SAFETY DATA SHEET

ENGINEERED POWER LP

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Product identifier	**Lithium Thionyl Chloride Metal Batteries with Aluminum Electrolyte**
GHS Product Identifier	**See Above**
Chemical Name	Not applicable
Trade name	**See Above**
CAS No.	Manufactured article containing hazardous mixture.

Details of the supplier of the safety data sheet

Company Identification	**Engineered Power**
Address	**#20, 3103 - 14th Avenue N.E. Calgary, Alberta, Canada T2A 7N6**
Telephone	**(403) 235-2584**
E-Mail (competent person)	info@engineeredpower.com

Emergency telephone number – ChemTel Inc.

Emergency Phone No. - ChemTel Inc. (800) 255-3924 Toll-Free , (813) 248-0585

SECTION 2: HAZARDS IDENTIFICATION

Note: The hazards listed in this document reference only the contents of cells and/or batteries that are leaking and/or ruptured. Undamaged cells and/or batteries possess no expected health or physical hazards during normal use. Intentional abuse of cells or batteries increases the risk of harm or damage to the product, to the user, and to surrounding materials and personnel. Do not attempt to open sealed cells or batteries. Do not intentionally short-circuit cells or batteries. Do not expose these products to temperatures exceeding the maximum manufacturers rating. Do not dispose of cells/batteries in landfills. Please follow all manufacturer guidelines in the use, storage, and disposal of these products. Consult manufacturer in cases of questions involving specific product usage.

GHS Product Identifier
Hazard pictogram(s)

Signal word(s) **DANGER (References Contents Only)**

Hazard statement(s)
H260: In contact with water releases flammable gases which may ignite spontaneously.
H330: Fatal if inhaled.
H314: Causes severe skin burns and eye damage.
H302: Harmful if swallowed.

Precautionary statement(s)
P260: Do not breathe mist/vapours/spray.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P284: Wear respiratory protection.
P301 + P330 + P331: IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a POISON CENTRE or doctor/physician.

USA
USA Classification: Hazardous under OSHA Hazard Communication Standard –Toxic by Inhalation, Corrosive (Eyes,Skin), Reactive with water
HMIS: Health-4, Flammability-3, Reactivity-3

CANADA
WHMIS Classification (Canada): Hazardous under WHMIS.
Class B6 – Reactive Flammable Material
Class D1A – Immediately Toxic Material
Class E – Corrosive Material

Other Information

Potential Health Effects **– This section references the contents of leaking and/or ruptured devices. Intact cells pose health hazards only through ingestion, and pose the same hazard as the device contents.**

Inhalation - Toxic or fatal if inhaled. Electrolyte is extremely corrosive to the tissue of the mucous membranes and upper respiratory tract.

Skin - May be absorbed through skin. Corrosive: causes skin burns. Lithium metal is corrosive.

Eyes – Both electrolyte and lithium metal cause severe eye burns. May cause irreversible corneal damage.

Ingestion - Harmful if swallowed. Corrosive to throat and digestive tract.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Hazardous ingredient(s)	%W/W	CAS No.	GHS Hazard pictogram(s) and Hazard statement(s)
Thionyl Chloride	40-50	7719-09-7	 3.1/2 (Inhalation), 3.1/4 (Oral), 3.2/1A : H302, H314, H330
Lithium Chloride	<10	7447-41-8	 3.1/4 (Oral), 3.2/2, 3.3/2: H302, H315, H319
Aluminum Chloride	<20	7446-40-0	 3.2/1B : H314
Lithium Metal	<10	7439-93-2	 2.12/1, 3.2/1B ; H260, H314

Additional Information - For full text of H phrases see section 16. Non-Hazardous ingredients are not listed and make up the balance of the product.

SECTION 4: FIRST AID MEASURES

The hazards listed below reference only the contents of cells and/or batteries that are leaking and/or ruptured, with the exception of ingestions. In the unlikely case where intact cells/batteries are ingested, the treatment is the same as for ingestions of device contents.

Inhalation	(Exposure to electrolyte fumes) Remove patient from exposure. Keep patient at rest; give oxygen if breathing difficult. Obtain immediate medical attention. Delayed pulmonary edema may occur.
Skin Contact	Contents of leaking or cracked batteries cause serious and painful burns. Remove contaminated clothing immediately and drench affected skin with plenty of water, then wash with soap and water. Obtain immediate medical attention.
Eye Contact	Battery contents will cause serious eye damage. Irrigate with eyewash solution or clean water, holding the eyelids apart, for at least 15 minutes. Obtain immediate medical attention.
Ingestion	DO NOT INDUCE VOMITING! Give milk of magnesia or chalk slurry if victim can swallow. Contents will damage esophageal and digestive tracts. If swallowed, seek medical advice immediately and show this Safety Data Sheet or label.
Most important symptoms and effects (Exposure to Battery Contents only)	**Acute:** Causes serious respiratory irritation. Causes burns to skin and eyes. **Delayed and chronic effects:** Pulmonary edema may be delayed. May cause irreversible damage to lungs, corneas, skin, esophageal tract, digestive tract, and generalized organ damage. Burns may heal slowly and leave scar tissue.
Indication of the immediate medical attention and special treatment needed	**Decontaminate patient thoroughly with sodium bicarbonate solution if contact with battery contents occurs.** Treat other symptoms symptomatically, with emphasis on maintaining electrolyte balance in cases of ingestion or fume inhalation.

SECTION 5: FIRE-FIGHTING MEASURES

Not flammable but device contents may react with water to give off toxic/corrosive/explosive/flammable vapors.
Flash Point: > 93.3°C / 200°F. Auto-ignition temperature: NA. Explosive Limits: NA

Extinguishing media	
Suitable Extinguishing Media	**USE WATER STREAMS IN FLOODING QUANTITIES ONLY.**
Unsuitable Extinguishing Media	**DO NOT USE OTHER AGENTS.**
Special hazards arising from the substance or mixture	Fire conditions may cause the evolution of toxic / corrosive / flammable fumes and gas. A self contained breathing apparatus and suitable protective clothing should be worn in fire conditions. As product reacts with water, large flooding quantities should be used to dilute reacted product and disperse any heat generated. **Decontaminate all equipment used in fire-fighting; sodium bicarbonate solution will neutralize any residues.**
Advice for fire-fighters	If large quantities of batteries are involved, consider using remote fire-fighting capabilities. Alternatively, evacuation of area and monitoring may be advisable.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures	For small content spills, ventilate area and put on gloves and safety glasses. Follow process below **if properly trained**. Large spills require special equipment and training to include the use of a respirator. For large spills involving many batteries, contact authorities, as mandatory evacuations may be required.
Environmental Precautions	Ventilation recommended for spilled contents. Avoid release to the environment.
Methods and material for containment and cleaning up	If a spill is small, attempt to contain the leak by carefully transferring leaking battery to plastic bag. Add sodium bicarbonate (baking soda) **powder** to bag, seal, then place bag inside a second bag. Seal second bag and label appropriately; DO NOT DISCARD INTO HOUSEHOLD TRASH. Carefully neutralize remainder by applying sodium bicarbonate solution SLOWLY, and then allow to cool. Wipe up, then place in a SEPARATE container from the battery as the water will react with the battery

contents. Consult an accredited waste disposal contractor or the local authority for additional advice. **Large spills should only be handled by specially trained hazardous materials personnel.**

Reference to other sections See sections 7, 8, 10, and 13.

Additional Information Short-circuited batteries may be especially hazardous due to rapid heat generation.

SECTION 7: HANDLING AND STORAGE

Precautions for safe handling Avoid ingestion. Use only in well-ventilated areas. Avoid inhalation of high concentrations of vapors. Keep away from fire, sparks and heated surfaces. **DO NOT ATTEMPT TO OPEN SEALED CELLS OR BATTERIES – BATTERY CONTENTS MAY PRESENT SERIOUS SAFETY AND HEALTH HAZARDS. SHORT-CIRCUITING THE TERMINALS OF A DEVICE MAY RESULT IN DAMAGE TO DEVICE AND ANY NEARBY OBJECTS OR PERSONNEL.**

Conditions for safe storage Store in a dry, well-ventilated place. Do not use or store near open flame. Do not store and transport with incompatible materials. Store individual batteries or cells only in approved packaging in order to avoid inadvertent short circuits, as this may result in damage to device, nearby objects, personnel, or all of the above.

Storage Temperature Ambient.

Storage Life Not available

Incompatible materials Contents may react violently if in contact with acids, alkalis, ammonia, metals, alcohols, water, esters, ethers, and metals. Conductive solutions may cause a short.

Specific end use(s) Consult the supplier.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational Exposure Limits

SUBSTANCE	CAS No.	LTEL (8 hr TWA ppm)	LTEL (8 hr TWA mg/m³)	STEL (ppm)	STEL (mg/m³)	Note:
Thionyl Chloride	7719-09-7	NE	NE	0.2 C	NE	ACGIH
Lithium Chloride	7447-41-8	NE	NE	NE	NE	None
Aluminum Chloride	7446-40-0	NE	2 (b)	2 C (a)	NE	ACGIH
Lithium Metal	7439-93-2	NE	NE	NE	NE	None

OELs are not available for non-listed components. C – Ceiling Value. (a) – Ceiling Value as Hydrogen Chloride from reaction with moisture. (b) – Value for Aluminum (soluble aluminum salt)

Personal protection equipment

	**Respirators**	Not generally needed. A NIOSH Approved Self-Contained Breathing Apparatus or Acid Gas Filter Mask must be worn if air levels are above the TWA (with large leaks).
	**Eye Protection**	Safety glasses suggested under all conditions. Face shield highly suggested for large leaking batteries.
	**Gloves**	Wear protective gloves for working with leaking devices.
	**Body protection**	Wear suitable protective clothing and/or gloves for work situation. A chemical suit may be needed when large quantities of devices are leaking.
	Engineering Controls	Use adequate ventilation. Eye wash should be provided as good practice. Provide sodium bicarbonate solution for skin contact with contents. Insulated tools required.
	Other	Shorting of batteries may cause thermal injuries. Wash or clean contaminated clothing.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance – metal device with internal contents.

Color - Colorless to Pale Yellow/Red for electrolyte; variable for container

Odor - Pungent / Sharp for thionyl chloride electrolyte

Odor Threshold (ppm) Not available

Melting Point / Freezing Point - ~ -161°F / -107°C ± 9°F/ 5°C (electrolyte); 356°F / 180°C ± 18°F/ 10°C (lithium)

Boiling point/boiling range: ~ 176°F / 80°C ± 18°F/ 10°C (electrolyte); ~2450°C / 1343°C ± 18°F/ 10°C (lithium metal)

Flash Point (°C) > 200°F / 93°C

Explosive limit ranges Not available

Auto Ignition Temperature Electrolyte decomposes

Decomposition Temperature ~ 285°F / 140.5°C ± 9°F/ 5°C (electrolyte)

Explosive properties Not available

Oxidizing properties - Potential oxidizer (electrolyte); Reducer (lithium)

Flammability (solid, gas) Not available

pH (Value) - <3 for 1% solution of electrolyte; metal reacts with water.

Evaporation rate Not available

Vapor Pressure (mm Hg)(electrolyte) 100 mm Hg @ 70°F / 21°C

Vapor Density (Air=1) ~ 4 for electrolyte

Density (g/ml) - 1.65 ± 0.05 (electrolyte); 0.53 ± 0.05 (lithium)

Solubility (Water) Contents - Violently Reactive

Solubility (Other) Contents react with alcohols

Partition Coefficient (n-Octanol/water) - Reactive

Viscosity (mPa.s) Not available

Other information Volatile Organic Chemical (VOC) Content – Not available.

SECTION 10: STABILITY AND REACTIVITY

Reactivity	Lithium metal is highly reactive / thionyl chloride is moderately reactive.
Chemical stability	Stable under normal conditions if moisture is not present. Short-circuited or leaking batteries present physical, safety and health risks.
Possibility of hazardous reactions	Contents can react violently if in contact with - acids, alkalis, ammonia, metals, alcohols, water, esters, ethers, many organic materials and metals.
Conditions to avoid	Temperatures exceeding manufacturer's maximum ratings, incompatible materials, moisture, shorting of terminals.
Incompatible materials (Internal Contents Only)	Acids, alkalis, ammonia, metals, organic materials, alcohols, water, esters, ethers, and metals.
Hazardous Decomposition Product(s)	Hydrogen chloride, sulfur oxides, metal oxides. Thermal decomposition of electrolyte will evolve toxic, irritant and flammable vapours. Shorted batteries may evolve dangerous gases that can explode or burn. Materials from shorted/leaking batteries are toxic and corrosive.

SECTION 11: TOXICOLOGICAL INFORMATION

SUBSTANCE	CAS No.	LD_{50} (Oral, Rat)	LC_{50} (Inhalation, Rat)	LD_{50} (Dermal, Rat)
Thionyl Chloride	7719-09-7	NE	500 ppm / 1 Hour	NE
Lithium Chloride	7447-41-8	526 mg/kg	NE	1488 mg/kg
Aluminum Chloride	7446-40-0	3450 mg/kg	NE	> 2 g/kg (Rabbit)
Lithium Metal	7439-93-2	NE	NE	NE

Information on toxicological effects – Effects reference internal contents of devices only.

Acute toxicity	Electrolyte is toxic by inhalation and harmful if swallowed. Causes burns to skin, eyes, respiratory system and gastrointestinal tract. Intact devices are hazardous only if ingested.
Irritation	Both lithium metal and electrolyte cause burns to skin, eyes, respiratory system and gastrointestinal tract.
Corrosivity	Both lithium metal and electrolyte cause burns to skin, eyes, respiratory system and gastrointestinal tract.
Repeated dose toxicity	Expected to be similar to single exposures. Irreversible damage to may occur.
Carcinogenicity	No data.
Mutagenicity	No data.
Toxicity for reproduction	No data.
Other information	Short-circuited devices may generate heat causing burns.

SECTION 12: ECOLOGICAL INFORMATION

Toxicity	Device contents are acutely harmful or toxic to aquatic life from reactions with moisture.
Persistence and degradability	Contents rapidly degrade. Case materials may bioaccumulate.
Bioaccumulative potential	Case materials may bioaccumulate.
Mobility in soil	Device contents are mobile in soil environment; case materials are immobile.
Other adverse effects	No data.

SECTION 13: DISPOSAL CONSIDERATIONS

Waste treatment methods	Disposal should be in accordance with local, state or national legislation. Do not send devices to be landfilled; only send to a properly licensed disposal facility.
Additional Information	Consult with a professional waste disposal company for further information concerning disposal of devices and product contents (where leaking or ruptured).

SECTION 14: TRANSPORT INFORMATION

Land transport (Canada / ADR) (c)(d)		**Land transport (USA) (c)(d)**	
UN number	**UN 3090 or 3091**	UN number	**UN 3090 or 3091**
Proper Shipping Name	Lithium Batteries	Proper Shipping Name	Lithium Batteries
Transport hazard class(es)	9	Transport hazard class(es)	9
Packing Group	II	Packing Group	II
Hazard label(s)	MISCELLANEOUS	Hazard label(s)	MISCELLANEOUS
Environmental hazards	None	Environmental hazards	None
Special precautions for user	None	Special precautions for user	None

Sea transport (IMDG) (c)(d)		**Air transport (IATA) (c)(d)**	
UN number	**UN 3090 or 3091**	UN number	**UN 3090 or 3091**
Proper Shipping Name	Lithium Metal Batteries	Proper Shipping Name	Lithium Metal Batteries
Transport hazard class(es)	9	Transport hazard class(es)	9
Packing Group	II	Packing Group	II
Marine Pollutant	MISCELLANEOUS	Environmental hazards	MISCELLANEOUS
Special precautions for user	None	Special precautions for user	Cargo Aircraft Only

(c)– Consult with transport provider for proper shipping information. UN 3091 applies solely to batteries contained within equipment during shipment, while UN 3090 is for separate shipments of batteries.

(d)– Exemptions: If batteries contain less than 1.0 grams of lithium or lithium alloy per battery pack, they are not restricted for shipping purposes by ground or air. If single cells contain less than 0.5 grams of lithium or lithium alloy, they are not restricted for shipping by ground or air. Check relevant regulations for all Special Provisions.

SECTION 15: REGULATORY INFORMATION

USA

TSCA (Toxic Substance Control Act)	All chemicals listed.
SARA 311/312 - Hazard Categories **(References internal contents only)**	Acute Health, Chronic Health, Flammable, Reactivity (with water)
SARA 302 - Extremely Hazardous Substances	Listed - None
SARA 313 - Toxic Chemicals	Listed - None
CERCLA (Comprehensive Environmental Response Compensation and Liability Act)	Listed - None
CAA (Clean Air Act 1990)	Listed - None
CWA (Clean Water Act)	Listed - None
State Right to Know Lists	Listed as required.
Proposition 65 (California)	Listed - None

Canada

WHMIS Classification **(References internal contents only)**	Class B, Division 6, Flammable Reactive Material Class D, Division 1, Subdivision A, Very Toxic Material Class E, Corrosive Material
Canada (DSL/NDSL)	Listed - DSL.
Canada Ingredient Disclosure List (CIDL)	Listed as required.

SECTION 16: OTHER INFORMATION

The following sections contain revisions or new statements: 1-16.

LEGEND

ACGIH	American Conference of Governmental Industrial Hygienists
AICS	Australian Inventory of Chemical Substances
ANSI	American National Standards Institute
atm	atmosphere (pressure unit)
BOD	biological oxygen demand
CAS	Chemical Abstracts Service
CC	closed cup
CDTA	Chemical Drug and Trafficking Act
COC	Cleveland Open Cup
COD	chemical oxygen demand
coeff.	coefficient
CFR	Code of Federal Regulations
CPR	cardio-pulmonary resuscitation
DEA	Drug Enforcement Agency
DOT	Department of Transportation
DSCL	Dangerous Substances Classification and Labeling
EEC	European Economic Community
FDA	Food and Drug Administration
HMIS	Hazardous Materials Information System
IARC	International Agency for Research on Cancer
IDLH	immediate danger to life or health
kg	kilogram
L	liter
LC50	median lethal concentration
LD50	median lethal dose
LEL	lower explosive limit
mg	milligram
mL	milliliter
NA	not applicable, not available
NIOSH	National Institute for Occupational Safety and Health
ND	not determined
NFPA	National Fire Prevention Association
NTP	National Toxicology Program
OC	open cup
OSHA	Occupational Safety and Health Administration
Part	partition
PEL	permissible exposure limits
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
psi	pounds per square inch
RCRA	Resource Conservation and Recovery Act
RQ	Reportable quantity
RTK	Right to Know
SARA	Superfund Amendments and Reauthorization Act
STEL	short-term exposure limit
SUSDP	Standard for the Uniform Scheduling of Drugs and Poisons (Australia)
TCC	Tagliabue Closed Cup
TDG	Transportation of Dangerous Goods
TPQ	threshold planning quantity
TQ	threshold quantity
TSCA	Toxic Substances Control Act
TWA	time-weighted average
UEL	upper explosive limit
WES	Workplace Exposure Standard (New Zealand)
WHMIS	Workplace Hazardous Material Information System

References: RTECS, CAS Registry, EINECS/ESIS, *Casarett & Doull's Toxicology*, *Goldfranks's Toxicological Emergencies*, Manufacturer Information

Hazard statement(s) (These reference internal electrolyte and lithium metal contents)
H260: In contact with water releases flammable gases which may ignite spontaneously
H302: Harmful if swallowed.
H314: Causes severe skin burns and eye damage.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
H330: Fatal if inhaled.

Training advice: All personnel who handle these devices should be aware of the proper procedures for normal product storage, usage and disposal (for intact devices). Personnel who service equipment containing these devices should be aware of the risks posed by leaking or damaged product. Personnel involved with leaking or ruptured products should have training in safely handling and re-packing damaged lithium thionyl chloride devices and should be fully aware of the required materials. Only personnel trained in the use of personal protective equipment to include respiratory protection and who have been examined by an occupational physician should clean up spills involving large quantities of electrolyte.

Additional Information: None