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SERIES L: CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

## Green battery solutions for mobile phones and other hand-held information and communication technology devices

Recommendation ITU-T L.1010

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## Green battery solutions for mobile phones and other hand-held information and communication technology devices


### Summary

Recommendation ITU-T L.1010 defines a minimum set of parameters necessary to identify green battery solutions that should be considered by developers/manufacturers to reduce the future environmental impact of battery use. The provision of so-called green batteries is to extend the lifetime of handsets, reduce global resources consumption and preserve the environment.

The compliance in terms of supporting green information and communication technology (ICT) efforts will be considered including the use of scarce resources, recycling and reuse. The existing environmental schemes available in different regions and international standards will be considered.



### History

| Edition | Recommendation | Approval | Study Group | Unique ID* |
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### Keywords

Ecodesign label, energy density, green batteries, lifetime, recycling.


* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

## FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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## Introduction

This Recommendation defines the requirements for utilizing existing standards that help to reduce the amount of e-waste material introduced into the environment over the service lifetime (including calendar life, number of cycles, thermal environment, etc.) of a battery relative to the service life of the portable electronic devices in which they are designed for use.

In some countries, there is a demand to extend lifetime of handsets using replaceable green batteries to reduce global resources consumptions and preserve environment.

Many companies are globally specialized in collection and reuse of mobile phones and other ICT products. These companies typically source new batteries from the manufacturer or other suppliers in order to meet consumer demand for such products. This model of refurbishment and re-use should contribute to reduce global resources consumptions and preserve environment.

When considering e-waste resulting from batteries, the battery itself as well as the entire life cycle from manufacturing and materials to usage and disposal should be considered. One of the most sensitive parameters of this life cycle is the number of charge/discharge cycles, mainly how many times a battery can be charged and discharged for a given amount of capacity. The number of charge/discharge cycle is important because lower quality batteries tend to generate a significantly greater quantity of e-waste in the environment. This is because lower quality batteries tend to have lower numbers of charge/discharge cycles available, and therefore must be replaced more frequently.

This Recommendation includes environmental considerations in the upstream supply chain, reliability and ecological design ("ecodesign") guidelines to help ensure longer lasting batteries with a reduced environmental impact over the entire life cycle, without compromising product safety.

# Recommendation ITU-T L.1010

## Green battery solutions for mobile phones and other hand-held information and communication technology devices

### 1 Scope

This Recommendation describes the general requirements for green battery solutions for mobile phones, and other terminals able to connect to a mobile network and other hand-held information and communication technology (ICT) devices.

This Recommendation applies to all battery chemistries utilised within the product described.

This Recommendation aims at identifying green battery solutions. Some of the aspects considered include: environmental compliance, safety and reliability, lifetime, and ecodesign.

Physical characteristics definitions are outside the scope of this Recommendation.

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1410] Recommendation ITU-T L.1410 (2012), *Methodology for the assessment of the environmental impact of information and communication technology goods, networks and services*.

[IEC60950-1] IEC60950-1 Ed.2.2 (2013), *Information technology equipment – Safety – Part 1: General requirements*.

[IEC 61960] IEC 61960 Ed.2.0 (2011), *Secondary cells and batteries containing alkaline and other non-acid electrolytes – Secondary lithium cells and batteries for portable applications*.

### 3 Definitions

This Recommendation defines the following terms:

**3.1 battery**: This is a common term to designate a two or more terminal devices consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy.

**3.2 battery cell**: It consists of an anode, cathode, separator and electrolyte.

**3.3 battery pack**: It consists of one or more battery cells and interconnections which provide connectivity between cells. In secondary batteries, battery packs can include semiconductor components such as temperature sensors and Zener diodes.

**3.4 counterfeit battery**: A battery that is not easily distinguishable from a genuine battery. It is usually purchased in an after-market, and it is possible that it is not equipped with protective devices necessary for the respect of the safety standard applicable to the battery.

**3.5 green battery**: A battery that has improved environmental performance compared to the previous generation of battery.

**3.6 lithium-ion batteries**: A battery containing lithium-ion polymer or other lithium-ion chemistry.

**3.7 secondary battery**: A rechargeable battery.

## 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

DoD Depth of Discharge

ICT Information and Communication Technology

Pb Lead

PBB Poly Brominated Biphenyls

PBDE Poly Brominated DiphenylEthers

PTC Positive Temperature Coefficient resistor

REACH Registration, Authorization and Restriction of Chemical substances

RoHS Restrictions of Hazardous Substances

## 5 General requirements

Each generation of battery (e.g., in mobile phones and other small consumer products) has typically less environmental impact than the previous generation due to changes in the material compositions, different chemical composition, increased capacity, smaller design footprint, etc. It is not possible to specify that a single design of battery is 'green'. The term can only be used in 'relative' terms compared to the previous generation of battery design, and not in an absolute sense.

Parameters to be considered shall include:

– Increased capacity, hence longer time between charges (for a given use pattern).

– Reduced, or eliminated hazardous material content.

– Incorporation of ecodesign principles.

– The lifetime of battery as number of charge/discharge cycles.

Such environmental enhancements must not compromise environmental compliance, product safety or reliability.

Administrations need to control the end of life of batteries in order not to pollute the environment

## 6 Ecodesign guidelines

Ecodesign is a broad area. In general, ecodesign takes into account the design of products to minimize the environmental impact in the total life cycle, from raw material, manufacturing, distribution, use in the end product to disposal and recycling. International directives or standards exist that address some aspects that could be considered for ecodesign. For example, many countries already have legislation and/or policy in place to manage battery recycling at end of life. Such schemes include:

• European battery directive [b-EU 2006/66/EC]

• North America: Rechargeable battery recycling corporation (RBRC) recycle scheme

• Japan: Portable rechargeable battery recycling centre (JBRC) and mobile recycle network (MRN)

A detailed analysis of the environmental impact of a battery should be conducted in line with [ITU-T L.1410].

### 6.1 Eco-label

There are existing requirements for battery marking in order to reduce their environmental impact, including material content and 'recycling symbols'. Thus, there is no need for additional marking on the batteries.

Eco-labels, as well as other regulatory certification marks, can often be easily copied by producers of counterfeit and substandard batteries; therefore, such labels do not prevent such batteries from being produced or placed on the market.

### 6.2 Environmental compliance

A 'green battery' has undergone significant changes to minimize environmentally hazardous materials to below defined thresholds. Hazardous materials include but are not limited to lead (Pb), which has been a key material in microelectronic components and telecommunication equipment over many years.

A 'green battery' has a list of banned and/or restricted materials with material content and disclosure thresholds based upon the weight percentage of similar homogeneous material in the component.

The present requirements of restricted substances established by national regulations must be met by the green battery pack electronics (excluding battery chemistry).

Green battery solutions shall:

- not contain toxic materials,
- not pollute the environment during the production process,
- not exceed 0.1% as maximum concentration values tolerated by weight in homogeneous materials of the following materials: lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominateddiphenyl ethers (PBDE), and the maximum concentration values of cadmium tolerated by weight in homogeneous materials shall not exceed 0.01%.

A list of some existing regulations is shown in Appendix I.

## 7 Safety

Considering the large amount of lithium-ion batteries already in the field, while there have been a small number of incidents reported, their seriousness highlights some safety concerns. As the energy density continues to increase, more attention should be placed on product safety. In addition to ensuring safe operation, batteries need to be reliable, which means they have to be able to perform routinely under stated design conditions for an extended period of time.

Green battery solutions shall have protective measures; the design of the battery shall prevent electric shock hazards, heat related hazards, mechanical hazards and the impact on the environment.

Using green batteries in mobile phones and other hand-held ICT equipment should meet the requirements of the international safety standard [IEC 60950-1]; when necessary, the battery shall be randomly tested with the ICT terminal to check for safety conformance.

The safety system of the green battery shall not only consider the safety of the battery in isolation (single element) but also the safety of the complete battery system and related cell phones.

The green battery safety shall meet the requirements of international standards e.g., [b-IEC 62133] as well as be in conformance with country or regional battery safety standards.

Transportation of lithium-ion batteries, such as transportation by air, shall follow the relevant available rules stipulated in the United Nations manual of test and criteria, chapter 38.3 [b-UN Manual of test].

## 8 Lifetime requirement (reliability)

The lifetime of the battery is calculated in 'cycles'. The period of the cycle includes a charging and discharging process.

As mentioned previously, long-lasting secondary batteries are able to withstand a large number of charge/discharge cycles without losing significant storage capacity after each cycle. A green battery shall withstand a minimum of 500 charge/discharge cycles (100% depth of discharge (DoD)) and retain at least 80% of its initial capacity specified by the manufacturer as described e.g., in [IEC 61960] with less than 10% cell/pack swelling.

Appendix II describes proposed charge/discharge cycle conditions for lithium ion battery chemistry to estimate the battery lifetime.

# Appendix I

## National/regional regulations on substance use and battery rules

(This appendix does not form an integral part of this Recommendation.)

The following are some rules on restricted substance use:

- The European directive for restrictions of hazardous substances (RoHS), [b-2011/65/EU], on the restriction of the use of certain hazardous substances in electrical and electronic equipment (also known as the 'EU RoHS directive recast'),
- China Management Methods – Administrative measures on the control of pollution caused by electronic information products [b-China],
- Korea RoHS – The act for recycling of electrical and electronic equipment and eutomobiles, Bill number 176319 [b-Korea].

Other applicable battery rules:

- The European Union's battery directive. [b-2006/66/EC]

  The registration, authorization and restriction of chemical substances methodology (REACH) [b-EU EC 1907/2006]. The REACH methodology is intended to be used to determine if substances are hazardous, to evaluate the hazards and to determine the suitability of alternative (environmentally safer/greener) substances. In principle, once the REACH methodology has been applied, material restrictions should only be invoked through the implementation of the EU RoHS directive.

# Appendix II

## Proposed charge/discharge cycle conditions for lithium-ion battery chemistry

(This appendix does not form an integral part of this Recommendation.)

This appendix reports a test methodology to verify the battery lifetime.

The test methodology is composed by the following steps, all conducted at room temperature.

**i) Measure fresh capacity using the method described in [IEC 61960]**

– A) Charge as defined by manufacturer.

– B) Perform discharge as defined by the manufacturer.

– C) Record fresh capacity following in [IEC 61960] test.

**ii) Perform 500 charge and discharge cycles**

– A) Charge as per manufacturer specifications.

– B) Perform Discharge as per manufacturer specifications.

– C) Repeat to 500 cycles. Measure IEC capacity at 300 and 500 cycles.

**iii) Compliance**

– IEC capacity after 500 cycles charge and discharge shall exceed 80% of fresh IEC capacity.

# Appendix III

## Counterfeit batteries

(This appendix does not form an integral part of this Recommendation.)

Safety can also be compromised if the end user uses a counterfeit or substandard battery. Such batteries are typically of a low quality.

Some of the attributes that a low quality battery could show:

- Poor cycle life, rapid capacity degradation and/or high swelling;
- Poor cell manufacturing quality processes which could result in inconsistent capacity and/or particle contamination;
- Poor cell safety, risk of fire or explosion due to a poor assembly process or cell design where safety design is compromised;
- Poor battery pack safety due to faulty or non-existent temperature sensors and/or over current/short circuit protection.

As a result, counterfeit and substandard batteries can be hazardous, and fail prematurely. Premature failure typically generates an increased environmental impact.

For this reason, these batteries are not necessarily a better value due to their reduced lifespan, and may pose increased safety and environmental impacts.

Therefore, it is important that administrations/regulators impose sufficient controls on counterfeit and substandard batteries, in order to ensure that only batteries meeting the required product safety and quality standards are placed on the market.

# Appendix IV

## Recycling criteria suggestions

(This appendix does not form an integral part of this Recommendation.)

### IV.1 General requirements

The recycling activity should respect the rules/regulations that are in force in the country.

Some national/regional regulations require end users to affix a special mark/label on the battery to identify the item for suitability of recycling process, and/or to encourage end users not to recycle waste batteries and not to dispose of them in household waste.

The battery should be marked to identify the principle battery chemistry (e.g., 'lithium-ion battery').

#### IV.1.1 Collection

The collection of waste lithium-ion batteries should address the issue of safety. The container should be equipped with the necessary safety measures.

#### IV.1.2 Transportation

During packing and transportation of wasted lithium-ion batteries, the structural integrity and safety should be guaranteed. Any broken or smashed wasted batteries are not acceptable in order to prevent pollution of harmful elements in the waste battery.

The container used to store and ship the wasted batteries should be designed according to the features of the batteries. They should not be easy to damage or deform. The material used should prevent leakage and diffusion of harmful elements; a logo used to identify the container is needed; the container should be equipped with safety measures and the transportation operator should establish an emergency plan in accordance with national legislation (e.g., health and safety law).

#### IV.1.3 Storage

Waste batteries should not be stacked in open areas; the waste batteries should be kept away from hot environments.

The container used as a storage facility should be corrosion resistant, overpressure resistant, hermetic, fireproof, explosion proof, electrically insulated, heat-insulated and should be intact. In the process of storage, the wasted lithium-ion battery should not be dismantled, rolled or undergo any other crushing operation, and should ensure the enclosure integrity of the wasted lithium-ion battery to guarantee safety.

#### IV.1.4 Disposal

Disassembly of the battery: The battery can be dismantled as encapsulation materials, protective circuit boards, wires, tabs, positive temperature coefficient (PTC) resistors, lithium-ion battery cells, etc., and be disposed according to respective characteristics.

# Appendix V

## National standards on green batteries

(This appendix does not form an integral part of this Recommendation.)

This Recommendation should be considered by administrations during the development of national standards on batteries.

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[b-EU EC 1907/2006] Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No. 793/93 and Commission Regulation (EC) No. 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

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[b-IEC 62281] IEC 62281 Ed. 2.0 (2012), *Safety of Primary and Secondary Lithium Cells and Batteries during Transport*.

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