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QUALITY SPECIFICATION - OEM

TITLE: CERTIFICATE OF QUALITY FOR LITHIUM MANGANESE DIOXIDE CELLS AND BATTERIES

PREPARED BY : B. RAU

STATUS: PRODUCTION

REVISIONS

REV.	DESCRIPTION	MEMO

DURACELL GLOBAL BUSINESS MANAGEMENT GROUP

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SPECIFICATION NUMBER 325521-OEM
REVISION: OEM
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1.0 **SCOPE**

This specification defines the criteria for the certificate of quality for the DL123A, DL2/3A, DL223A, DL245A, DLGR2, and CRV3 Lithium Manganese Dioxide primary cells and batteries detailing physical, electrical, performance, reliability, and safety characteristics. The specification may be used by Duracell external customers at their incoming inspection as a guideline for verification of these products' fitness for use.

2.0 **APPLICABLE DOCUMENTS**

2.1

2.2 315755-Date Coding of Battery and Packaged Product

2.3 IEC 60086-1 (2000) Primary Batteries/General and IEC 60086-2 (2000), Primary Batteries/Specification Sheets, International Standards of the International Electrotechnical Commission.

2.4 IEC 60086-4 - Primary batteries: Safety of lithium batteries, International Standards of the International Electrotechnical Commission.

2.5 MIL-STD-105D (ISO-2859) - ANSI/ASQC Z1.4 - Sampling Plans and Procedures for Inspection by Attributes. All three references are equivalent.

2.6 ANSI C18.3M – Part I and Part II - American National Standard for Portable Primary Lithium Cells and Batteries – General Specifications and Safety Standards

2.7 UL1642 - Underwriter Laboratories Inc, Standard for Safety - Lithium Batteries

2.8 UN - Manual of Tests and Criteria, Part III, Sub-section 38.3- United Nations, Committee of Experts on the Transportation of Dangerous Goods.

3.0 **REQUIREMENTS**

3.1 General Requirements - The particular requirements for each battery are defined in a separate specification sheet, which shall be read in conjunction with this procedure.

3.2 Environmental Storage Requirements and Conditions—

3.2.1 Cells and batteries should be stored under monitored conditions with no risk of water damage or any other contamination. The required storage environment is between 10°C (50°F) and 25°C (77°F), with relative humidity not exceeding 65%.

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- 3.3 Dimensions - Dimensions and tolerances shall be in accordance with those specified for the cell on the specification sheet.
- 3.4 Performance & Electrical Requirements
- 3.4.1 Shelf Life - Typical rated capacity loss of less than 3% per year at room temperature storage (21 °C +/- 2°C)
- 3.4.2 Electrical and Performance Tests / Criteria - Per Specification sheet
- 3.4.2.1 Application Testing - Values given in the specification sheets are the minimum average (mean) expected from a test per recommended sample size under the given discharge cycle. Equipment used in this testing at ambient conditions is per section 4.0 of this document. Failure to achieve these values is a MAJOR defect per criteria given in section 6.0 of this document.
- 3.4.3 Visual - Inspection sample size is found from MIL-STD-105D, (ISO-2859), ANSI/ASQC Z1.4-1993. Acceptability is judged by the maximum parts per million (PPM) allowable per nonconformance type (section 6.0).
- 3.4.4 Leakage – Upon receipt or when the batteries are subjected to the conditions specified in IEC 60086-1 Part 1- 2000-11 sub-clause 4.2.3 and/or ANSI C18.3M - Part 1 sub-clause 1.4.4.2. , no electrolyte, sealing compound, or any other internal component, shall appear on any of the external surfaces of the cell or battery during discharge. Leakage ppm is defined in section 6.1.2.
- 3.4.5 Appearance – The appearance of the battery shall be free from any debris, deformation, or damage that impairs the intended use. The associated MAJOR or MINOR nonconformance ppm criteria will be applied accordingly, see section 6.0.
- 3.4.6 Workmanship - The cells shall be manufactured so that they are uniform in quality. All graphics and copy shall be legible and uniformly spaced and aligned. The cell is to be free of any physical damage, distortion, dents, rust, leakage, foreign material or other defects which could adversely affect actual use or performance.
- 3.5 Safety –
- 3.5.1 Duracell lithium products referenced within this specification are designed and manufactured to be in compliance with the ANSI C18.3, Part 2 and IEC 60086-4 Safety Standards.
- 3.5.2 Duracell Lithium cells are also recognized under the component program of Underwriters Laboratories.
- 3.5.3 Install and use cells in accordance with equipment and manufacturers instructions. Dispose of cells in accordance with applicable regulations.

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3.6 Storage - Cells and batteries should be stored under monitored conditions with no risk of water damage or any other contamination. The required storage environment is between 10°C (50°F) and 25°C (77°F), with relative humidity not exceeding 65%.

4.0 **QUALITY ASSURANCE PROVISIONS**

4.1 Quality Assurance - For primary quality assurance test, refer to specification sheets for each battery.

4.2 Environmental Conditions - All electrical and performance tests shall be conducted (in the sequence shown here under) at a temperature of 21 °± 2°C at 50 +/- to 15% relative humidity after stabilization under these conditions for a minimum period of 24 hours.

4.2.1 Measurement Equipment - A Vernier caliper having a minimum graduation of 0.05mm or a caliper of equivalent precision shall be used to measure the dimensions.

4.2.2 Voltage Test Equipment - A precision multimeter with an accuracy of at least ± 0.005 volts and an internal resistance of 10 megaOhms or more shall be used for all electrical measurements.

4.2.3 Performance Testing - Discharge loads and end point voltages shall be in accordance with the individual product specification sheets, which are added to this document.

4.2.3.1 Sample sizes for discharge shall be 8.

4.3 Cold Temperature Testing (-20°C) - Shall be conducted in a cold air chamber in which the batteries are exposed to the chamber air flow in a uniform manner. Batteries should be soaked for a minimum of four hours at the specified temperature prior to testing.

4.4 Sampling Plan - General Inspection Level II, NORMAL, will be used with MIL-STD-105D (ISO-2859) sampling plan, unless otherwise specified. Refer to section 6.0 for acceptance criteria by nonconformance classification.

5.0 **PACKAGING** - Refer to packaging charts for each specified pack type.

6.0 **NOTES** - Duracell employs a rigorous quality system utilizing on-line quality control and final inspections. Methodologies include specifications, extensive operator training and SPC methods plus 100% final inspection for electrical, leakage and visual appearance. All manufacturing plants meet the requirements of the ISO 9000 standard for quality systems.

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6.1 Definitions

- 6.1.1 Critical - Nonconformances that are a safety hazard and render the product unfit for use. These nonconformances have a definite negative impact on the consumer decision to purchase or repurchase. A PPM level of zero (0) will be used for audits and inspections for this defect class.
- 6.1.2 Major - Nonconformances that have the potential to affect product performance, render the product unfit for use, or affect product traceability. These nonconformances have the potential to adversely affect the consumer decision to purchase or repurchase. A PPM level of 100 will be used for audits and inspections for this class. (i.e. OCV, SCC, performance, contamination, corrosion, etc.) with the exception of leakage, which will have a maximum allowable PPM level of 50.
- 6.1.3 Minor - Nonconformances that will not affect product performance but a departure from good workmanship and detract from the appearance of the product. These nonconformances will not affect the consumer purchase or repurchase decision. A PPM level of 200 will be used for audits and inspections for this defect class (i.e. Dents, Scratches, etc.)
- 6.2 Shipment Lot - Shall be defined as batteries that have been assembled within the same calendar month. A lot may contain multiple date codes. For example 3F20/3F21/3F22.
- 6.3 Initial - Shall be defined as product tested within 6 months of the date of manufacture.
- 6.4 Manufacturing Date Codes - Refer to specification 315755. The daily manufacturing code consists of five digits specifying year, month, day, and plant of manufacture. The code will be one digit prefix for year, one alpha for month, two digits for day, and one alpha suffix for plant of manufacture.

Example of date code: 3F04X for June 4, 2003

6.5 Appendix

- 6.5.1 Appendix I - Product Specification Sheets

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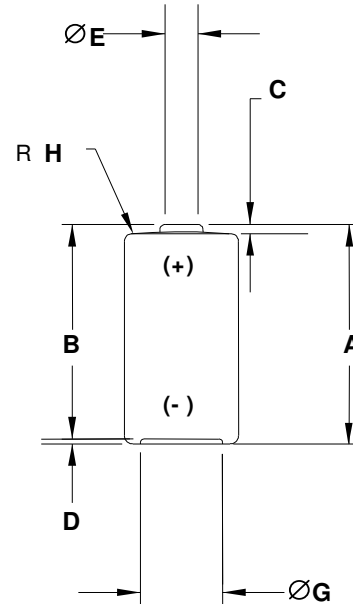
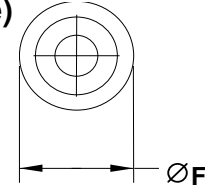
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Certificate Of Quality Specification Duracell DL123A, (DL2/3A performance)

Dimensions	mm	in
A(max/min)	34.49/33.93	1.358/1.336
B(max/min)	34.40/33.00	1.338/1.301
C(min)	1.295	0.051
D(max/min)	0.889/0.508	0.035/0.020
E(max)	6.400	.252
F(max/min)	16.64/16.26	0.655/0.640
G	12.065	0.475
H(max)	1.524	0.060



- Battery Type: Lithium Manganese Dioxide DL123A;
- Nominal Voltage: 3.1 volts;
- Typical Capacity: 1400 mAh @ 100 ohms to 2 volts @ 21 °C;
- Standard Drain: 28 mA;
- Average Weight: 17 grams;
- Operating Temperature Range: -20 °C to 60 °C;
- Nominal Impedance: 0.3 ohm @ 1 kHz;
- Actual Volume: (Liquid Displacement) 7.2 cc;
- Appearance: Product will be free of any debris, deformation, or damage that impairs the intended use.

Electricals	Initial	After 12 Months Storage @ 21 °C
Open Circuit Voltage Test No Load	3.10 - 3.30V	3.10 - 3.30V
Closed Circuit Voltage Test 3.0 A for 500 ± 50 milliseconds	2.0 V min.	2.0 V min.

Performance	Regime	Test Temperature (± 2 °C)	Initial
Continuous	100 ohms continuous to 2.0 volts	21 °C	1400 mAh nom
Life Test 1	1800 mA pulse, 3 seconds ON, 7 seconds OFF, to 1.70 volts	21 °C	600 cycles min.
Life Test 2	900 mA pulse, 3 sec on/27 sec off to 2.0 volts	-10 °C	500 cycles min

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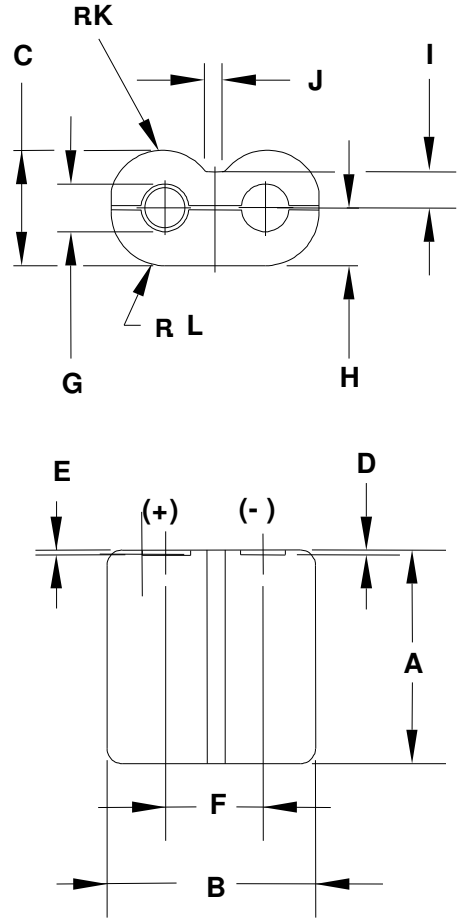
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Certificate Of Quality Specification Duracell DL223A

Dimensions	mm	in
A(max/min)	35.99/35.59	1.417/1.401
B(max/min)	35.00/34.49	1.378/1.358
C(max/min)	19.50/19.10	0.768/0.752
D(max/min)	1.52/1.016	0.060/0.040
E(max/min)	1.016/0.152	0.040/0.006
F	16.79	0.661
G	8.0	0.315
H	9.58	0.377
I(max/min)	6.04/5.89	0.238/0.232
J	2.39	0.094
K(radius)	8.89	0.350
L(radius)	8.99	0.354



1. Battery Type: Lithium Manganese Dioxide DL223A;
2. Nominal Voltage: 6.2 volts;
3. Typical Capacity: 1400 mAh @ 200 ohms to 4 volts @ 21 °C;
4. Standard Drain: 28 mA;
5. Average Weight: 38 grams;
6. Operating Temperature Range: -20 °C to 60 °C;
7. Nominal Impedance: 0.7 ohm @ 1 kHz;
8. Actual Volume: (Liquid Displacement) 20.1 cc;
9. Appearance: Product will be free of any debris, deformation, or damage that impairs the intended use.

Electricals	Initial	After 12 Months Storage @ 21 °C
Open Circuit Voltage Test No Load	6.20 - 6.60V	6.20 - 6.60V
Closed Circuit Voltage Test 3.0 A for 500 ± 50 milliseconds	3.8V min.	3.8V min.

Performance	Regime	Test Temperature (± 2 °C)	Initial
Continuous	200 ohms continuous to 4.0 volts	21 °C	1400 mAh nom
Life Test 1	1800 mA pulse, 3 seconds ON, 7 seconds OFF, to 3.4 volts	21 °C	600 cycles min.
Life Test 2	900 mA pulse, 3 sec on/27 sec off to 4.0 volts	-10 °C	300 cycles min

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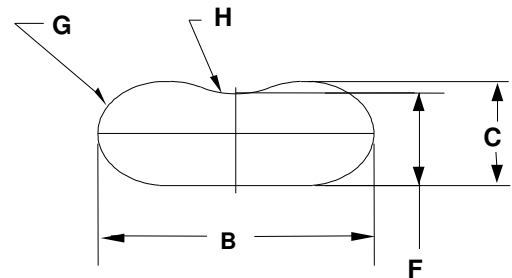
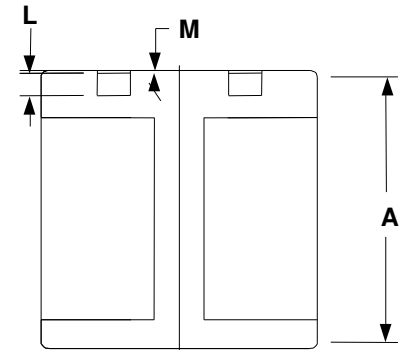
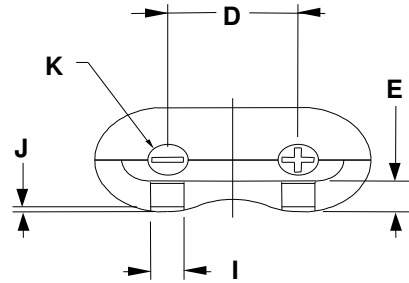
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Certificate Of Quality Specification Duracell DL245A

Dimensions	mm	in
A(max/min)	45.0/44.7	1.772/1.760
B(max/min)	34.00/33.7	1.339/1.325
C(max/min)	17.0/16.6	0.669/0.655
D(max/min)	16.3/15.7	0.641/0.618
E(max/min)	4.2/3.7	0.165/0.146
F	14.4	0.567
G(max/min)	8.7 / 8.3	0.343 / 0.327
H(max/min)	9.1 / 8.5	0.358 / 0.335
I(max/min)	4.57 / 4.26	0.179 / 0.168
J(max/min)	0.8 / 0.4	0.031 / 0.016
K(max)	0.2	0.008
L(max/min)	4.3 / 3.8	0.169 / 0.150
M(max/min)	0.7 / 0.3	0.028 / 0.012



1. Battery Type: Lithium Manganese Dioxide DL245A;
2. Nominal Voltage: 6.2 volts;
3. Typical Capacity: 1400 mAh @ 200 ohms to 4 volts @ 21 °C;
4. Standard Drain: 28 mA;
5. Average Weight: 39.7 grams;
6. Operating Temperature Range: -20 °C to 60 °C;
7. Nominal Impedance: 0.7 ohm @ 1 kHz;
8. Actual Volume: (Liquid Displacement) 21.7 cc;
9. Appearance: Product will be free of any debris, deformation, or damage that impairs the intended use.

Electricals	Initial	After 12 Months Storage @ 21 °C
Open Circuit Voltage Test No Load	6.20 - 6.60V	6.20 - 6.60V
Closed Circuit Voltage Test 3.0 A for 500 ± 50 milliseconds	3.8V min.	3.8V min.

Performance	Regime	Test Temperature (± 2° C)	Initial
Continuous	200 ohms continuous to 4.0 volts	21 °C	1400 mAh nom
Life Test 1	1800 mA pulse, 3 seconds ON, 7 seconds OFF, to 3.4 volts	21 °C	600 cycles min.
Life Test 2	900 mA pulse, 3 sec on/27 sec off to 4.0 volts	-10 °C	300 cycles min

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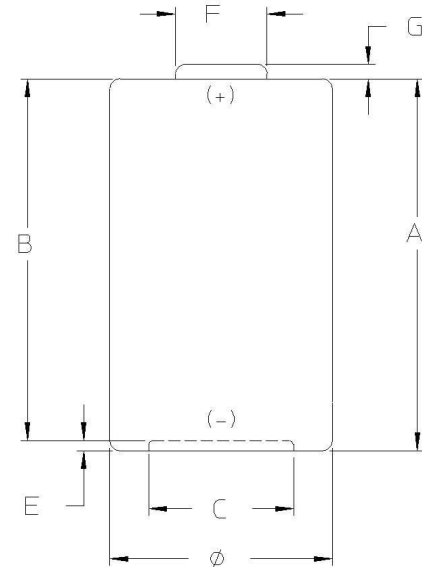
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Certificate Of Quality Specification Duracell DLCR2

Dimensions	mm	in
A (Max)	27.0	1.063
B (Min)	25.8	1.015
C (Min)	8.5	0.335
E (Max)	0.5	0.020
E (Min)	-0.05	-0.002
F (Max)	6.5	0.256
G (Min)	0.7	0.027
φ (Max)	15.6	0.614
φ (Min)	15.1	0.594



1. Battery Type: Lithium Manganese Dioxide DLCR2;
2. Nominal Voltage: 3.1 volts;
3. Typical Capacity: 900 mAh @ 100 ohms to 2 volts @ 21 °C;
4. Average Weight: 10.7 grams;
5. Operating Temperature Range: -20°C to 60°C;
6. Nominal Impedance: 0.3 ohm @ 1 kHz;
7. Actual Volume: (Liquid Displacement) 4.9 cc;
8. Appearance: Product will be free of any debris, deformation, or damage that impairs the intended use.

Electricals	Initial	After 12 Months Storage @ 21 °C
Open Circuit Voltage Test No Load	3.10 - 3.30V	3.10 - 3.30V
Closed Circuit Voltage Test 3.0 A for 500 ± 50 milliseconds	2.05 V min.	2.05 V min.

Performance	Regime	Test Conditions (± 2° C)	Initial
Continuous	100 ohm continuous to 2.0V	21 °C	885 mAh
ANSI Pulse Service Life Test	900 mA pulse, 3 sec on/27 sec off to 1.55 volts	21 °C	990 cycles
ANSI Pulse Service Life Test	900 mA pulse, 3 sec on/27 sec off to 2.0volts	-10 °C	121 cycles

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