“State of the Art Fuze Batteries and their Performance“

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Roland Hein
Diehl & Eagle Picher GmbH
Overview

- Introduction of the Design Features of Reserve Batteries
- Reserve Battery - Versions
- Reserve Battery - Versions Overview
- Reserve Battery - Application
- Reserve Battery - Testing
- Reserve Battery - Versions Summary
- Recommendations for Fuze Electronic Design
- Future developments
Introduction of the Design Features of Reserve Batteries

- **Primary Design Features of all Reserve Batteries**
  - Lithium Metal Battery
  - Lithium Thionylchloride electrolyte (LiSOCl$_2$)
  - glass ampoule
  - release mechanism/activation mechanism
  - metal to glass seal
  - hermetically sealed stainless steel case
  - 100% helium leak test
Reserve Battery - Versions

Battery Parameter

Diameter max. : 18,2 mm (0.72 in)
Height : 13,7 mm (0.54 in)
Electrode Area : 1,4 cm² (0.22 in²)
Volume : 1,8 cm³ (0.11 in³)

Diameter max. : 32,2 mm (1.27 in)
Height : 25,5 mm (1.0 in)
Electrode Area : 3,5 cm² (0.54 in²)
Volume : 15 cm³ (0.92 in³)

Diameter : 11 mm (0.43 in)
Height : 11 mm (0.43 in)
Electrode Area : 0,4 cm² (0.06 in²)
Volume : 1,0 cm³ (0.06 in³)
# Reserve Battery - Versions Overview

<table>
<thead>
<tr>
<th>“Large”</th>
<th>“Large”</th>
<th>“Midi”</th>
<th>“Mini”</th>
<th>“Ultra Mini”</th>
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<tbody>
<tr>
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<td>DEP14007/17/12</td>
<td>DEP14020/21</td>
<td>DEP14202</td>
<td>DEP14103</td>
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<td>5 – 10 cells</td>
<td>1 – 4 cells</td>
<td>1 – 2 cells</td>
<td>1 cell</td>
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<td>8 cells</td>
<td>2 cells</td>
<td>2 cells</td>
<td>1 cell</td>
</tr>
<tr>
<td>25.2 V</td>
<td>28.8 V</td>
<td>7.2 V</td>
<td>7.2 V</td>
<td>3.6 V</td>
</tr>
</tbody>
</table>
Reserve Battery in a typical application

1. How much Power does the Fuze Electronic need?
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2. What is the minimum Voltage for operating a Fuze Electronic?
Reserve Battery - Application

Reserve Battery – Equivalent Circuit Diagram

Some Equations of Electrical Power

\[ P = U_{\text{Batt}} \times I \]

or

\[ P = \frac{U_{\text{Batt}}^2}{R} \]

\[ P = \frac{[U_o - (R_i \times I)]^2}{R} \]

Battery State

Fuze Electronic
Reserve Battery – Battery-Test-System

Flexible Configuration of

- Acceleration Pulse
- Rotation
- Electrical Load
Reserve Battery - Testing

**Reserve Battery – Test Results (Example)**

1. How much Power may a Fuze Electronic require at what time?

2. What is then the minimum Voltage for operating a Fuze Electronic?
## Reserve Battery - Versions Summary

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<tr>
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</tr>
<tr>
<td>Voltage</td>
<td>25.2 V</td>
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<td>7.2 V</td>
<td>7.2 V</td>
<td>3.6 V</td>
</tr>
<tr>
<td>Volume</td>
<td>15 cm³</td>
<td>11.7 cm³</td>
<td>1.8 cm³</td>
<td>1.0 cm³</td>
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</tr>
<tr>
<td>Cell Area (ea.)</td>
<td>3.5 cm²</td>
<td>3.5 cm²</td>
<td>1.4 cm²</td>
<td>0.4 cm²</td>
<td></td>
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<tr>
<td>Spec. Current</td>
<td>235 mA/cm²</td>
<td>187 mA/cm²</td>
<td>150 mA/cm²</td>
<td>80 mA/cm²</td>
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<tr>
<td>Rec. Max. Power</td>
<td>3100 mW</td>
<td>2800 mW</td>
<td>1400 mW</td>
<td>140 mW</td>
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</table>
Recommendations for Fuze Electronic Design

- Timing of Power Electronic Fuze Parts
  - Controlled Charge of Ignition Capacitors
  - Start Up of µController (delayed)
  - Switched Sensor Start

- No “Big” Capacitors on Power Inlet (DC/DC-Converter)

- Small Power Buffer (Capacitors) for Actuators

- Moderate Power Consumption can lead to Standard Fuze Battery

- Involve D&EP early in Power Consumption of your Fuze Electronic
Future developments

- 1 & 2 cell batteries for high spin and high acceleration application
- Development on super quick in barrel activation batteries for artillery and naval versions
- Development of new electrode material for higher current / power application
Thank you for your attention!

Questions?
Diehl & Eagle Picher Contact

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