IS 16048-2 (2013): Secondary Cells and Batteries containing Alkaline or other non-acid Electrolytes - Portable Sealed Rechargeable Single Cells, Part 2: Nickel-Metal Hydride [ETD 11: Electrotechnical]

IS 16048 (Part 2) : 2013
IEC 61951-2 : 2011

भारतीय मानक

अल्कालाईन या अन्य अम्ल-रहित इलैक्ट्रोलाइट्स वाली सैकेंडरी सैल एवं बैटरियाँ — सुबाहय सील्ड रिचार्जेब्ल सिंगल सैल

भाग 2 निकल-मैटल हायड्राईड

Indian Standard

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES — PORTABLE SEALED RECHARGEABLE SINGLE CELLS

PART 2 NICKEL-METAL HYDRIDE

ICS 29.220.30

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April 2013 **Price Group 10**

Secondary Cells and Batteries Sectional Committee, ETD 11

NATIONAL FOREWORD

This Indian Standard (Part 2) which is identical with IEC 61951-2 : 2011 'Secondary cells and batteries containing alkaline or other non-acid electrolytes — Portable sealed rechargeable single cells — Part 2: Nickel-metal hydride' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Secondary Cells and Batteries Sectional Committee and approval of the Electrotechnical Division Council.

This standard is published in three parts. Other parts in this series are:

Part 1 Nickel-cadmium
Part 3 Thermal cutting

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminology and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard, references appear to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60050-482 International Electrotechnical Vocabulary — Part 482: Primary and secondary cells and batteries	IS 1885 (Part 15) : 2008 Electrotechnical vocabulary: Part 15 Primary cells and batteries	Technically Equivalent
IEC 60410 Sampling plans and procedures for inspection by attributes	IS 10673 : 1983 Sampling plans and procedures for inspection by attributes for electronic items	do
IEC 62133 : 2002 Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for portable sealed secondary cells and for batteries made from them, for use in portable applications	IS 16046 : 2012 Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for portable sealed secondary cells and for batteries made from them, for use in portable applications	Identical

This standard also makes a reference to the BIS Certification Marking of the product. Details of which is given in the National Annex A.

(*Continued on third cover*)

Indian Standard

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES — PORTABLE SEALED RECHARGEABLE SINGLE CELLS

PART 2 NICKEL-METAL HYDRIDE

1 Scope

This part of IEC 61951 specifies marking, designation, dimensions, tests and requirements for portable sealed nickel-metal hydride, small prismatic, cylindrical and button rechargeable single cells, suitable for use in any orientation.

2 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 60050-482, *International Electrotechnical Vocabulary – Part 482: Primary and secondary cells and batteries*

IEC 60086 (all parts), *Primary batteries*

IEC 60086-1 (2006), *Primary batteries – Part 1: General*

IEC 60086-2 (2006), *Primary batteries – Part 2: Physical and electrical specifications*

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

IEC 61959, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Mechanical tests for sealed portable secondary cells and batteries*

IEC 62133, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells and for batteries made from them, for use in portable applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the IEC 60050-482 and the following apply.

3.1
nominal voltage
suitable approximate value of voltage used to designate or identify the voltage of a cell or battery

NOTE 1 The nominal voltage of a sealed nickel-metal hydride rechargeable single cell is 1,2 V.

NOTE 2 The nominal voltage of a battery of n series connected cells is equal to n times the nominal voltage of a single cell.

3.2
rated capacity
quantity of electricity C_5 Ah (ampere-hours) declared by the manufacturer which a single cell can deliver during a 5 h period when charging, storing and discharging under the conditions specified in 7.3.2

3.3
small prismatic cell
cell in the form of a rectangular parallelepiped whose width and thickness dimensions are not more than 25 mm

3.4
cylindrical cell
cell of circular cross-section in which the overall height is equal to, or greater than the overall diameter

3.5
button cell
cell of circular cross-section in which the overall height is less than the overall diameter

3.6
nickel-metal hydride cell
cell containing a nickel hydroxide compound for the positive electrode, a hydrogen absorbing alloy for the negative electrode, and potassium hydroxide or other alkaline solution as electrolyte. Positive electrodes are isolated from negative electrodes by a separator

3.7
sealed cell
cell which remains closed and does not release either gas or liquid when operated within the limits of charge and temperature specified by the manufacturer. The cell is equipped with a safety device to prevent dangerously high internal pressure. The cell does not require addition to the electrolyte and is designed to operate during its life in its original sealed state

NOTE The nickel-metal hydride cell, however, may release gas towards the end of its life due to the accumulation of hydrogen in the cell.

3.8
portable cell
cell designed mainly for use in an easily hand-carried battery

3.9
surface temperature limited cell
cell which performs a function that prevents the temperature increase from a certain standard point even at the moment of anomaly occurrence such as short circuit of cell

4 Parameter measurement tolerances

The overall accuracy of controlled or measured values, relative to the specified or actual values, shall be within the following tolerances:

a) ± 1 % for voltage;

b) ± 1 % for current;

c) ± 1 % for capacity;

d) ± 2 °C for temperature;

e) ± 0,1 % for time;

f) ± 0,1 mm for dimensions;

g) ± 2 % for humidity.

These tolerances comprise the combined accuracy of the measuring instruments, the measurement techniques used and all other sources of error in the test procedure.

The details of the instrumentation used shall be provided in each report of results.

5 Cell designation and marking

5.1 Cell designation

5.1.1 Small prismatic cells and cylindrical cells

5.1.1.1 General

Sealed nickel-metal hydride small prismatic rechargeable single cells and cylindrical rechargeable single cells shall be designated by a letter L, M, H or X which signifies:

- low rate of discharge (L);
- medium rate of discharge (M);
- high rate of discharge (H);
- very high rate of discharge (X).

NOTE These cells are typically but not exclusively used for the following discharge rates:

- L up to 0,5 I_t A;
- M up to 3,5 I_t A;
- H up to 7,0 I_t A;
- X up to and above 7,0 I_t A.

When a cell is intended for permanent charge at elevated temperatures, typically higher than 40 °C, a letter "T" is placed after the letter L, M, H or X.

When a cell is intended for permanent charge at elevated temperatures, typically higher than 50 °C, a letter "U" is placed after the letter L, M, H or X.

When a cell is intended for surface temperature limitation, a letter “S” is placed after the letter L or M.

When a cell is intended for rapid charge, typically at 1,0 I_t A, a letter "R" is placed after the letter L, M, H or X.

5.1.1.2 Small prismatic cells

Sealed nickel-metal hydride small prismatic rechargeable single cells shall be designated by the letters "HF" followed by a letter L, M, H or X followed by three groups of figures, each group being separated by a solidus, as follows:

a) The two figures to the left of the first solidus shall indicate the maximum width specified for the cell, expressed in millimetres, rounded up to the next whole number.

b) The two figures in the middle shall indicate the maximum thickness specified for the cell, expressed in millimetres, rounded up to the next whole number.

c) The two figures to the right of the second solidus shall indicate the maximum height specified for the cell, expressed in millimetres, rounded up to the next whole number.

EXAMPLE HFL 18/07/49 designation identifies a small prismatic cell of low discharge rate capability, with a maximum width of 18 mm, a maximum thickness of 7 mm and a maximum height of 49 mm.

5.1.1.3 Cylindrical cells

Sealed nickel-metal hydride cylindrical rechargeable single cells shall be designated by the letters "HR" followed by a letter L, M, H or X followed by two groups of figures, each group being separated by a solidus, as follows:

a) The two figures to the left of the solidus shall indicate the maximum diameter specified for the cell, expressed in millimetres, rounded up to the next whole number.

b) The two figures to the right of the solidus shall indicate the maximum height specified for the cell, expressed in millimetres, rounded up to the next whole number.

When a manufacturer designs a cell with dimensions and tolerances which make it interchangeable with a primary cell, the designation of Table 2 shall also be marked on the cell.

EXAMPLE 1 HRL 33/62 designation identifies a cylindrical cell of low discharge rate capability, with a maximum diameter of 33 mm and a maximum height of 61,5 mm.

EXAMPLE 2 HRLT 33/62 designation identifies a cylindrical cell of low discharge rate capability, intended for permanent charge at elevated temperatures with a maximum diameter of 33 mm and a maximum height of 61,5 mm.

EXAMPLE 3 HRXR 23/43 designation identifies a cylindrical cell of very high discharge rate capability, intended for rapid charge, with a maximum diameter of 23 mm and a maximum height of 43 mm.

For cells dimensionally interchangeable with primary cells, the following single or double figures following the letter L, M, R or S may indicate:

- 20- Size D;
- 14- Size C;
- 6- Size AA;
- 03- Size AAA.

NOTE Cells dimensionally interchangeable with primary cells correspond to M type unless otherwise specified

For the purpose of this explanation, an example is given below.

EXAMPLE 4 HRMR03 designation identifies a sealed nickel-metal hydride cylindrical rechargeable single cell, of medium discharge rate capability, also intended for rapid charge, dimensionally interchangeable with primary cell and whose type designation is AAA.

5.1.2 Button cells

Sealed nickel-metal hydride button rechargeable single cells shall be designated by the letters "HB" followed by two groups of figures separated by a solidus, as follows:

a) The three figures to the left of the solidus shall indicate the maximum diameter specified for the cell, expressed in tenths of millimetres, rounded up to the next whole number.

b) The three figures to the right of the solidus shall indicate the maximum height specified for the cell, expressed in tenths of millimetres, rounded up to the next whole number.

EXAMPLE HB 116/054 designation identifies a button cell, with a maximum diameter of 11,6 mm and a maximum height of 5,4 mm.

5.2 Cell termination

This standard does not specify cell termination.

5.3 Marking

5.3.1 Small prismatic cells and cylindrical cells

Each jacketed cell supplied without connections shall carry durable markings giving the following minimum information:

- sealed rechargeable nickel-metal hydride or Ni-MH;
- designation as specified in 5.1 (in addition, it is permissible for a manufacturer to use his own type designation);
- rated capacity;
- nominal voltage;
- recommended charge rate and time or permanent charge current for "T" cells;
- polarity;
- date of manufacture (which may be in code);
- name or identification of manufacturer or supplier.

NOTE In general, sealed nickel-metal hydride rechargeable single cells with connection tabs need no labels if they form an integral part of a battery, in which case, the battery itself is marked with the above information.

5.3.2 Button cells

Each button cell supplied without connection shall carry durable markings giving the following minimum information:

- designation as specified in 5.1;
- polarity;
- date of manufacture (which may be in code);
- name or identification of manufacturer or supplier.

6 Dimensions

6.1 Small prismatic cells and cylindrical cells

6.1.1 General

Figures 1 and 2 show the shape of the cells.

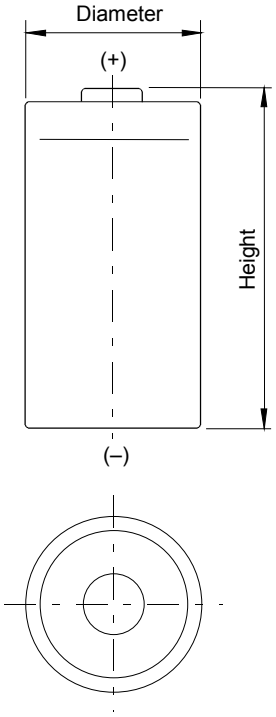


Figure 1 – Jacketed cylindrical cells

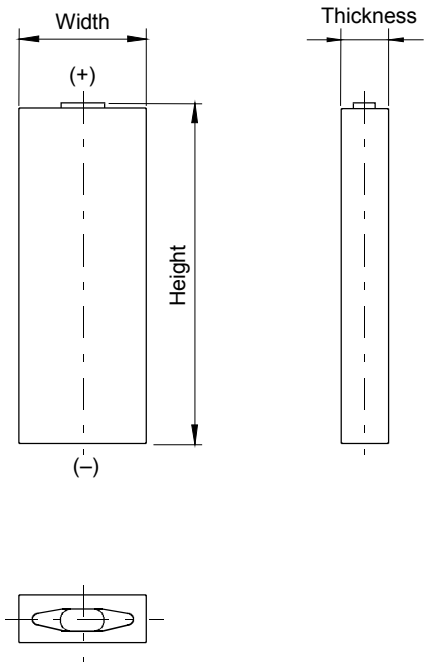


Figure 2 – Jacketed small prismatic cells

6.1.2 Small prismatic cells

Table 1 shows the dimensions for jacketed small prismatic cells.

Table 1 – Dimensions of jacketed small prismatic cells

Cell designation	Width mm	Thickness mm	Height mm
HF 15/08/49	14,5	7,4	48,2
HF 15/09/49	14,5	8,3	48,2
HF 16/07/34[a]	16,0	6,6	34,0
HF 18/07/36	17,3	6,1	35,7
HF 18/07/49	17,3	6,1	48,2
HF 18/09/49	17,3	8,3	48,2
HF 18/07/68	17,3	6,1	67,3
HF 18/11/68	17,3	10,7	67,3
HF 18/18/68	17,3	17,3	67,3
HF 23/11/68	22,7	10,7	67,3
HF 23/15/68	22,7	14,5	67,3
	0 –1,0	0 –0,7	0 –1,0
		0 –1,0	0 –1,5

[a] New cell.

6.1.3 Cylindrical cells

6.1.3.1 Cells dimensionally interchangeable with primary cells

Table 2 gives the requirements relative to the dimensions for jacketed cylindrical cells which are dimensionally interchangeable with primary cells.

Table 2 – Jacketed cylindrical cells dimensionally interchangeable with primary cells

Cell Designation [a]	Type designation (reference) [b]	Corresponding primary cell CEI 60086 [c]	Nominal voltage (V)	Dimensions (mm)										
				A	B	C	D [d]	E	F		G	Φ		ΦP
				Max	Min	Min	-	Max	Max	Min	Min	Max	Min	Max
HR03	AAA	R03 LR03	1,2	44,5	(43,3)	4,3	-	0,5	3,8	(2,0)	0,8	10,5	9,5	0,4
HR6	AA	R6 LR6		50,5	(49,2)	7,0	-	0,5	5,5	(4,2)	1,0	14,5	13,5	0,5
HR14	C	R14 LR14		50,0	(48,6)	13,0	-	0,9	7,5	(5,5)	1,5	26,2	24,9	1,0
HR20	D	R20 LR20		61,5	(59,5)	18,0	-	1,0	9,5	(7,8)	1,5	34,2	32,3	1,0

NOTE Figures in parentheses are reference values.

[a] Cell designations shall be in accordance with the nomenclature rules given in IEC 60086-1.

[b] In some countries, these cell types are also known as AAA (R 03); AA (R 6); C (R 14); D (R 20).

[c] Carbon zinc cells (R) and alkaline primary cells (LR) shall be compliant with the provisions of IEC 60086-2, respectively.

[d] There is no specification for the value “D” for sealed nickel-metal hydride cylindrical rechargeable single cells interchangeable with primary cells.

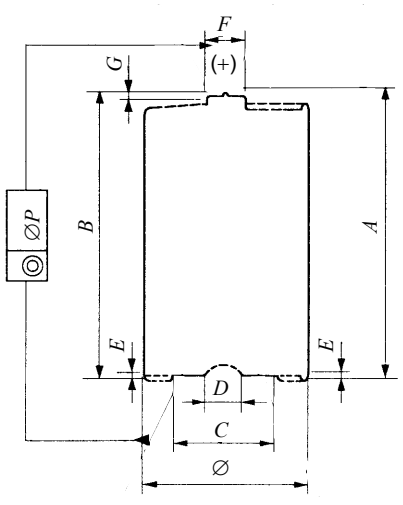


Figure 3 – Jacketed cells dimensionally interchangeable with primary cells

The cell dimensions of Figure 3 are given below:

a) *A:* maximum overall height of the cell;

b) *B*: minimum distance between the flats of the positive and the negative contacts;

c) *C*: minimum outer diameter of the negative flat contact surface;

d) *D*: maximum inner diameter of the negative flat contact surface;

e) E: maximum recess of the negative flat contact surface;

f) F: maximum diameter of the positive contact within the specified projection height;

g) G: minimum projection of the flat positive contact;

h) $\varnothing$: maximum and minimum diameters of the cell;

i) $\varnothing P$: concentricity of the positive contact.

6.1.3.2 Cells not dimensionally interchangeable with primary cells

Table 3 shows the dimensions for jacketed cylindrical cells not dimensionally interchangeable with primary cells.

Table 3 – Jacketed cylindrical cells not dimensionally interchangeable with primary cells

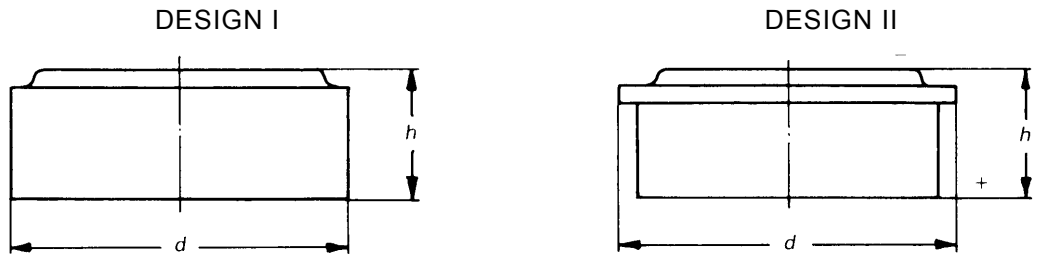
Cell designation [a]	Diameter mm		Height mm	
HR 11/45	10,5		44,5	
HR 11/51	10,5		50,5	
HR 11/67	10,5		67,0	
HR 15/43	14,5		43,0	
HR 15/49	14,5		49,0	0 –1,5
HR 15/51	14,5		50,5	
[b] HR 15/67	15,0		67,0	
HR 17/29	17,0	0 –0,7	28,5	
HR 17/43	17,0		43,0	
HR 17/50	17,0		50,0	
HR 17/67	17,0		67,0	0 –2,0
[b] HR 18/44	18,0		43,5	
[b] HR 18/67	18,0		67,0	
[b] HR 19/67	19,0		67,0	
HR 23/34	23,0		34,0	
HR 23/43	23,0		43,0	0 –1,5
[b] HR 23/44	23,0		43,5	
[b] HR 23/50	23,0		50,0	
[b] HR 23/60	23,0		61,0	
HR 26/47	25,8		47,0	
HR 26/50	25,8	0 –1,0	50,0	
HR 33/36	33,0		36,0	0 –2,0
HR 33/62	33,0		61,5	
HR 33/91	33,0		91,0	0 / –2,5
[b] HR 34/60	33,5		59,5	0 / –2,0

[a] The letters HR to be followed by L, M, H or X and T and/or R as appropriate (see 5.1).

[b] 8 new cells.

6.2 Button cells

Cells shall be constructed as design I or II.



NOTE The polarity of design I is not standardized.

Figure 4 – Button cells

Table 4 shows the dimensions of sealed nickel-metal hydride button rechargeable single cells.

Table 4 – Dimensions of button cells

Cell designation	Overall diameter *d* mm		Overall height *h* mm	
HB 079/054	7,9	0 −1,0	5,4	0 −0,6
HB 116/054	11,6		5,4	
HB 156/064	15,6		6,4	
HB 222/048	22,2	0 −0,3	4,8	
HB 252/061	25,2		6,1	
HB 252/065	25,2		6,5	
HB 252/078	25,2		7,8	
HB 347/060	34,7		6,0	

7 Electrical tests

7.1 General

Charge and discharge currents for the tests in accordance with this clause and with Clause 5 shall be based on the rated capacity, (C_5 Ah). These currents are expressed as multiples of I_t A, where I_t A = C_5 Ah/1 h.

In all tests, except where noted, no leakage of electrolyte in liquid form shall be observed.

7.2 Charging procedure for test purposes

Unless otherwise stated in this standard, the charging procedure for test purposes shall be carried out in an ambient temperature of 20 °C ± 5 °C and a relative humidity of 65 % ± 20 %, at a constant current of 0,1 I_t A, for 16 h. The tests shall be performed within one month of the arrival date or the purchasing date.

Prior to charging, the cell shall be discharged in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, down to a final voltage of 1,0 V.

7.3 Discharge performance

7.3.1 General

The following discharge tests shall be carried out in the sequence given.

7.3.2 Discharge performance at 20 °C

The cell shall be charged in accordance with 7.2. After charging, the cell shall be stored in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

The cell shall then be discharged in an ambient temperature of 20 °C ± 5 °C and as specified in Tables 5 or 6. The duration of discharge shall be not less than the values specified in Tables 5 or 6.

The 0,2 I_t A discharge test is performed in order to verify the declared rated capacity of the cell.

Table 5 – Discharge performance at 20 °C for small prismatic cells and cylindrical cells

Discharge conditions		Minimum discharge duration h/min			
Rate of constant current	Final voltage	Cell designation			
A	V	L/LT/LU/LS	M/MT/MU/MS	H/HT/HU	X
0,2 I_t [a]	1,0	5 h	5 h	5 h	5 h
1,0 I_t	0,9	–	42 min	48 min	54 min
5,0 I_t [b]	0,8	–	–	6 min	9 min
10,0 I_t [b]	0,7	–	–	–	4 min

[a] Five cycles are permitted for this test. The test shall be terminated at the end of the first cycle which meets the requirement.

[b] Prior to the 5 I_t A and 10 I_t A tests, a conditioning cycle may be included if necessary. This cycle shall consist of charging at 0,1 I_t A in accordance with 7.2 and discharging at 0,2 I_t A in an ambient temperature of 20 °C ± 5 °C according to 7.3.2.

Table 6 – Discharge performance at 20 °C for button cells

Discharge conditions		Minimum discharge duration h/min
Rate of constant current A	Final voltage V	
0,2 I_t [a]	1,0	5 h
1,0 I_t	0,9	35 min

[a] Five cycles are permitted for this test. The test shall be terminated at the end of the first cycle which meets the requirement.

7.3.3 Discharge performance at 0 °C

The cell shall be charged in accordance with 7.2. After charging, the cell shall be stored, in an ambient temperature of 0 °C ± 2 °C for not less than 16 h and not more than 24 h.

The cell shall then be discharged in an ambient temperature of 0 °C ± 2 °C and as specified in Tables 7 or 8. The duration of discharge shall be not less than the values specified in Tables 7 or 8.

Table 7 – Discharge performance at 0 °C for small prismatic cells and cylindrical cells

Discharge conditions		Minimum discharge duration h/min			
Rate of constant current A	Final voltage V	Cell designation			
		L/LT/LU/LS	M/MT/MU/MS	H/HT/HU	X
0,2 I_t	1,0	2 h	4 h	4 h	4 h 30 min
1,0 I_t	0,9	–	36 min	42 min	48 min
2,0 I_t [a]	0,8	–	–	15 min	21 min
3,0 I_t [a]	0,8	–	–	–	12 min

[a] Prior to the 2,0 I_t A and 3,0 I_t A tests, a conditioning cycle may be included if necessary. This cycle shall consist of charging at 0,1 I_t A in accordance with 7.2 and discharging at 0,2 I_t A in an ambient temperature of 20 °C ± 5 °C according to 7.3.2.

Table 8 – Discharge performance at 0 °C for button cells

Discharge conditions		Minimum discharge duration h/min
Rate of constant current A	Final voltage V	
0,2 I_t	1,0	4 h
1,0 I_t	0,9	27 min

7.3.4 Discharge performance for rapid charge cells (R cells)

R cells shall be charged at a constant current of 1,0 I_t A for 1,2 h or other appropriate charge termination method as recommended by the cell manufacturer, followed by a charge at 0,1 I_t A for 2 h, in an ambient temperature of 20 °C ± 5 °C. After charging, the cell shall be stored and discharged as specified in 7.3.2 and 7.3.3.

The duration of discharge shall be not less than the values specified in Table 5 for discharge at 20 °C ± 5 °C and in Table 7 for discharge at 0 °C ± 2 °C.

7.4 Charge (capacity) retention

The charge (capacity) retention shall be determined by the following test. After charging in accordance with 7.2, the cell shall be stored on open circuit for 28 days. The average ambient temperature shall be 20 °C ± 2 °C. The temperature may be allowed to vary within the range of 20 °C ± 5 °C for short periods during the storage.

The cells shall be discharged under the conditions specified in 7.3.2 at a rate of 0,2 I_t A.

The duration of discharge after 28 days storage at 20 °C shall be not less than:

- 3 h for small prismatic cells and cylindrical cells;
- 3 h 45 min for button cells.

7.5 Endurance

7.5.1 Endurance in cycles

7.5.1.1 General

Prior to the endurance in cycles test, the cell shall be discharged at a constant current of 0,2 I_t A to a final voltage of 1,0 V.

The following endurance test shall then be carried out, irrespective of cell designation, in an ambient temperature of 20 °C ± 5 °C. Charge and discharge shall be carried out at constant current throughout, in accordance with the conditions specified in Tables 9, 10, 11 and 12. Precautions shall be taken to prevent the cell-case temperature from rising above 35 °C during the test, by providing a forced air draught if necessary.

NOTE The actual cell temperature, not the ambient temperature, determines cell performance.

7.5.1.2 Small prismatic, button and cylindrical cells not dimensionally interchangeable with primary cells

Table 9 – Endurance in cycles for small prismatic, button and cylindrical cells not dimensionally interchangeable with primary cells

Cycle number	Charge	Stand in charged condition	Discharge
1	0,10 I_t A for 16 h	None	0,25 I_t A for 2 h 20 min [a]
2 to 48	0,25 I_t A for 3 h 10 min	None	0,25 I_t A for 2 h 20 min [a]
49	0,25 I_t A for 3 h 10 min	None	0,25 I_t A to 1,0 V
50	0,10 I_t A for 16 h	1 h to 4 h	0,20 I_t A to 1,0 V [b]

[a] If the cell voltage drops below 1,0 V, discharge may be discontinued.

[b] It is permissible to allow sufficient open-circuit rest time after the completion of discharge at cycle 50, so as to start cycle 51 at a convenient time. A similar procedure may be adopted at cycles 100, 150, 200, 250, 300, 350, 400 and 450.

Cycles 1 to 50 shall be repeated until the discharge duration on any 50th cycle becomes less than 3 h. At this stage, a repeat capacity measurement as specified for cycle 50 shall be carried out.

The endurance test is considered complete when two such successive capacity cycles give a discharge duration of less than 3 h. The total number of cycles obtained when the test is completed shall be not less than:

- 400 for small prismatic cells;
- 500 for L/LR, M/MR, H/HR or X/XR cells;
- 50 for LT/LU, MT/MU or HT/HU cells;
- 500 for button cells.

7.5.1.3 Cylindrical cells dimensionally interchangeable with primary cells

The cell shall be tested in accordance with 7.5.1.2. The total number of cycles obtained when the test is completed shall be not less than:

- 500 for AAA cells with a rated capacity less than 800 mAh;
- 300 for AAA cells with a rated capacity of 800 mAh or more;
- 500 for AA cells with a rated capacity less than 2 100 mAh;
- 300 for AA cells with a rated capacity of 2 100 mAh or more;
- 500 for D and C cells.

7.5.1.4 Cylindrical cells (accelerated test procedures)

7.5.1.4.1 General

In order to accelerate the test or to use cycling conditions approximating those in actual applications, one of the following alternative procedures, shown in Tables 10, 11 and 12, relevant to the cell may be carried out as an alternative to 7.5.1.2.

7.5.1.4.2 H or X cells

Table 10 – Endurance in cycles for H or X cells

Cycle number	Charge	Stand in charged condition	Discharge	Total duration including subsequent rest
1	0,1 I_t A for 16 h	30 min	1,0 I_t A to 1,0 V	90 min
2 to 48	0,3 I_t A for 4h [a]	30 min	1,0 I_t A to 1,0 V	90 min
49	0,3 I_t A for 4h [a]	24 h	1,0 I_t A to 1,0 V	90 min
50	0,1 I_t A for 16 h	1 h to 4h	0,2 I_t A to 1,0 V	[b]

[a] Or appropriate charge termination, as recommended by the manufacturer.

[b] It is permissible to allow sufficient open-circuit rest time after the completion of discharge at cycle 50, so as to start cycle 51 at a convenient time. A similar procedure may be adopted at cycles 100, 150, 200, 250, 300, 350, 400, and 450.

Cycles 1 to 50 shall be repeated until the discharge duration to the final voltage of 1,0 V on any 49th cycle becomes less than 30 min or until the discharge duration to the final voltage of 1,0 V on any 50th cycle becomes less than 3 h. At this stage, a repeat capacity measurement as specified for cycle 50 shall be carried out and if the discharge time is less than 3 h again the test is terminated.

The total number of cycles obtained when the test is completed shall be not less than 500.

7.5.1.4.3 X cells

Table 11 – Endurance in cycles for X cells

Cycle number	Charge	Stand in charged condition	Discharge	
			Conditions	Total duration including subsequent rest
1	0,1 I_t A for 16 h	30 min	5,0 I_t A to 0,8 V	42 min
2 to 48	1,0 I_t A for 1h [a]	30 min	5,0 I_t A to 0,8 V	42 min
49	1,0 I_t A for 1h [a]	24 h	5,0 I_t A to 0,8 V	42 min
50	0,1 I_t A for 16 h	1 h to 4 h	0,2 I_t A to 1,0 V [b]	[b]

[a] Or appropriate charge termination, as recommended by the manufacturer.

[b] It is permissible to allow sufficient open-circuit rest time after the completion of discharge at cycle 50, so as to start cycle 51 at a convenient time. A similar procedure may be adopted at cycles 100, 150, 200, 250, 300, 350, 400 and 450.

Cycles 1 to 50 shall be repeated until the discharge duration to the final voltage of 0,8 V on any 49th cycle becomes less than 5 min or until the discharge duration to the final voltage of 1,0 V on any 50th cycle becomes less than 3 h. At this stage, a repeat capacity measurement as specified for cycle 50 shall be carried out and if the discharge time is less than 3 h again the test is terminated.

The total number of cycles obtained when the test is completed shall be not less than 500.

7.5.1.4.4 HR or XR cells

Table 12 – Endurance in cycles for HR or XR cells

Cycle number	Charge	Stand in charged condition	Discharge	
			Conditions	Total duration including subsequent rest
1	0,1 I_t A for 16 h	30 min	1,0 I_t A to 1,0 V	90 min
2 to 48	1,0 I_t A for [a]	30 min	1,0 I_t A to 1,0 V	90 min
49	1,0 I_t A for [a]	24 h	1,0 I_t A to 1,0 V	90 min
50	1,0 I_t A for [a] plus 0,1 I_t A for 2 h	1 h to 4 h	0,2 I_t A to 1,0 V [b]	[b]

[a] With appropriate charge termination, as recommended by the manufacturer, for example use -ΔV or ΔT/Δt control method.

[b] It is permissible to allow sufficient open-circuit rest time after the completion of discharge at cycle 50, so as to start cycle 51 at a convenient time. A similar procedure may be adopted at cycles 100, 150, 200, 250, 300, 350, 400 and 450.

Cycles 1 to 50 shall be repeated until the discharge duration to the final voltage of 1,0 V on any 49th cycle becomes less than 30 min or until the discharge duration to the final voltage of 1,0 V on any 50th cycle becomes less than 3 h. At this stage, a repeat capacity measurement as specified for cycle 50 shall be carried out and if the discharge time is less than 3 h again the test is terminated.

The total number of cycles obtained when the test is completed shall be not less than 500.

7.5.2 Permanent charge endurance

7.5.2.1 Small prismatic and button cells

There is no requirement for permanent charge endurance tests on small prismatic and button cells.

7.5.2.2 L, M, H or X cylindrical cells

Prior to this test, the cell shall be discharged at 0,2 I_t A to a final voltage of 1,0 V.

The following permanent charge endurance test shall be carried out in an ambient temperature of 20 °C ± 5 °C. Charge and discharge shall be carried out at constant current throughout, using the conditions specified in Table 13.

Table 13 – Permanent charge endurance for L, M, H or X cells

Cycle number	Charge	Discharge [a]
1	0,05 I_t A for 91 days	0,2 I_t A to 1,0 V
2	0,05 I_t A for 91 days	0,2 I_t A to 1,0 V
3	0,05 I_t A for 91 days	0,2 I_t A to 1,0 V
4	0,05 I_t A for 91 days	0,2 I_t A to 1,0 V

[a] The discharge is carried out immediately on completion of charging.

Precautions shall be taken to prevent cell-case temperature from rising above 25 °C during the test by providing a forced air draught if necessary.

The discharge duration at cycle 4 shall be not less than 3 h.

7.5.2.3 LT, MT or HT cylindrical cells

The permanent charge endurance test shall be performed in three steps according to the conditions specified in Table 14.

It consists of:

- a charge acceptance test at +40 °C;
- an ageing period of six months at +70 °C;
- a final charge acceptance test to check the cell's performance after ageing.

NOTE 1 The six months aging period and the temperature of +70 °C has been selected to simulate four years of permanent charge operation at +40 °C.

Prior to this test, the cell shall be discharged at 20 °C ± 5 °C, at 0,2 I_t A, to a final voltage of 1,0 V and stored, in an ambient temperature of +40 °C ± 2 °C, for not less than 16 h and not more than 24 h.

The cell shall then be charged and discharged at constant current under the conditions specified in Table 14 while maintained in an ambient temperature of +40 °C ± 2 °C or +70 °C ± 2 °C as appropriate.

The discharge conditions A or B may be chosen to suit the user's requirements. The discharge is carried out immediately on completion of charging.

After performing the first charge acceptance test at +40 °C the cell is stored in an ambient temperature of +70 °C ± 2 °C for not less than 16 h and not more than 24 h.

During the ageing period of six months at +70 °C, precautions shall be taken to prevent the cell-case temperature from rising above +75 °C, by providing a forced air draught, if necessary.

NOTE 2 The actual cell case temperature, not the ambient temperature, determines cell performance.

The discharge duration of the three cycles at +70 °C shall be recorded. Leakage of electrolyte shall not occur during this test.

After completion of the ageing period, the cell shall be stored in an ambient temperature of +40 °C ± 2 °C for not less than 16 h and not more than 24 h. The three cycles at +40 °C of the initial charge acceptance test are then repeated using the conditions specified in Table 14. The duration of discharge shall be not less than the values specified in Table 14.

Table 14 – Permanent charge endurance for LT, MT or HT cells

Cycle number	Ambient temperature	Charge	Discharge A or B [a]	Minimum discharge duration
1		0,05 I_t A for 48 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	No requirement
2	+40 °C ± 2 °C	0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	3 h 45 min 42 min
3		0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	3 h 45 min 42 min
4		0,05 I_t A for 60 days	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	
5	+70 °C ± 2 °C	0,05 I_t A for 60 days	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	No requirement
6		0,05 I_t A for 60 days	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	
7		0,05 I_t A for 48 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	No requirement
8	+40 °C ± 2 °C	0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	2 h 30 min 24 min
9		0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	2 h 30 min 24 min

[a] A: for LT, MT or HT cells.
B: for MT or HT cells only.

7.5.2.4 LU, MU or HU cylindrical cells

The permanent charge endurance test shall be performed in three steps according to the conditions specified in Table 15

It consists of:

- a charge acceptance test at +50 °C;
- an ageing period of twelve months at +70 °C;
- a final charge acceptance test to check the cell's performance after ageing.

NOTE 1 The twelve months ageing period and the temperature of +70 °C has been selected to simulate four years of permanent charge operation at +50 °C.

Prior to this test, the cell shall be discharged at 20 °C ± 5 °C, at 0,2 I_t A, to a final voltage of 1,0 V and stored, in an ambient temperature of +50 °C ± 2 °C, for not less than 16 h and not more than 24 h.

The cell shall then be charged and discharged at constant currents under the conditions specified in Table 15 while maintained in an ambient temperature of +50 °C ± 2 °C or +70 °C ± 2 °C as appropriate.

The discharge conditions A or B may be chosen to suit the user's requirements. The discharge is carried out immediately on completion of charging.

After performing the first charge acceptance test at +50 °C, the cell is stored in an ambient temperature of +70 °C ± 2 °C for not less than 16 h and not more than 24 h.

During the ageing period of twelve months at +70 °C, precautions shall be taken to prevent the cell-case temperature from rising above +75 °C, by providing a forced air draught, if necessary.

NOTE 2 The actual cell case temperature, not the ambient temperature, determines cell performance.

The discharge duration of the three cycles at +70 °C shall be recorded. Leakage of electrolyte shall not occur during this test.

After completion of the ageing period, the cell shall be stored in an ambient temperature of +50 °C ± 2 °C for not less than 16 h and not more than 24 h. The three cycles at +50 °C of the initial charge acceptance test are then repeated using the conditions specified in Table 15. The duration of discharge shall be not less than the values specified in Table 15.

Table 15 – Permanent charge endurance for LU, MU or HU cells

Cycle number	Ambient temperature	Charge	Discharge A or B [a]	Minimum discharge duration
1		0,05 I_t A for 48 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	No requirement
2	+50 °C ± 2 °C	0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	3 h 45 min 42 min
3		0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	3 h 45 min 42 min
4		0,05 I_t A for 120 days	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	
5	+70 °C ± 2 °C	0,05 I_t A for 120 days	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	No requirement
6		0,05 I_t A for 120 days	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	
7		0,05 I_t A for 48 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	No requirement
8	+50 °C ± 2 °C	0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	2 h 30 min 24 min
9		0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V	2 h 30 min 24 min

[a] A: for LU, MU or HU cells.
B: for MU or HU cells only.

7.6 Charge acceptance at constant voltage

This standard does not specify a charge acceptance test at constant voltage.

Charging at constant voltage is not recommended.

7.7 Overcharge

7.7.1 Small prismatic, L, M, H, X, LS or MS cylindrical, and button cells

The ability of the cell to withstand an overcharge shall be determined by the following test.

Prior to this test, the cell shall be discharged in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, down to a final voltage of 1,0 V.

The cell shall then be charged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,1 I_t A for 48 h. After this charging operation, the cell shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

The cell shall then be discharged at 20 °C ± 5 °C at a constant current of 0,2 I_t A to a final voltage of 1,0 V.

The duration of discharge shall be not less than 5 h.

7.7.2 LT/LU, MT/MU or HT/HU cylindrical cells

The ability of the cell to withstand an overcharge shall be determined by the following test performed at 0 °C ± 2 °C in circulating air.

Prior to this test, the cell shall be discharged in an ambient temperature of 20 °C ± 5 °C at 0,2 I_t A to a final voltage of 1,0 V and stored, at 0 °C ± 2 °C, for not less than 16 h and not more than 24 h.

Charge and discharge shall be carried out at constant current, using the conditions specified in Table 16. The discharge condition A or B may be chosen to suit the user's requirements.

Table 16 – Overcharge at 0 °C

Charge	Discharge A [a]	Discharge B [a]
	LT/LU, MT/MU, HT/HU cells	MT/MU, HT/HU cells
0,05 I_t A for 28 days	0,2 I_t A to 1,0 V	1,0 I_t A to 0,9 V
[a] The discharge is carried out immediately on completion of charging.		

The duration of discharge shall be not less than that specified in Table 7.

7.7.3 R cylindrical cells

The ability of the cell to withstand an overcharge shall be determined by the following test.

Prior to this test, the cell shall be discharged in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, to a final voltage of 1,0 V.

The cell shall be charged in an ambient temperature of 20 °C ± 5 °C at a constant current of 1,0 I_t A for 1,2 h or other appropriate charge termination such as -ΔV or as recommended by the manufacturer. Then charging should be continued in the same ambient temperature at a

constant current of 0,1 I_t A for 48 h. After this charging operation, the cell shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

The cell shall then be discharged at 20 °C ± 5 °C at a constant current of 0,2 I_t A to a final voltage of 1,0 V.

The duration of discharge shall be not less than 5 h.

7.8 Safety device operation

Warning: EXTREME CAUTION SHALL BE EXERCISED WHEN CARRYING OUT THIS TEST ! CELLS SHALL BE TESTED INDIVIDUALLY, AND IT SHOULD BE NOTED THAT CELLS FAILING TO MEET THE REQUIREMENT COULD BURST WITH EXPLOSIVE FORCE EVEN AFTER THE CELL HAS BEEN DISCONNECTED FROM THE CHARGE CURRENT.

FOR THIS REASON, THE TEST SHALL BE CARRIED OUT IN A PROTECTIVE CHAMBER.

The following test shall be carried out in order to establish that the safety device of the cell will operate to allow the escape of gas when the internal pressure exceeds a critical value.

NOTE Some button cells do not have a safety vent. This test should not be performed on this type of cell.

The cell shall undergo a forced discharge in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, to a final voltage of 0 V.

The current shall then be increased to 1,0 I_t A and the forced discharge continued in the same ambient temperature of 20 °C ± 5 °C, for 60 min.

During and at the end of this discharge, the cell shall not disrupt or burst. Leakage of electrolyte and deformation of the cell are acceptable.

7.9 Surface temperature limitation device operation (for S cell only)

Warning: EXTREME CAUTION SHALL BE EXERCISED WHEN CARRYING OUT THIS TEST! THE CELL COULD BURST WITH EXPLOSIVE FORCE OR ITS CONTENT COULD FLOW OUT. IN ADDITION, IT SHOULD BE NOTED THAT THE CELL WILL GENERATE HEAT.

FOR THIS REASON, THE TEST SHALL BE CARRIED OUT IN A PROTECTIVE CHAMBER.

The following test shall be carried out in order to establish that the surface temperature limitation device will operate to prevent the cell temperature from excessively rising when the surface temperature limited cell is misused.

After charging in accordance with 7.2, the test shall be carried out as follows:

Test method: Four cells shall be connected in series but one of the four cells shall be placed in a reverse position. In this state, the terminals of the series string are connected by a wire to cause a short circuit. Short-circuit resistance: 100 mΩ or less.

The test shall be terminated, when one of the following two cases occurs first:

- 24 hours have elapsed or
- the cell-case temperature has been reduced by 20 % from the maximum temperature increase.

Then, verify the followings:

- the cell has not exploded and not taken fire;

- the cell temperature increase is less than 45 °C;
- no leakage shall be found by visual inspection.

7.10 Storage

Storage should be carried out according to the recommendations of the manufacturer.

Prior to this test, the cell shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, to a final voltage of 1,0 V. It shall then be charged in accordance with:

- 7.2 for button cells, small prismatic cells, L, M, H, X, LS, MS, LT/LU, MT/MU or HT/HU cylindrical cells;
- 7.3.4 for R cylindrical cells.

The cell shall then be stored on open circuit, at a mean temperature of 20 °C ± 5 °C and a relative humidity of 65 % ± 20 % for 12 months.

During the storage period, the ambient temperature shall not, at any time, fluctuate beyond the limits of 20 °C ± 10 °C.

After completion of the storage period, the cell shall be discharged in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, to a final voltage of 1,0 V and then charged in accordance with:

- 7.2 for button cells, small prismatic cells, L, M, H, X, LS, MS, LT/LU, MT/MU or HT/HU cylindrical cells;
- 7.3.4 for R cylindrical cells.

The cell shall then be discharged at each rate of constant current appropriate to cell designation as specified in 7.3.2. Five cycles are permitted for this test. The test shall be terminated at the end of the first cycle which meets the requirement.

The minimum discharge duration for each rate of constant current shall be not less than 80 % of the values specified in Tables 5 or 6.

NOTE In the case of a quality acceptance procedure, provisional approval of cell performance may be agreed, pending satisfactory results on discharge after storage.

7.11 Charge acceptance at +55 °C for LT, MT or HT cylindrical cells

This test is not a requirement. It will be used as reference of performance and is applicable to LT, MT or HT cylindrical cells only.

The cell shall be discharged in an ambient temperature of 20 °C ± 5 °C at a constant current of 0,2 I_t A to a final voltage of 1,0 V and stored in an ambient temperature of +55 °C ± 2 °C for not less than 16 h and not more than 24 h.

The charge acceptance test shall then be carried out in an ambient temperature of +55 °C ± 2 °C. Charge and discharge shall be carried out at constant currents, using the conditions specified in Table 17. The discharge conditions A or B may be chosen to suit the users' requirements.

Table 17 – Charge and discharge at +55 °C

Cycle number	Charge	Discharge A or B [a]
1	0,05 I_t A for 48 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V
2 [b]	0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V
3 [b]	0,05 I_t A for 24 h	A: 0,2 I_t A to 1,0 V or B: 1,0 I_t A to 1,0 V
[a] Discharge A is used with LT, MT or HT cells. Discharge B is used with MT or HT cells.		
[b] The duration of discharge of cycles 2 and 3 shall be recorded and provided in any report of results.		

7.12 Internal resistance

7.12.1 General

The internal resistance of sealed nickel-metal hydride small prismatic or cylindrical rechargeable single cells shall be checked either by the alternating current (a.c.) or by the direct current (d.c.) method.

Should the need arise for the internal resistance to be measured by both a.c. and d.c. methods on the same cell, then the a.c. method shall be used first, followed by the d.c. method. In this case, it is not necessary to discharge and charge the cell between conducting a.c. and d.c. methods.

Prior to the measurements, the cell shall be discharged at 0,2 I_t A to a final voltage of 1,0 V. The cell shall be charged in accordance with 7.2. After charging, the cell shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

The measurement of internal resistance shall be carried out in an ambient temperature of 20 °C ± 5 °C.

7.12.2 Measurement of the internal a.c. resistance

The alternating r.m.s. voltage, U_a, shall be measured when applying to the cell an alternating r.m.s. current, I_a, at the frequency of 1,0 kHz ± 0,1 kHz for a period of 1 s to 5 s.

The internal a.c. resistance, R_{ac}, is given by

$$R_{ac} = \frac{U_a}{I_a} \quad \Omega$$

where

U_a is the alternating r.m.s. voltage;

I_a is the alternating r.m.s. current.

NOTE 1 The alternating current should be selected so that the peak voltage stays below 20 mV.

NOTE 2 This method will measure the impedance which, in the range of frequency specified, is approximately equal to the resistance.

NOTE 3 Connections to the battery terminals should be made in such a way that voltage measurement contacts are separate from contacts used to carry current.

7.12.3 Measurement of the internal d.c. resistance

The cell shall be discharged at a constant current of value I_1 as specified in Table 18. At the end of a discharge period of 10 s, the voltage U_1 during discharge shall be measured and recorded. The discharge current shall then be immediately increased to a constant value of I_2 as specified in Table 18 and the corresponding voltage U_2 during discharge shall be measured and recorded again at the end of a discharge period of 3 s.

All voltage measurements shall be made at the terminals of the cell independently of contacts used to carry current.

The internal d.c. resistance, R_{dc}, of the cell shall be calculated using the following formula:

$$R_{dc} = \frac{U_1 - U_2}{I_2 - I_1} \quad \Omega$$

where

I_1, I_2 are the constant discharge currents;

U_1, U_2 are the appropriate voltages measured during discharge.

Table 18 – Constant discharge currents used for measurement of d.c. resistance

Current	Cell designation		
	HRL[a]	HRM [a] HRH [a]	HRX
I_1	0,2 I_t A	0,5 I_t A	1,0 I_t A
I_2	2,0 I_t A	5,0 I_t A	10,0 I_t A
[a] And corresponding "T", "S" and "R" cells.			

8 Mechanical tests

Mechanical tests shall be performed according to IEC 61959.

9 Safety requirements

Safety requirements shall be fulfilled according to IEC 62133.

10 Type approval and batch acceptance

10.1 Type approval

10.1.1 Type approval for small prismatic cells and button cells

For type approval, the sequence of tests and sample sizes given in Table 19 shall be used. Six groups of cells, denominated A, B, C, D, E and F respectively, shall be tested. The total number of cells required for type approval is 27. This total includes an extra cell, permitting a repeat test to cover any incident which may occur outside the supplier's responsibility.

Tests shall be carried out in sequence within each group of cells. All cells are subjected to the test in group A, after which they are divided into five groups at random according to the sample sizes shown in Table 19.

The number of defective cells tolerated per group, and in total, is given in Table 19. A cell is considered to be defective if it does not meet the requirements of all or part of the tests of a group.

Table 19 – Sequence of tests for type approval for small prismatic and for button cells

Group	Sample size	Clause or subclause	Tests	Number of defective cells tolerated	
				Per group	In total
A	27	5.3 6 7.3.2 7.3.2	Marking Dimensions Discharge at 20 °C, at 0,2 I_t A Discharge at 20 °C, at 1,0 I_t A	0	3
B	5	7.3.3 7.3.3	Discharge at 0 °C, at 0,2 I_t A Discharge at 0 °C, at 1,0 I_t A	1	
C	5	7.7 7.8	Overcharge Safety device operation	0	
D	5	7.5	Endurance in cycles	1	
E	6	7.4	Charge (capacity) retention	1	
F	5	7.10 7.3.2	Storage Discharge at 20 °C, at 0,2 I_t A	1	

10.1.2 Type approval for cylindrical cells

For type approval, the sequence of tests and sample sizes given in Table 20 shall be used. Seven groups of cells, denominated A, B, C, D, E, F and G respectively, shall be tested. The total number of cells required for type approval is 32. This total includes an extra cell, permitting a repeat test to cover any incident which may occur outside the supplier's responsibility.

Tests shall be carried out in sequence within each group of cells. All cells are subjected to the test in group A, after which they are divided into six groups at random according to the sample sizes shown in Table 20.

The number of defective cells tolerated per group, and in total, is given in Table 20. A cell is considered to be defective if it does not meet the requirements of all or part of the tests of a group.

Table 20 – Sequence of tests for type approval for cylindrical cells

Group	Sample size	Clause or subclause	Tests	Number of defective cells tolerated	
				per group	in total
A	32	5.3 6.1 7.3.2 7.3.2	Marking Dimensions Discharge at 20 °C at 0,2 I_t A Discharge at 20 °C at 1,0 I_t A (M, H and X cells) [a] 5,0 I_t A (H and X cells) [a] 10,0 I_t A (X cells only)	0	3
B	5	7.3.3 7.3.3	Discharge at 0 °C at 0,2 I_t A Discharge at 0 °C at 1,0 I_t A (M, H and X cells) [a] 2,0 I_t A (H and X cells) [a] 3,0 I_t A (X cells only)	1	
C	5	7.7 7.8	Overcharge Safety device operation	0	
D	5	7.5.1	Endurance in cycles	1	
E	5	7.5.2 7.8	Permanent charge endurance Safety device operation	1 0	
F	6	7.4	Charge retention	1	
G	5	7.10 7.3.2 7.3.2	Storage Discharge at 20 °C at 0,2 I_t A Discharge at 20 °C at 1,0 I_t A (M, H and X cells) [a] 5,0 I_t A (H and X cells) [a] 10,0 I_t A (X cells only)	1	

[a] And corresponding "T", “U” and "R" cells.

10.2 Batch acceptance

These tests are applicable to deliveries of individual cells.

The sampling procedure shall be established in accordance with IEC 60410. Unless otherwise agreed between supplier and purchaser, inspections and tests shall be performed using inspection levels and AQLs (acceptable quality level) recommended in Table 21.

Table 21 – Recommended test sequence for batch acceptance

Group	Clause or subclause	Inspection/tests	Recommendation	
			Inspection level	AQL %
A		Visual inspection		
		– absence of mechanical damage	II	4
		– absence of corrosion on case and terminals	II	4
	As agreed	– number, position and secure fittings of connection tabs	S3	1
		– absence of liquid electrolyte on case and terminals	II	0,65
B		Physical inspection		
	6	– dimensions	S3	1
	As agreed	– weight	S3	1
	5.3	– marking	S3	1
C		Electrical inspection		
		– open-circuit voltage and polarity	II	0,65
	7.3.2	– discharge at 20 °C at 0,2 I_t A	S3	1
	7.3.2	– discharge at 20 °C at 1,0 I_t A	S3	1
NOTE Two or more failures on a single cell are not cumulative. Only the failure corresponding to the lowest AQL is taken into consideration.				

Bibliography

IEC 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60485, *Digital electronic d.c. voltmeters and d.c. electronic analogue-to-digital convertors*[1]

IEC 61434, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Guide to the designation of current in alkaline secondary cell and battery standards*

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[1] This publication was withdrawn.

NATIONAL ANNEX A
(*National Foreword*)

A-1 BIS CERTIFICATION MARKING

The product may also be marked with the Standard Mark.

A-1.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

(*Continued from second cover*)

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
IEC 60086 (All parts)	Primary batteries
IEC 60086-1 : 2006	Primary batteries — Part 1: General
IEC 60086-2 : 2006	Primary batteries — Part 2: Physical and electrical specifications
IEC 61959	Secondary cells and batteries containing alkaline or other non-acid electrolytes — Mechanical tests for sealed portable secondary cells and batteries

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Bureau of Indian Standards

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

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