

**MOLYBDENUM CONCENTRATE  
SAFETY DATA SHEET**

**SECTION 1. IDENTIFICATION**

**Product Identity:** Highland Valley Molybdenum Concentrate

**Trade Names and Synonyms:** None.

**Manufacturer:**

Teck Highland Valley Copper Partnership  
P.O. Box 1500  
Logan Lake, British Columbia V0K 1W0  
Emergency Telephone:  
CANUTEC(613) 996-6666

**Supplier:**

Teck Highland Valley Copper Partnership  
P.O. Box 1500  
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**Product Use:** Mine concentrate suitable for the recovery of molybdenum by smelting.

**SECTION 2. HAZARDS IDENTIFICATION**

**CLASSIFICATION:**

Health	Physical	Environmental
Acute Toxicity (Oral, Inhalation) – Does not meet criteria Skin Corrosion/Irritation – Does not meet criteria Eye Damage/Eye Irritation – Does not meet criteria Respiratory or Skin Sensitization – Does not meet criteria Mutagenicity – Does not meet criteria <b>Carcinogenicity – Category 1</b> Reproductive Toxicity – Does not meet criteria <b>Specific Target Organ Toxicity</b> Acute Exposure – Does not meet criteria <b>Chronic Exposure – Category 1</b>	Does not meet criteria for any Physical Hazard	<b>Aquatic Toxicity – Long Term – Category 4</b>

**LABEL:**

<b>Symbols:</b> 	<b>Signal Word:</b> DANGER
<b>Hazard Statements</b> <b>DANGER!</b> May cause cancer through inhalation of dust. Causes damage to the respiratory system through prolonged or repeated exposure to fine respirable dust. May cause long-lasting harmful effects to aquatic life.	<b>Precautionary Statements:</b> Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe dust. Wear protective gloves, protective clothing, and eye protection. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Avoid release to the environment. If exposed or concerned or you feel unwell: Get medical advice/attention.

**Emergency Overview:** A grey, finely-ground material that is not flammable or combustible under normal conditions of transport and storage. However, when heated strongly in air it will burn, releasing toxic and irritating sulphur dioxide gas as well as possible molybdenum and iron oxide fumes. Contact with strong acids will generate flammable and highly toxic hydrogen sulphide gas.

Acute inhalation of molybdenum concentrate dust or fume may produce irritation of the upper airways. Possible cancer hazard due to the silica content. Full face piece SCBA and protective clothing are required for fire emergency response personnel due to the possibility of release of high concentrations of sulphur dioxide from burning concentrate. The metals content in this product has low direct bioavailability and poses little immediate ecological risk.

**Potential Health Effects:** Inhalation of molybdenum concentrate dust may be irritating to the nose, throat and respiratory tract. It may cause irritation of the upper respiratory tract with symptoms of coughing, wheezing, shortness of breath, etc. Crystalline silica is classified as a Group 1 Carcinogen by IARC and as an A2 Carcinogen by the ACGIH (see Toxicological Information, Section 11).

**Potential Environmental Effects:** Molybdenum concentrate is relatively insoluble in water, and therefore its constituent metals have low direct bioavailability. However, extended exposure of the concentrate in aquatic and terrestrial environments can lead to the release of the constituent metals in more bioavailable forms; these forms have the potential to cause adverse effects on biota (see Ecological Information, Section 12).

### SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENTS	CAS Registry No.	CONCENTRATION (% wt/wt)
Molybdenum (present as Sulphides/Oxides)	1317-33-5 / 1313-27-5	30 – 60%
Sulphur (present as Mineral Sulphides)	7704-34-9	30 – 40%
Silica (Amorphous and/or Crystalline)	60676-86-0 / 14808-60-7	3 – 7%
Alumina (Aluminum Oxide)	1344-28-1	1 – 5%
Iron (present as Sulphides/Oxides)	1317-37-9 / 1332-37-2	1 – 5%

Note: See Section 8 for Occupational Exposure Guidelines.

### SECTION 4. FIRST AID MEASURES

**Eye Contact:** *Symptoms:* Eye irritation, redness. Gently brush product off face if necessary. Do not rub eye(s). Let the eye(s) water naturally for a few minutes. Look right and left, then up and down. If particle/dust does not dislodge, cautiously rinse eye(s) with lukewarm, gently flowing water for 5 minutes or until particle/dust is removed, while holding eyelid(s) open. If irritation persists, get medical advice/attention. DO NOT attempt to manually remove anything stuck to the eye.

**Skin Contact:** *Symptoms:* Skin soiling, mild irritation. Wash gently and thoroughly with lukewarm, gently flowing water and non-abrasive soap for 5 minutes, or until product is removed. If skin irritation occurs or you feel unwell, get medical advice/attention.

**Inhalation:** *Symptoms:* Respiratory irritation. Remove source of exposure or move person to fresh air and keep comfortable for breathing. Seek medical attention if you feel unwell.

**Ingestion:** *Symptoms:* Stomach upset. If you feel unwell or are concerned, get medical advice/attention.

### SECTION 5. FIRE FIGHTING MEASURES

**Fire and Explosion Hazards:** Molybdenum concentrate is not considered a fire or explosion hazard. However, it may burn violently if mixed with finely ground metals such as aluminum or magnesium and heated strongly enough and for sufficient time in a fire situation. When burning, it releases toxic and highly irritating sulphur dioxide gas (SO<sub>2</sub>). Contact with strong acids such as hydrochloric or sulphuric acid may also generate flammable and highly toxic hydrogen sulphide gas (H<sub>2</sub>S).

**Extinguishing Media:** Use any means of extinction appropriate for the surrounding fire conditions such as water spray, carbon dioxide, dry chemical, or foam.

**Fire Fighting:** Highly irritating and toxic fumes of sulphur dioxide will be released by burning molybdenum concentrate. Fire fighters must be fully-trained and wear full protective clothing including an approved, self-contained breathing apparatus which supplies a positive air pressure within a full face piece mask.

### SECTION 6. ACCIDENTAL RELEASE MEASURES

**Procedures for Cleanup:** Control source of spillage if possible to do so safely. Restrict access to the area until completion of clean up. Clean up spilled material immediately, observing precautions in Section 8, Personal Protection and using methods which will minimize dust generation (e.g., vacuum solids, dampen material and shovel or wet sweep). Return uncontaminated spilled material to the process if possible. Place contaminated material in suitable labelled containers for later recovery or disposal. Treat or dispose of waste material in accordance with all local, regional, and national requirements.

**Personal Precautions:** Persons responding to an accidental release should wear coveralls or other protective clothing, gloves and a respirator (see also Section 8). Close-fitting safety goggles may be necessary in some circumstances to prevent eye contact with dust. Workers should wash and change clothing following cleanup of a spill to prevent personal contamination.

**Environmental Precautions:** The handling, shipment, storage and processing of this material requires appropriate controls and care to prevent spillage or gradual accumulation in aquatic and terrestrial environments. Any spilled material should be promptly cleaned up.

## SECTION 7. HANDLING AND STORAGE

**Precautions for Safe Handling:** Some sulphide concentrates may slowly oxidize in storage and generate sulphur dioxide as well as deplete the oxygen content of a confined space, such as a ship's hold. The atmosphere within confined spaces containing concentrate must be tested before entry and the area thoroughly ventilated or self-contained breathing apparatus used, if conditions warrant.

**Conditions for Safe Storage:** Store in a dry, well-ventilated area away from sources of combustion, acids and strong oxidizers. Some sulphide concentrates may also oxidize and generate heat which accumulates in storage piles. If material is to be stored for an extended period, the temperature of storage piles should be monitored.

## SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

**Occupational Exposure Guidelines:** (*Time-Weighted Average (TWA) concentration over 8 hr. unless otherwise indicated.*)

<b>Component</b>	<b>ACGIH TLV</b>	<b>OSHA PEL</b>	<b>NIOSH REL</b>
Molybdenum (Insoluble Mo compounds)	10 mg Mo/m <sup>3</sup> (Inhalable) 3 mg Mo/m <sup>3</sup> (Respirable)	15 mg/m <sup>3</sup> (Total dust)	None established
Silica (assumed as alpha-Quartz)	0.025 mg/m <sup>3</sup> (Respirable SiO <sub>2</sub> )	3.3 mg/m <sup>3</sup> (Total Concentrate Dust) ‡ 1.1 mg/m <sup>3</sup> (Resp Concentrate Dust) ‡	0.05 mg/m <sup>3</sup> (Respirable SiO <sub>2</sub> )
Alumina (Aluminum Oxide)	1 mg/m <sup>3</sup> (Respirable dust)	15 mg/m <sup>3</sup> (Total dust) 5 mg/m <sup>3</sup> (Respirable dust)	10 mg/m <sup>3</sup> (Total dust) 5 mg/m <sup>3</sup> (Respirable dust)
<b>Iron</b> (Insoluble Fe compounds)	None established <sup>†</sup>	None established <sup>†</sup>	None established <sup>†</sup>
<b>Sulphur</b> (Potentially present as SO <sub>2</sub> )	None established*	None established*	None established*

NOTE: OEGs for individual jurisdictions may differ from those given above. Check with local authorities for the applicable OEGs in your jurisdiction.

ACGIH - American Conference of Governmental Industrial Hygienists; OSHA - Occupational Safety and Health Administration; NIOSH - National Institute for Occupational Safety and Health. TLV – Threshold Limit Value, PEL – Permissible Exposure Limit, REL – Recommended Exposure Limit.

‡ The OSHA PEL for quartz (crystalline silica) applies to the total airborne concentrate dust concentration and has been calculated based on the maximum percent SiO<sub>2</sub> in the sample using the formula: Total Dust PEL = 30 mg/m<sup>3</sup> / (%SiO<sub>2</sub> + 2) and Respirable Dust PEL = 10 mg/m<sup>3</sup> / (%SiO<sub>2</sub> + 2). The NIOSH and ACGIH limits apply to the actual amount of respirable quartz or silica in the workplace air.

† While there is no established Occupational Exposure Limit for iron as such, there are OELs for iron oxides which may be formed during burning, welding or other fuming processes. The OSHA PEL for iron oxide fume is 10 mg/m<sup>3</sup>. The NIOSH REL for iron oxide dust and fume is 5 mg/m<sup>3</sup> (as Fe) and the ACGIH TLV is 5 mg/m<sup>3</sup> of iron oxide dust/fume (respirable fraction).

\* While there are no established OELs for sulphur as such, there are OELs for sulphur dioxide which will be formed during any combustion processes. The OSHA PEL for SO<sub>2</sub> is a time-weighted average concentration (TWA) of 5 ppm and the NIOSH REL is 2 ppm TWA and 5 ppm STEL. In 2008 the ACGIH significantly reduced their TLV<sup>®</sup> to a short term exposure limit (STEL) of 0.25 ppm over any 15 minute exposure.

**NOTE:** The selection of the necessary level of engineering controls and personal protective equipment will vary depending upon the conditions of use and the potential for exposure. The following are therefore only general guidelines that may not fit all circumstances. Control measures to consider include:

**Ventilation:** Use adequate local or general ventilation to maintain the concentration of molybdenum concentrate dust in the working environment well below recommended occupational exposure limits. Supply sufficient replacement air to make up for air removed by the exhaust system.

**Protective Clothing:** Coveralls or other work clothing, safety glasses, and gloves are recommended to prevent prolonged or repeated direct skin and eye contact. Close-fitting safety goggles may be required to prevent eye contact if excessive dust is generated. Workers should wash immediately when skin becomes heavily contaminated as well as at the end of each work shift.

**Respirators:** Where molybdenum concentrate dust and/or sulphur dioxide gas is generated and cannot be controlled to within acceptable levels by engineering means, use appropriate NIOSH-approved respiratory protection equipment (as a minimum a

combination N-100 or P-100 particulate filter & acid gas cartridge) in an air purifying respirator (APR) or powered air purifying respirator (PAPR). A full face piece chemical cartridge respirator or even a self-contained breathing apparatus may be required for higher concentrations of sulphur dioxide gas that could also generate significant eye irritation.

**General Hygiene Considerations:** Minimize dust generation and accumulation. Avoid breathing dust. Always practice good personal hygiene. Refrain from eating, drinking, or smoking in work areas. Thoroughly wash hands after handling and before eating, drinking, or smoking in appropriate designated areas only. Remove contaminated clothing and wash before reuse.

## SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Appearance:</b> Grey powder with green overtones	<b>Odour:</b> Odourless	<b>Odour Threshold:</b> None	<b>pH:</b> Not Applicable
<b>Vapour Pressure:</b> <1 mm Hg @ 25°C	<b>Vapour Density:</b> Not Applicable	<b>Melting Point/Range:</b> >450°C (Sublimation point)	<b>Boiling Point/Range:</b> Not Available
<b>Relative Density</b> (Water = 1): >2	<b>Evaporation Rate:</b> Not Applicable	<b>Coefficient of Water/Oil Distribution:</b> Not Applicable	<b>Solubility:</b> Relatively insoluble in water
<b>Flammability:</b> Non-combustible solid	<b>Flammable Limits (LEL/UEL):</b> Not Applicable	<b>Auto-ignition Temperature:</b> Not Applicable	<b>Decomposition Temperature:</b> Not Available

## SECTION 10. STABILITY AND REACTIVITY

**Stability & Reactivity:** This material is stable and not considered reactive under normal temperatures and pressures. Hazardous polymerization or runaway reactions will not occur.

**Incompatibilities:** Incompatible with strong oxidizing agents such as hydrogen peroxide or concentrated nitric acid. Other incompatible compounds include: strong acids such as hydrochloric and sulphuric acids, alkalis, hot chlorinated rubber, chlorine trifluoride, ethylene oxide, potassium nitrate, catechol, and iodine monochloride.

**Hazardous Decomposition Products:** Many sulphides react violently and explosively with powerful oxidizers, at the same time releasing large volumes of highly irritating and toxic SO<sub>2</sub>. May release highly toxic and flammable hydrogen sulphide (H<sub>2</sub>S) gas on contact with strong acids. High temperature operations such as oxy-acetylene cutting, electric arc welding or arc-air gouging may generate irritating molybdenum and iron oxide fumes as well as large volumes of toxic and irritating sulphur dioxide gas. Long term storage may result in oxidation and under certain conditions, spontaneous combustion may occur.

## SECTION 11. TOXICOLOGICAL INFORMATION

**General:** NOTE: The toxicological properties of this material have not been fully investigated. The information contained in this SDS is therefore based on information in the technical and scientific literature about the material's constituent components.

### Acute:

**Skin/Eye:** Contact with the eyes may cause local irritation due to direct abrasive action of the particles but would not cause tissue damage. Direct contact with the skin may also cause local mechanical irritation but is not known to be irritating or corrosive.

**Inhalation:** Acute inhalation of dusts may result in irritation of the nose, throat and upper respiratory passages. Symptoms may include discomfort, coughing, tingling sensation, sneezing and/or shortness of breath and wheezing as well as metallic taste. However, the metals are present predominantly as sulphides that are relatively insoluble and poorly absorbed within the body.

**Ingestion:** Molybdenum disulphide, iron sulphide and the other ingredients are poorly absorbed from the gastrointestinal tract, limiting exposure by ingestion. Ingestion of small amounts of molybdenum concentrate is therefore likely to be without ill effect.

**Chronic:** Prolonged exposure to molybdenum concentrate dust or fume can cause irritation to the upper respiratory tract. Prolonged inhalation of iron oxide fume causes a benign pneumoconiosis called siderosis. Alumina and molybdenum disulphide are considered to be relatively benign compounds with no significant effects on the respiratory system or other body organs. Chronic inhalation of crystalline free silica causes silicosis, a form of disabling, progressive, and sometimes fatal pulmonary fibrosis. Silicotics are also at increased risk of developing tuberculosis and/or lung cancer. IARC has classified crystalline silica of respirable particle size as a *Group 1 Carcinogen (Carcinogenic to Humans)* while ACGIH classifies it as a *Suspected Human Carcinogen (A2)*. The NTP recently reclassified silica as a *Known Human Carcinogen*. OSHA and the EU do not list silica as a carcinogen.

### Animal Toxicity:

<u>Hazardous Ingredient:</u>	<u>Acute Oral Toxicity:</u>	<u>Acute Dermal Toxicity:</u>	<u>Acute Inhalation Toxicity:</u>
Molybdenum Sulphide	>6,000 mg/kg <sup>†</sup>	>2,000 mg/kg*	>2.82 mg/L <sup>‡</sup>
Silica	No data	No data	No data
Alumina	>15,900 mg/kg <sup>†</sup>	No data	>2.3 mg/L <sup>‡</sup>
Iron Sulphide	>2,000 mg/kg <sup>†</sup>	>2,000 mg/kg*	No data

<sup>†</sup> LD<sub>50</sub>, Rat, Oral     \* LD<sub>50</sub>, Rabbit, Dermal     <sup>‡</sup> LC<sub>50</sub>, Rat, Inhalation, 4 hour

## SECTION 12. ECOLOGICAL INFORMATION

Molybdenum concentrate is relatively insoluble in water, and therefore, its constituent metals have low direct bioavailability. However, extended exposure of the concentrate in aquatic and terrestrial environments can lead to the release of the constituent metals in more bioavailable forms; these forms have the potential to cause adverse effects on biota. The mobility of the constituent metals in more soluble forms is media-dependent; they can bind with inorganic and organic ligands, reducing their mobility and bioavailability in both soil and water. Bioavailability is also mediated by other factors (e.g., pH, hardness, total organic carbon) in the aquatic environment.

## SECTION 13. DISPOSAL CONSIDERATIONS

If material cannot be returned to process or salvage, dispose of in accordance with applicable regulations. Empty and thoroughly clean all residues from containers before reuse or disposal.

## SECTION 14. TRANSPORT INFORMATION

TRANSPORT CANADA CLASSIFICATION..... Not regulated  
U.S. DOT CLASSIFICATION ..... Not regulated  
MARINE POLLUTANT ..... No

## SECTION 15. REGULATORY INFORMATION

### U.S.

INGREDIENTS LISTED ON TSCA INVENTORY ..... Yes  
HAZARDOUS UNDER HAZARD COMMUNICATION STANDARD..... Yes  
CERCLA SECTION 103 HAZARDOUS SUBSTANCES ..... None of the ingredients qualify  
EPCRA SECTION 302 EXTREMELY HAZARDOUS SUBSTANCE ..... None of the ingredients qualify  
EPCRA SECTION 311/312 HAZARD CATEGORIES..... Delayed (Chronic) Health Hazard - Carcinogen (due to presence of silica)  
EPCRA SECTION 313 TOXIC RELEASE INVENTORY:..... Molybdenum Trioxide ..... CAS No. 1313-27-5  
Percent by Weight: ..... 30-60%  
Aluminum Oxide ..... CAS No. 1344-28-1  
Percent by Weight ..... 1-5%

## SECTION 16. OTHER INFORMATION

**Date of Original Issue:** June 15, 2010     **Version:** 01 (*first edition*)  
**Date of Latest Revision:** October 17, 2018     **Version:** 04

The information in this Safety Data Sheet is based on the following references:

- American Conference of Governmental Industrial Hygienists, 2004, Documentation of the Threshold Limit Values and Biological Exposure Indices, Seventh Edition plus updates.
- American Conference of Governmental Industrial Hygienists, 2018, Guide to Occupational Exposure Values.
- Bretherick's Handbook of Reactive Chemical Hazards, 20<sup>th</sup> Anniversary Edition. (P. G. Urben Ed.) 1995.
- Canadian Centre for Occupational Health and Safety CHEMINFO Record No: 500, Molybdenum Disulphide.
- European Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures.
- Health Canada, SOR/2015-17, 11 February 2015, Hazardous Products Regulations.

- International Agency for Research on Cancer (IARC), Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.
- Merck & Co., Inc., 2001, The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, Thirteenth Edition.
- Patty's Toxicology, Fifth Edition, 2001: E Bingham, B Cohrssen & C H Powell, Ed.
- U.S. Dept. of Health and Human Services, National Institute for Occupational Safety and Health, Registry of Toxic Effects of Chemical Substances (RTECS) CCOHS Web Access subscription.
- U.S. Occupational Safety and Health Administration, 1989, Code of Federal Regulations, Title 29, Part 1910.1000 and 1910.1200.

Acronyms not spelled out elsewhere in the SDS:

CAS: Chemical Abstract Service

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act

DOT: Department of Transportation

EPCRA: Emergency Planning and Community Right-to-Know Act

IMO: International Maritime Organization

LD50, LC50: Lethal Dose 50%, Lethal Concentration 50%

MSHA: Mine Safety and Health Administration, U.S. Department of Labour

TSCA: Toxic Substances Control Act

Wt.: Weight

### **Notice to Reader**

Although reasonable precautions have been taken in the preparation of the data contained herein, it is offered solely for your information, consideration and investigation. Teck Highland Valley Copper Partnership extends no warranty and assumes no responsibility for the accuracy of the content and expressly disclaims all liability for reliance thereon. This safety data sheet provides guidelines for the safe handling and processing of this product; it does not and cannot advise on all possible situations. Therefore, your specific use of this product should be evaluated to determine if additional precautions are required. Individuals exposed to this product should read and understand this information and be provided pertinent training prior to working with this product.