CYMBET™
CORPORATION

PI-72-04
Product Information Sheet

EnerChip Standards Compliance and Use Procedures

Section I - Product Information Sheet Scope

This Product Information Sheet provides specific compliance and procedural instruction information for global standards, guidelines and directives in the areas of battery safety and environmental concerns. These standards, documents and instructions have been created over the last two decades by many different organizations in many different countries around the world. In some cases, there is harmony of regulations and instructions, but in other cases these documents can be contradictory. Cymbet believes it is very important to support environmental and safety initiatives around the world, as the concerns raised in these standards are one of the main product requirements drivers for the creation of the EnerChip solid state battery. The intent of this document is to inform our customers about standards and regulations that might potentially apply to both EnerChip batteries and our customers' end user products that incorporate EnerChips. Customers in turn can then take appropriate actions to meet standards and directives that apply to their products.

Cymbet EnerChip™ Rechargeable Solid State Batteries are a new class of battery that uses solid state materials and semiconductor manufacturing processes. EnerChips are very different as compared to legacy storage devices such as coin cell batteries and super capacitors that may contain toxic chemicals. EnerChip products were first commercially released in 2007 and were not in existence when many environmental and battery standards and directives were written and released. Therefore, it is important to properly interpret how to meet the intent and instructions of global standards that apply to legacy energy storage devices when using new and environmentally friendly EnerChip solid state batteries.

The following Sections cover EnerChip applicable environmental and safety standards, directives and guidelines:

Section II - RoHS
Section III - China RoHS
Section IV - REACH
Section V - CE Mark
Section VI - UL - Underwriters Laboratory
Section VII - JEDEC IC Packaging Standards and Tape and Reel EIA Standards
Section VIII - IEC, NEMA/ANSI
Section IX- United Nations Transportation Air Safety Regulations
Section X- WEEE Waste Electrical and Electronic Equipment Directive
Section XI - EU Battery Directive
Section XII - MSDS and OSHA Information
Section XIII- EnerChip End-of-life Disposal Instructions
Section XIV - In vitro Biocompatibility Test Standards for Cytotoxicity

Section II - RoHS - Restriction of Hazardous Substances 2002/95/EC

The European Union [EU] adopted directives on "Restriction of Hazardous Substances" [RoHS] February 2003 and the RoHS Directive took effect on 1 July 2006. To minimize the environmental impact, the EU restricts the use of certain hazardous substances, which include: lead, cadmium, hexavalent chromium, mercury, polybrominated biphenyls [PBBs] and polybrominated diphenyl ethers [PBDEs] in the electrical and electronic equipment. Per this directive, the following limits have been imposed: for lead, mercury, hexavalent chromium, PBBs and PBDEs: 0.1% w/w; and for cadmium: 0.01% w/w.

Note that batteries are not included within the scope of RoHS but instead are covered under the Battery Directive 2006/66/EC. However, since EnerChips are solid state devices like other integrated circuits in a product.
Cymbet has reviewed the formulations of the EnerChip™ and this review revealed that the Cymbet EnerChip™ does not use any cadmium, lead, mercury, hexavalent chromium, PBBs and PBDEs in formulation of the products. And none of the ingredients for our products exhibit contamination by these heavy metals.

On the basis of collected data, Cymbet has determined all EnerChip products comply with the limits established in the EU's directives on "RoHS". Since EnerChip devices are RoHS tested compliant they should be treated in the same fashion as other WEEE components for end-of-life disposal purposes. **Cymbet has tested all EnerChip products and documented them to be tested RoHS compliant.**

Section III - China RoHS SJ/T 11363-2006

Cymbet Products are compliant with the China Requirement for Concentration Limits for Certain Hazardous Substances in Electronic Information Products, SJ/T 11363-2006 [China RoHS]. To minimize the environmental impact, The People's Republic of China limits or prohibits the use of certain hazardous substances, which include lead, cadmium, hexavalent chromium, mercury, polybrominated biphenyls [PBBs] and polybrominated diphenyl ethers [PBDEs] in the electrical and electronic equipment. To achieve reduction of these substances, the People's Republic of China has created a requirement SJ/T 11363-2006. Per this requirement, the following limits have been imposed: lead, mercury, hexavalent chromium, PBBs and PBDEs: 0.1% w/w; cadmium: 0.01% w/w.

Cymbet has reviewed the formulations of all released products as of March 19, 2012. This review revealed that the Cymbet products do not use any cadmium, lead, mercury, hexavalent chromium, PBBs and PBDEs in formulation of the products. And none of the ingredients for our products exhibit contamination by these heavy metals. On the basis of collected data, **Cymbet has determined all Cymbet products comply with the limits established in the China SJ/T 11363-2006.**

Section IV - REACH

Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) is a European Union Regulation of 18 December 2006. REACH addresses the product and use of chemical substances and their potential impacts on both human health and the environment.

Cymbet Corporation (Cymbet) products and packing materials are considered articles under the provisions if Regulation (EC) No. 1907/2006 (REACH Regulation). The following REACH statements are provided:

1. With regard to the Substances of Very High Concern (SVHC) candidate list published and last updated June 18, 2012 on the European Chemicals Agency (ECHA) website in reference to the REACH Regulation, based on information from our suppliers and internal screening analysis, **Cymbet products or packing materials (articles) do not contain any of the substances identified on the SVHC candidate list and are considered REACH compliant.**

2. Cymbet products and packing materials do not contain, based on information from our suppliers and internal screening analysis, any of the 52 substances or groups of substances banned in the REACH Regulations Annex XVII.

3. Given Cymbet products or packing materials do not contain any substances listed on the SVHC list, Cymbet is not obligated by the REACH Regulations to supply Notification of substances, Registration of substances, or Communication of information on substances to the European Chemical Agency (ECHA).

Cymbet Corporation has taken and continues to take reasonable steps to provide representative and accurate information concerning the application of REACH Regulations for Cymbet products and packing materials.

Cymbet will update this document and notify the appropriate parties, if a new Cymbet product is commercially released that requires modification of the statements made in this document.

Section V - CE Mark 93/68/EEC

CE Mark is a mandatory conformity mark for products placed on the market in the European Economic Area. With CE marking on a product, Cymbet ensures that the product conforms with the essential requirements of the applicable EU directives. Product manufacturers perform self-certification. CE marking applies to product groups. **EnerChip solid state battery devices are not covered by these product groups. Cymbet Evaluation Kits CBC-EVAL-05, EVAL-06, EVAL-09, EVAL-10, EVAL-10B and CBC-EVAL-3105 have been self-certified to CE Mark 93/68/EEC and CE marked.**

Section VI - Underwriters Laboratory Standards and Specifications

The UL standard that cover the types of batteries used in smaller rechargeable apparatus and appliances is UL1642 “UL Standard for Safety for Lithium Batteries”. The testing requirements in this standard cover primary (nonrechargeable) and secondary (rechargeable) lithium batteries for use as power sources in products.

This document is instructional for electronics designers using EnerChip solid state batteries. However, **Cymbet EnerChip Solid State Batteries are not covered under the scope of the UL1642 standard for two main reasons:**

1. These requirements cover lithium batteries intended for use in technician replaceable or user-replaceable applications. EnerChip solid state batteries are permanently soldered to a printed circuit board or substrate for life-of-product performance and are not replaceable. UL 1642 does not apply to Cymbet EnerChip products.

2. These requirements cover batteries that contain 4.0 grams or less total metallic lithium with not more than 1.0 gram of metallic lithium per cell. A Cymbet EnerChip does not contain any metallic lithium. The highest capacity commercially available EnerChip CBC050 contains only 500 micrograms of crystalline Lithium Cobalt Oxide and 500 micrograms of crystalline Lithium Phosphorous OxyNitride (LiPON).

Even though EnerChips are not explicitly covered under UL1642, Cymbet EnerChips do meet UL1642 requirements for battery safety testing and marking. Cymbet EnerChips comply with the important battery use considerations detailed in UL1642 as follows:

- Requirement 4.1 - Casing - The casing of a lithium battery shall have the strength and rigidity necessary to resist the abuses to which it may be subjected, without the resulting in a risk of fire. EnerChip devices are typically packaged in a plastic semiconductor package, molded device or product package that provides abuse resistance. Moreover, EnerChips do not have any chemical mechanisms that could result in a risk of fire.

- Requirement 4.2 - Electrolyte - A user replaceable battery shall not contain pressurized vapor or liquid that could spray materials into the eyes of leak more than 5 milliliters of liquid when the battery casing is punctured under normal laboratory conditions. Cymbet EnerChips utilize a solid state electrolyte that does not contain any vapor or liquid.

- Requirement 4.3 - Use - A lithium battery shall be protected from abnormal charging currents during use. The Cymbet EnerChip uses a Constant Voltage/Any Current charging mechanism. When charging currents rise, the EnerChip impedance rises automatically protecting the EnerChip from abnormal charging currents. Furthermore, EnerChip batteries are covered under Exception 2 of this requirement since the EnerChip has been tested and found not to have a risk of explosion.

- Tests for Technician-Replaceable and User-Replaceable Batteries Sections 10-20. Even though EnerChip batteries are not within the scope of UL 1642, the tests described in this document should be understood and EnerChip batteries should pass these criteria for safe operation :

  - 10 - Short Circuit Test - The battery is to discharge until a fire or explosion is obtained, or until it has reached a completely discharged state of less than 0.1 volts. The EnerChip will not catch on fire and will reach a state of less than 0.1 volts in the presence of a short circuit.
  - 11 - Abnormal Charging Test - The battery is to be subjected to a charging current of three times the current specified by Cymbet for a minimum of 7 hours without catching fire. The highest amount of charging current used for a particular EnerChip device is 4 times the energy storage capacity of a device. For example this would be 200 microamperes for a CBC050. Therefore for this test 600 microamperes would be supplied to an EnerChip CBC050 for 7 hours. When this is done, the EnerChip does not catch on fire.
  - 12 - Forced Discharge Test - this test is intended for cells that are to be used in series-connected multi-cell applications. EnerChips are typically connected together for increased capacity, but could be connected in series for increased voltage. A completely discharged cell is to force-charged by connecting it in series with fully charged cells of the same kind and not explode or catch on fire when done so. EnerChips do not explode or catch on fire.
  - 13 Crush Test- A battery is to be crushed between two flat surfaces and not explode or catch fire. EnerChips when crushed do not explode or catch fire.
  - 14 - Impact test - A test sample battery is to be placed on a flat surface and struck with a 20 pound bar is to be dropped 24 inches onto the device and not explode or catch fire. EnerChip batteries when impacted do not explode or catch fire.
  - 15 - Shock Test - a cell is to be subjected to 3 shocks where the shock to the cell is be accelerated such that the during the initial 3 milliseconds the minimum average acceleration is 75g with no explosion or fire. EnerChips do not explode or catch fire.
  - 16 - Vibration Test - A battery is to be subjected to simple harmonic motion with an amplitude of 0.8mm with varying frequency between 10 and 55 Hz over 90 minutes tested in three mutually perpendicular directions and not explode, catch fire, vent or leak. EnerChip batteries do not explode, catch fire, vent or leak.
  - 17 Heating Test - A battery is to be heated from a temperature of 20 degrees C to a temperature of 130 degrees C and remain for 10 minutes at that temperature and then cool down to 20 degrees C without exploding or catch fire. EnerChip batteries do not explode or catch fire.
  - 18 - Temperature Cycling - Repeating 9 temperature variation cycles from 70 to 20 to 40 to 20 degrees C and not explode, catch fire, vent or leak. EnerChip batteries do not explode, catch fire, vent or leak.
  - 19 - Low Pressure (Altitude Simulation) Test - Sample batteries are stored for 6 hours at an absolute pressure of 1.68 psi and temperature of 20 degrees C and not explode, catch fire, vent or leak. EnerChip batteries do not explode, catch fire, vent or leak.
  - 20 - Projectile Test - When a cell is subjected to a fire heated screen until it explodes, no part of an exploding cell shall penetrate a wire screen. EnerChips do not explode under these heating conditions and would not project cell debris through this wire screen.

- Marking Guidelines - EnerChips also comply with the device marking requirements:
  - Cymbet's trade name appears on the device
  - A distinctive model number identification is marked
  - A dating period of manufacture is marked

Section VII - JEDEC Standards for Semiconductor Device Testing

Cymbet EnerChip solid state battery products are packaged using standard semiconductor packaging techniques and use surface mount technology with reflow solder attachment. The JEDEC (Joint Electron

Device Engineering Council) Solid State Technology Association has release a series of test standards used by Semiconductor Manufacturers to test the performance and reliability of their devices. Cymbet has tested EnerChip solid state battery products against the following JEDEC standards and the results have been published in "**Cymbet EnerChip Qualification and Characterization Report, March 2012**" :

- JEDEC JESD78B IC Latch-up Test
- ESD Human Body Model EIA/JESD22-A114E
- ESD Charge Device Model EIA/JESD22-C101D
- ESD Machine Mode JESD22-A115-A
- High Temp Operating Lifetime Test JESD22-A-108-C
- Temperature Cycling JESD22-104D
- High Temp Storage Life JESD22-A-103-C
- Moisture Resistance Test JESD22-A-113-F
- Temperature Humidity Bias JESD11-A-101--C
- Highly Accelerated Temperature/Humidity Stress Test JESD22-A-110-C
- Unbiased Highly Accelerated Temperature/Humidity Stress Test JESD22-A118
- Vibration Test JESD22-B103B
- Mechanical Shock JESD22-B104C
- Convection Oven Solder Reflow to 240C peak temperature in accordance with JEDEC-STD-020 profile
- Moisture/Reflow Sensitivity Test - tested to MSL Level 3 of JEDEC J-STD-020D.1

Section VIII - IEC-62133 and NEMA ANSI C18.2M

In June 2009 the CMC (Certification Management Committee of the CB Scheme) made a decision that Lithium Ion batteries used in equipment and appliances should comply with the IEC-62133 Standards for Portable Secondary Batteries (Rechargeable). The IEC-62133 is very similar in scope and test procedures to the UL1642 standard. First edition was released in 2002 update scheduled for 2012. Beginning in May 2012, the CMC is encouraging testing to 62133 rather than UL1642. However, the first edition of IEC 62133 has some short comings identified by test houses and manufacturers and it has not been widely used by the industry. It is anticipated that the 2012 updated IEC-62133 will be more widely accepted and utilized.

The National Electrical Manufacturers Association ANSI C18.2M, Part 2-2007 is a Safety Standard for Portable Rechargeable Cells and Batteries. This standard is pointed toward batteries that have significantly greater size, capacity and chemical composition. This standard tests for battery designs that do not present a safety hazard under conditions of normal (intended) use. When discharged on a performance test in accordance with C18.2M Part 1, (which are very similar to UL1642) there shall be no evidence of leakage, venting, fire or explosion. **EnerChips do not have leakage, venting, fire or explosion mechanisms. Although these standards do not apply directly to batteries in the range EnerChip storage capacities, EnerChip batteries would comply to these standards if tested using these test criteria**.

Section IX - UN Transportation Air Safety Regulations

UN Transportation Air Safety Regulations are detailed in 49 CFR Subchapter C Subsection 172.102 Special Provision 188. This section provides the explanation of how the Cymbet EnerChip™ solid state batteries meet the requirements following each section. Also included are excerpts from other Subparts in CFR 49 referenced in Special Provision 188 that are applicable to lithium batteries.

All Cymbet Corporation batteries meet the requirements of 49 CFR Subchapter C Subsection 172.102 Special Provision 188. Therefore, they are not subject to any other requirements of Subchapter C (Hazardous Materials Regulations) as long as they are packaged to prevent short circuits and packed in strong packing for conditions normally encountered in transportation.

§ 172.102 Special provisions

188 Small lithium cells and batteries. Lithium cells or batteries, including cells or batteries packed with or contained in equipment, are not subject to any other requirements of this subchapter if they meet all of the following:

a. Primary lithium batteries and cells. (1) Primary lithium batteries and cells are forbidden for transport aboard passenger-carrying aircraft. The outside of each package that contains primary (nonrechargeable) lithium batteries or cells must be marked "PRIMARY LITHIUM BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT" or "LITHIUM METAL BATTERIES—FORBIDDEN FOR TRANSPORT ABOARD PASSENGER AIRCRAFT" on a background of contrasting color. The letters in the marking must be:

(i) At least 12 mm (0.5 inch) in height on packages having a gross weight of more than 30 kg (66 pounds); or

(ii) At least 6 mm (0.25 inch) on packages having a gross weight of 30 kg (66 pounds) or less, except that smaller font may be used as necessary to fit package dimensions; and

(2) The provisions of paragraph (a)(i) do not apply to packages that contain 5 kg (11 pounds) net weight or less of primary lithium batteries or cells that are contained in or packed with equipment and the package contains no more than the number of lithium batteries or cells necessary to power the piece of equipment;

The Cymbet EnerChip™ batteries are rechargeable and therefore are not primary lithium batteries. Section a. does not apply to EnerChip batteries.

b. For a lithium metal or lithium alloy cell, the lithium content is not more than 1.0 g. For a lithium-ion cell, the equivalent lithium content is not more than 1.5 g;

The Cymbet EnerChip™ lithium content is much less than 1 mg. Therefore the requirements of Section b are met by Cymbet EnerChip devices.

c. For a lithium metal or lithium alloy battery, the aggregate lithium content is not more than 2.0g. For a lithium-ion battery, the aggregate equivalent lithium content is not more than 8 g;

The Cymbet EnerChip™ lithium content is much less than 1 mg. Therefore, the requirements of Section c are met by Cymbet EnerChip devices.

d. Effective October 1, 2009, the cell or battery must be of a type proven to meet the requirements of each test in the UN Manual of Tests and Criteria (IBR; see §171.7 of this subchapter);

Cymbet EnerChip batteries meet these tests and criteria.

e. Cells or batteries are separated so as to prevent short circuits and are packed in a strong outer packaging or are contained in equipment;

The packaging of the Cymbet EnerChip™ meets the requirements of section e.

f. Effective October 1, 2008, except when contained in equipment, each package containing more than 24 lithium cells or 12 lithium batteries must be:

(1) Marked to indicate that it contains lithium batteries, and special procedures should be followed in the event that the package is damaged;

(2) Accompanied by a document indicating that the package contains lithium batteries and special procedures should be followed in the event that the package is damaged;

(3) Capable of withstanding a 1.2 meter drop test in any orientation without damage to cells or batteries contained in the package, without shifting of the contents that would allow short circuiting and without release of package contents; and

(4) Gross weight of the package may not exceed 30 kg (66 pounds). This requirement does not apply to lithium cells or batteries packed with equipment;

Cymbet EnerChips are safe to package in any number of devices due to their intrinsic safety. There are no special procedures to be followed in the event of package damage. Packaged EnerChips can safely withstand a drop of 1.2 meters. EnerChip packages can safely exceed 30kg but in practice this package weight is impractical.

g. Electrical devices must conform to §173.21 of this subchapter.

§ 173.21 Forbidden materials and packages.

Unless otherwise provided in this subchapter, the offering for transportation or transportation of the following is forbidden:

(c) Electrical devices which are likely to create sparks or generate a dangerous quantity of heat, unless packaged in a manner which precludes such an occurrence.

Cymbet EnerChip™ batteries will not create sparks or generate heat as they are packaged to prevent contact with other batteries or materials and are shipped in a fully discharged condition. EnerChips meet the requirements of section g.

h. Lithium batteries or cells are not authorized aboard an aircraft in checked or carry-on luggage except as provided in §175.10.

§ 175.10 Exceptions for passengers, crew members, and air operators.

(a) This subchapter does not apply to the following hazardous materials when carried by aircraft passengers or crew members provided the requirements of this section are met:

17) Except as provided in §173.21 of this subchapter, consumer electronic and medical devices (watches, calculating machines, cameras, cellular phones, lap-top and notebook computers, camcorders, etc.) containing lithium cells or batteries and spare lithium batteries and cells for these devices, when carried by passengers or crew members for personal use. Each spare battery must be individually protected so as to prevent short circuits (by placement in original retail packaging or by otherwise insulating terminals, e.g., by taping over exposed terminals or placing each battery in a separate plastic bag or protective pouch) and carried in carry-on baggage only. In addition, each installed or spare battery must not exceed the following:

(i) For a lithium metal battery, a lithium content of not more than 2 grams per battery; or

(ii) For a lithium-ion battery, an aggregate equivalent lithium content of not more than 8 grams per battery, except that up to two batteries with an aggregate equivalent lithium content of more than 8 grams but not more than 25 grams may be carried.

The Cymbet EnerChip™ lithium content is much less than 1 mg. Therefore the requirements of Section h are met by Cymbet EnerChip devices.

Section X - WEEE Directive 2002/96/EC

The Waste Electrical and Electronic Equipment Directive sets the collection, recycling and recovery targets for electrical goods and is part of a legislative initiative to solve the problem of huge amounts of toxic e-waste. The WEEE Directive is meant to work in concert with the RoHS Directive to set restrictions upon manufacturers as to the material content of new electronic equipment placed on the market. The WEEE Directive sets a total of 10 categories of electronics products. EnerChips could be designed into any category by Cymbet's customers. Given it is the responsibility of the equipment producer/distributor to make provisions for waste collection and recycling, Cymbet provides the following instructions for products the incorporate EnerChip devices:

EnerChip devices are both RoHS compliant and REACH Compliant and should be processed as part of a

WEEE marked product with other on-board integrated circuit devices using the appropriate processes that adheres to local disposal and recycling regulations and instructions.

Section XI - EU Battery Directive 2006/66/EC

Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators, commonly known as the Battery Directive, regulates the manufacture and disposal of batteries in the European Union with the aim of "improving the environmental performance of batteries and accumulators". Directive 2006/66/EC repealed Directive 91/157/EEC and sets maximum quantities for certain chemicals and metals in batteries;tasks Member States with encouraging improvements to the environmental performance of batteries; requires proper waste management of these batteries, including recycling, collections, "take-back" programs, and disposal;sets waste battery collection rates; sets financial responsibility for programs; and makes rules covering most phases of this legislation, including labeling, marking, documentation, reviews, and other administrative and procedural matters.

The Battery Directive was created prior to the introduction of solid state thin film batteries and is focused on issues surrounding legacy chemical batteries that use lead, mercury and cadmium in particular (EnerChips do not contain any of these materials). Cymbet is absolutely committed to environmentally friendly battery solutions and believes it is important to support the Battery Directive and provide Cymbet customers with the information required to properly support the intent of this Directive. There are several Articles in the Directive 2006/66/EC that are applicable to Cymbet EnerChip solid state batteries:

- Article 3 - Definitions - The Cymbet EnerChip does use an electrochemical conversion to generate electricity and therefore is considered to be a battery as defined in this Article. The EnerChip is considered to be a Portable Battery as defined in this Article. Appliance is any electrical or electronic equipment sold by a Cymbet customer that integrates an EnerChip solid state battery. Producer means any person or company that places appliances or vehicles on the market for the first time that contains a battery such as the EnerChip.

- Article 4 - Prohibitions - There are exemptions to the Directive for producers of: emergency and alarm systems including emergency lighting, medical equipment, or cordless power tools.

- Article 5 - Increased Environmental Performance - This Article promotes research and encourages improvements in the overall environmental performance of batteries through their entire life cycle. **EnerChip solid state batteries have been commercialized specifically to increase environmental performance in support of this Article.**

- Article 11 - Removal of waste batteries and accumulators - This article suggests that batteries be readily removed from appliances at time of disposal with instructions showing how they can be removed safely. **Producer and Recycler EnerChip removal Instructions to satisfy this Article are: EnerChip devices are to be removed from a printed circuit board at the processing stage when the other RoHS compliant devices and integrated circuits are safely removed from a printed circuit board at time of disposal in a manner that complies with local practices and regulations.**

- Article 12 - Treatment and Recycling - Article 12 section 1a states: producers or third parties set up schemes using best available techniques in terms of the protection of heath and the environment, to provide for the treatment and recycling of waste batteries and accumulators; and (b) all identifiable batteries and accumulators collected in accordance with Article 8 of this Directive or with Directive 2002/96/EC undergo treatment and recycling through schemes that comply as a minimum, with Community legislation in particular as regards health, safety, and waste management. **Producer and Recycler EnerChip treatment and recycling Instructions to satisfy this Article are: After EnerChip**

devices are removed from a printed circuit board with the other RoHS compliant devices and integrated circuits as per Article 11, they are to be recycled in combination with this material in a manner that complies with local treatment and recycling practices and regulations. It is important to note that EnerChip devices do not contain any materials in amounts that can be appreciably recycled.

- Article 13 - New Recycling Technologies - "Member States shall encourage the development of new recycling and treatment technologies and promote research into environmentally friendly and cost effective methods for all types of batteries and accumulators" **Cymbet EnerChip solid state battery products have met the challenge of this Article as an environmentally friendly commercially available battery with the most cost effective disposal method.**

Section XII - MSDS and OSHA Information

Material Safety Data Sheets (MSDS) are a sub-requirement of the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200. This Hazard Communication Standard does not apply to various subcategories including anything defined by OSHA as an "article". OSHA has defined an "article" as a manufactured item other than a fluid or particle; (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; (iii) which under normal conditions of use does not release more than very small quantities, e.g. minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees. Cymbet EnerChip devices are defined as OSHA articles.

As an MSDS consideration, the following materials are present in an EnerChip Solid State Battery:

Material	**Formula**
Lithium Cobalt Oxide	$LiCoO_2$
Lithium Phosphate Oxynitride	LiPON
Standard IC Packaging Materials	

Because Cymbet EnerChip™ batteries are defined as "articles", they are exempt from the requirements of the Hazard Communication Standard; hence an Material Safety Data Sheet is not required.

Section XIII - EnerChip End-of-life Disposal Instructions and Recycling Information

The EnerChip solid state battery is a new innovative technology designed to overcome the environmental disposal issues posed by the legacy technologies coin cell batteries and super capacitors. Unfortunately, many of the Standards and Directives listed in this Product Information Sheet were created before the commercial availability of solid state batteries. Therefore, it is important to utilize the most environmentally friendly and cost effective disposal methods that meet the intent of these various Standards and Directives.

As highlighted in the previous WEEE Directive and Battery Directive Sections: **As a RoHS tested compliant device, the Cymbet EnerChip should be disposed of with other WEEE marked electronics and RoHS components as per local practices and regulations.**

Typically electronic components will be separated from printed circuit boards. The printed circuit boards are often recycled to recover copper and potentially gold if present. The removed electronic components including Cymbet EnerChips are typically sent to a smelting operation for recycling. Alternatively, the entire PCB and components might be smelted together. **EnerChip batteries do not need to be removed from circuit boards before incineration**. **EnerChip batteries are safe for incineration and will not release extra or unusual substances. Cymbet Enerchip products contain no substances of very high concern listed in the European Union REACH Directive. There are no toxic chemicals in the EnerChip.**

EnerChips contain no materials that can be appreciably reclaimed in a recycling process. The materials that constitute various Cymbet EnerChip solid state batteries are as follows:

Bare die:

- CBC050 weighs approximately 16 mg.
  - 15 mg of Silicon and Silicon Dioxide which is 93.75% of the mass
  - 500 micrograms of Lithium Cobalt Oxide which is 3.1%
  - 500 micrograms of LiPON which is 3.1%
  - The remainder is less than .1% of Aluminum, nickel, titanium and a polyimide
- CBC012 weighs approximately 5 mg.
  - 4.7 mg of Silicon and Silicon Dioxide which is 93.75% of the mass
  - 150 micrograms of Lithium Cobalt Oxide which is 3.1%
  - 150 micrograms of LiPON which is 3.1%
  - The remainder is less than .1% of Aluminum, nickel, titanium and a polyimide

Packaged Enerchip:

- CBC050 weighs approximately 160 mg.
  - A majority of the mass is the molding compound. This is Sumitomo Bakelite EME-G770H.
  - The remainder is the bare die, gold wire. A lead frame made of nickel, palladium and gold with copper plating and an epoxy coating which is Ablestik 84-1LMI. All materials are ROHS compliant.
- CBC012 weighs approximately 69 mg.
  - Contains the same materials as the CBC050.
- CBC3150 weighs approximately 220 mg
  - The only difference from the CBC050 is the CBC3150 contains an ASIC control chip. This is a the CBC910 ASIC device. The remaining components are the same as in the CBC050.
- CBC3112 weighs approximately 130 mg and contains the same materials as the CBC3150.

Section XIV - In vitro Biocompatibility Test Standards for Cytotoxicity

There are many medical applications where EnerChip solid state batteries might be used in vitro or in vivo. The biocompatibility of the EnerChip was evaluated using the following battery of in vitro test methods:

- Cytotoxicity: Medium Eluate Method (MEM) - 1x CMEM Cell Growth Medium Extract
- Cytotoxicity: Agar Diffusion - Solid Sample

Passing results in these procedures has a strong correlation to acceptable results in the remaining aspects of biocompatibility as suggested by both the EN ISO 10993-1:2009 *Biological Evaluation of Medical Devices - Part 1: Evaluation and testing within a risk management process* and the U.S. Food and Drug Administration (FDA) *Blue Book Memorandum No. G95-1 (1995)* guidelines. The test conclusions for the EnerChip test article were:

The gamma sterilized Cymbet CBC005-BDC-ES 5µA-hr EnerChipTM was found to be non-cytotoxic (0% cell lysis) using both the Medium Eluate Method Eluation Test and Agar Diffusion Test feasibility screening procedures. The lack of any adverse biological responses in these very sensitive in vitro cell culture assays is indicative (although not a guarantee) of biocompatible test results in the other in vitro and in vivo aspects of biocompatibility as suggested by the ISO 10993-1 and FDA G95-1 guidelines.

For Additional Information

For additional information concerning the topics addressed in this Product Information Sheet please contact Cymbet at:

Telephone: +1-763-633-1780

Email: apps@cymbet.com