Small Thermal Battery for High Spin Environments

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A Gun Launch Thermal Battery

• Primary Reserve Gun Launch Thermal Battery
  - One Time Use – Not Rechargeable (This electrochemistry can be charged)
  - Assembled in a Dormant State
  - Primer Activated

• Characteristics that Make Thermal Batteries Ideal Power Sources for Weapon Systems
  - Long Shelf Life (Up to 30 Years)
  - No Maintenance Required
  - High Power Density
  - Rapid Discharge
  - Wide Operating Temperature Range
  - No Self Discharge
  - Low Life Cycle Cost
  - Fast Activation (under 60 ms for gun launch)
  - Extremely Rugged
  - No Out-gassing
  - High Reliability (4 - 9’s)
  - No External Heating Required
  - Flexibility in Design (Multiple Voltage Sections in Parallel or in Series)
Powering 57mm Smart Munitions

- EAS thermal batteries now power cutting edge gun launch munitions

- Currently flying in a Navy MK Format Smart Projectile

- Powering a 24 volt system @ a nominal 50 watt load with power excursions reaching more than 100 watts.

- Battery life exceeds typical round flight times with exceptional margins, operating for more than 20 seconds.

40 mm (1.60 in) Diameter

57 mm (2.24 in) Diameter

EAS Thermal Battery
Powering Smart Round

MK Navy Style Round
Extreme Environments

- **Set Back Acceleration**
  - *Continued Operation during applied forces over 35,000 g’s*

- **Angular Acceleration**
  - *Continued Operation during applied angular acceleration over 1M rad/sec²*

- **Angular Deceleration**
  - *Continued Operation during applied angular deceleration over -2M rad/sec²*

A Highly Rugged Design, Built to Survive Some of the Harshest Man Made Environments
EAS Cobalt Disulfide Cathode Technology

- Traditional Cathode Electrochemistry active material, FeS$_2$, does not perform well under high spin conditions.

  Voltage noise and higher impedances (overall) plague this chemistry when subjected to high spin environments

- In a one-to-one spin test comparison, EnerSys Advanced Systems’ CoS$_2$ technology outperforms in impedance, voltage, and capacity - providing more than double the mission capability

More than Double the Mission Capability when using CoS$_2$ over the Conventional FeS$_2$
With many years of experience and various design iterations, EAS has produced a unique battery that eliminates extreme performance degradation from high spin environments.

- The internal wrapping pattern, in combination with advanced insulation materials, ensures a rugged design tempered to survive intense G loads and acceleration forces.

- The primer activation system employs a striker method anvil which is activated under specific gun launch environments ~ making the batteries safe to handle in the event they are dropped.

- A unique lead routing design mechanically immobilized in a propriety blend of epoxy and hardeners, enables strain relief during some of the harshest environments.

- Custom tailoring of the primer assembly allows for various no fire/all fire scenarios to be met.

- Electrical Isolators are strategically placed in the battery to not only serve as electrical isolators but also to contribute to an already internal rugged core.
EnerSys Advanced Systems has demonstrated performance in gun launched systems with both high power density thermal batteries and high energy density liquid reserve batteries.
EAS Battery Design Capabilities

EnerSys Advanced Systems battery design and analysis capabilities ensure that the battery is designed to meet program performance requirements, including the most extreme environmental requirements.

Using a combination of the latest software packages, EAS can generate thermal and mechanical models to reduce cost and time to PDR.
EAS Battery Test Capabilities

- Temperature Cycling
- Temperature Conditioning
- Acceleration Table w/ Slip Rings
- High-g Shock Tower (simulate gun-fire conditions)
- Salt Fog Chamber
- Programmable Testers and High-Speed Data Acquisition
- Altitude Chamber
- Vibration Tables / Slip Plates

Capabilities Support Full Range of Product Development, Qualification and Lot Acceptance Test Requirements
- 96 kW Programmable Load Not Shown
Powering the Smart Weapon

Our experienced team of thermal battery engineers at EAS Tampa are ready to discuss your specifications and how we can start powering your smart weapons!