

**BISMUTH BULLION
SAFETY DATA SHEET**

SECTION 1. IDENTIFICATION

Product Identity: Bismuth Bullion

Trade Names and Synonyms: None.

Manufacturer:
Teck Metals Ltd.
Trail Operations
Trail, British Columbia
V1R 4L8
Emergency Telephone: 250-364-4214

Supplier:
Teck Metals Ltd.
Trail Operations
Trail, British Columbia
V1R 4L8

Preparer:
Teck Metals Ltd.
Suite 3300 – 550 Burrard Street
Vancouver, British Columbia
V6C 0B3

Date of Last Revision: October 14, 2015.

Date of Last Edit: October 14, 2015.


Product Use: As a source of bismuth used in the manufacture of low melting solders and fusible alloys as well as low toxicity birdshot and fishing sinkers.

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 Carcinogenicity – Category 2 Reproductive Toxicity – Category 1 Specific Target Organ Toxicity Acute Exposure – Does not meet criteria Chronic Exposure – Category 1	Does not meet criteria for any Physical Hazard	Aquatic Toxicity – Long Term (Chronic) Category 3

LABEL:

Symbols: 	Signal Word: DANGER
Hazard Statements DANGER! Causes damage to kidneys, blood-forming systems, central nervous system and digestive tract through prolonged or repeated inhalation of dust or fumes. May damage the unborn child. May cause harm to breast-fed children. Suspected of damaging fertility. Suspected of causing cancer. Harmful to the aquatic environment with long-lasting effects.	Precautionary Statements: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection. Do not breathe dust or fumes. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. If exposed or concerned or you fell unwell: Get medical advice/attention. Avoid release to the environment.

Emergency Overview: A bluish-white to silvery-grey heavy, soft metal that does not burn in bulk. Finely-divided dust clouds are a moderate fire hazard and moderate explosion hazard, however. When heated to fuming in air metal oxide fumes are generated which will contain significant levels of lead oxides. Inhalation or ingestion may produce both acute and chronic health effects. Possible cancer and reproductive hazard due to the lead content. SCBA and full protective clothing are required for fire emergency response personnel.

Potential Health Effects: Bismuth is poorly absorbed and is relatively non-toxic by inhalation or ingestion. However, due to the lead content, inhalation or ingestion of dust or fume may result in headache, nausea, vomiting, abdominal spasms, fatigue, sleep disturbances, weight loss, anemia and leg, arm, and joint pain. Prolonged exposure may also cause central nervous system damage (e.g., fatigue, headaches, tremors and hypertension), gastrointestinal disturbances, anemia, kidney dysfunction and possible reproductive effects. Pregnant women should be protected from excessive exposure in order to prevent lead crossing the placental barrier and causing infant neurological disorders. Lead is considered a potential carcinogen by IARC, ACGIH & NTP. Bismuth and zinc are not considered human carcinogens by OSHA, NTP, ACGIH, IARC, or the EU (see Toxicological Information, Section 11).

Potential Environmental Effects: This product, a bismuth-lead-zinc alloy, has low bioavailability and is therefore unlikely to pose any immediate ecological risks; however, compounds of two constituent metals, lead and zinc, can be acutely and chronically toxic, particularly when released into the aquatic environment and under certain conditions (e.g., high acidic conditions). Compounds of bismuth are not known to be very toxic (see Ecological Information, Section 12).

SECTION 3. COMPOSITION / INFORMATION ON INGREDIENTS

HAZARDOUS COMPONENTS	CAS Registry No.	CONCENTRATION (% wgt/wgt)
Bismuth	7440-69-9	80 - 85%
Lead	7439-92-1	15 - 20%
Zinc	7440-66-6	1 - 2%

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 left and right, 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. *Dust:* Gently brush away excess dust. Wash gently and thoroughly with lukewarm, gently flowing water and non-abrasive soap for 5 minutes or until the product is removed. If skin irritation occurs or you feel unwell get medical advice/attention. *Molten Metal:* Flush contact area to solidify and cool but do not attempt to remove encrusted material or clothing. Cover burns and seek medical attention immediately.

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: Massive metal is not flammable or combustible. Finely-divided dust or powder is a moderate fire and explosion hazard when dispersed in the air at high concentrations and exposed to heat, flame, or other sources of ignition. Explosions may also occur upon contact with certain incompatible materials (see Stability and Reactivity, Section 10).

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

Fire Fighting: If possible, move material from fire area and cool material exposed to flame. Highly toxic lead oxide fumes may evolve in fires. 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. Do not use direct water streams on fires where molten metal is present.

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. Molten metal should be allowed to cool and harden before cleanup. Once solidified, wear gloves, pick up and return to process. If dust, wear recommended personal protective equipment (see Section 8) and use methods which will minimize dust generation (e.g., vacuum solids). 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 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 and fume. Where molten metal is involved, wear heat-resistant gloves and suitable clothing for protection from radiant heat and hot-metal splash as well as a respirator to protect against inhalation of lead fume. Workers should wash and change clothing following cleanup of a bullion spill to prevent personal contamination with lead dust.

Environmental Precautions: This product, a metal alloy, has low bioavailability and is therefore unlikely to pose any immediate ecological risks; however, compounds of the constituent metals, particularly lead and zinc, can pose risks, particularly in aquatic environments. Releases of the product to water and soil should be prevented.

SECTION 7. HANDLING AND STORAGE

No special packaging materials are required. Store in a DRY, covered area away from incompatible materials, strong acids and food or foodstuffs. Solid metal that is suspected of containing moisture should be THOROUGHLY DRIED before being added to a molten bath. Otherwise, entrained moisture could expand explosively and spatter molten metal out of the bath. Bullion, in contact with wood or other surfaces, may leave traces of lead particulate that can accumulate over time. Cleaning or disposal of these surfaces requires review to ensure that any effluent or solid waste disposal meets the requirements of regulations in the applicable jurisdiction.

SECTION 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

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

<u>Component</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>NIOSH REL</u>
Bismuth	Not established	Not established	Not established
Lead	0.05 mg/m ³	0.05 mg/m ³	0.05 mg/m ³
Zinc	Not established	Not established	Not 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.

While there is no established OEL for zinc as such, there are OELs for zinc oxide fume which may be formed during burning, welding or other fuming processes. The OSHA PELs are 15 mg/m³ (total) and 5 mg/m³ (respirable) for zinc oxide dust; while the PEL for zinc oxide fume is 5 mg/m³. The ACGIH TLV for zinc oxide (both dust and fume) is 2 mg/m³ (respirable fraction) with a Short Term Exposure Limit (STEL) of 10 mg/m³ (respirable fraction). The NIOSH REL for zinc oxide (dust or fume) is 5 mg/m³ 10 hr TWA with a 15 mg/m³ ceiling for zinc oxide dust and a 10 mg/m³ STEL for zinc oxide fume (15 min sample). There are no OELs established for either bismuth or bismuth oxide.

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 lead fumes in the working environment well below recommended occupational exposure limits. Supply sufficient replacement air to make up for air removed by the exhaust system. Local exhaust is recommended for melting, casting, grinding and burning.

Protective Clothing: Gloves and coveralls or other work clothing are recommended to prevent prolonged or repeated direct skin contact when this material is processed. Appropriate eye protection should be worn where fume or dust is generated. Where hot or molten metal is handled, heat resistant gloves, goggles or face shield, and clothing to protect from radiant heat and hot metal splash should be worn. Safety type boots are recommended.

Respirators: Where dust or fumes are generated and cannot be controlled to within acceptable levels by engineering means, use appropriate NIOSH-approved respiratory protection equipment (a 42CFR84 Class N, R or P-100 particulate filter cartridge). When exposure levels are obviously high but the actual concentration is unknown, a self-contained breathing apparatus which supplies a positive air pressure within a full face piece mask should be worn.

General Hygiene Considerations: Always practice good personal hygiene. Do not eat, drink or smoke in work areas. Thoroughly wash hands at the end of the workday as well as before eating, drinking, or smoking in appropriate, designated areas. A double locker-shower system with separate clean and dirty sides is usually required for lead handling operations. Remove contaminated clothing promptly and discard or launder before reuse. Inform laundry personnel of contaminants' hazards.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Bluish-white or silvery-grey metal	Odour: None	Odour Threshold: None	pH: Not Applicable
Vapour Pressure: Not Applicable	Vapour Density: Not Applicable	Melting Point/Range: Approx. 300°C	Boiling Point/Range: No Data
Relative Density (Water = 1): Approx. 10 – 11	Evaporation Rate: Not Applicable	Coefficient of Water/Oil Distribution:	Solubility: Insoluble in water
Flash Point: None	Flammable Limits (LEL/UEL): Not Flammable	Auto-ignition Temperature: None	Decomposition Temperature: None

SECTION 10. STABILITY AND REACTIVITY

Stability & Reactivity: Massive metal is stable and not considered reactive under normal temperatures and pressures. Hazardous polymerization or runaway reactions will not occur. Fresh cut or cast surfaces may tarnish rapidly due to the formation of an insoluble protective layer of basic lead carbonate.

Incompatibilities: Incompatible with strong acids and strong oxidizing agents such as hydrogen peroxide, chlorine trifluoride, chlorine, fused ammonium nitrate, nitrosyl fluoride, and iodine pentafluoride. In contact with solutions of sodium azide or hydrazoic acid it can form lead azide, which is a detonating compound.

Hazardous Decomposition Products: High temperature operations such as oxy-acetylene cutting, electric arc welding or overheating a molten bath will generate fumes of bismuth and lead oxide plus minor amounts of zinc oxide. Lead and zinc oxides are highly soluble in body fluids and the particle size of the metal fumes is largely within the respirable size range, which increases the likelihood of inhalation and deposition of the fume within the body.

SECTION 11. TOXICOLOGICAL INFORMATION

General: Industrial bismuth poisoning has not been reported. Much of what is known about bismuth toxicity has been derived from therapeutic uses. The solubility of most bismuth salts is very low and they are poorly absorbed by inhalation or ingestion. Lead however can be absorbed and accumulates in bone and body organs once it enters the body. Elimination from the body is slow. Initial and periodic medical examinations are advised for persons repeatedly exposed to levels above the exposure limits of lead dust or fumes. Once lead enters the body, it can affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal system. The primary routes of exposure are through inhalation or ingestion of dust and fumes.

Acute:

Skin/Eye: Contact with dust or fume may cause local irritation but would not cause tissue damage. This material is not absorbed through the skin.

Inhalation: Inhalation of dust or fume may irritate the upper respiratory tract. Symptoms may include coughing, sneezing and/or shortness of breath. Intense exposure to dust or fume may cause headache, nausea, vomiting, abdominal spasms, fatigue, sleep disturbances, weight loss, anemia, and pain in legs, arms, and joints.

Ingestion: Symptoms due to ingestion of lead dust or fume would be similar to those from inhalation including nausea, vomiting, weakness, diarrhea, ulcerative stomatitis, pyorrhea, swelling of the buccal membranes, and increased salivation. Other health effects such as metallic taste in the mouth and constipation or bloody diarrhea might also be expected to occur.

Chronic: Prolonged overexposure to bismuth bullion dust or fume may cause chronic health effects. Signs of toxicity may include fatigue, nausea, loss of appetite and weight, headache, sleeplessness, depression, diarrhea, and skin reactions. In severe cases a bluish or brownish discolouration of the gums may also occur due to deposition of bismuth and lead sulphide in the gums. It may also cause central nervous system damage, gastrointestinal disturbances, and anemia. Reduced hemoglobin production has been associated with low lead exposures. Kidney dysfunction and possible injury has also been associated with chronic lead poisoning. Chronic over-exposure to lead has been implicated as a causative agency for the impairment of male and female reproductive capacity. Pregnant women should be protected from excessive exposure as lead can cross the placental barrier and unborn children may suffer neurological damage or developmental problems. Teratogenic and mutagenic effects from exposure to lead have been reported in some studies but not in others. The literature is inconsistent and no firm conclusions can be drawn at this time. Lead and lead compounds are listed as an A3 Carcinogen (Confirmed Animal Carcinogen with Unknown Relevance to Humans) by the ACGIH. IARC has listed lead compounds as Group 2A Carcinogens (Probably Carcinogenic to Humans) while lead metal is listed as Group 2B (Possibly Carcinogenic to Humans). The NTP has listed lead and lead

compounds as Reasonably Anticipated to be a Human Carcinogen. OSHA and the EU do not currently list lead as a human carcinogen. Bismuth and zinc are not considered human carcinogens by the ACGIH, IARC, NTP, OSHA, or the EU.

Animal Toxicity:

<u>Hazardous Ingredient:</u>	<u>Acute Oral Toxicity:</u>	<u>Acute Dermal Toxicity:</u>	<u>Acute Inhalation Toxicity:</u>
Bismuth	5,000 mg/kg [†]	No data	No data
Lead	No data	No data	No data
Zinc	>5,000 mg/kg [†]	No data	No data

[†] LD₅₀, Rat, Oral,

[‡] LC₅₀, Rat, Inhalation, 4 hour

SECTION 12. ECOLOGICAL INFORMATION

This product, a metal alloy, is relatively insoluble; however, processing of the product or extended exposure in aquatic and terrestrial environments may lead to the release of bismuth, lead and zinc compounds in bioavailable forms. Compounds of lead and zinc have been shown to yield toxic effects in aquatic organisms, especially fish. Lead compounds can be toxic at relatively low concentrations. Water hardness, pH and dissolved organic carbon content are physico-chemical characteristics which regulate the degree of toxicity by lead and zinc in solution. Lead compounds are not particularly mobile in surface water or groundwater; however, zinc compounds are quite mobile in both media. Compounds of bismuth are not known to be very toxic; however, their ecological risks are not yet fully understood.

In soil, lead has a tendency to become highly sorbed onto soil particles in accordance with certain soil properties; zinc is more mobile and bioavailable, especially in acidic (i.e., low pH) soils. Both lead and zinc also have the tendency to bioaccumulate in plants and animals in both aquatic and terrestrial environments.

SECTION 13. DISPOSAL CONSIDERATIONS

If material cannot be returned to process, dispose of only in accordance with applicable regulations. Waste material would meet the requirements of a hazardous waste in most jurisdictions. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated in order to determine the proper waste classification and disposal methods.

SECTION 14. TRANSPORT INFORMATION

TRANSPORT CANADA AND U.S. DOT HAZARD CLASSIFICATION Not Regulated
 TRANSPORT CANADA AND U.S. DOT SHIPPING NAME Not Applicable
 TRANSPORT CANADA AND U.S. DOT PIN Not Applicable
 MARINE POLLUTANT No
 IMO CLASSIFICATION Not Regulated

SECTION 15. REGULATORY INFORMATION

U.S.

INGREDIENTS LISTED ON TSCA INVENTORY Yes

HAZARDOUS UNDER HAZARD COMMUNICATION STANDARD Yes

CERCLA SECTION 103 HAZARDOUS SUBSTANCES Lead Yes RQ: 10lb. (4.54kg.)*
 Zinc Yes RQ: 1,000lbs. (454 kg.)*

* reporting not required when diameter of the pieces of solid metal released is equal to or exceeds 100 micrometers (0.004 inches).

EPCRA SECTION 302 EXTREMELY HAZARDOUS SUBSTANCE No ingredients qualify.

EPCRA SECTION 311/312 HAZARD CATEGORIES Delayed (chronic) health hazard – Carcinogen
 Delayed (chronic) health hazard – Reproductive toxin

EPCRA SECTION 313 TOXIC RELEASE INVENTORY: Lead CAS No. 7439-92-1
 Percent by Weight: 15-20%
 Zinc (fume or dust) CAS 7440-66-6 5
 Percent by Weight: 1-2%

SECTION 16. OTHER INFORMATION

Date of Original Issue: March 22, 2004 **Version:** 01 (*First edition*)

Date of Latest Revision: October 14, 2015 **Version:** 07

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 Supplements.
- American Conference of Governmental Industrial Hygienists, 2015, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.
- American Conference of Governmental Industrial Hygienists, Guide to Occupational Exposure Values - 2015.
- Bretherick's Handbook of Reactive Chemical Hazards, 20th Anniversary Edition. (P. G. Urben, Ed.) 1995.
- Canadian Centre for Occupational Health and Safety (CCOHS), Hamilton, ON. CHEMINFO Record No. 608 Lead (Rev. 009-05).
- European Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures, amending and repealing directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (REACH).
- Health Canada, SOR/2015-17, Hazardous Products Regulations, effective February 11, 2015.
- International Agency for Research on Cancer (IARC), Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, 1972 – present, (multi-volume work), World Health Organization, Geneva.
- International Chemical Safety Cards (WHO/IPCS/ILO), ICSC:0052 – Lead (Revised Oct 2002).
- Merck & Co., Inc., 2001, The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals, Thirteenth Edition.
- National Library of Medicine, National Toxicology Information Program, Hazardous Substance Data Bank (on-line version).
- Palmieri, Yves, Bismuth Institute, 1993, Bismuth: The Amazingly "Green" Environmentally-Minded Element.
- 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, NIOSH Pocket Guide to Chemical Hazards. CD-ROM Edition, September 2005.
- U.S. Dept. of Health and Human Services, National Institute for Occupational Safety and Health, Registry of Toxic Effects of Chemical Substances (RTECS) (on-line version – last accessed 14 September 2015).
- U.S. Dept. of Health and Human Services, National Institute of Environmental Health Sciences, National Toxicology Program (NTP), 13th Report on Carcinogens, October 2014.
- U.S. Dept. of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Toxicological Profile for Lead (September 2005).
- U.S. Occupational Safety and Health Administration, 1989, Code of Federal Regulations, Title 29, Part 1910.

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 Metals Ltd. 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.