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Methods for the measurement of direct interelectrode capacitances of electronic tubes and valves
Amendment No.1 (1969)

This Harmonization Document was adopted by CENELEC on 1976-06-29.

The National Electrotechnical Committees, members of CENELEC, in

A : Austria
B : Belgium
CH : Switzerland
D : Germany
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F : France
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Reference of the relevant National Harmonized Standards overleaf

are obliged, in accordance with the CENELEC Internal Regulations, to implement this Harmonization Document in their respective country by

- Issuing harmonized national standard(s) and/or
- Withdrawing conflicting national standard(s)

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Methods for the measurement of direct interelectrode capacitances of electronic tubes and valves

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

METHODS FOR THE MEASUREMENT OF DIRECT INTERELECTRODE CAPACITANCES OF ELECTRONIC TUBES AND VALVES

FOREWORD

(1) The formal decisions or agreements of the I.E.C. on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.

(2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.

(3) In order to promote this international unification, the I.E.C. expresses the wish that all National Committees having as yet no national rules, when preparing such rules, should use the I.E.C. recommendations as the fundamental basis for these rules in so far as national conditions will permit.

4) The desirability is recognised of extending international agreement on these matters through an endeavour to harmonize national standardization rules with these recommendations in so far as national conditions will permit. The National Committees pledge their influence towards that end.

PREFACE

This publication has been prepared by Technical Committee No. 39, Electronic tubes and valves.

Work on the second edition was started directly after the publication of the first edition in 1958. Drafts were discussed at meetings in Zurich in 1957, Stockholm in 1958 and Madrid in 1959. At the Madrid meeting, it was decided that the work was sufficiently advanced for a draft to be submitted to the National Committees for approval. Accordingly a final draft was circulated under the Six Months' Rule in May 1960.

The following countries voted explicitly in favour of publication:

Austria
Belgium
Canada
Czechoslovakia
Denmark
France
Germany
Israel
Italy
Netherlands
Poland
Romania
Sweden
Switzerland
Union of Soviet Socialist Republics
United Kingdom
United States of America

METHODS FOR THE MEASUREMENT OF DIRECT INTERELECTRODE CAPACITANCES OF ELECTRONIC TUBES AND VALVES

Scope

This recommendation covers the measurement of direct interelectrode capacitances of tubes and valves within the conditions outlined in Clause 4 for the following classes:

Receiving tubes and valves
Cathode-ray tubes
Gas tubes and gas-filled valves
Phototubes, photocells and multiplier types
High-power vacuum tubes and valves

1. Definitions

In this recommendation the following definitions apply:

1.1 *Element (of an electronic tube or valve).* Any integral part of the tube or valve that contributes to its operation and to which external connections can be made.

1.2 *Electrode (of an electronic tube or 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.

1.3 *Filament (of an electronic tube or valve).* A hot cathode (usually in the form of a wire or ribbon) which is heated directly by current flowing in it.

2. General rules for interconnections

2.1 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 earth. This is not to be confused with earthing in circuit applications. A connection which is not identified, for instance to a pin or lead marked "internal connection", shall be left floating.

2.2 When measuring cathode-ray tubes, the post-deflection accelerators (intensifier electrodes) are left floating.

2.3 When measuring tubes and valves with a metal base sleeve not connected internally, the metal base sleeve is left floating.

2.4 On all types where elements are connected to two or more pins or leads, all such pins or leads shall be connected together.

2.5 In those cases where two or more elements are declared to be internally connected, the major element is used to describe the combination. For example, the combination of a grid internally connected to a cathode shall be regarded as a cathode in the tables of connections.

2.6 For directly-heated filament types, the filament is regarded as the cathode electrode.

2.7 In all cases, when stating capacitance values, it shall be made clear which elements are connected to the active terminals of the measuring equipment, and which are connected to the reference earth. This may be done either in words or symbols. Certain descriptive terms are in common use and where they are used they will have the meaning given in Appendix I or Appendix II of this publication.

3. Systems of symbols used for interelectrode capacitances

In the tables of the Appendices I and II of this publication two symbols are given for each interelectrode capacitance. They refer to two different systems: A and B. System A which is outlined in Clause 3.1 is a simple system for normal use, while system B which is outlined in Clause 3.2 is a more complex system which may be used in those cases where it is desirable to give more information.

3.1 SYMBOL SYSTEM A

3.1.1 The symbol consists of a capital *C* followed by a suffix of one or more small letters and digits. The small letters, sometimes in combination with a digit, each indicate a part of the tube or valve according to the system given in Clause 3.3.

3.1.2 Unbracketed letters in the suffix following the capital *C* indicate the parts of the tube or valve to be connected to the active terminals of the measuring equipment. An oblique stroke separates the parts to be connected to the different active terminals, but see also 3.1.6 and 3.1.7.

3.1.3 If parts of the tube or valve are indicated in the suffix on both sides of the oblique stroke, all parts that are not mentioned are connected to the reference earth during the measurement (except those referred to in Clauses 2.1, 2.2 and 2.3).

Example:

Symbol $C_{fk/a}$
Type of tube or valve unit: triode, tetrode, pentode
Measure between: cathode + heater
and anode
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.1.4 If in the suffix no letter follows the oblique stroke, this means that the second active terminal of the measuring equipment is connected to "all other elements, shields, metal parts, etc.", and not to some separate part.

3.1.5 If one or more electrodes are excluded from "all elements, shields, metal parts, etc.", and these electrodes are to be connected to the reference earth, this is indicated by showing the letters for these electrodes between brackets.

Example:

Symbol $C_{kf/(au)}$
Type of tube or valve: triode, tetrode, pentode, with other units
Measure between: cathode + heater
and grid + screen + suppressor + shield
+ metal parts, etc.
Connect to the reference earth: anode + elements of other units.

3.1.6 If, in the above system, the unbracketed part of the suffix consists of only one letter, the oblique stroke will be omitted.

Example:

Symbol C_a (instead of $C_{a/}$)
Type of tube or valve unit: mixer
Measure between: anode
and all other elements, shields, metal parts, etc.
Connect to the reference earth: none.

3.1.7 If, in the above system, the unbracketed part of the suffix consists of only two letters and the oblique stroke appears between them, then the oblique stroke will be omitted.

Example:

Symbol C_{ga} (instead of $C_{g/a}$)
Type of tube or valve unit: triode, tetrode, pentode
Measure between: grid
and anode
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.1.8 If the tube or valve is a multi-unit type, containing two or more dissimilar units, the parts of each unit will be indicated in the symbol by a subscript in accordance with Clause 3.4.1.

Example:

Symbol $C_{g_{1T}{}^{a}{}_{P}}$
Type of tube or valve: triode-pentode
Measure between: g_1 of triode
and anode of pentode
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.1.9 If the tube or valve is a multi-unit type containing two or more similar units, the part of each unit will be indicated in the subscript of the symbol in accordance with Clause 4.3.2.

Example:

Symbol $C_{k'k''}$
Type or tube or valve: twin unit
Measure between: cathode of first unit
and cathode of second unit
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.1.10 From the above rules for system A, the following forms of symbols may be expected to occur:

Symbols	Capacitance	Measure between		Connect to the reference earth
C_x	x to all	x	R, u	—
$C_{x(y)}$	x to all except y	x	R, u	y
$C_{x(yz)}$	x to all except y + z	x	R, u	y, z
$C_{x(u)}$	x to all of same unit	x	R	u
$C_{x(yu)}$	x to all of same unit except y	x	R	y, u
$C_{x(yzu)}$	x to all of same unit except y + z	x	R	y, z, u
C_{xy}	between x and y	x	y	R, u
$C_{xy/}$	x + y to all	x, y	R, u	—
$C_{xy/(z)}$	x + y to all except z	x, y	R, u	z
$C_{xy/(u)}$	x + y to all of same unit	x, y	R	u
$C_{xy/(zu)}$	x + y to all of same unit except z	x, y	R	z, u
$C_{x/yz}$	x to y + z	x	y, z	R, u

x, y and z = individual electrodes or elements of tubes and valves

R = Remaining elements of the active unit (units), shields, metal parts (such as external shields, base sleeves which have internal connections, unused pins or leads, etc.)

u = Inactive units of multiple unit tubes and valves

Note: Where no confusion is likely to result, qualifiying symbols shown as suffixes (inferior) may be in line with the main symbol for typewritten documents.

3.2 SYMBOL SYSTEM B

3.2.1 The symbol consists of a capital *C* followed by a suffix of one or more letters and digits. The small letters, sometimes in combinations with a digit, each indicate a part of the tube or valve according to the system given in Clause 3.3.

3.2.2 Unbracketed letters in the suffix following the capital *C* indicate the parts of the tube or valve to be connected to the active terminals of the measuring equipment. An oblique stroke separates the parts to be connected to the different active terminals.
The suffix letters shown in brackets indicate those parts of the tube or valve which are connected to the reference earth.

Example:
Symbol $C_{fk/a(R)}$
Type of tube or valve unit: triode, tetrode, pentode
Measure between: cathode + heater
and anode
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.2.3 If the tube or valve is a multi-unit type containing two or more dissimilar units, the parts of each unit will be indicated in the symbol by a subscript in accordance with Clause 3.4.1.

Example:
Symbol: $C_{g_T/a_P(R_T R_P)}$
Type of tube and valve: triode-pentode
Measure between: grid of triode
and anode of pentode
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.2.4 If the tube or valve is a multi-unit type containing two or more similar units, the part of each unit will be indicated in the subscript(s) of the symbol in accordance with Clause 3.4.2.

Example:
Symbol: $C_{a'/g'(Ru)}$
Type of tube or valve: double triode
Measure between: anode (of first unit)
and grid (of first unit)
Connect to the reference earth: all other elements, shields, metal parts, etc.

3.2.5 From the above rules for system B, the following forms of symbols may be expected to occur

Symbols	Capacitance	Measure between		Connect to the reference earth
$C_{x/y(Ru)}$	between x and y	x	y	R, u
$C_{x/yz(Ru)}$	between x and y + z	x	y, z	R, u
$C_{x/Ru}$	x to remaining elements	x	R, u	—
$C_{x/Ru(y)}$	x to remaining elements except y	x	R, u	y
$C_{x/Ru(yz)}$	x to remaining elements except y and z	x	R, u	y, z
$C_{x/R(u)}$	x to remaining elements of the same unit	x	R	u
$C_{x/R(yu)}$	x to remaining elements of the same unit except y	x	R	y, u
$C_{x/R(yzu)}$	x to remaining elements of the same unit except y and z	x	R	y, z, u
$C_{xy/Ru(z)}$	x and y to remaining elements except z	x, y	R, u	z
$C_{xy/R(zu)}$	x and y to remaining elements of the same unit except z	x, y	R	z, u

x, y and z = Individual electrodes or elements of tube or valve
R = Remaining elements of the active unit or units, shields, metal parts (such as external shields, base sleeves which have internal connections, unused pins or leads, etc.)
u = Inactive units of multiple unit tubes and valves

Note: Where no confusion is likely to result, qualifying symbols shown as suffixes (inferior) may be in line with the main symbol for typewritten documents.

3.3 LIST OF SYMBOLS FOR ELECTRODES AND OTHER ELEMENTS

The following symbols will be used:

a — anode
(*Note:* In some countries "p" is used).

d — diode anode

d_y — dynode in photo-multiplier

g — grid

g_1 — grid 1

g_2 — grid 2, etc.

f — heater

k — cathode and in the case of directly heated tubes and valves: filament

m — external conductive coating

x_1, x_2, y_1, y_2 — deflection plates in cathode-ray tubes
(*Note:* In some countries D_1, D_2, D_3, D_4 are used).

s — internal shield

3.4 SUBSCRIPTS

3.4.1 For combinations of dissimilar units in multi-unit tubes and valves, the following subscripts will be used to designate the electrodes of the different units:

D — diode

T — triode

Q — tetrode

P — pentode

H — hexode or heptode

3.4.2 For combinations of two or more similar units in one tube or valve, several systems are used to distinguish the electrodes as follows:

a′	a″
a	a′
1a	2a
a_I	a_{II}

The system a′ a″ is recommended

4. Conditions for measurements

4.1 For all tubes and valves, interelectrode capacitances shall be measured with the cathode cold and with no direct voltages present, unless otherwise specified.

4.2 For all tubes and valves, interelectrode capacitances shall be measured using the standard sockets and the standard cap connectors described in Clauses 6 and 8.

4.3 The socket face-plate on the standard socket shall be connected to the reference earth.

4.4 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.