PS: IEC: 61960-3

Adopted

PAKISTAN STANDARD

Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes - Secondary Lithium Cells And Batteries For Portable Applications - Part 3: Prismatic And Cylindrical Lithium Secondary Cells And Batteries Made From Them

PAKISTAN STANDARDS AND QUALITY CONTROL AUTHORITY,
STANDARDS DEVELOPMENT CENTRE,
PSQCA Complex Street 7 A Block –3
Scheme –36 Gulistan –e- johar Karachi

Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes - Secondary Lithium Cells And Batteries For Portable Applications - Part 3: Prismatic And Cylindrical Lithium Secondary Cells And Batteries Made From Them

0. FOREWORD

0.1 This Pakistan Standard was adopted by the authority of the Board of Directors for Pakistan Standard and Quality Control Authority after approval by the Technical Committee for "Dry Cell Batteries and Accumulators (TC-6)" had been approved and endorsed by the Electrotechnical National Standards Committee on 31 January 2018.

0.2 This International Standard IEC: 61960-3 has adopted by the technical committee since IEC Standard have been established in 2017, hence it is deemed necessary to adopt the International standard to keep abreast with the latest technology and as par with IEC standard.

0.3 This for Pakistan Standard is an adoption of IEC: 61960-3 "Secondary Cells And Batteries Containing Alkaline Or Other Non-Acid Electrolytes - Secondary Lithium Cells And Batteries For Portable Applications - Part 3: Prismatic And Cylindrical Lithium Secondary Cells And Batteries Made From Them," and its use hereby acknowledged with thanks.

0.4 This standard is subject to periodical review in order to keep pace with the development in industry. Any suggestions for improvement shall be recorded and placed before the revising committee in due course.

0.5 This standard is intended chiefly to cover the technical provisions relating to this standard and it does not include all the necessary provisions of a Contract.

CONTENTS

SECONDARY CELLS AND BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES – SECONDARY LITHIUM CELLS AND BATTERIES FOR PORTABLE APPLICATIONS –

Part 3: Prismatic and cylindrical lithium secondary cells, and batteries made from them

1 Scope

This part of IEC 61960 specifies performance tests, designations, markings, dimensions and other requirements for secondary lithium single cells and batteries for portable applications.

The objective of this document is to provide the purchasers and users of secondary lithium cells and batteries with a set of criteria with which they can judge the performance of secondary lithium cells and batteries offered by various manufacturers.

Portable applications comprise hand-held equipment, transportable equipment and movable equipment.

Examples of the main uses are shown below:

a) hand-held equipment: smartphone, tablet PCs, audio/video players, and similar equipment;

b) transportable equipment: notebook computers, CD players, and similar equipment;

c) movable equipment

- 18 kg or less in mass and not fixed in place, or
- provided with wheels, castors, or other means to facilitate movement by an ordinary person as required to perform its intended use,
- power tools, power assisted cycles, business-use video cameras, and similar equipment.

NOTE 1 All applications using batteries whose nominal voltages are equal to or over the hazardous voltage of 60 V DC are excluded.

NOTE 2 EESS (Electrical Energy Storage Systems) and UPS, which use batteries over 500 Wh of electric energy are excluded.

NOTE 3 Self-propelled vehicles are excluded.

This document defines a minimum required level of performance and a standardized methodology by which testing is performed and the results of this testing reported to the user. Hence, users will be able to establish the viability of commercially available cells and batteries via the declared specification and thus be able to select the cell or battery best suited for their intended application. The end user can handle only batteries which have completely fulfilled all the requirements of this document and others concerning safety such as IEC 62133-2.

This document covers secondary lithium cells and batteries with a range of chemistries. Each electrochemical couple has a characteristic voltage range over which it releases its electrical capacity, a characteristic nominal voltage and a characteristic final voltage during discharge. Users of secondary lithium cells and batteries are requested to consult the manufacturer for advice.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60050-482:2004, *International Electrotechnical Vocabulary (IEV) – Part 482: Primary and secondary cells and batteries*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 62133-2:2017, *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 – Part 2: Lithium systems*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
charge recovery
capacity recovery
capacity that a cell or battery can deliver with subsequent recharge after storage, at a specific temperature, for a specific time, as a percentage of the rated capacity

3.2
charge retention
capacity retention
capacity that a cell or battery can deliver after storage, at a specific temperature, for a specific time without subsequent recharge as a percentage of the rated capacity

3.3
final voltage
end-of-discharge voltage
specified closed circuit voltage at which a discharge of a cell or battery is terminated

3.4
nominal voltage
suitable approximate value of the voltage used to designate or identify a cell, a battery or an electrochemical system

Note 1 to entry: The nominal voltages of secondary lithium cells are shown in Table 1 and 2.

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

[SOURCE: IEC 60050-482:2004, 482-03-31, modified – Addition Notes 1 and 2 to entry.]

3.5
rated capacity
capacity value of a cell or battery determined under specified conditions and declared by the manufacturer

Note 1 to entry: The rated capacity is the quantity of electricity C_5 Ah (ampere-hours) declared by the manufacturer which a single cell can deliver during a 5-h period, when charged, stored and discharged under the conditions specified in 7.3.1

[SOURCE: IEC 60050-482:2004, 482-03-15, modified – Addition of Note 1 to entry.]

3.6
secondary lithium battery
unit which incorporates one or more secondary lithium cells and which is ready for use

Note 1 to entry: It may incorporate adequate housing and a terminal arrangement and may have electronic control devices.

3.7
secondary lithium cell
secondary cell where electrical energy is derived from the insertion/extraction reactions of lithium ions or oxidation/reduction reaction of lithium between the negative electrode and the positive electrode

Note 1 to entry: The cell typically has an electrolyte that consists of a lithium salt and organic solvent compound in liquid, gel or solid form and has a metal or a laminate film casing. It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.8
lithium ion polymer cell
cell using gel polymer electrolyte or solid polymer electrolyte, not liquid electrolyte

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.

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 any report of results.

5 Cell designation and marking

5.1 Cell and battery designation

Batteries shall be designated with following form:

$$N_1\ A_1\ A_2\ A_3\ N_2\ /\ N_3\ /\ N_4 - N_5$$

Cells shall be designated with following form:

$$A_1\ A_2\ A_3\ N_2\ /\ N_3\ /\ N_4$$

where

N_1 is the number of series connected cells in the battery;

A_1 designates the negative electrode basis in which

- I is carbon;
- L is lithium metal or lithium alloy;
- T is titanium;
- X is others;

A_2 designates the positive electrode basis in which

- C is cobalt;
- F is iron;
- Fp is iron phosphate;
- N is nickel;
- M is manganese;
- Mp is manganese phosphate;
- T is titanium;
- V is vanadium;
- X is others;

A_3 designates the shape of the cell in which

- R is cylindrical;
- P is prismatic;

N_2 is the maximum diameter (if R) or the maximum thickness (if P) in millimetres rounded up to the next whole number;

N_3 is the maximum width (if P) in millimetres rounded up to the next whole number (N_3 not shown if R);

N_4 is the maximum overall height in millimetres rounded up to the next whole number;

NOTE 1 If any dimension is less than 1 mm, the units used are tenths of millimetres and the single number is written tN.

N_5 is the number of parallel connected cells if two or more (not shown if value is 1).

EXAMPLE 1 ICR19/66 designates a cylindrical Li-ion secondary cell, with a cobalt-based positive electrode, a maximum diameter which is greater than 18 mm and less than or equal to 19 mm, a maximum overall height which is greater than 65 mm and less than or equal to 66 mm.

EXAMPLE 2 ICP9/35/150 designates a prismatic Li-ion secondary lithium cell, with a cobalt-based positive electrode, a maximum thickness which is greater than 8 mm and less than or equal to 9 mm, a maximum width which is greater than 34 mm and less than or equal to 35 mm, and a maximum overall height which is greater than 149 mm and less than or equal to 150 mm.

EXAMPLE 3 ICPt9/35/48 designates a prismatic Li-ion secondary lithium cell, with a cobalt-based positive electrode, a maximum thickness which is greater than 0,8 mm and less than or equal to 0,9 mm, a maximum width which is greater than 34 mm and less than or equal to 35 mm, and a maximum overall height which is greater than 47 mm and less than or equal to 48 mm.

EXAMPLE 4 1ICR20/70 designates a cylindrical Li-ion secondary battery with one single cell, a cobalt-based positive electrode, a maximum diameter which is greater than 19 mm and less than or equal to 20 mm, and a maximum overall height which is greater than 69 mm and less than or equal to 70 mm.

EXAMPLE 5 2ICP20/34/70 designates a prismatic Li-ion secondary battery with two series connected cells, a cobalt-based positive electrode, a maximum thickness which is greater than 19 mm and less than or equal to 20 mm, a maximum width which is greater than 33 mm and less than or equal to 34 mm, and a maximum overall height which is greater than 69 mm and less than or equal to 70 mm.

EXAMPLE 6 1ICP20/68/70-2 designates a prismatic Li-ion secondary battery with two parallel connected cells, a cobalt-based positive electrode, a maximum thickness which is greater than 19 mm and less than or equal to 20 mm, a maximum width which is greater than 67 mm and less than or equal to 68 mm, and a maximum overall height which is greater than 69 mm and less than or equal to 70 mm.

EXAMPLE 7 When the batteries which have different designation such as ICR19/66 and ICP9/35/150 are parallel connected into single case, the marking to the case is taken as (ICR19/66)(ICP9/35/150).

NOTE 2 Notwithstanding the above specification, other designations can be used according to agreement between manufacturer and user.

5.2 Marking

Each cell or battery shall carry clear and durable markings giving the following information:

Manufacturer shall provide the following information in document form such as specification sheet or instruction manual or similar documents. When the battery is handled by end-users, the following information shall be marked on it.

- secondary (rechargeable) Li or Li-ion;
- battery or cell designation as specified in 5.1;
- polarity;
- date of manufacture (which may be in code);
- name or identification of manufacturer or supplier;
- rated capacity;
- nominal voltage.

When a cell or battery is considered swallowable the following additional information shall be marked on it or on the immediate package:

- caution for batteries which are considered swallowable (see IEC 60086-4).

When the battery surface is too small to accommodate all markings, information shall be given in specification sheet or in instruction manual or on the immediate package instead of on the battery.

Polarity need not be marked when the battery has been exclusively designed not to be connected wrongly.

Instead of designation as specified in 5.1, product code or name of battery can be used when the battery is designed for use in particular end product.

By agreement between the cell manufacturer and battery and/or end product manufacturer, cells used in the assembly of a battery need not be marked. The battery designed not to be replaced by the end user also need not be marked.

5.3 Providing the design and produce requirement of batteries

In order to ensure the safe use of lithium-ion secondary batteries, cell manufacturers shall provide equipment manufacturers who design and produce lithium-ion secondary batteries with the requirements specified in IEC 62133-2:2017, Annex A.

6 Examples of cells

Table 1 shows the specifications of some secondary lithium cell(s), and Table 2 shows the chemistries of the secondary lithium cell(s) that are suitable for standardization and used in assembling batteries.

Table 1 – Specification examples of secondary lithium cells for portable applications

	Cylindrical	Prismatic (metal case)	Prismatic (laminate film case)
Secondary lithium cell	ICR19/66	ICP5/34/50	ICP7/34/50
Height (mm)	64,0/65,2	49,0/49,6	49,2/50,0
Diameter (mm)	17,8/18,5	NA	NA
Width (mm)	NA	33,6/34,0	33,2/34,0
Thickness (mm)	NA	4,1/4,6	6,2/7,0
Nominal voltage (V)	3,7	3,7	3,7
Final voltage (V)	2,50	2,50	2,50
Final voltage (V) for endurance (cycle life)	2,75	2,75	2,75

Table 2 – Examples of secondary lithium cells for portable applications

Cell type	Positive electrode	Electrolyte	Negative electrode	Cell case	Nominal Voltage (V)
Lithium ion	Lithium transition metal (Nickel, Cobalt, Manganese) oxide	Non-aqueous solution with lithium salt	Carbon	Metal	3,6~3,9
				Laminate film	
			Tin based Compound	Metal	3,3~3,6
			Titanium oxide	Metal	2,2~2,5
				Laminate film	
	Lithium iron phosphate		Carbon	Metal	3,2
				Laminate film	
Lithium ion polymer	Lithium transition metal (Nickel, Cobalt, Manganese) oxide	Gel polymer with lithium salt	Carbon	Laminate film	3,6~3,8
NOTE A lithium ion cell is a secondary cell. The electrode materials are selected so that lithium metal is not involved in the charge and the discharge directly. Typical examples of lithium ion cells are listed in this table.					

7 Electrical tests

7.1 General

Only cell or battery samples which are less than two months (60 days) old, from the date of manufacture, shall be used for the tests specified in this document.

NOTE Generally capacity of lithium ion cells or batteries gradually decreases (see Table B.1).

Charge and discharge currents for the tests shall be based on the value of the rated capacity (C_5 Ah). These currents are expressed as a multiple of I_t A, where: I_t A = C_5 Ah/1 h.

The minimum values required for each electrical test are stated in Table 5. Sample sizes and sequence of tests are described in Figure 1.

7.2 Charging procedure for test purposes

Prior to charging, the cell or battery shall be discharged at 20 °C ± 5 °C at a constant current of 0,2 I_t A, down to a specified final voltage.

Unless otherwise stated in this document, cells or batteries shall be charged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

7.3 Discharge performance

7.3.1 Discharge performance at 20 °C (rated capacity)

This test verifies the rated capacity of a cell or battery.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified final voltage.

Step 4 – The capacity (Ah) delivered during step 3 shall be not less than 100 % of the rated capacity declared by the manufacturer. Steps 1 to 4 may be repeated up to four additional times, as necessary to satisfy this requirement.

7.3.2 Discharge performance at –20 °C

This test determines the capacity of the cell or battery at low temperature.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be stored, in an ambient temperature of −20 °C ± 2 °C, for not less than 16 h and not more than 24 h.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of −20 °C ± 2 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified final voltage.

Step 4 – The capacity (Ah), delivered during step 3, shall be not less than that specified for this characteristic in Table 5.

7.3.3 High rate discharge performance at 20 °C

This test determines the capacity of a cell or battery when discharged at a high rate. This test is not required if the cell or battery is not designed to be used at this rate.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 1,0 I_t A, until its voltage is equal to the specified final voltage.

Step 4 – The capacity (Ah) delivered during step 3 shall be not less than that specified for this characteristic in Table 5.

7.4 Charge (capacity) retention and recovery

This test determines firstly the capacity which a cell or battery retains after storage for an extended period of time, and secondly the capacity that can be recovered by a subsequent recharge.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be stored in an ambient temperature of 20 °C ± 5 °C, for 28 days.

Step 3 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified final voltage.

Step 4 – The 28-day retained capacity (Ah) delivered, during step 3, shall be not less than that specified for this characteristic in Table 5.

Step 5 – The cell or battery shall then be charged in accordance with 7.2, within 24 h following the discharge of step 3.

Step 6 – The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 7 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified final voltage.

Step 8 – The recovery capacity (Ah) delivered, during step 7, shall be not less than that specified for this characteristic in Table 5.

7.5 Charge (capacity) recovery after long term storage

This test determines the capacity of a cell or battery after extended storage at 50 % state of charge, followed by a subsequent charge.

Step 1 – The cell or battery shall be charged in accordance with 7.2.

Step 2 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, for 2,5 h.

Step 3 – The cell or battery shall be stored in an ambient temperature of 40 °C ± 2 °C, for 90 days.

Step 4 – The cell or battery shall be charged, in an ambient temperature of 20 °C ± 5 °C, using the method declared by the manufacturer.

Step 5 – The cell or battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 6 – The cell or battery shall be discharged, in an ambient temperature of 20 °C ± 5 °C, at a constant current of 0,2 I_t A, until its voltage is equal to the specified final voltage.

Step 7 – The capacity (Ah) delivered during step 6 shall be not less than that specified for this characteristic in Table 5. Steps 4, 5 and 6 may be repeated up to four additional times, as necessary to satisfy this requirement.

7.6 Endurance in cycles

7.6.1 General

This test determines the number of charge/discharge cycles which a cell or battery can endure before its useful capacity has been significantly depleted or the remaining capacity after a specified number of cycles.

Prior to charging, the cell or battery shall be discharged at 20 °C ± 5 °C at a constant current of 0,2 I_t A, down to a specified final voltage.

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 in accordance with the conditions specified in either Table 3 or Table 4.

7.6.2 Endurance in cycles at a rate of 0,2 I_t A

Table 3 – Endurance in cycles at a rate of 0,2 I_t A

Cycle number	Charge	Stand in charged condition h	Discharge
Until capacity delivered is less than 60 % of the rated capacity	Method declared by the manufacturer	0 to 1	0,2 I_t A to final voltage

The total number of cycles obtained when the test is completed shall be not less than that specified for this characteristic in Table 5.

7.6.3 Endurance in cycles at a rate of 0,5 I_t A (accelerated test procedure)

In order to accelerate the test, following alternative procedures may be carried out as an alternative to 7.6.2.

Table 4 – Endurance in cycles at a rate of 0,5 I_t A

Cycle number [a]	Charge	Stand in charged condition h	Discharge
A: 1 to 400 or B: 1 to 300	Method declared by the manufacturer	0 to 1	0,5 I_t A to final voltage
[a] A: for cells, B: for batteries.			

The remaining capacity measured according to step 1 to step 3 of 7.3.1 when the test is completed shall be not less than that specified for this characteristic in Table 5.

7.7 Battery internal resistance

7.7.1 General

This test determines the internal resistance of a secondary lithium battery by either the alternating current (AC) or by the direct current (DC) method.

Should the need arise for the internal resistance to be measured by both AC and DC methods on the same battery, then the AC method shall be used first followed by the DC method. It is

not necessary to discharge and charge the battery between conducting AC and DC measurements.

Step 1 – The battery shall be charged in accordance with 7.2.

Step 2 – The battery shall be stored, in an ambient temperature of 20 °C ± 5 °C, for not less than 1 h and not more than 4 h.

Step 3 – The measurement of internal resistance shall be performed in accordance with 7.7.2 or 7.7.3 in an ambient temperature of 20 °C ± 5 °C.

7.7.2 Measurement of the internal AC resistance

7.7.2.1 Measurement

The alternating RMS voltage, U_a, shall be measured while applying an alternating RMS current, I_a, at the frequency of 1,0 kHz ± 0,1 kHz, to the battery, for a period of 1 s to 5 s.

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

The internal AC resistance, R_{ac}, is given by:

$$R_{ac} = \frac{U_a}{I_a} \ (\Omega)$$

where

U_a is the alternating RMS voltage;

I_a is the alternating RMS current.

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

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

7.7.2.2 Acceptance criterion

The internal AC resistance of the battery shall be not greater than the value of R_{ac}, declared by the manufacturer.

7.7.3 Measurement of the internal DC resistance

7.7.3.1 Measurement

The battery shall be discharged at a constant current of I_1 = 0,2 I_t A. At the end of a discharge period of 10 s ± 0,1 s, the discharge voltage U_1 under load shall be measured and recorded. The discharge current shall then be immediately increased to a value of I_2 = 1,0 I_t A and the corresponding discharge voltage U_2 measured under load and recorded again at the end of a discharge period of 1 s ± 0,1 s.

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

The internal DC resistance, R_{dc}, of the battery shall be calculated using the following formula:

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

where

I_1, I_2 are the constant discharge currents;

U_1, U_2 are the appropriate voltages measured during discharge.

7.7.3.2 Acceptance criterion

The internal DC resistance of the battery shall be not greater than the value of R_{dc}, declared by the manufacturer.

7.8 Electrostatic discharge (ESD)

7.8.1 General

This test is to evaluate the ability of a battery to withstand electrostatic discharge.

This test shall be conducted on a battery containing electronic protection devices, such as diodes, transistors or integrated circuits.

7.8.2 Test procedure

This test shall be carried out in accordance with IEC 61000-4-2, which concerns electronic discharge requirements (see Clauses 1 to 8).

The batteries shall be tested for contact discharge at 4 kV and air discharge at 8 kV.

7.8.3 Acceptance criterion

The battery shall operate with all protection circuits operational.

8 Test protocol and conditions for type approval

8.1 Test protocol

If there is no agreement between manufacturer and user, the test protocol and conditions for type approval shall conform to the following.

The sample size and protocol for conducting the electrical tests in Clause 7 are given in Figure 1.

8.2 Conditions for type approval

8.2.1 Dimensions

The dimensions of the cell or battery shall not exceed the manufacturers' specified values.

8.2.2 Electrical tests

8.2.2.1 The manufacturer shall declare the rated capacity (C_5 Ah) of the cell or battery based on its performance under the conditions specified in 7.3 to 7.8.

8.2.2.2 In order to meet the requirements of this document, all samples shall meet all the performances specified in 7.3 to 7.8.

8.2.3 Conditional type approval

The cell or battery can be considered conditionally type approved prior to the completion of the charge (capacity) recovery after storage test specified in 7.5 and the endurance in cycles test specified in 7.6.2 if:

- 20 % of the required cycles of the endurance test have been completed and the capacity delivered during any discharge remains above 85 % of the rated capacity, and
- the requirements of all the other tests specified in Clause 7 have been met.

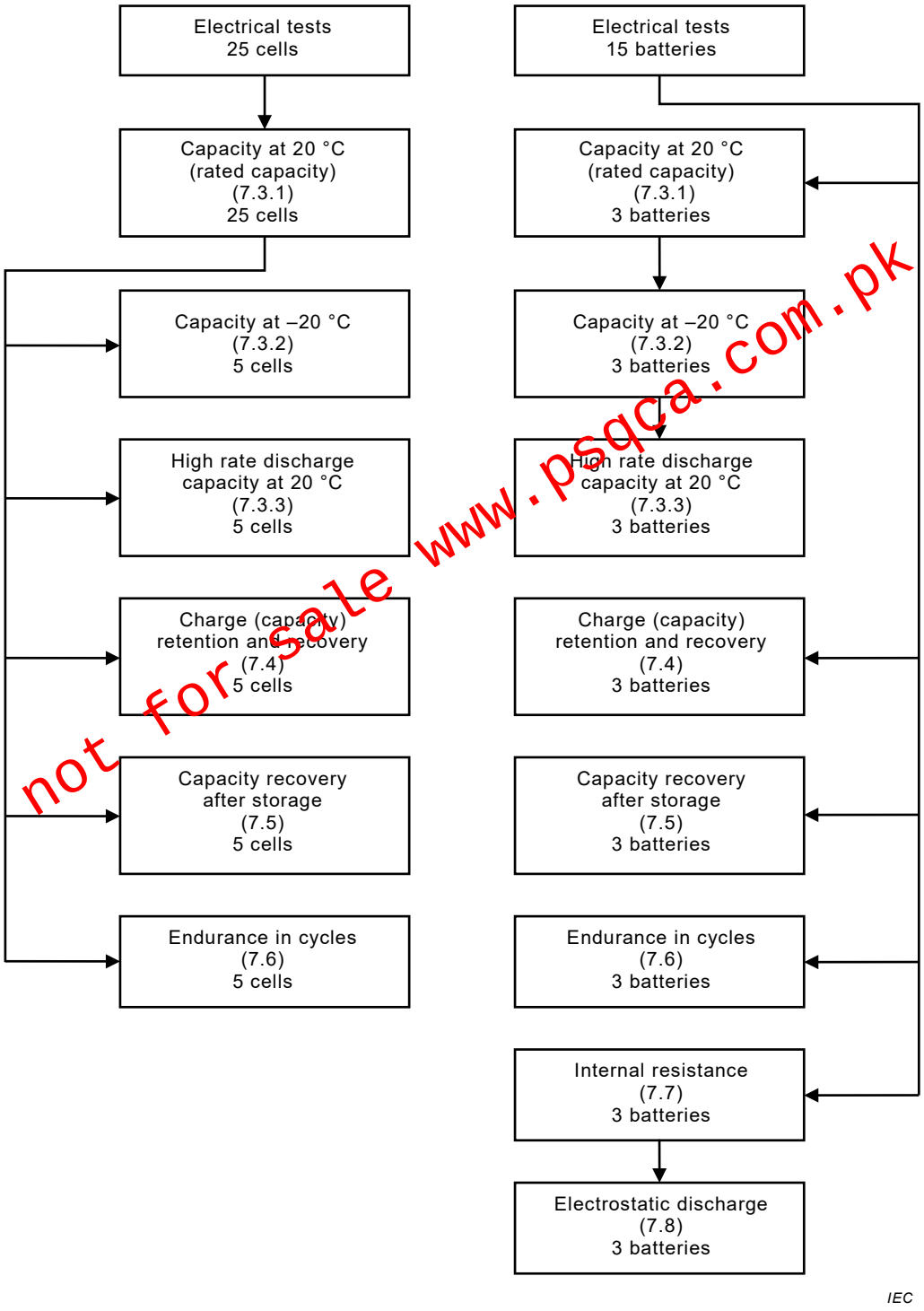

Figure 1 – Sample sizes and sequence of tests

Table 5 – Minimum requirements for each type of secondary lithium cells and batteries

Parameter	Reference subclause	Acceptance criteria – cells	Acceptance criteria – batteries
Capacity at 20 °C ± 5 °C (rated capacity)	7.3.1	100 % C_5 Ah	100 % C_5 Ah
Capacity at -20 °C ± 2 °C	7.3.2	30 % C_5 Ah	30 % C_5 Ah
High rate discharge capacity at 20 °C ± 5 °C	7.3.3	70 % C_5 Ah	60 % C_5 Ah
Charge (capacity) retention	7.4	70 % C_5 Ah	60 % C_5 Ah
Charge (capacity) recovery	7.4	85 % C_5 Ah	85 % C_5 Ah
Capacity recovery after storage	7.5	50 % C_5 Ah	50 % C_5 Ah
Endurance in cycles	7.6.2	400 cycles	300 cycles
Endurance in cycles (accelerated)	7.6.3	60 % C_5 Ah	60 % C_5 Ah
Electrostatic discharge	7.8	n.a.	Operational

Annex A
(informative)

Dimensions of the cell with a laminate film case

A.1 General

The dimensions of the cell with a laminate film case should be measured according to the method specified below.

A.2 Measuring method of cell thickness

To measure the thickness of a cell with a laminate film case, the cell surface area is pressed using a flat plate with sufficient dimension to cover all the area of the cell and with a pressure from 0,4 N/cm^2 to 0,6 N/cm^2 applied to the cell during measurement as shown in Figure A.1.

Calculation method of the cell surface area should be according to the formula as follows.

$$N_3 \times N_4 / 100 \text{ (cm}^2\text{)} \quad \text{see 5.1}$$

A.3 Measuring method of cell width

Two types of case construction exist in the cell with a laminate film case. One has the shape that its side sealed area is still strained, and the other has edges bent toward the side surface of the cell. The measuring method of the latter cell's width is described below.

To measure the width of a cell with a laminate film case, the cell side area is pressed using a flat plate with sufficient dimension to cover all the area of the cell and with a weight or a weight per cell height specified by the manufacture as shown in Figure A.2.

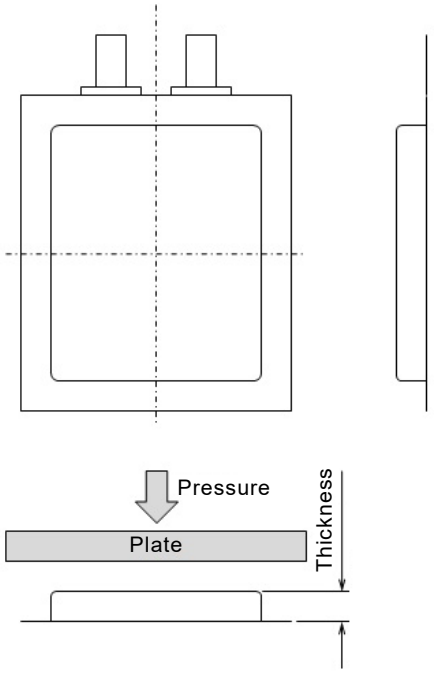

Figure A.1 – Thickness measuring method

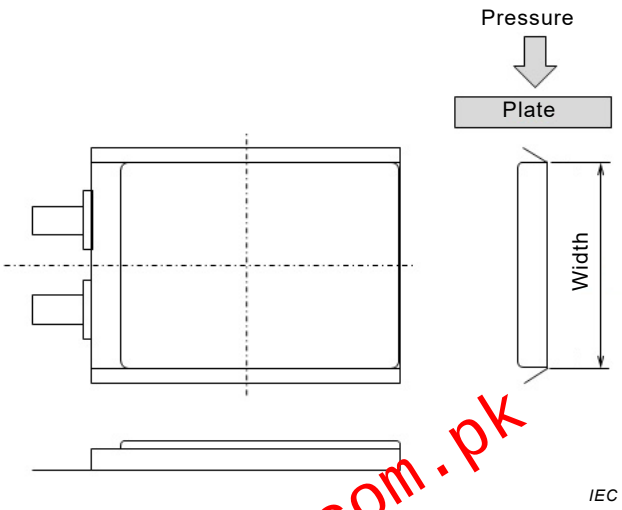

Figure A.2 – Width measuring method

Annex B
(informative)

Capacity after storage

Table B.1 – Capacity after storage

Storage duration (from the date of manufacture) (Ambient temperature: 20 °C ± 5 °C)	**Minimum capacity** (% of the rated capacity)
New cells (within 2 months from the date of manufacture)	100 %
exceeding 2 months and up to 6 months	92 %
exceeding 6 months and up to 12 months	88 %
exceeding 12 months and up to 18 months	85 %