



Interference Suppression Film Capacitors MKP Radial Potted Type



FEATURES

- 15 mm to 27.5 mm lead pitch.
Supplied in box, taped on ammpack or reel
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912



RoHS
COMPLIANT

APPLICATIONS

X1 class

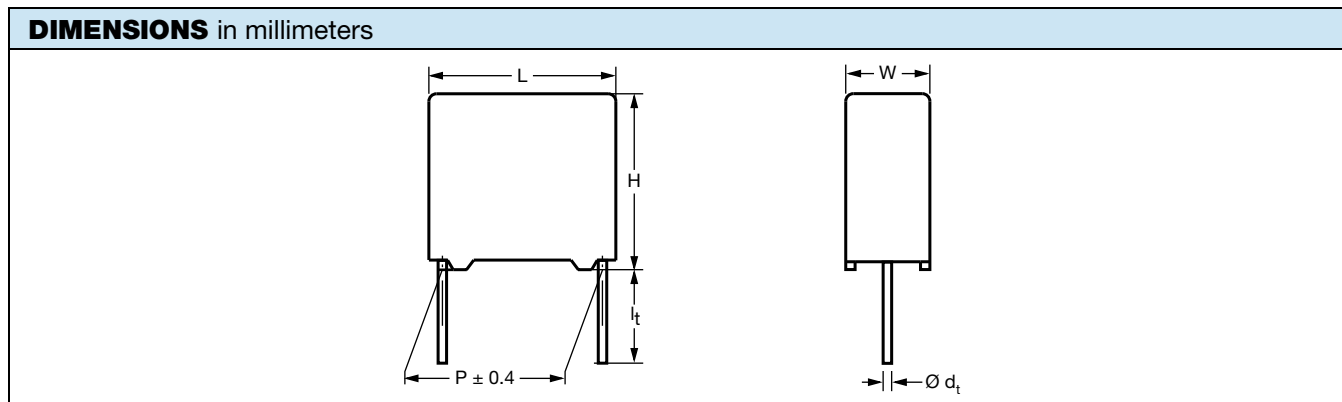
For X1 electromagnetic interference suppression in across the line applications (50 Hz/60 Hz) with a maximum mains voltage of 275 V_{AC}.

For application limitations please refer to section "Application Notes".

| QUICK REFERENCE DATA | |
|--|--|
| Capacitance range (E12 series) | 0.01 μF to 1 μF (preferred values according to E6) |
| Capacitance tolerance | ± 20 %; ± 10 %; ± 5 % |
| Rated AC voltage | 275 V _{AC} ; 50 Hz to 60 Hz |
| Permissible DC voltage | 630 V _{DC} |
| Climatic testing class (according to EN 60068-1) | 55/105/56/B |
| Maximum application temperature | 105 °C |
| Rated temperature | 105 °C |
| Leads | Tinned wire |
| Reference standards | IEC 60384-14 and EN 132400 IEC 60065, pass. flamm. class B UL 60384-14 CSA E384-14 |
| Dielectric | Polypropylene film |
| Electrodes | Metallized film |
| Construction | Mono construction |
| Encapsulation | Plastic case, epoxy resin sealed, flame retardant UL-class 94 V-0 |
| Marking | C-value; tolerance; rated voltage; sub-class; manufacturer's type; code for dielectric material; manufacturer location, year and week; manufacturer's logo or name; safety approvals |

Note

- For more detailed data and test requirements, contact rfi@vishay.com





COMPOSITION OF CATALOG NUMBER



Note

(1) For detailed tape specifications refer to packaging information: www.vishay.com/doc?28139

| SPECIFIC REFERENCE DATA | |
|---|-------------------------|
| DESCRIPTION | VALUE |
| Tangent of loss angle: | at 10 kHz |
| C ≤ 100 nF | ≤ 10 x 10 ⁻⁴ |
| 100 nF < C ≤ 470 nF | ≤ 20 x 10 ⁻⁴ |
| C > 470 nF | ≤ 70 x 10 ⁻⁴ |
| Rated voltage pulse slope (dU/dt) _R at 385 V _{DC} : | |
| P = 15 mm | 250 V/μs |
| P = 22.5 mm | 150 V/μs |
| P = 27.5 mm | 100 V/μs |
| R between leads, for C ≤ 0.33 μF at 100 V; 1 min | > 15 000 MΩ |
| RC between leads, for C > 0.33 μF at 100 V; 1 min | > 5000 s |
| R between leads and case; 100 V; 1 min | > 30 000 MΩ |
| Withstanding (DC) voltage (cut off current 10 mA) ⁽¹⁾ ; rise time ≤ 1000 V/s | 3400 V; 1 min |
| Withstanding (AC) voltage between leads and case | 2050 V; 1 min |

Note

(1) See "Voltage Proof Test for Metalized Film Capacitors": www.vishay.com/doc?28169



| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | | |
|---|--------------------|---------------------------------|----------------------------|---|-------|---------------------------------------|-------|--|------|
| U _{RAC} (V) | CAP. (µF) | DIMENSIONS W x H x L (mm) | MASS (g) ⁽¹⁾ | CATALOG NUMBER BFC2 336 1 AND PACKAGING | | | | | |
| | | | | LOOSE IN BOX | | | | REEL 500 mm ⁽¹⁾⁽²⁾ | |
| | | | | l _t = 3.5 mm ± 0.3 mm | | l _t = 25.0 mm ± 2.0 mm | | H = 18.5 mm; P ₀ = 12.7 mm | |
| | | | | LAST 5 DIGITS OF CATALOG NUMBER | SPQ | LAST 5 DIGITS OF CATALOG NUMBER | SPQ | LAST 5 DIGITS OF CATALOG NUMBER | SPQ |
| PITCH = 15.0 mm ± 0.4 mm; d_t = 0.6 mm ± 0.06 mm; U_{RAC} = 275 V; C-TOL. = ± 20 % | | | | | | | | | |
| 0.010 | 5.0 x 11.0 x 17.5 | 17.5 | 1 | 19001 | 1000 | 19007 | 1000 | 19002 | 1100 |
| 0.015 | | | | 10153 | | 16153 | | 13153 | |
| 0.022 | | | | 10223 | | 16223 | | 13223 | |
| 0.033 | 6.0 x 12.0 x 17.5 | 17.5 | 1.4 | 10333 | | 16333 | | 13333 | 900 |
| PITCH = 15.0 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 20 % | | | | | | | | | |
| 0.047 | 7.0 x 13.5 x 17.5 | 17.5 | 1.8 | 10473 | 1000 | 16473 | 500 | 13473 | 800 |
| 0.068 | 8.5 x 15.0 x 17.5 | 17.5 | 2.4 | 10683 | | 16683 | | 13683 | 650 |
| 0.100 | 10.0 x 16.5 x 17.5 | 17.5 | 3 | 10104 | 500 | 16104 | | 13104 | 600 |
| PITCH = 22.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 20 % | | | | | | | | | |
| 0.10 | 7.0 x 16.5 x 26.0 | 26.0 | 2.9 | 19003 | 200 | 19008 | 500 | 19004 | 550 |
| 0.15 | 8.5 x 18.0 x 26.0 | 26.0 | 3.8 | 10154 | | 16154 | | 13154 | 450 |
| 0.22 | 10.0 x 19.5 x 26.0 | 26.0 | 6.8 | 10224 | | 16224 | | 13224 | 400 |
| PITCH = 27.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 20 % | | | | | | | | | |
| 0.22 | 11.0 x 21.0 x 31.0 | 31.0 | 7.4 | 19005 | 100 | 19009 | 125 | | |
| 0.33 | 13.0 x 23.0 x 31.0 | 31.0 | 9.2 | 10334 | | 16334 | | | |
| 0.47 | 15.0 x 25.0 x 31.0 | 31.0 | 12.3 | 10474 | | 16474 | | | |
| 0.68 | 18.0 x 28.0 x 31.0 | 31.0 | 16.1 | 10684 | | 16684 | | | |
| 1.00 | 21.0 x 31.0 x 31.0 | 31.0 | 20.3 | 10105 | 50 | 16105 | 75 | | |
| PITCH = 15.0 mm ± 0.4 mm; d_t = 0.6 mm ± 0.06 mm; U_{RAC} = 275 V; C-TOL. = ± 10 % | | | | | | | | | |
| 0.010 | 5.0 x 11.0 x 17.5 | 17.5 | 1 | 11103 | 1000 | 17103 | 1000 | 14103 | 1100 |
| 0.012 | | | | 11123 | | 17123 | | 14123 | |
| 0.015 | | | | 11153 | | 17153 | | 14153 | |
| 0.018 | 6.0 x 12.0 x 17.5 | 17.5 | 1.4 | 11183 | | 17183 | | 14183 | 900 |
| 0.022 | | | | 11223 | 17223 | 14223 | | | |
| 0.027 | | | | 11273 | 17273 | 14273 | | | |
| PITCH = 15.0 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 10 % | | | | | | | | | |
| 0.033 | 7.0 x 13.5 x 17.5 | 17.5 | 1.8 | 11333 | 1000 | 17333 | 500 | 14333 | 800 |
| 0.039 | | | | 11393 | | 17393 | | 14393 | |
| 0.047 | | | | 11473 | | 17473 | | 14473 | |
| 0.056 | 8.5 x 15.0 x 17.5 | 17.5 | 2.4 | 11563 | | 17563 | | 14563 | 650 |
| 0.068 | | | | 11683 | 17683 | 14683 | | | |
| 0.082 | | | | 11823 | 17823 | 14823 | | | |
| PITCH = 22.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 10 % | | | | | | | | | |
| 0.10 | 7.0 x 16.5 x 26.0 | 26.0 | 2.9 | 11104 | 200 | 17104 | 500 | 14104 | 550 |
| 0.12 | 8.5 x 18.0 x 26.0 | 26.0 | 3.8 | 11124 | | 17124 | 250 | 14124 | 450 |
| 0.15 | | | | 11154 | | 17154 | 14154 | | |
| 0.18 | 10.0 x 19.5 x 26.0 | 26.0 | 6.8 | 11184 | | 17184 | 500 | 14184 | 400 |
| PITCH = 27.5 mm ± 0.4 mm; d_t = 0.8 mm ± 0.08 mm; U_{RAC} = 275 V; C-TOL. = ± 10 % | | | | | | | | | |
| 0.22 | 11.0 x 21.0 x 31.0 | 31.0 | 7.4 | 11224 | 100 | 17224 | 125 | | |
| 0.27 | | | | 11274 | | 17274 | | | |
| 0.33 | 13.0 x 23.0 x 31.0 | 31.0 | 9.2 | 11334 | | 17334 | | | |
| 0.39 | 15.0 x 25.0 x 31.0 | 31.0 | 12.3 | 11394 | | 17394 | | | |
| 0.47 | | | | 11474 | | 17474 | | | |
| 0.56 | | | | 11564 | | 17564 | | | |
| 0.68 | 18.0 x 28.0 x 31.0 | 31.0 | 16.1 | 11684 | | 17684 | | | |
| 0.82 | 21.0 x 31.0 x 31.0 | 31.0 | 20.3 | 11824 | 50 | 17824 | 75 | | |

Notes

- SPQ = Standard Packing Quantity
- (1) Reel diameter = 356 mm is available on request
- (2) H = In tape height; P₀ = Sprocket hole distance; for detailed specifications refer to Packaging Information.
- (3) Weight for short lead product only



| APPROVALS | | | |
|---|---------------------|---------------|--------------|
| SAFETY APPROVALS X1 | VOLTAGE | VALUE | FILE NUMBERS |
| EN 60384-14 (ENEC) (= IEC 60384-14) | 275 V _{AC} | 10 nF to 1 μF | FI 2013012 |
| UL 60384-14 | 275 V _{AC} | 10 nF to 1 μF | E354331 |
| CSA E384-14 | 275 V _{AC} | 10 nF to 1 μF | E354331 |
| CB-Test-Certificate | 275 V _{AC} | 10 nF to 1 μF | FI 5254 A1 |
| The ENEC-approval together with the CB-Certificate replace all national marks of the following countries (they have already signed the ENEC-Agreement): Austria; Belgium; Czech. Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; Netherlands; Norway; Portugal; Slovenian; Spain; Switzerland and United Kingdom. | | | |
| | | | |

MOUNTING

Normal Use

The capacitors are designed for mounting on printed-circuit boards. The capacitors packed in bandoliers are designed for mounting in printed-circuit boards by means of automatic insertion machines.

For detailed tape specifications refer to “Packaging information”.

Specific Method of Mounting to Withstand Vibration and Shock

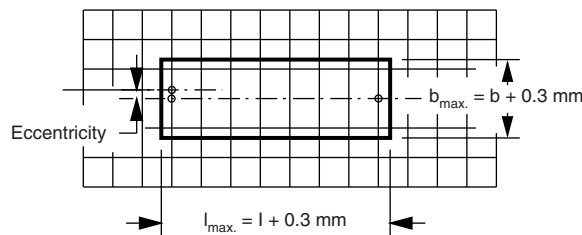
In order to withstand vibration and shock tests, it must be ensured that the stand-off pips are in good contact with the printed-circuit board:

- For pitches ≤ 15 mm capacitors shall be mechanically fixed by the leads
- For longer pitches the capacitors shall be mounted in the same way and the body clamped

Space Requirements on Printed Circuit Board

The maximum length and width of film capacitors is shown in Figure:

- Eccentricity as in figure. The maximum eccentricity is smaller than or equal to the lead diameter of the product concerned
- Product height with seating plane as given by “IEC 60717” as reference: $h_{max.} \leq h + 0.3 \text{ mm}$



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SOLDERING CONDITIONS

For general soldering conditions and wave soldering profile, we refer to the application note:

“Soldering Guidelines for Film Capacitors”: www.vishay.com/doc?28171

Storage Temperature

- Storage temperature: $T_{stg} = -25 \text{ °C}$ to $+35 \text{ °C}$ with RH maximum 75 % without condensation

Ratings and Characteristics Reference Conditions

Unless otherwise specified, all electrical values apply to an ambient temperature of $23 \text{ °C} \pm 1 \text{ °C}$, an atmospheric pressure of 86 kPa to 106 kPa and a relative humidity of $50 \% \pm 2 \%$.

For reference testing, a conditioning period shall be applied over $96 \text{ h} \pm 4 \text{ h}$ by heating the products in a circulating air oven at the rated temperature and a relative humidity not exceeding 20 %.



CHARACTERISTICS



Capacitance



Tangent of loss angle



Impedance



Resonant frequency



Max. RMS voltage and AC current (sinewave)





APPLICATION NOTES

- For X2 electromagnetic interference suppression in standard across the line applications (50 Hz/60 Hz) with a maximum mains voltage of 310 V_{AC}.
- For series impedance applications we refer to application note www.vishay.com/doc?28153
- For capacitors connected in parallel, normally the proof voltage and possibly the rated voltage must be reduced. For information depending of the capacitance value and the number of parallel connections contact: dc-film@vishay.com
- These capacitors are not intended for continuous pulse application. For these situations capacitors of the AC and pulse programs must be used.
- The maximum ambient temperature must not exceed 110 °C. (125 °C for less than 1000 h) for C ≤ 470 nF and 110 °C for C > 470 nF.
- Rated voltage pulse slope:
If the pulse voltage is lower than the rated voltage, the values of the specific reference data can be multiplied by 435 V_{DC} and divided by the applied voltage.

INSPECTION REQUIREMENTS

General Notes

1. Sub-clause numbers of tests and performance requirements refer to the “Sectional Specification, IEC-Publication EN 132400 (IEC 60384-14) and section one of this specification”.
2. In this table: D = Destructive
ND = Non destructive

| GROUP C INSPECTION REQUIREMENTS | | | |
|---|---------|--|---|
| SUB-CLAUSE NUMBER AND TEST | D OR ND | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1 | D | | |
| 4.1 Dimensions (detail) Initial measurements | | Capacitance Tangent of loss angle: For C ≤ 470 nF at 100 kHz For C > 470 nF at 10 kHz | As specified in chapters “General Data” of this specification |
| 4.3 Robustness of terminations | | Tensile: load 10 N; 10 s Bending: load 5 N; 4 x 90° | No visible damage |



| GROUP C INSPECTION REQUIREMENTS | | | |
|--|----------------|---|--|
| SUB-CLAUSE NUMBER AND TEST | D OR ND | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C1A PART OF SAMPLE OF SUB-GROUP C1 | | D | |
| 4.4 Resistance to soldering heat | | No pre-drying Method: 1A Solder bath: 260 °C Duration: 10 s | |
| 4.19 Component solvent resistance | | Isopropylalcohol at room temperature Method: 2 Immersion time: 5 min ± 0.5 min Recovery time: Min. 1 h, max. 2 h | |
| 4.4.2 Final measurements | | Visual examination Capacitance Tangent of loss angle Insulation resistance | No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured initially Increase of $\tan \delta: \leq 0.008$ Compared to values measured initially As specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1 | | D | |
| Initial measurements | | Capacitance Tangent of loss angle: For $C \leq 470$ nF at 100 kHz For $C > 470$ nF at 10 kHz | No visible damage Legible marking |
| 4.20 Solvent resistance of the marking: see section "General Notes"; item 5 | | Isopropylalcohol at room temperature Method: 1 Rubbing material: cotton wool Immersion time: 5 min ± 0.5 min | No visible damage |
| 4.6 Rapid change of temperature | | $\theta A = -55$ °C $\theta B = +105$ °C 5 cycles | |
| SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1 | | D | |
| 4.6.1 Inspection | | Duration $t = 30$ min | |
| 4.7 Vibration (see note 3.1) | | Visual examination Mounting: see section "Mounting" of this specification Procedure B4: Frequency range: 10 Hz to 55 Hz Amplitude: 0.75 mm or Acceleration 98 m/s ² (whichever is less severe) Total duration 6 h | No visible damage |
| 4.7.2 Final inspection | | Visual examination | No visible damage |



| GROUP C INSPECTION REQUIREMENTS | | | |
|--|----------------|---|---|
| SUB-CLAUSE NUMBER AND TEST | D OR ND | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C1B PART OF SAMPLE OF SUB-GROUP C1 | | D | |
| 4.9 Shock (see note 3) | | Mounting: See section "Mounting" for more information Pulse shape: Half sine Acceleration: 490 m/s ² Duration of pulse: 11 ms | |
| 4.9.2 Final measurements | | Visual examination Capacitance Tangent of loss angle Insulation resistance | No visible damage $ \Delta C/C \leq 5\%$ of the value measured initially Increase of $\tan \delta: \leq 0.008$ Compared to values measured initially As specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B | | D | |
| 4.11 Climatic sequence | | | |
| 4.11.1 Initial measurements | | Capacitance Measured in 4.4.2 and 4.9.2 Tangent of loss angle: Measured initially in C1A and C1B | |
| 4.11.2 Dry heat | | Temperature: 105 °C Duration: 16 h | |
| 4.11.3 Damp heat cyclic Test Db First cycle | | | |
| 4.11.4 Cold | | Temperature: - 55 °C Duration: 2 h | |
| 4.11.5 Damp heat cyclic Test Db remaining cycles | | | |
| SUB-GROUP C1 COMBINED SAMPLE OF SPECIMENS OF SUB-GROUPS C1A AND C1B | | D | |
| 4.11.6 Final measurements | | Visual examination Capacitance Tangent of loss angle Voltage proof 1200 V _{DC} ; 1 min between term Insulation resistance | No visible damage Legible marking $ \Delta C/C \leq 5\%$ of the value measured in 4.11.1. Increase of $\tan \delta: \leq 0.008$ compared to values measured in 4.11.1 No permanent breakdown or flash-over $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



| GROUP C INSPECTION REQUIREMENTS | | | |
|--|----------------|---|--|
| SUB-CLAUSE NUMBER AND TEST | D OR ND | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C2 | | D | |
| 4.12 Damp heat steady state | | 56 days, 40 °C, 90 % to 95 % RH, no load capacitance | |
| 4.12.1 Initial measurements | | Tangent of loss angle at 10 kHz | |
| 4.12.3 Final measurements | | Visual examination | No visible damage Legible marking |
| | | Capacitance | $ \Delta C/C \leq 5\%$ of the value measured in 4.12.1. |
| | | Tangent of loss angle | Increase of $\tan \delta: \leq 0.008$ Compared to values measured in 4.12.1. |
| | | Voltage proof 1200 V _{DC} ; 1 min between term | No permanent breakdown or flash-over |
| | | Insulation resistance | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| SUB GROUP C3 | | D | |
| 4.13.1 Initial measurements | | Capacitance Tangent of loss angle: For C \leq 470 nF at 100 kHz For C > 470 nF at 10 kHz | |
| 4.13 Impulse voltage | | 3 successive impulses, full wave, peak voltage: X1: 4 kV Max. 24 pulses | No selfhealing breakdowns or flashover |
| 4.14 Endurance | | Duration: 1000 h 1.25 U _{RAC} at 105 °C Once in every hour the voltage is increased to 1000 V _{RMS} for 0.1 s via resistor of 47 $\Omega \pm 5\%$ | |
| SUB GROUP C3 | | D | |
| 4.14.7 Final measurements | | Visual examination | No visible damage Legible marking |
| | | Capacitance | $ \Delta C/C \leq 10\%$ compared to values measured in 4.13.1. |
| | | Tangent of loss angle | Increase of $\tan \delta: \leq 0.008$ Compared to values measured in 4.13.1. |
| | | Voltage proof 1200 V _{DC} ; 1 min between terminations 2050 V _{DC} ; 1 min between terminations and case | No permanent breakdown or flash-over |
| | | Insulation resistance | $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |



| GROUP C INSPECTION REQUIREMENTS | | | |
|--------------------------------------|---------|---|---|
| SUB-CLAUSE NUMBER AND TEST | D OR ND | CONDITIONS | PERFORMANCE REQUIREMENTS |
| SUB-GROUP C 4 | | D | |
| 4.15 Charge and discharge | | 10 000 cycles (50 c/s) charge to U_R half sinewave Duration: 5 ms Discharge resistance: $R = \frac{385 V_{DC}}{1.5 \times C(dU/dt)}$ $R_{min.} = 2.2$ | |
| 4.15.1 Initial measurements | | Capacitance Tangent of loss angle For $C \leq 470$ nF at 100 kHz For $C > 470$ nF at 10 kHz | |
| 4.15.3 Final measurements | | Capacitance Tangent of loss angle Insulation resistance | $ \Delta C/C \leq 10\%$ compared to values measured in 4.15.1. Increase of $\tan \delta: \leq 0.008$ Compared to values measured in 4.15.1 $\geq 50\%$ of values specified in section "Insulation Resistance" of this specification |
| SUB-GROUP C5 | | D | |
| 4.16 Radio frequency characteristic | | Resonance frequency | As specified in section "Resonant Frequency" of this specification. $\pm 10\%$ |
| SUB-GROUP C6 | | D | |
| 4.17 Passive flammability Class B | | Bore of gas jet: $\varnothing 0.5$ mm Fuel: Butane Test duration for actual volume V in mm^3 : $V \leq 250$: 10 s $250 < V \leq 500$: 20 s $500 < V \leq 1750$: 30 s $V > 1750$: 60 s One flame application  | After removing test flame from capacitor, the capacitor must not continue to burn for more than 10 s. No burning particle must drop from the sample. |
| SUB-GROUP C7 | | D | |
| 4.18 Active flammability | | 20 x 4 kV discharges on the test capacitor connected to U_R | The cheese cloth around the capacitors shall not burn with a flame. No electrical measurements are required. |



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