

SAFETY DATA SHEET



CROWN ALLOYS COMPANY

Section 1 – PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Cobalt Based Alloy

PRODUCT IDENTIFICATION:

ROYAL 116-E	ROYAL 116-T
E CoCr-A	ER CoCr-A
AWS A5.13	AWS A5.21

SPECIFICATION:

RECOMMENDED USE: SMAW (Shielded Metal Arc Welding), GTAW (Gas Tungsten Arc Welding) and OFW (Oxyfuel Gas Welding)

SUPPLIER: Crown Alloys Company
 30105 Stephenson Hwy.
 Madison Heights, MI. 48071

TELEPHONE NUMBER: (248) 588-3790

EMERGENCY NUMBER: Call CHEMTREC Day or Night 1-800-424-9300 / +1 703-527-3887

WEBSITE: www.crownalloys.com

Section 2 – HAZARDS IDENTIFICATION

2.1 Classification of the mixture

This product is placed on the market in solid form

2.1.1 Classification in accordance with GHS-US

Acute Tox. 4 (Oral)	H302	Resp. Sens. 1B	H334
Skin Sens. 1	H317	Carc. 1B	H350i
		Repr. Tox 2	H361f

2.2 Label elements

GHS-US labelling

This product does not require a hazard communication label as it does not pose a hazard in the form delivered. Hazards can occur while using this product. Please read and follow the instructions listed in this SDS.

Emergency Overview

DANGER

Hazard Statements

Harmful if swallowed. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause cancer by inhalation. May cause an allergic skin reaction. May damage fertility. Causes damage to organs through prolonged or repeated exposure. May cause long lasting harmful effects to aquatic life. Heating may cause a fire.

Signal word (GHS-US): Danger

Hazard statements (GHS-US):

H302 – Harmful if swallowed	H350i – May cause cancer by inhalation
H317 – May cause an allergic skin reaction	H361f – Suspected of damaging fertility
H334 – May cause allergy or asthma symptoms or breathing difficulties if inhaled	

Precautionary statements (GHS-US):

P201 – Obtain special instructions before use	P403+P233 – Store in a well-ventilated place. Keep container tightly closed.
P202 – Do not handle until all safety precautions have been read and understood	P302+P352 – IF ON SKIN: Wash with plenty of soap and water
P260 – Do not breathe dust/fume/gas/mist/vapors/spray	P308+P313 – IF EXPOSED OR CONCERNED: Get medical advice/attention
P261 – Avoid breathing dust/fume/gas/mist/vapors/spray	P314 – Get medical advice and attention if you feel unwell
P264 – Wash thoroughly after handling	P321 – Specific treatment (see label)
P270 – Do not eat, drink or smoke when using this product	P330 – If swallowed, rinse mouth
P271 – Use only outdoors or in a well-ventilated area	P333+P313 – If skin irritation or rash occurs: Get medical advice/attention
P272 – Contaminated work clothing should not be allowed out of the workplace	P362+P364 – Take off contaminated clothing and wash it before reuse
P273 – Avoid release to the environment	P391 – Collect spillage
P280 – Wear protective gloves/protective clothing/eye protection/face protection	P405 – Store locked up
P284 – In case of inadequate ventilation wear respiratory protection	P501- Dispose of contents/container in accordance with local / regional / national / international regulations
P301+P312 – If swallowed: Call a poison center or physician if you feel unwell	P305+P351+P338 – If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P304+P340 – IF INHALED: Remove person to fresh air and keep comfortable for breathing	P337+P313 – If eye irritation persists: Get medical advice/attention

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2.3 Other hazards

No additional information available

2.4 Unknown acute toxicity (GHS-US)

No data available

Other hazards which do not result in GHS classification:

Electrical shock can kill.
 Arc rays can injure eyes and burn skin.
 Welding arc and sparks can ignite combustibles and flammable materials.
 Overexposure to welding fumes and gases can be hazardous.
 Read and understand the manufacturer's instructions, Safety Data Sheets and the precautionary labels before using these alloys. Refer to Section 8.

Substance(s) formed under the conditions of use:

The welding fumes produced from these welding alloys may contain the following constituent(s) and/or their complex metallic oxides as well as solid particles or other constituents from the consumables, base metal, or base metal coating not listed below:

Chemical Identity	CAS-No.	Chemical Identity	CAS-No.	Chemical Identity	CAS-No.
Carbon Dioxide	124-38-9	Ozone	10028-15-6	Manganese	7439-96-5
Carbon Monoxide	630-08-0	Nitrogen Dioxide	10102-44-0	Chromium Oxide	1308-38-9
Nickel	7440-02-0	Chromium (VI)	18540-29-9	Cobalt	7440-48-4

Section 3 – COMPOSITION / INFORMATION ON INGREDIENTS

3.1 Substances

Not applicable

Full text of H-phrases: See section 16

3.2 Mixture

Reportable Hazardous Ingredients

Chemical Identity	CAS-No.	Weight Percent (%)	GHS-US Classification
Carbon (C)	7440-44-0	1.00 – 2.50	Not classified
Chromium (Cr)	7440-47-3	25.0 – 32.0	Comb. Dust
Cobalt (Co)	7440-48-4	50.0 min.	Acute Tox. 4 (Oral), H302 Acute dust/mist 1, H330 Eye Irrit. 2A, H319 Resp. Sens. 1B, H334 Skin Sens. 1, H317 Carc. 1B, H350i Repro. tox. 2, H361f Aquatic Acute 1 M=10, H400 Aquatic Chronic 1 M=1, H410
Iron (Fe)	7439-89-6	5.00 max.	Acute Tox. 4 (Oral), H302
Manganese compounds and fumes (as Mn)	7439-96-5	2.00 max.	Not classified
Molybdenum soluble and insoluble compounds (as Mo)	7439-98-7	1.00 max.	Not classified
Nickel (Ni)	7440-02-0	3.00 max.	Skin Sens. 1, H317 Carc. 1B, H350 STOT RE 1, H372 Aquatic Chronic 3, H412
Silicon (Si)	7440-21-3	2.00 max.	Not classified
Tungsten metal powder (W)	7440-33-7	3.00 – 6.00	Not classified

Composition Comments: The term "Hazardous Ingredients" should be interpreted as a term defined in Hazard Communication standards and does not necessarily imply the existence of a welding hazard. These alloys may contain additional non-hazardous ingredients or may form additional compounds under the condition of use. Refer to Sections 2 & 8 for more information.

Section 4 – FIRST AID MEASURES

4.1 Description of first aid measures

Ingestion: Unlikely due to the form of the product. Avoid hand, clothing, food, and drink contact with metal fume or powder which can cause ingestion of particulate during hand to mouth activities such as drinking, eating, smoking, etc. If ingested, do NOT induce vomiting. Contact a poison control center. Unless the poison control center advises otherwise, wash out mouth thoroughly with water. If symptoms develop, seek medical attention at once.

Inhalation: Move to fresh air if breathing is difficult. If not breathing, perform artificial respiration. If breathing is difficult, give oxygen. Avoid direct contact with skin. Use barrier to give mouth-to-mouth resuscitation. Seek medical assistance immediately.

Skin Contact: Flush with soap and water for at least 15 minutes. For reddened or blistered skin, or thermal burns, obtain medical assistance.

Eye Contact: Dust or fume from these alloys should be flushed from the eyes with clean, tepid water until transported to a medical facility. Do not rub eyes or keep eyes tightly closed. Obtain immediate medical assistance.
 Arc rays can injure eyes. If exposed, move victim to a dark room, remove contact lenses and cover eyes with a padded dressing and rest. Obtain medical assistance if symptoms persist.

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4.2 Most important symptoms/effects, acute and delayed

Symptoms/injuries after inhalation:	May cause allergy or asthma symptoms or breathing difficulties if inhaled. CNS and psychiatric effects, Parkinson-like symptoms. Languor, sleepiness and weakness in legs. A stolid masklike appearance of face, emotional disturbances such as uncontrollable laughter and spastic gait with tendency to fall in walking and findings in more advanced cases. Persons with a history of asthma, allergies, chronic or recurrent respiratory disease should not be exposed to any process in which this product is used.
Symptoms/injuries after skin contact:	Dusts may cause irritation.
Symptoms/injuries after eye contact:	Causes eye irritation.
Symptoms/injuries after ingestion:	Not an anticipated route of exposure during normal product handling. May be harmful if ingested.

4.3 Indication of immediate medical attention and special treatment needed

Note to Physician:	Treat symptomatically. May cause sensitization by inhalation and skin contact. May cause sensitization of susceptible persons.
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Section 5 – FIRE-FIGHTING MEASURES

General Fire Hazards: *As shipped*, this product is nonflammable. However, welding arc and sparks can ignite combustibles and flammable products. Read and understand American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" and National Fire Protection Association NFPA 51B, "Standard for Fire Prevention During Welding, Cutting and Other Hot Work" before using this product.

5.1 Extinguishing media

Suitable extinguishing media:	Use extinguishing media appropriate for surrounding fire.
Unsuitable extinguishing media:	Do not use carbon dioxide, which may form an explosive mixture with powdered chromium.

5.2 Special hazards arising from the substance

Fire hazard:	May be a potential hazard under the following conditions: <ul style="list-style-type: none">The Royal 116-E and Royal 116-T in their solid form will not ignite. However, these alloys may decompose upon heating to produce corrosive and/or toxic fumes. Thermal decomposition can lead to the release of irritating and toxic gases and vapors. May cause sensitization by inhalation and skin contact.
Explosion hazard:	None known.

5.3 Special protective equipment and precautions for firefighters

Special firefighting procedures:	Use standard firefighting procedures and consider the hazards of other involved materials.
Special protective equipment for firefighters:	Firefighters should wear full protective gear. Wear self-contained breathing apparatus.

Section 6 – ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

If airborne dust and/or fume is present, use adequate engineering controls and, if needed, personal protection to prevent overexposure. Avoid contact with skin and eyes. Avoid dust accumulation in enclosed spaces. Refer to recommendations in Section 8.

6.2 Environmental precautions

Avoid release to the environment

6.3 Methods and material for containment and cleaning up

Clean up spills immediately, observing precautions in the personal protective equipment in Section 8. Avoid generating dust. Prevent product from entering any drains, sewers or water sources. Refer to Section 13 for proper disposal. Attempt to reclaim the product if possible.

Section 7 – HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid inhaling welding fumes. Keep formation of airborne dusts to a minimum. Provide appropriate exhaust ventilation at places where dust is formed. Read and understand the manufacturer's instruction and the precautionary label on the product. See American National Standard Z49.1, "Safety In Welding, Cutting and Allied Processes" published by the American Welding Society, <http://pubs.aws.org> and OSHA Publication 2206 (29CFR1910), U.S. Government Printing Office, www.gpo.gov.

Do not eat, drink or smoke when using the product. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Cosmetics should not be applied in areas where exposures exist! Routinely wash work clothing and protective equipment to remove contaminants.

7.2 Conditions for safe storage, including any incompatibilities

Store in closed original container in a dry place. Store away from incompatible materials. Store in a cool, well-ventilated place. Store in accordance with local/regional/national regulations.

7.3 Specific end use(s)

For welding consumables and related products

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Section 8 – EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control parameters

Chemical Identity (CAS-No.)	ACGIH TLV (TWA)	OSHA PEL (TWA)	NIOSH REL/IDLH	NIOSH STEL
Chromium (7440-47-3)	0.5 mg/m ³ [metal compound as Cr] 0.05 mg/m ³ [Cr(VI) inorganic compounds as Cr, water soluble] 0.01 mg/m ³ [Cr(VI) inorganic compounds as Cr, water insoluble]	1.0 mg/m ³ [metal compound as Cr] 0.005 mg(5 µg)/m ³ [Cr(VI) inorganic compounds as Cr(VI), water soluble] 0.005 mg(5 µg)/m ³ [Cr(VI) inorganic compounds as Cr(VI), insoluble]	250 mg/m ³ IDLH	N/A
Cobalt (7440-48-4)	0.02 mg/m ³	0.01 mg/m ³ (dust and fume)	20 mg/m ³ IDLH	N/A
Iron (7439-89-6)	5.0 mg/m ³ (as Fe ₂ O ₃) respirable fraction	10.0 mg/m ³ (fume, as Fe ₂ O ₃)	N/A	N/A
Manganese (7439-96-5)	0.02 mg/m ³ (elemental and inorganic compounds, as Mn – respirable fraction) 0.1 mg/m ³ (elemental and inorganic compounds, as Mn – inhalable fraction)	5.0 mg/m ³ (fume, as Mn) Ceiling	1 mg/m ³ REL 500 mg/m ³ IDLH	3 mg/m ³
Molybdenum (7439-98-7)	3.0 mg/m ³ (respirable fraction, as Mo) 10.0 mg/m ³ (inhalable fraction, as Mo)	15.0 mg/m ³ (total dust, as Mo)	N/A	N/A
Nickel (7440-02-0)	1.5 mg/m ³ as metal (inhalable fraction)	1.0 mg/m ³ (metal and insoluble compounds as Ni)	0.015 mg/m ³ REL 10 mg/m ³ IDLH	N/A
Silicon (7440-21-3)	Withdrawn	15.0 mg/m ³ (total dust) 5.0 mg/m ³ (respirable fraction)	5.0 mg/m ³ (respirable) REL 10.0 mg/m ³ (total) REL	N/A
Tungsten (7440-33-7)	5.0 mg/m ³	5.0 mg/m ³	5.0 mg/m ³ REL	10.0 mg/m ³

Chemical Identity (CAS-No.)	Derived No Effect Level (DNEL)	Predicted No Effect Concentration (PNEC)
Chromium (7440-47-3)	0.5 mg/m ³ local inhalation	Not listed
Cobalt (7440-48-4)	0.04 mg/m ³ long term local inhalation	2.36 µg Co/l (AF 3) marine water; 0.74 µg/l (AF 3) fresh water
Iron (7439-89-6)	3.0 mg/m ³ local inhalation	Not listed
Manganese (7439-96-5)	0.2 mg/m ³ systemic inhalation	Not listed
Carbon (7439-98-7)	10.0 mg/m ³ systemic inhalation	Not listed
Nickel (7440-02-0)	4.0 mg/m ³ short term local inhalation; 0.05 mg/m ³ long term local inhalation	0.0035-0.0218 mg/l freshwater; 0.0023 mg/l marine water
Tungsten (7440-33-7)	5.8 mg/m ³ systemic inhalation	Tungsten 0.338 mg/l freshwater; 0.0338 mg/l marine water; 2.17 mg/kg soil; 11.0 mg/kg food

8.2 Exposure controls

Appropriate Engineering Controls:

Use enough ventilation, local exhaust at the arc, or both to keep the fumes and gases from the worker's breathing zone & the general area. Maintain exposures below acceptable exposure levels (see Section 8.1). Use industrial hygiene air monitoring to ensure that your use of these products does not create exposures that exceed the recommended exposure limits. Always use exhaust ventilation in user operations such as high temperature cutting, grinding, welding and brazing. Train the welder to keep his head out of the fume plume. Confined spaces require adequate ventilation and/or air supplied respirators. Read and understand the manufacturer's instructions and the precautionary label on the product. See American National Standard Z49.1, Safety in Welding, Cutting, and Allied Processes, published by the American Welding Society, 8669 Doral Blvd. Suite 130, Doral, FL 33166 and OSHA Publication 2206 (29CFR1910), US Government Printing Office, Washington, D.C. 20402 for more details on many of the following.

General information:

Exposure Guidelines: Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs) are values published by the American Conference of Government Industrial Hygienists (ACGIH). ACGIH Statement of Positions Regarding the TLVs® and BEIs® states that the TLV-TWA should be used as a guide in the control of health hazards and should not be used to indicate a fine line between safe and dangerous exposures. See Section 10 for information on potential fume constituents of health interest. Threshold Limit Values are figures published by the American Conference of Government Industrial Hygienists.

Chemical Identity (CAS-No.)	ACGIH - BEI
Cobalt (7440-48-4)	15 µg/L Medium: urine Time: end of shift at end of workweek Parameter: Cobalt (background); 1 µg/L Medium: blood Time: end of shift at end of workweek Parameter: Cobalt (background, semi-quantitative)

Eye/face protection: Wear helmet or use face shield with filter lens shade number 12 or darker for open arc processes. No specific lens shade recommendation for submerged arc processes. Shield others by providing screens and flash goggles.

Skin/Hand Protection: Wear protective gloves. Suitable gloves can be recommended by the glove supplier.

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- Protective Clothing:** Wear hand, head, and body protection which help to prevent injury from radiation, sparks and electrical shock. See Z49.1. At a minimum this includes welder's gloves and a protective face shield, and may include arm protectors, aprons, hats, shoulder protection, as well as dark substantial clothing. Wear dry gloves free of holes or split seams. Train the welder not to permit electrically live parts or electrodes to contact skin . . . or clothing or gloves if they are wet. Insulate yourself from the work piece and ground using dry plywood, rubber mats or other dry insulation.
- Respiratory Protection:** Keep your head out of fumes. Use enough ventilation and local exhaust to keep fumes and gases from your breathing zone and the general area. An approved respirator should be used unless exposure assessments are below applicable exposure limits. Use respirable fume respirator or air supplied respirator when welding in confined space or where local exhaust or ventilation does not keep exposure below TLV's (see Section 8.1). Use only NIOSH approved respirators in accordance with 29 CFR 1910.134 – Respiratory Protection. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998).
- Hygiene measures:** Do not eat, drink or smoke when using the product. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Cosmetics should not be applied in areas where exposures exist! Routinely wash work clothing and protective equipment to remove contaminants.
- Determine the composition and quantity of fumes and gases to which workers are exposed by taking an air sample from inside the welder's helmet if worn or in the worker's breathing zone. Improve ventilation if exposures are not below limits. See ANSI/AWS F1.1, F1.2, F1.3 and F1.5, available from the American Welding Society, www.aws.org.

Section 9 – PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Solid or flux coated welding rod
Physical state	Solid
Form	Solid
Color	Metallic blue
Odor	None
Odor threshold	No data available
pH	Not applicable
Melting point/freezing point	No data available
Flammability (solid, gas)	No data available
Flash Point	Not applicable
Evaporation rate	Not applicable
Initial boiling point and boiling range	No data available
Density	8.44 g/cm ³

Flammability limit - upper (%)	No data available
Flammability limit - lower (%)	No data available
Explosive limit - upper (%)	No data available
Explosive limit - lower (%)	No data available
Vapor pressure	Not applicable
Vapor density	Not applicable
Relative density	No data available
Solubility in water	None
Solubility (other)	No data available
Partition coefficient (n-octanol/water)	No data available
Auto-ignition temperature	No data available
Decomposition temperature	No data available
Viscosity	Not applicable
VOC content	Not applicable

Section 10 – STABILITY AND REACTIVITY

10.1 Reactivity

This product is non-reactive under normal conditions of use, storage and transport.

10.2 Chemical stability

This product is stable under normal conditions.

10.3 Possibility of hazardous reactions

None under normal processing.

10.4 Conditions to avoid

Uncontrolled exposure to extreme temperatures and/or contamination.

10.5 Incompatible materials

Strong acids, strong oxidizers, mineral acids, some halogenated compounds, phosphorus and mercury.

10.6 Hazardous decomposition products

Welding/brazing fumes and gases can't be classified simply. The composition and quantity of both are dependent upon the metal being welded/brazed and the rods used. Coatings on the metal being welded/brazed (such as paint, plating, or galvanizing), the number of welders, the volume of the work area, the quality and the amount of ventilation, the position of the welder's head with respect to the gas plume, the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing activities), the process and procedures, as well as the welding/brazing consumables.

When these cobalt rods are consumed, the fume and gas decomposition products generated are different in percent and form from the ingredients listed in Section 3. Decomposition products of normal operation include those originating from the volatilization, reaction, or oxidation of the materials shown in Section 3, plus those from the base metal, coatings, etc., as noted above. Gaseous reaction products may include carbon monoxide and carbon dioxide. Ozone and nitrogen oxides may be formed by the radiation from an arc, in addition to the shielding gases like argon and helium, whenever they are employed. Reasonably expected fume constituents of these cobalt rods would include: Complex oxides of iron, manganese, nickel, molybdenum, silicon, chromium, cobalt, tungsten, carbon dioxide, carbon monoxide, ozone and nitrogen oxides. The fume limit for chromium, cobalt, nickel, and/or manganese may be reached before the general welding fume limit of 5 mg/m³ is reached. One recommended way to determine the composition and quantity of fumes and gases to which workers are exposed is to take an air sample inside the welder's helmet if worn or in the worker's breathing zone. See ANSI/AWS F1.1 "Method for Sampling Airborne Particles Generated by Welding and Allied Processes" and "Characterization of Arc Welding Fume" available from the American Welding Society, 8669 Doral Blvd. Suite 130, Doral, FL 33166.

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A SIGNIFICANT AMOUNT OF THE CHROMIUM IN THE FUMES CAN BE HEXAVALENT CHROMIUM , ALSO KNOWN AS Cr(VI), WHICH HAS A VERY LOW EXPOSURE LIMIT OF 0.005 mg/m³ (5 µg/m³).

Monitor fume levels and Cr(VI) level. Train workers about the hazards of Cr(VI). **Read and comply with OSHA’s permissible exposure limits for hexavalent chromium Cr(VI), Fed. Reg. 71 – 10099 (specifically 29 CFR 1910.1026, 29 CFR 1915.1026, and 29 CFR 1926.1126).** For Cr(VI), OSHA requires: “The employer shall perform initial monitoring to determine the 8-hour TWA exposure for each employee on the basis of a sufficient number of personal breathing zone air samples to accurately characterize full shift exposure on each shift, for each job classification, in each work area”. Specialized equipment is required for monitoring Cr(VI) concentration in the workplace. OSHA Analytical Method Number ID-215 for area and breathing zone sampling and OSHA Analytical Method Number W4001 for wipe samples are listed on the OSHA website – www.osha.gov – as methods for measuring Cr(VI). This standard is complex and the employer should contact an occupational health professional for doing the Cr(VI) monitoring and all other fume monitoring.

EU RoHS (European Union Restriction of Hazardous Substances): These cobalt rods contain Chromium. During welding these alloys will produce Cr(VI) (hexavalent chromium), however, the weld deposit does not contain Cr(VI) as it will all be in the zero valent state or as Cr(III) as an oxide. FINISHED PRODUCTS MANUFACTURED USING THESE COBALT RODS WILL NOT CONTAIN ANY Cr(VI).

Section 11 – TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

- Ingestion:** Health injuries from ingestion are not expected under normal use. Should ingestion occur, it may cause gastrointestinal irritation, nausea, vomiting and diarrhea. Ingestion may cause irritation to mucous membranes.
- Inhalation:** Potential chronic health hazards related to the use of welding consumables are most applicable to the inhalation route of exposure. It may cause allergy or asthma symptoms or breathing difficulties if inhaled. Refer to Inhalation statements in this section.
- Skin Contact:** Repeated or prolonged skin contact may cause allergic reactions with susceptible persons. Prolonged contact may cause redness and irritation. Prolonged skin contact may defat the skin and cause dermatitis. May cause sensitization by skin contact. Arc rays can burn skin. Skin cancer has been reported.
- Eye contact:** May cause eye irritation with susceptible persons. Arc rays can injure eyes.

Symptoms related to the physical, chemical and toxicological characteristics

- Inhalation:** Short-term (acute) overexposure to welding fumes may result in discomfort such as metal fume fever, dizziness, nausea, or dryness or irritation of nose, throat, or eyes. May aggravate pre-existing respiratory problems (e.g. asthma, emphysema). Long-term (chronic) overexposure to welding fumes can lead to siderosis (iron deposits in lung), central nervous system effects, bronchitis and other pulmonary effects.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure): Harmful if swallowed

Specified substance: IRON LD50 (oral, rat) = 98.6 g/kg ATE (oral) = 984.00 mg/kg LDLO (intraperitoneal, rabbit) = 20 mg/kg – no toxic effect noted	Specified substance: MANGANESE LD50 (oral, rat) = 9000 mg/kg ATE (oral) = 9000000.0 mg/kg LC50 (inhalation) > 5.14 mg/l air (analytical)	Specified substance: TUNGSTEN LD50 (oral) > 2000 mg/kg bw LD50 (dermal) > 2000 mg/kg bw LC50 (inhalation) > 5.4 mg/l air
Specified substance: NICKEL LD50 (oral, rat) > 9000 mg/kg bw NOAEC > 10.2 mg/l air	Specified substance: COBALT LD50 (oral, rat) = 215.9 – 1140 mg/kg LC50 (inhalation, rat, 1h) > 10 mg/l ATE (oral) = 215.90 mg/kg ATE (dust/mist, 4h) = 0.01 mg/l LD50 (oral) = 550 mg/kg bw LD50 (dermal) > 2000 mg/kg bw LC50 (inhalation) = 0.05 mg/l	Specified substance: CARBON LD50 (oral, rat) > 10000 mg/kg
Specified substance: CHROMIUM LD50 (oral) >5000 mg/kg bw LC50 (inhalation) > 5.41 mg/l air (analytical)		Specified substance: SILICON ATE (oral) = 3160.0 mg/kg LD50 (oral, rat) = 3160 mg/kg

- Repeated dose toxicity (product):** Not classified
- Skin corrosion/irritation (product):** Not classified
- Serious eye damage/irritation (product):** Not classified
- Respiratory or skin sensitization (product):** May cause an allergic skin reaction
- Germ cell mutagenicity (product):** Not classified

Carcinogenicity (product): May cause cancer

Chromium (7440-47-3)	
International Agency for Research on Cancer (IARC) Monographs	3 (Not classifiable as to its carcinogenicity to humans)
American Conference of Governmental Industrial Hygienists (ACGIH)	A4 (Not classifiable as a human carcinogen)
Cobalt (7440-48-4)	
International Agency for Research on Cancer (IARC) Monographs	2B (Possibly carcinogenic to humans)
National Toxicology Program (NTP) Status	Post Peer Review Technical Reports in Progress 16 (Long-Term Studies) Male Rat – Clear Evidence; Female Rat – Clear Evidence; Male Mice – Clear Evidence; Female Mice – Clear Evidence (TR-581)
American Conference of Governmental Industrial Hygienists (ACGIH)	A3 (Confirmed animal carcinogen with unknown relevance to humans)
Tungsten (7440-33-7)	
National Toxicology Program (NTP) Status	Short-term exposure studies in progress 5 (including sub oxide fibers)
Nickel (7440-02-0)	
International Agency for Research on Cancer (IARC) Monographs	Nickel Compounds: 1 (Known human carcinogen) Nickel, Metallic & Alloy: 2B (Possibly carcinogenic to humans)
National Toxicology Program (NTP) Status	Reasonably anticipated to be a Human Carcinogen
American Conference of Governmental Industrial Hygienists (ACGIH)	A5 (Not suspected as a human carcinogen)

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Reproductive toxicity (product):

Contains a known or suspected reproductive toxin.

Chronic toxicity (product):

Prolonged exposure may cause chronic effects such as central nervous system (CNS) and psychiatric effects and Parkinson-like symptoms. It can also cause languor, sleepiness and weakness in legs. It may even cause a stolid masklike appearance of the face, emotional disturbances such as uncontrollable laughter and spastic gait with a tendency to fall while walking. Repeated contact may cause allergic reactions in very susceptible persons. Avoid repeated exposure. Repeated or prolonged skin contact may cause skin irritation and/or dermatitis and sensitization of susceptible persons. Repeated or prolonged exposure may cause central nervous system damage. Contains a known or suspected reproductive toxin. This product contains one or more substances which are classified by the IARC as carcinogenic to humans (Group I), probably carcinogenic to humans (Group 2A) or possibly carcinogenic to humans (Group 2B).

Specific target organ toxicity - single exposure (product):

May cause drowsiness or dizziness. May cause respiratory irritation.

Specific target organ toxicity - repeated exposure (product):

Blood, central nervous system (CNS), central vascular system (CVS), eyes, kidney, liver, lungs, nasal cavities, respiratory system and/or skin.

Neurological effects:

Repeated or prolonged exposure may cause central nervous system damage. Prolonged or excessive exposure to manganese in dust or fume may cause irreversible central nervous system damage (Manganism). Symptoms resemble Parkinson's disease and include tremors, impaired speech, mask like face and impaired movement.

Aspiration hazard (product):

Not classified

Other Effects:

Organic polymers may be used in the manufacture of various welding consumables. Overexposure to their decomposition byproducts may result in a condition known as polymer fume fever. Polymer fume fever usually occurs within 4 to 8 hours of exposure with the presentation of flu like symptoms, including mild pulmonary irritation with or without an increase in body temperature. Signs of exposure can include an increase in white blood cell count. Resolution of symptoms typically occurs quickly, usually not lasting longer than 48 hours.

Symptoms related to the physical, chemical and toxicological characteristics under the condition of use:

<p>Specified substance: CHROMIUM (VI) Inhalation: Chromates may cause ulceration, perforation of the nasal septum, and severe irritation of the bronchial tubes and lungs. Liver damage and allergic reactions, including skin rash, have been reported. Asthma has been reported in some sensitized individuals. Skin contact may result in irritation, ulceration, sensitization, and contact dermatitis. Chromates contain the hexavalent form of chromium [Chromium (VI)]. Hexavalent chromium and its compounds are on the IARC and NTP lists as posing a cancer risk to humans.</p>	<p>Specified substance: MANGANESE Inhalation: Overexposure to manganese fumes may affect the brain and central nervous system, resulting in poor coordination, difficulty speaking, and arm or leg tremors. This condition can be irreversible. Specified substance: NICKEL Inhalation: Nickel and its compounds are on the IARC and NTP lists as posing respiratory cancer risk, and are skin sensitizers with symptoms ranging from slight itch to severe dermatitis. Specified substance: COBALT Inhalation: Repeated overexposure to cobalt compounds can produce reduced pulmonary function, diffuse nodular fibrosis of lungs and respiratory hypersensitivity.</p>
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Additional toxicological information under the conditions of use:

Acute toxicity

<p>Specified substance: CHROMIUM (VI) LD50 (oral, rat) = 27 – 59 mg/kg LC50 (inhalation, rat) = 33 – 70 mg/m³/4h</p>	<p>Specified substance: CARBON DIOXIDE LCLo (inhalation, human) = 90000 ppm/5 min. Specified substance: CARBON MONOXIDE LC50 (inhalation, rat) = 1300 mg/l/4h</p>	<p>Specified substance: NITROGEN DIOXIDE LC50 (inhalation, rat) = 88 ppm/4h Specified substance: OZONE LCLo (inhalation, human) = 50 ppm/30 min.</p>
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Section 12 – ECOLOGICAL INFORMATION

Eco-toxicity

Acute hazards to the aquatic environment:

Fish

<p>Specified substance: NICKEL LC50 (Fathead minnow (Pimephales promelas), 96 h): 2.916 mg/l LC50 (Brachydanio rerio), 96 h): >100 mg/l EC50 (Daphnia magna), 48 h): >100 mg/l LC50 (Cyprinus carpio) [semi-static], 96 h): 1.3 mg/l EC50 (Daphnia magna) [static], 48 h): 1 mg/l</p>	<p>Specified substance: COBALT LC50 (Brachydanio rerio) [static], 96 h): >100 mg/l LOEC (Daphnia Magna): 5.6 mg/l LC50 (Daphnia Magna): >100 mg/l Specified substance: MOLYBDENUM LC50 (Rainbow trout, donaldson trout (Oncorhynchus mykiss), 96 h): 800 mg/l Specified substance: IRON and/or iron alloys (as Fe) LC50 (Cyprinus carpio) [semi-static], 96 h): 0.56 mg/l</p>
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SAFETY DATA SHEET



Aquatic Invertebrates:

Specified substance: NICKEL EC50 (Water flea (Daphnia magna), 48 h): 1 mg/l EC50 (Pseudokirchneriella subcapitata), 72 h): 0.18 mg/l EC50 (Pseudokirchneriella subcapitata) [static], 96 h): 0.174 – 0.311 mg/l	Specified substance: MANGANESE EC50 (Water flea (Daphnia magna), 48 h): 40 mg/l
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Chronic hazards to the aquatic environment:

Fish (product):	Not classified
Aquatic Invertebrates (product):	Not classified
Toxicity to Aquatic Plants:	Not classified

Persistence and Degradability

Biodegradation (product):	No data available
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Bioaccumulative Potential

Bioconcentration Factor (BCF) (product):	No data available
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Specified substance: NICKEL

Zebra mussel (Dreissena polymorpha), Bioconcentration Factor (BCF): 5,000 – 10,000 (Lotic) Bioconcentration factor calculated using dry weight tissue conc.

Mobility in Soil: No data available

Other Adverse Effects: Very toxic to aquatic organisms

Section 13 – DISPOSAL CONSIDERATIONS

Waste disposal recommendations: Prevent waste from contaminating surrounding environment. Discard any product, residue, disposable container or liner in an environmentally acceptable manner, in full compliance with international/federal/state/local regulations. However, alloy wastes are normally collected to recover metal values.

Section 14 – TRANSPORT INFORMATION

In accordance with DOT / ADR / RID / ADNR / IMDG / ICAO / IATA

14.1 UN number

Not a dangerous good in sense of transport regulations

14.2 UN proper shipping name

Not applicable

14.3 Additional information

Other information: No supplementary information available

Overland transport:

No additional information available

Transport by sea:

No additional information available

Air transport:

No additional information available

Section 15 – REGULATORY INFORMATION

15.1 US Federal regulations

Chromium (7440-47-3) Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings) SARA Section 313 - Emission Reporting: 1.0 %	Nickel (7440-02-0) Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings) SARA Section 313 - Emission Reporting: 0.1%
Cobalt (7440-48-4) Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings) SARA Section 313 - Emission Reporting: 0.1 %	Manganese (7439-96-5) Listed on the United States TSCA (Toxic Substances Control Act) inventory Listed on SARA Section 313 (Specific toxic chemical listings) SARA Section 313 - Emission Reporting: 1.0 %
Iron (7439-89-6) Listed on the United States TSCA (Toxic Substances Control Act) inventory	Carbon (7440-44-0) Listed on the United States TSCA (Toxic Substances Control Act) inventory
Molybdenum (7439-98-7) Listed on the United States TSCA (Toxic Substances Control Act) inventory	Silicon (7440-21-3) Listed on the United States TSCA (Toxic Substances Control Act) inventory

SAFETY DATA SHEET



CROWN ALLOYS COMPANY

15.2 US State regulations

Nickel (7440-02-0)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
Yes				
U.S. - Massachusetts - Right To Know List		U.S. - New Jersey - Right to Know Hazardous Substance List		
U.S. - Minnesota - Hazardous Substance List		U.S. - Pennsylvania - RTK (Right to Know) List		
Cobalt (7440-48-4)				
U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No significance risk level (NSRL)
Yes				
U.S. - Massachusetts - Right To Know List		U.S. - New Jersey - Right to Know Hazardous Substance List		
U.S. - Minnesota - Hazardous Substance List		U.S. - Pennsylvania - RTK (Right to Know) List		
Chromium (7440-47-3)		Manganese (7439-96-5)		
U.S. - Massachusetts - Right To Know List		U.S. - Massachusetts - Right To Know List		
U.S. - Minnesota - Hazardous Substance List		U.S. - Minnesota - Hazardous Substance List		
U.S. - New Jersey - Right to Know Hazardous Substance List		U.S. - New Jersey - Right to Know Hazardous Substance List		
U.S. - Pennsylvania - RTK (Right to Know) List		U.S. - Pennsylvania - RTK (Right to Know) List		
Silicon (7440-21-3)		Tungsten (7440-33-7)		
U.S. - Massachusetts - Right To Know List		U.S. - Massachusetts - Right To Know List		
U.S. - Minnesota - Hazardous Substance List		U.S. - Minnesota - Hazardous Substance List		
U.S. - New Jersey - Right to Know Hazardous Substance List		U.S. - New Jersey - Right to Know Hazardous Substance List		
U.S. - Pennsylvania - RTK (Right to Know) List		U.S. - Pennsylvania - RTK (Right to Know) List		
Molybdenum (7439-98-7)				
U.S. - Massachusetts - Right To Know List		U.S. - New Jersey - Right to Know Hazardous Substance List		
U.S. - Minnesota - Hazardous Substance List		U.S. - Pennsylvania - RTK (Right to Know) List		

Section 16 – OTHER INFORMATION

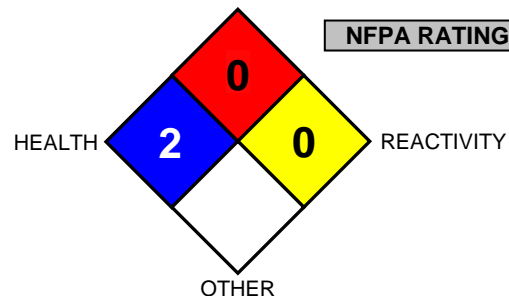
SUPERSEDES LAST REVISION: 12/03/2015 (SDS)

HMIS RATING (Hazardous Materials Information System)

Health (blue) - 2	Flammability (red) - 0	Reactivity (yellow) - 0	Protective Equipment - X (See Sections 4, 8 & 10)
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Health Hazard: **2** (moderate acute or significant chronic exposure hazard) Flammability Hazard: **0** (minimal hazard) Reactivity Hazard: **0** (normally stable)

FLAMMABILITY



NATIONAL FIRE PROTECTION ASSOCIATION:

Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury).

Flammability Hazard: Refer to definitions for "HMIS RATING"

Reactivity Hazard: Refer to definitions for "HMIS RATING"

DEFINITIONS OF TERMS

- ACGIH - American Conference of Governmental Industrial Hygienists
- CAS No. - Chemical Abstracts Service Number
- EPA - Environmental Protection Agency
- GHS - Globally Harmonized System
- IARC - International Agency for Research on Cancer
- LC50 - Lethal Concentration (50 percent kill)
- LCLO - Lowest published lethal concentration
- LD50 - Lethal dose (50 percent kill)
- LDLO - Lowest published lethal dose
- NIOSH - National Institute of Occupational Safety and Health

- NTP - National Toxicology Program
- OSHA - U.S. Occupational Safety and Health Administration
- PEL - Permissible Exposure Limit
- SARA - Superfund Amendments and Reauthorization Act
- STEL - Short Term Exposure Limit
- TCLo - the lowest concentration to cause a symptom
- TDLo - the lowest dose to cause a symptom
- TLV - Threshold Limit Value
- TSCA - Toxic Substances Control Act
- TWA - Time Weighted Average

Full text of H-phrases (from Section 2)

Acute Tox. 4 (Oral)	Acute toxicity (oral), Category 4	H319	Causes serious eye irritation
Aquatic Acute 1	Hazardous to the aquatic environment — Acute Hazard, Category 1	H330	Fatal if inhaled
Aquatic Chronic 3	Hazardous to the aquatic environment — Chronic Hazard, Category 3	H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled
Carc. 1A	Carcinogenicity, Category 1A	H335	May cause respiratory irritation
Carc. 1B	Carcinogenicity, Category 1B	H336	May cause drowsiness or dizziness
Carc. 2	Carcinogenicity, Category 2	H350i	May cause cancer by inhalation
Repr. Tox. 2	Reproductive toxicity, Category 2	H351	Suspected of causing cancer
Skin Sens. 1	Sensitisation — Skin, category 1	H361f	Suspected of damaging fertility
STOT RE 1	Specific target organ toxicity — Repeated exposure, Category 1	H372	Causes damage to organs through prolonged or repeated exposure if inhaled (lungs)
STOT RE 2	Specific target organ toxicity — Repeated exposure, Category 2	H373	May cause damage to organs through prolonged or repeated exposure
STOT SE 3	Specific target organ toxicity — Single exposure, Category 3	H400	Very toxic to aquatic life
H302	Harmful if swallowed	H410	Very toxic to aquatic life with long lasting effects
H317	May cause an allergic skin reaction	H412	Harmful to aquatic life with long lasting effects

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