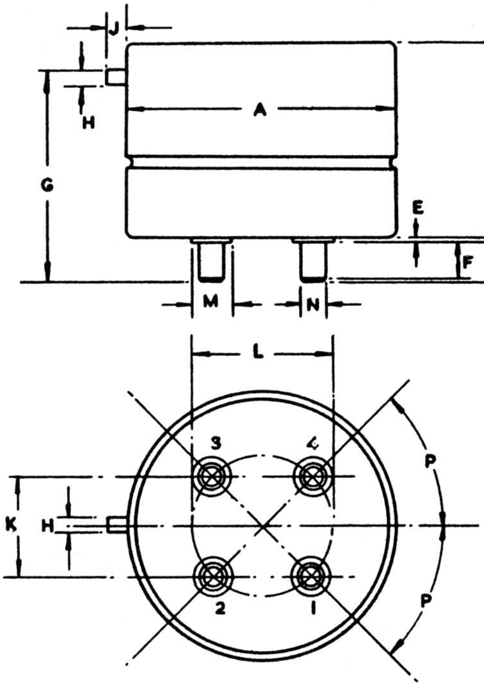
2. THE VALVE SHALL SEAT INTO THE GAUGE UNDER ITS OWN WEIGHT

DRAWING NO. 23

B4F BASE

ILLUSTRATIVE

THIRD ANGLE PROJECTION.



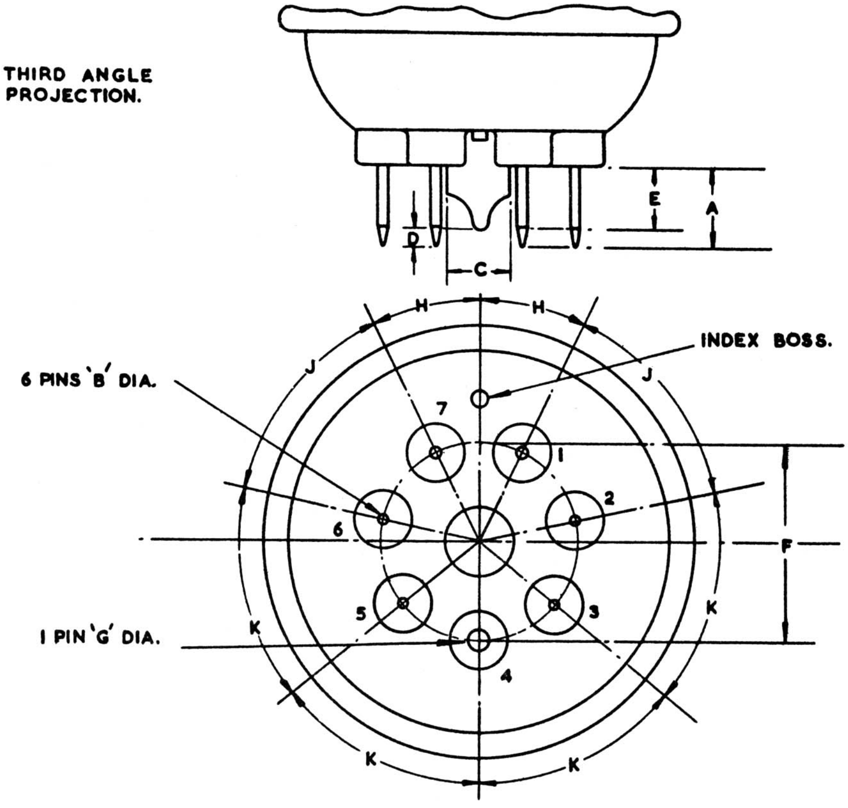
NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED			
A	1·854	H	0·082 MAX.
B	1·670	J	0·094
C	1·395	K	0·688
D	0·320 MAX.	L	0·971
E	0·030 MAX.	M	0·260 MAX.
F	0·250 MIN.	N	0·187
G	1·165	P	45°

NOTES.

1. DIMENSIONS B, D AND G MAY BE INCREASED 0·060 IN. MAX. FOR SOLDER ON THE ENDS OF THE PINS.
2. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS VIEWED FROM THEIR FREE ENDS.
3. REFERENCE SHOULD BE MADE TO BS 448 FOR FULL INFORMATION.

DRAWING NO. 24

B7A BASE
ILLUSTRATIVE



DIMENSIONS	
A	0·438 IN. NOM.
B	0·058 IN. NOM.
C	0·375 IN. MAX.
D	ZERO MIN.
E	0·312 IN. MIN.
F	1·000 IN. NOM.
G	0·125 IN. NOM.
H	26° NOM.
J	52° NOM.
K	51° NOM.

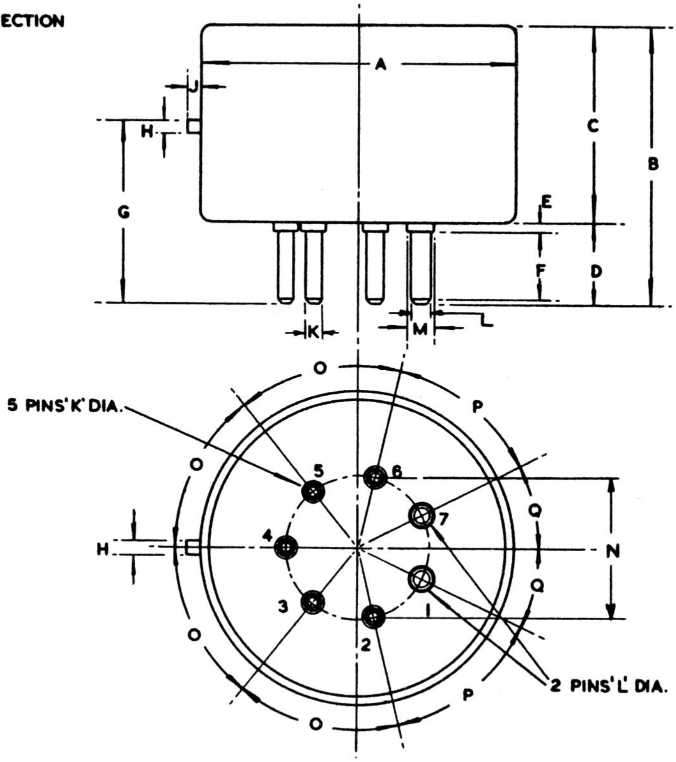
NOTES.

1. THE DIMENSIONS FIXING THE POSITION OF THE PINS REFER TO THE FIXED END OF THE PIN.
2. THE TIPS OF THE PINS SHALL BE TAPERED OR ROUNDED.
3. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.
4. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING No. 25

B7D VALVE BASE
ILLUSTRATIVE.

THIRD ANGLE PROJECTION



NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED			
A	2·167	J	0·094
B	1·875	K	0·125
C	1·338	L	0·156
D	0·562 MAX.	M	0·195 MAX.
E	0·065 MAX.	N	1·000
F	0·450 MIN.	O	51° NOM.
G	1·230	P	52° NOM.
H	0·082 MAX.	Q	26° NOM.

NOTES

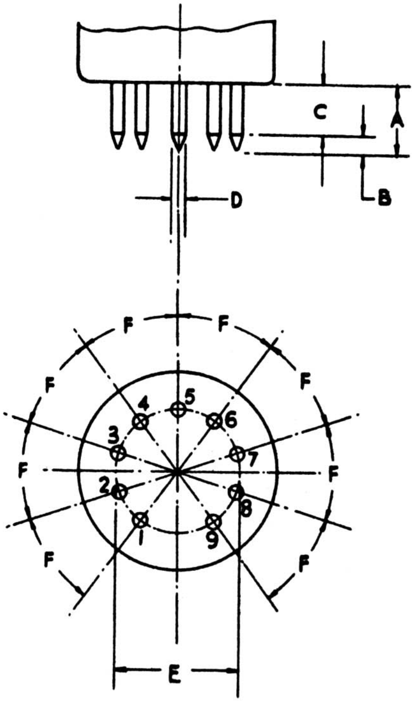
1. DIMENSIONS B, D AND G MAY BE INCREASED BY 0·030 IN. MAX. FOR SOLDER ON THE ENDS OF THE PINS
2. THE DIMENSIONS FOR THE POSITION OF PINS REFER TO THEIR FIXED ENDS.
3. THE ENDS OF PINS MAY BE ROUNDED OR TAPERED.
4. THE DRAWING SHOWS THE NUMBERING OF THE PINS VIEWED FROM THEIR FREE ENDS.
5. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING No. 26

B9A BASE

ILLUSTRATIVE.

THIRD ANGLE PROJECTION



DIMENSIONS	
A	0·28 IN. MAX.
B	0·015 IN. MIN.
C	0·187 IN. MIN.
D	0·040 IN. NOM.
E	0·468 IN. NOM.
F	36° NOM.

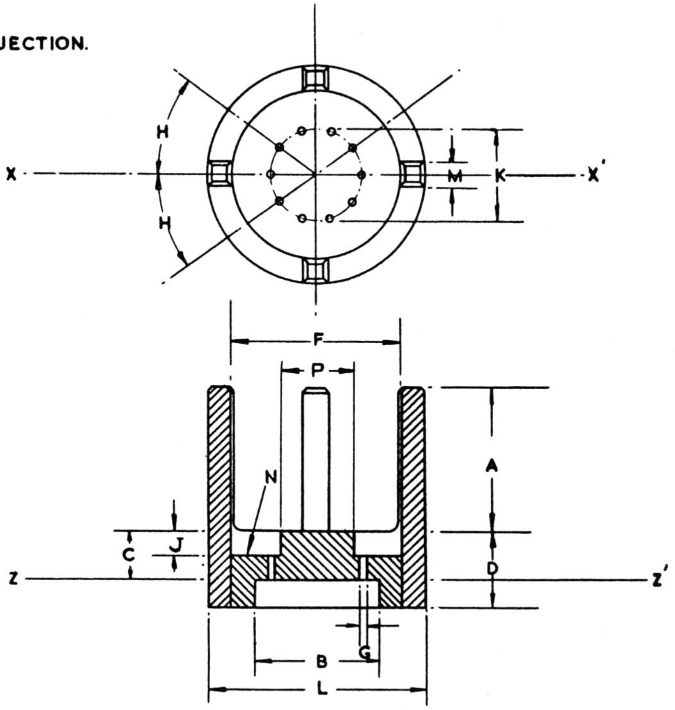
NOTES

1. THE DIMENSIONS FIXING THE POSITIONS OF THE PINS REFER TO THE FIXED ENDS.
2. THE TIPS OF THE PINS SHALL BE TAPERED OR ROUNDED
3. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS VIEWED FROM THEIR FREE ENDS.
4. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING NO. 26B

B9A PIN POSITION GAUGE
MANDATORY.

THIRD ANGLE PROJECTION.



SECTION ON XX'

THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS.

REF.	DIMENSIONS							NOTES
	INCHES			DEGREES	MILLIMETRES			
	MIN.	NOM.	MAX.	NOM.	MIN.	NOM.	MAX.	
A	0·750	—	—	—	19·05	—	—	
B	0·65	—	—	—	16·51	—	—	
C	—	0·25	—	—	—	6·35	—	
D	—	0·4	—	—	—	10·2	—	
F	0·875	0·875	0·880	—	22·225	22·225	22·350	2 & 3
G	0·048	0·048	0·0485	—	1·219	1·219	1·232	2
H	—	—	—	36	—	—	—	
J	0·124	0·124	0·125	—	3·15	3·15	3·17	
K	—	0·468	—	—	—	11·887	—	
L	—	1·125	—	—	—	25·58	—	
M	—	0·125	—	—	—	3·18	—	3
P	0·373	0·375	0·375	—	9·474	9·525	9·525	

NOTES.

1. BEFORE GAUGING, THE PINS ON THE B9A BASE MAY REQUIRE STRAIGHTENING IN THE TOOL SHOWN ON DRAWING NO. 26A.
2. THE HOLES G HAVE POSITIONAL TOLERANCE ZONES 0·0008 IN. (0·02 mm.) DIAMETER. DATUM-FACE N. CYLINDER F SHOULD HAVE A CONCENTRICITY TOLERANCE OF 0·005 IN (0·125 mm). DIAMETER. DATUM-GROUP OF HOLES G.
3. THE PILLARS SHOWN ON THE GAUGE ARE PROVIDED TO CHECK THAT THE VERTICAL SIDES OF THE BULBS ARE SENSIBLY AT RIGHT ANGLES TO THE SOLE OF BASE.
4. THE VALVE SHALL SEAT INTO THE GAUGE UNDER ITS OWN WEIGHT.
5. DIMENSIONS, MOUNTING METHOD, MOUNTING FLANGE, ETC., BELOW PLANE Z–Z' ARE OPTIONAL, PROVIDED ADEQUATE SPACE IS LEFT FOR THE PROTRUSION OF THE PINS.

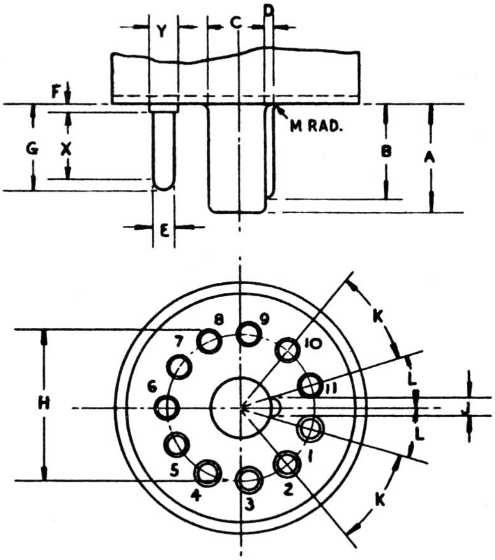
MARCH 1954

DRAWING No27

B11A BASE

ILLUSTRATIVE.

THIRD ANGLE PROJECTION



NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED			
A	0·560 MAX.	H	0·750
B	0·480 MIN.	J	0·085
C	0·308	K	32 8/11°
D	0·048	L	16 4/11°
E	0·093	M	0·050 MAX.
F	0·035 MAX.	X	0·340 MIN.
G	0·437 MAX.	Y	0·135 MAX.

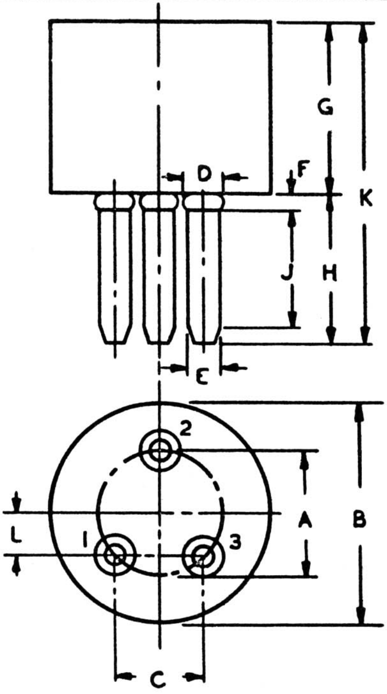
NOTES.

1. DIMENSION 'G' MAY BE INCREASED BY 0·031IN. MAXIMUM FOR SOLDER.
2. THE DIMENSIONS FIXING THE POSITIONS OF PINS REFER TO THE FIXED END OF THE PIN.
3. ANY PROJECTIONS ON THE UNDER SURFACE OF THE BASE OTHER THAN THOSE SHOWN, SUCH AS A RIM, SHALL HAVE A HEIGHT NOT EXCEEDING 0·020IN.
4. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.
5. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING Nº 28

B3A BASE.

ILLUSTRATIVE.



THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS.

REF.	INCHES			MILLIMETRES			NOTES
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	—	0·344	—	—	8·74	—	—
B	0·610	—	0·656	15·50	—	16·65	—
C	—	0·243	—	—	6·17	—	—
D	—	—	0·135	—	—	3·42	—
E	0·090	0·093	0·096	2·286	2·362	2·438	—
F	—	—	0·045	—	—	1·14	—
G	—	0·500	—	—	12·7	—	—
H	—	—	0·447	—	—	11·35	1
J	0·340	—	—	8·64	—	—	—
K	—	0·937	—	—	23·8	—	—
L	—	0·122	—	—	3·1	—	—

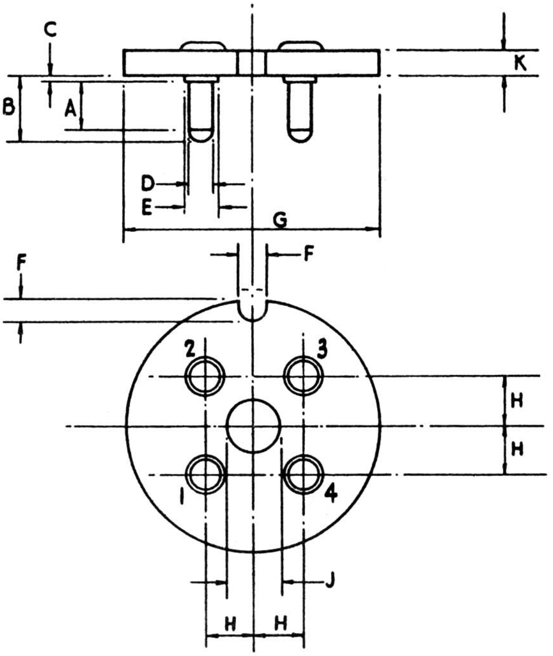
NOTES.

1. ON THE FINISHED TUBE ADD 0·030 IN. (0·76 mm.) FOR SOLDER.
2. THE DISPOSITION OF THE PINS SHALL BE CHECKED BY MEANS OF THE GAUGE SHOWN IN Fig. B3A/1.2, B.S. 448.
3. THE DIMENSIONS ON THE DRAWING FIXING THE POSITIONS OF THE PINS REFER TO THE FIXED ENDS OF THE PINS.
4. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING No 29

B4A BASE

MANDATORY

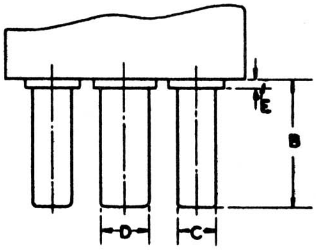


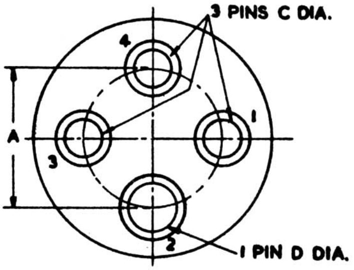
THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS

REF	DIMENSIONS.							NOTES
	INCHES			DEGREES	MILLIMETRES			
	MIN.	NOM.	MAX	NOM	MIN	NOM	MAX	
A	0·328				8·33			
B	0·413	0·423	0·433		10·50	10·74	10·98	
C			0·040				1·01	
D	0·183	0·187	0·191		4·65	4·75	4·85	
E	0·240	0·250	0·260		6·10	6·35	6·60	
F	0·171	0·187	0·203		4·36	4·75	5·14	
G	1·788	1·813	1·813		45·42	46·04	46·04	
H	0·324	0·344	0·364		8·25	8·74	9·20	
J			0·383				9·75	
K		0·187				4·75		

DRAWING NO. 30

B4B BASE.
ILLUSTRATIVE.





DIMENSIONS IN INCHES	
A	0·362 NOM
B	0·333 NOM
C	0·090 NOM
D	0·122 NOM
E	0·040 MAX.

NOTES

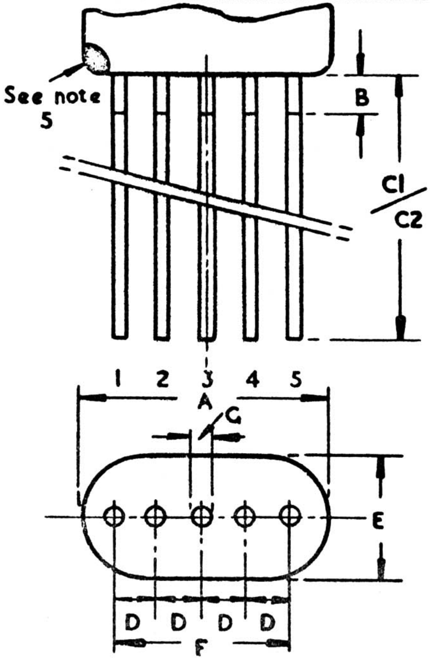
1. DIMENSION B MAY BE INCREASED BY 0·03 IN MAX. FOR SOLDER

2. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING No. 31

B5A and B5A/F BASES

ILLUSTRATIVE.



THE INCH DIMENSIONS ARE DERIVED FROM THE ORIGINAL MILLIMETRE DIMENSIONS EXCEPT WHERE STATED.

REF.	DIMENSIONS							NOTES
	INCHES			DEG^{S}.	MILLIMETRES.			
	MIN	NOM	MAX	NOM	MIN	NOM	MAX	
A	—	—	0·400	—	—	—	10·16	3
B	—	—	0·078	—	—	—	2·0	1
C1	1·5	—	—	—	31·75	—	—	2, 3
C2	0·169	0·200	0·231	—	4·30	5·08	5·85	2, 3
D	0·032	—	0·061	—	0·80	—	1·55	—
E	—	—	0·291	—	—	—	7·4	—
F	0·126	0·2	0·216	—	3·2	5·08	5·5	4
G	0·0134	—	0·019	—	0·34	—	0·48	—

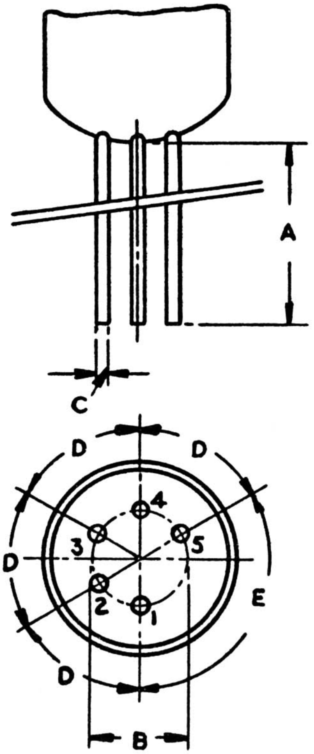
NOTES.

1. WIRES SHALL BE TINNED EXCEPT FOR DIMENSION B.
2. THERE ARE TWO VERSIONS OF THIS BASE B5A/F HAS LONG WIRES, B5A HAS SHORT WIRES.
3. THESE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE INCH ORIGINALS.
4. THE MILLIMETRE NOMINAL OF THIS DIMENSION IS DERIVED FROM THE ORIGINAL INCH NOMINAL DIMENSION.
5. THERE IS A RED SPOT ADJACENT TO PIN 1.
6. REFERENCE SHOULD BE MADE TO BS 448 FOR FULL INFORMATION.

DRAWING No. 32

B5B and B5B/F BASES

ILLUSTRATIVE.



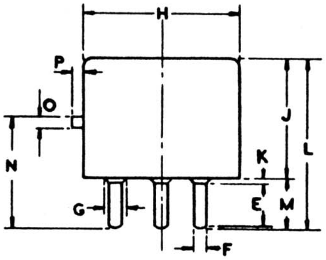
THE INCH DIMENSIONS ARE DERIVED FROM THE ORIGINAL MILLIMETRE DIMENSIONS.

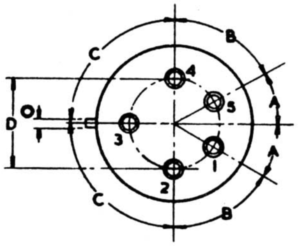
REF.	DIMENSIONS							NOTES
	INCHES			DEG^{S}	MILLIMETRES			
	MIN	NOM	MAX	NOM	MIN	NOM	MAX	
A	1·5	—	—	—	32	—	—	—
B	—	0·091	—	—	—	2·3	—	—
C	—	0·0158	—	—	—	0·4	—	—
D	—	—	—	60	—	—	—	—
E	—	—	—	120	—	—	—	—

NOTE

1. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING No. 33
B5D BASE.
ILLUSTRATIVE.



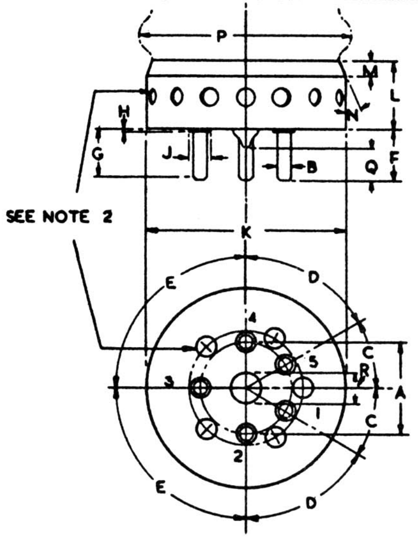


NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED			
A	30°	J	1·750
B	60°	K	0·073 MAX.
C	90°	L	2·487
D	1·250	M	0·740 MAX.
E	0·575 MIN.	N	1·576
F	0·187	O	0·082 MAX.
G	0·260 MAX.	P	0·120
H	2·165		

NOTES

1. DIMENSIONS L, M AND N MAY BE INCREASED BY 0·03 INCH MAX. FOR SOLDER.
2. THE DIMENSIONS FIXING THE POSITIONS OF THE PINS REFER TO THE FIXED END OF THE PINS.
3. REFERENCE SHOULD BE MADE TO BS448 FOR FULL INFORMATION.

DRAWING No 34
B5E BASE.
ILLUSTRATIVE



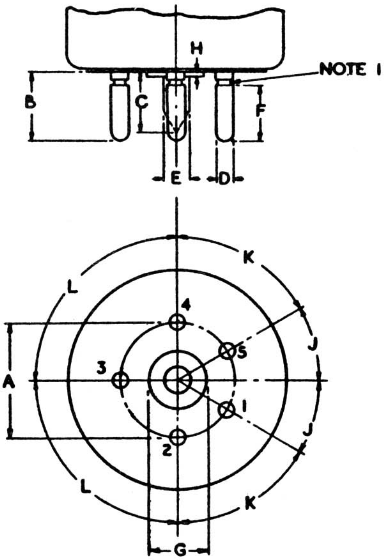
NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED			
A	1·250	J	0·260 MAX.
B	0·187	K	2·711
C	30°	L	0·945
D	60°	M	0·197
E	90°	N	13°
F	0·740 MAX.	P	2·875 MAX.
G	0·575 MIN.	Q	0·500 MIN.
H	0·073 MAX.	R	0·500

NOTES

1. DIMENSION F MAY BE INCREASED BY 0·03 IN. MAX. FOR SOLDER
2. FIVE HOLES 0·315 IN. DIA. PLACED AS SHOWN ON THE BASE AND FIFTEEN HOLES 0·236 IN. DIA. EQUALLY SPACED ROUND THE SHELL TO ALLOW FORCED AIR COOLING.
3. P IS THE MAXIMUM PERMISSIBLE DIAMETER OF THE VALVE.
4. THE ENDS OF THE PINS MAY BE TAPERED OR ROUNDED.
5. FOR FURTHER INFORMATION SEE BS:448.

DRAWING Nº 35

B5F BASE.
ILLUSTRATIVE.



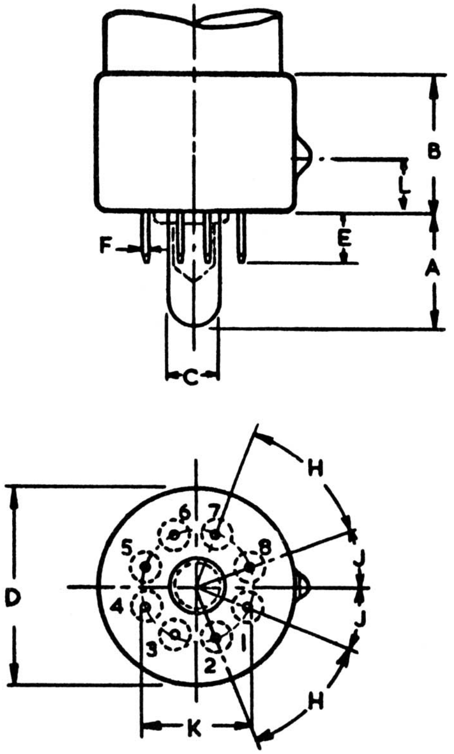
NOMINAL DIMENSIONS IN MILLIMETRES EXCEPT WHERE OTHERWISE STATED			
A	31·75	G	16·0
B	17·0	H	0·2 MAX.
C	15·0 MAX.	J	30°
D	4·75	K	60°
E	7·375	L	90°
F	15·0		

NOTES

1. THE WAIST SHOWN ON THE PINS IS OPTIONAL AND SHOULD NOT BE USED FOR ANY LOCKING DEVICE.
2. THE DIMENSIONS FIXING THE POSITION OF THE PINS REFER TO THEIR FIXED ENDS.
3. THE ENDS OF THE PINS MAY BE ROUNDED OR TAPERED.
4. C IS THE OVERALL LENGTH OF THE EXHAUST TUBULATION
5. FOR FULL INFORMATION SEE BS: 448.

DRAWING No. 36.

B8A BASE
ILLUSTRATIVE



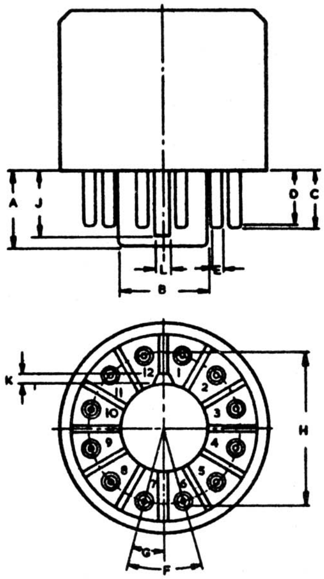
NOMINAL DIMENSIONS IN MM EXCEPT WHERE OTHERWISE STATED			
A	13·4	F	0·040 INCH
B	15·0	H	45°
C	5 · 25	J	22½°
D	22·0	K	11·5
E	6 · 0	L	5·75

NOTES

1. THE SPIGOT IS OPTIONAL, BUT WHEN ONE IS NOT FITTED THERE MAY BE A GLASS BOSS AND EXHAUST PIPE AS SHOWN BY BROKEN LINES IN THE DRAWING.
2. THE ENDS OF THE PINS SHALL BE TAPERED OR ROUNDED.
3. REFERENCE SHOULD BE MADE TO B.S.448 FOR FULL INFORMATION.

DRAWING NO. 39

B12A BASE.
ILLUSTRATIVE.



NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED.			
A	0·530 MAX.	G	15°
B	0·616	H	1·063
C	0·410 MAX.	J	0·430 MIN
D	0·320 MIN.	K	0·070
E	0·093	L	0·155
F	30°		

NOTES

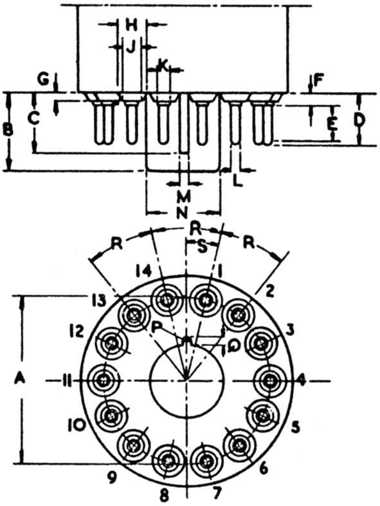
NOTE 1. DIMENSION C MAY BE INCREASED BY 0·03 IN. MAXIMUM FOR SOLDER.

NOTE 2. THE DIMENSIONS FIXING THE POSITION OF THE PINS REFER TO THE FIXED END OF THE PIN. THE PIN DISPOSITION SHALL BE CHECKED BY MEANS OF THE GAUGE SHOWN IN FIG. B12A/L2. (BS448)

NOTE 3. REFERENCE SHOULD BE MADE TO BS 448 FOR FULL INFORMATION.

DRAWING No 40

B14A BASE.
ILLUSTRATIVE.



NOMINAL DIMENSIONS IN INCHES EXCEPT WHERE OTHERWISE STATED.			
A	1·750	K	0·135 MAX.
B	0·775 MAX.	L	0·093
C	0·610 MIN.	M	0·085
D	0·515 MAX.	N	0·752
E	0·340 MIN.	P	0·046 RAD.
F	0·120 MAX.	Q	0·078
G	0·110 MAX.	R	$25\frac{5}{7}^\circ$
H	0·320	S	$12\frac{6}{7}^\circ$
J	0·253 MAX.		

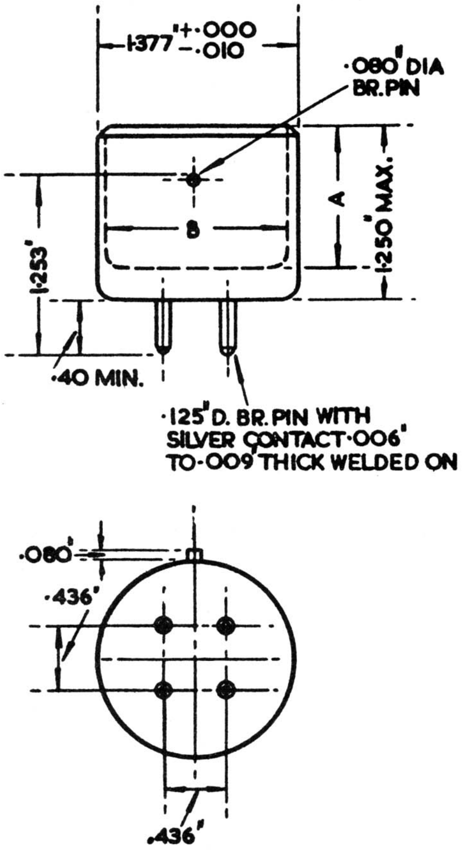
NOTES

1. DIMENSION D MAY BE INCREASED BY 0·03IN. MAXIMUM FOR SOLDER.
2. THE DIMENSIONS FIXING THE POSITION OF THE PINS REFER TO THE FIXED END OF THE PIN AND ARE GIVEN FOR INFORMATION ONLY. THE PIN POSITION MAY BE CHECKED ONLY BY MEANS OF THE GAUGE SHOWN IN FIG B14A/1.2., B.S. 448.
3. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THE FREE ENDS.
4. REFERENCE SHOULD BE MADE TO BS 448 FOR FULL INFORMATION.

DRAWING No. 41.

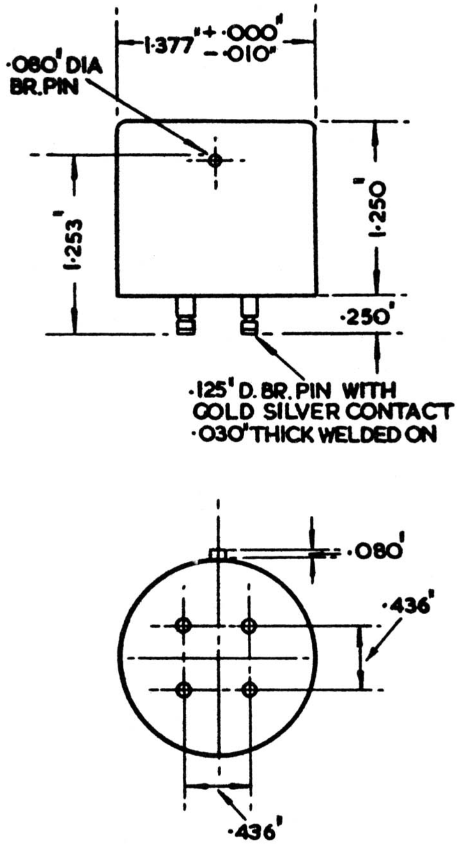
BC4 BASE

MANDATORY



INTERNAL DIMENSIONS A & B TO SUIT MANUFACTURERS REQUIREMENTS.

FIG. 1. MOULDED TYPE



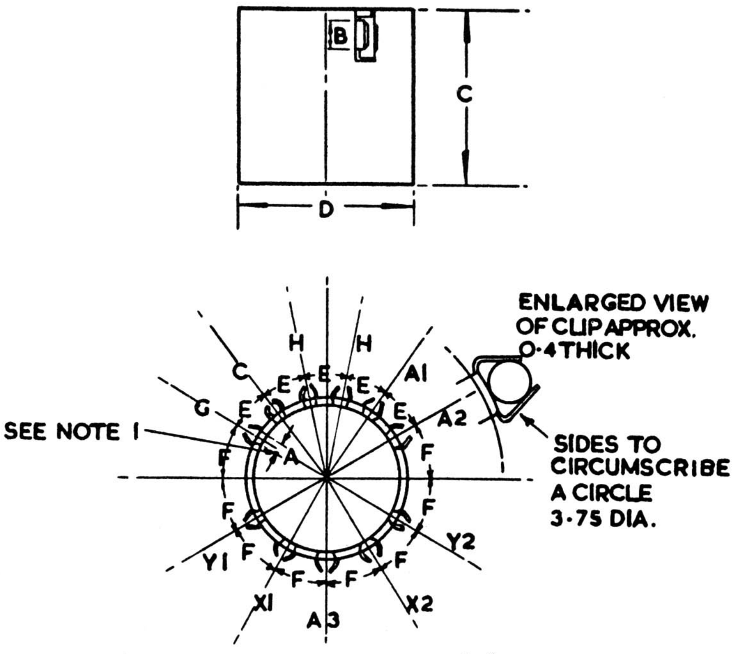
MATERIAL:- NI.P. BRASS CYLINDER WITH MOULDED INTERIOR.

FIG. 2. METAL SHELL TYPE

DRAWING No. 42.

C11 BASE

MANDATORY



SLEEVE & END PLATE PAXOLIN "Q" QUALITY 1·6 THICK

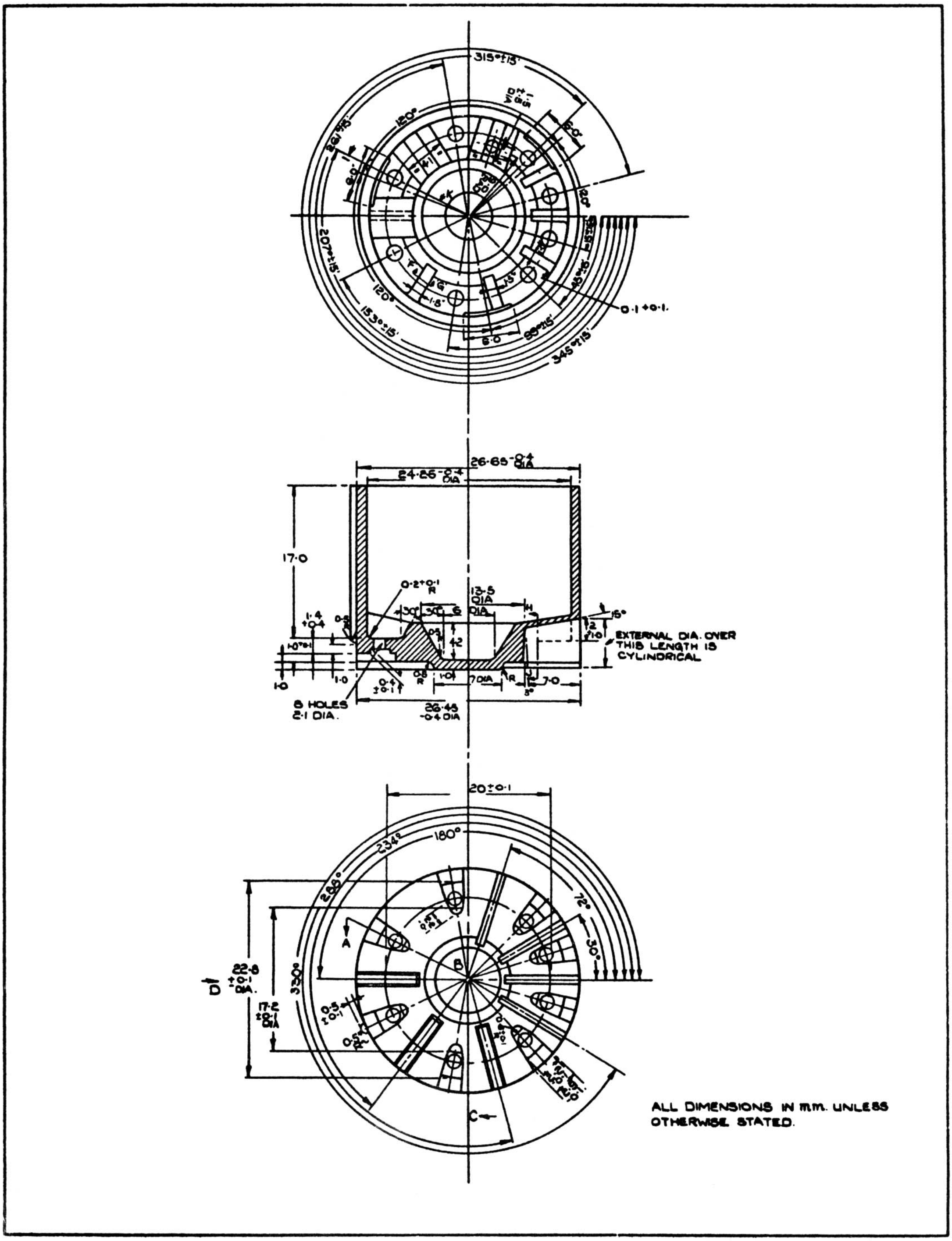
DIMENSIONS IN MMS. EXCEPT WHERE OTHERWISE STATED	A	B	C	D	E	F
	5·5 ± 0·13	11·0 ± 0·2	70·0 ± 0·5	72·6 ± 0·3	24° ± 0·75	30° ± 0·75

NOTE

1. DIMENSION "A" REFERS TO THE SLOT IN THE PAXOLIN INTO WHICH THE CLIP IS FITTED.

DEC. 1955

DRAWING No. 43
SC8 BASE
MANDATORY

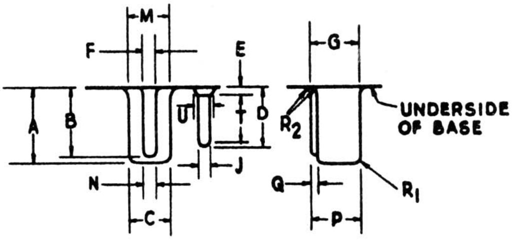


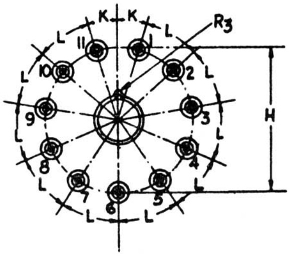
ALL DIMENSIONS IN mm. UNLESS OTHERWISE STATED.

DEC. 1955

DRAWING NO. 45
MAGNAL BASE
MANDATORY

	REFERENCE		
REF.	MIN.	CENTER	MAX.
	IN.	IN.	IN.
A	·550	·560	·570
B	·490	·500	·510
C	·300	·308	·315
D	·427	·437	·447
E	—	—	·050
F	·085	·090	·095
G	·352	·362	·372
H	—	1·063	—
J	·090	·093	·096
K	—	16-4/11°	—
L	—	32-8/11°	—
M	·305	·312	·317
N	·075	·080	·085
P	·343	·353	·363
Q	·040	·047	·055
R_1	—	·031	—
R_2	—	—	·050
R_3	—	·040	—
T	·340	—	—
U	—	—	·135





NOTES 1. DIMENSIONS FIXING THE CONTACT PIN POSITIONS REFER TO THEIR FIXED ENDS AND ARE GIVEN FOR INFORMATION ONLY. PIN POSITIONS MAY BE CHECKED ONLY BY MEANS OF ALIGNMENT GAUGE No. GB11-1 AS SPECIFIED IN RETMA STANDARD ET-106-C OF JUNE 1955.

2. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.

3. DIMENSION 'J' DOES NOT INCLUDE INCREASE IN PIN DIAMETER DUE TO SOLDER.

4. DIMENSION 'D' MAY BE INCREASED BY ·030" MAX. FOR SOLDER.

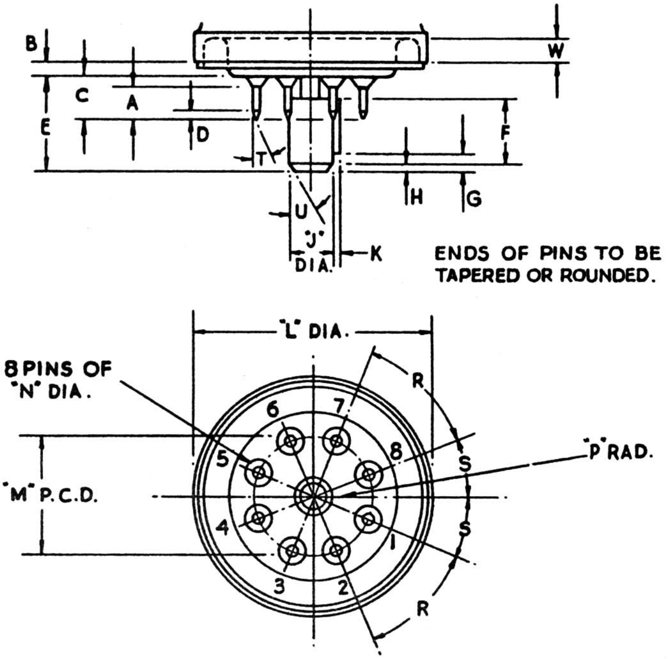
5. ANY PROJECTION ON THE UNDER-SURFACE OF THE BASE OTHER THAN THESE SHOWN SUCH AS A RIM OR EXTERNAL BARRIERS, SHALL HAVE A HEIGHT NOT EXCEEDING ·040".

6. EXTRACTED FROM RETMA PUBLICATION ET-103-D OF MARCH 1955

DRAWING No. 46

B8F BASE

MANDATORY

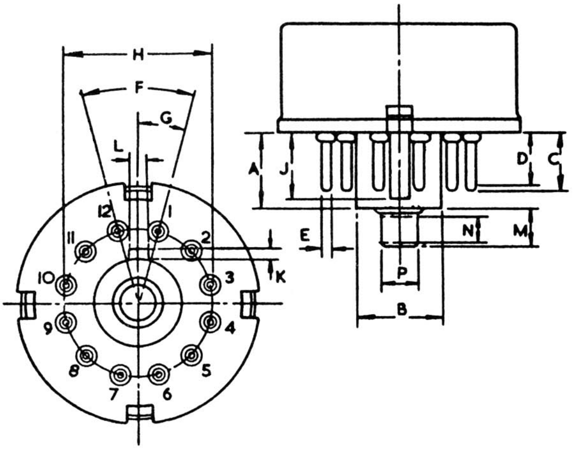


ENDS OF PINS TO BE TAPERED OR ROUNDED.

THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS

REF.	DIMENSIONS.							NOTES
	INCHES			DEGREES	MILLIMETRES.			
	MIN	NOM	MAX	NOM	MIN	NOM	MAX	
A	0·187				4·75			
B		0·080				2·03		
C			0·250				6·35	
D		0·035				0·89		
E	0·514	0·534	0·554		13·10	13·55	14·05	
F	0·381	0·401	0·456		9·7	10·2	11·5	
G	0·068	0·088	0·108		1·75	2·25	2·70	
H		0·035				0·89		
J	0·255	0·260	0·265		6·48	6·60	6·73	
K			0·049				1·24	
L	1·417	1·425	1·433		36·00	36·20	36·38	
M	0·680	0·687	0·694		17·28	17·45	17·62	
N	0·045	0·050	0·053		1·15	1·27	1·34	
P			0·043				1·09	
R				45				
S				22·5				
T				22·5				
U				30				
W	0·187				4·75			

DRAWING No. 47
B12E BASE
MANDATORY



THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS.

REF.	DIMENSIONS							NOTES
	INCHES			DEGREES	MILLIMETRES			
	MIN	NOM	MAX	NOM	MIN	NOM	MAX	
A			0·530				13·46	
B	0·598	0·616	0·635		15·19	15·65	16·1	4
C			0·410				10·4	1
D	0·320				8·13			
E	0·090	0·093	0·096		2·29	2·36	2·43	
F				30				2
G				15				2
H		1·063				2·70		
J	0·430				10·95			
K	0·065	0·070	0·075		1·66	1·78	1·90	
L	0·145	0·155	0·165		3·70	3·94	4·18	4
M	0·240	0·256	0·270		6·10	6·50	6·85	
N	0·200				5·10			6
P	0·245	0·250	0·255		6·23	6·35	6·47	

NOTES

1. DIMENSION C MAY BE INCREASED BY 0·03 IN. (0·076MM.) MAXIMUM FOR SOLDER.
2. THE DIMENSIONS FIXING THE POSITION OF THE PINS REFER TO THE FIXED END OF THE PIN AND ARE GIVEN FOR INFORMATION ONLY. THE PIN POSITION MAY BE CHECKED ONLY BY MEANS OF THE GAUGE IN B.S. 448, FIG. B12A/1.2
3. DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THE FREE ENDS.
4. THE SPIGOT & KEY MAY BE TAPERED WITHIN THE LIMITS QUOTED.
5. THE RADII OF CORNERS, IF ROUNDED SHALL NOT EXCEED 0·020 IN. (0·5 MM.)
6. CONTACT LENGTH.

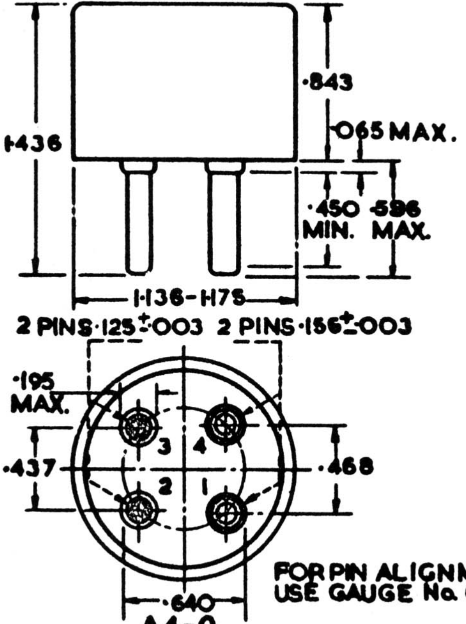
DRAWING No. 48

DRAWINGS OF AMERICAN A4-5 & A4-9

MANDATORY

A4-5

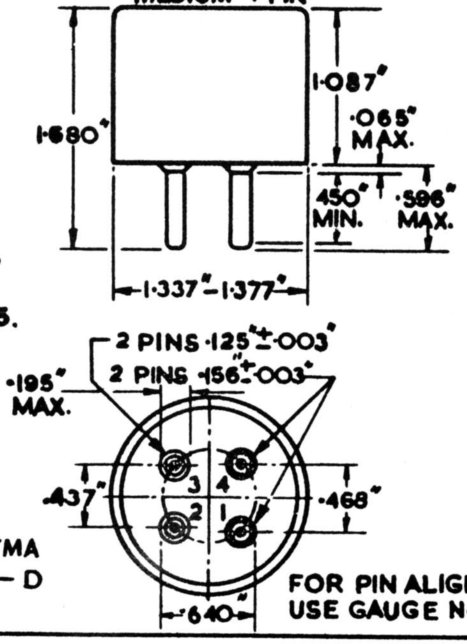
SMALL 4 PIN



FOR PIN ALIGNMENT
USE GAUGE No. GA4-1

A4-9

MEDIUM 4 PIN



FOR DETAILS OF GAUGES
SEE RETMA STANDARD
ET-106-C OF JUNE 1955.

FOR PIN ALIGNMENT
USE GAUGE No. GA4-1

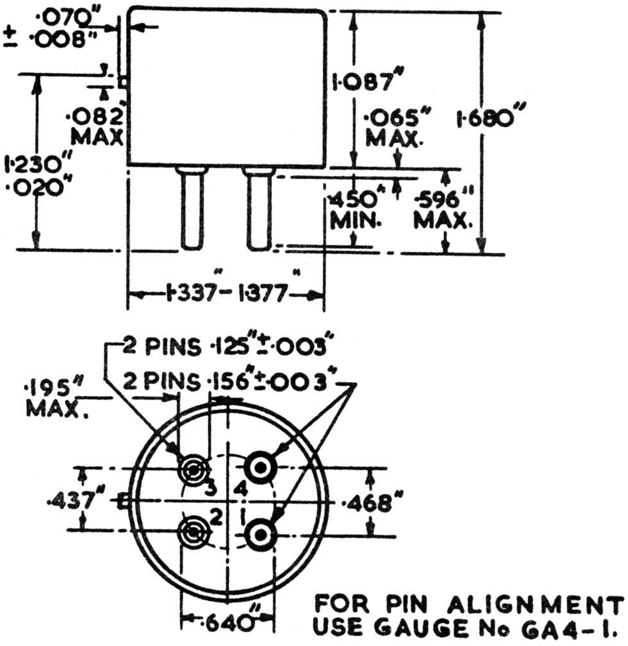
EXTRACTED FROM RETMA
STANDARD ET – 103 – D
OF MARCH 1955.

DRAWING No. 49

DRAWING FOR AMERICAN A4 – 10
MANDATORY

A4-10

MEDIUM 4-PIN
BAYONET



FOR PIN ALIGNMENT
USE GAUGE No GA4-1.

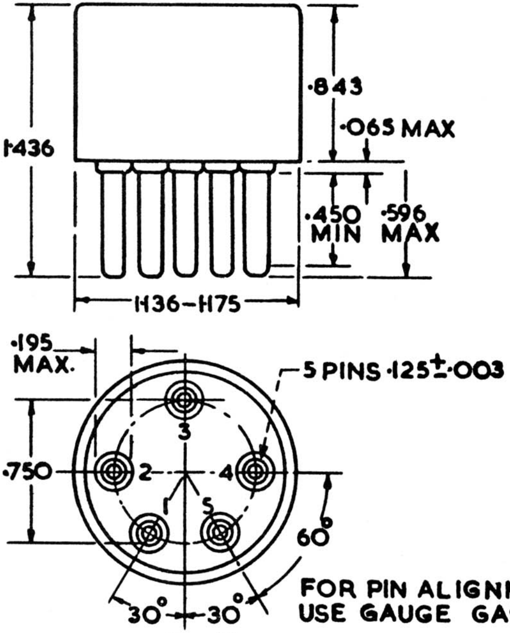
EXTRACTED FROM RETMA
STANDARD ET – 103 – D
OF MARCH 1955.

FOR DETAILS OF GAUGES
SEE RETMA STANDARD
ET– 106–C OF JUNE 1955.

DRAWING No. 50

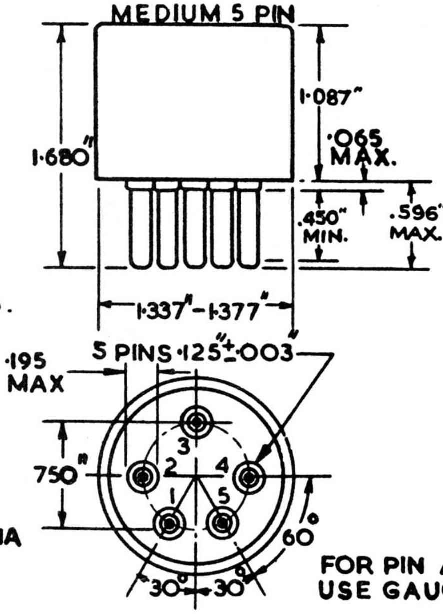
DRAWINGS FOR AMERICAN A5-6 & A5-11
MANDATORY

A5-6
SMALL 5-PIN



FOR PIN ALIGNMENT
USE GAUGE GA5-1

A5-11
MEDIUM 5 PIN



FOR DETAILS OF GAUGES
SEE RETMA STANDARD
ET-106-C OF JUNE 1955.

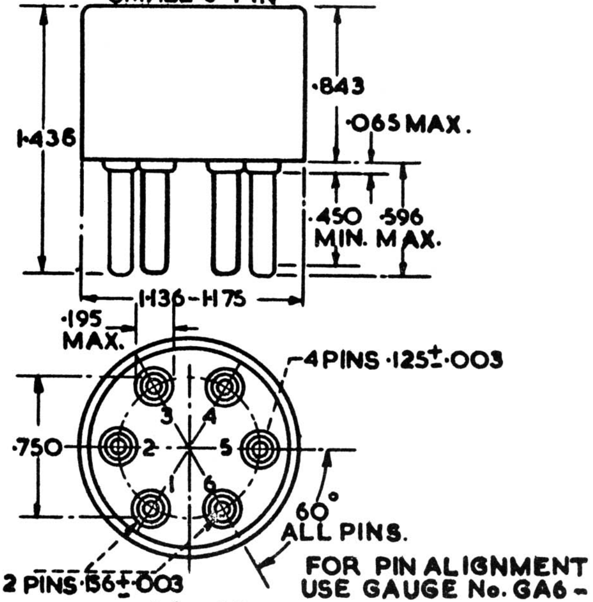
EXTRACTED FROM RETMA
STANDARD ET-103-D
OF MARCH 1955.

FOR PIN ALIGNMENT
USE GAUGE No. GA5-1

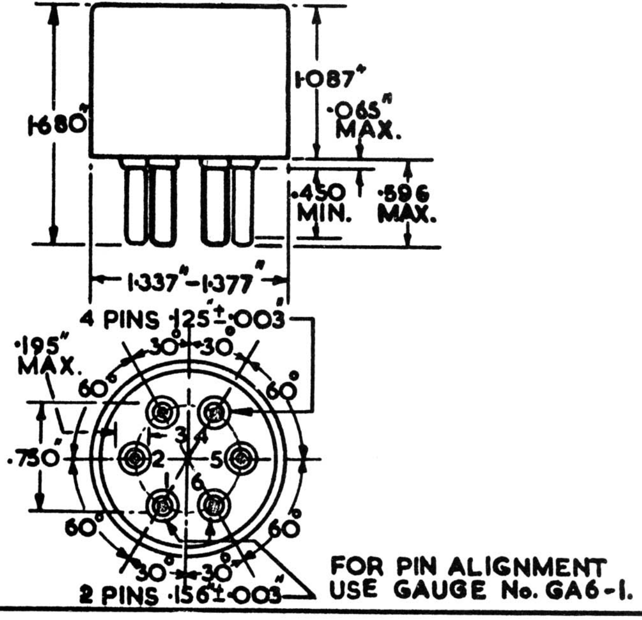
DRAWING No. 51

DRAWINGS FOR AMERICAN A6 -7 & A6 -12
MANDATORY

A6 -7
SMALL 6-PIN



A6 -12
MEDIUM 6-PIN



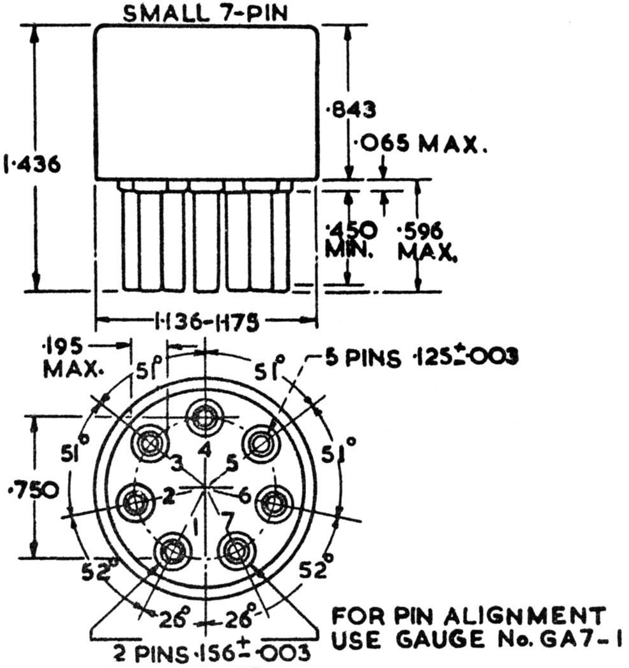
FOR DETAILS OF GAUGES
SEE RETMA STANDARD
ET- 106-C OF JUNE 1955

EXTRACTED FROM RETMA
STANDARD ET - 103 - D
OF MARCH 1955.

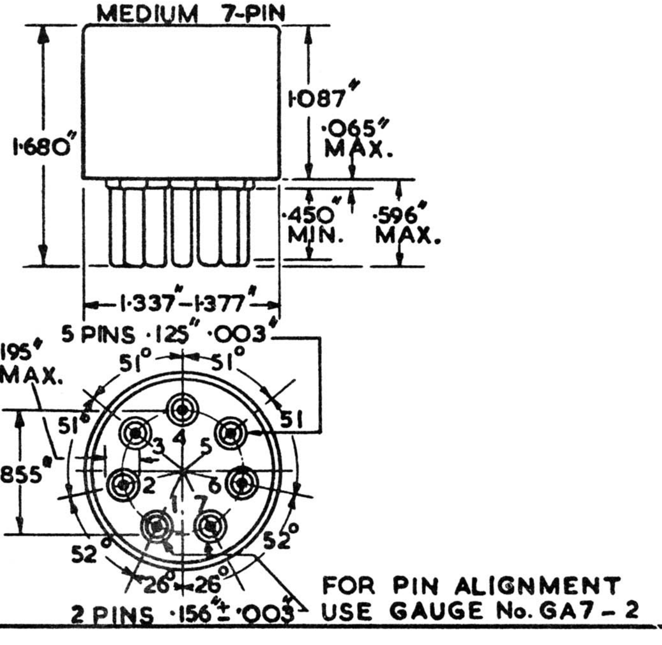
DRAWING No. 52

DRAWINGS FOR AMERICAN A7-8 & A7-13
MANDATORY

A7-8
SMALL 7-PIN



A7-13
MEDIUM 7-PIN



FOR DETAILS OF GAUGES
SEE RETMA STANDARD
ET-106-C OF JUNE 1955.

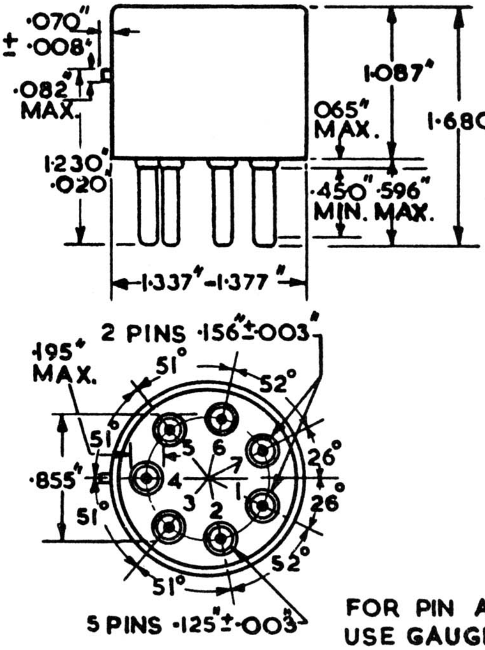
EXTRACTED FROM RETMA
STANDARD ET-103-D
OF MARCH 1955

DRAWING No. 53

DRAWING FOR AMERICAN A7 – 14
MANDATORY

A7–14

MEDIUM 7 PIN BAYONET

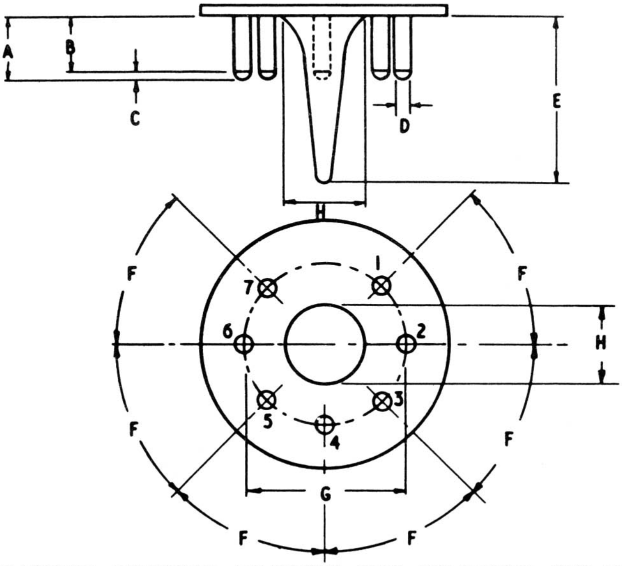


FOR PIN ALIGNMENT USE GAUGE No GA7–2

EXTRACTED FROM RETMA STANDARD ET – 103 – D OF MARCH 1955.

FOR DETAILS OF GAUGES SEE RETMA STANDARD ET – 106 – C OF JUNE 1955

DRAWING No. D54.
B7B BASE
MANDATORY

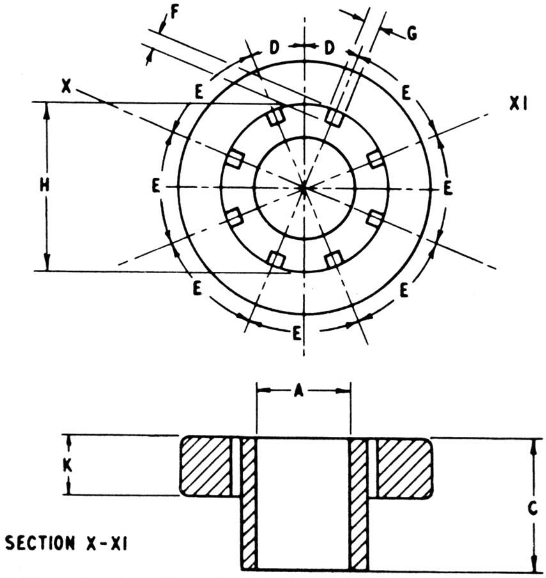


THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS

DIMENSIONS							
REF.	INCHES			DEGREES	MILLIMETRES		
	MIN.	NOM.	MAX.	NOM.	MIN.	NOM.	MAX.
A			0·281				7·13
B	0·180				4·58		
C	0·015				0·39		
D	0·048	0·050	0·052		1·220	1·270	1·320
E			0·750				19·05
F				45			
G		0·687				17·45	
H			0·420				10·66

NOTES:
1. THE DIMENSIONS FIXING THE POSITION OF PINS REFER TO THE FIXED END OF THE PIN AND ARE FOR INFORMATION ONLY. THE PIN DISPOSITIONS MAY BE CHECKED ONLY BY MEANS OF THE B.7.B. POSITION GAUGE.
2. THE DRAWING SHOWS THE NUMBERING OF THE PINS AS SEEN FROM THEIR FREE ENDS.
3. THE TIPS OF THE PINS SHALL BE ROUNDED OR TAPERED.

DRAWING No. D54A
B7B GAUGE
MANDATORY



THE MILLIMETRE DIMENSIONS ARE DERIVED FROM THE ORIGINAL INCH DIMENSIONS

REF	DIMENSIONS							NOTES
	INCHES			DEGREES	MILLIMETRES			
	MIN.	NOM.	MAX.	NOM.	MIN.	NOM.	MAX.	
A	0·450				11·43			
C	0·6				15·3			
D				22½				
E				45				
F	0·064	0·065	0·065		1·626	1·650	1·650	
G	0·064	0·065	0·065		1·626	1·650	1·650	
H	0·7520	0·7525	0·7530		19·102	19·114	19·126	
K	0·290	0·295	0·300		7·37	7·50	7·62	

NOTES:

1. THE EIGHT SLOTS 'G' SHALL BE WITHIN 0·0004 IN. (0·01 m/m) OF THEIR TRUE GEOMETRICAL POSITION IN RELATION TO THE DATUM HOLE 'A'
2. THE COMPLETE LENGTH OF THE PINS SHALL PASS INTO AND DISENGAGE FROM THE GAUGE WITH AN AXIAL FORCE OF 8 OUNCES OR LESS APPLIED TO THE VALVE GAUGING PROCEDURE I.

APPENDIX V

THE MEASUREMENT OF THERMIONIC EMISSION

1. GENERAL

1.1. The emission from the cathode, when specified, may be measured by one of the methods described in the following paragraphs.

1.2. In general, it is not possible to measure the emission by drawing the current continuously from the cathode, as the cathode temperature may be disturbed or the valve itself damaged through overheating the emission collecting electrodes. Therefore the collecting voltage will be applied periodically at such a rate and with a sufficiently brief duration of the actual application of voltage that appreciable temperature changes in the valve during measurement are avoided. Two alternative methods are outlined in this appendix and the particular method to be applied will be indicated in the individual valve specification.

1.3. The important circuit parameters in emission testing are the value of collecting voltage and the cathode temperature. The latter is governed largely by heater power which must therefore be adjusted with special care. Test values of heater voltage and collecting voltage will be specified in individual specifications.

2. METHOD I

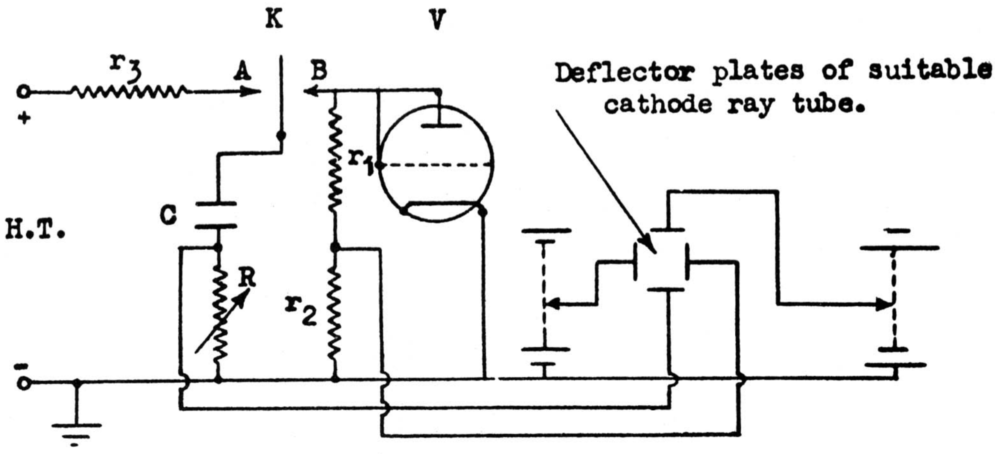


Fig. 1.

2.1. The circuit for this method of test is shown in Fig. 1. C is a capacitor of suitable value and capable of withstanding the voltages V_0 which are to be applied across the valve V under test. The cathode ray tube has its final anode at earth potential. "Shift" circuits may be used as shown to move the zero position of the spot to any desired position on the screen of the C.R.T. R is a non-inductive variable resistor of known value; r_1 r_2 is a non-inductive potentiometer of known resistance values. Resistor "r_3" is a current limiting resistor of suitable value.

2.2. Methods of operation

The capacitor C is charged to the potential V_0 of the H.T. supply by means of the key or contactor K connecting to terminal A. "C" is then discharged through valve V by moving K to position B. Voltages proportional to the collecting voltage V_a and the corresponding space current I_a appear simultaneously across the pairs of deflecting plates. As the capacitor progressively discharges, these voltages decrease and a characteristic curve of I_a versus V_a is traced on the C.R. Tube screen.

The deflecting voltages are

$$V_x = \frac{r_2}{r_1 + r_2} \times V_a; \quad V_y = I_a R$$

The ratio $\frac{r_2}{r_1 + r_2}$ and the resistance R are adjusted to obtain suitable scales for the X and Y deflection so that the form of the I_a, V_a curve gives a clear indication of the emission performance of the valve.

2.3. Calibration

By providing D.C. voltmeters across the shift voltages it is possible to calibrate the deflection directly in the following manner.

The shift voltages are adjusted so that the spot is returned to the arbitrary zero position from its position of maximum deflection during the test. The change in the shift voltages will then measure the maximum collecting voltage and current on arbitrary but easily determined scales dependent only on $r_1 r_2$ and R respectively.

In many cases, it may be sufficient to assume a linear relation between deflections and applied voltages and to provide scales on the tube face, or on a visor, calibrated in collector voltage and emission current.

3. METHOD II

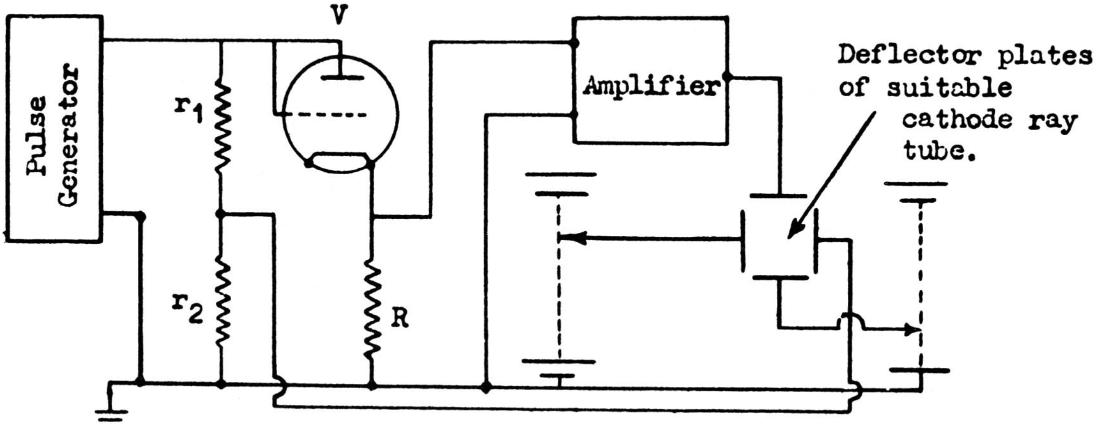


Fig.2.

3.1. The circuit for this method is indicated in Fig. 2. In principle the circuit conditions are identical with those of Method 1 but the contactor K of Fig. 1 is replaced by an impulse generator of suitable type, and an amplifier is interposed in the Y or current deflection circuit.

3.2. "Duty" Cycle

The duty cycle of the applied pulse, which is chosen to avoid damage to the valve or appreciable disturbance of the cathode temperature, shall be as detailed below.

3.3. Pulse Form.

The pulse shape shall be substantially half sine wave in character unless otherwise specified.

3.4. Pulse Length

The pulse length shall be approximately 2 µ secs. unless otherwise specified.

3.5. Repetition Frequency

A frequency of 500 pulses per second shall be used unless otherwise specified.

3.6. Limitation of Resistor R

The value of resistor R shall be limited so that the voltage appearing across R shall be not greater than 1% of the voltage across the potential divider resistors r_1, r_2.

4. Procedure of Testing to be applied to both methods of Test

4.1. Filament or Heater Voltage

The filament or heater voltage shall be the specified nominal value within the limits + 0%, -2%.

4.2. Application of "Collecting" Voltage

The full specified limiting voltage may be applied immediately to the valve or the applied voltage may be increased gradually and observations continued until either the specified current is obtained or the specified limiting voltage is reached.

4.3. Checking the apparatus

The following test should be carried out to ensure that the resistances and capacitances of the deflecting circuit components are not so excessive as to produce appreciable disturbances of the valve characteristics and to ensure that the calibrations are correct.

Substitute a non-inductive resistor of known value R_v chosen to give a curve of comparable size to that of the valve under test. With this resistor substituted, the trace on the screen should be a straight line free of appreciable looping and of slope $\frac{Ia}{Va} = \frac{1}{R_v}$ when the co-ordinates of the trace have been translated into the corresponding current I_a and Voltage V_a

JOINT SERVICE SPECIFICATION K1001

APPENDIX VI

LIFE TESTS

1. FOREWORD

Electronic valves, other than Reliable types, are not normally subject to life tests as a specification requirement. See, however, Section 13.

2. Cancelled

3. Cancelled

4. Cancelled

Section 1, but see also Appendix IX

5. RELIABLE VALVES

The life testing of Reliable Valves shall be on a Sampling Inspection basis. The Inspection Levels and Acceptance Quality Levels for individual and group tests will be given in the individual Test Specifications. The sampling plans shall be in accordance with Appendix XI, and the provisions for transfer between Normal, Tightened or Reduced Inspection given therein shall apply except as follows:- Amdt 3

~~Normal Inspection shall be used initially and until Reduced or Tightened Inspection is merited in accordance with paragraphs 7.1.2 and 7.1.3 of Appendix XI.~~

~~Selection of Sampling Plans. The sampling plans shall be in accordance with Table IIIA of Appendix XI except that lot sizes between 301 and 800 valves shall be considered in accordance with paragraph 2.6.1 of Appendix IX and lots containing more than 8000 valves shall be considered to consist of 8001 valves. Either single or double sampling may be used at the option of the manufacturer. Multiple sampling is not recommended for this application because of the time factor.~~ Amdt 3

The life tests shall be divided into three classes:-

(a) Stability life tests

(b) Intermittent life tests of 500 hours

(c) Intermittent life tests of 1,000 hours

Individual test specifications may require all or part of the above procedure to be performed and may state alternative and/or additional test periods.

5.1. Stability Life Test

(a) Serially mark all valves from the sample

(b) Record referenced characteristic measurements after a maximum operation of 15 minutes at life test voltage and current conditions on the entire sample

(c) Operate at life test conditions for one hour (plus 30 minutes minus 0 minutes)

(d) Record referenced characteristic measurements at the end of this life test period. These measurements shall be taken immediately following the life test, or, alternatively, the valves may be pre-heated for 15 minutes under life test conditions, the 15 minutes preheating time being considered as part of the life test time.

(e) A defective valve shall be defined as a valve having a percentage change in a referenced characteristic greater than that specified in the individual test specification.

$$\text{Percentage change} = \frac{\text{Initial value - one hour value}}{\text{Initial value}} \times 100$$

(f) A lot failing to comply with the requirements of this test may be resubmitted but once for re-evaluation

(g) The conditions for the 15 minute preheating period specified in sub-paragraphs (b) and (d) above shall be deemed to have been met provided the electrode voltages and currents on a valve with nominal characteristics are the same as they would be on the same valve at life test conditions.

5.2. (This paragraph has been amended and incorporated in the introductory paragraphs above).

5.3. Intermittent Life Tests - 500 and 1000 hours

The valves used for intermittent life test may be selected at random from the valves used for the stability life test. When the stability life test is not included in the Test Specification the valves shall be selected from the lot.

The valves shall be operated under specified life test conditions. The mean electrode potentials shall not deviate by more than 5% from the specified values and the rated electrode dissipations shall not be exceeded. The heater or filament potential shall be maintained as close as practical to the specified value. If a heater-cathode potential is required during the life test, the resistance applied in series with this potential shall not exceed 5000 ohms.

Valves ahall be operated intermittently with not less than 12 interruptions occurring per 24 hours of life testing. The maximum frequency shall be one interruption per hour and the valves shall be operating for approximately 20 hours out of the 24-hour period. The 'on' and 'off' periods shall consist of the immediate application of the filament voltage and then the removal of filament voltage. Other electrode potentials may be applied continuously at the option of the manufacturer. The accumulation of the 'on' time shall be the only time considered in determining the life test time. The filament supply impedance shall not exceed 10% of the hot filament load impedance.

5.3.1. Regular Life Test

Regular life test shall be conducted for 1000 hours and acceptance shall be on the basis of the 500-hour and 1000-hour requirements stated on the individual Test Specification. Regular life test shall be in effect initially and shall continue in effect until the conditions for reduced hours life test have been met.

5.3.2. Reduced Hours Life Test

Reduced hours life test shall be conducted for 500 hours or as otherwise stated in the Test Specification and acceptance shall be based on the 500-hour end-point limits or as qualified above.

In the event of no lot failure in three consecutive 1000-hour life test batches the subsequent batches become eligible for reduced hours life test.

Loss of eligibility for reduced hours life test shall ~~be based on two or more life test lot failures occurring in the last thr~~ occur if any test lot fails at the ee 500-hour life test~~s~~. end point. Amdt 3

5.3.3. The life test sample shall be read at the start of the life test period and at 500 hours plus 48 hours minus 24 hours and at 1000 hours plus 48 hours minus 24 hours when applicable. Additional reading periods may be stated in the test specification and may also be used at the discretion of the manufacturer.

5.3.4. Acceptance Conditions

The lot shall be accepted providing:-

(a) The change in the average characteristic in the life test sample specified for life test control of averages is not exceeded. The average percentage change shall be computed from the individual changes for each valve in the life test sample from the zero hour value for the referenced characteristic or characteristics. For the purposes of computation of this average percentage change the absolute values of the individual changes for each valve in the life test sample shall be used. Any valve found inoperative during the life testing shall not be considered in the calculation of this average.

(b) The specified group and individual AQLs are not exceeded.

5.3.5. A lot failing to comply with the requirements of this test, may be resubmitted but once for re-evaluation.

5.4. Equivalents of Intermittent Life Test Conditions

These shall be defined as those conditions which yield the same incidence of failures. These conditions shall be interpreted as having the same heater voltage, heater-cathode voltage and interruptions as the intermittent life test.

The electrode voltages shall be selected to give element dissipations which are approximately equal to those specified for intermittent life test, i.e. not less than 80%.

The voltages shall be selected to be within plus 100% and minus 50% of the intermittent life test voltages.

5.5. All valves shall be tested at room temperature.

5.6. Order of Evaluation of Life Test Defects

In the event of a valve being defective for more than one attribute characteristic, the lowest number characteristic in the following table shall constitute the failure:-

1. Inoperatives (see paragraph 5.14)
2. Heater current
3. Heater-cathode leakage
4. Grid current
5. Mutual conductance
6. Anode current
7. Electrode insulation
8. Mutual conductance change

JOINT SERVICE SPECIFICATION K1001

APPENDIX VII

VALVE PIN AND FLYING LEAD PROTECTORS

(I) PIN PROTECTORS

1.1. GENERAL

B7G and B9A based valves have pins which are liable to be bent and thus may not safely engage with holder contacts. To prevent this all such valves are to be supplied fitted with Pin Protectors as described and illustrated in this appendix.

1.2. MATERIAL

The Pin Protectors shall be made of an approved moulded material not liable to appreciable deterioration in quality or dimensions under any climatic conditions. Materials approved for this purpose are listed in Schedule A below.

1.3. TESTS

The Pin Protectors shall conform to all dimensions shown on the appropriate drawing and be accepted with only slight finger pressure by the corresponding assembly gauge.

1.4. FINISH

Mouldings shall not be machined except for the removal of flash.

1.5. QUALIFICATION APPROVAL

Not less than six Pin Protectors of each type shall be sent for Qualification Approval to A.S.W.E. These may be submitted either by the valve manufacturer or by the sub-contractor manufacturing the protectors.

SCHEDULE A

Approved Phenolic Resin Moulding Materials

Material	Manufacturer
X262/2	Messrs. Bakelite Ltd., 12 Hobart Place, London, S.W.1.
X5337	" " " " " " " "
X4892/4	" " " " " " " "
X17163	" " " " " " " "
"Rockite" 3920	British Resin Products, 21, St. James' Square, S.W.1.
A.864	James Ferguson and Co. Ltd., Prince George's Road, S.W.19
"Carinex" TGH Polystyrene Heat Resistant, Toughened Grade	Shell Chemical Co. 170 Piccadilly London W.1.

Amdt. 1

SCHEDULE B

Manufacturers of Approved Pin Protectors

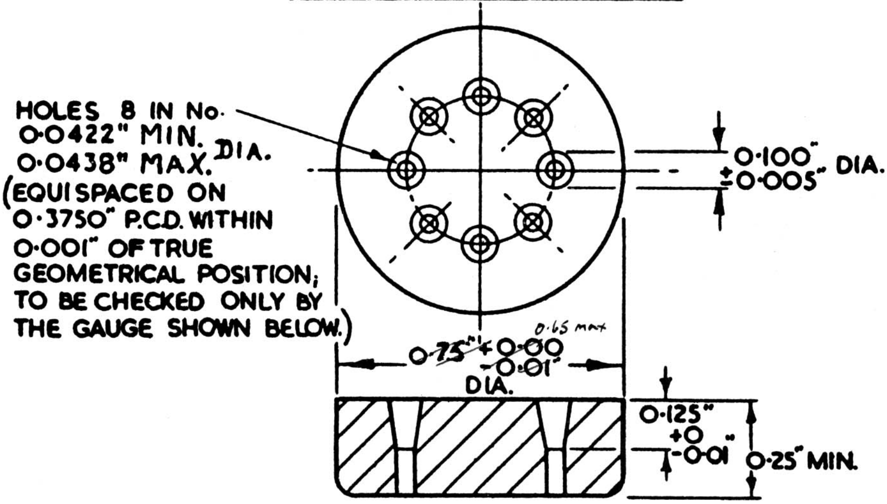
Protectors	Manufacturer	Code
B7G	Messrs. Insulators Ltd., Leopold Road, Angel Road, Edmonton, London, N.18	INS
B7G	Kent Mouldings, Footscray, Sidcup, Kent.	KFA
B7G B9A	British Mechanical Productions Ltd., Barton Hill Works, Bristol, 5.	BMP
B7G	Electrothermal Engineering Ltd., 270 Neville Road, London, E.7.	ETH/VP
B7G and B9A	Enalon Plastics Ltd., South Premier Works, Drayton Road, Tonbridge, Kent.	EPL

Amdt 1
Amdt 2

DRAWING No. 1.

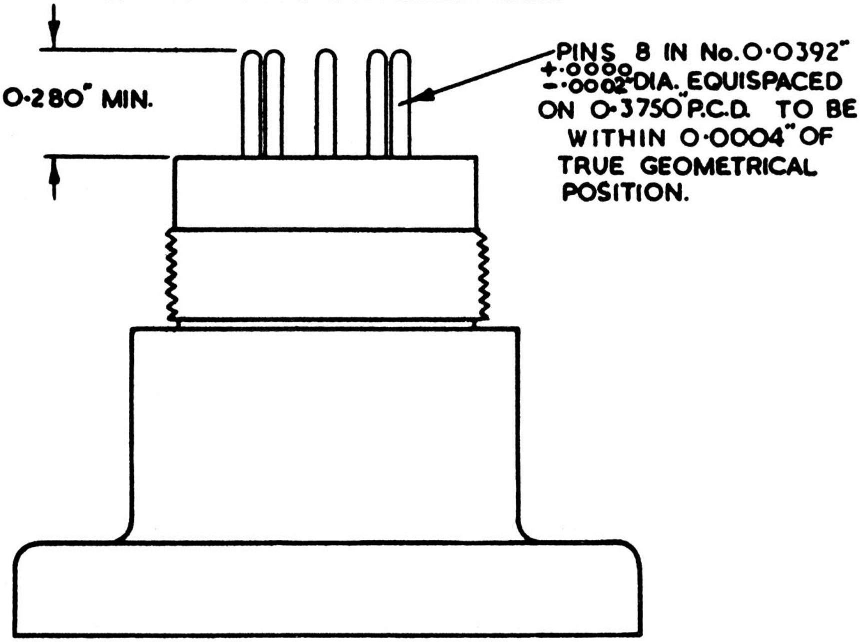
B7G PIN PROTECTOR AND PROTECTOR GAUGE

FIG. 1. PIN PROTECTOR



Amdt 1

FIG. 2. PROTECTOR GAUGE



DRAWING No. 2

B9A PIN PROTECTOR AND PROTECTOR GAUGE

FIG. 1 PIN PROTECTOR

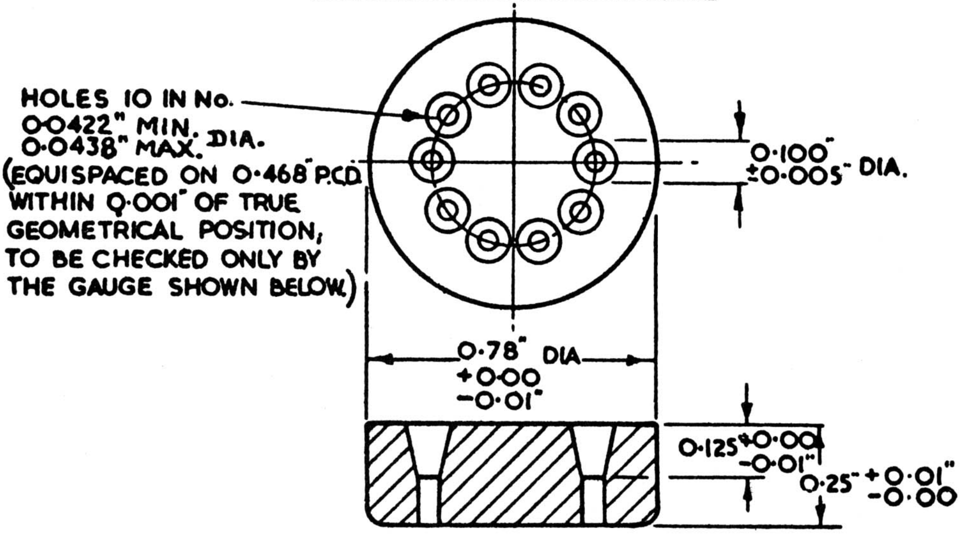
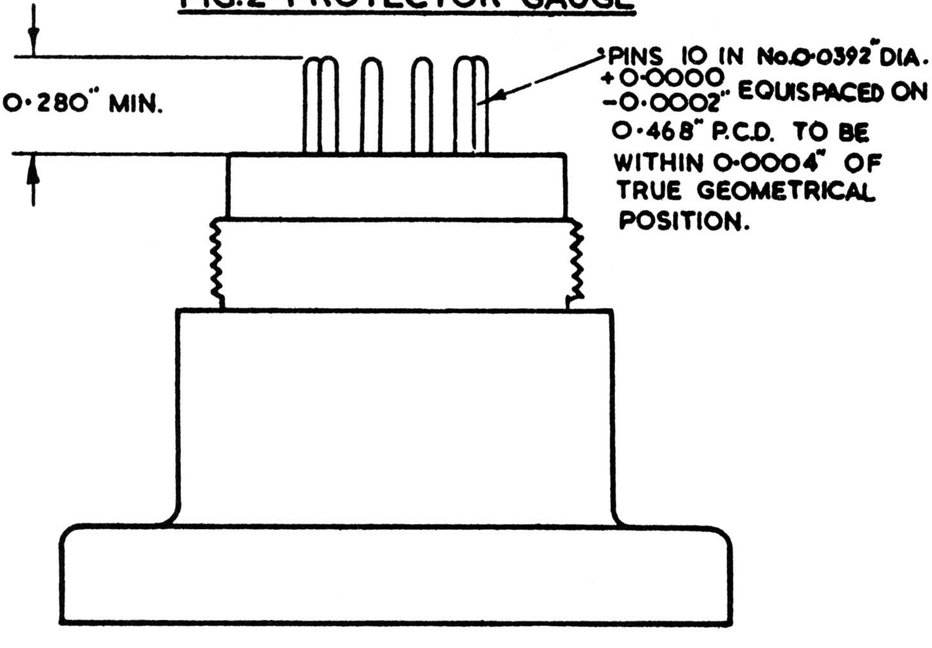


FIG. 2 PROTECTOR GAUGE



(II) FLYING LEAD PROTECTORS

2.1. Flying lead valves having B7G/F or B9A/F bases shall be supplied fitted with protective discs, which unless the contract specifies otherwise shall be type 1 below (polythene).

Alternatively, in place of the Type 1, polythene discs, B7G/F and B9A/F flying lead valves may, at the discretion of the manufacturer be fitted with the appropriate B7G or B9A pin protector specified in Section 1 of this Appendix.

All other flying lead types shall be supplied without protective discs unless the contract specifies otherwise.

Two types are suitable:-

Type 1 Polythene Discs These are suitable for packaging purposes to protect the valve base and leads during transit.

(Note: This type is not suitable for wiring into equipment).

B7G/F and B9A/F see Page 6 of this Appendix

Type 2 P.T.F.E. Insulating Discs These will withstand the temperatures expected from normal soldering techniques in wiring the valve into circuit and also the environmental temperatures applicable to airborne equipment.

See Page 8 of this Appendix.

2.2 Qualification Approval

Not less than 6 samples of each type shall be sent for Qualification Approval to A.S.W.E. These may be submitted by either, the valve manufacturer or by the sub-contractor manufacturing the protectors.

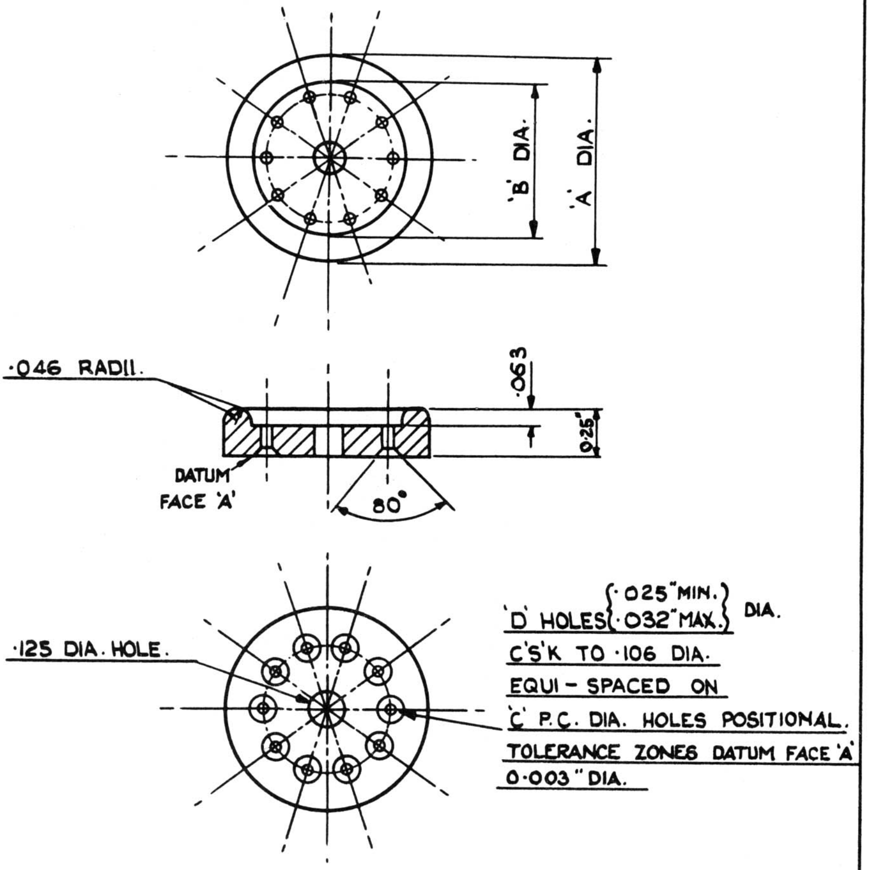
SCHEDULE C

Manufacturers of Approved Lead Protectors

Material	Base	Manufacturer

TYPE I POLYTHENE DISCS.

(SUITABLE FOR PACKAGING ONLY)



'D' HOLES {·025" MIN. / ·032" MAX.} DIA.
C'S'K TO ·106 DIA.
EQUI - SPACED ON
'C' P.C. DIA. HOLES POSITIONAL.
TOLERANCE ZONES DATUM FACE 'A'
0·003" DIA.

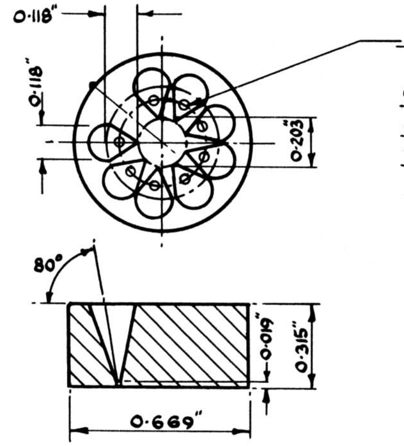
GENERAL TOLERANCES: ± 0.005"

MATERIAL: POLYTHENE

FINISH: NATURAL.

TYPE OF BASE	DIMENSIONS (INCHES)			'D' Nº OF HOLES
	'A' OVERALL DIA.	'B' INTERNAL FLANGE DIA.	'C' HOLE P.C. DIA. NOM	
B7G/F	0·620	0·470 -0·478	0·375	8
B9A/F	0·775	0·563 -0·571	0·468	10

B.8.D. LEAD PROTECTOR.



8-HOLES 0·0295" MIN.
0·0335" MAX. DIA.
SPACED AT 40° INTERVALS
ON A 0·335° P.C.D.
WITHIN 0·004" OF TRUE
GEOMETRICAL POSITION.

GENERAL TOLERANCES ± 0·005"

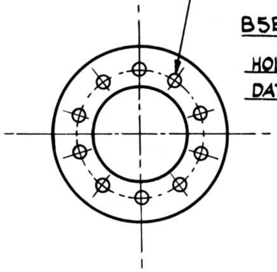
MATERIAL APPROVED PHENOLIC RESIN
FINISH CLEAN.

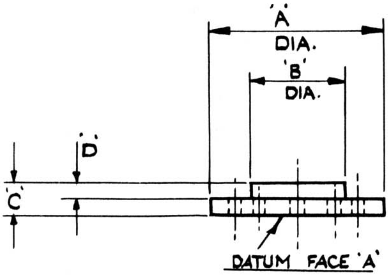
TYPE II P.T.F.E. INSULATING DISCS.

'F' HOLES 0·031" DIA. EQUI. SPACED.
ON 'E' P.C. DIA.

B5B/F. 0·028 DIA. (Nº 70 DR.)

HOLES POSITIONAL TOLERANCE ZONES
DATUM FACE 'A' 0·003" DIA.





MATERIAL: P.T.F.E.
FINISH: CLEAN

GENERAL TOLERANCES ± 0.005

TYPE OF BASE	DIMENSIONS (INCHES)					'F' NUMBER OF HOLES	JOINT SERVICE CATALOGUE NUMBER.
	'A' OVERALL DIA.	'B' SPIGOT DIA.	'C' OVERALL DEPTH	'D' SPIGOT DEPTH	'E' HOLE P.C. DIA.		
B5B/F	0·188	0·045 +0, -0·002	0·10	0·040	0·093	6	5970-99- 972-8777
B7G/F	0·5	0·312	0·125	0·062	0·375	8	5970-99- 972-8775
B8D/F	0·350	0·175	0·125	0·062	0·236	9	5970-99- 972-8776
B9A/F	0·625	0·344	0·125	0·062	0·468	10	5970-99- 972-8774

JOINT SERVICE SPECIFICATION K1001

APPENDIX VIII

ELECTRONIC VALVE MANUFACTURERS' FACTORY IDENTIFICATION CODE

Valves shall be marked with the appropriate letters from the following list to show where the pumping process was completed. (See K1001, Section 4)

AB	Sylvania-Thorn, Enfield	
AD	Thorn-A.E.I.(Brimar), Rochester	
BC	Joseph Lucas, Birmingham	
CC	Cathodeon, Cambridge	
CF	20th Century Electronics, New Addington	
CO	Newmarket Transistors, Newmarket	
CS	Cathodeon, Southend	
D	Mullard Radio Valve Co., Mitcham	
DA	" " " " Blackburn	
DB	" " " " Salfords	
DC	" " " " Whyteleafe	
DG	Associated Semiconductor Manufacturers, Southampton	
DH	Societe Anonyme Philips, Brive, France	
DJ	Wiener Radio Werke, A.G. Abbegasse 1, Vienna 14/89	Amdt 3
E	Thorn-A.E.I., Brimsdown	
EN	" " Sunderland	
F	S.T.C., Paignton	
FB	S.T.C., Footscray	
FC	S.T.C., Lorenz, Esslingen, Germany	
FE	S.T.C., Oldway (Additional to Paignton Factory at 'F' above)	
FF	S.T.C., Harlow	
G	Ericsson, Beeston	
GA	(Ericsson), A.B. Svenska Elektronror, Stockholm, Sweden	
HC	Hivac, Chesham	
HR	Hivac, Ruislip	
JA	S.G.S. Fairchild, Ruislip	
JB	S.G.S. Fairchild, Agrate, Milan, Italy	
JD	Elliott Bros. (London) Ltd. Borehamwood	
JK	La Radio Technique, Suresne, Paris, France	
JN	International Rectifier Co. (Gt. Britain) Ltd., Oxted	
JT	Microwave Associates Ltd., Luton	
K	Electronic Tubes, High Wycombe	
L	C.S.F., Levallois-Perret (Seine), Paris, France	
LB	C.S.F., St. Egreve, Grenoble, Isere, France	
ME	E.M.I., Hayes	
MR	E.M.I. (Valve Div.), Ruislip	
N	Nore Electric, Southend	
NQ	Texas Instruments, Bedford	
NR	Texas Instruments, Nice, France	
DK	Philips GMBH, 140 Ebentalerstrasse, Klagenfurt	
DL	NV Philips Gloeilampenfabrieken Nijmegen	
DM	NV Philips, Stadskanaal, Holland	
DN	La Radio Technique, Caen, France	
DP	Valvo GMBH Hamburg 1, Germany	Amdt 3
DQ	Philips SPA, Milan Italy	
DR	Philips AG, Zurich, Switzerland	

O	Rank Cintel, Lower Sydenham
OS	" " Sidcup
P	Philips, Eindhoven, Holland
PA	Philips Teleindustri, Stockholm, Sweden
Q	English Electric Valve Co., Chelmsford
QB	Marconi W.T. Co., Great Baddow
QC	" " " Chelmsford
QD	English Electric Valve Co., Stafford
QE	" " " " Kidsgrove
QF	" " " " Nelson Res. Labs., Hixon
QG	" " " " Carholme Rd. Lincoln
R	Ferranti, Moston
RA	" Edinburgh
RB	" Dundee
RC	" Chadderton, Oldham
S	A.E.I., Rugby
SB	" Lincoln
SC	C.F.T.H., Usine de Joinville, Seine, France
SD	S.E.S.C.O., Rue de L'Amiral, Mouchez, Paris, France
SF	C.F.T.H., Rue Mario-Nikis, Paris, France
T	British Tungsram, Tottenham
V	Wilbert Photoelectrics, Isleworth
VA	Westinghouse, Chippenham
VF	M.C.P. Electronics, Alperton
VL	Hughes Int. (U.K.) Ltd., Glenrothes
VR	Brush Crystal Co., Hythe
W	(G.E.C.), (A.S.M. Ltd.) Hirst Labs, Wembley
WD	Claude General Neon Lights, Wembley
WE	A.S.M. Ltd., Hazel Grove
YC	Semiconductors Ltd., Cheney Manor, Swindon
Z	M.O. Valve Co., Hammersmith, W6.

OBSOLETE CODES

A	(Mullard, Blackburn, prior to Jan. 1951 (Thorn, Tottenham, prior to April 1964
AC	Thorn-A.E.I., Footscray
B	Edison Swan, Baldock, prior to Sept. 1945
BA	A.E.I., Woolwich
C	Edison Swan, Ponders End, prior to Sept. 1951
CE	20th Century Electronics, prior to March 1957
CN	Pye Industrial Electronics
DE	Mullard Radio Valve Co., Fleetwood
DF	" " " " Waddon
EA	Edison Swan, Ponders End
EB	" " Gateshead
EC	" " Tottenham

FD	S.T.C. Rochester
FDA	Alexandria, N.S.W., Australia
H	Hivac, Harrow
J	S.T.C., Crewkerne, prior to Jan 1946
J	Radar Electronic Equipment
JE	Elliott-Litton, Borehamwood
JQ	Associated Transistors, Ruislip
L	M.O. Valve Co., prior to Oct. 1951
M	Gramophone Co., Hayes
MA	E.M.I., Res. Labs., Hayes
MB	E.M.I., " " , Ruislip
MT	E.M.I., Treorchy
N	S.T.C., Footscray, prior to Aug. 1951
NP	Texas Inst., Dallas Rd., Bedford
OR	Rank Cintel, Rotunda
P	G.E.C., Shaw, prior to Aug. 1948
PDA	Philips, Hendon, Australia
R	Ferranti, Gem Mill, prior to July 1947
SA	A.E.I., Lutterworth
SDA	Amalgamated Wireless, Australia
SL	A.E.I., Leicester
SP	A.E.I., Peterborough
U	M.O. Valve Co., Bulmer, prior to Oct. 1945
U	Nucleonic and Radiological Div., Stratford
V	Cossor, Highbury, prior to Sept. 1945
~~V~~	~~Gilbert Photoelectrics~~
WB	G.E.C., Coventry
WF	A.S.M. Ltd., Broadstone
X	M.O. Valve Co., Springvale, prior to Oct. 1951
Y	M.O. Valve Co., Moray, prior to April 1945
YA	Leigh Electronics, Havant
YD	Semiconductors Ltd., Towcester
ZA	M.O. Valve Co., Gateshead, prior to March 1957
ZB	M.O. Valve Co., Perivale
ZC	M.O. Valve Co., Springvale, prior to Aug. 1957
ZD	M.O. Valve Co., Dover, prior to Dec. 1956
ZE	Osram G.E.C. Lamp Works, M.X.T. Dept., prior to March 1957

Amdt 3

APPENDIX IX
RELIABLE VALVES

1. FOREWORD

1.1. This Appendix shall apply when the valve is specified in the Test Specification as a Reliable Valve.

1.2. Reliable Valves are defined as valves designed and manufactured to give continuity of operation superior to ordinary valves when used under Service conditions of shock and vibration.

2. TEST PROCEDURE FOR RELIABLE VALVES

All Reliable valves submitted to the Inspection Authority shall undergo the following tests as detailed in the Test Specification.

2.1. Group A Tests. All valves shall be inspected in accordance with Section 5.1 of the general specification and tested for insulation resistance and reverse grid current. Any failures will not count in any further assessment of quality.

2.2. Formation of Lot. All the remaining valves shall be formed into a Lot; see Appendix XI, Section 1, Clause 3.1.1.

2.3. Holding Period. The valves assembled into the Lot shall be stored for a period of not less than 28 days. Those valves normally fitted with pin protectors shall be stored with the pin protectors in position. During the holding period sampling inspection will be made to the schedule detailed below and in accordance with Appendix XI, Sections 1 and 2, unless otherwise stated.

2.4. Sampling Inspection Tests

2.4.1. Electrical Tests

Amdt 3

2.4.1.1. Sampling Inspection by Attributes. Sampling Inspection by Attributes shall be used when an Inspection Level and an Acceptable Quality Level (AQL) are given in the Test Specification. The sampling plans for these tests will be determined by the individual specification and by Appendix XI, Section 1. The primary electrical tests will be at Inspection Level II and to an AQL of 0.65%. These tests will be grouped together in Group B and will be subject to an overall AQL of 1%. The secondary electrical tests will be at Inspection Level I and to an AQL of 2.5%. These tests will be grouped together in Group C and will be subject to an overall AQL of 6.5%. Certain electrical tests which may be destructive, difficult to perform, require specialist testing, or are loosely controlled will be performed at Inspection Levels ~~1A or 1C~~ S4 or S2 and to an AQL or 6.5%. These tests will be grouped together in Group D and, in general, there will be no overall AQL given for this group. When an Inspection Level is specified for each individual test the manufacturer may select a different sample for each test. If he elects to use a single sample of the specified number of valves for all the tests in the group any failure shall be removed forthwith from the test and shall count but once in the evaluation of the AQL values. It will not be necessary to replace any defective valve which has thus been removed. If the manufacturer elects to use separate samples for each test the acceptance and rejection numbers for the combined AQL for the total failures shall be the same as if a single sample had been used throughout.

2.4.1.2. Sampling Inspection by Variables. Sampling Inspection by Variables shall be performed in accordance with Appendix XI, Section 2, and with the Test Specification.

2.4.2. Mechanical Tests

2.4.2.1. Glass Envelope Strain Test. This test shall be as given in Section 7 of the general specification. This is not a destructive test and valves which pass will be accepted for delivery.

2.4.2.2. Base Strain Test. This test shall be as given in Section 7 of the general specification or as amended by the Test Specification. This is a destructive test and valves used for this test will not be accepted for delivery.

2.4.2.3. Lead Fragility Test. This test shall be as given in Section 5 of the general specification. This is a destructive test and valves used for this test will not be accepted for delivery.

2.4.2.4. Vibration and Shock Tests. The Vibration and Shock Tests shall be grouped together in Group E and shall be performed on a sampling basis; they shall include one or more of the following tests:-

2.4.2.4.1. Resonance Search Test. This test shall be as given in Section 11 of the general specification. This is not a destructive test and valves which pass will be accepted for delivery.

An alternative form of reduced inspection may be instituted in which these tests are done on every fourth lot, after reduced inspection has been merited provided that

Amdt 3

(a) production is continuous
(b) the three preceding lots have been accepted

If the fourth lot fails, when on reduced inspection, the three preceding lots shall be tested and normal inspection shall be reinstated until the above conditions have again been satisfied

2.4.2.4.2. Fatigue Test. This test shall be as given in Section 11 of the general specification. This is a destructive test and valves used for this test will not be accepted for delivery. An alternative form of reduced inspection may be instituted in which these tests are done on every fourth lot, after reduced inspection has been merited, provided that

(a) production is continuous

(b) the three preceding lots have been accepted.

If the fourth lot fails, when on reduced inspection, the three preceding lots shall be tested and normal inspection shall be re-instated until the above conditions have again been satisfied.

2.4.2.4.3. Shock Test. This test shall be as given in Section 11 of the general specification. This is a destructive test and valves used for this test will not be accepted for deliverv. Shock testing is waived when ten successive lots have been tested and there has been no individual failures for shock test. Shock testing shall be resumed when production becomes discontinuous or at twelve monthly intervals, whichever is the shorter period. A single individual failure in any sample shall cause reversion to normal inspection.

2.4.3. Life Tests. The electrical life tests will be generally grouped together in Group F and will be performed on a sampling basis. The general requirements of these tests will be based on the procedure given in Appendix VI or as given in the Test Specification. In addition, selected tests may be required at intervals during life testing. Intermediate failure rates and the overall AQL will be stated in the Test Specification. These tests are destructive and valves will not be accepted for delivery except those which pass the stability life test.

2.5. Retests After Holding Period. At the end of the Holding Period all the valves in the Lot, excluding those used for the destructive Sampling Inspection Tests shall be tested for air leaks and open or short circuits between electrodes. A lot will be accepted if the number of inoperative valves as defined above does not exceed 0.5%. For other tests as detailed in the Test Specification the maximum allowable failure will be specified.

2.6. Sampling Inspection Procedure for Small Lot Sizes. DEF-131A allows the following minimum lot sizes for acceptance on one reject.

Insp. Level II			Insp. Level I			Insp. Level S-4			Insp. Level S-2		
AQL			AQL			AQL			AQL		
0.65%	1%	1.5%	1.5%	2.5%	4%	2.5%	4%	6.5%	4%	6.5%	10%
281	151	91	281	151	91	151	91	26	1201	151	26

Thus the smallest lot sizes for the usual CV4000 Specifications, when amended by the change of IA to S-4 and IC to S-2, would be 281.

For lot sizes between 151 and 500, where individual and combined AQL's are specified, only the combined AQL shall be used. Where no combined AQL is specified the individual AQL's shall be increased as follows:-

for Inspection Level II — 1% AQL
" " I - 2.5% AQL
" " S-4 - 4.0% AQL
" " S-2 - 6.5% AQL

For lot sizes between 91 and 150, the combined AQL's for electrical tests in Group B shall be increased to 1.5%, in Group C shall be increased to 4% and in other Groups, 2.5% AQL shall be increased to 4% and 6.5% increased to 10%.

/For lot

For lot sizes below 91, deferred acceptance can be applied over 4 or 5 consecutive lots, as follows:-

Group B	8 valves per week, 1 reject allowed over 4 weeks.
Group C	3 valves per week, 1 reject allowed over 4 weeks.
Group D	2 valves per week, 1 reject allowed over 4 weeks.
Group E	As for Group D
Group F (Life Tests)	4 valves per week. If no failures have occured at the end of the fourth week in any of the life test valves, accept the first lot and remove the valves from test. If no failures have occured at the end of the fifth week, accept the second lot, and so on, until the fourth lot has been accepted at the end of the eighth week. Continue acceptance if there is no more than one failure in any group of 16 individuals tested. Alternatively, test three valves over a five week period. (The first procedure gives a life test time of approximately 640 hours and the second 800 hours).

2.6.3. Production Rate Less than Fifty Valves Per Week. Since the test sampling procedures described above are not applicable to a rate of manufacture of less than fifty valves per week, the Test Specification or contract documents will indicate where 100% testing shall not be used and will specify the requirements for the destructive tests for such cases.

JOINT SERVICE SPECIFICATION K1001

APPENDIX X

MECHANICAL TEST APPARATUS

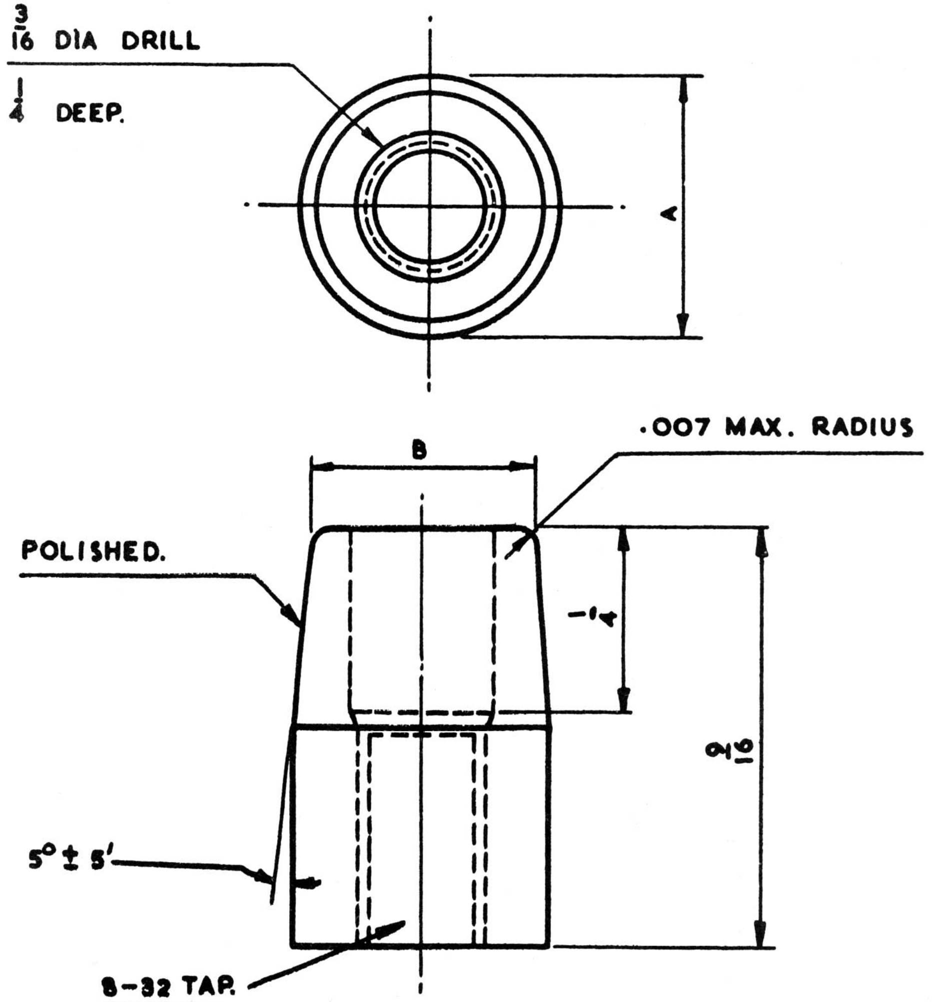
GENERAL

This Appendix specifies certain apparatus necessary for the mechanical testing of electronic valves.

CONTENTS

DRAWING No. 1.

DEFLECTION CONE FOR MINIATURE VALVE BASE STRAIN TEST.



MAT$^{L.}$ STAINLESS STEEL.

DEFLECTION CONE.	VALVE TYPE.	DIMENSION A.	DIMENSION B.
A	B7G	·375 ± ·002 DIA.	·325 ± ·002 DIA.
B	B9A	·468 ± ·002 DIA.	·418 ± ·002 DIA.

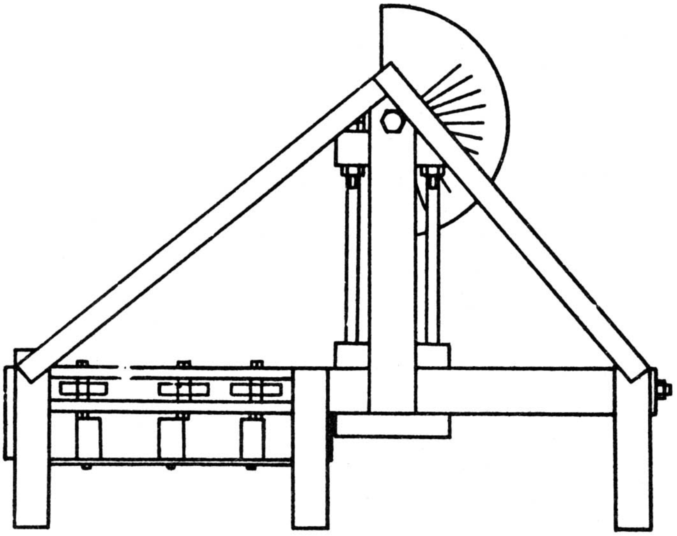
NOTE:- VARIATIONS ON FRACTIONAL DIMENSIONS SHALL BE, UNLESS OTHERWISE STATED, 1/4 OR LESS ± ·008, OVER 1/4 ± ·015

DIMENSIONS IN INCHES.

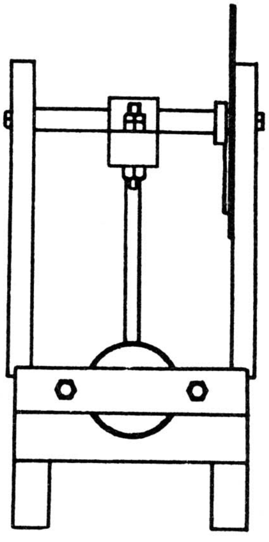
DRAWING No. 2

SHOCK TESTING MACHINE

ILLUSTRATIVE ONLY



SIDE VIEW



END VIEW

NOTE

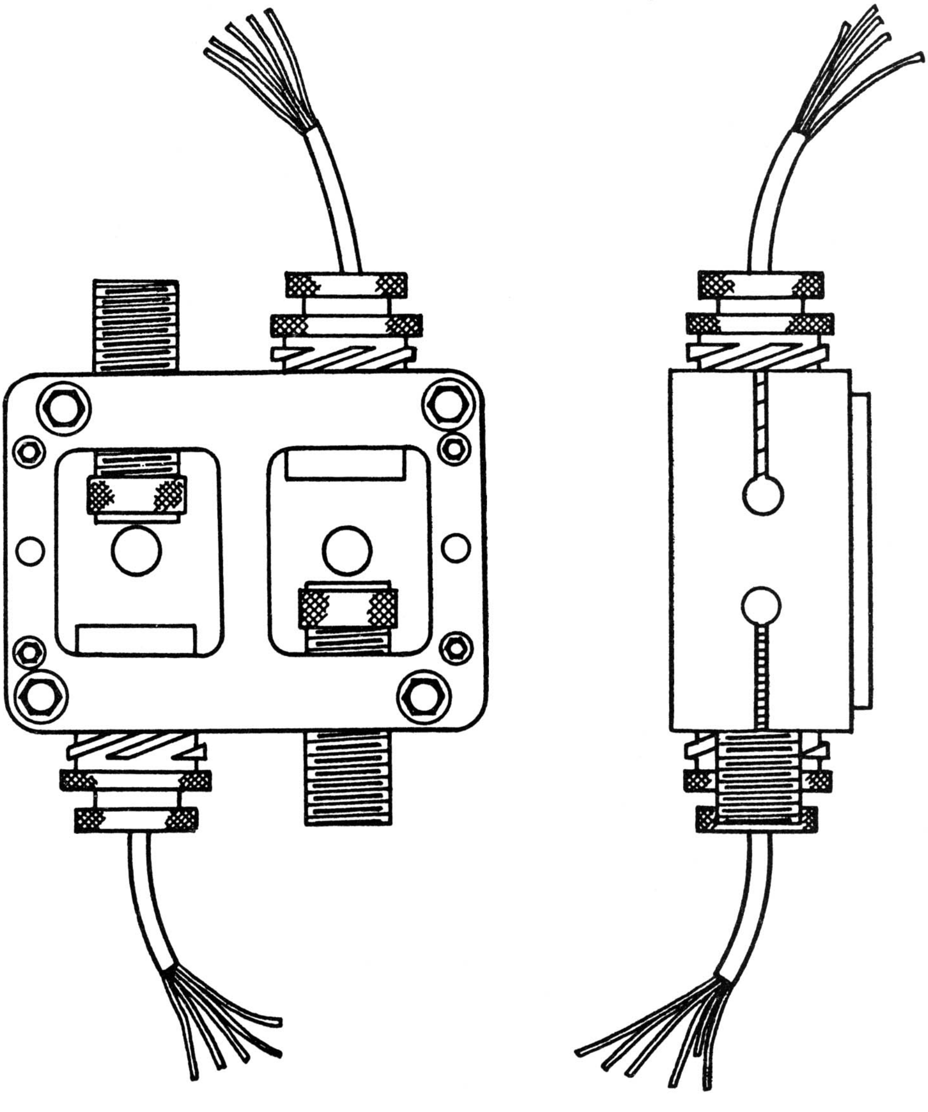
FOR FURTHER INFORMATION APPLY TO : -

THE OFFICER-IN-CHARGE,
SERVICES VALVE TEST LABORATORY,
ADMIRALTY,
HASTE HILL,
HASLEMERE, SURREY.

DRAWING No. 3.

VALVE HOLDER FOR SHOCK TESTS

ILLUSTRATIVE ONLY



NOTE

THESE ILLUSTRATIONS HAVE BEEN EXTRACTED FROM DRAWING 184—JAN. FOR FULL DETAILS AND CONSTRUCTIONAL DRAWINGS APPLY TO THE TVC OFFICE.

2. MICROPHONY IMPACT TESTER

2.1 The Microphony Impact Tester is suitable for testing miniature and sub-miniature valves. It subjects the valve under test to an impact of 50g with a sensibly sine-wave distribution - see figure 2 below.

2.2 The Block schematic shows the arrangement of the equipment. It consists of a light hammer freely pivoted about a horisontal axis and is electro-magnetically released to strike a duralumin block upon which the valve under test is rigidly clamped. The block is resiliently mounted upon foamed neoprene of suitable mechanical characteristics and in order to eliminate high order frequencies from the acceleration impulse the impact is given to the block through a thin rubber plug fitted to the hammer head. The hammer and block are calibrated to give 50g on standard type equipment. The microphony transient voltage output from the valve is measured on a peak to peak indicator, see figure 1.

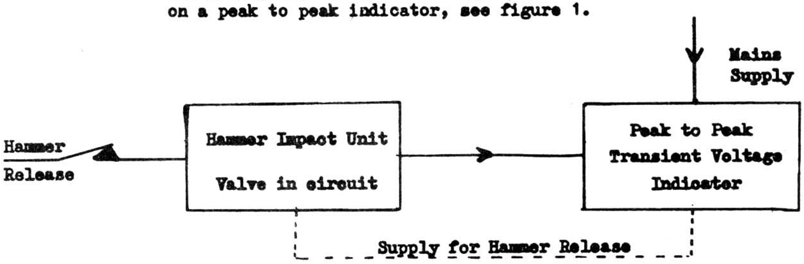
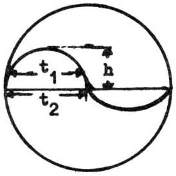


FIG. 1



t_1 at $\frac{1}{2}$h = 200 µS (approx)

t_2 at 0h = 350 µS (approx)

h = 50g

FIG. 2

2.3 The hammer with its rubber plug and the block with its rubber pad will be periodically returned to the design authority for check calibration. It is essential that the bearings of the hammer arm are regularly lubricated.

2.4 The operation of the peak to peak transient voltage amplifier/indicator is more fully described in Clause 4.2. of Appendix XII.

3. VIBRATION NOISE TESTING

3.1 The valve shall be vibrated in the specified directions at the required frequency. The required frequency and specified acceleration shall both be adjusted to an accuracy better than 10% of their stated values.

3.2. The waveform of the vibration shall be sensibly sinusoidal with a total harmonic distortion of not more than 5% at any frequency within the range.

3.3. Where the swept frequency vibration test is specified, the rate of change of frequency shall not exceed one octave per minute from 25 c/s to 200 c/s and 100 c/s per minute between 200 c/s and 500 c/s and 250 c/s per minute between 500 c/s and 2.5 Kc/s.

Where approved high sensitivity recording equipment is being used the rate of sweep shall not be less than 15 seconds per octave up to 200 c/s and not greater than 45 seconds per octave above 200 c/s and up to 2.5 Kc/s.

The time of rise of the indicator to full-scale deflection shall not be greater than one fiftieth (1/50) of the sweep time per octave up to 200 c/s and not greater than one one hundred and fiftieth (1/150) of the sweep time per octave above 200 c/s and up to 2.5 Kc/s.

3.4. The acceleration shall be measured using a barium titanate acceleromter mounted rigidly adjacent to the valve and capable of monitoring acceleration during actual test. The accelerometer shall not possess a resonance below 20 Kc/s.

3.5. The accelerometer and its associated amplifier shall be calibrated at 50 c/s and at the lowest frequency to be used in the test.

3.6. The output from the accelerometer and its associated amplifier shall be constant for constant g to within ± 0.5 dB over the range 40 c/s to 2.5 Kc/s and within ± 2 dB at 25 c/s.

3.7. The valve under test shall be rigidly mounted on the vibration table by means of a clamp. The table shall be of approved construction giving a minimum of spurious vibrations or resonances in the specified frequency range.

JOINT SERVICE SPECIFICATION K1001

APPENDIX XI

ACCEPTANCE SAMPLING

GENERAL

Acceptance sampling is divided into two systems. One determines the acceptance of valves on a qualitative basis and tests are made on a go-no-go principle. This is called Acceptance Sampling by Attributes and the sampling plans and procedures for this system are given in Defence Specification DEF-131A. as implimented by Section 1 of this Appendix.

In the second system, measurements are made to determine where the characteristics lie with respect to the upper and lower specification limits, and also to determine the spread of these characteristics. This system is called Acceptance Sampling by Variables and the sampling plans are fully detailed in Section 2 of this Appendix.

Acceptance Sampling by Attributes shall be used when an inspection level and an A.Q.L. are acceptance inspection conditions in the Test Specification.

Acceptance Sampling by Variables shall be used when a variables inspection level, acceptance limit for sample dispersion, upper and lower limits for averages of samples are quoted, or as otherwise stated in the Test Specification.

SECTION I SAMPLING INSPECTION BY ATTRIBUTES

1 General

Unless otherwise specified by the Authority the statistical sampling procedures and tables used shall be those specified in DEF-131A.

1.1. Unit of Product

The unit of product is as defined by the detail specification.

1.2. Consecutive Lots

Consecutive lots are lots following in an uninterrupted succession submitted for acceptance when obtained from continuous production.

1.3. Continuous Production

Continuous production prevails when:-

(a) There has not been any change of design affecting Qualification Approval.

(b) There has not been any change in the place of manufacture.

(c) There has not been any break in production exceeding one month (or a longer period if approved by the Authority).

2./

2. Table of Cross-reference of Inspection Levels.

For Test Specifications issued prior to June 1966, the following cross-reference tables shall be used:-

K1001/App. XI, Sect.1 (for reference purposes)	DEF-131	DEF-131A
III	III	III
II	II	II
I	I	I
IA	IA	S-4
IB	IB	S-3
IC	IC	S-2
	L1, L2	S-1
	L3, L4	S-2
	L5, L6	S-3
	L7, L8	S-4
	Code Letter I	Code Letter H
	Code Letter O	Code Letter N
	All other Code Letters	Same Code Letter
	All A.Q.L.'s	Same A.Q.L.'s
	Code Letter and Sample Size	Sample size from same Code Letter

SECTION 2. ACCEPTANCE SAMPLING BY VARIABLES

1. GENERAL

The following information on Acceptance Sampling by Variables has been extracted from various sources including "Control Chart Method of Controlling Quality during Production" American War Standard, April, 1942, "Quality Control Handbook" - J.M. Juran, and "Proposed Inspection Manual for Use in Conjunction with JAN-1A for the Acceptance Sampling of Reliable Tubes" - JETEC, March, 1952.

1.1. Purpose

This section of the Appendix establishes various methods and procedures for Inspection by Variables. It is intended for use in the determination of the acceptability of electronic valves supplied under Government contract.

2. GLOSSARY OF SYMBOLS AND TERMS

The following list of symbols, abbreviations and definitions will be found useful in the general appreciation of Sampling by Variables.

N	the number of valves in a lot
n	the number of valves in a sample
m	the number of sub-groups in a sample (There are generally five valves per sub-group)
X	the observed value of a quality characteristic. Specific values are designated X_1 , X_2 - - - X_n .
$\bar{X}$	the Average or Arithmetic Mean of n observed values.
$\bar{\bar{X}}$	the average of the last 10 sample averages or Process Average. $\bar{\bar{X}} = \dfrac{\bar{X}_1 + \bar{X}_2 + - - - \bar{X}_{10}}{10}$
x	the deviation of X from the average $\bar{X}$
i	the Class Interval between values of X.
R	the Range. The difference between maximum and minimum values of X in a sub-group.
$\bar{R}$	the average value of the ranges R for m sub-groups in a sample.
$\bar{\bar{R}}$	the average value of the ranges $\bar{R}$ for the last 10 samples.
s	the Standard Deviation for a sample of values X_1, X_2, - - - X_n about their mean value, $\bar{X}$ $s = \sqrt{\dfrac{(X_1 - \bar{X})^2 + (X_2 - \bar{X})^2 + - - - - (X_n - \bar{X})^2}{n}}$ and $s' = s\sqrt{\dfrac{n}{n-1}}$ where s' is the best estimate or σ , the Standard Deviation of the Universe.

Note: The Acceptance Limit for Dispersion may be estimated in other simpler ways. See sub-para. 3.7.1.

MEDIAN	the middle figure when results are tabulated according to ascending order of magnitude.
MODE	the value of the maximum of a frequency histogram.
DISPERSION	generally means Standard Deviation
MRSD	Maximum Rated Standard Deviation. This will be quoted on the Test Specification.
NORMAL DISTRIBUTION	an essentially uniform, symmetrical and uni-mode distribution.
SKEWNESS	defined as the degree to which the distribution is not symmetrical.
KURTOSIS	defined as the degree of "flatness" of the distribution.
ALD	Acceptance Limit for Sample Dispersion. The ALD shall be computed so that the probability of acceptance is 95% for a lot whose standard deviation is equal to the MRSD.
USLA	Upper Specification Limit for Averages of acceptable lots.
LSLA	Lower Specification Limit " " " " "
UAL	Upper Acceptance Limit for average of samples.
LAL	Lower " " " " " "
VIL	Variables Inspection Level. This is an index of the ability of a variables sampling plan to distinguish between good and bad lots.
a	a factor used in the computation of the ALD. It is a factor which converts sampling variations in terms of s into sampling variations in terms of range, and has been derived to give 95% assurance of acceptance if s is equal to the specified MRSD. See Table 1.
k	a factor used in the computation of Acceptance Limits for Sample Averages. It is a factor derived to ensure 95% acceptance of lots, the average of which is equal to the specification limit for averages of acceptable lots. The values of k quoted in Table 1 have been derived from

$$k = \frac{1.64}{n}$$

where 1.64 equals the single tail value equivalent to 5%.

3. PROCEDURE FOR ACCEPTANCE SAMPLING BY VARIABLES

The following simplified procedure has been proposed by the Joint Electron Tube Engineering Council and published in America on 13th March, 1952. This procedure may be required by CV specifications but is subject to change. Alternatively, other acceptance procedures may be used in agreement with the Approving and Inspection Authorities.

3.1. Variables Inspection Level

This shall be designated as an Acceptance Inspection condition on the Test Specification.

3.2. Sample Selection

Each sample shall be selected to represent fairly the quality of the lot. See also Section 1, para. 5.

3.3. Variables Sampling Plan

This plan is suitable for use where the distribution of the characteristics is essentially normal. Table 1 below gives details of sample sizes and multiplying factors for Normal and Reduced Inspection.

Table 1

NORMAL INSPECTION	LOT SIZE						REDUCED INSPECTION
	301-3200			Over 3200			
Variables Inspection Level	n	k	a	n	k	a	
V_1	15	0.42	3.17	25	0.33	2.98	V_1 & V_2
V_2	35	0.28	2.87	50	0.23	2.78	V_3
V_3	110	0.16	2.63	225	0.11	2.54	-

In this tsble the factors k and a have values as defined in para. 2 of this section, and they are used as follows:-

The Acceptance Limit for Sample Dispersion (ALD) is calculated from:-

ALD = a(MRSD)

The Acceptance Limits for Averages of Samples are determined from:-

UAL = USLA + k(MRSD)

LAL = LSLA - k(MRSD)

3.4. Normal Inspection

Sample sizes for Normal Inspection are given in Table 1

3.5. Reduced Inspection

Sample sizes for Reduced Inspection are given in Table 1. Reduced Inspection may be used if the following conditions are satisfied:-

(a) Each lot of the last 20 submitted under either Normal or Reduced Inspection shall have been acceptable;

(b) The Process Average and the Standard Deviation as calculated from samples selected from the last 20 lots, shall fall between the USLA and LSLA, and below the MRSD, respectively.

Normal Inspection shall replace Reduced Inspection whenever the above requirements are not satisfied.

3.6. Non-conforming Lots

A non-conforming lot shall be 100% reprocessed and/or retested by the manufacturer before re-submission to the Acceptance Sampling Test of Variables. The lot may be re-submitted for test by variables for a single non-conforming test item if this test is of such a nature that 100% retesting without reprocessing is sufficient. If the non-conforming test item is of such a nature to require reprocessing and retest, all characteristics of the lot which are specified for variables testing shall be re-inspected by variables.

If the values are considerably off-centre it may be necessary to test to tighter limits than those specified in order to move the average or Median within the limits for acceptance.

3.7. Operation of the Variables Sampling Plan where the Distribution of the Characteristics is Essentially Normal

3.7.1. Test for Lot Dispersion

Select and test a sample of size n as specified in Table 1. Divide the sample into random sub-groups of 5 valves each and determine the range R for each sub-group. Compute the average range $\bar{R}$ for the sample.

If the sample $\bar{R}$ is equal to or less than the ALD, accept the characteristic for dispersion. If $\bar{R}$ is greater than the ALD the lot shall be declared non-conforming with respect to dispersion. If an alternative routine method for determining Standard Deviation is used, this value of Standard Deviation shall be multiplied by 2.33, and the resulting value compared with the ALD.

3.7.2. Test for Lot Average

Using the same sample as in 3.7.1., compute the Average Value or Median Value of the characteristic. If the value of $\bar{X}$ is within, or on, the Acceptance Limits for Sample Averages, accept the characteristic for Lot Average. If the value is outside the acceptance limits, the lot shall be declared non-conforming with respect to the Lot Average.

3.8. Operation of the Variables Sampling Procedure where the Distribution of the Characteristics is Essentially Non-normal

Select the sample as in 3.7.1.

3.8.1. The MRSD need not be specified.

3.8.2. Compute the median value of the characteristic. If this value is on or between the USLA and the LSLA for the characteristic, accept the lot for the characteristic under consideration. If the value is outside the above limits, the lot shall be declared non-conforming for this characteristic.

3.9. Discrimination Values

The use of Variables Inspection Levels permits the specifying body to obtain various degrees of assurance that the specified lot parameters will be met. The discrimination of a Sampling Plan (i,e, the ability to distinguish between good and bad lots) is measured in terms of the number of Maximum Rated Standard Deviations between the process averages of lots which are acceptable 95% of the time and those acceptable 10% of the time. Table 2 shows how discrimination relates to Variables Inspection Level, lot size and type of inspection.

Table 2

NORMAL INSPECTION	Discrimination Values		REDUCED INSPECTION
Variables Inspection Level	LOT SIZE		Variables Inspection Level
	0-3200	Over 3200	
V_1	0.8	0.6	V_1 & V_2
V_2	0.5	0.4	V_3
V_3	0.3	0.2	-

TABLE V SINGLE SAMPLING ONLY

Master Table for Reduced Inspection

Sample Size Code Letter	Sample Size	Acceptance Quality Levels																				
		0.24		0.4		0.65		1.0		1.5		2.5		4.0		6.5		10.0		15.0		25.0	
		Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re
A, B C&D	2	B		B		B		B		0	1	B		B		B		B		1	2	1	2
E	2	B		B		B		B		0	1	B		B		1	2	1	2	2	3	3	4
F	3	B		B		B		0	1	A		B		1	2	1	2	1	2	2	3	3	4
G	5	B		B		0	1	A		B		1	2	1	2	2	3	3	4	3	4	5	6
H	7	B		0	1	A		B		1	2	1	2	2	3	3	4	3	4	5	6	7	8
I	10	0	1	A		B		1	2	1	2	2	3	2	3	3	4	4	5	6	7	9	10
J	15	A		B		1	2	1	2	2	3	2	3	3	4	4	5	6	7	8	9	12	13
K	22	B		1	2	1	2	2	3	2	3	3	4	4	5	5	6	8	9	11	12	14	15
L	30	1	2	1	2	2	3	2	3	3	4	4	5	5	6	7	8	11	12	12	13	16	17
M	45	1	2	2	3	2	3	3	4	4	5	5	6	7	8	10	11	13	14	15	16	20	21
N	60	2	3	2	3	3	4	4	5	5	6	6	7	9	10	12	13	15	16	18	19	24	25
O	90	2	3	3	4	3	5	5	6	6	7	9	10	11	12	14	15	18	19	23	24	A	
P	150	3	4	4	5	5	6	7	8	9	10	11	12	14	15	18	19	23	24	A		A	

SUPERSEDED

Ac = Acceptance number

Re = Rejection number

A = Use next sampling plan above

B = Use next sampling plan below

APPENDIX XII

MEASUREMENT OF VIBRATION NOISE, HUM, HISS AND MICROPHONY

1. GENERAL

This appendix describes amplifier-indicator systems suitable for measuring Vibration Noise, Hum, Hiss and microphony from valves.

The Noise, Hum and Hiss amplifier described in Clause 3, is basically a calibrated feedback amplifier system in which the valve under test forms the first stage. A calibration system is built in. For convenience, the test valve stage is in a small independent chassis unit, separate units being used for different valve types. The system can measure a wide range of amplitudes in the frequency range 50 c/s to 5 Kc/s.

The microphonic output from a valve subjected to impact in the equipment described in Appendix X, Section 2, shall be measured using an amplifier and peak to peak transient voltage indicator as described in Clause 4 of this Appendix.

2. MEASUREMENT OF VIBRATION NOISE, HUM AND HISS

2.1. Vibration Noise Measurement

The noise output from the valve under test shall be measured using an amplifier whose frequency response is 3 dB down on the mid-band gain at 30 c/s and 5.5 Kc/s, the response falling at the rate of approximately 6 dB per octave beyond these points. The amplifier described in Clause 3 below may be used.

2.2. Hum and Hiss Measurement

Hum shall be measured using the special feedback amplifier and indicator described in Clause 3 below.

Hum produced by the valve under test has two main components.

(a) Cathode Hum
(b) Grid Hum

These components are separately assessed by respectively short circuiting the grid resistor and capacitatively by-passing the cathode resistor. In addition, since the Hum components can be produced either by electro-magnetic or electrostatic coupling, each of the above measurements shall be performed by earthing each of the two heater connections in turn.

Hiss is measured under conditions which remove the Hum component by operating the heater on d.c. and at the same time short circuiting the grid resistor and by-passing the cathode resistor with a suitable capacitor.

3. FEEDBACK AMPLIFIER AND INDICATOR

This system is intended basically for the measurement of very low levels of hum and hiss but includes also an alternative condition in which the feedback is removed, making it suitable for normal levels of vibration noise. The amplifier is followed by a rectifier and moving coil type meter.

3.1. Amplifier Details

The Amplifier is intended primarily for the measurement of very low levels of Hum, Hiss and Vibration Noise but is also suitable for higher levels of audio frequency noise.

In the high sensitivity condition the amplifier shown in Figure 2 consists of V_2 and V_3, the valve under test, V_1, being arranged for convenience of operation, on a separate sub-chassis. The basic circuit arrangement for the valve under test is shown in Figure 1.

Overall feedback is applied in order that the readings referred to the input grid can be read directly and they will be unaffected by drift or by mutual conductance variations of individual valves under test.

The gain of the amplifier is adjustable in calibrated steps by means of S2 (Figure 2) which controls the feedback. Table 1 shows the sensitivities at various switch positions for one particular type of valve, namely CV4085. These sensitivities will not be applicable to other valve types but suitable circuit values will be shown in the appropriate valve specification.

For measurement of higher noise levels the output from the test chassis is injected into J1 (Figure 2), the maximum sensitivity then being 5 mV for full scale deflection.

The attenuator S3, which operates under both conditions shown above reduces the sensitivity by a factor of 10 or 100 according to the switch position.

3.2. Amplifier System Sensitivity

The figures shown in Table 1 represent the r.m.s. input voltage required from a sine wave source to give 0.4 full-scale deflection and these sensitivities will be satisfactory for the measurement of Hum and Hiss. For Vibration Noise a reduction of gain may be necessary.

TABLE 1

S2 POSITION	GAIN	R.M.S. INPUT
1	200,000	2 /uV
2	100,000	4 /uV
3	80,000	5 /uV
4	40,000	10 /uV
5	20,000	20 /uV

3.3. Amplifier Frequency Response

The overall frequency response is selected according to the measurement being made. For low frequency Hum measurement, the high frequency Hiss component can be rejected by a simple low pass filter which is brought into circuit by S4 (Figure 2).

Two frequency characteristics are thus available, one for Hum and the other for Hiss measurement. During the latter measurement, introduction of a Hum component may be avoided if the heater of the test valve is operated on d.c. provided by an external accumulator and selected by S5 (Figure 2). A graph of the frequency response characteristic is shown in Figure 4.

3.4. Amplifier System Calibration

If close tolerance components are employed as indicated in the theoretical circuit diagrams and also as indicated in the specification for the test valve circuit, the overall gain in the high sensitivity condition should be within 5% of the indicated values as shown in Table 1.

The overall gain may be checked by means of the calibration input provided on the test valve sub-chassis. Application of a sinusoidal voltage of 0.5V r.m.s. at 1000 c.p.s. through 1 megohm to the test socket with S3 set to X1.0 and with full frequency response of the amplifier should give a full scale deflection of the meter in position 1 of Switch S2. The amplifier will read r.m.s., correctly but only for sine wave inputs, owing to the form of meter used. The use of this form of meter is desirable for the sake of robustness.

3.5. Amplifier Arrangement for Vibration Noise Measurement

The valve shall be operated at the specified frequency and acceleration whilst it is being held rigidly on the vibrating table with screened flexible leads making connection from the valve under test to the valveholder of the test valve sub-chassis operating under the specified circuit conditions. The output from the test valve chassis shall be connected through a short length of co-axial cable to the input Jack J1 on the main amplifier, the amplification at this point of the circuit being appropriately reduced. Since feed-back is removed when thus operating, re-calibration will be necessary with each individual valve tested using the injection socket of the test valve sub-chassis as before.

3.6. Amplifier Construction Details

The performance is critically dependent on the detailed layout of the sub-amplifier unit (Figure 3). A unit built closely to the design shown can be expected to give results in close agreement with those from the prototype, but it is recommended that a check be made with the equipment held at S.V.T.L. Haslemere.

The three basic circuits consist of:-

(a) Valve Test Circuit Unit 1. (Figure 1).
(b) Amplifier)
  and) Unit 2 (Figure 2).
Indicator)

4. MICROPHONY TEST AMPLIFIER AND INDICATOR

This equipment consists of two main units:-

(a) Test Valve Unit.
(b) Peak to Peak Transient Voltage Indicator.

4.1. Test Valve Unit

This unit consists of a single stage with the valve to be tested connected as an amplifier. This circuit is mounted directly under the hammer unit in order to minimise lead length and also to allow easy modification of the circuit arrangement by inter-connection plugs for each valve type being tested. A suitable circuit will be given in the appropriate individual test specification.

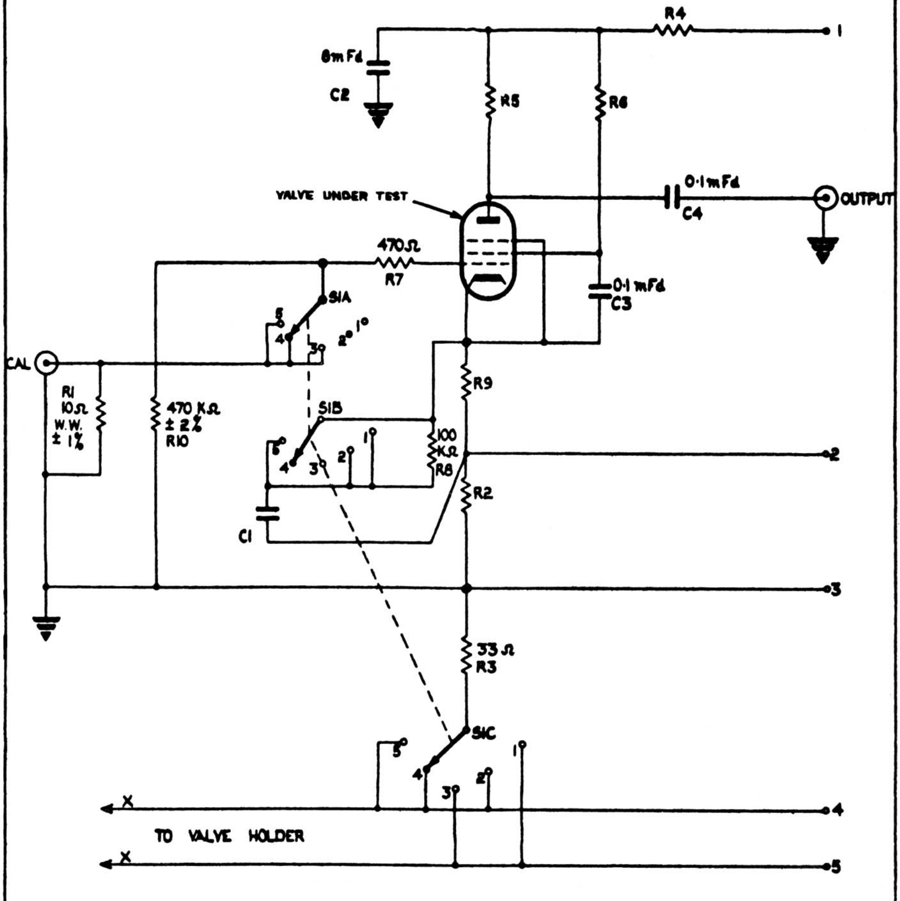
4.2. Peak to Peak Transient Voltage Indicator

In addition to a single stage amplifier and indicator, this unit contains a small stabilised power supply feeding both the unit and the test valve unit.

The peak to peak indicator consists of a single stage Pentode amplifier coupled into a phase inverter, the outputs from which are rectified and thus generate two d.c. voltages proportional to the peak of the positive and negative half cycles respectively to the applied waveform. These outputs are added in a double cathode follower the output of which feeds direct to the meter. The circuit arrangement ensures that the meter reading remains as long as the hammer operating switch is depressed. A suitable circuit is shown in Figure 5.

FIG.1 VALVE TEST CIRCUIT

(BASIC ARRANGEMENT FOR PENTODE)



Positions 1 & 2 Grid Hum

Positions 3 & 4 Cathode Hum

R2 Feedback Res. W.W., ±1%
R4 H.T. Dropper Res.
R5 Anode Res. H.S. Close Tol.
R6 Screen Res., H.S. Close Tol.
R9 Cathode Bias Res., H.S. Close Tol.

Position 5 Hiss

The value of these resistors depends on the type of valve being tested.

FIG.2. AMPLIFIER & INDICATOR UNIT. UNIT 2.

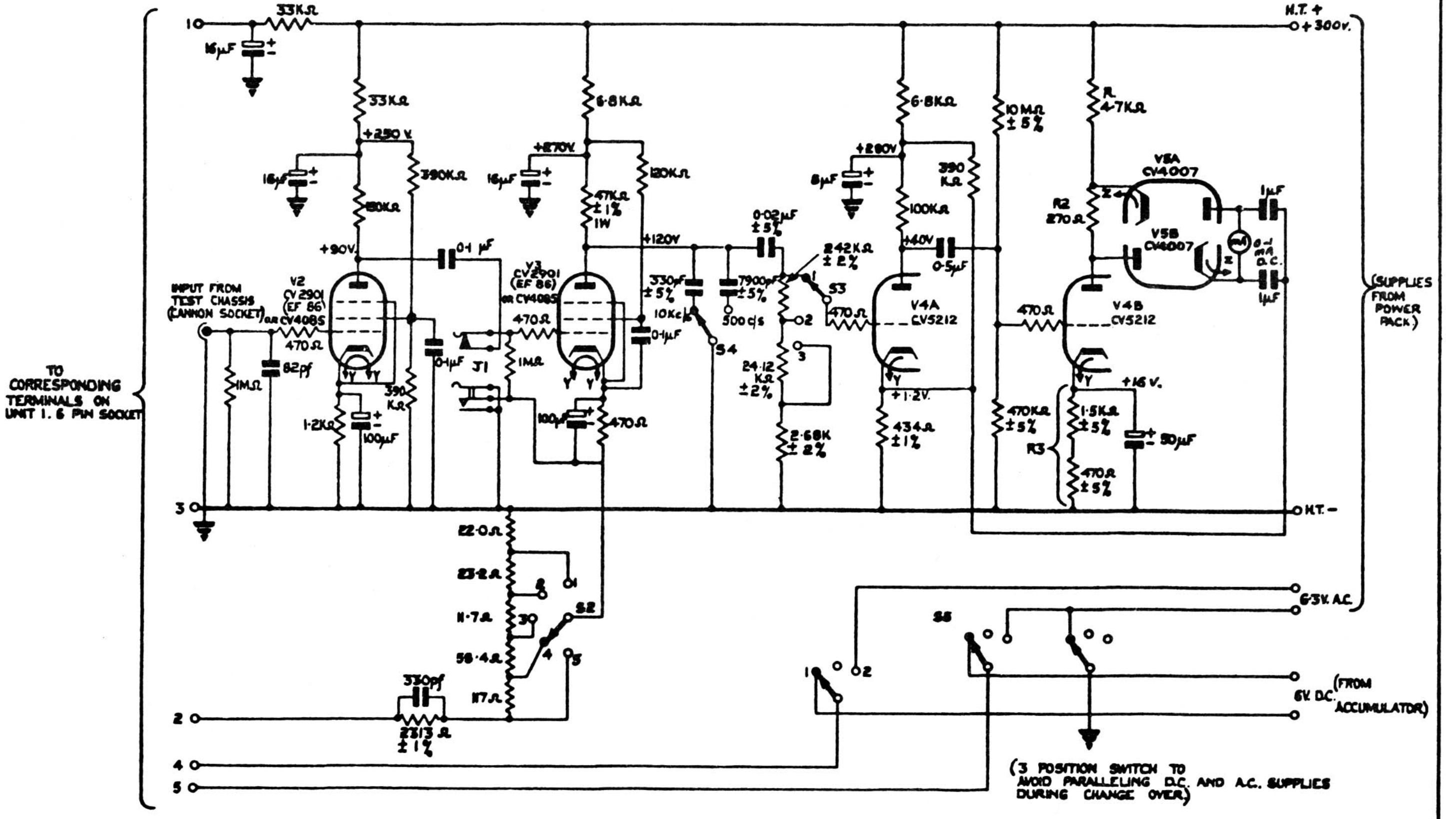
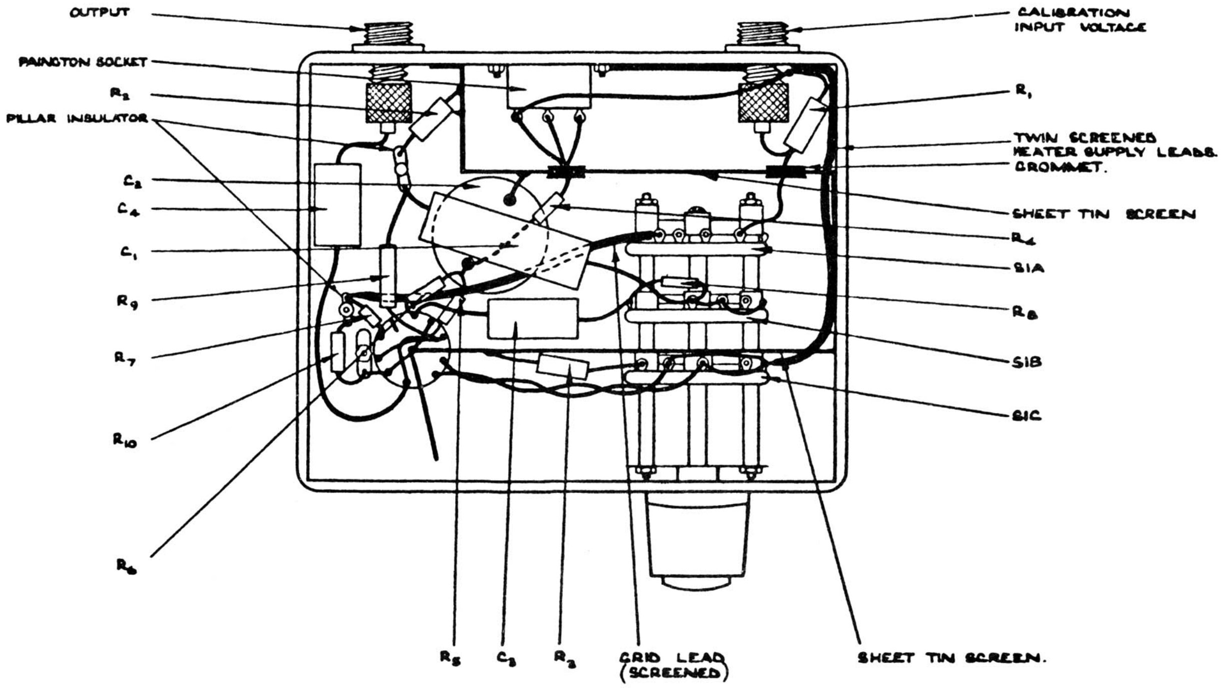


FIG. 3. WIRING & COMPONENT LAYOUT OF UNIT I.



AMPLIFIER FREQUENCY RESPONSE

FIG. 4.

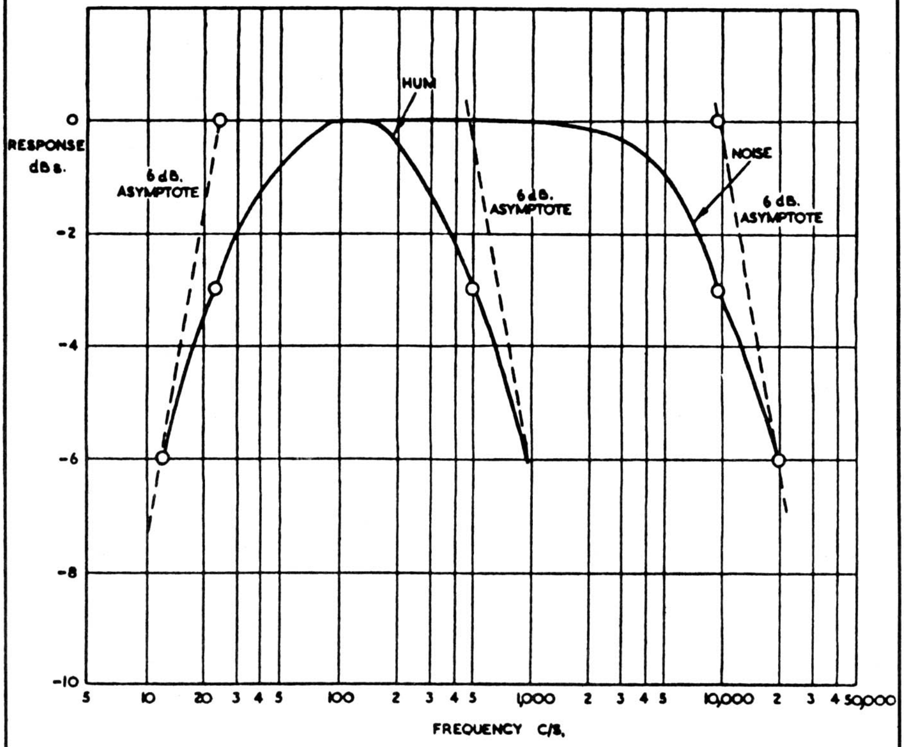
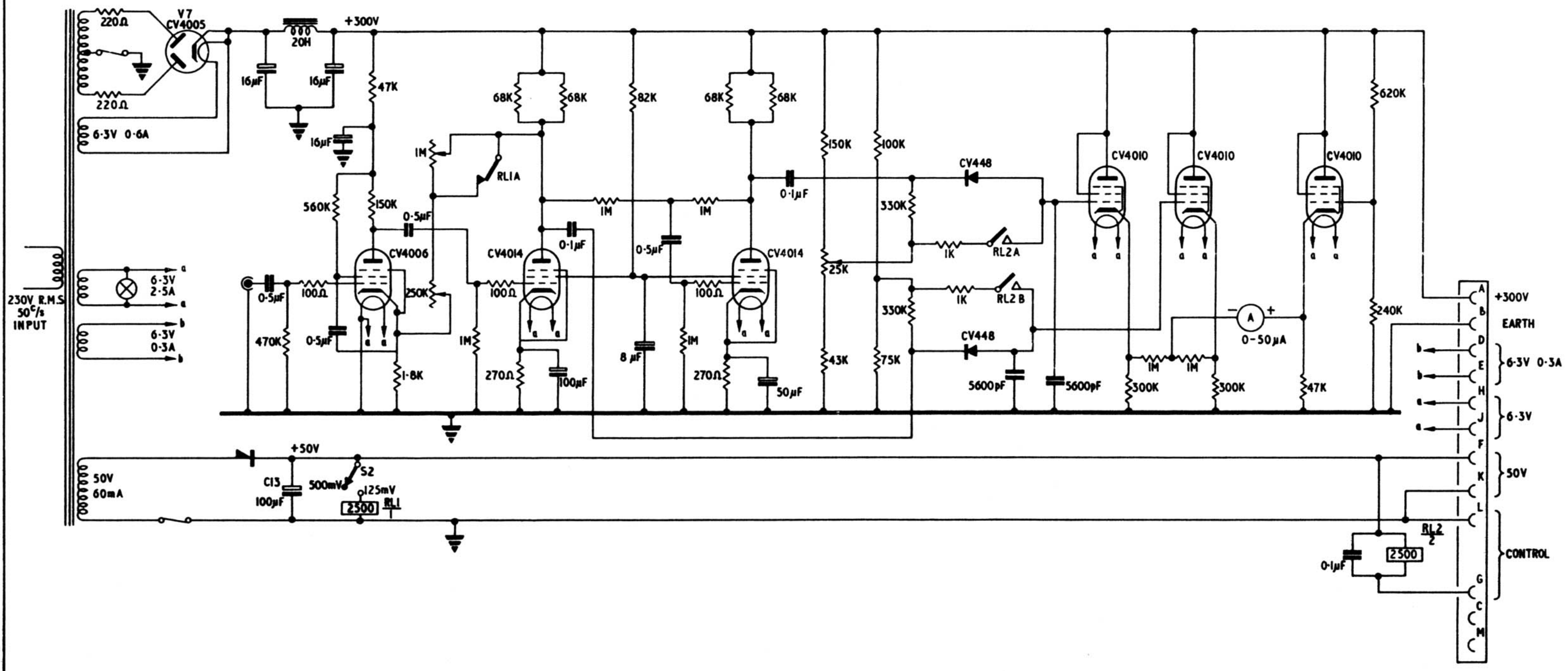


FIG. 5 PEAK TO PEAK TRANSIENT VOLTAGE INDICATOR



APPENDIX XIII

MEASUREMENT OF NOISE FACTOR

1. Definition of Noise Factor.

The noise factor F of an amplifier is defined numerically by the expression:

$$F = \frac{S_1/n_1}{S_2/n_2}$$

where S_1/n_1 is the available signal-to-noise power ratio at the amplifier input and S_2/n_2 is the available signal-to-noise power ratio at the amplifier output when the temperature of the source is standard i.e. 290°K.

The "term available" power implies the maximum power which can be obtained from a source.

The noise factor may also be expressed in decibel notation as:

$$F = 10 \log_{10} \frac{S_1/n_1}{S_2/n_2}$$

In present usage, noise factor, and noise figure are synonymous.

Noise Temperature T_F in degrees Kelvin and Noise Factor F are related by the expression:

$$T_F = (F - 1)\ 290$$

2. General

Unless otherwise specified, noise measurements are to be made by the dispersed signal source method. The source is usually a temperature limited diode. This noise source is satisfactory up to the frequency at which transit time and lead inductance effects become significant; with present diodes this is in the region of some hundreds of Mc/s. For higher frequencies, noise discharge tubes may be used. The specification will state the type of source to be used.

A general outline of the test equipment is shown in block diagram form in fig. 1.

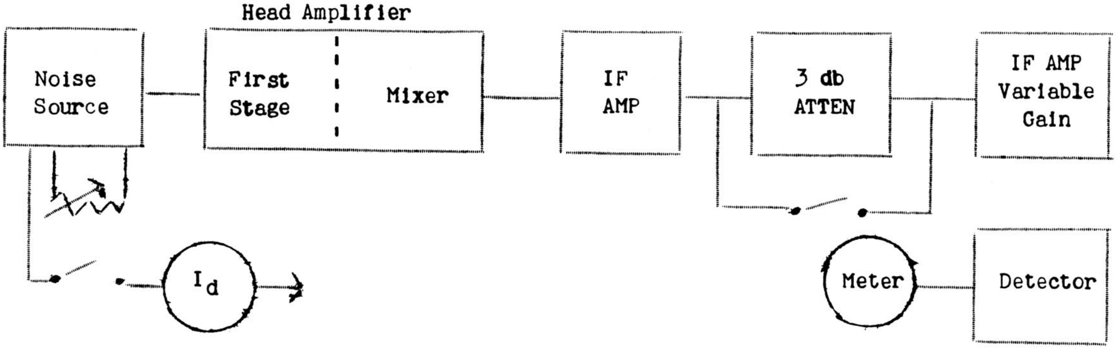


Fig. 1.

The valve to be measured for noise factor comprises the first stage of a receiving system which will be specified.

The overall noise factor of the system is given by:

$$F = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 G_2} + \text{-----} \frac{F_r - 1}{G_1 . G_2 . \text{------} G_{(r-1)}}$$

Where F_r = the numerical value of the noise factor of the r^{th} stage when fed from a source impedance equal to the output impedance of the $(r - 1)^{th}$ stage

$G_{(r-1)}$ = the numerical value of the available power gain of the $(r - 1)^{th}$ stage.

Usually the gain of the first stage is made sufficiently high so that the noise arising from succeeding stages will be negligible. In addition the bandwidth of the first stage must be wider than that of all the following stages.

For certain systems, where this condition cannot be obtained it is usual to measure the overall noise factor of the system. In these cases, if it is desired to measure the noise factor of the valve itself, it is necessary to measure the gain G_1 of the first stage and the noise factor F_2 of the second stage and make corrections in accordance with the above equation.

The specification will state:

(a) the input coupling conditions and whether these conditions shall be adjusted for optimum power match or for optimum noise factor

(b) the frequency of measurement

(c) the bandwidth of the system

(d) the gain of the first stage when this is required to be specified.

3. Methods of Measurement.

The noise factor may be measured, when specified, by one of the methods described in the following paragraphs.

The measurement is made by comparing the noise output of the first stage of a receiving system with an equal amount of noise produced by the noise source i.e. the input to the receiver from the noise source is adjusted until it exactly doubles the noise output of the first stage. This is achieved by the use of an amplifier, detector and output indicating meter.

Either the law of the detector must be known so that an accurate doubling of noise input power can be obtained or, alternatively, some device must be used to eliminate the effect of this law.

In the methods described below, this has been done by the use of a calibrated attenuator, in method A and by the use of two similar noise sources and an output meter shunt in method B.

If a saturated noise diode is used as the noise source and the diode anode current is measured, the noise factor F of the system is calculated from the formula:

$$F = \frac{e}{2\ KT} I_d R$$

where e = electron charge (1.60 x 10^{-19} coulomb)

k = Boltzmann's constant (1.38 x 10^{-23} joule per degree)

T = temperature of the source resistor in ^{o}K

I_d = anode current of the noise diode in amperes

R = value of the source resistor in ohms.

For a source resistor temperature of $290^{o}K$, this formula reduces to:

(1) numerically, $F = 20\ I_dR$

(2) in db notation, $F = 10 \log_{10} (20\ I_dR)$

3.1 Method A

This method is shown in fig. 1. It uses a passive power halving attenuator as early in the system as is practicable where the signal level is small enough to avoid any errors due to circuit nonlinearities. Such an attenuator can be calibrated by standard methods external to the circuit. The attenuator must not affect the frequency response of the system and must be correctly matched into the amplifier.

The output indicating meter is required to indicate a standard reference reading at some arbitrary power level.

With the noise diode switched off, the output meter is set to the standard reference reading by adjustment of the gain of its auxiliary amplifier. The diode is then switched on and the attenuator is switched into circuit. The diode anode current is adjusted by control of the diode filament supply until the output meter is again set to the same mark. The noise factor is then calculated from the above formula.

3.2 Method B

This method is shown in fig. 2 and uses a calibrating unit and an output meter shunt. The calibrating unit consists of two saturated diodes, each with its own amplifying system with outputs connected to a common output. The noise outputs of the diodes must be considerably greater than the noise outputs of the amplifiers so that the latter have no effect on the calibration.

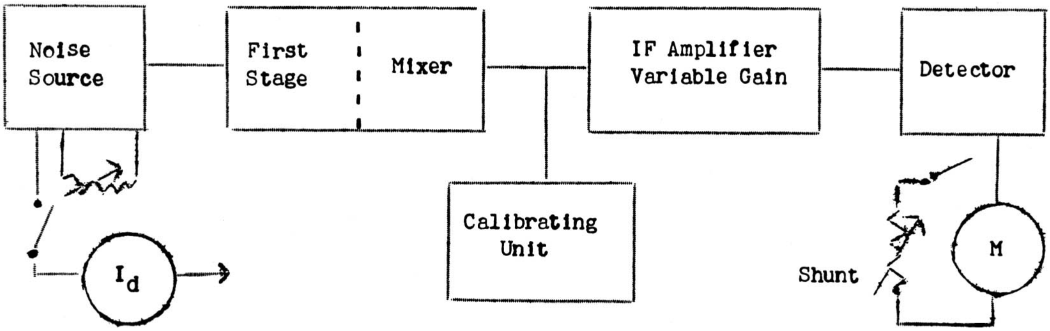


Fig. 2

With a typical valve in the test position, the gain of the receiver system is adjusted to give a suitable reading on the output meter. This reading becomes the standard reference reading.

3.2.1 Receiver calibration

The receiver is calibrated by feeding the calibrator unit into the IF amplifier with one of the calibrating noise sources operating and the gain of its associated amplifier is adjusted until the reading on the output meter is equal to the standard reference reading obtained with the valve under test. With the second calibrating noise source switched into circuit in place of the first, its associated amplifier is also adjusted to give the same standard reference reading. This results in the equalisation of the two calibration noise sources.

Both noise sources are then switched on together doubling the noise input to the receiver. The shunt across the output meter is adjusted until the deflection is exactly equal to the standard reference reading.

The receiver and shunt are now calibrated.

3.2.2 Valve test

The Calibrator unit is removed and the valve to be tested is connected into circuit and the meter shunt removed. The gain of the IF amplifier is adjusted to give the standard reference reading on the output meter. With the noise source switched on and the meter shunt connected in circuit, the noise source is adjusted to give the standard reference reading on the output meter. The anode current of the noise diode is measured and the noise factor of the amplifier calculated.

3.3 Precautions for Methods A and B

1. It is essential to stabilise both the noise diode anode voltage and filament voltage supplies against mains voltage fluctuations, and to take adequate precautions to eliminate, by suitable filtering, any radio frequency signals which may be present on the outputs from these supplies.

2. It is usually advisable to provide a well screened enclosure or room, for the measuring equipment and the operator, and to provide adequate radio frequency filtering for the mains power supply, where they enter the screened enclosure or room.

3. For absolute measurement it is essential to maintain the temperature of Noise Source Resistance at 290°K or to make correction for any difference from this temperature. Arrangements should be made to maintain the test amplifier at a constant temperature which should be recorded.

4. The noise generator must be designed to have an output impedance equal to that of the source used with the circuit under test.

The value of source resistance must be accurately known. This source resistance consists of a resistor shunted by a tuned circuit, the effect of which may not always be negligible. Therefore, it is necessary for absolute measurements, to be able to ascertain the dynamic impedance represented by this tuned circuit and thus calculate the resultant value of source resistance which will be the true value for noise factor measurements.

Frequent checks of the value of the source resistor should be made to eliminate errors due to its value altering with time due to resistor ageing, etc.

It is essential to provide the best possible coupling between the noise source resistor and the input terminals of the test amplifier to obtain minimum noise factor. This coupling is not necessarily the same as that for the best impedance match.

The actual noise factor of the tube or valve will be somewhat lower than the measured value due to various losses, such as those occurring in the matching transformer, etc.

5. It is essential to measure the noise diode anode current with the best possible accuracy and to make frequent checks of the accuracy against some standard.

3.4 Method C

The use of gas discharge noise sources at frequencies above several hundred megacycles - to be included.

APPENDIX XIV

MODULATOR DESIGN AND RATE OF RISE OF VOLTAGE IN MAGNETRON TESTING

1. THE MEASUREMENT OF RATE OF RISE OF VOLTAGE

The most convenient method of measurement of the instantaneous value of the rate of rise of voltage (as required by section 5.F.2.5.5.) is by means of a differentiating circuit, the amplitude of the output being measured on a cathode ray tube using a calibrated shift voltage. This avoids errors due to X-Y coupling and other defects in the C.R.T., the need for a linear time base with accurate time calibration, and the difficulty of accurate measurement of the slope of the resulting trace.

The most convenient type of differentiator is the CR circuit (Fig.1)

The type of waveform obtained is shown in Fig.2.

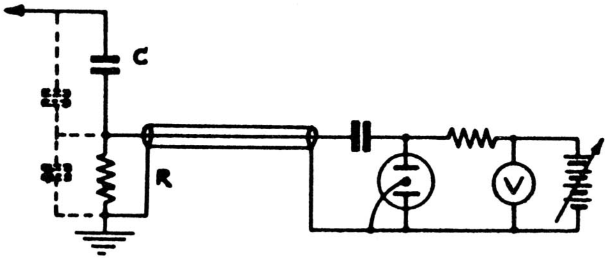


FIG. 1

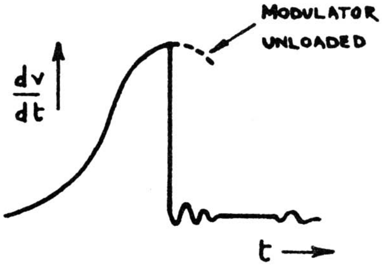


FIG. 2

Errors can arise due to the inductance of the resistor, stray capacitance across the resistor or the capacitor, and reflections in the cable (if any) connecting the C.R. circuit to the C.R.T.

Grade I Carbon Resistors Pattern CT3 of RCL 112 have been found suitable; the lowest wattage permitted by the conditions should be used. Errors due to the cable can be minimised by making R equal to the characteristic impedance of the cable.

It is an advantage to use a vacuum or oil-filled capacitor because the reduced bulk thus obtainable enables the stray capacitance across the resistor to be minimised.

The time constant of the stray capacitance with the resistor should not exceed about one tenth of the rise time of the pulse.

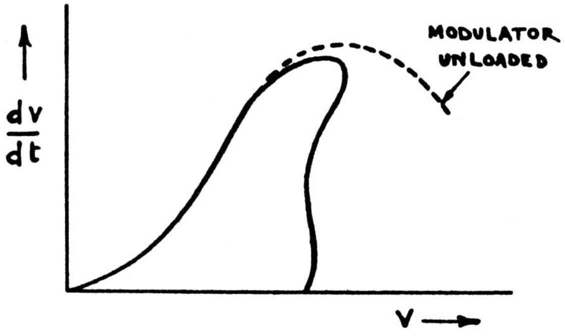
The differentiating capacitor should be screened to limit shunting stray capacitance from other conductors forming part of the high voltage circuit of the modulator.

The change in the rate of rise of the modulator due to connection or removal of the differentiator must be taken into account.

2. CORRELATION OF THE INSTANTANEOUS RATE OF RISE OF VOLTAGE WITH THE INSTANTANEOUS VOLTAGE.

To determine the instantaneous rate of rise at a particular voltage (as required by section 5.F.2.5.5) it is convenient to connect the output of the differentiator to one pair of plates of a C.R.T., with the voltage reduced with a potential divider, to the other pair. The type of trace is shown in figure 3.

FIG. 3



The measurements should be made using calibrated shift voltages.

The potential divider is required to pass the leading edge of the pulse without distortion; a capacitance divider with a suitably short connecting cable is indicated.

The total delay times of the X and Y paths must be made equal to a suitable degree allowing, in the case of very short rise times, for the transit time of the C.R.T.

3. THE DESIGN OF TEST MODULATORS HAVING DESIRED CHARACTERISTICS IN RESPECT OF RATE OF RISE OF VOLTAGE.

In network type modulators, the value of the rateof rise can be controlled by varying either the inductance in series with the discharge circuit or the capacitance shunted across the load. When it is permissible to neglect the effect of strays other than those which can be included in the total series inductance and the total shunt capacitance of the circuit so that the circuit becomes as shown in Fig. 4, the shape of the rate of rise/voltage characteristic is a function of $\sqrt{\frac{L}{C}} / Z_0$ as shown in Fig.5.

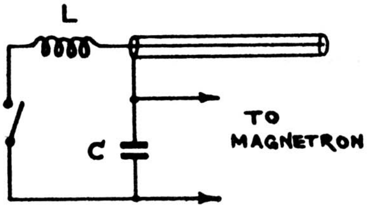


FIG. 4

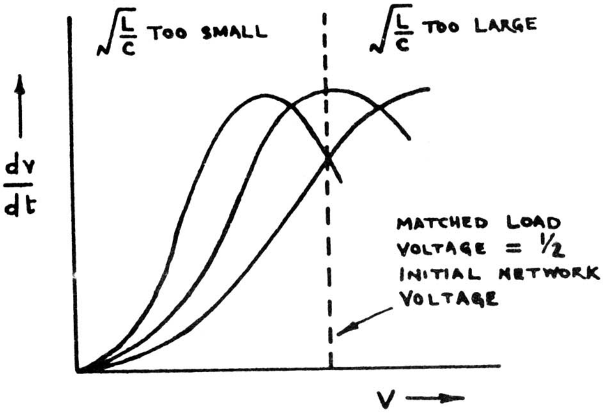
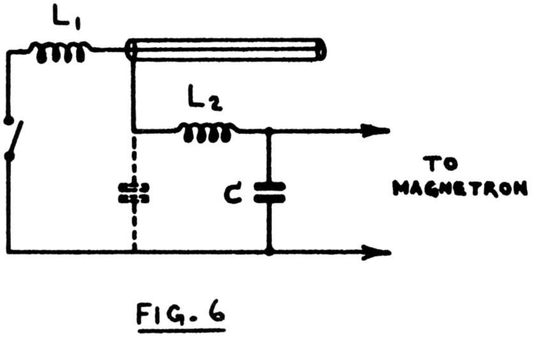


FIG. 5

The rate of rise/voltage trace may depart from the shapes shown in Fig.5 due to the effect of strays which have been neglected. In particular, excessive capacitances of the pulse forming networth to earth, together with too high a ratio $\frac{L_2}{L_1 + L_2}$ (Fig.6) can give rise to a superimposed oscillation, (Fig.7).



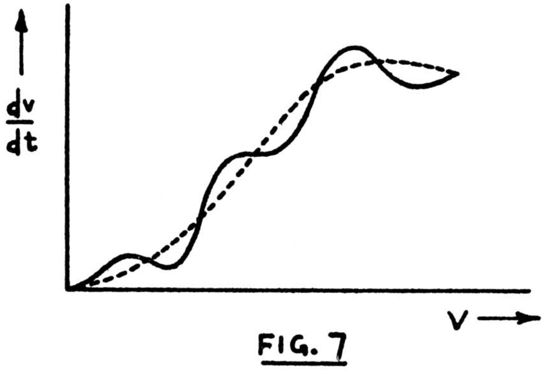


Fig. 6

Fig.7

Similar effects can arise from excessive distributed capacitance to earth of the pulse-transformer windings or excessive strays at other points in the circuit.

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APPENDIX XV

CATHODE RAY TUBES:-

ENVELOPE FACE PLATE AND SCREEN QUALITY

1. SCOPE This Appendix describes defects which may be present in individual tubes.

2. GENERAL INSTRUCTIONS

Inspection is to be made with the unaided eye unless magnification is specified.

3. DEFINITIONS OF GENERAL DEFECTS

3.1 General

Blister - A bubble in the glass due to the inclusion of air having a maximum dimension in excess of that specified in paragraph 5.2 of this Appendix.

Bruise - Crushed or cracked surface, spot or area on glass resulting from an impact with another object.

Bubble - See Blister.

Bulls Eye Top - A thickening of the glass in the centre of the top of a bulb resulting in optical distortion.

Check or Crack - A fissure extending into or through the glass.

Chill Wrinkle - Rippled or wavy surface caused by non-uniform glass flow in the pressing operation.

Cluster - Two or more stones or knots when the minimum separation is not greater than 1/16 inch.

Cord - An attenuated transparent inclusion possessing optical or other properties differing from the parent glass.

Glass Knot - A small transparent area of incompletely assimilated glass having an irregular, knotty or tangled appearance; a transparent stone. The "size" of a knot refers to the maximum linear dimension in its most distinct contour. A "cluster" of knots is a group of two or more knots that are speced not more than 1/16 inch apart. A cluster is considered as one knot. The size of a cluster shall be considered as the maximum overall dimension of the group.

Lap - A fold in the surface of the glass.

Loading Mark - Imperfections in the outer surface glass of a bulb caused by lehr stands, pokers, etc.

Plunger Pull - See Suck Up.

Rouge or Rust - See Scale.

Run Down - This is caused by plastic glass running down into the dome of a blown bulb after release from the mould.

Scale - A small piece of metallic oxide or carbon embedded in the glass. Not to be confused with allowable slight blackening of seal area caused by reduced lead in the glass.

Scuff - Small scratches or abrasions in the surface of the glass.

Shear Mark - A scar in the glass caused by cutting with shears.

Stone - An opaque or white spot caused by undissolved or foreign material.

Suck Up - or Plunger Pull - A distortion or deviation from the intended shape, caused by the plastic glass following the plunger as it is withdrawn from the mould.

3.2. Screen and Face Plate Defects

Definitions

Bright spot - A small area or point source of light on the tube screen with an intensity (fluorescent or phosphorescent) at least twice the brightness of the surrounding area.

Colour - Unless otherwise stated, this refers to the colour observed with the screen activated as specified in paragraph 4.1 of this Appendix.

Colour Spot - A small area which is noticeably dis-coloured and which has fluorescent or phosphorescent intensity less than one-half or greater than one and one half times that of the surrounding area.

Combination Spots - Spots which appear to have combinations of the characteristics of dead, bright and colour spots shall be classified as the type they most resemble.

Dead Spot - A small area which emits practically no light. For example, holes and non-fluorescent or non-phosphorescent spots in the screen and opaque particles, open blisters and bruises in the face-plate glass.

Face Contour Variation - Variation in the inside or outside face surface contour, such as Bulls Eye Top or Suck Up.

Quality Area - The area specified as the minimum useful screen area.

Shaded or Mottled Areas - Minor gradation in colour or luminous intensity with respect to the overall screen background, such as may be caused by uneven screen distribution, water marks, loading marks or scum.

Surface Blemish - Inside or Outside surface defects such as Spot, Chill Wrinkle and Cord.

4. CLASSIFICATION OF GLASS DEFECTS

All face-plate defects shall be classified into one or the following groups:-

Dead Spot - Blister (except that clear buried or unbroken surface blisters which meet the requirements of paragraph 4.5 of this Appendix shall not be considered as defects), Bruise, Check, Scale.

Shaded or Mottled Area - Scum (de-vitrification) or Shear Mark.

Face Contour Variation - Bulls Eye Top, Chill Wrinkle (flow line), Loading Mark, Suck Up or Plunger Pull, Run Down.

Surface Blemish - Cord, Lap (inside surface).

Colour Spot - Bright spot or other colour spot.

NOTE: The criteria for Acceptance and Rejection will be published later.

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APPENDIX XVI

RADIOACTIVE MATERIALS AND VALVES

CODES OF PRACTICE AND FACTORY REGULATIONS

Codes of Practice and Factory Regulations

Valves containing radioactive materials, whether or not they are labelled as such, and irrespective of the quantity they contain, constitute sources of ionising radiation, and must therefore be dealt with according to approved practices. Such approved practices are exemplified by:-

(i) "Code of Practice for Protection of Persons exposed to Ionising Radiations - (Ministry of Health and Medical Research Council)" - published by H.M.S.O.

(ii) Ministry of Aviation, Ionising Radiations - Code of Practice 1962.

(iii) "Factories (Ionising Radiations) Special Regulations" (Ministry of Labour) - published by H.M.S.O.

(iv) "Precautions in the Use of Ionising Radiations in Industry" - published for H.M. Factory Inspectorates, Ministry of Labour and National Service, by H.M.S.O."

Cancelled

Amdt 3. Addendum

APPENDIX XVII

WITHDRAWAL OF QUALIFICATION APPROVAL AS A REQUIREMENT FOR SOME CV VALVES

1. Qualification Approval is deleted as a requirement for the valves listed below.

Never-the-less it is open to any Qualification Approval Authority to reinstate the requirement and to any firm to seek Qualification Approval in particular cases.

2. Marking See Amd 10

If any valves listed below, are supplied by a manufacturer who holds a valid Qualification or Type Approval Certificate the marking of K1001/4.1 should be used. Otherwise K1001/4.2.3 applies (that is, 4.1 excluding the Type Approval letter).

3. Type Approval Tests

Some of the specifications of the valves listed below contain tests which are quoted as Type Approval only. These tests are to be performed once only at the beginning of any contract at Inspection Leval 1A and AQL.6.5 or as agreed with the Inspection Authority.

CV 6
8
9
12
13
15
16
18
19
20
22
24 - 27 inclusive
29 - 31 "
33
34
36 - 57 "
59 - 72 "
74 - 94 "
96 - 116 "
118 - 121 "
124 - 128 "
130 - 140 "
151 - 161 "
171 - 182 "
185 - 186 "
188 - 213 "

CV 215 - 216 inclusive
218 - 220 "
221 - 227 "
230 - 242 "
246 - 251 "
255 - 257 "
259 - 260 "
264
266 - 272 "
274
278 - 288 "
290
292
294 - 298 "
300 - 306 "
308
310
312
315 - 319 "
321 - 322 "
324 - 325 "
327 - 336 "
338 - 344 "
346 - 347 "
349 - 353 "
355 - 357 "

CV 361 - 362 inclusive
365 - 369 "
371
373 - 377 "
379
384
390
392 - 393 "
396
398 - 401 "
403 - 407 "
413 - 419 "
421
423 - 424 "
426
431
434
441
444
452 - 455 "
459
466
467
469
476
483
486
489
491 - 493 "
496
509
511
572
574
575

CV 580
581
585
587
589
609
668
686
717
729
753
782 - 785 inclusive
n797
807
818
820
850
858
950 - 957 inclusive
959 - 960
962 - 964 "
968 - 971 "
973 - 974 "
977 - 990
995 - 1002 "
1018 - 1028 "
1029
1030
1032 - 1051 "
1053 - 1097 "
1099 - 1161 ""
1163 - 1184 "
1186 - 1239 "
1241 - 1249

CV 1251 - 1296 inclusive
1300 - 1346 "
1348 - 1349 "
1355 - 1356 "
1359
1363
1366 - 1374
1377
1379 - 1399
1400
1409 - 1410
1432
1472 - 1473
1487 - 1503 inclusive
1505 - 1506
1508
1510 - 1511
1514 - 1529 inclusive
1531 - 1534 "
1536
1540
1546 - 1599
1636 - 1733
1736
1738
1743
1758
1762
1790
1795
1832 - 1833
1856
1861
1862
1863

CV 1871 - 1872
1874 - 1875
1877
1879 - 1880
1883
1891
1893
1900
1911
1932
1934 - 1935
1937
1941
1943
1944
1947
1955
1959
1971
1985
1988
2101 - 2104 inclusive
2106 - 2108
2110
2124
2125
2127 - 2129 inclusive
2132 - 2137 "
2164
2172
2174
2184
2186
2192

APPENDIX XVIII

MEASUREMENT OF VALVE CATHODE INTERFACE RESISTANCE

GENERAL

This Appendix describes a convenient low frequency method of measuring thermionic valve cathode interface resistance.

Section 1. THEORETICAL ANALYSIS

1.1. The measuring method outlined below gives a simple means of measuring the total effective resistance occurring in the cathode coating and cathode interface layer of triodes and pentodes.

1.2. Referring to Fig. 1, fundamentally the assumption is made that at constant grid current V_{g-k} is constant, so that a variation in cathode current δI_k produces a variation in cathode surface potential $\delta I_a \times r_{kt}$. Since at constant grid current V_{g-k} is constant, then

$$\delta I_k \times r_{kt} = \delta V_{g-e}$$

$$\therefore \quad r_{kt} = \frac{\delta V_{g-e}}{\delta I_k}$$

i,e, r_{kt} (the total coating and interface resistance) is equal to the slope of the V_g: I_k characteristic at constant grid current.

A more strict mathematical analysis of the system leads to the equation

$$\frac{\delta V_{g-e}}{\delta I_k} = r_{kt} + \frac{1}{1 + \mu'/\mu} \cdot \frac{1}{g_m}$$

where $\mu = \frac{\delta V_{a-k}}{\delta V_{g-k}}$, I_a being constant

and $\mu' = \frac{\delta V_{a-k}}{\delta V_{g-k}}$, I_g being constant

and $g_m = \frac{\delta I_k}{\delta V_{g-k}}$

As the valve is connected as a triode, and as the grid current is maintained at a constant value, then $\delta I_k = \delta I_a$ and the expression becomes:

$$\frac{\delta V_{g-e}}{\delta I_a} = r_{kt} + \frac{1}{I + \mu' / \mu} \cdot \frac{1}{g_m}$$

The error caused by the second term in the above expression is usually not greater than about 10 ohms, and if new valves can be assumed to have very low values of r_{kt}, the correction can be determined by measurement.

For the purpose of investigating changes in interface occurring during life, the correction can be ignored if this second term stays constant.

Section 2. PRACTICAL METHODS OF MEASURING INTERFACE RESISTANCE

2.1. A practical circuit for performing the measurements described in Section 1 above is given in Fig. 2.

2.2. The grid is returned through a 0.5 MΩ resistor to a variable positive voltage and the grid current is conveniently set to about 0.4mA. Since 0.5 MΩ is large compared with the grid-cathode diode-impedance, the grid current is held closely constant and the grid follows the cathode surface potential. The $I_a = I_k$ is adjusted by the V_a control to nominal and the anode voltage is modulated by the low impedance 0-10-50 v transformer in the anode lead. The modulation is increased to give a reading of 100 mV across the 100Ω resistor. If the valve voltmeter is switched into the grid circuit, δV_g will be indicated for a pre-set value of δI_a. The grid reading is therefore $\frac{K \delta V_g}{\delta I_a}$ where K is a constant calibration.

The instrument may be made direct reading in ohms.

By inserting a decade box in the cathode, the performance of the apparatus may be checked. With a new valve inserted and zero resistance inserted, a value of resistance is read. This has been found to be closely constant for all new valves of the same type measured at the same values of I_g and I_a.

This is termed the zero error and is subtracted from all subsequent measurements, the I_a and I_g always being the same.

2.3. The limitation of the method is that no indication is obtained of the capacitive component of interface, and no distinction can be drawn between true interface and the actual resistance of the cathode coating.

THEORETICAL CIRCUIT

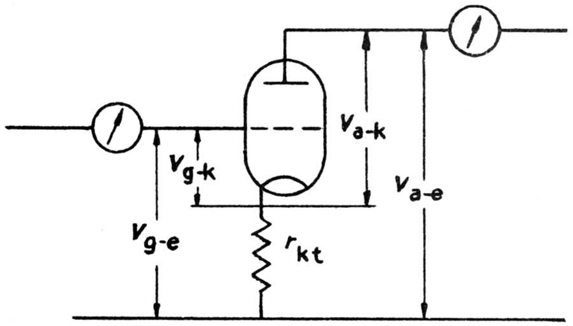
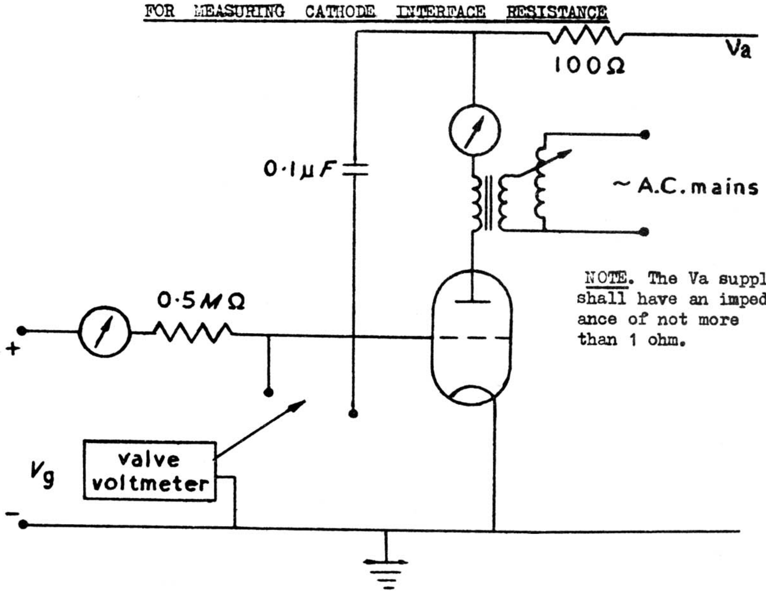


FIG. 1

PRACTICAL CIRCUIT
FOR MEASURING CATHODE INTERFACE RESISTANCE



NOTE. The Va supply shall have an impedance of not more than 1 ohm.

FIG. 2

CV 2208
2210
2212
2214
2215
2217
2218
2224
2225
2228
2238
2240
2241
2243
2254
2259
2270
2273
2280
2282
2286
2288
2300
2301
2319
2320
2322 - 2324
2331
2342
2343
2360
2361
2370
2377
2390
2399
2411
2416
2419
2447
2524
2742
2747
2748
2785
2791
2795
2810
2851
2868
2902
2983
3798

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APPENDIX XIX

INSPECTION PROCEDURE FOR GOLD PLATED PINS AND ACCESSORIES

When specified in the individual specification the following procedure shall apply:-

1. Samples, which may be electrical rejects from the lot under inspection, shall be subjected to the Climatic Tests specified in Section 10.

2. At the conclusion of the climatic cyclying the plated surfaces shall be examined and shall not show any evidence of corrosion or peeling, such as could cause unsatisfactory operation of equipment in which the valve may be used.

3. Unless otherwise specified an Inspection Level of IA and A.Q.L. of 0.65% shall apply. /The Inspection Level shall refer to the number of sample valves, and the Acceptance Number, (as a result of the above A.Q.L.) shall indicate the number of individual item rejections allowed e.g. pins/.

See Amd 10

JOINT SERVICE SPECIFICATION K1001

APPENDIX XX

CODE OF PRACTICE RELATING TO JOINT SERVICE RADIOACTIVE VALVES

(Superseding T.V.C. Information Sheet No. 11)

Contents:

1. Explanatory Notes

1.1 Introduction

This Code of Practice is designed as a guide to all concerned with Joint Service Radioactive Valves. The currently accepted view is that no quantity of radioactive material however small ought to be ignored: it is always possible that there will be circumstances in which its presence will be of some importance, even though these circumstances seldom arise.

In order to ensure the greatest practicable convenience to users, this Code divides Joint Service Radioactive Valves into three grades or classes:

(a) Class 1,	which are subject to so few restrictions that for almost all purposes the presence of radioactive material may be disregarded.
(b) Class 2,	which are subject to comparatively few restrictions, especially individual valves.
(c) Hazard Grade,	which are subject to many restrictions which will inevitably embarrass the user.

It is expected that nearly all Service Valves will fall within Class 1.

An important feature is the need to be able to identify each grade of valve by its markings. This calls for correct action both in drawing up the specification and in manufacture. Mistakes made in these stages cannot easily be rectified.

Annexe 2. List of UK Manufactured Joint Service Valves which may be Radioactive

Annexe 3. List of American Manufactured British Joint Service Radioactive Valves showing British CV Numbers and American Tube Types

1.2 The Radioactive Valve Problem

1.2.1 The hazard presented by radioactive material in valves depends not only upon its nature but upon many other factors including:

(a) the quantity in a valve.

(b) whether the valve is whole or has been broken.

(c) the degree of handling by personnel.

(d) the number of valves in one place.

The quantity of radioactive material in a single valve is usually very small and there seems no technical reason why it should ever become large. It is therefore misleading to speak of a radioactive valve as dangerous; but on the other hand, precautions are necessary where people continually handle valves or when valves get broken or when many valves are collected in one place. By imposing restrictions on the quantity and range of radioactive materials introduced into valves and by paying proper attention to marking and labelling, the general need for precautions can be reduced to a minimum. The Code of Practice follows this course and is governed very largely by the requirements of the various Regulations discussed below.

1.2.2 The Radioactive Substances Act 1960 (Ministry of Housing and Local Government)

The main purpose of this Act is to control the disposal of radioactive waste. To do this the Act requires that any person who keeps and uses radioactive material (as defined in the Act) is to be registered in respect of his premises by the Minister of Housing and Local Government and that no person shall accumulate or dispose of radioactive waste except in accordance with an authorisation granted by the Ministry. The Act does not apply to Crown premises but comparable controls to those exercised under the Act are extended to them by administrative means.

There are a number of Exemption Orders which have been made under the Act. These orders exempt the keeping and use of specified materials (usually of low activity) from registration, and exempt the accumulation and disposal of specified wastes from authorisation, either conditionally or unconditionally. Among them is the Electronic Valves Exemption Order which grants exemption from rwgistration for the keeping and use of most types of electronic valves. In some cases the exemption is unconditional; in others the exemption is granted subject to conditions which are specified in the Order. The Order also grants exemption from the authorisation requirements for the disposal of waste valves. The Order does not apply to premises used in connection with the manufacture or storage of valves by the manufacturer.

1.2.3 Regulation for the Safe Transport of Radioactive Materials

These Regulations of the International Atomic Energy Agency, to which all the principal nations belong, cover all forms of transport and will form the basis for all national Regulations. Whatever the situation at the moment, we can be confident that in the reasonably near future, the regulations of all transport undertakings of all countries will be framed so as to comply with (or at least not to conflict with) these Regulations. These Regulations provide conditional exemption for electronic valves containing specified radioactive materials below specified limits.

1.2.4 The Factories Act 1961 (Ministry of Labour)

Under this Act, a Statutory Instrument, the Ionising Radiations (Sealed Sources) Regulations 1961 governs work in factory premises (but not other premises). Radioactive Valves are Sealed Sources under these Regulations. However, there is conditional exemption for feeble sources.

1.3 Broad Outline of the Code of Practice

This Code of Practice is based on the assumption that the intrinsic risk can always be made small. Broadly speaking it treats valves as feeble sealed sources of relatively fragile construction. It divides them into three classes, of ascending intrinsic risk, and deals with each class separately, paying special attention to identification and labelling. The most generally convenient class is Class 1, for which precautions and procedures are at their simplest. The Code does not deal with the manufacture of radioactive valves because the hazards then involved are different from those confronting the user and do not arise mainly from the finished article.

The Code treats each of the three classes separately as regards procedures and precautions for all the following circumstances:

1 Inspection

2 Transport

3 Storage

4 Building and repair of equipment

5 Normal Service use (in apparatus and equipment)

6 Breakage

7 Fire

8 Disposal as waste

9 Disposal as surplus to requirements.

1.4 Regulations

This Code of Practice is designed to facilitate compliance with the principal Acts and Statutory Regulations dealing with radioactive materials viz.

(a) Radioactive Substances Act 1960, and its Exemption Orders.

(b) Factories Act 1961 and its Statutory Regulations.

(c) International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials.

2. General Provisions Relating to Radioactive Valves for Joint Service Use

2.1 This Code of Practice applies in respect of every Joint Service Radioactive Valve from the moment it is offered for inspection for acceptance to the moment the Service or other Government Department concerned rids itself of the Valve.

2.2 This Code of Practice does not apply in respect of Valves in the course of manufacture, or while valves are in the manufacturer's hands, except insofar as the valve specification embodies certain provisions of the Code, namely, one or more of the following clauses:-

3.1, 3.2(a) and (b), 4.1, 4.2(a) and (b), 5.1, 5.2(a), (b) and (c).

2.3 Responsibility for ensuring compliance with the detailed terms of this Code of Practice rests with the Responsible Authority in the Establishment or Unit concerned; except that the contractor originally supplying the valve has the duty of supplying proper identification and labelling in the first place.

2.4 The Responsible Authority has the specific duty of ensuring that the proper persons under his control receive adequate information about the significance of the markings associated with the various grades of Valve.

2.5 Each Government Department concerned should have available for deployment on reasonable notice, a monitoring team able to assess the degree of contamination resulting from fire or accident involving Radioactive Valves; and able to supervise decontamination measures.

Note: In many cases such teams are already in existence for other purposes and could perform this extra function on the few occasions it would be required.

2.6 Radium shall not be incorporated into Joint Service Valves.

2.7 Class 1 valves are preferred to Class 2 valves; and Class 2 valves preferred to Hazard Grade valves. A list of approved radionuclides is included in Table 1.

2.8 Hazard Grade valves should never be specified nor their use permitted unless it can be shown that in a given case, the technical advantage clearly outweighs the numerous disadvantages.

2.9 Joint Service Radioactive Valves made prior to the date of this code which are variously identified by an orange band or the trefoil symbol or the words "Radioactive Hazard" shall be deemed to be Class 2 valves for the purposes of this Code unless it is known that their radioactive content would bring them into Hazard Grade.

2.10 When radioactive material is to be incorporated into any valve whatever, the radioactive substances and quantities must be declared by the manufacturer to the Qualification Approval Authority at the time of submitting samples for Qualification Approval. The Q.A. Authority will insert this information on the Q.A. Certificate.

In those instances where Qualification Approval is not required, e.g. where the requirement has been withdrawn or no published C.V. Specification exists, the manufacturer/supplier must inform the Ministry of Aviation, T.V.C. Office of the radioactive substances and quantities used and the Class to which each belongs.

2.11 The Qualification Approval Authority concerned will supply to other Specification and Qualification Approval Authorities, T.V.C. Office and to the Inspectorate, details of the radioactive content of valves and the Class to which each belongs.

2.12 Where a particular C.V. specification is or may be met either by a non-radioactive valve or by a radioactive valve, that C.V. specification shall be endorsed. "This Valve may be Radioactive".

3. Procedures and Precautions for dealing with Radioactive Valves (Class 1) for Joint Service Use

3.1 Definition

A Radioactive Valve (Class 1) for Joint Service Use is one into whose manufacture a small quantity of one or more of the radionuclides listed in Table 1 has deliberately been introduced, up to the maximum that will satisfy the requirements of Table 1, modified if necessary as shown in Note 1.

Table 1

Column 1	Column 2	Column 3
Radionuclide	Permitted Quantity per valve in microcuries	Permitted Radiation Dose Rate in millirads in air per hour at surface of valve averaged over any one square centimetre
Hydrogen 3 (Tritium)	150.0	0.03
Krypton 85	10.0	0.03
Carbon 14	1.0	0.03
Chlorine 36	1.0	0.03
Cobalt 60	0.1	0.03
Nickel 63	0.1	0.03
Caesium 137	0.1	0.03
Thorium (any isotope)	0.1	0.03
Thallium 204	0.1	0.03
Uranium (any isotope)	0.1	0.03

Note 1: More than one of the radionuclides listed in Table 1 may be used provided the sum of the amounts expressed as fractions of the permitted quantities in column 2 does not exceed unity.

Note 2: In practice either column 2 or column 3 may provide the limiting factor.

3.2 Identification

(a) Each Class 1 valve must be marked with the "Theta" marking illustrated in Figure 1 (page 14), as part of the normal marking requirements in Specification K1001. Provided the correct proportions are preserved, the size of the symbol may be at the manufacturer's discretion, subject to a minimum overall dimension of 0.1 inch.

(b) Similar identification must appear on the individual cartons and upon bulk packs. The "Theta" mark shall be prominent.

(c) The significance of this special marking must be made known to persons responsible for the following functions:

(i) Inspection for acceptance.

(ii) Storage in bulk.

(iii) Transport (as items not already built-in to equipment).

(iv) Disposal as waste of more than ten Class 1 valves on any one occasion.

(v) Decision as to whether surplus electronic valves can be offered for sale to the general public.

3.3 Inspection

(a) Routine inspection of Class 1 valves calls for no precautions, either personal or administrative, beyond those in use for electronic valves in general.

(b) If more than 10 such valves get broken in any one inspection bay during any one week, monitoring of the area shall be arranged to assess within three days of the last breakage, the extent of the radioactive contamination. Any subsequent necessary decontamination should be arranged.

(c) If none of the valves broken contained any radioactive material except tritium, (b) above need not be implemented.

3.4 Transport

(a) Parcels of Class 1 valves may be transported in any convenient manner and without disclosing to the carrier that there is radioactive material present, subject to the conditions specified below:

  (i) The package must be strong enough to maintain its integrity under all the conditions likely to prevail during the journey, including such mishandling and minor accidents as are commonly met with in connection with transport.

  (ii) No valve shall be closer than one centimetre to the outer surface of the package; nor shall valves be more closely packed than one centimetre centre to centre, except that this provision need not apply if the only radionuclide is tritium.

  (iii) The package must contain only Class 1 valves and not more than 1,000.

  (iv) The package shall not bear on it any indication that the contents are radioactive (the "theta" mark is held not to give such indication).

(b) Class 1 valves may be carried by road in Crown vehicle manned solely by Crown servants without regard to any of the restrictions listed in (a) above <u>provided</u>:

  (i) The destination is a Crown Establishment

  (ii) The entire journey is undertaken in the same vehicle (except in case of accident or breakdown)

  (iii) The package is marked "Keep away from photographic film and X-ray film".

  (iv) The driver is told in advance what to do in case of damage to his load (broadly speaking, he should salvage as much as possible).

  (v) Reasonable precautions are taken against theft and fire.

3.5 Storage

Provided the store keeper is told the significance of the identification, there are no storage restrictions on Class 1 valves beyond those customary for electronic valves in general.

3.6 Building or Repair of Equipment

Class 1 valves should be treated in exactly the same way as ordinary electronic valves.

3.7 Normal Service Use (in apparatus and equipment)

Class 1 valves should be treated in exactly the same way as ordinary electronic valves.

3.8 Breakage

(a) There must be no deliberate breakage of large numbers of Class 1 valves.

(b) Suitable instructions should be issued to persons responsible for holding or disposing of stocks of Class 1 valves.

(c) Occasional accidental breakage calls for no action beyond that customary for dealing with broken electronic valves. The procedure of Appendix 1 does not apply.

3.9 Fire

(a) No special action need be taken until the fire has been extinguished. If the fire involved large numbers of Class 1 valves e.g. a fire at a storage depot, the site (having been roped off) should be monitored to determine the degree of contamination and suitable further action should be taken if necessary.

(b) If in such a case the stocks of valves are declared useless, the Ministry of Housing & Local Government should be consulted before disposal is put in hand (see 3.10 below).

3.10 Disposal as Waste

Perons who, knowing the significance of the identification mark, are faced with the problem of disposing of more than 100 Class 1 valves as waste must first seek advice from the Radiochemical Inspectorate, Ministry of Housing & Local Government (WHItehall 4300, Extn. 556). Quantities of less than this may be disposed of with other refuse destined to be collected in the ordinary way by the Local Authority.

3.11 Disposal as Surplus to Requirements

Class 1 valves must not be disposed of by sale to the public or in any other way which is likely to result in their falling into the hands of members of the public.

4. Procedures and Precautions for dealing with Radioactive Valves (Class 2) for Joint Service Use

Special Note If on any premises within the United Kingdom a stock of more than 10 Class 2 valves is held, the valves not being built-in to equipment, the Ministry of Housing & Local Government must be informed.

4.1 Definition

A Radioactive Valve (Class 2) for Joint Service Use is one into whose manufacture a small quantity of one or more of the radionuclides listed in Table 2 has deliberately been introduced, up to the maximum that will satisfy the req uirements of Table 2, modified if necessary as shown in Note 1.

Table 2

Amdt 7

Column 1	Column 2	Column 3
Radionuclide	Permitted Quantity per Valve in microcuries	Permitted Radiation Dose Rate in millirads in air per hour at surface of valve averaged over any one square centimetre
Hydrogen 3 (Tritium)	1500	0.2
Krypton 85	100	0.2
Carbon 14	10	0.2
Chlorine 36	10	0.2
Cobalt 60	1	0.2
Nickel 63	1	0.2
Caesium 137	1	0.2
Thorium (any isotope)	1	0.2
Thallium 204	1	0.2
Uranium (any isotope)	1	0.2

Note 1: More than one substance listed in Table 2 may be incorporated provided the sum of the amounts expressed as fractions of the permitted quantities in Column 2 does not exceed unity.

Note 2: In practice either column 2 or column 3 may provide the limiting factor.

4.2 Identification

(a) Each Class 2 valve must be marked with the trefoil symbol together with the words "Class 2". See Figure 2 (page 14).

(b) Similar identification must appear on individual cartons and upon bulk packs containing a number of such valves. The trefoil symbol shall be black on a yellow background, generally in accord with BS 3510, Fig. 1 with the word "Class 2" and nothing else.

(c) The significance of the markings must be made known to persons responsible for the following functions:

(i) Inspection for acceptance.

(ii) Storage in bulk.

(iii) Transport of valves not already built-in to equipment.

(iv) Disposal as waste of any Class 2 valve on any occasion.

(v) Decision as to whether surplus electronic valves can be offered for sale to general public.

4.3 **Inspection**

(a) Inspectors should not spend more than 40 hours in any period of four weeks on the inspection of Class 2 valves unless either:

(i) they are classified workers.

or

(ii) their work does not involve bringing their eyes nearer to a valve than 12 inches.

or

(iii) it can be demonstrated that the ~~does~~ dose rate at or near the surface of the valves in question is less than 0.03 millirads in air per hour. Amdt 3 Addendum

(b) ~~Stokes~~ Stocks of Class 2 valves should not be held in the inspection bay. Amdt 3 Addendum

(c) In the event of breakage of a valve the procedure given on page 15 should be used.

(d) If more than one valve is broken in any one inspection bay during any one week, monitoring of the area shall be arranged to assess within three days of the last breakage, the extent of the radioactive contamination. Any subsequent necessary decontamination should be arranged.

4.4 **Transport**

(a) Parcels of Class 2 valves may be transported in any convenient manner without disclosing to the carrier that there is radioactive material present, subject to the conditions specified below:

(i) The package must be strong enough to maintain its integrity under all the conditions likely to prevail during the journey, including such mishandling and minor accidents as are commonly met with in connection with transport.

(ii) The consignor must verify, by the use of monitoring instruments, that the dose rate at the surface of the package, as presented for transport, does not exceed 0.5 millirads in air per hour. He must keep the record of this verification for six months.

(iii) The package shall not bear on it any indication that the contents are radioactive but shall bear the marking "Class 2".

(iv) The package must contain only Class 2 valves and not more than 250.

Note 1: Condition (ii) above will call for careful attention to spacing of the valves within the package. The requirement is in reality much more stringent than that of 3.4 (a) (ii).

Note 2: When the package is placed in store (see 4.5) the trefoil symbol on it must be in plain view.

(b) Transport of Class 2 valves in Crown vehicles is subject to all the above conditions.

(c) If the conditions of (a) above cannot be met, then Class 2 valves must be carried as "White Label" class of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Materials. unless the dose rate at the surface of the package exceeds 0.5 millirads in air per hour, ((a),(ii) above), when "Yellow Label" class of the same regulations is applicable. Amdt 3 Addendum

4.5 **Storage**

(a) Stocks of Class 2 valves must be segregated from other stores (except other radioactive electronic valves) and in particular must be kept at least six feet distant from photographic or X-ray film.

(b) The storekeeper must be warned that no person should remain in that portion of the store for longer than is necessary to complete his business there.

(c) If small numbers of Class 2 valves (fewer than 10) are found to be broken in store, the procedure to be adopted is that laid down on Page 15.

(d) If many Class 2 valves are broken in store e.g. through fire or accident, the area should be roped off. Monitoring of the area shall be arranged to assess, within three days, the extent of radioactive contamination. Any subsequent necessary decontamination should be arranged. The Radiochemical Inspectorate Ministry of Housing & Local Government (WHItehall 4300, Extn. 556) should be consulted before any disposal action is taken.

4.6 Building or Repair of Equipment

(a) Provided Class 2 valves remain unbroken they may be handled in exactly the same way as ordinary electronic valves.

(b) If a Class 2 valve becomes broken the procedure of Appendix 1 should be used.

(c) If more than one Class 2 valve is broken in any one shop during any one week, monitoring of the area shall be arranged to assess within three days of the last incident, the extent of radioactive contamination. Any subsequent necessary decontamination should be arranged.

4.7 Normal Service Use (in apparatus and equipment)

Class 2 valves should be treated in exactly the same way as ordinary electronic valves.

4.8 Breakage

(a) There must be no deliberate breakage of Class 2 valves.

(b) In the case of accidental breakage of one or more Class 2 valves, the immediate action is that outlined on page 15.

(c) Broken Class 2 valves must only be disposed of in the manner indicated in 4.10 below.

4.9 Fire

(a) No special action need to be taken until the fire has been extinguished. If stocks of Class 2 valves have been involved in the fire, the site (having been roped off) should be monitored within three days to determine the degree of contamination and suitable further action should be taken if necessary, as decided by the appropriate Departmental Authority.

(b) Disposal of Class 2 valves as waste after a fire must be in the manner indicated in 4.10 below.

4.10 Disposal as Waste

(a) In any one week, at any given premises, no more than 10 Class 2 valves whether broken or not, may be disposed of (e.g. in the dustbin) with other refuse destined to be collected in the ordinary way by the Local Authority.

(b) Broken Class 2 valves must be disposed of on the day the breakage occurred unless more than 10 are involved.

(c) If it is found impossible to dispose of waste Class 2 valves in accordance with paragraphs (a) and (b) above, either because of the number of valves or because of the inadequacy of the available non-radioactive waste in which to disperse them, the Radiochemical Inspectorate, Ministry of Housing & Local Government (WHItehall 4300, Extn. 556) should first be consulted.

(d) If the disposal is necessarily delayed for reasons such as those mentioned in paragraph (c) above, up to five (5) broken Class 2 valves may be placed in a press-in lid container, marked "Broken Class 2 Valves". (See Page 15). Amdt. 3 Addendum

(e) Class 2 valves must not be disposed of by burial on the premises.

(f) If more than 10 Class 2 valves have to be disposed of onany one occasion, the Radio Chemical Inspectorate Ministry of Housing & Local Government (WHItehall 4300, Extn. 556) should first be consulted.

4.11 Disposal as Surplus to Requirements

Class 2 valves must <u>not</u> be disposed of by sale or in any other way which is likely to result in their falling into the hands of members of the public.

5. Procedures and Precautions for dealing with Radioactive Valves (Hazard Grade) for Joint Service Use

5.1 Definition

A Radioactive Valve (Hazard Grade) is one into whose manufacture there has been introduced a quantity of radioactive material which, by reason of its nature or amount, causes the valve to lie outside the provisions for Class 1 and Class 2 valves.

5.2 Identification (See Figure 3 (page 14))

(a) Each Hazard Grade valve must bear imprinted on it:

(i) The standard trefoil symbol, black on yellow background, generally in accord with BS 3510 Fig. 1.

(ii) The word CAUTION in black lettering.

(iii) The symbol for the isotope used e.g. Sr 90.

(iv) The quantity in microcuries e.g. 5 (or 5 μC if space allows).

Note: (iii) and (iv) should be combined in one expression e.g. 5 Sr 90 (or 5 μC Sr 90).

It is to be understood that so long as the correct proportions are maintained, the size of the trefoil is at the discretion of the manufacturer, subject to a minimum overall diameter of 0.3 inch.

(b) Similar identification must appear on the immediate wrapping (if any) of the valve.

(c) Cartons or boxes containing one or more Hazard Grade valves must be marked in accordance with BS 3510 Fig. 1 and must carry in bold lettering the inscription: Radioactive - handle only as instructed.

5.3 Statutory Rules and Orders

(a) The Radioactive Substances (Electronic Valves) Exemption Order does not apply.

The Ministry of Housing & Local Government must be notified of all Hazard Grade valves held on premises.

(b) Factories Act 1961, Ionising Radiations (Sealed Sources) Regulations 1961.

Hazard Grade valves must be presumed to be sealed sources within the meaning of the Regulations unless the contrary can be proved.

In premises governed by the Factories Act, the Regulations must be complied with in detail. In other premises the spirit of the Regulations ought to be observed, but the appropriate Departmental Authority should stand in the place of the District Inspector of Factories. This applies particularly to Inspection and the Building and Repair of Equipment. There is a likelihood that personnel will have to be classified workers.

5.4 Transport

The Regulations for the Safe Transport of Radioactive Materials, issued by the International Atomic Energy Agency must be complied with. Part B of these regulations details the preferred method. These Regulations may be purchased from H.M.S.O.

5.5 Storage

Hazard Grade valves must be kept in stores set apart for radioactive materials.

5.6 Normal Service Use (in apparatus and equipment)

If necessary, personnel must be told not to approach nearer than a specified distance. The appropriate Departmental Authority will give a ruling.

5.7 Fire

No special action should be taken until the fire has been extinguished. Within three days afterwards a monitoring survey should be carried out and appropriate action taken, as decided by the appropriate Departmental Authority. Meanwhile the site should be placed out of bounds.

5.8 Disposal as Surplus to Requirements

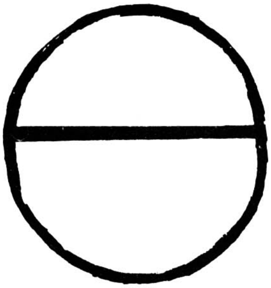
Hazard Grade valves surplus to requirements may only be disposed of by returning them to the manufacturer or by treating them as waste, in the latter case, approval to the disposal must be obtained from the Radiochemical Inspectorate Ministry of Housing & Local Government (WHItehall 4300, Extn. 556).

5.9 Breakage

Specific instructions, prepared in advance by a competent person, must be available.

Figure 1

'Theta' Marking for Class 1 Radioactive Valves



Minimum overall dimension
= 0.1 inch.

Figure 2

Marking for Class 2 Radioactive Valves

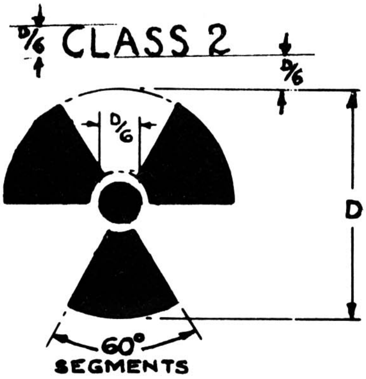
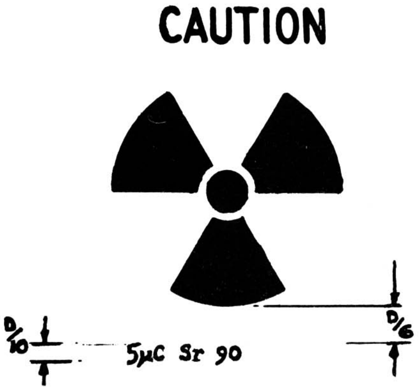


Figure 3

Marking for Hazard Grade Radioactive Valves



<u>Size of Imprinting</u>

(Figures 2 and 3)

(a) VALVES

Dimension 'D' to be not less than half the diameter of bulb or envelope.

(b) PACKAGES

Where smallest side dimension (Y) or smallest end dimension (Z) of package is:-

Below 2 inches then 'D'=Y/2 or Z/2

From 2 to 6 inches then 'D' = Y/3 or Z/3

Above 6 inches then 'D' = Y/4 or Z/4 (maximum 6 inches).

Annexe 1

Procedures for dealing with Broken Class 2 Radioactive Valves

1. The procedures detailed below apply when a single radioactive valve Class 2 has been accidentally broken.

The same procedures will apply if more than one valve is broken in the same accident provided the number is not large.

(a) Do not eat drink or smoke in the contaminated area.

(b) Using a damp cloth, adequate to protect the hands, brush the remnants carefully on to a piece of cardboard or stiff paper and place the whole lot (cloth, debris and card or paper) straight into a dustbin already containing ordinary waste material. If this last procedure cannot be followed, the whole lot may be placed in a tin (2 lb. size would be suitable) with a press-in lid. The container should be labelled "Broken Class 2 valves" and placed in a safe place pending disposal which should be as prompt as possible (see Provision 4.10).

(c) Using a second damp cloth, wipe across the contaminated area until it is visibly clean, folding the cloth in half after each stroke keeping the clean side out at all times. Avoid rubbing particles into the surface being cleaned. When the process is complete, add this cloth to the other radioactive waste.

(d) Wash the hands very thoroughly.

Note: Any cuts or abrasions caused by the breakage or sustained during the clean-up process should at once be washed clean and then treated in the normal manner.

LIST OF UK MANUFACTURED JOINT SERVICE VALVES WHICH MAY BE RADIOACTIVE

CV No / NSN	Manufacturer	Radionuclide	Radioactive Class
CV188	Mullard	Hydrogen 3	1
CV216	"	"	1
CV284	EEV	Tritium	1
CV287	"	"	1
CV431	Mullard	"	1
CV449	"	"	1
CV449	EEV	"	1
CV460	"	Nickel 63	1
CV461	"	"	1
CV462	"	"	1
CV463	"	"	1
CV1070	Mullard	Hydrogen 3	1
CV1832	"	"	1
CV1832	EEV	"	1
CV1833	Mullard	"	1
CV1923	EEV	Tritium	1
CV1992	Mullard	Hydrogen 3	1
CV2012	EEV	Tritium	1
CV2225	Mullard	Hydrogen 3	1
CV2225	EEV	Tritium	1
CV2236	Mullard	Hydrogen 3	1
CV2248	Ferranti	"	1
CV2249	"	"	1
CV2250	"	"	1
CV2251	"	"	1
CV2252	"	"	1
CV2255	Mullard	"	1
CV2271	"	"	1
CV2274	EEV	Nickel 63	1
CV2308	"	"	1
CV2309	"	"	1
CV2325	Mullard	Hydrogen 3	1

CV No/NSN	Manufacturer	Radionuclide	Radioactive Class
CV2351	EEV	Tritium	1
CV2374	Ferranti	Hydrogen 3	1
CV2375	"	"	1
CV2434	Mullard	"	1
CV2482	EEV	Tritium	1
CV2482	Nore Electric	Hydrogen 3	1
CV2483	" "	"	1
CV2573	Mullard	"	1
CV3539	EEV	Tritium	
CV3960	Mullard	Hydrogen 3	1
CV3987	"	"	1
CV4020	"	"	1
CV4020	EEV	Tritium	1
CV4028	Mullard	Hydrogen 3	1
CV4048	"	"	1
CV4048	EEV	Uranium Oxide (U308)/ Tritium	1
CV4052	"	" "	1
CV4053	"	" "	
CV4054	"	" "	1
CV4054	Mullard	Hydrogen 3	1
CV4066	"	"	1
CV4080	"	"	1
CV4100	"	"	1
CV4100	EEV	"	1
CV4101	Mullard	"	1
CV4104	"	"	1
CV4516	"	"	1
CV5122	"	"	1
CV5132	"	"	1
CV5162	EEV	Tritium	1
CV5173	"	"	1
CV5229	Ferranti	"	1
CV5278	Mullard	"	1
CV5278	ITT	Krypton 85	1
CV5285	EEV	Uranium Oxide (U308)	1
CV5312	Ferranti	Hydrogen 3	1

CV No/ NSN	Manufacturer	Radionuclide	Radioactive Class
CV5351	ITT	Krypton 85	1
CV5373	EEV	Tritium	1
CV5374	EEV	"	1
CV5375	EEV	"	1
CV5384	Hivac	Hydrogen 3	1
CV5375	EEV	"	1
CV5820	Mullard	"	1
CV6028	Nore Electric	"	1
CV6028	EEV	Tritium	1
CV6070	"	Nickel 63	1
CV6086	"	Tritium	1
CV6086	Nore Electric	Hydrogen 3	1
CV6089	" "	"	1
CV6110	" "	Tritium	1
CV6129	MOV	Hydrogen 3	HAZARD GRADE
CV6129	EEV	Tritium	1
CV6245	EMI-Varian	Hydrogen 3	1
CV6246	"	"	1
CV8963	Mullard	Hydrogen 3	1
CV8105	Ferranti	"	1
CV8161	EEV	Tritium	1
CV8292	Mullard	Hydrogen 3	1
CV8323	Ferranti	"	1
CV8380	"	"	1
CV8462	Mullard	"	1
CV8482	"	"	1
CV8572	"	"	1
CV8572	ITT	Krypton 85	1
CV8670	MOV	Thorium	1
CV8670	EEV	Tritium	1
CV8671	MOV	Thorium	1
CV8671	EEV	Tritium	1
CV8679	Mullard	Hydrogen 3	1
CV8766	EEV	Tritium	1
CV8096	Mullard	Hydrogen 3	1
CV8958	MOV	Thorium	1

CV NO/ NSN	Manufacturer	Radionuclide	Radioactive Class
CV8958	EEV	Thorium/Tritium	1
CV9314	ITT	Hydrogen 3	1
CV9316	Mullard	Hydrogen 3	1
CV9316	ITT	Krypton 85	1
CV9732	"	"	1
CV10054	Mullard	Hydrogen 3	1
CV10079	"	"	1
CV10664	"	"	1
CV10816	"	"	1

LIST OF AMERICAN MANUFACTURED BRITISH JOINT SERVICE RADIOACTIVE VALVES SHOWING BRITISH CV NUMBERS AND AMERICAN TUBE TYPES

(Note: The information in Columns 3, 4 and 5 below is extracted from SSC 347)

Column 1 CV Number	Column 2 American Type	Column 3 Manufacturer	Column 4 Isotope	Column 5 Isotope Quantity per Tube (Microcuries)
508	1B49	West	Ra 226	2.0
539	1B23	Bomac	Co 60	0.15
539	1B23	Cent	Co 60	0.5 to 1.0
576	1B26	Bomac	Co 60	0.15
577	1B36	Bomac	Co 60	0.25
713	1B27	Bomac	Co 60	0.15
725	1B24	West	Ra 226	2.0
761	1B22	Bomac	Co 60	0.25
-	BL-63			
1793	724B	Bomac	Co 60	0.15
1832	OA2	Ray	Co 60	0.0067
1833	OB2	Ray	Co 60	0.0067
2573	5651	Ray	Co 60	0.0067
2615	313C	WE	Ra 226	0.01
2626	346A	-	-	-
-	346B	WE	Ra 226	1.0
2826	1B63A	Bomac	Co 60	0.15
"	1B63A	Microwave	Co 60	0.5
"	1B63A	Syl	Co 60	1.0
2914	1B40	Bomac	Co 60	0.2
"	1B40	Syl	Co 60	1.0
3539	6024/ATR387	Bomac	Co 60	0.45
3548	1B24A	Bomac	Co 60	0.15
"	1B24A	Microwave	Co 60	0.5
"	1B24A	Syl	Co 60	1.0
"	1B24A	West	Ra 226	2.0
3549	1B38	Bomac	Co 60	0.9
3550	1B41	Bomac	Co 60	0.25
"	1B41	West	Ra 226	2.0
3628	1B35A	Bomac	Co 60	0.4
"	1B35A	Syl	Co 60	1.0
-	5791	-	-	-
-	5791/X6007	Syl	Co 60	1.0
-	446	AE	C 14	1.0
3745	1B58	-	-	-
-	GL-1B58	GE	Co 60	0.475
3877	1B56	Bomac	Co 60	0.45
3897	5787	Ray	Co 60	0.0067
3906	6117	Bomac	Co 60	0.45
"	6117	Microwave	Co 60	0.5
"	6117	Syl	Co 60	1.0
3933	5783	Ray	Co 60	0.0067
3960	5783WA	Ray	Co 60	0.0067
4020	OA2WA	Hy	Ni 63	0.01-0.05
"	OA2WA	Ray	Co 60	0.0067
4028	OB2WA	Hy	Ni 63	0.01-0.05
"	OB2WA	Ray	Co 60	0.0067
5062	5841			
5113	5787WA			
5186	5651WA	Ch	Ra 226	0.045-0.055
"	5651WA	Ray	Co 60	0.0067

APPENDIX XXI

LIST OF HAZARDOUS VALVES AND SEMICONDUCTOR DEVICES. (MERCURY, MAGNETIC AND SERYLLUM COMPOUNDS)

These lists quote types of potentially hazardous valves and semiconductor devices. The hazards are:-

(i) conponents embodying beryllium compounds

(ii) external magnetic fields

(iii) mercury content

Reference is to be made to the Detail Specification or to the manufacturers for information regarding the extent of the hazard or to the Defence Standard - Code of Practice - for items of this nature.

LIST OF DEVICES WHICH CONTAIN BERYLLIUM COMPOUND

CV No / NSN	Manufacturer	CV No / NSN	Manufacturer
~~CV6437~~	~~ITT~~		
CV6230	Ferranti		
CV6231	Ferranti		
CV9706	Texas		
CV10507	EEV		
5960-99- 038-0432	} Ferranti		

LIST OF MAGNETIC TYPES

NOTE: Field Strength at seven feet

CV No / NSN	Manufacturer	Field Strength at 7 feet * M gauss
CV 370	Mullard	
CV1866	EEV	
CV2166	Mullard	
CV2261	EEV	
CV2262	EEV	
CV2281	EEV	2.5
CV2284	EEV	3
CV2326	Mullard	
CV2373	Mullard	
CV2381	EEV	
CV2393	EEV	2.5
CV2412	EEV	3
CV2420	Mullard	
CV2421	Mullard	
CV2424	EEV	3
CV2424	Mullard	
CV2425	EEV	3
CV2425	Mullard	
CV2426	EEV	3
CV2426	Mullard	
CV2427	EEV	3
CV2427	Mullard	
CV2470	MOV	
CV2471	MOV	
CV2473	Mullard	
CV3340	Ferranti	390
CV3341	"	390
CV3342	"	390
CV3343	"	390
CV3344	"	390
CV3345	"	390
CV3346	"	390
CV3347	"	390

CV No / NSN	Manufacturer	Field Strength at 7 feet * M gauss
CV3348	Ferranti	390
CV3349	"	390
CV3350	"	390
CV3351	"	390
CV3352	"	390
CV3353	"	390
CV3354	"	390
CV3355	"	390
CV3356	"	390
CV3357	"	390
CV3358	"	390
CV3359	"	390
CV3360	"	390
CV3361	"	390
CV3362	"	390
CV3363	"	390
CV3364	"	390
CV3365	"	390
CV3366	"	390
CV3367	"	390
CV3368	"	390
CV3369	"	390
CV3370	"	390
CV3371	"	390
CV3372	"	390
CV3373	"	390
CV3374	"	390
CV3375	"	390
CV3376	"	390
CV3377	"	390
CV3378	"	390
CV3379	"	390

* NOTE: Where no information is given, the actual field strength figures are not available although the valve is considered potentially hazardous from this cause.

LIST OF MAGNETIC TYPES

NOTE: Field Strength at seven feet

CV No / NSN	Manufacturer	Field Strength at 7 feet * M gauss	CV No / NSN	Manufacturer	Field Stength at 7 feet * M gauss
CV3528	EEV		CV6199	Mullard	
CV3560	Mullard		CV6200	MOV	
CV3676	Mullard		CV6205	-	
CV3953	Mullard		CV6214	Mullard	
CV3966	-		CV6215	Mullard	
CV3997	Mullard		CV6216	MOV	
CV5018	EEV	2.5	CV6219	MOV	
CV5018	Mullard		CV6220	MOV	
CV5123	Mullard		CV6221	MOV	
CV5134	Mullard		CV6222	MOV	
CV5277	Mullard		CV6225	Mullard	
CV5290	Plessey		CV6226	MOV	
CV5290	Hivac		CV6227	MOV	
CV5392			CV6228	MOV	
CV5443	Mullard		CV6234	Mullard	
CV5911	-		CV6239	ITT	5
CV6035	MOV		CV6248	Mullard	
CV6056	Mullard		CV8629	Mullard	
CV6072	MOV		CV8356	EEV	
CV6077	MOV		CV8505	Mullard	
CV6078	MOV		CV9424	MOV	0.9
CV6079	MOV		CV9424	Mullard	
CV6087	Mullard		CV10758	Mullard	
CV6096	MOV				
CV6103	Mullard				
CV6108	EEV				
CV6114	Mullard				
CV6128	MOV				
CV6153	MOV	6.4			
CV6179	-				
CV6180	-				
CV6181	-				
CV6182	-				
CV6183	Mullard				

LIST OF HAZARDOUS VALVES WHICH CONTAIN MERCURY

CV No NSN	Manufacturer	CV No NSN	Manufacturer
CV5	EEV	CV2638	Ferranti
CV5	ITT	CV2673	EEV
CV32	"	CV2720	Ferranti
CV74	"	CV2723	"
CV152	Mullard	CV2738	Mullard
CV447	ITT	CV2746	Ferranti
CV532	EEV	CV2943	Ediswan
CV642	"	CV2943	ITT
CV642	ITT	CV2946	"
CV1029	Ediswan	CV2957	EEV
CV1072	ITT	CV2957	Mullard
CV1072	EEV	CV3667	"
CV1072	Mullard	CV3670	"
CV1144	EEV	CV3710	EEV
CV1144	Mullard	CV5027	"
CV1147	EEV	CV5027	ITT
CV1263	Mullard	CV5027	Mullard
CV1355	ITT	CV5028	"
CV1420	"	CV5141	EEV
CV1420	EEV	CV5278	Mullard
CV1435	Mullard	CV5278	ITT
CV1435	EEV	CV5351	"
CV1446	ITT	CV8572	"
CV1449	"	CV8572	Mullard
CV1471	"	CV9316	"
CV1625	Mullard	CV9316	ITT
CV1626	"	CV9732	"
CV1626	ITT	CV10816	Mullard
CV1629	MOV	CV10816	ITT
CV1629	EEV		
CV1629	Mullard		
CV2455	EEV		

JOINT SERVICE SPECIFICATION K1001, ISSUE NO 6 DATED JULY 1964.

ELECTRONIC VALVES

AMENDMENT NO 10

Insert the following amendments as instructed :-

i) Section 4 Marking
Delete this section in toto,
Replace by :-
"Marking requirements shall be in accordance with
Def.Stan.5960 Part 1 Annex B".

ii) Appendix XV11
Clause 2
Delete the text and insert :-
"Marking requirements shall be in accordance with
Def.Stan.59-60 Part 1 AnnexeB".

iii) Appendix XX
This appendix to be deleted intoto and replaced by :-
"For requirements for hazardous tubes - see Def.Stan
59-60 Part 1 Annex A."

December 1975 SLR 23 for RRE

JOINT SERVICE SPECIFICATION K1001 ISSUE NO 6 DATED JULY 1964

AMENDMENT NO 9

1 APPENDIX IV page 2 Table 1

Against material X5337, in the "Colour" column after "NATURAL" add "AND BLACK".

2 APPENDIX XX(1) page 22

Delete "CV 6137" - "ITT".

Add "5960-99-038-0432 - FERRANTI.

SLR 23
February 1975

RPL/1026/02/STR
PSV2-1

✓ AAS $\overset{3}{5}$/75

JOINT SERVICE SPECIFICATION K1001, ISSUE NO 6 DATED JULY 1966

ELECTRONIC VALVES

AMENDMENT NO 8

1 Remove Annex 2 and Annex 3 Appendix XX Pages 16-19 inclusive.
Insert new Annex 2 and Annex 3 Appendix XX Pages 16-20 inclusive, attached hereto.

2 Insert manuscript amendment as follows:-

Contents Page 2 "Appendix XXI" List of Hazardous Valves and Semiconductors.
(Beryllium Compounds, Magnetic and Mercury.)

3 Insert New Appendix XXI List of Hazardous Valves and semiconductors (Beryllium Conpounds.)
Magnetic and Mercury). Pages 23-25 inclusive, attached hereto

4 Amendment record sheet

Record amendment number and date in the appropriate space in page 3 of Specification K1001.
Issue 6.

✓ARB 11 1/73

April 1972
LP/T 23 AJH

Annexe 2

LIST OF U.K. MANUFACTURED JOINT SERVICE VALVES WHICH MAY BE RADIOACTIVE

CV No.	Manufacturer	Radionuclide	Quantity per Valve (μ C)	Radioactive Class
CV188	Mullard	Hydrogen 3		1
CV216	"	"		1
CV431	"	"		1
CV449	"	"		1
CV460	E.E.V.	Nickel 63		1
CV461	"	"		1
CV462	"	"		1
CV463	"	"		1
CV1070	Mullard	Hydrogen 3		1
CV1832	"	"		1
CV1833	"	"		1
CV1992	"	"		1
CV2225	"	"		1
CV2236	"	"		1
CV2248	Ferranti	Hydrogen 3	< 150	1
CV2249	"	"	< 150	1
CV2250	"	"	< 150	1
CV2251	"	"	< 150	1
CV2252	"	"	< 150	1
CV2255	Mullard	"		1
CV2271	"	"		1
CV2274	E.E.V.	Nickel 63		1
CV2308	"	"		1
CV2309	"	"		1
CV2325	Mullard	Hydrogen 3		1
CV2374	Ferranti	Hydrogen 3	< 150	1
CV2375	"	"	< 150	1
CV2434	Mullard	"		1
CV2482	Nore Electric	Hydrogen 3	92	1
CV2483	" "	"	92	1
CV2573	Mullard	"		1
CV3987	"	"		1
CV4020	"	"		1
CV4028	"	"		1
CV4048	Mullard	"		1
	E.E.V.	Uranium Oxide (U 308)		1
CV4054	E.E.V.	" "		1
	Mullard	Hydrogen 3		1
CV4066	"	"		1
CV4080	"	"		1

SUPERSEDED BY APRIL 1972 LIST

CV No.	Manufacturer	Radionuclide	Quantity per Valve (μ C)	Radioactive Class
CV4100	Mullard	Hydrogen 3		1
CV4101	"	"		1
CV4104	"	"		1
CV4516	"	"		1
CV5122	"	"		1
CV5132	"	"		1
CV5173	"	"		1
CV5229	Ferranti	"	<150	1
CV5278	Mullard	"		1
CV5285	E.E.V.	Uranium OxideU308		1
CV5312	Ferranti	Hydrogen 3	<150	1
CV5384	Hivac	"		1
CV5820	Mullard	"		1
CV6028	Nore Electric	"		1
CV6070	E.E.V.	Nickel 63		1
CV6086	Nore Electric	Hydrogen 3		1
CV6089	" "	"		1
CV6110	" "	"		1
CV6129	M.O.V.	"	3200	HAZARD GRADE
CV8063	Mullard	"		1
CV8105	Ferranti	"	<150	1
CV8292	Mullard	"		1
CV8380	Ferranti	"	<150	1
CV8462	Mullard	"		1
CV8482	"	"		1
CV8572	"	"		1
CV8670	M.O.V.	Thorium	0.003	1
CV8671	"	"	0.003	1
CV8679	Mullard	Hydrogen 3		1
CV8906	"	"		1
CV8958	M.O.V.	Thorium	0.003	1

Annexe 3

LIST OF AMERICAN MANUFACTURED BRITISH JOINT SERVICE RADIOACTIVE VALVES

SHOWING BRITISH CV NUMBERS AND AMERICAN TUBE TYPES

(Note: The information in Columns 3, 4 and 5 below is extracted from SSC.347)

SUPERSEDED BY APRIL 72 LIST

Column 1 CV Number	Column 2 American Type	Column 3 Manufacturer	Column 4 Isotope	Column 5 Isotope Quantity per Tube (Microcuries)
508	1B49	West	Ra 226	2.0
539	1B23	Bomac	Co 60	0.15
539	1B23	Cent	Co 60	0.5 to 1.0
576	1B26	Bomac	Co 60	0.15
577	1B36	Bomac	Co.60	0.25
713	1B27	Bomac	Co 60	0.15
725	1B24	West	Ra 226	2.0
761	1B22	Bomac	Co 60	0.25
–	BL-63			
1793	724B	Bomac	Co 60	0.15
1832	OA2	Ray	Co 60	0.0067
1833	OB2	Ray	Co 60	0.0067
2573	5651	Ray	Co 60	0.0067
2615	313C	WE	Ra 226	0.01
2626	346A	–	–	–
–	346B	WE	Ra 226	1.0
2826	1B63A	Bomac	Co 60	0.15
"	1B63A	Microwave	Co 60	0.5
"	1B63A	Syl	Co 60	1.0
2914	1B40	Bomac	Co 60	0.2
"	1B40	Syl	Co 60	1.0
3539	6024/ATR387	Bomac	Co 60	0.45
3548	1B24A	Bomac	Co 60	0.15
"	1B24A	Microwave	Co 60	0.5
"	1B24A	Syl	Co 60	1.0
"	1B24A	West	Ra 226	2.0
3549	1B38	Bomac	Co 60	0.9
3550	1B41	Bomac	Co 60	0.25
"	1B41	West	Ra 226	2.0
3628	1B35A	Bomac	Co 60	0.4
"	1B35A	Syl	Co 60	1.0
–	5791	–	–	–

Column 1	Column 2	Column 3	Column 4	Column 5
CV Number	American Type	Manufacturer	Isotope	Isotope Quantity per Tube (Microcuries)
-	5791/X6007	Syl	Co 60	1.0
-	446	AE	Co 14	1.0
3745	1B58	-	-	-
-	GL-1B58	GE	Co 60	0.475
3877	1B56	Bomac	Co 60	0.45
3897	5787	Ray	Co 60	0.0067
3906	6117	Bomac	Co 60	0.45
"	6117	Microwave	Co 60	0.5
"	6117	Syl	Co 60	1.0
3933	5783	Ray	Co 60	0.0067
3960	5783WA	Ray	Co 60	0.0067
4020	OA2WA	Hy	Ni 63	0.01-0.05
"	OA2WA	Ray	Co 60	0.0067
4028	OB2WA	Hy	Ni 63	0.01-0.05
"	OB2WA	Ray	Co 60	
5062	5841			
5113	5787WA			
5186	5651WA	Ch	Ra 226	0.045-0.055
"	5651WA	Ray	Co 60	0.0067

JOINT SERVICE SPECIFICATION K1001, ISSUE NO. 6, DATED JULY 1966

ELECTRONIC VALVES

AMENDMENT NO. 7

1. Insert manuscript amendment as follows:-

   (i) Appendix XX, page 8

   Add the following, as the first entry, in the existing Table 2.

Column 1	Column 2	Column 3
Hydrogen 3 (tritium)	1500	0.2

2. Amendment Record Sheet

   Record amendment number and date in the appropriate space in page 3 of Specification K1001, Issue 6.

Admiralty Surface Weapons
Establishment.
February, '71.

√ 7/9/71

JOINT SERVICE SPECIFICATION K1001, ISSUE No.6, DATED JULY 1964

ELECTRONIC VALVES

AMENDMENT NO. 6

Insert the following amendments as instructed:-

1. **Page 1 Paragraph 3.5**

   Insert new sub-paragraph 3.5.2 as follows:-

   > "3.5.2 Valve bases having brass or bronze steel sleeves attached shall be tested in accordance with the requirements specified in Appendix IV, paragraph 3.5.

2. **Appendix IV**

   Insert new page 2A attached hereto.

3. **Appendix XVII**

   Remove and destroy existing Appendix XVII (Pages 1 &2), and substitute new Appendix XVII, dated April 1967, attached hereto

4. **Amendment Record Sheet**

   Record amendment number and date in the appropriate space in Page 3 of Specification K1001, Issue 6, and file this amendment sheet inside the front cover for future reference.

April, 1967

T.V.C. Office

✓ARS
2/68

JOINT SERVICE SPECIFICATION K1001

APPENDIX XV11

WITHDRAWAL OF QUALIFICATION APPROVAL AS A REQUIREMENT FOR SOME CV VALVES

1. Qualification Approval is deleted as a requirement for the valves listed below.

Never-the-less it is open to any Qualification Approval Authority to reinstate the requirement and to any firm to seek Qualification Approval in particular cases.

2. Marking

If any valves, listed below, are supplied by a manufacturer who holds a valid Qualification or Type Approval Certificate the marking of K1001/4.1 should be used. Otherwise K1001/4.2.3 applies (that is, 4.1 excluding the Type Approval letter).

3. Type Approval Tests

Some of the specifications of the valves listed below contain tests which are quoted as Type Approval only. These tests are to be performed once only at the beginning of any contract at Inspection Leval 1A and AQL 6.5 or as agreed with the Inspection Authority.

Superseded by issue dated April 1967

Amdt-6

CV 6
8
9
12
13
15
16
18
19
20
22
24 - 27 inclusive
29 - 31 "
33
34
36 - 57 inclusive
59 - 72 "
74 - 94 "
96 - 116 "
118 - 121 "
124 - 128 "
130 - 140 "
151 - 161 "
171 - 182 "
185 - 186 "
188 - 213 "

CV 215 - 216 inclusive
218 - 220 "
221 - 227 "
230 - 242 "
246 - 251 "
255 - 257 "
259 - 260 "
264
266 - 272 "
274
278 - 288 "
290
292
294 - 298 "
300 - 306 "
308
310
312
315 - 319 "
321 - 322 "
324 - 325 "
327 - 336 "
338 - 344 "
346 - 347 "
349 - 353 "
355 - 357 "

CV 361 - 362 inclusive
365 - 369 "
371
373 - 377 "
379
384
390
392 - 393 "
396
399 - 401 "
403 - 407 "
413 - 419 "
421
423 - 424 "
426
431
434
441
444
452 - 455 inclusive
459
483
486
489
491 - 493 "
496
509
511
572
574
575
581
585
587
589
609
668
686
753
782 - 785 inclusive
797
807
820
850
858
950 - 957 inclusive
959 - 960
962 - 964 "
968 - 971 "
973 - 974
977 - 990
995 - 1002 "
1018 - 1028 "
1030
1032 - 1051 "
1053 - 1097 "
1099 - 1161 "
1163 - 1184 "
1186 - 1239 "
1241 - 1249

CV 1251 - 1296 inclusive
1300 - 1346 "
1348 - 1349 "
1355 - 1356 "
1359
1363
1366 - 1374
1377
1379 - 1399
1400
1409 - 1410
1432
1472 - 1473
1487 - 1503 inclusive
1505 - 1506
1508
1510 - 1511
1514 - 1529 inclusive
1531 - 1534 "
1536
1540
1546 - 1599
1636 - 1733
1736
1738
1743
1758
1795
1832 - 1833
1861
1863
1871 - 1872
1874 - 1875
1877
1879 - 1880
1883
1891
1893
1900
1911
1932
1934 - 1935
1937
1941
1943
1947
1955
1985
1988

Superseded by issue dated April 1965

Amdt 6

JOINT SERVICE SPECIFICATION K1001, ISSUE NO.6, DATED JULY 1964

ELECTRONIC VALVES

AMENDMENT NO. 5

1. Appendix XX

(i) Page 1 Contents

Below 'Annexe 1' insert

Annexe 2. List of UK Manufactured Joint Service Valves which may be Radioactive. ✓

Annexe 3. List of AMERICAN MANUFACTURED BRITISH JOINT SERVICE Radioactive Valves showing British CV Numbers and American Tube Types.

(ii) Page 15 ✓

Following 'Annexe' insert "I"

(iii) Insert new pages 16 to 19 inclusive, attached hereto. ✓

2. Amendment Record Sheet

Record Amendment number and date in the appropriate space in Page 3 of Specification K1001, Issue 6 and file this amendment sheet inside the front cover for future reference. ✓

T.V.C. Office

January 1967

✓AAS 14/2/67

JOINT SERVICE SPECIFICATION K1001, ISSUE No. 6, DATED JULY 1964.

ELECTRONIC VALVES

AMENDMENT No. 4

Insert the following amendment:-

Appendix IX, Pages 3 and 4, (inserted by Amendment No. 3)

Remove and destroy these pages (dated June 1966) and substitute the new pages, dated October 1966, attached hereto.

October 1966
(445220)

T.V.C. Office

JAN 22/7/66

2.4.2.4.2. Fatigue Test. This test shall be as given in Section 11 of the general specification. This is a destructive test and valves used for this test will not be accepted for delivery. An alternative form of reduced inspection may be instituted in which these tests are done on every fourth lot, after reduced inspection has been merited, provided that

(a) production is continuous

(b) the three preceding lots have been accepted.

If the fourth lot fails, when on reduced inspection, the three preceding lots shall be tested and normal inspection shall be re-instated until the above conditions have again been satisfied.

2.4.2.4.3. Shock Test. This test shall be as given in Section 11 of the general specification. This is a destructive test and valves used for this test will not be accepted for deliverv. Shock testing is waived when ten successive lots have been tested and there has been no individual failures for shock test. Shock testing shall be resumed when production becomes discontinuous or at twelve monthly intervals, whichever is the shorter period. A single individual failure in any sample shall cause reversion to normal inspection.

2.4.3. Life Tests. The electrical life tests will be generally grouped together in Group F and will be performed on a sampling basis. The general requirements of these tests will be based on the procedure given in Appendix VI or as given in the Test Specification. In addition, selected tests may be required at intervals during life testing. Intermediate failure rates and the overall AQL will be stated in the Test Specification. These tests are destructive and valves will not be accepted for delivery except those which pass the stability life test.

2.5. Retests After Holding Period. At the end of the Holding Period all the valves in the Lot, excluding these used for the destructive Sampling Inspection Tests shall be tested for air leaks and open or short circuits between electrodes. A lot will be accepted if the number of inoperative valves as defined above does not exceed 0.5%. For other tests as detailed in the Test Specification the maximum allowable failure will be specified.

SUPERSEDED

2.6. Sampling Inspection Procedure for Small Lot Sizes. DEF-131A allows the following minimum lot sizes for acceptance on one reject.

Insp. Level II			Insp. Level I			Insp. Level S-4			Insp. Level S-2		
AQL			AQL			AQL			AQL		
0.65%	1%	1.5%	1.5%	2.5%	4%	2.5%	4%	6.5%	4%	6.5%	10%
281	151	91	281	151	91	151	91	26	1201	151	26

Thus the smallest lot sizes for the usual CV4000's when amended by the change of IA to S-4 and IC to S-2, would be 281.

If lot eceptance was based only on Group AQL's the smallest lot size would reduce to 151.

For lot sizes between 91 and 150, the overall AQL's for electrical tests in Group B can be increased to 1.5%, Group C increased to 4% and in other Groups 2.5% AQL shall be changed to 4% and 6.5% changed to 10%.

For lot sizes below 91, deferred acceptance can be applied over 4 or 5 consecutive lots, as follows:-

Group B	8 valves per week, 1 reject allowed over 4 weeks.
Group C	3 valves per week, 1 reject allowed over 4 weeks.
Group D	2 valves per week, 1 reject allowed over 4 weeks.
Group E	As for Group D
Group F (Life Tests)	4 valves per week. If no failures have occured at the end of the fourth

/week

week in any of the life test valves, accept the first lot and remove the valves from test. If no failures have occured at the end of the fifth week, accept the second lot, and so on, until the fourth lot has been accepted at the end of the eighth week. Continue acceptance if there is no more than one failure in any group of 16 individuals tested.

Alternatively, test three valves over a five week period.

(The first procedure gives a life test time of approximately 640 hours and the second 800 hours).

2.6.3. Production Rate Less than Fifty Valves Per Week. Since the test sampling procedures described above are not applicable to a rate of manufacture of less than fifty valves per week, the Test Specification or contract documents will indicate where 100% testing shall not be used and will specify the requirements for the destructive tests for such cases.

SUPERSEDED

JOINT SERVICE SPECIFICATION K1001, ISSUE No. 6, DATED JULY 1966

ELECTRONIC VALVES

AMENDMENT No. 3

1. Appendix IV

1.1. Page 2, Table 1.
Add the following to the existing table:-

Approved Moulding Materials		Manufacturer
Grade	Colour	
Philite 437 (Spec. NLN-K 437)	Yellow - brown or black	N.V. Philips Gloeilampenfabrieken Eindhoven, Holland

1.2. Remove and destroy existing Pages 3 and 4 and substitute new Pages 3 and 4, dated June 1966, attached hereto.

2. Appendix VI

2.1. 5. RELIABLE VALVES.(page 1)

(a) Amend 4th and 5th lines to read as follows:-
" with Appendix XI, Section 1, but see also Appendix IX."

(b) Delete entirely the next two paragraphs, beginning "Normal Inspection .... the time factor."

2.2. Page 3
Amend the second paragraph to read as follows:-
"Loss of eligibility for reduced hours life tset shall occur if any test lot fails at the 500 hour life test end point.".

3. Appendix VII

Remove and destroy existing Pages 5 and 6, and substitute new Pages 5 and 6, dated June 1966, attached hereto.

4. Appendix VIII

4.1. Insert the following Factory Codes in their correct alphabetical order:-

DJ	Wiener Radio Werkr, A.G., Abbegasse 1, Vienna 14/89
DK	Philips GMBH, 140 Ebentalerstrasse, Klagenfurt
DL	N.V. Philips, Gloeilampenfabrieken, Nijmegan
DM	N.V. Philips, Stadskanaal, Holland
DN	La Radio Technique, Caen, France
DP	Valvo GMBH, Hamburg 1, Germany
DQ	Philips SPA, Milan, Italy
DR	Philips AG, Zurich, Switzerland
QG	English Electric Valve Co. , Carholm Rd., Lincoln
V	Gilbert Photoelectrics, Isleworth

4.2. Obsolete Codes. (page 3)

Delete "V Gilbert Photoelectrics"

5. Appendix IX

5.1. Paragraph 2.4.1.1, 11th line.
Delete "IA or IC" and substitute "S4 or S2".

5.2. Paragraph 2.4.2.4.1. At the end of the paragraph, add the following:-

"An alternative form of reduced inspection may be instituted in which these tests are done on every fourth lot, after reduced inspection has been merited, provided that
(a) production is continuous
(b) the three preceding lots have been accepted.

If/

If the fourth lot fails, when on reduced inspection, the three preceding lots shall be tested and normal inspection shall be re-instated until the above conditions have again been satisfied.

5.3 Remove and destroy existing Pages 3 and 4, and substitute new Pages 3 and 4, dated June 1966, attached hereto.

6. Appendix XI

(i) Remove and destroy existing Pages 1 to 12 inclusive.
(ii) Insert new Pages 1 and 2, dated June 1966, attached hereto.
(iii) Cross out, but do not remove existing Page 13.
(iv) Renumber existing Pages 14 to 18 inclusive to read Pages 3 to 7 inclusive.

7. Appendix XX

Insert new Appendix XX, attached hereto.

8. Contents Sheet, Page 2.

Following Appendix XIX, insert, "Appendix XX, Code of Practice Relating to Joint Service Radioactive Valves.".

9. Amendment Record Sheet

Record amendment number and date in the appropriate space in Page 3 of Specification K1001, Issue 6 and file this amendment sheet inside the front cover for future reference.

✓APG
31/8/66

JOINT SERVICE SPECIFICATION K1001, ISSUE No. 6, DATED JULY 1964

ELECTRONIC VALVES

ADDENDUM TO AMENDMENT No. 3

Insert the following manuscript amendments:-

(i) Section 3, Page 1, Paragraph 3.6

Delete existing text and substitute, "Radioactive valves are defined in Appendix XX". ✓

(ii) Section 4

(a) Page 2, Paragraph 4.1.5.

Delete existing text, (in brackets) and substitute, "See Appendix XX". ✓

(b) Pages 2 and 3, Paragraph 4.1.5.1.

Delete existing text entirely, (including the symbol and note etc. on page 3) and substitute, "Additional to the general marking requirements at 4.1.1 to 4.1.4 above, all British manufactured radioactive valves shall be marked on the bulb or envelope in accordance with the requirements specified in Appendix XX, according to the radioactive class to which the valve is assigned.".

(iii) Section 19

Delete existing text in Section 19 entirely and substitute, "Radioactive valves shall conform to the requirements specified in Appendix XX.". ✓

(iv) Appendix XVI

Cross out this Appendix and endorse it "Cancelled". ✓

(v) Appendix XX (enclosed with this Amendment)

(a) Page 9, Paragraph 4.3, sub-para. (a),(iii). Amend "does" to read "dose".

(b) Page 9, Paragraph 4.3, sub-para. (b). Amend "Stokcs" to read "Stocks". ✓

(c) Page 9, Paragraph 4.4, sub-para. (c). Extend existing paragraph as follows:-
"unless the dose rate at the surface of the package exceeds 0.5 millirads in air per hour, ((a),(ii) above), when "Yellow Label" class of the same regulations is applicable.".

(d) Page 11, Sub-paragraph (d). Amend the bracket insertion to read "(See Page 15)".

AOC 14/4/67

4. CEMENT FOR BASING AND CAPPING

The cement used for securing the bases and or cap to the bulb shall be of approved material (see below) and the method of basing shall be such that the completed valve satisfies the requirements of Section 12 of this Specification.

A list of approved cements for bases and caps and the method of use is given below. Contractors wishing to use other materials should submit samples to the Approving Authority for test.

The cements in Table 2 cannot be used for certain photo tubes and a few other electronic valves as the requisite heat treatment would damage the tubes. For such valves other material and processes may be used subject to approval. Special precautions will be required in the packaging to prevent moisture from affecting the cement joints.

Amdt 3

TABLE 2

LIST OF APPROVED CEMENTS FOR BASING AND CAPPING

SUPERSEDED

Approved Cements	Composed of:-	Manufacturer
G17146 keyed with Bostik 1775	G17146 Bostik 1775	Bakelite Ltd., 12 Hobart Place, S.W.1. B.B. Chemical Co. Ltd., Ulverscroft Road, Leicester.
Footscray	JK 5176	British Resin Products Ltd., Devonshire House, Mayfair Place, London, W.1.
	PR 1221	British Paints Ltd., Crewe House, Curzon Street, London, W.1.
	MS. 996	Midland Silicones Ltd., 19, Upper Brook Street, London, W.1.

METHOD OF USE

G17146 Keyed with Bostik 1775

The Bostik 1775 should be applied with a brush to the glass envelope of the valve before basing and the G17146 to the base. The valve is then based in the normal manner for G17146 cement.

Footscray Cement

(a) Mixing

To make 1 lb. of Footscray Cement:-

- (i) Mix 440 cubic centimetres (360 grammes) of JX5176 to a tacky solution with addition of 68 o.p. methylated spirit.
- (ii) Add to the above 22 cubic centimetres (18 grammes) of prepared PR1221 rubber additive and mix.
- (iii) Add to the above 24 cubic centimetres (20 grammes) of Silicon varnish MS996.

(b) Curing Time

Approximately 10 minutes at 120°C cement temperature (not necessarily baking oven temperature).

(c) Working Life

It is recommended that this cement is mixed daily and used for a period not exceeding 10 hours after mixing.

Superseded Amdt 5

(II) FLYING LEAD PROTECTORS

2.1. All valves with flying leads shall be supplied fitted with protective discs, which unless the contract specifies otherwise shall be Type I below (polythene). Alternatively, in place of the Type I, Polythene Discs, B7G/F and B9A/F flying lead valves may, at the discretion of the manufacturer, be fitted with the appropriate B7G or B9A pin protector specified in Section 1 of this appendix. Amdt 5
Two types are suitable:-

Type 1 Polythene Discs These are suitable for packaging purposes to protect the valve base and leads during transit.

(Note: This type is not suitable for wiring into equipment).

B7G/F and B9A/F see Page 6 of this Appendix
B8D/F see Page 7 of this Appendix.

Type 2 P.T.F.E. Insulating Discs These will withstand the temperatures expected from normal soldering techniques in wiring the valve into circuit and also the environmental temperatures applicable to airborne equipment.

See Page 8 of this Appendix.

2.2. Qualification Approval

Not less than 6 samples of each type shall be sent for Qualification Approval to A.S.W.E. These may be submitted by either, the valve manufacturer or by the sub-contractor manufacturing the protectors.

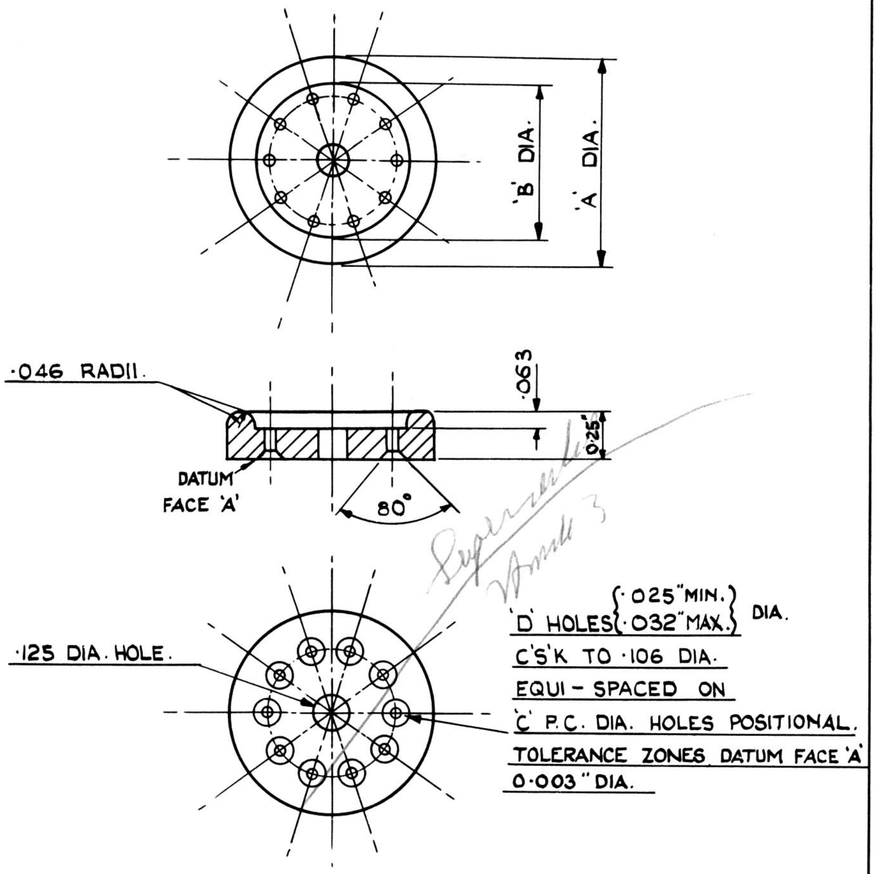
Superseded
See Amdt 3

SCHEDULE C

Manufacturers of Approved Lead Protectors

Material	Base	Manufacturer

TYPE I POLYTHENE DISCS.
(SUITABLE FOR PACKAGING ONLY)



Superseded Amdt 3

GENERAL TOLERANCES: ± 0.005"

MATERIAL: POLYTHENE

FINISH: NATURAL.

TYPE OF BASE	DIMENSIONS (INCHES)			'D' Nº OF HOLES
	'A' OVERALL DIA.	'B' INTERNAL FLANGE DIA.	'C' HOLE P.C. DIA. NOM	
B7G/F	0·620	0·470 - 0·478	0·375	8
B9A/F	0·775	0·563 -0·571	0·468	10

2.4.2.4.2. Fatigue Test. This test shall be as given in Section 11 of the general specification. This is a destructive test and valves used for this test will not be accepted for delivery.

2.4.2.4.3. Shock Test. This test shall be as given in Section 11 of the general specification. This is a destructive test and valves used for this test will not be accepted for delivery. Where reduced testing is in operation and no failures have been experienced in the last 10 successive lots this requirement will be waived provided that production is continuous.

2.4.3. Life Tests. The electrical life tests will be generally grouped together in Group F and will be performed on a sampling basis. The general requirements of these tests will be based on the procedure given in Appendix VI or as given in the Test Specification. In addition, selected tests may be required at intervals during life testing. Intermediate failure rates and the overall AQL will be stated in the Test Specification. These tests are destructive and valves used will not be accepted for delivery except those which pass the stability life test.

SUPERSEDED FAS

2.5. Retests after Holding Period. At the end of the Holding Period all the valves in the Lot, excluding those used for the destructive Sampling Inspection Tests shall be tested for air leak and open or short circuits between electrodes. A lot will be accepted if the number of inoperative valves as defined above does not exceed 0.5%. For other tests as detailed in the Test Specification the maximum allowable failure will be specified.

2.6. Sampling Inspection Procedure for Small Lot Sizes. The Sampling Inspection Procedure as given above will apply to lot sizes of 801 valves and above. The following modified procedure shall apply for lot sizes of 800 valves and below.

2.6.1. Lot Sizes 301 to 800 Valves

Group B Primary Electrical Tests remain as specified.

Group C Secondary Electrical Tests remain as specified.

Group D, E and F Where individual and combined AQL's are specified the combined AQL only shall apply. Where no combined AQL is specified the individual AQL's shall be modified as follows:- increase 2.5% to 4% and increase 6.5% to 10%, the Inspection Levels remaining at 1A or 1C as specified. In addition, for the stability life test in Group F the AQL shall be increased to 1.5%, the Inspection Level remaining at 1.

2.6.2. Lot Sizes 50 - 300 Valves

2.6.2.1. Non-Destructive Tests. On all tests (other than destructive tests) where the specified individual AQL is less than 1.5% it shall be increased to 1.5%, and where the specified combined AQL is less than 4% it shall be increased to 4%.

2.6.2.2. Destructive Tests. Where the combined AQL is less than 6.5% it shall be increased to 6.5% and the individual AQL's shall not apply. Where no combined AQL is specified the individual AQL applicable to the destructive test shall be increased to 6.5%. The following Deferred Acceptance or Chain Sampling Procedure shall be used.

2.6.2.2.1. Deferred Acceptance or Chain Sampling System for an AQL of 6.5%.

(a) A sample of two valves shall be taken at random from each lot for test.

(b) The samples from five consecutive lots shall be accumulated. If there be not more than one failure in all the samples together the lots shall be accepted.

(c) The results of the next lot shall be added to those of the immediately preceding four lots and the current lot shall be accepted if all five lots together contain not more than one failure, and so on for succeeding lots.

(d) If whilst sampling according to (b) more than one failure occurs all the lots in the chain up to this point shall be rejected. If whilst sampling according to (c) more than one failure occurs only the lot under inspection shall be rejected and test procedure shall start again from (b).

SUPERSEDED

2.6.2.2.2. Deferred Acceptance or Chain Sampling System for an AQL of 10%.

(a) A sample of two valves shall be taken at random from each lot for test.

(b) The samples from five consecutive lots shall be accumulated. If there be not more than two failures in all the samples together the lots shall be accepted.

(c) The results of the next lot shall be added to those of the immediately preceding four lots and the current lot shall be accepted if all five lots together contain not more than two failures, and so on for succeeding lots.

(d) If whilst sampling according to (b) more than two failures occur all the lots in the chain up to this point shall be rejected. If whilst sampling according to (c) more than two failures occur only the lot under inspection shall be rejected and test procedure shall start again from (b).

2.6.2.2.3. Re-Submission of Rejected Lots. Rejected lots may be resubmitted together as a single lot in accordance with Appendix XI, Clause 10, using the sampling scheme for normal inspection applicable to the appropriate lot size. If the number of valves is less than 301 the plan for 301 to 800 valves in clause 2.6.1 shall be used.

2.6.3. Production Rate Less than Fifty Valves Per Week. Since the test sampling procedures described above are not applicable to a rate of manufacture of less than fifty valves per week the test specification or contract documents will indicate where 100% testing shall not be used and will specify the requirements for the destructive tests for such cases.

APPENDIX XI

ACCEPTANCE SAMPLING

1. GENERAL

Acceptance sampling is divided into two systems. One determines the acceptance of valves on a qualitative basis and tests are made on a go- no go principle. This is called Acceptance Sampling by Attributes and the sampling plans amd procedure for this system are given in Defence Specification DEF.-131.

In the second system, measurements are made to determine where the characteristics lie with respect to the upper and lower specification limits, and also to determine the spread of these characteristics. This system is called Acceptance Sampling by Variables and the sampling plans are fully detailed in Section 2 of this Appendix.

Acceptance Sampling by Attributes shall be used when an inspection level and an A.Q.L. are acceptance inspection conditions in the Test Specification.

Acceptance Sampling by Variables shall be used when a variables inspection level, acceptance limit for sample dispersion, upper and lower limits for averages of samples are quoted, or as otherwise stated in the Test Specification.

SUPERSEDED

SECTION 1. SAMPLING INSPECTION BY ATTRIBUTES
(For Reference Purposes Only)

1. GENERAL

The following sampling inspection procedure has been extracted from "Sampling Procedures and Tables for Inspection by Attributes" MIL-STD-105A dated 11th September, 1950 and published by the Department of Defense, U.S.A.

1.1. Purpose

This section of the Appendix establishes sampling plans and procedures for inspection by attributes. It is intended for use in the determination of acceptability of electronic valves supplied under government contract.

1.2. Defects

There is only one class of defect for electtronic valves, i.e., that which results in the failure of the valve to be acceptable for Service use. A valve may be defective under several counts, but the test schedule is arranged so that a valve is removed from inspection and test after its first failure. This does not apply when AQL's of 10 or above are quoted. (See Note to Table I).

1.3. Percentage Defective

For any given test the Percentage Defective is expressed as:-

$$\text{Percentage Defective} = \frac{\text{Number of failures}}{\text{Number of valves}} \times 100$$

SUPERSEDED

2. ACCEPTANCE QUALITY LEVEL

The Acceptance Quality Level, AQL, is a nominal value expressed in terms of the Percentage Defective specified for a given test. Certain numerical values of AQL are given in Table I. When a specified AQL is a particular value other than that for which sampling plans are furnished the AQL to be used shall be as shown in Table I.

TABLE I

For AQL value falling within the range	Use AQL value below
up to 0.018	0.015
0.019 to 0.039	0.035
0.040 to 0.069	0.065
0.070 to 0.109	0.10
0.110 to 0.164	0.15
0.165 to 0.279	0.25
0.280 to 0.439	0.40
0.440 to 0.699	0.65
0.700 to 1.09	1.0
1.10 to 1.64	1.5
1.65 to 2.79	2.5
2.80 to 4.39	4.0
4.40 to 6.99	6.5
7.00 to 10.9	10.0
11.0 to 16.4	15.0
16.5 to 27.9	25.0

A single AQL may be specified for a group of tests to which a valve is inspected, and/or separate AQLs may be specified for each of the tests in the group. The procedures specified below shall be applied separately to each group and to each test in the group.

Note to Table I

AQL's above 10 refer to Percentage Defects per 100 valves and not to Percentage Defectives.

3. SUBMISSION OF VALVES

3.1. Inspection Lot

The term "lot" shall mean "Inspection Lot" i.e., a group of valves submitted by the manufacturer for acceptance by the Inspection Authority or his deputy.

3.1.1. Formation of Lots

The manufacturer shall assemble valves into identifiable lots or in such other manner as may be prescribed. Each lot shall consist of valves manufactured essentially under the same conditions.

3.2. Lot Size

The lot size is the number of valves in the lot. The maximum and minimum lot sizes will be determined by the Inspecting Authority, and will usually be not greater than the combined output of seven consecutive days production - or 301 valves - whichever is greater. No lot shall be greater than five times the average size of the preceding five lots.

4. ACCEPTABILITY OF LOTS

The acceptability of a lot of valves submitted to the Inspection Authority shall be determined by use of one of the designated sampling plans associated with the specified values of AQL.

SUPERSEDED

5. DRAWING OF SAMPLES

5.1. Sample

A sample is one or more valves drawn from a lot, the valves being selected without regard for their quality or to their previous history. Samples will be drawn in sub-groups of five consecutively, where applicable, but the sub-groups must be drawn at random from the lot. The drawing of samples from a continuously running test line on a time scale is permissible and is to be encouraged.

6. PROCESS AVERAGE

6.1. The Process Average is the average percentage defective of valves submitted for original inspection. Original inspection is the first inspection of a particular lot of valves as distinguished from the inspection of valves which have been re-submitted after prior rejection. The process average shall be computed from the results of sampling inspection of the preceding 10 lots, or such other quantity of production as the Inspection Authority shall designate.

6.2. The Inspection Authority reserves the right to exclude from the estimated process average, the results of inspection of valves manufactured under conditions deemed by the Inspection Authority to be not typical of usual production.

7. NORMAL TIGHTENED AND REDUCED INSPECTION

7.1. The Inspection Authority shall determine whether normal, tightened or reduced inspection shall be used in respect of valves submitted by the manufacturer.

7.1.1. Normal inspection shall be used when the estimated process average is not outside the applicable upper and lower limits shown in Tables IIA and IIB.

7.1.2. Tightened inspection shall be instituted when the estimated process average exceeds the applicable upper limit shown in Table IIB. Normal inspection shall be re-instated if the estimated process average is equal to or less than the AQL while tightened inspection is in effect.

7.1.3. Reduced inspection may be instituted at the discretion of the Inspection Authority provided that the following conditions are satisfied:-

(a) the preceding ten lots have been under normal inspection and none have been rejected;

(b) the estimated process average is less than the applicable lower limit shown in Table IIA.

(c) production is continuous

Normal inspection shall be re-instated if any one of the following conditions occur while reduced inspection is in effect:-

(a) a lot is rejected;

(b) the estimated process average is greater than the AQL;

(c) production becomes irregular and delayed;

(d) the Inspection Authority deems that normal inspection should be re-instated.

SUPERSEDED

TABLE IIA. LOWER LIMITS

No. of samples included in estimated process average	Acceptance Quality Levels										
	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10.0	15.0	25.0
25 - 34	Number of sample units included in estimated process average insufficient for reduced inspection										
35 - 49											1.86
50 - 74										0.25	5.95
75 - 95										2.54	8.92
100 - 124									1.04	4.02	10.83
125 - 149									1.89	5.07	12.18
150 - 199								0.71	2.82	6.20	13.64
200 - 249								1.40	3.67	7.24	14.99
250 - 299							0.38	1.88	4.27	7.99	15.95
300 - 349							0.67	2.25	4.73	8.55	16.67
350 - 399						0.05	0.90	2.55	5.10	9.00	17.25
400 - 449						0.20	1.09	2.79	5.40	9.36	17.72
450 - 549						0.38	1.32	3.08	4.76	9.80	18.29
550 - 649						0.56	1.55	3.38	6.13	10.25	18.87
650 - 749					0.11	0.71	1.73	3.61	6.41	10.61	19.33
750 - 899					0.22	0.85	1.91	3.84	6.70	10.95	19.78
900 - 1,099				0.05	0.34	1.00	2.10	4.08	7.00	11.32	20.26
1,100 - 1,299				0.13	0.44	1.13	2.27	4.29	7.26	11.64	20.67

TABLE IIB. UPPER LIMITS

No. of samples included in estimated process average	Acceptance Quality Levels										
	0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10.0	15.0	25.0
25 - 34			5.103	6.52	8.27	11.23	15.05	20.58	27.47	36.39	52.62
35 - 49		3.328	4.383	5.63	9.82	9.82	13.26	18.30	24.64	32.93	48.14
50 - 74	2.155	2.810	3.722	4.81	6.17	8.52	11.62	16.21	22.05	29.75	44.05
75 - 99	1.858	2.434	3.243	4.22	5.44	7.59	10.43	14.70	20.17	27.46	41.08
100 - 124	1.667	2.193	2.935	3.83	4.97	6.98	9.67	13.73	18.96	25.98	39.17
125 - 149	1.532	2.021	2.716	3.56	4.64	6.55	9.13	13.03	18.11	24.93	37.82
150 - 199	1.386	1.836	2.481	3.27	4.28	6.09	8.54	12.29	17.18	23.80	36.36
200 - 249	1.251	1.666	2.264	3.00	3.95	5.67	8.00	11.60	16.33	22.76	35.01
250 - 299	1.155	1.545	2.110	2.81	3.72	5.36	7.62	11.12	15.73	22.01	34.05
300 - 349	1.083	1.453	1.993	2.67	3.54	5.13	7.33	10.75	15.27	21.45	33.33
350 - 399	1.025	1.380	1.900	2.55	3.40	4.95	7.10	10.45	14.90	21.00	32.75
400 - 449	0.978	1.321	1.824	2.46	3.28	4.80	6.91	10.21	14.60	20.64	32.28
450 - 549	0.921	1.249	1.732	2.34	3.14	4.62	6.68	9.92	14.24	20.20	31.71
550 - 649	0.863	1.175	1.638	2.23	3.00	4.44	6.45	9.62	13.87	19.75	31.13
650 - 749	0.817	1.117	1.564	2.13	2.89	4.29	6.27	9.39	13.59	19.39	30.67
750 - 899	0.772	1.061	1.492	2.04	2.78	4.15	6.09	9.16	13.30	19.05	30.22
900 - 1,099	0.724	1.000	1.415	1.95	2.66	4.00	5.90	8.92	13.00	18.68	29.74
1,000 - 1,299	0.683	0.948	1.348	1.87	2.56	3.87	5.73	8.71	12.74	18.36	29.33

(SUPERSEDED)

7.1.4. At the start of a production run, normal inspection shall be used but acceptance may be suspended until three lots have been tested.

7.2. An alternative form of reduced inspection for Resonance Search (K1001 11.2), Fatigue and Post Fatigue tests (K1001 11.3) and Shock and Post Shock tests (K1001 11.4) in which these tests are done only on every fourth lot of valves may be instituted when Normal or Reduced inspection as specified in 7.1. above is in operation and when the following additional conditions are satisfied:-

(a) Production is continuous

(b) The three preceding lots have been accepted.

If the fourth lot fails, the three preceding lots shall be tested and normal testing shall be reinstated until the above conditions are again satisfied.

The process average shall be computed from the lots submitted to the Inspection Authority.

8. SAMPLING PLANS

8.1. A sampling plan for each AQL value specified shall be selected from the following tables.

8.2. Determination of Sample Size Code Letter

The relative sample sizes are designated by code letters and will depend on the inspection level and the lot size. There are three Inspection Levels, I, II and III and, unless otherwise specified, Inspection Level II shall be used. Variation of the inspection level may be used at the discretion of the Inspection Authority in order to inspect critical defects

SUPERSEDED

TABLE IIIA

Sample size code letters

Lot Size	Inspection Levels		
	I	II	III
2 to 8	A	A	C
9 to 15	A	B	D
16 to 25	B	C	E
26 to 40	B	D	F
41 to 65	C	E	G
66 to 110	D	F	H
111 to 180	E	G	I
181 to 300	F	H	J
301 to 500	G	I	K
501 to 800	H	J	L
801 to 1300	I	K	L
1301 to 3200	J	L	M
3201 to 8000	L	M	N
8001 to 22000	M	N	O
22001 to 110000	N	O	P

Additional inspection levels are given below for those cases where a large sampling risk can be tolerated.

TABLE IIIB

Lot Size	Inspection Levels		
	1C	1B	1A
301 - 800	E	E	E
801 - 1300	E	E	F
1301 - 3200	E	F	G
3201 - 8000	E	G	H
8001 and over	E	G	I

8.3. Selection of Master Sampling Plan

The appropriate master sampling plan shall be selected as follows:-

For normal or tightened inspection,

Single Sampling	Table IVA
Double Sampling	Table IVB
Multiple Sampling	Table IVC

For reduced inspection,

All AQL values

Single Sampling	Table V

8.4. Obtaining a Sampling Plan

A sampling plan consists of a sample size or series of sample sizes with associated acceptance and rejection numbers and is used to determine the acceptability of the lot. The sampling plan to be applied shall be obtained from the appropriate master tables as follows:-

SUPERSEDED

8.4.1. Sample Size

The sample size or series of sample sizes shall be as indicated by the master table for the application sample size code letter.

8.4.2. Acceptance and Rejection Numbers

The acceptance and rejection numbers corresponding to the sample size or series of sample sizes shall be as indicated in that column of the master table for the applicable AQL value and for normal, tightened or reduced inspection, whichever is in effect. The table is entered from the top for normal inspection and from the bottom for reduced inspection.

8.4.3. Matching of Sampling Plans

When three types of sampling plans are available for a given lot size and AQL, they are matched so that the percentage of lots of any given quality which may be expected to be accepted is essentially the same. For AQL values over 10% only the single sampling plan is available.

The type of sampling plan to be used shall be acceptable to the Inspection Authority.

9. DETERMINATION OF ACCEPTABILITY

Percentage Defective Inspection

9.1. Use of Sampling Plans

To determine whether a lot shall be accepted with respect to a particular AQL value, the applicable sampling plan shall be used in accordance with the following procedure.

9.2. Single Sampling Plan

When the number of defectives found in a sample is equal to or less than the acceptance number in the sampling plan, the lot from which the sample was drawn shall be accepted. If the number of defectives is equal to or greater than the rejection number the lot shall be rejected.

9.3. Double Sampling Plan

When the number of defectives found in the first sample is equal to, or less than the first acceptance number of the sampling plan, the lot from which the sample was drawn shall be accepted. When the number of defectives found in the first sample is equal to, or greater than the first rejection number, the lot shall be rejected. When the number of defectives is between the first acceptance and the first rejection numbers, a second sample of the size as indicated in the sampling plan shall be examined. The number of defectives found in the first and second samples shall be accumulated. If the cumulative number of defects is equal to, or less than the second acceptance number, the lot shall be accepted. If the cumulative number of defects is equal to, or greater than the second rejection number, the lot shall be rejected.

SUPERSEDED

9.4. Multiple Sampling Plans

For multiple sampling, the procedure shall be similar to that specified in 9.3 except that the number of successive samples required to reach a decision may be more than two.

10. Resubmission of Rejected Lots

When the manufacturer elects to resubmit a rejected lot he shall first inspect the rejected lot, repair or remove all defectives and then present the valves as a resubmitted lot. The Inspection Authority shall inspect the resubmitted lot with either normal or tightened inspection for all the tests on the test specification or merely inspect for the particular test clause which caused the lot to be rejected.

TABLE IVA SINGLE SAMPLING

Master Table for Normal and Tightened Inspection

Code Letter	Sample Size	Acceptance Quality Levels (Normal Inspection)																				
		0.25		0.4		0.65		1.0		1.5		2.5		4.0		6.5		10		15		25
		Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re
A	2	Use first sample plan below. When sample size equals lot size do 100% inspection														B		0	1	B		B	
B	3													B		0	1	A		B		1	2
C	5											B		0	1	A		B		1	2	2	3
D	7									B		0	1	A		B		1	2	2	3	3	4
E	10							B		0	1	A		A		1	2	2	3	3	4	5	6
F	15					B		0	1	A		B		1	2	2	3	3	4	4	5	7	8
G	25			B		0	1	A		B		1	2	2	3	3	4	5	6	7	8	11	12
H	35	B		0	1	A		B		1	2	2	3	3	4	5	6	7	8	10	11	15	16
I	50	0	1	A		B		1	2	2	3	3	4	4	5	6	7	9	10	13	14	20	21
J	75	A		B		1	2	2	3	3	4	4	5	6	7	9	10	13	14	19	20	29	30
K	110	B		1	2	2	3	3	4	4	5	6	7	8	9	12	13	18	19	26	27	40	41
L	150	1	2	2	3	3	4	4	5	5	6	8	9	11	12	17	18	24	25	34	35	53	54
M	225	2	3	3	4	4	5	5	6	8	9	11	12	17	18	24	25	34	35	48	49	76	77
N	300	3	4	4	5	5	6	7	8	10	11	14	15	20	21	32	33	44	45	63	64	98	99
O	450	4	5	5	6	7	8	10	11	14	15	20	21	29	30	43	44	62	63	89	90	A	
P	750	6	7	8	9	11	12	15	16	20	21	31	32	45	46	68	69	98	99	A		A	
		0.4		0.65		1.0		1.5		2.5		4.0		6.5		10		15		25		40
		Acceptance Quality Levels (Tightened Inspection)																				

SUPERSEDED

Ac = Acceptance number

Re = Rejection number

A = Use next sampling plan <u>above</u>

B = Use next sampling plan <u>below</u>

TABLE IVB DOUBLE SAMPLING

Master Table for Normal and Tightened Inspection

Sample Size Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptance Quality Levels (Normal Inspection)								
				0.25	0.40	0.65	1.0	1.5	2.5	4.0	6.5	10.0
				Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re	Ac Re
A & B	No Double Sampling plans for these code letters											
C	Use Single Sampling plan.											
D	First	5	5	Use corresponding Single Sampling plan. Table IVA in this area.					S	S	B	1 3
	Second	10	15									2 3
E	First	7	7								0 3	1 5
	Second	14	21					S	A	B	2 3	4 5
F	First	10	10							0 3	1 4	2 6
	Second	20	30				S	A	B	2 3	3 4	5 6
G	First	15	15						0 3	1 4	1 5	3 7
	Second	30	45			S	A	B	2 3	3 4	4 5	6 7
H	First	25	25					1 3	1 4	2 5	3 7	5 11
	Second	50	75		S	A	B	2 3	3 4	4 5	6 7	10 11
I	First	35	35				0 3	1 3	1 5	2 7	3 12	6 15
	Second	70	105	S	A	B	2 3	2 3	4 5	6 7	11 12	14 15
J	First	50	50			0 3	1 4	1 6	2 7	3 10	5 15	8 21
	Second	100	150	A	B	2 3	3 4	5 6	6 7	9 10	14 15	20 21
K	First	75	75		0 3	1 3	1 6	2 8	4 9	5 12	7 20	12 29
	Second	150	225	B	2 3	2 3	5 6	7 8	8 9	11 12	19 20	28 29
L	First	100	100	0 3	1 4	1 6	2 6	3 8	5 12	7 17	10 31	14 49
	Second	200	300	2 3	3 4	5 6	5 6	7 8	11 12	16 17	30 31	48 49
M	First	150	150	1 3	2 5	2 7	3 8	5 14	7 19	11 29	15 47	21 65
	Second	300	450	2 3	4 5	6 7	7 8	13 14	18 19	28 29	46 47	64 65
N	First	200	200	1 6	2 7	3 8	4 10	6 17	9 25	12 36	18 67	27 89
	Second	400	600	5 6	6 7	7 8	9 10	16 17	24 25	35 36	66 67	88 89
O	First	300	300	2 7	3 9	4 11	6 17	8 26	12 36	18 55	26 88	38 123
	Second	600	900	6 7	8 9	10 11	16 17	25 26	35 36	54 55	87 88	122 123
P	First	500	500	3 10	5 13	6 22	9 25	12 37	18 65	27 89	43 131	62 191
	Second	1000	1500	9 10	12 13	21 22	24 25	36 37	64 65	88 89	130 131	190 191
				0.25	0.65	1.0	1.5	2.5	4.0	6.5	10.0	
				Acceptance Quality Levels (Tightened Inspection)								

SUPERSEDED

Ac = Acceptance number
Re = Rejection number

S = Use Single Sampling plan
A = Use next sampling plan <u>above</u>
B = Use next sampling plan <u>below</u>

TABLE IVC MULTIPLE SAMPLING

Master Plan for Normal and Tightened Inspection

SUPERSEDED

Sample Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptance Quality Levels (Normal Inspection)																	
				0.25		0.40		0.65		1.0		1.5		2.5		4.0		6.5		10.0	
				Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re
A&B	No Multiple Sampling plan for these sample size code letters.																				
C	Use Single Sampling plan																				
D	1st	3	3	Use Single Sampling plan in this area. When sample size equals or exceeds lot size, do 100% inspection.										S		S		B		D	
	2nd	3	6																		
	3rd	3	9																		
	4th	3	12																		
E	1st	4	4									S		A		B		x	2	x	2
	2nd	4	8															0	2	1	3
	3rd	4	12															1	3	2	4
	4th	4	16															1	3	2	5
	5th	4	20															3	4	4	5
F	1st	5	5							S		A		B		x	2	x	2	x	2
	2nd	5	10													0	2	1	3	1	4
	3rd	5	15													0	3	1	4	2	5
	4th	5	20													1	3	1	4	4	6
	5th	5	25													2	3	3	4	6	7
G	1st	7	7					S		A		B		x	1	x	2	x	2	0	3
	2nd	7	14											x	2	0	3	1	3	2	4
	3rd	7	21											0	2	1	3	3	4	3	6
	4th	7	28											1	3	2	4	3	5	5	7
	5th	7	35											2	4	3	5	4	6	6	9
	6th	7	42											3	4	4	5	5	6	8	9
H	1st	10	10			S		A		B		x	2	x	2	x	3	0	4	0	4
	2nd	10	20									x	2	0	3	0	3	1	5	3	6
	3rd	10	30									0	2	1	3	1	4	3	7	5	8
	4th	10	40									0	3	1	4	2	6	4	8	6	10
	5th	10	50									1	3	2	4	3	7	5	9	8	12
	6th	10	60									2	4	2	4	4	7	7	10	10	14
	7th	10	70									3	4	4	5	6	7	10	11	13	14
I	1st	14	14	S		A		B		x	2	x	2	x	2	x	3	0	4	1	5
	2nd	14	28							0	2	0	3	0	3	1	4	2	5	3	8
	3rd	14	42							0	2	1	3	1	4	2	4	4	8	5	10
	4th	14	56							0	2	1	3	3	5	3	6	5	9	8	12
	5th	14	70							1	3	2	4	3	5	4	6	7	10	11	14
	6th	14	84							1	3	3	5	3	5	5	7	10	12	13	16
	7th	14	98							2	3	4	5	4	5	6	7	11	12	15	16
J	1st	20	20	A		B		x	2	x	2	x	3	x	3	0	4	1	5	1	6
	2nd	20	40					x	2	0	3	0	4	1	4	1	5	3	7	5	10
	3rd	20	60					0	2	1	3	1	4	2	5	3	6	5	10	9	14
	4th	20	80					1	3	2	4	2	5	3	6	5	8	7	12	13	17
	5th	20	100					1	3	2	4	4	6	5	7	8	10	9	13	15	20
	6th	20	100					1	3	2	4	4	6	6	8	9	11	12	16	19	23
	7th	20	140					2	3	3	4	5	6	7	8	10	11	16	17	22	23

TABLE IVC MULTIPLE SAMPLING

Master Plan for Normal and Tightened Inspection (Continued)

Sample Code Letter	Sample	Sample Size	Cumulative Sample Size	Acceptance Quality Levels (Normal Inspection)																	
				0.25		0.40		0.65		1.0		1.5		2.5		4.0		6.5		10.0	
				Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re	Ac	Re
K	1st	30	30	B		x	2	x	2	x	3	x	3	0	4	0	4	1	6	2	8
	2nd	30	60			0	2	0	2	0	3	1	4	2	5	3	7	5	9	8	13
	3rd	30	90			0	2	1	3	1	4	2	5	3	8	5	9	8	13	12	19
	4th	30	120			0	2	2	4	2	6	4	6	4	9	7	11	11	16	17	22
	5th	30	150			1	3	3	5	3	6	5	7	6	10	9	13	13	19	21	27
	6th	30	180			1	3	3	5	5	7	6	8	8	12	12	15	16	22	27	32
	7th	30	210			2	3	4	5	6	7	7	8	11	12	14	15	21	22	35	36
L	1st	40	40	x	2	x	2	x	3	x	3	x	4	0	4	1	6	2	8	4	10
	2nd	40	80	x	2	0	3	0	3	1	4	1	5	2	7	4	8	6	12	10	16
	3rd	40	120	0	2	1	3	1	4	2	4	3	6	5	9	7	11	11	16	16	23
	4th	40	160	0	3	3	5	3	5	4	6	4	7	7	11	10	14	16	21	22	29
	5th	40	200	1	3	3	5	4	6	5	7	6	8	9	13	13	17	22	26	28	35
	6th	40	240	2	4	3	5	6	8	6	8	6	8	11	15	16	21	28	31	36	42
	7th	40	280	4	5	4	5	8	9	8	9	9	10	15	16	20	21	30	31	44	45
M	1st	50	50	x	2	x	2	x	3	x	3	0	4	0	5	2	7	3	10	5	12
	2nd	50	100	0	2	0	4	0	4	1	4	2	6	3	8	4	11	8	15	12	20
	3rd	50	150	0	3	2	4	1	4	2	6	3	8	5	11	8	15	13	19	19	28
	4th	50	200	1	3	2	5	3	6	3	7	5	10	8	13	12	19	18	24	26	35
	5th	50	250	2	4	3	6	4	7	4	8	7	12	10	15	16	22	23	30	33	42
	6th	50	300	2	4	4	7	5	8	5	9	9	14	13	18	21	26	28	35	40	49
	7th	50	350	2	4	5	7	6	8	7	10	11	16	15	20	25	29	33	40	48	56
	8th	50	400	3	4	6	7	7	8	9	10	15	16	19	20	28	29	40	41	56	57
N	1st	75	75	x	3	x	3	x	4	0	4	0	5	1	7	2	9	4	13	8	16
	2nd	75	150	0	3	1	4	1	5	2	5	3	8	4	10	7	13	11	21	18	27
	3rd	75	225	1	4	1	5	3	5	3	7	6	10	8	14	13	18	19	29	28	37
	4th	75	300	2	5	2	6	4	7	5	9	8	13	12	18	18	23	27	37	39	48
	5th	75	375	3	6	3	6	5	8	7	10	11	16	15	21	23	27	35	45	50	59
	6th	75	450	4	6	5	8	7	9	9	10	13	18	18	25	28	32	43	53	61	69
	7th	75	525	7	8	7	8	9	10	10	11	18	19	24	25	34	35	55	56	75	75
O	1st	100	100	x	3	x	3	x	4	0	5	0	7	1	8	3	11	6	15	9	19
	2nd	100	200	0	4	1	5	1	5	2	7	4	9	5	13	9	17	15	24	22	33
	3rd	100	300	1	4	1	6	3	7	5	9	6	13	10	18	16	23	24	33	37	47
	4th	100	400	3	6	3	7	5	9	7	11	9	16	14	22	24	29	33	34	52	62
	5th	100	500	4	7	4	8	7	11	10	14	12	19	18	26	30	35	42	53	66	74
	6th	100	600	5	8	5	9	9	12	12	16	15	22	23	31	37	42	51	62	80	88
	7th	100	700	6	8	7	10	11	13	15	18	19	25	27	35	43	47	62	72	94	102
	8th	100	800	7	8	9	10	12	13	18	19	24	26	34	35	46	47	74	75	108	109
P	1st	150	150	x	3	0	4	0	5	0	6	1	8	2	11	6	11	6	15	10	29
	2nd	150	300	1	5	1	5	2	7	4	9	5	11	8	17	14	24	22	34	34	49
	3rd	150	450	2	6	2	7	4	9	7	12	10	15	14	23	24	35	37	48	54	69
	4th	150	600	3	7	4	9	7	12	10	15	14	19	20	29	32	44	50	61	73	88
	5th	150	750	4	9	6	11	9	14	13	18	17	24	26	36	40	52	62	74	92	108
	6th	150	900	6	10	8	13	12	16	16	21	21	28	32	42	48	60	74	88	110	128
	7th	150	1050	8	11	10	14	15	18	19	23	26	31	38	48	56	68	87	101	127	145
	8th	150	1200	9	11	12	15	17	20	22	26	31	37	44	54	64	73	100	114	144	162
	9th	150	1350	11	12	15	16	19	20	26	27	36	37	54	55	72	73	113	114	161	162
				0.40		0.65		1.0		1.5		2.5		4.0		6.5		10.0			
				Acceptance Quality Levels (Tightened Inspection)																	

SUPERSEDED

Ac = Acceptance number
Re = Rejection number

S = Use Single Sampling plan
D = Use Double Sampling plan

A = Use sampling plan above
B = Use sampling plan below

x = Acceptance not permitted at this sample size.

JOINT SERVICE SPECIFICATION K1001, ISSUE No. 6, DATED JULY 1964

ELECTRONIC VALVES

AMENDMENT No. 2

1. Insert manuscript amendments as follows:-

   (i) Contents Sheet, Page 2.

   (a) Section 16: Under Holding Period insert
   "Part 1. Mandatory.
   Part 2. Delayed Shipment of Inspected Valves."

   (b) Following Appendix XVIII insert "Appendix XIX Inspection Procedures for Gold Plated Pins and Accessories."

   (ii) Section 3, Page 1.

   Between paragraphs 3.5 and 3.6 insert new paragraph 3.5.1 as follows:-

   "3.5.1. When specified in the individual test specification, gold plated pins and accessories shall be tested in accordance with Appendix XIX."

   (iii) Section 16.

   (a) Page 1. Under the title Holding Period insert
   "PART 1. MANDATORY."

   (b) Page 3. Following paragraph 16.6 insert
   "PART 2. DELAYED SHIPMENT OF INSPECTED VALVES.

   16.7 Valves which have passed inspection and have subsequently been held in storage for a period in excess of twelve months shall prior to delivery be re-tested for inoperatives."

   (iv) Appendix VIII

   Page 2, Schedule B.

   In the table against 'Enalon Plastics Ltd.' (inserted by Amendment No. 1) amend the entry in the column headed 'Protectors' to read "B7G and B9A."

2. Remove and Insert the following sheets as appropriate:-

   (i) Section 6. Remove and destroy existing Section 6 and substitute new Section 6 (pages 1 and 2) dated June, 1965, attached hereto.

   (ii) Appendix XIX. Insert new Appendix XIX, dated June, 1965 attached hereto.

3. Amendment Record Sheet.

Record Amendment number and date in the appropriate space in Page 3 of Specification K1001 Issue 6 and file this amendment sheet inside the front cover for future reference.

T.V.C. Office

✓AAS 10/8/65

Section 6

SAMPLING AND STATISTICAL TESTS

Where a Test Specification requires that inspection and acceptance for any test or group of tests shall be on a statistical basis the sampling procedure shall be in accordance with Appendix XI. Sampling Inspection will be indicated by the inclusion of an Inspection Level and an Acceptable Quality Level (AQL) in the Test Specification.

6.1 Test Specifications issued prior to Issue 5 of this specification or subsequently re-issued. In some Test Specifications issued before the publication of Issue 5 of K.1001 it was shewn that 100% inspection was not essential for certain tests. This was indicated by one of the following methods:-

(a) A percentage of each quantity of valves to be submitted to the Inspecting Officer, with an overriding minimum; e.g. 1% (20).

This shall now be interpreted as Inspection Level IB and AQL 6.5%. (See Appendix XI).

(b) A fixed quantity to be tested per week or month; e.g. 6 per week.

This shall now be interpreted as Inspection Level IC and AQL 6.5%. (See Appendix XI).

(c) 100% or S.

This shall now be interpreted as giving the manufacturer permission to use a Sampling Inspection Plan instead of 100%. The following procedure shall apply:-

(i) Characteristic tests for Ih, Ih-k, Ia and gm

Inspection Level = II. AQL = 1.5%. (See Appendix XI)

(ii) Other characteristics

Inspection Level = I. AQL = 4.0%. (See Appendix XI)

6.2 Test Specifications for Normal Quality General Purpose Receiving Valves

6.2.1. Test specifications for normal quality general purpose receiving valves often specify tests to be performed at an Inspection Level of 100%. In these cases the manufacturer may with the agreement of the Inspecting and Approving Authority, apply Sampling and Statistical Testing in accordance with Appendix XI.

The tests shall be grouped (see also Appendix IX clause 2.4.1.1.) as follows:-

(a) Group A.

Reverse Grid Current and Electrode Insulation Tests. Inspection Level = 100% (alternatively these may be submitted to Group B testing).

(b) Group B.

Major Electrical Parameters. (These will be those tests not already covered in either clauses 6.1. or 6.2.(a) above. Inspection Level = II. A.Q.L. = 0.65%. A combined A.Q.L. of 1% shall also be applied to each set of four test parameters, (or less as necessary), taken in the sequence in which they are specified.

(c) Group C.

Secondary Electrical Parameters. The Sampling specified in clause 6.1. above, applies as appropriate.

SUPERSEDED
BY SECTION DATED JUNE 1965

ADDENDUM TO E.V.S. MANUALS CHANGE SHEET DATED 30TH NOVEMBER 1964

(A and B and C and D Manuals)

JOINT SERVICE SPECIFICATION K1001, ISSUE NO.6, DATED JULY 1964

AMENDMENT NO.1

Insert manuscript amendments as follows:-

1. Section 4

(i) Page 2, paragraph 4.1.2.1. first line - delete "January, 1st 1965" and substitute "further notice"

(ii) Page 2, paragraph 4.1.5.1.(i) - after the first sentence, delete the text in brackets i.e. beginning "(This is opposite .... background colour)"

(iii) Page 3, sub-paragraph (iv) - below 47142 Magenta insert "or Black (See Note)" and at foot of page insert the following:-

Note: In due course it is intended to align the requirements with those specified in British Standard Specification 3510 which will necessitate at least the following amendments.

Sub-paragraph (iv) Imprinting Colour - deletion of 796 Dark Violet and 47142 Magenta

and

Sub-paragraph (v) Background Colour - present paragraph to be deleted and replaced with "Yellow, Colour No.309 of BS.381C".

(iv) Page 4, paragraph 4.7 - amend "Appendix VIII" to read "Appendix VII"

2. Appendix VII

(i) Page 1, Schedule A - Add the following to the existing table:-

Material	Manufacturer
"Carinex" TGH Polystyrene Heat Resistant, Toughened Grade.	Shell Chemical Co. 170 Piccadilly, London, W.1.

(ii) Page 2, Schedule B, add the following to the existing table.

Protectors	Manufacturers	Code
B7G	Enalon Plastics Ltd., South Premier Works, Drayton Road, Tonbridge, Kent.	EPL

(iii) Page 3, Drawing No.1, Fig.1 - Amend the overall diameter of "0.75" + 0.00" to read "0.65 max."
- 0.01"

(iv) Page 5, paragraph 2.1. At the end of the first paragraph add new sentence as follows:-

"Alternatively, in place of the Type I, Polythene Discs, B7G/F and B9A/F flying lead valves may, at the discretion of the manufacturer, be fitted with the appropriate B7G or B9A pin protector specified in Section 1 of this appendix."

3. Amendment Record Sheet

Record amendment number and date in the appropriate space in Page 3 of Specification K1001 Issue 6 and file this amendment sheet inside the front cover for future reference.

November, 1964 T.V.C. Office

(222422)

✓AAS
4/1/65