

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed electric double-layer capacitors for use in electronic equipment –
Part 2: Sectional specification – Electric double layer capacitors for power
application**

**Condensateurs électriques fixes à double couche utilisés dans les équipements
électroniques –
Partie 2: Spécification intermédiaire – Condensateurs électriques à double
couche pour application de puissance**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIXED ELECTRIC DOUBLE-LAYER CAPACITORS
FOR USE IN ELECTRONIC EQUIPMENT –**
**Part 2: Sectional specification –
Electric double layer capacitors for power application**

FOREWORD

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International Standard IEC 62391-2 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This bilingual version corresponds to the monolingual English version, published in 2006-04.

The text of this standard is based on the following documents:

FDIS	Report on voting
40/1641/FDIS	40/1713/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62391 consists of the following parts, under the general title *Fixed electric double-layer capacitors for use in electronic equipment*:

Part 1: Generic specification

Part 2: Sectional specification – Electric double-layer capacitors for power application

The sectional specification mentioned above does have a blank detail specification being a supplementary document, containing requirements for style, layout and minimum content of detail specifications.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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FIXED ELECTRIC DOUBLE-LAYER CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 2: Sectional specification – Electric double-layer capacitors for power application

1 General

1.1 Scope

This part of IEC 62391 applies to electric double-layer capacitors for power application.

Electric double-layer capacitors for power are intended for applications that require discharge currents in the range from mA to A. The characteristics of the capacitors include such performance as relatively high capacitance and low internal resistance, which is applicable to Class 3 of the measurement classification specified in IEC 62391-1.

The definition of power density and its calculating procedure should be in accordance with Annex A.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 62391-1 the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. Test severities and requirements prescribed in detail specifications referring to this sectional specification shall be of equal or higher performance level; lower performance levels are not permitted.

1.3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60063, *Preferred number series for resistors and capacitors*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60384-1, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60410, *Sampling plans and procedures for inspection by attributes*

IEC 62391-1, *Fixed electric double-layer capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 62391-2-1, *Fixed electric double-layer capacitors for use in electronic equipment – Part 2-1: Electric double-layer capacitors for power application – Assessment level EZ*

ISO 3, *Preferred numbers – Series of preferred numbers*

1.4 Information to be given in a detail specification

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in 1.9 of the detail specification and indicated in the test schedules, for example by an asterisk.

NOTE The information given in 1.4.1 may, for convenience, be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

1.4.1 Outline drawing and dimensions

There shall be an illustration of the surface mount capacitors as an aid to easy recognition and for comparison of the surface mount capacitors with others.

Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres; however, when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

Normally, numerical values shall be given for the length of the body, the width and height of the body and wire spacing, or, for cylindrical types, the body diameter and length, and the length and diameter of the terminations. When necessary, for example, when a number of case sizes are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the capacitor. When the capacitor is not designed for use on printed boards, this shall be clearly stated in the detail specification.

1.4.2 Mounting

The detail specification shall specify the method of mounting to be applied for normal use and for the application of the vibration and the bump or shock test. The capacitors shall be mounted by their normal means. The design of the capacitor may be such that special mounting fixtures are required for its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of the vibration and bump or shock tests.

1.4.3 Rating and characteristics

The ratings and characteristics shall be in accordance with the relevant clauses of this specification, together with the following.

1.4.3.1 Rated capacitance range

See 2.2.1.

NOTE When products approved to the detail specification have different ranges, the following statement should be added: "The range of capacitance values available in each voltage range is given in IEC QC 001005."

1.4.3.2 Particular characteristics

Additional characteristics may be listed, when they are considered necessary to specify adequately the component for design and application purposes.

1.4.3.3 Soldering

The detail specification shall prescribe the test methods, severities and requirements applicable to the solderability and the resistance to soldering heat tests.

1.4.4 Marking

The detail specification shall specify the content of the marking on the capacitor and on the package. Deviations from 1.6 of this sectional specification shall be specifically stated.

1.5 Terminology

For the purposes of this document, the terms and definitions of IEC 62391-1, together with the following, apply.

1.5.1

surface mount capacitor

capacitor whose small dimensions and nature or shape of terminations make it suitable for surface mounting

1.5.2

electric double layer capacitors for power application

capacitors intended for the applications that require discharge currents in the range from mA to A

NOTE The characteristics of the capacitors include such performance as relatively high capacitance and low internal resistance, which is applicable to Class 3 of the measurement classification specified in IEC 62391-1.

1.6 Marking

IEC 62391-1, 2.4, applies with the following details.

1.6.1 The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

- a) polarity of the terminations (unless identified by the construction);
- b) rated capacitance;
- c) rated voltage (d.c. voltage may be indicated by the symbol --- or —);
- d) style (in accordance with 1.1);
- e) year and month (or week) of manufacture;
- f) manufacturer's name or trade mark;
- g) manufacturer's type designation;
- h) classification of processing lead terminals (if applicable).

1.6.2 Capacitors shall bear a), b) and c) in 1.6.1, and as many of the rest of the items as possible which should be as legible as possible. Indication of marked items on a capacitor shall not overlap.

1.6.3 Any marking shall be legible and not easily smeared or removed by rubbing with the finger.

1.6.4 The package containing the capacitor(s) shall be clearly marked with all the information listed in 1.6.1, except polarity, unless this is applicable to the method of packaging.

1.6.5 Any additional marking shall be so applied that no confusion can arise.

2 Preferred rating and characteristics

2.1 Preferred characteristics

The values given in the detail specification shall preferably be selected from the following:

2.1.1 Preferred climatic categories

The surface mount capacitors covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1.

The lower and upper category temperatures and the duration of the damp-heat, steady-state test shall be chosen from the following.

Lower category temperature: –25 °C (–40 °C)

Upper category temperature: +60 °C and +70 °C

Duration of the damp-heat, steady-state test: 10 days

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively.

NOTE The damp-heat steady-state test conditions (here should be at a temperature of 40 °C, and the relative humidity should be between 90 % and 95 %.

2.2 Preferred values of ratings

2.2.1 Rated capacitance (C_R)

The rated capacitance shall be expressed in farads (F) and as agreed between the sending and receiving parties. Preferred values of rated capacitance are the values from the E24 series of IEC 60063 and their decimal multiples.

2.2.2 Tolerance on rated capacitance

The preferred values of tolerance on rated capacitance are:

±20 % and –20 %/+80 %.

2.2.3 Rated voltage (U_R)

The rated voltage shall be as agreed between the sending and receiving parties. The preferred values of the rated direct voltages are taken from the R20 series of ISO 3 and their decimal multiples.

2.2.4 Rated temperature

The value of the rated temperature is 60 °C or 70 °C.

2.2.5 Internal resistance

The internal resistance shall be as agreed between the sending and receiving parties. The internal resistance shall be measured with the d.c. resistance method. However, if a coefficient can be obtained from both d.c. and a.c. resistance methods, the a.c. resistance method may be used for measurement.

3 Quality assessment procedures

3.1 Primary stage of manufacture

The primary stage of manufacture is the inspection process for activated carbon electrodes, provided that the activated carbon electrodes include the condition where the collector has been bonded in advance.

3.2 Structurally similar components

Capacitors considered as being structurally similar are capacitors produced with similar processes and materials, though they may be of different case sizes and values.

3.3 Declaration of conformity (basic requirements)

3.4 Test schedule and requirement for initial assessment (mandatory and optional tests)

The procedures for qualification approval testing are given in IEC 60384-1, 3.5.

The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in 3.5 of this specification. The procedure using a fixed sample size schedule is given in 3.4.1 and 3.4.2. [IEC 62391-2:2006](https://standards.iteh.ai/catalog/standards/sist/bc6a04ad-d1f3-48e6-836f-a59e61db77f9/iec-62391-2-2006)

3.4.1 Qualification approval on the basis of the fixed sample size procedures

The fixed sample size procedure is described in IEC 60384-1, 3.5.3b). The sample shall be representative of the range of capacitors for which approval is sought. This may or may not be the complete range covered by the detail specification.

For each temperature characteristic, the sample shall consist of specimens of capacitors of maximum and minimum size and, for each of these sizes, the maximum capacitance value for the highest rated voltage and the minimum rated voltage of the voltage ranges for which approval is sought. When there are more than four rated voltages, an intermediate voltage shall also be tested.

The numbers given in Group 0 assume that all groups are applicable. If this is not so, the numbers may be reduced accordingly.

When additional groups are introduced into the qualification approval test schedule, the number of specimens required for Group 0 shall be increased by the same number as that required for the additional groups.

Table 1 gives the number of samples to be tested in each group or subgroup together with the number of permissible non-conformances for the qualification approval test.

3.4.2 Tests

The complete series of tests specified in Tables 1 and 2 is required for the approval of capacitors covered by one detail specification. The tests of each group shall be carried out in the order given.

The whole sample shall be subjected to the tests of Group 0 and then divided for the other groups.

Non-conforming specimens (Table 1) found during the tests of Group 0 shall not be used for the other groups.

“One non-conforming item” is counted when a capacitor has not satisfied the whole or a part of the tests of a group.

Approval is granted when the number of nonconforming items does not exceed the specified number of permissible non-conforming items for each group or subgroup and the total number of permissible non-conforming items.

NOTE Tables 1 and 2 together form the fixed sample size test schedule. Table 1 includes the details for the sampling and permissible non-conforming items for the different tests or groups of tests. Table 2, together with the details of the test contained in Clause 4, gives a complete summary of test conditions and performance requirements and indicates where, for example for the test method or conditions of test, a choice has to be made in the detail specification.

The conditions of test and performance requirements for the fixed sample size test schedule should be identical to those prescribed in the detail specification for quality conformance inspection.

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Table 1 – Fixed sample size test plan for qualification approval**Assessment level EZ**

Group No.	Test	Subclause of this publication	Number of specimens <i>n</i> ^a	Permissible number of non-conforming items <i>c</i> ^c
0 ^b	Visual examination	4.3	56	0 ^c
	Dimensions	4.3		
	Leakage current	4.4.1		
	Capacitance	4.4.2		
	Internal resistance	4.4.3		
	Spare specimens		2	
1A	Robustness of terminations	4.5	8	0
	Resistance to soldering heat	4.6		
1B	Solderability	4.7	8	0
	Rapid change of temperature	4.8		
	Vibration	4.9		
2	Endurance	4.10	16	0
3A	Self-discharge	4.11	8	0
	Storage at high temperature	4.12		
3B	Damp heat, steady state	4.14	8	0
4	Characteristics at high and low temperature	4.13	8	0
4A	Passive flammability (if applicable)	4.15	4	0
4B	Pressure relief (if applicable)	4.16	4	0
^a	For case size/voltage combinations, see 3.4.1.			
^b	The values of these measurements serve as initial measurements for the tests of Subgroup 0.			
^c	Specimens found to be nonconforming shall not be taken into account when calculating the permissible non-conforming items for the following tests. They shall be replaced by spare parts.			

Table 2 – Tests schedule for qualification approval

Subclause number and test ^a	D or ND ^b	Conditions of test ^a	n and c ^b	Performance requirements ^a
Group 0	ND		See Table 1	
4.3 Visual examination				As in 4.3.2 Legible marking and as specified in the detail specification
4.4 Dimension (detail)				See the detail specification
4.4.1 Leakage current		Protective resistor: Ω		As in 4.4.1.2
4.4.2 Capacitance		Per Class 3		As in 4.4.2.2
4.4.3 Internal resistance	D.C. resistance ^d): per Class 3	As in 4.4.3.2		
Group 1A	D		See Table 1	
4.5 Robustness of terminations		Test method: Test U_{a1} (Tensile strength) Test U_b (Bending strength)		
4.5.1 Initial measurement		Capacitance		
4.5.2 Final measurement		Visual examination		No visible damage Legible marking
4.6 Resistance to soldering heat ^c		Capacitance		$\Delta C/C \leq 10\%$ of value measured in 4.5.1
4.6.1 Initial measurement		Method 1a of Test Tb Recovery: ...		
4.6.3 Final measurement		Capacitance Visual examination Capacitance		No visible damage Legible marking and no leakage of electrolyte $\Delta C/C \leq 10\%$ of value measured in 4.6.1
Group 1B	D		See Table 1	
4.7 Solderability ^c		Test method: Solder bath method (Method 1)		
4.7.1 Final measurement		Visual examination		75 % or more of terminals shall be covered with new solder
4.8 Rapid change of temperature		T_A : Lower category temperature T_B : Upper category temperature 5 cycles		
4.8.1 Initial measurement		Test time t_1 :		
4.8.3 Final inspection		Visual examination capacitance Visual examination capacitance		No visible damage and no leakage of electrolyte $\Delta C/C \leq 10\%$ of value measured in 4.8.1 for capacitance
4.9 Vibration		Mounting method: see 1.4.2		
4.9.1 Initial measurement		Capacitance (the value obtained in 4.8.3 may be used)		
4.9.3 Final inspection	Visual examination Capacitance	No visible damage Legible marking and no leakage of electrolyte $\Delta C/C \leq 10\%$ of value measured in 4.9.1		

Subclause number and test ^a	D or ND ^b	Conditions of test ^a	n and c ^b	Performance requirements ^a
Group 2 4.10 Endurance 4.10.1 Initial measurement 4.10.3 Final measurements	D	Duration: 1 000 h for upper category temperature 70 °C grade capacitors 2 000 h for upper category temperature 60 °C grade capacitors Voltage: ... V Recovery: 16 h min Capacitance Visual examination Capacitance Internal resistance	See Table 1	No visible damage and no leakage of electrolyte $\Delta C/C \leq 30$ % of value measured in 4.10.1 ≤ 4 times the limit specified in 4.4.3
Group 3A 4.11 Self-discharge 4.11.2 Final measurements 4.12 Storage at high temperature 4.12.1 Initial measurement 4.12.3 Final measurements	D	Discharge time: Charge voltage: Charge time: 8 h Measurement time: Retention voltage Test temperature: upper category temperature Duration: 96 h \pm 4 h Recovery: 16 h min. Capacitance Visual examination Capacitance Internal resistance	See Table 1	Retention voltage after a 24 h exposure at room temperature after charge shall be 80 % or more of the charge voltage No visible damage and no leakage of electrolyte $\Delta C/C \leq 10$ % of value measured in 4.12.1 ≤ 2 times the limit specified in 4.4.3
Group 3B 4.14 Damp heat, steady state 4.14.1 Initial measurement 4.14.3 Final measurements	D	Temperature, humidity: 40 °C, 90 % to 95 % Time: 10 days Capacitance Visual examination Capacitance Internal resistance	See Table 1	No visible damage and no leakage of electrolyte $\Delta C/C \leq 30$ % of value measured in 4.14.1 ≤ 4 times the limit specified in 4.4.3