

# TECHNOLOGY IN FUZING



The challenge for Reserve Batteries

## WHAT IS A RESERVE BATTERY

- A Reserve Battery needs to be activated to provide power.
- Anode and cathode remain separated until the battery is activated.
- The battery has no self-discharge.
- Mainly used as powersource for electronic artillery fuzes.

## REQUIREMENTS

- Long shelf life (up to 20 years)
- High linear acceleration (up to 50.000G)
- High rotation speed (up to 30.000 rpm)
- Operational temperature between -46°C and +63°C
- Compliance with MIL-STD331B

**Question: Is this available as COTS ???**



## Lithium & Lead Reserve Batteries

- Thales Munitronics
- Bofors (Sweden)
- Simmel (Italy)
- Junghans (Germany)
- KDI (USA)
- Patria Vammass (Finland)
- SNC (Canada)
- Royal Ordnance (UK)
- TDA (France)
- Hanwha (Korea)
- Noptel (Finland)
- Miltech Hellas (Greece)
- NSWC (USA)
- Oto Melara (Italy)
- NAMMO (Norway)



## Applications:

- Army Proximity fuzes 105-203 mm
- Naval Proximity fuzes 40 - 127 mm
- Electronic Time Fuzes (Army)
- Naval Multi Role Fuzes
- Army Multi Role Fuzes
- Naval Extended range ammunitions
- Army Extended range ammunitions
- Sensor fuzed ammunitions
- Self Destruct Fuzes
- Air Bursting Fuzes
- Anti Tank Systems (ADW)

Over 3.5 million batteries produced

- Reliable activation at all charges (1.500 - 50.000G)
- Very quick activation (voltage rise time) at all temperatures
- Process control for repeatability of voltage risetime
- Voltage constant over temperature range (-46/+63°C)
- Test conditions are different from real firings
- MIL-STD requirements are for complete fuzes
- Low electronic noise
- Long function time
- Limited space envelop, different for many fuzes
- Proof of long storage life for new designs
- Different voltage and load requirement per customer!

**RESULT: Reserve batteries become dedicated components**

# Different Fuze = Different Battery

All batteries have common parts, but are never fully interchangeable.

Cells, Ampoule, housing, brackets

Development & Qualification cost  
= \$\$\$



- Existing batteries are available today in various configurations, right from the start of development of fuzes.
- Use of existing batteries will reduce risk and development cost for new fuze projects.
- New developments focus on battery design that fulfills requirements for different fuzes.

Question: Can this be done?



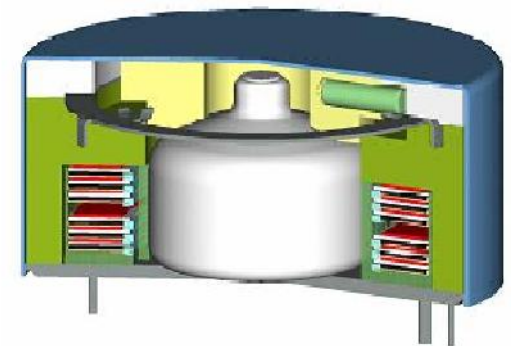
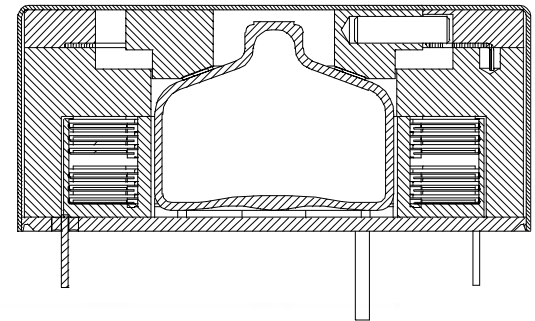


- Over 20 years experience in Lithium Reserve batteries development
- Expertise in power sources for fuze calibers from 40 to 155 mm since 1948
- Expertise in low to high G acceleration environments for battery applications

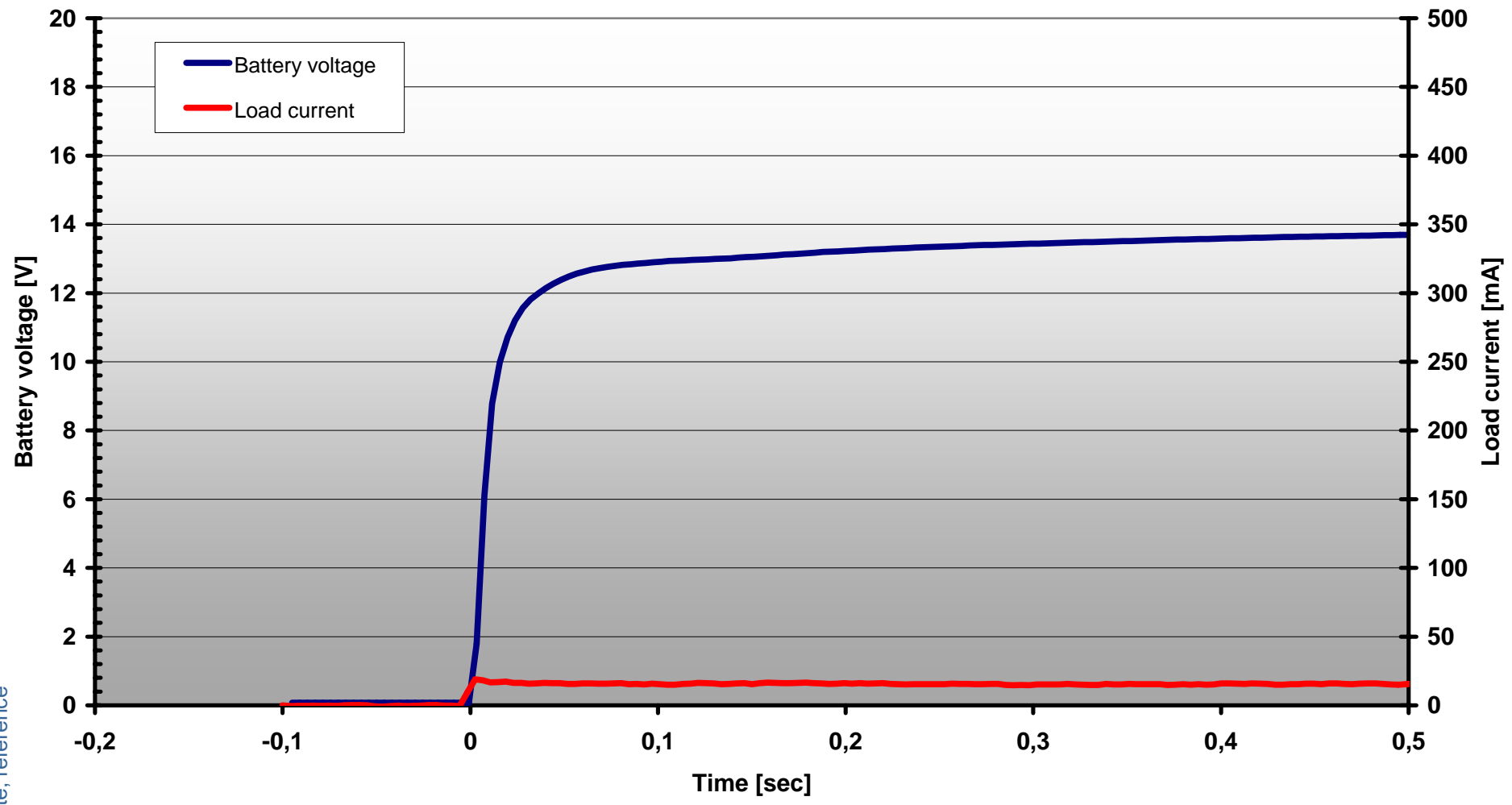
Glass ampoule know-how  
Li-Cell technology  
Dry Room RH <1%

Elements

- Mechanical
- Electro-chemical (Electrolyte)
- Environmental constraints
- Shelf life
- Power density
- Development cost vs. quantities



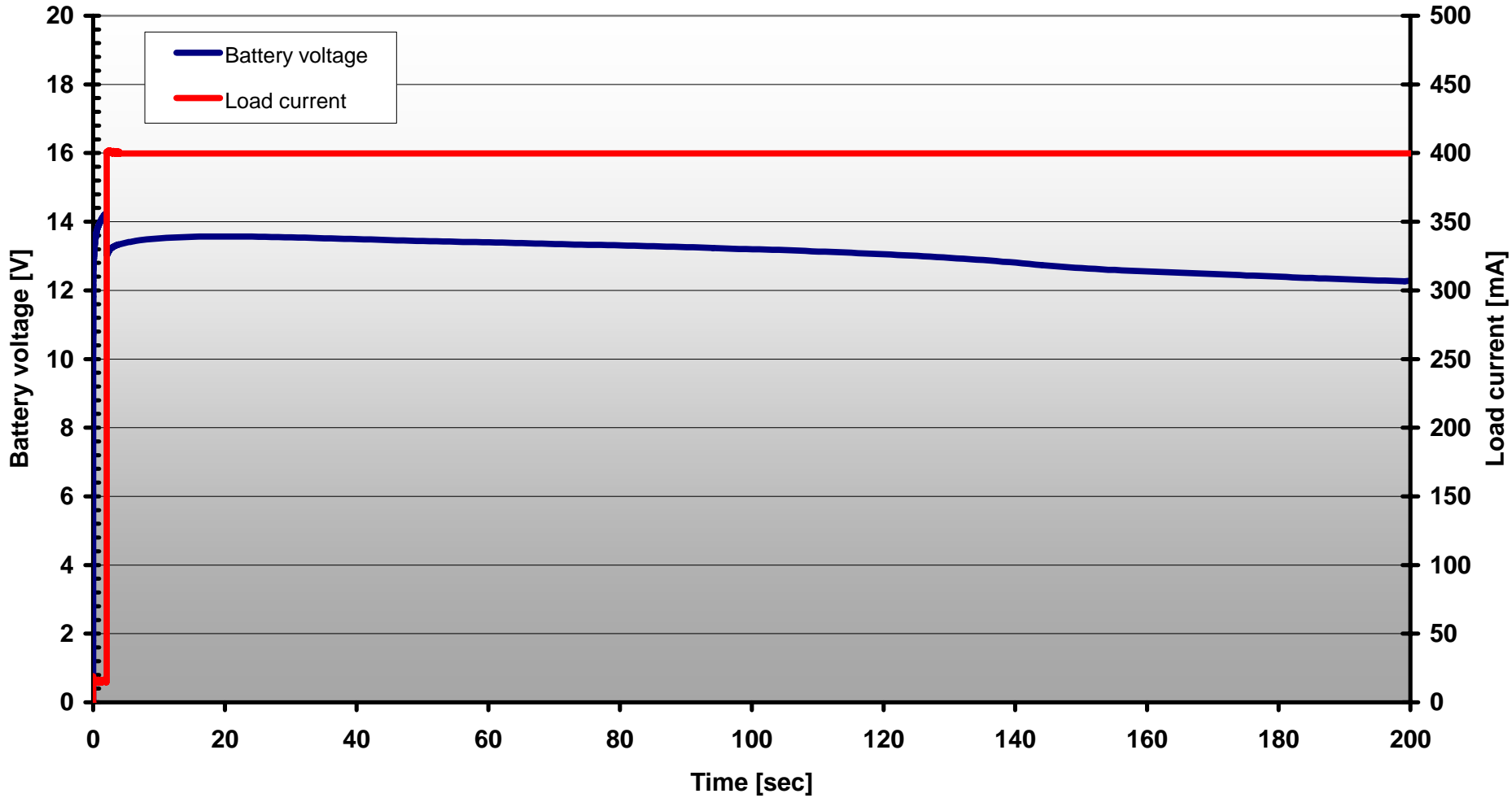
### Activation curve, 2x4 lithium battery 23°C, 3000rpm



Date, reference



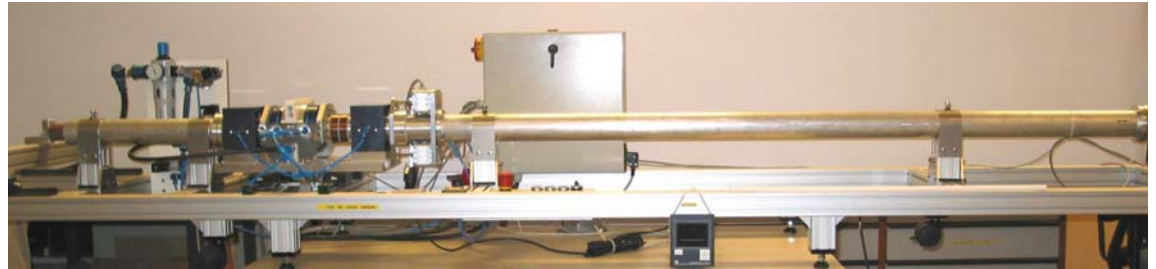
## Endurance curve, 2x4 lithium battery 23°C, 3000rpm



Date, reference

- One basic design size to meet many of the different requirements (MFF/MOFA/MEDEA)
- Activation mechanism settable and measurable
- Reduction in number of batteries types
- Modular design allows easy adaptation to customer's requirements:
  - number of cells (1-9 cells)
  - number of cell stacks (2x4, 2x3, 3x3)
  - patented activation principle independent of application
  - standardized connection pins

- Dedicated tooling & test equipment developed



Airgun for acceleration/flick ramming simulation



Temperature cabinet  
Shaker  
Drop testing



Centrifuge for rotation and performance testing

## Lithium-Thionylchloride (Existing & new design)

- 👍 Stable chemistry
- 👍 Reliable separation of electrolyte and cells (No glass corrosion)
- 👍 3% voltage delta over full temperature range
- 👍 Typical 0,1% electronic noise relative to battery voltage
- 👍 Allowable load up to 450 mA
- 👍 Function time up to 200 sec.
- 👍 High energy density/mm<sup>2</sup> cell surface



- Proof consistency of new design
  - Laboratory testing in FY04
- Proof reliability of design
  - Laboratory & real firings FY04/05
- Qualification of battery
  - Implement in fuzes FY05
- Release for production FY05/06

- Commercial Off the Shelf batteries are not self evident!
- Dedicated batteries will still be available
- Fuze developers need to address the battery requirement at the beginning of the program in order to minimize cost & surprises.
- We have successfully taken the first steps in the approach to maximize commonality.

All That Knowledge can be yours!