TECHNICAL REPORT

ISO TR 10219

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Batteries for watches — Dimensions, requirements and marking

Piles pour montres — Dimensions, exigences et marquage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types:

— type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development, requiring wider exposure;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 10219, which is a technical report of type 1, was prepared by Technical Committee ISO/TC 114, *Horology*.

International Organization for Standardization
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Introduction

This Technical Report applies to primary batteries used as the energy source for watches. This kind of battery is known by experts as a "button cell" and/or a "small battery". Button cells and small batteries are used not only for watches but also for other applications, for example pocket calculators, hearing aids, etc.

The standardization of button cells and small batteries is conducted within IEC/TC 35, *Primary cells and batteries*. Specifications are laid down in IEC 86. The standards of IEC/TC 35 are applicable in the fields with the highest applications of button cells and small batteries, such as pocket-calculators. However, specific requirements for batteries used in watches are not sufficiently covered by IEC 86.

Consequently, a working group for watch batteries within ISO/TC 114, *Horology* was set up and has clarified questions of specific requirements for watch batteries. The results of this working group have been submitted to IEC/TC 35 and have been included in its discussions. A full agreement on many detail requirements, however, could not yet be achieved. In particular the following points still meet with different opinions:

- main dimensions for watch batteries;
- specific requirements concerning the design;
- tolerances,
- nomenclature,
- performance tests.

Since IEC/TC 35 is continuing its discussions on batteries, the ISO/TC 114 working group will continue to provide the necessary information on requirements for watch batteries. ISO/TC 114 is, however, of the opinion that it is inevitable that requirements and other specifications for watch batteries must be included in complete documents and must be provided for the manufacturers of watches and the consumers. This Technical Report takes care of this justified wish.

This Technical Report is also subject to further considerations and members of WG 1 have already provided relevant proposals. Moreover, ISO/TC 114 intends that this Technical Report be reviewed regularly in the light of technological advances and the availability of more data, with the ultimate objective of converting it into an International Standard or of incorporating the contents of this Technical Report into already existing International Standards.

In following up the previous discussions of IEC/TC 35 for a revision of IEC 86 (see decision 1, Ankara), this Technical Report has been prepared in the shape of a TC 114 proposal for an International Standard for button cells/small batteries. In this way, the envisaged conversion into an International Standard would be facilitated considerably.

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Batteries for watches — Dimensions, requirements and marking

1 Scope

This Technical Report specifies the requirements of batteries for watches and the related methods of test.

It aims to

a) guarantee the physical and electronic interchangeability of batteries made by different producers;

b) limit the number of types of batteries;

c) specify the marking of the different types of batteries; and

d) specify the quality criteria by supplying guidelines for their evaluation.

This Technical Report applies to button cells or small batteries for electronic watches.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Report. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Technical Report are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2859 : 1974, *Sampling procedures and tables for inspection by attributes*.

ISO 8601 : 1988, *Data elements and interchange formats — Information interchange — Representation of dates and times*.

ISO/TR 10220 : 1989, *Batteries for watches — Leakage tests*.

IEC 86-1 : 1987, *Primary batteries — Part 1: General*.

IEC 86-2 : 1987, *Primary batteries — Part 2: Specification sheets*.

3 Definitions

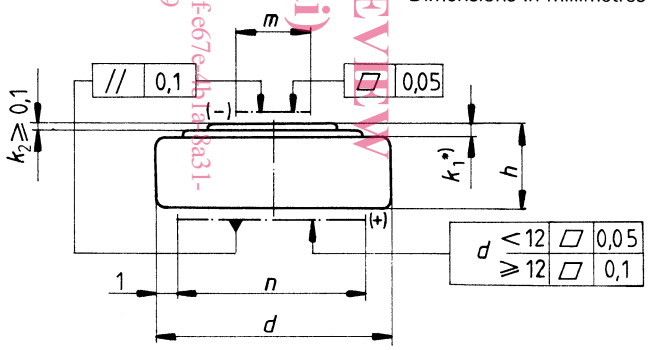
For the purposes of this Technical Report, the definitions given in IEC 86-1 apply.

4 Mechanical requirements

4.1 Dimensions and tolerances

Dimensions and tolerances of batteries for watches shall be in accordance with figure 1 and table 1. The dimensions shall be tested in accordance with 8.2.

Dimensions in millimetres



*) See 4.3.

Figure 1 — Dimensional characteristics

4.2 Contact area

4.2.1 Negative contact (−)

The negative contact (dimension m) shall be in accordance with table 1.

4.2.2 Positive contact (+)

The positive contact shall be maintained over the total surface of the cell-jar.

4.3 Projection of the negative contact

A distance $k_2 \geqslant 0,1$ mm shall be allowed between the centre surface of the negative contact and the highest point of insulation.

NOTE — A minimum distance k_1 (see figure 1), allowed between the centre surface of the negative contact and the highest point of the positive contact (cell-jar), is still under consideration and will be defined later.

4.4 Mechanical pressure resistance

A force of 10 N applied for 10 s through a steel ball of 1 mm diameter on the surface of the battery shall not cause any deformation, i.e. after this test, the battery shall pass the tests specified in clause 8.

4.5 Swelling

The dimensions of batteries shall remain within the tolerance range indicated in table 1, whatever their condition may be, i.e. new, in storage, in use up to the end of discharge.

4.6 Leakage

New batteries, or batteries discharged according to the procedure described in 8.6 or having been subjected to tests according to ISO/TR 10220 shall be examined as stated in this Technical Report. The number of tolerated defects shall be agreed between users and manufacturers.

5 Electrical requirements

5.1 Electrochemical systems, rated voltage, end point voltage and off-load voltage

The requirements for the electrochemical system, the rated voltage, the end point voltage and the off-load voltage are given in table 2.

NOTE — The electrical requirements for lithium batteries and the relevant test methods referred to are provisional and are still under study. They will be confirmed or amended at the revision of this Technical Report.

5.2 On-load voltage, internal impedance and internal resistance

On-load voltage, internal impedance and internal resistance shall be measured in accordance with 8.5. Limit values shall be agreed between manufacturers and users.

NOTE — Knowledge of the internal resistance alone is not sufficient for horological applications.

Table 1 — Basic dimensional characteristics

Values in millimetres

Diameter Code[1)]	d	tol.	m_{min}	Height, h Code[1)] 10	12	14	16	20, 21	25, 26, 27	30	36	42	54
				Tolerance 0 −0,1	0 −0,15	0 −0,15	0 −0,18	0 −0,2	0 −0,2	0 −0,25	0 −0,25	0 −0,25	0 −0,3
5	5,8	0 −0,12	2,6	1,05	1,25	1,45	1,65 (R62)	2,15 (R63)	2,7 (R64)				
6	6,8	0 −0,15	3	1,05	1,25	1,45	1,65 (R65)	2,15 (R60)	2,6 (R66)				
7	7,9	0 −0,15	3,5	1,05	1,25	1,45	1,65 (R67)	2,1 (R58)	2,6 (R59)	3,05	3,6 (R41)		
9	9,5	0 −0,15	4,5	1,05	1,25	1,45	1,65 (R68)	2,1 (R69)	2,7 (R57)		3,6 (R45)		
11	11,6	0 −0,18	6	1,05	1,25	1,45	1,65	2,1 (R55)	2,6 (R56)	3,05 (R54)	3,6 (R42)	4,2 (R43)	5,4 (R44)
12	12,5	0 −0,25	4		1,2		1,6	2 (R1220)	2,5				
16	16	0 −0,25	5		1,2		1,6	2 (R1620)	2,5				
20	20	0 −0,25	8		1,2		1,6 (R2016)	2 (R2020)	2,5 (R2025)				
23	23	0 −0,3	8		1,2		1,6	2 (R2320)	2,5				
24	24,5	0 −0,3	8		1,2		1,6	2 (R2420)	2,5 (R2425)				

1) See clause 6.

NOTE — IEC numbers, according to IEC 86, are given in brackets.

Table 2 — Basic electrical characteristics

Values in volts

Code letter	Positive electrode	Electrolyte	Negative electrode	Nominal voltage	End-point voltage	Off-load voltage max.	min.
L	Manganese dioxide	alkali	zinc	1,5	1	1,65	1,5
M	Mercuric oxide	alkali	zinc	1,35	1	1,37	1,35
S	Silver oxide (Ag_2O)	alkali	zinc	1,55	1,2 (1,4)	1,63	1,57
T	Silver oxide (AgO/Ag_2O)	alkali	zinc	1,55	1,2 (1,4)	1,87[2]	1,57
P	Oxygen	alkali	zinc	1,4	1,2	1,68	1,4
C	Manganese dioxide	organic	lithium	3	2	3,7	3,4
B	Carbon monofluoride	organic	lithium	3	2	3,7	3,1
H[1]	Lead bismuthate	organic	lithium	1,5	1,2	2,3	1,8
D[1]	Bismuth trioxide	organic	lithium	1,5	1,2	2,3	1,8
F[1]	Iron disulfide	organic	lithium	1,5	1,2	2,3	1,7
G[1]	Copper oxide	organic	lithium	1,5	1,2	2,3	1,7
X[1]	Copper sulfide	organic	lithium	2,1	1,2 (1,4)	2,5	2,1

1) Provisional letter code.

2) Attention is drawn to the fact that for special applications, the maximum off-load voltage of the T-system batteries has to be reduced by pre-discharge.

5.3 Minimum capacity

The minimum capacity shall be agreed between manufacturers and users on the basis of a continuous discharge test lasting 20 days to 35 days according to the method described in 8.6.

6 Designation

Batteries used for watches shall be designated by a system of code letters and code numbers as shown below:

EXAMPLE

S R 7 21 S W

- S — Electrochemical system: Code letter according to table 2
- R — Round cell: (according to IEC 86-1 : 1982)
- 7 — Size: diameter, in millimetres
- 21 — Size: height, in tenths of millimetres
- S — Electrolyte:
  - — Alkaline electrolyte:
    low peak current application: S
    (electrolyte: Sodium hydroxide NaOH)
    high peak current application: P
    (electrolyte: Potassium hydroxide KOH)
  - — Organic electrolyte: nil
- W — Letter W to indicate compliance with the requirements specified

7 Marking

Batteries shall be marked with the following information:

a) designation according to clause 6;

b) name or trademark of manufacturer or supplier;

c) polarity of connection component (+);

d) date of manufacture indicating the year and month in conformity with ISO 8601:

EXAMPLE

86 06

- 86 — Year: 1986
- 06 — Month: June

e) date by which the battery should be used can be marked, but on the packaging only.

The marking shall not interfere with the electrical contacts.

8 Test methods

8.1 Sampling

When testing by attributes is required, the sampling plan chosen, for all methods of inspection and measurement of clause 8, shall be in accordance with the specifications of ISO 2859. The parameters shall be treated individually and the acceptance quality level (AQL) values shall be agreed between manufacturers and purchasers.

8.2 Test of dimensions

8.2.1 Diameter and height

The diameter and height shall be checked by calibration with an accuracy sufficient to comply with the tolerances of table 1.

Other test methods are permissible provided that they are of equivalent accuracy.

8.2.2 Space requirement

The space requirement of batteries of diameter $\leqslant$ 11,6 mm shall be contained within an angle of 45 °.

This angle shall be checked with an open gauge (see figure 2) consisting of two perpendicular parts connected by a 45° segment. The minimum values of a are given in table 3.

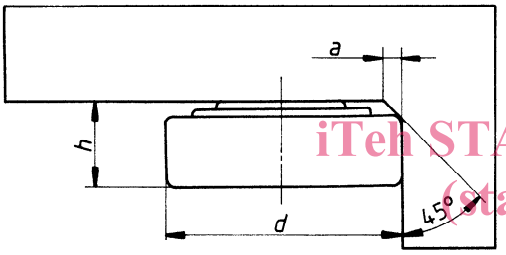


Figure 2 — Space requirement of batteries

Other test methods are permissible provided that they are of equivalent accuracy.

Table 3 — Minimum values of a
(see figure 2)

Dimensions in millimetres

h	a_{min}
$1 < h \leqslant 1,5$	0,25
$1,5 < h \leqslant 1,9$	0,35
$1,9 < h \leqslant 2,2$	0,4
$2,2 < h \leqslant 3,1$	0,5
3,6	0,75
4,2	0,85
5,4	1,1

8.3 Voltage measurement

The accuracy of the voltmeter shall be within 0,01. Its internal resistance shall be at least 10 MΩ.

8.4 Measurement of the off-load voltage, U_{co}

See 8.3.

8.5 Measurement of on-load voltage, U_{cf}, internal impedance, Z_i, and internal resistance, R_i

8.5.1 Environmental conditions

Measurements shall be carried out at temperatures 20 °C ± 2 °C and 0 °C ± 2 °C.

NOTE — For laboratory tests, a temperature of −10 °C is recommended.

Avoid any condensation on the samples during the tests.

8.5.2 Voltage measurement

See 8.3.

8.5.3 On-load voltage, U_{cf}

The battery under test shall be discharged during a time t with a resistance R. The voltage between terminals of the battery at the end of the time t is the on-load voltage.

The values of R and t given in table 4 shall be used.

Table 4 — On-load voltage discharge

Test method	PW batteries		All other batteries	
	R	t	R	t
A	150Ω ± 1 %	1 s ± 5 %	1500Ω ± 1 %	0,01 s ± 5 %
B	150Ω ± 1 %	0,5 s to 2 s	470Ω ± 1 %	0,5 s to 2 s

NOTE — Method B shall be used only if the equipment necessary for the correct application of method A is not available.

8.5.4 Internal impedance, Z_i

The use of method A for measuring the on-load voltage U_{cf} permits the internal impedance Z_i to be determined from the following formula:

$$Z_i = \frac{U_{co} - U_{cf}}{U_{cf}/R}$$

NOTES

1 Method A and the above formula may be used when discharging the battery; it is understood that the voltage measured before the measurement impulse is not really the off-load voltage since the battery is supplying the discharge resistance.

2 The use of on-load voltage values determined according to method B does not allow a sufficiently accurate calculation of the internal impedance for battery types other than PW.

8.5.5 Internal resistance, R_i

The internal resistance, R_i, is given by the following formula:

$$R_i = \frac{U_{co} - U'_{cf}}{U'_{cf}/R}$$

The on-load voltage, U'_{cf}, is measured at the end of a time t less than or equal to 10 µs. The discharge resistance is between 150 Ω and 1 500 Ω.

NOTE — A.C. measurement methods made between 100 Hz and 1 000 Hz give approximate values for the internal resistance.

8.6 Measurement of capacity

8.6.1 Environmental conditions

Measurements shall be carried out at a temperature of 20 °C ± 2 ° C and a relative humidity of between 45 % and 75 %.

8.6.2 Discharge resistance

The value of the discharge resistance, including all the parts of the external circuit, is specified in table 5 and shall have an accuracy of 0,5 %.

8.6.3 Voltage measurement

See 8.3.

8.6.4 Test method

The battery under test shall be discharged continuously with the resistance specified in table 5 until the on-load voltage drops for the first time below the end-point voltage given in table 2.

8.6.5 Self-discharge

Batteries stored for 365 days under the conditions specified in 8.6.1 shall present at least 90 % of their minimum capacity when discharged in accordance with 8.6.4.