INTERNATIONAL STANDARD

IEC 60384-17-1

QC 301301

Second edition
2005-11

Fixed capacitors for use in electronic equipment –

Part 17-1:
Blank detail specification:
Fixed metallized polypropylene film dielectric a.c. and pulse capacitors – Assessment levels E and EZ

Reference number
IEC 60384-17-1:2005(E)

Publication numbering

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE P

For price, see current catalogue

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 17-1: Blank detail specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors – Assessment levels E and EZ

FOREWORD

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International Standard IEC 60384-17-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition cancels and replaces the first edition published in 1987 and constitutes minor revisions related to tables, figures and references.

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

FDIS	Report on voting
40/1598/FDIS	40/1631/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.

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

IEC 60384 consists of the following parts, under the (new) general title *Fixed capacitors for use in electronic equipment:*

Part 1: Generic specification

Part 2: Sectional specification: Fixed metallized polyethylene-terephthalate film dielectric d.c. capacitors

Part 3: Sectional specification: Fixed tantalum chip capacitors

Part 4: Sectional specification: Aluminium electrolytic capacitors with solid and non-solid electrolyte

Part 5: Sectional specification: Fixed mica dielectric d.c. capacitors with a rated voltage not exceeding 3000 V – Selection of methods of test and general requirements

Part 6: Sectional specification: Fixed metallized polycarbonate film dielectric d.c. capacitors

Part 7: Sectional specification: Fixed polystyrene film dielectric metal foil d.c. capacitors

Part 8: Sectional specification: Fixed capacitors of ceramic dielectric, Class 1

Part 9: Sectional specification: Fixed capacitors of ceramic dielectric, Class 2

Part 11: Sectional specification: Fixed polyethylene-terephthalate film dielectric metal foil d.c. capacitors

Part 12: Sectional specification: Fixed polycarbonate film dielectric metal foil d.c. capacitors

Part 13: Sectional specification: Fixed polypropylene film dielectric metal foil d.c. capacitors

Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains

Part 15: Sectional specification: Fixed tantalum capacitors with non-solid or solid electrolyte

Part 16: Sectional specification: Fixed metallized polypropylene film dielectric d.c. capacitors

Part 17: Sectional specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors

Part 18: Sectional specification: Fixed aluminium electrolytic chip capacitors with solid and non-solid electrolyte

Part 19: Sectional specification: Fixed metallized polyethylene-terephthalate film dielectric chip d.c. capacitors

Part 20: Sectional specification: Fixed metallized polyphenylene sulfide film dielectric chip d.c. capacitors

Part 21: Sectional specification: Fixed surface mount multilayer capacitors of ceramic dielectric, Class 1

Part 22: Sectional specification: Fixed surface mount multilayer capacitors of ceramic dielectric, Class 2

Part 23: Sectional specification: Fixed surface mount metallized polyethylene naphthalate film dielectric d.c. capacitors

Part 24: Sectional specification – Surface mount fixed tantalum electrolytic capacitors with conductive polymer solid electrolyte (under consideration)

Part 25: Sectional specification – Surface mount fixed aluminium electrolytic capacitors with conductive polymer solid electrolyte (under consideration)

All sectional specifications mentioned above do have one or more blank detail specifications being a supplementary document, containing requirements for style, layout and minimum content of detail specifications.

The QC 301301 number that appears on the front cover of this publication is the specification number in the IECQ Quality Assessment System for Electronic Components.

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

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 17-1: Blank detail specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors – Assessment levels E and EZ

INTRODUCTION

Blank detail specification

A blank detail specification is a supplementary document to the sectional specification and contains requirements for style and layout and minimum content of detail specifications. Detail specifications not complying with these requirements may not be considered as being in accordance with IEC specifications nor shall they be so described.

In the preparation of detail specifications the content of 1.4 of the sectional specification shall be taken into account.

The numbers between brackets on the first page correspond to the following information which shall be inserted in the position indicated:

Identification of the detail specification

[1] The "International Electrotechnical Commission" or the National Standards Organization under whose authority the detail specification is drafted.

[2] The IEC or National Standards number of the detail specification, date of issue and any further information required by the national system.

[3] The number and issue number of the IEC or national generic specification.

[4] The IEC number of the blank detail specification.

Identification of the capacitor

[5] A short description of the type of capacitor.

[6] Information on typical construction (when applicable).

NOTE When the capacitor is not designed for use in printed board applications, this must be clearly stated in the detail specification in this position.

[7] Outline drawing with main dimensions which are of importance for interchangeability and/or reference to the national or international documents for outlines. Alternatively, this drawing may be given in an appendix to the detail specification.

[8] Application or group of applications covered and/or assessment level.

NOTE The assessment level(s) to be used in a detail specification must be selected from the sectional specification, 3.5.4. This implies that one blank detail specification may be used in combination with several assessment levels provided the grouping of the tests does not change.

[9] Reference data on the most important properties, to allow comparison between the various capacitor types.

[1]	IEC 60384-17-1-XXX QC XXXXXXXXXXX [2]
ELECTRONIC COMPONENTS OF ASSESSED QUALITY IN ACCORDANCE WITH: [3]	IEC 60384-17-1 QC XXXXXX [4]
	FIXED METALLIZED POLYPROPYLENE FILM DIELECTRIC AC AND PULSE CAPACITORS [5]
Outline drawing (see Table 1) (first angle projection) [7]	[6]
(Other shapes are permitted within the dimensions given)	Assessment levels E and EZ [8] Performance grade: Stability grade:
NOTE For [1] to [9]: see previous page.	

Information on the availability of components qualified to this detail specification is given in IEC QC 001005 [9]

1 General data

1.1 Recommended method(s) of mounting (to be inserted)

See IEC 60384-17, 1.4.2.

1.2 Dimensions

Table 1 – Case size reference and dimensions

Case size reference	Dimensions						
	∅	*L*	*H*	*d*	.....		

When there is no case size reference, Table 1 may be omitted and the dimensions shall be given in Table 2, which then becomes Table 1.

The dimensions shall be given as maximum dimensions or as nominal dimensions with a tolerance.

1.3 Ratings and characteristics

Capacitance range (see Table 2)

Tolerance on rated capacitance

Rated voltage (see Table 2)
– rated d.c. voltage (if applicable)
– rated a.c. voltage (and frequency if different from 50/60 Hz)

Category voltage (if applicable) (see Table 2)

Climatic category

AC rated temperature

Tangent of loss angle (frequency ...) (see Table 2)

Insulation resistance (see Table 2)

Rated peak current or rated voltage pulse slope $\frac{(\mathrm{d}U)}{(\mathrm{d}t)_{\mathrm{R}}}$ (if applicable)

Sinusoidal rated a.c. current (at reference frequency ...) and derating curve versus temperature (if applicable)

Reference frequency (if applicable)

Table 2 – Values of capacitance, a.c. voltage and peak current (or voltage pulse slope), related to case sizes

Rated a.c. voltage ($U_{\mathrm{R\sim}}$)				
Category voltage[1)] ($U_{\mathrm{C\sim}}$)				
	Rated capacitance (in nF or µF)	Peak current or dU/dt	Rated capacitance (in nF or µF)	Peak current or dU/dt
Case size reference				
[1)] If different from the rated voltage.				

Table 2a (if applicable) – Rated a.c. current related to rated a.c. voltage and rated capacitance and case sizes

Rated a.c. voltage ($U_{\mathrm{R\sim}}$)				
Rated a.c. current	Rated capacitance (in nF and/or µF)	Case size	Rated capacitance (in nF and/or µF)	Case size
NOTE Other presentations are possible.				

Permitted effective current characteristics (if applicable)

Table 3 – Particular characteristics

1.4 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 60384-1, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60384-17, *Fixed capacitors for use in electronic equipment – Part 17: Sectional specification: Fixed metallized polypropylene film dielectric a.c. and pulse capacitors*

1.5 Marking

The marking of the capacitor and the packing shall be in accordance with the requirements of IEC 60384-17, 1.6.

NOTE The details of the marking of the component and packing must be given in full in the detail specification.

1.6 Ordering information

Orders for capacitors covered by this specification shall contain, in clear or in coded form, the following minimum information:

a) rated capacitance;

b) tolerance on rated capacitance;

c) rated a.c. voltage, and frequency if different from 50/60 Hz (if applicable);

d) rated voltage, pulse slope or peak current (if applicable);

e) rated a.c. current and corresponding frequency (if applicable);

f) number and issue reference of the detail specification and style reference;

g) performance and stability grade (if required).

1.7 Certified records of released lots

Required/not required.

1.8 **Additional information** (not for inspection purposes)

1.9 Additional or increased severities or requirements to those specified in the generic and/or sectional specification

NOTE Additions or increased requirements should be specified only when essential.

Table 3 – Other characteristics

This table is to be used for defining characteristics which are additional to or more severe than those given in the sectional specification.

2 Inspection requirements

2.1 Procedures

2.1.1 For qualification approval, the procedures shall be in accordance with the sectional specification, IEC 60384-17, 3.4.

2.1.2 For quality conformance inspection the test schedule (Table 4) includes sampling, periodicity, severities and requirements. The formation of inspection lots is covered by 3.5.1 of the sectional specification.

Table 4 – Test schedule for quality conformance inspection

Subclause number and test[a]	D or ND[c]	Conditions of test[a]	IL	E lev. AQL[c]	EZ lev. n	EZ lev. c	Performance requirements[a]
Group A inspection (lot-by-lot)							
Subgroup A0	ND				100%[g]		
4.2.2 Capacitance							Within specified tolerance
4.2.3 Tangent of loss angle		Frequency : 1 kHz for all capacitance values					As in 4.2.3.2
4.2.1 Voltage proof (Test A)		Method: ... Measuring point 1a					No breakdown or flashover. Self-healing breakdowns allowed
4.2.4 Insulation resistance (Test A)		Measuring point 1a					As in 4.2.4.3
Subgroup A1	ND		S-3	2,5%	[b]	0	
4.1 Visual examination							As in 4.1 Legible marking and as specified in 1.5 of this specification
4.1 Dimensions (gauging)							As specified in Table 1 of this specification
Subgroup A2	ND		S-3	1,0%	[b]	0	
4.2.2 Capacitance							Within specified tolerance
4.2.3 Tangent of loss angle							As in 4.2.3.2
4.2.1 Voltage proof (Test A)		Method: ...					No breakdown or flashover
4.2.4 Insulation resistance (Test A)		Method: ...					As in 4.2.4.2
Group B inspection (lot-by-lot)							
Subgroup B1	ND		S-3	2,5%	[b]	0	
4.5 Solderability		Without ageing Method: ...					Good tinning as evidenced by free flowing of the solder with wetting of the termina-tions or solder shall flow within ... s, as applicable
4.15 Solvent resistance of the marking (if applicable)		Solvent: ... Solvent temperature: ... Method 1 Rubbing material: ... Recovery time:					Legible marking

Table 4 *(continued)*

Subclause number and test[a]	D or ND[c]	Conditions of test[a]	Sample size and criterion of acceptability[c]						Performance requirements[a]
			E			EZ			
			p	*n*	*c*	*p*	*n*	*c*	
Group C inspection (periodic)									
Subgroup C1A Part of sample of Subgroup C1	D		6	9	1	6	5	0	
4.1 Dimensions (detail)									See detail specification
4.3.1 Initial measurements		Capacitance Tangent of loss angle: for C_R > 1 µF: at 1 kHz C_R ≤ 1 µF: at 10 kHz							
4.3 Robustness of terminations		Visual examination							No visible damage
4.4 Resistance to soldering heat		Method: …							
4.4.2 Final measurements		Visual examination							No visible damage Legible marking
		Capacitance							$\Delta C/C$ for Grade 1.1: ≤1 % Grade 1.2: ≤2 % Grade 2: ≤3 % of value measured in 4.3.1
		Tangent of loss angle							Increase of tan δ: for C ≤ 1 µF: for Grade 1.1: ≤0,001 Grade 1.2: ≤0,002 Grade 2: ≤0,004 for C > 1 µF: see detail specification, compared to values measured in 4.3.1
4.14 Component solvent resistance (if applicable)		Solvent: … Solvent temperature: … Method 2 Recovery time:							See detail specification
Subgroup C1B Other part of sample of Subgroup C1	D		6	18	1	6	5	0	
4.6.1 Initial measurements		Capacitance Tangent of loss angle: for C_R > 1 µF: at 1 kHz C_R ≤ 1 µF: at 10 kHz							
4.6 Rapid change of temperature		T_A = Lower category temperature T_B = Upper category temperature Five cycles Duration t = 30 min							
		Visual examination							No visible damage

Table 4 *(continued)*

Subclause number and test[a]	D or ND[c]	Conditions of test[a]	Sample size and criterion of acceptability[c]						Performance requirements[a]
			E			EZ			
			p	*n*	*c*	*p*	*n*	*c*	
4.7 Vibration		Method of mounting: see 1.1 of this specification							
		Frequency range: ... Hz to ... Hz Amplitude 0,75 mm or acceleration 100 m/s^2 (whichever is the less severe) Total duration: 6 h							
4.7.2 Final inspection		Visual examination							No visible damage
4.8 Bump (or shock, see 4.9)		Method of mounting: see 1.1 of this specification Number of bumps: ... Acceleration: .. m/s^2 Duration of pulse: ... ms							
4.9 Shock (or bump, see 4.8)		Method of mounting: see 1.1 of this specification Acceleration: .. m/s^2 Duration of pulse: ... ms							
4.8.3 or 4.9.3 Final measurements		Visual examination							No visible damage
		Capacitance							$\Delta C/C$ for Grade 1.1: ≤1 % Grade 1.2: ≤2 % Grade 2: ≤3 % of value measured in 4.6.1
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,001 Grade 1.2: ≤0,002 Grade 2: ≤0,004 for $C > 1$ µF: see detail specification, compared to values measured in 4.6.1
		Insulation resistance							≥50 % of the values in 4.2.4.2
Subgroup C1 Combined sample of specimens of Subgroups C1A and C1B	D		6	27	2	6	10	0	
4.10 Climatic sequence									
4.10.2 Dry heat		Temperature: upper category temperature Duration: 16 h							
4.10.3 Damp heat, cyclic, Test Db, first cycle									
4.10.4 Cold		Temperature: lower category temperature Duration: 2 h							
4.10.5 Low air pressure (if required by the detail specification)		Air pressure: 8 kPa							
4.10.5.3 Final measurement		Visual examination							No permanent breakdown, flashover or harmful deformation of the case

Table 4 *(continued)*

Subclause number and test[a]	D or ND[c]	Conditions of test[a]	Sample size and criterion of acceptability[c]						Performance requirements[a]
			E			EZ			
			p	*n*	*c*	*p*	*n*	*c*	
4.10.6 Damp heat, cyclic, Test Db, remaining cycles									
4.10.6.2 Final measurement		Visual examination							No visible damage Legible marking
		Capacitance							$\Delta C/C$ for Grade 1.1: ≤1 % Grade 1.2: ≤3 % Grade 2: ≤5 % of value measured in 4.4.2, 4.8.3 or 4.9.3 as applicable
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,0015 Grade 1.2: ≤0,003 Grade 2: ≤0,005 for $C > 1$ µF: see detail specification, compared to values measured in 4.3.1 or 4.6.1 as applicable
		Insulation resistance							≥50 % of values in 4.2.4.2
Subgroup C2	D		6	15	1	6	10	0	
4.11 Damp heat, steady state									
4.11.1 Initial measurements		Capacitance Tangent of loss angle at 1 kHz							
4.11.3 Final measurement		Visual examination							No visible damage Legible marking
		Capacitance							$\Delta C/C$ for Grade 1.1: ≤1 % Grade 1.2: ≤3 % Grade 2: ≤5 % of value measured in 4.11.1
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,001 Grade 1.2: ≤0,002 for $C > 1$ µF: see detail specification, compared to values measured in 4.11.1
		Insulation resistance							≥50 % of values in 4.2.4.2
Subgroup C3A	D		3[4)]	20	1	6	5	0	
4.12.1 Endurance test at 50/60 Hz alternating voltage (if applicable)		Duration: Grade 1: 2 000 h Grade 2: 1 000 h							
4.12.1.1 Initial measurement		Capacitance Tangent of loss angle: for $C_R > 1$ µF: at 1 kHz $C_R \leq 1$ µF: at 10 kHz							

Table 4 *(continued)*

Subclause number and test[a]	D or ND[c]	Conditions of test[a]	Sample size and criterion of acceptability[c]						Performance requirements[a]
			E			EZ			
			p	*n*	*c*	*p*	*n*	*c*	
4.12.1.3 Final measurement		Visual examination							No visible damage Legible marking
		Capacitance							$\Delta C/C$ for Grade 1: ≤5 % Grade 2: ≤10 % of value measured in 4.12.1.1
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,0015 Grade 1.2: ≤0,003 for $C > 1$ µF: see detail specification, compared to values measured in 4.12.1.1
		Insulation resistance							≥50 % of values in 4.2.4.2
Subgroup C3B	D		3[d]	5	1[e]	6	5	0	
4.12.2 Endurance test with sinusoidal current or voltage (if applicable)		Duration: Grade 1: 2 000 h Grade 2: 1 000 h Frequency: ... Hz							
4.12.2.1 Initial measurement		Capacitance Tangent of loss angle: for $C_R > 1$ µF: at 1 kHz $C_R \leq 1$ µF: at 10 kHz							
4.12.2.3 Final measurement		Visual examination							No visible damage Legible marking
		Capacitance							$\Delta C/C$ for Grade 1: ≤5 % Grade 2: ≤10 % of value measured in 4.12.2.1
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,0015 Grade 1.2: ≤0,003 for $C > 1$ µF: see detail specification, compared to values measured in 4.12.2.1
		Insulation resistance							≥50 % of values in 4.2.4.2
Subgroup C3C[6)]	D		3[d]	5	1[e]	6	5	0	
4.12.3 Pulse endurance test (if applicable)		Duration: 1000 h Pulse repetition rate: ... Hz Discharge time constant: as in 4.12.3.1 Applied peak voltage: equal to the rated peak voltage (Table 2 of this specification)							
4.12.3.1 Initial measurement		Capacitance Tangent of loss angle: for $C_R > 1$ µF: at 1 kHz $C_R \leq 1$ µF: at 10 kHz							

Table 4 *(continued)*

Subclause number and test[a]	D or ND[c]	Conditions of test[a]	Sample size and criterion of acceptability[c]						Performance requirements[a]
			E			EZ			
			p	*n*	*c*	*p*	*n*	*c*	
4.12.1.3 Final measurement		Visual examination							No visible damage Legible marking
		Capacitance							$\Delta C/C$ for Grade 1: ≤5 % Grade 2: ≤10 % of value measured in 4.12.3.1
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,0015 Grade 1.2: ≤0,003 for $C > 1$ µF: see detail specification, compared to values measured in 4.12.3.1
		Insulation resistance							≥50 % of values in 4.2.4.2
Subgroup C4	D		3	9	1	6	10	0	
4.2.6 Temperature characteristics (if applicable)		Capacitance Insulation resistance							As in 4.2.6
4.13 Charge and discharge (not applicable when pulse endurance test is required)									
4.13.1 Initial measurement		Capacitance Tangent of loss angle: for $C_R > 1$ µF: at 1 kHz $C_R \leq 1$ µF: at 10 kHz Duration of charge: ... s Duration of discharge: ... s							
4.13.3 Final measurement		Capacitance							$\Delta C/C$ for Grade 1.1: ≤1 % Grade 1.2: ≤3 % Grade 2: ≤5 % of value measured in 4.13.1
		Tangent of loss angle							Increase of tan δ: for $C \leq 1$ µF: for Grade 1.1: ≤0,003 Grade 1.2: ≤0,005 for $C > 1$ µF: see detail specification, compared to values measured in 4.13.1
		Insulation resistance							≥50 % of values in 4.2.4.2
Subgroup C5	ND		12	6	1	6	10	0	
4.2.5 Inductance (if applicable)									$L \leq$ ... mH

[a] Subclause numbers of tests and performance requirements refer to the sectional specification, IEC 60384-17 and Clause 1 of this specification.

[b] Number to be tested: Sample size as directly allotted to the code letter for IL in Table 2a of IEC 60410 .

[c] In this table:
p = periodicity (in months);
n = sample size;
c = acceptance criterion (permitted number of defectives);
D = destructive;
ND = non-destructive;
IL = inspection level;
AQL = acceptable quality level } IEC 60410

[d] In the case of more than one endurance test, the detail specification may change the periodicity in such a way that only one endurance test is carried out every 3 months.

[e] If one defect occurs, a second endurance test shall be carried out after which no defects are permitted.

[f)] The detail specification may additionally prescribe either or both endurance tests.

[g] 100% testing shall be followed by re-inspection by sampling in order to monitor outgoing quality level by non-conforming items per million (10^{-6}). The sampling level shall be established by the manufacturer. For the calculation of 10^{-6} values, any parametric failure shall be counted as a non-conforming item. In case one or more non-conforming items occur in a sample, this lot shall be rejected.

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librarian ❑
researcher ❑
design engineer ❑
safety engineer ❑
testing engineer ❑
marketing specialist ❑
other.....

Q3 I work for/in/as a: *(tick all that apply)*

manufacturing ❑
consultant ❑
government ❑
test/certification facility ❑
public utility ❑
education ❑
military ❑
other.....

Q4 This standard will be used for: *(tick all that apply)*

general reference ❑
product research ❑
product design/development ❑
specifications ❑
tenders ❑
quality assessment ❑
certification ❑
technical documentation ❑
thesis ❑
manufacturing ❑
other.....

Q5 This standard meets my needs: *(tick one)*

not at all ❑
nearly ❑
fairly well ❑
exactly ❑

Q6 If you ticked NOT AT ALL in Question 5 the reason is: *(tick all that apply)*

standard is out of date ❑
standard is incomplete ❑
standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
other .....

Q7 Please assess the standard in the following categories, using the numbers:
(1) unacceptable,
(2) below average,
(3) average,
(4) above average,
(5) exceptional,
(6) not applicable

timeliness.....
quality of writing.....
technical contents.....
logic of arrangement of contents .....
tables, charts, graphs, figures.....
other .....

Q8 I read/use the: *(tick one)*

French text only ❑
English text only ❑
both English and French texts ❑

Q9 Please share any comment on any aspect of the IEC that you would like us to know:

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ISBN 2-8318-8339-3

ICS 31.060.30

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND