

## B.12 Material Safety Data Sheet



### MATERIAL SAFETY DATA SHEET

(form according to EEC Directive 93/112/EC)

NAME : LITHIUM-ION RECHARGEABLE BATTERIES

#### 1- IDENTIFICATION (of the product and the supplier)

##### 1.1. Product

Rechargeable battery

yes	X
no	

Trade name and model : LITHIUM-ION RECHARGEABLE BATTERIES

IEC designation :

Models : MP series MP 144350 - MP 174865 - MP 176065  
 VL series VL34570 - VL34480

Electrochemical system :

Electrodes	Negative electrode Carbon	Positive electrode Lithium cobaltite (LiCoO <sub>2</sub> )*
Electrolyte	Solution of lithium hexafluorophosphate (LiPF <sub>6</sub> ) in a mixture of organic solvents**	
Nominal voltage	3.6 Volt	

\* Equivalent name : lithiated cobalt oxide

\*\* Ethylene Carbonate (EC) + DiMethyl Carbonate (DMC) + DiEthyl Carbonate (DEC)  
 + Ethyl Acetate (EA).

##### 1.2 - Supplier

Name : SAFT

Address :	for MP series	for VL series
	Rue Georges Leclanché - BP 1039 86060	313 Crescent Street
	Poitiers Cedex 09 - France	Valdese, NC USA
	Phone : +33 (0)5 49 55 48 48	+1 (0)828-874-4111
	Fax : +33 (0)5 49 55 48 50	+1 (0)828-874-2431

##### 1.3 - Emergency contact :

for MP series : Plant Manager Phone: +33 - (0)5 49 55 48 48  
 for VL series : CHEMTREC Phone: +1 - 800 424-9300  
 for information : +1-828-874-4111 or +1-828-438-3287

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**S A F T**

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## 2 - COMPOSITION (typical weight percentages of basic material)

Metals	%	Plastics	%	Others	%
Steel, Copper, Aluminum	31	Polypropylene	10	- Lithium cobaltite	29
				- Carbon	16
				- Organic solvents	13
				- Salts	1
				- Lithium metal	0

## 3 - HAZARDS IDENTIFICATION

### 3.1 - Physical :

The Lithium-Ion rechargeable batteries described in this Material Safety Data Sheet are sealed units which are not hazardous when used according to the recommendations of the Manufacturer.

Under normal conditions of use, the solid electrode materials and liquid electrolyte they contain are non-reactive provided the battery integrity is maintained and seals remain intact. Risk of exposure only in case of abuse (mechanical, thermal, electrical) leading to the activation of safety valves and/or the rupture of the battery containers. Electrolyte leakage, electrode materials reaction with moisture/water or battery vent/explosion/fire may follow, depending upon the circumstances.

MP batteries are fitted with a safety vent for protection incase of excessive internal pressure and/or temperature.

### 3.2 - Chemical :

Classification of dangerous substances contained into the product  
as per directive 67/548/EEC

Substance	CAS N°	Chemical symbol	Melting Point	Boiling Point	Classification			
					Exposure limit	Indication of danger	Special risk (1)	Safety advice (2)
	12190-79-3	LiCoO <sub>2</sub>	> 1000°C	N/A	0.1 mg/m <sup>3</sup> OSHA		R22 R43	S2 S22 S24 S26 S36 S37 S43 S45
EC : 96-49-1 DMC : 616-38-6 DEC : 105-58-8 EA : 141-78-6		Organic solvents (DC-DMC DEC-EA)	EC : 38°C DMC : 4 °C DEC : -43°C EA : -84°C	EC : 243°C DMC : 90°C DEC : 127°C EA : 77°C	None established OSHA	Flammable	R21 R22 R41 R42/43	S2 S24 S26 S36 S37 S45
21324-40-3		LiPF <sub>6</sub>	N/A (decomposes at 160°C)	N/A	None established OSHA	Irritant Corrosive	R14 R21 R22 R41 R43	S2 S8 S22 S24 S26 S36 S37 S45



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1 - Nature of special risks :

- R 14            Reacts with water
- R 21            Harmful in contact with skin
- R 22            Harmful if swallowed
- R 41            Risk of serious damage to the eye
- R 42/43        May cause sensitization by inhalation and skin contact
- R 43            May cause sensitization by skin contact

2 - Safety advices :

- S 2            Keep out of reach from children
- S 8            Keep away from moisture
- S 22           Do not breathe dust
- S 24           Avoid contact with skin
- S 26           In case of contact with eyes, rinse immediately with plenty of water and seek medical attention
- S 36           Wear suitable protective clothing
- S 37           Wear suitable gloves
- S 45           In case of incident, seek medical attention.

4 - FIRST AID MEASURES

In case of battery rupture or explosion, evacuate personnel from contaminated area and provide maximum ventilation to clear out fumes/gases.

In all case, seek medical attention.

**Eye contact :** Flush with plenty of water (eyelids held open) for at least 15 minutes.

**Skin contact :** Remove all contaminated clothing and flush affected areas with plenty of water and soap for at least 15 minutes.  
Do not apply greases or ointments.

**Ingestion :** Dilute by giving plenty of water and get immediate medical attention. Assure that the victim does not aspirate vomited material by use of positional drainage.  
Assure that mucus does not obstruct the airway.  
Do not give anything by mouth to an unconscious person.

**Inhalation :** Remove to fresh air and ventilate the contaminated area.  
Give oxygen or artificial respiration if needed.



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## 5 - FIRE-FIGHTING MEASURES

**Fire and explosion hazard :** The battery can leak and/or spout vaporized or decomposed and combustible electrolyte fumes in case of exposure above 70°C resulting from inappropriate use or the environment.

Possible formation of hydrogen fluoride (HF) and phosphorous oxides during fire.

Li PF<sub>6</sub> salt contained in the electrolyte releases hydrogen fluoride (HF) in contact with water.

**Extinguishing media :**  
*Suitable :* CO<sub>2</sub>,  
Dry chemical or Foam extinguishers  
*Not to be used :* Type D extinguishers

**Special exposure hazards :** Following cell overheating due to external source or due to improper use, electrolyte leakage or battery container rupture may occur and release inner component/material in the environment.

**Eye contact :** The electrolyte solution contained in the battery is irritant to ocular tissues.

**Skin contact :** The electrolyte solution contained in the battery causes skin irritation.

**Ingestion :** The ingestion of electrolyte solution causes tissue damage to throat and gastro/respiratory tract.

**Inhalation :** Contents of a leaking or ruptured battery can cause respiratory tract, mucus, membrane irritation and edema.

**Special protective equipment :** Use self-contained breathing apparatus to avoid breathing irritant fumes.  
Wear protective clothing and equipment to prevent body contact with electrolyte solution.

## 6 - ACCIDENTAL RELEASE MEASURES

The material contained within the batteries would only be expelled under abusive conditions.

Using shovel or broom, cover battery or spilled substances with dry sand or vermiculite, place in approved container (after cooling if necessary) and dispose in accordance with local regulations.



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## 7 - HANDLING AND STORAGE

The batteries should not be opened, destroyed nor incinerated since they may leak or rupture and release in the environment the ingredients they contain.

**Handling :** Do not crush, pierce, short (+) and (-) battery terminals with conductive (i.e. metal) goods. Do not directly heat or solder. Do not throw into fire. Do not mix batteries of different types and brands. Do not mix new and used batteries. Keep batteries in non conductive (i.e. plastic) trays.

**Storage :** Store in a cool (preferably below 30°C) and ventilated area away from moisture, sources of heat, open flames, food and drink. Keep adequate clearance between walls and batteries. Temperature above 70°C may result in battery leakage and rupture. Since short circuit can cause burn, leakage and rupture hazard, keep batteries in original packaging until use and do not jumble them.

**Other :** Follow Manufacturers recommendations regarding maximum recommended currents and operating temperature range.

Applying pressure on deforming the battery may lead to disassembly followed by eye, skin and throat irritation.

## 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

**Respiratory protection :** *Not necessary under normal use.*  
In case of battery rupture, use self contained full-face respiratory equipment.

**Hand protection :** *Not necessary under normal use.*  
Use gloves if handling a leaking or ruptured battery.

**Eye protection :** *Not necessary under normal use.*  
Wear safety goggles or glasses with side shields if handling a leaking or ruptured battery.

**Skin protection :** *Not necessary under normal use*  
Use rubber protective working in case of handling of a ruptured battery.

## 9 - PHYSICAL AND CHEMICAL PROPERTIES

**9.1 Appearance :** (Physical shape and color as supplied)  
Small prismatic metal cylinders, hermetically sealed and fitted with an external plastic sleeving.



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9.2 Temperature range :

	Continuous	Occasional
in storage	+ 30°C max	-40/+70°C
during discharge	-30/+70°C	-40/+70°C
during charge	0/+50°C	0/50°C

9.3 Specific energy :

≈ 130 Wh/kg

(Note : Wh = Nominal voltage x Rated Ah as defined in IEC Standard N° 285. Kg = Average battery weight)

9.4 Specific pulse power : ≈ 300 Wh/kg

9.5 Mechanical resistance : As defined in relevant IEC Standard

9.6 Other :

10 - STABILITY AND REACTIVITY

Conditions to avoid : Heat above 70°C or incinerate.  
Deform, mutilate, crush, pierce, disassemble.  
Short circuit.  
Prolonged exposure to humid conditions.

Materials to avoid : N/A

Hazardous decomposition products :

Corrosive/Irritant Hydrogen fluoride (HF) is produced in case of reaction of *lithium hexafluorophosphate (LiPF<sub>6</sub>)* with water..

Combustible vapors and formation of Hydrogen fluoride (HF) and phosphorous oxides during fire.

11 - TOXOLOGICAL INFORMATION

SAFT MP and VL Lithium-Ion rechargeable batteries do not contain toxic materials.

12 - ECOLOGICAL INFORMATION

**SAFT**

When properly used or disposed, SAFT MP and VL Lithium-Ion rechargeable batteries do not present environmental hazard.

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**13 - DISPOSAL CONSIDERATIONS**

Dispose in accordance with applicable regulations which vary from country to country.

*(In most countries, the trashing of used batteries is forbidden and the end-users are invited to dispose them properly, eventually through not-for-profit profit organizations, mandated by local governments or organized on a voluntary basis by professionals).*

Lithium-Ion batteries should have their terminals insulated and be preferably wrapped in plastic bags prior to disposal.

13.1 . Incineration : Incineration should never be performed by battery users but eventually by trained professionals in authorized facilities with proper gas and fumes treatment.

13.2 . Landfilling : Leachability regulations (mg/l)

Component	Leachability	EC limit	EPA	Other*
Iron	100			5
Nickel	500	2		0.5

\* applicable to France

13.3 . Recycling : Send to authorized recycling facilities, eventually through licensed waste carrier.

**14 - TRANSPORT INFORMATION**

14.1 United Nations : UN N° 3090 }  
 Classification 9  
 Packaging ICAO 903 for Air Transport  
 IMDG for Sea Transport

14.1 International conventions :  
 Air IATA Yes  
 Sea IMDG Yes  
 Land ADR (road) Yes  
 RID (rail) Yes

14.3 Other : in the USA Code of Federal Regulations  
 (49 CFR Ch. 1 § 173-185)



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#### 15 - REGULATORY INFORMATION

The transport of rechargeable Lithium-ion batteries is regulated by the United Nations as detailed in the "Model Regulations on the Transport of Dangerous Goods Ref. ST/SG/AC.10/1 Revision 11 1999".

Depending on their lithium equivalent weight content, and ability to pass safety tests defined by UN in the "Recommendations on the Transport of Dangerous Goods Chapter 38.3 Manual of Tests and Criteria Ref. ST/SG/AC. 10/11 Third Revised Edition 1999", the Lithium-ion cells and the battery packs may or may not be assigned to the UN N° 3090 Class-9 that is restricted for transport.

Individual Lithium-ion cells and battery packs with respectively less than 1.5 and 8 gram of Lithium Equivalent Weight content (case of the MP 14 43 50 and MP 17 48 65 batteries; and VL34570 and VL34480 batteries) are not restricted for transport (1.0. Ah of Nominal Capacity = 0.3 gram of LEW).

#### 16 - OTHER INFORMATION / DISCLAIMER

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge and belief, accurate and reliable as of the date compiled. However, no representation, warranty (either expressed or implied) or guarantee is made to the accuracy, reliability or completeness of the information contained herein.

This information relates to the specific materials designated and may not be valid for such material used in combination with any other materials or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

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First Edition    Date 07/2000

Signed \_\_\_\_\_  
Lithium Product Manager



### B.13 Procedure #020



UNCONTROLLED  
DOCUMENT

#### RESEARCH AND DEVELOPMENT CENTER

#### HANDLING AND SAFETY RECOMMENDATIONS FOR NON-COMMERCIAL AND HIGH POWER LITHIUM ION BATTERIES

#### PROCEDURE # 020

Prepared By:  Date: 4/7/00  
Guy Chagnon  
Checked By:  Date: 7 Apr 00  
Lisa Bull  
Approved By:  Date: 4/7/00  
Steve Hafner

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Issue Date: 04-04-00  
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NON-COMMERCIAL AND HIGH POWER LITHIUM ION BATTERIES  
PROCEDURE #20

REVISION PAGE

Revision Level	Date	SCO Number	Pages Revised	Approved By
0		N/A	New Release	

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HANDLING AND SAFETY RECOMMENDATIONS FOR  
NON-COMMERCIAL AND HIGH POWER LITHIUM ION BATTERIES  
PROCEDURE #20**

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## 1.0 SUBJECT

The purpose of this document is to:

- Define safety recommendations for battery transportation
- Provide recommendations that must be followed to test SAFT batteries, at the bench level or on board vehicles in safe conditions for lithium ion (LiON) cells, modules, and batteries

The acknowledgment form (§8) must be completed and returned to Saft within ten days after receipt of this specification.

## 2.0 DEFINITIONS

- 2.1 A battery is composed of one or several electrochemical LiON cells. It can include a mechanical frame, a thermal management system, an electronic management system, a power circuit, and interfaces with external devices.
- 2.2 "User" means the company or the laboratory in charge of tests, its staff, its subcontractors or any other person working under its responsibility, its control, or appointed by it.
- 2.3 "Test" means the handling and/or the storage of a battery, test operations in the test facility and on board vehicles.

## 3.0 PROCEDURES

### 3.1 Handling

For each handling operation, the battery must be in a low state of charge. This state is defined by open circuit voltage (OCV) of each electrochemical cell lower than 3.5 Volts.

### 3.2 Storage

Before, between, and after each test period, batteries must be stored according to the following recommendations:

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- 3.2.1 Storage on a dry, clean, and insulated surface at ambient temperature (between 0 and 30°C).
- 3.2.2 For batteries on board vehicles, long-term storage must take place in a temperature controlled area (between 0 and 30°C).
- 3.2.3 Smoking and spark generation around stored batteries is strictly prohibited.
- 3.2.4 No permanent electrical connection with charge or discharge equipment is allowed.
- 3.2.5 Periodic inspection of each electrochemical cell voltage (periodically once per week) must be performed. If the OCV (Open Circuit Voltage) is under 3 Volts for one cell, a charge must be performed with the voltage limitation set at 3.5 Volts per cell with the recommended charge current.
- 3.2.6 The area must be protected and fitted with appropriate equipment for fire detection and fire suppression.

**3.3 Transportation**

For each battery, the following recommendations must be adhered to for transportation:

- 3.3.1 The transport firm must be qualified to carry products of class 9 UN 3090
- 3.3.2 The battery packaging must be compliant with the text 3500 of the ADR
- 3.3.3 The type of the battery must be mentioned on the packing list: lithium ion battery
- 3.3.4 The battery must be at a state of charge lower than 3.5 Volts per cell
- 3.3.5 Road Transportation Documents

SAFT's non-commercial and high power LiON batteries are produced at various SAFT International facilities and transport to and from various countries.

- a) Three documents must be attached to the battery for US Department of Transportation (DOT):

A DOT approval to ship large LiON cell and battery: CA-9802002

This SAFT document

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Material Safety Data Sheet (MSDS)

- b) Three documents must be attached to the battery for French road transportation:

A French road transportation approval N° 99/087

This SAFT document

Material Safety Data Sheet (MSDS)

**3.3.6 Air Transportation Documents**

- a) Three documents must be attached to the battery for Air transportation per the US DOT:

A DOT approval to ship large LION cell and battery: CA-9802002

This SAFT document .

Material Safety Data Sheet (MSDS)

- b) Three documents must be attached to the battery for Air transportation from a location in France

A Cargo Air transportation approval N° 903-99

This SAFT document

Material Data sheet (MSDS)

**3.3.7** Batteries must be transported according to local regulations for other countries.

**3.3.8** If the battery voltage is higher then 60V, the proper high voltage hazard label must be affixed to the packaging.

**4.0 GENERAL SAFETY RECOMMENDATIONS**

The test must be done according to a test program and test procedures written or approved by Saft.

Each operation of dismantling, repairing or assembling the battery by the user is strictly forbidden.

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The test operators and vehicle drivers must have read this document.

Each test not in accordance with the recommendations of this document will be made at the user's risk. The user will take full responsibility for the direct and indirect consequences of any resulting incidents.

At the end of the test, or at the end of life of the battery, it is the responsibility of the user to take appropriate measures to handle, transport, and ultimately, recycle the battery.

## **5.0 SPECIFIC PROCEDURES FOR BATTERY TESTING**

Each battery component previously damaged (fall – shock – exposed to high temperature – short circuited – overcharged – over discharged – immersion – etc.) or having any abnormal characteristics (deformation, visual defects, coolant leakage, insulation failure, etc.) must not be submitted to test. It must be submitted to Saft for analysis.

Connecting/disconnecting the battery shall be performed according to the SAFT installation procedure. Any concerns and/or questions shall be clarified with SAFT engineering personnel before starting any operation (connection, testing, ...).

It is strictly forbidden to modify the battery management system (BMS) without SAFT's written agreement.

It is the responsibility of the user to ensure that any bench test equipment involved does not create any of the following:

### **5.1 Electric insulation problem between battery components**

The battery has to rest on an insulated surface. Any cooling liquid leak must be removed in order to avoid insulation problems. The electric insulation of the battery must be monitored periodically.

### **5.2 External short circuit**

A fuse, calculated according to the test procedures and to the test equipment characteristics, must be connected to at least on one polarity of the battery in a series connection with the battery output.

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**5.3 Overcharge**

The following safety limits must be programmed in the test equipment. If one of the following thresholds is reached, the equipment must stop the test immediately:

- A maximum battery voltage set at 105% of the recommended end-of-charge voltage
- A maximum current for charge set at 110% of the recommended charge current
- A maximum charge capacity set at 110% of the nominal battery capacity
- A maximum cell temperature of 65°C

**Very Important:**

To prevent the effects of test equipment failure, an independent safety device must be installed. It must switch off the test equipment as soon as the battery voltage reaches the safety limits defined above.

**5.4 Overdischarge**

The normal end of discharge battery voltage is 2.7 Volts per cell. It must not decrease below 2.0 Volts per cell. An independent safety system must be installed to prevent the effects of test equipment failure; as specified in to §5.3.

**5.5 Tests Performed In a Climatic Chamber**

When tests are performed in a climatic chamber or in confined atmosphere, the following equipment must be installed:

- Flammable gas sensors. These devices must stop the test immediately and start the ventilation as soon as the gas concentration is higher than 20 % of the lower explosive limit. If no specific requirements are defined by Saft, these devices must be calibrated on H<sub>2</sub>.
- Safety devices limiting over pressure in the chamber (such as blow out panel).
- Fan/ventilation system for the chamber.

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Automatic extinguishing devices compatible with lithium ion must be implemented and linked with ventilation as necessary.

In addition to previous recommendations when using a CAN bus interface to perform the test, the test equipment must stop when:

The CAN bus line is opened

The CAN bus line is short circuited

The BMS power supply is switched OFF

Software is provided by Saft to record the information given by the BMS. It must be installed on a computer to help perform diagnostics in case of CAN failures. Data files must be sent to Saft at Saft's request.

## **6.0 BATTERY TESTING ON BOARD VEHICLES**

It is the responsibility of the user to ensure that any battery tested on board a vehicle is not subjected to any of the following:

### **6.1 Overcharge**

- > In the vehicle, the safety limits defined in § 5.1.3 must be programmed at the charger and/or vehicle controller level and must be based on independent voltage measurement.
- > The charge must be stopped by direct action on the charger.

### **6.2 Overdischarge**

- > The normal end-of-discharge cell voltage is 2.7 Volts. It must not decrease lower than 2.5 Volts per cell, except under pulse below 0°C, with a limit of 2.0V.
- > A second independent safety device is also necessary to detect any CAN bus failure.
- > The vehicle controller must open the power circuit if the battery voltage is lower than the minimum voltage allowed for the battery.

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- A computer must be connected to the battery manager computer records the data given by the electronics to check the vehicle. Data files must be sent to Saft at Saft's request.

Prior to removing the battery from the vehicle, the battery must be fully charged (cf. §3.1).

## **7.0 HAZARDOUS SITUATIONS**

In some extreme hazardous situations (Crush, shock, drop, immersion, high temperature, short circuit, overcharge, over-discharge, or flames) may occur.

It is the responsibility of the user to take appropriate actions following:

- 7.1 To protect people and equipment
- 7.2 To provide emergency exits for evacuation
- 7.3 To train the fire department in the risks associated with lithium

## **8.0 ACKNOWLEDGE RECEIPT**

The following page must be completed and returned to Saft's representative within ten days after receipt.

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Saft Research and Development Center  
107 Beaver Court  
Cockeysville, MD 21030  
Tel: (410)-771-3200  
Fax: (410)-771-0234

Dear Sir/Madam:

Attached, please find the latest release of SAFT's Handling and Safety Recommendations for LiON Batteries.

Please do the following:

1. Destroy all previous releases of that document you may already have.
2. Review this document to become familiar with any changes.
3. Complete the bottom of this page and return it to SAFT at the

Sincerely yours.

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NAME:

Position/Title

COMPANY:

Date:

We acknowledge receipt of the attached SAFT document regarding Handling and Safety Recommendations for LiON Batteries.

SIGNATURE

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### B.14 Shipper's Declaration for Dangerous Goods

**SHIPPER'S DECLARATION FOR DANGEROUS GOODS**

Shipper: \_\_\_\_\_  
To: \_\_\_\_\_  
From: \_\_\_\_\_  
Shipper's Reference No.: \_\_\_\_\_

Origin: \_\_\_\_\_

As a shipper of dangerous goods, I hereby declare that the goods are for transport by air.

**TRANSPORT DETAILS**

Proper shipping name: \_\_\_\_\_  
Quantity: \_\_\_\_\_  
Gross weight: \_\_\_\_\_  
Net weight: \_\_\_\_\_  
Volume: \_\_\_\_\_  
Number of packages: \_\_\_\_\_  
Number of consignees: \_\_\_\_\_

Assessment of hazard: \_\_\_\_\_

**WARNING**

These goods are dangerous and may be hazardous to health, property, or the environment. They are subject to special handling and packaging requirements. The shipper is responsible for ensuring that the goods are properly packaged and labeled in accordance with applicable regulations.

**LABORATORY DECLARATION**

Origin: \_\_\_\_\_  
Destination: \_\_\_\_\_  
Product Name: \_\_\_\_\_  
Quantity: \_\_\_\_\_  
Gross weight: \_\_\_\_\_  
Net weight: \_\_\_\_\_  
Volume: \_\_\_\_\_  
Number of packages: \_\_\_\_\_  
Number of consignees: \_\_\_\_\_

Additional Handling Information: \_\_\_\_\_

**SHIPPER'S DECLARATION**

I hereby declare that the contents of this declaration are true and accurate, and that the goods described above are properly packaged, labeled, and marked in accordance with applicable regulations. I understand that I am responsible for ensuring that the goods are properly packaged and labeled in accordance with applicable regulations.

Signature: \_\_\_\_\_  
Date: \_\_\_\_\_

