SAFETY DATA SHEET

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

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Product identifier	Steel Products
Synonyms	None identified
Trade names	None identified
Chemical family	Mixture
Relevant identified uses of the substance or mixture and uses advised against	Industrial steel.
Note	This SDS is written to address potential worker health and safety issues associated with the handling of the formulated product. Workers manufacturing this product should consult the SDSs of each hazardous ingredient for hazard information and handling recommendations.
Issue Date	31 January 2014

SECTION 2 - HAZARDS IDENTIFICATION

Classification of the substance or mixture	**Solid metallic products are generally classified as articles and do not constitute a hazardous material in solid form under the definitions of OSHA Hazard Communication Standard (29 CFR 1910.1200). Any articles manufactured from these solid products would generally be classified as non- hazardous. However, some hazardous elements contained in these products can be emitted under certain processing conditions such as but not limited to: burning, melting, cutting, sawing, brazing, grinding, machining, milling, and welding. Products in the solid state present no fire or explosion hazard; however, small chips, fines, and dust may ignite readily. The following classification information is for the hazardous elements which may be released during processing.**

Classification of the substance or mixture
…continued

Regulation (EC) 1272/2008 [GHS]	Specific Target Organ Toxicity (repeated exposure) - Category 2. Carcinogenic - Category 2.
Directive 67/548/EEC or 1999/45/EC	Xn - R48/20/22. R40 (Carc. Cat 3)

Label elements

CLP/GHS hazard pictogram	
CLP/GHS signal word	Warning
CLP/GHS hazard statements	H373 - May damage to the respiratory system and gastrointestinal tract through prolonged or repeated exposure. H351 - Suspected of causing cancer.
CLP/GHS precautionary statements	P201 - Obtain special instructions before use. P202 - Do not handle until all safety precautions have been read and understood. P260 - Do not breathe dust. P281 - Use personal protective equipment as required. P308 + P313 - If exposed or concerned: get medical advice/attention. P314 - Get medical advice/attention if you feel unwell. P405 - Store locked up. P501 - Dispose of contents/container to location in accordance with local/regional/national/international regulations.
EU symbol/indication of danger	 Xn - Harmful
Risk (R) Phrase(s)	R48/20/22 - Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed. R40 - Limited evidence of a carcinogenic effect.
Safety Advice	S2 - Keep out of reach of children. S22 - Do not breathe dust. S36/37/39 - Wear suitable protective clothing, gloves and eye/face protection. S46 - If swallowed, seek medical advice immediately and show this container or label.
Other hazards	Chronic inhalation of excessive concentrations of iron oxide fumes or dusts may result in the development of a benign pneumoconiosis, called siderosis. No physical impairment of lung function has been associated with siderosis. Inhalation of excessive concentrations of iron oxide may enhance the risk of lung cancer development in workers exposed to pulmonary carcinogens.

Other hazards
…continued

Welding and plasma cutting of alloys may present the potential for overexposure to metal fumes (chromium, nickel, copper) which can result in upper respiratory tract irritation, nausea, and metal fume fever. Symptoms of metal fume fever resemble those of the flu and consist of chills and fever, progressive weakness and muscle pain, and metallic taste in the mouth with dryness/irritation of throat. Welding of material may generate carbon monoxide, carbon dioxide, ozone nitrogen oxides, infrared and/or UV radiation.

The health hazards associated with exposure to chromium are dependent upon its oxidation state. The metal form (chromium as it exists in this product) is of very low toxicity. The hexavalent form is very toxic. Repeated or prolonged exposure to hexavalent chromium compounds may cause respiratory irritation, nosebleed, ulceration and perforation of the nasal septum.

Chronic exposure to high concentrations of manganese fumes and dusts may adversely affect the central nervous system with symptoms including: languor, sleepiness, weakness, emotional disturbances, spastic gait, mask-like facial expression and paralysis. Occupational overexposure is a progressive, disabling neurological syndrome that typically begins with relatively mild symptoms and evolves to include altered gait, fine tremor, and sometimes psychiatric disturbances.

Exposure to nickel dusts and fumes can cause sensitization dermatitis, respiratory irritation, asthma, pulmonary fibrosis, edema and may cause nasal or lung cancer in humans. Nickel causes damage to lungs through prolonged or repeated inhalation exposure. Chronic exposures to low levels of lead can affect the digestive system, nervous system, reproductive system, muscles and joints, and result in blood lead levels that can adversely affect the developing fetus.

US Signal word

Attention

US Hazard overview

May cause damage to respiratory system and gastrointestinal tract based on animal and human data. Possible cancer hazard: contains nickel and chromium which may cause cancer based on animal and human data.

Note

This mixture is classified as dangerous/hazardous according to Directive 1999/45/EC, Regulation EC No 1272/2008 (EU CLP) and applicable US regulations. See Section 16 for full text of EU and GHS classifications. The CLP/GHS classifications are based on Regulation (EC) 1272/2008. The EU symbol/indicator of danger, R Phrases and Safety Advice are based on Directive 67/548/EEC or 1999/45/EC.

SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS #	EINECS/ELINCS#	Amount	EU Classification	GHS Classification
Iron	7439-89-6	231-096-4	91-98%	Harmful - Xn: R48/20/22	STOT-RE2: H373
Carbon	7440-44-0	231-153-3	0.05-1%	Harmful - Xn: R40; R36/37/38	Carc2: H351; SI2: H315; EI2: H319; STOT-SE3: H335
Copper	7440-50-8	231-159-6	0.05-1%	Harmful - Xn: R22; R36/37/38; R43; R62, R63; N: R50/53	ATO4: H302; SI2: H315; SS1: H317; EI2: H319; STOT-SE3: H335; RT2: H361fd; CA1: H410
Chromium	7440-47-3	231-157-5	0.05-1.3%	Toxic - T: R23/24/25; R48/23/24/25; R42/43	ATO2: H300; ATI2: H330, AD3: H311; SS1: H317; RS1: H334; STOT-RE1: H372
Nickel	7440-02-0	231-111-4	0.05-0.8%	Toxic - T: R48/23, R40, R43, R52/53	STOT-S1: H370; SS1: H317; Carc2: H351; CA3: H412
Manganese	7439-96-5	231-105-1	0.1-2%	Harmful - Xn: R48/20/22	STOT-RE2: H373
Silicon	7440-21-3	231-130-8	0.1-1%	Irritant - Xi: R36/37/38	SI2: H315; EI2: H319; STOT-SE3: H335

Note The ingredient(s) listed above are considered hazardous. Mixture also contains trace levels (~0.0001% - <0.1%) of the following compounds: aluminum, boron, calcium, lead, molybdenum, niobium, nitrogen, phosphorus, sulfur, tin, titanium, vanadium, and zinc. See Section 16 for full text of EU and GHS classifications. The EU classification is based on Directive 1999/45/EC and the CLP/GHS classification is based on Regulation (EC) 1272/2008.

SECTION 4 - FIRST AID MEASURES

Description of first aid measures The following first-aid precautions apply during the processing of these products:

Immediate Medical Attention Needed Yes - Delayed effects may occur.

SECTION 4 - FIRST AID MEASURES …continued

Eye Contact	Not anticipated during routine handling of finished product. For contact with dusts or particulates, flush eyes with water for 15 minutes and notify medical personnel and supervisor. Eye injuries from solid particles should be treated by a physician immediately.
Skin Contact	Not anticipated during routine handling of finished product. For skin contact with dusts or powders, wash immediately with soap and water. Cuts or abrasions should be treated promptly with thorough cleansing of the affected area; notify medical personnel and supervisor
Inhalation	Not anticipated during routine handling of finished product. If large amounts of dusts, fumes, or particulates are generated, move person to fresh air. If symptoms develop, seek medical attention and notify supervisor.
Ingestion	Not anticipated during routine handling of finished product. If dusts or particulates are accidentally swallowed, notify medical personnel and supervisor.
Protection of first aid responders	See Section 8 for Exposure Controls/Personal Protection recommendations.
Most important symptoms and effects, both acute and delayed	See Sections 2 and 11
Indication of immediate medical attention and special treatment needed, if necessary	Treat symptomatically and supportively.

SECTION 5 - FIREFIGHTING MEASURES

Extinguishing media	Use water spray (fog), foam, dry powder, or carbon dioxide, as appropriate for surrounding fire and materials (including hot metal chips and sparks).
Specific hazards arising from the substance or mixture	May emit toxic gases of carbon monoxide and carbon dioxide, oxides of nitrogen, and metal fumes which may contain the following: aluminum, boron, calcium, chromium, carbon, copper, iron, lead, manganese, molybdenum, nickel, niobium, phosphorus, silicon, sulfur, tin, titanium, vanadium, and zinc.
Flammability/Explosivity	Finished product is not considered to be flammable or a fire hazard under normal conditions of use. Small chips, fines, and dust generated from processing operations may be readily ignitable. Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source, is a potential dust explosion hazard. Sparks generated may ignite other flammable materials in the area, if present; employ necessary and appropriate measures to avoid fire (*e.g.*, flame retardants, lubrication fluids, etc.)

SECTION 5 - FIREFIGHTING MEASURES …continued

Advice for firefighters In case of fire in the surroundings: use the appropriate extinguishing agent. DO NOT use halogenated extinguishing agents on small chips or fines. DO NOT use water for fires involving molten metal. These fire extinguishing agents will react burning material. Wear full protective clothing and a self-contained breathing apparatus with a full face piece operated in the pressure demand or other positive pressure mode. Decontaminate all surfaces and equipment which may have come into contact with this product/mixture, using an appropriate agent.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures If products from the processing of steel (*e.g.*, dust generation or used metal lubrication fluid) are released or spilled, take proper precautions to minimize exposure by using appropriate personal protective equipment (see Section 8). Area should be adequately ventilated.

Environmental precautions Do not empty products from processing into drains. Avoid release to the environment.

Methods and material for containment and cleaning up Clean up spill with HEPA-filtered vacuum if available. Place spill materials into a leak-proof container suitable for disposal. Avoid contact with sharp edges (*e.g.*, metal chips). Dispose of material in a manner that is compliant with federal, state and local laws.

Reference to other sections See Sections 8 and 13 for more information.

SECTION 7 - HANDLING AND STORAGE

Precautions for safe handling Avoid contact with eyes, skin and clothing. When handling, use proper personal protective equipment as specified in Section 8. Avoid generating airborne dust when handling. Avoid contact with sharp edges or heated material.

Conditions for safe storage including any incompatibilities Avoid extreme temperatures. Protect against physical damage.

Specific end use(s) No information identified.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters/Occupational Exposure Limit Values

Compound	Issuer	Type	OEL
Iron	ACGIH	TLV-TWA	5 mg/m³ (respirable fraction, iron oxide)
	NIOSH	TWA-8 HR	5 mg/m³ (dust and fume, as Fe)
	NIOSH	IDLH (Immediately dangerous to life or health)	2500 mg/m³ (dust and fume, as Fe)
	OSHA	PEL-TWA 8-Hr	10 mg/m³ (fume, iron oxide)

Control Parameters/Occupational Exposure Limit Values
…continued

Compound	Issuer	Type	OEL
Iron	Austria	TWA-8 HR	10 mg/m³ (inhalable fraction, iron oxide); 5 mg/m³ (respirable fraction, iron oxide)
	Austria	STEL (2 x 60 min)	10 mg/m³ (iron oxide)
	Germany	TWA-8 HR	1.5 mg/m³ (respirable fraction, iron oxide)
	Hungary	TWA-8 HR	6 mg/m³ (respirable dust, iron oxide)
	Italy	TWA-8 HR	5 mg/m³ (respirable fraction)
	Lithuania	TWA-8 HR	3.5 mg/m³ (inhalable fraction, as Fe)
	Portugal	TWA-8 HR	5 mg/m³ (respirable fraction, as Fe)
	Romania	TWA-8 HR/STEL	5/10 mg/m³ (dust and fume, iron oxide)
	Slovak Republic	TWA-8 HR	1.5 mg/m³ (iron oxide) 3.5 mg/m³ (respirable dust, as Fe)
	Sweden	TLV	
	Other EU Countries	TWA-8 HR(range)	3.5-10 mg/m³ (fume, as Fe)
Carbon	Austria	8-hour TWA	5 mg/m³ (alveolar dust w/ <1% Quartz)
	Poland	8-hour TWA	4 mg/m³ (natural, total inhalable dust); 1 mg/m³ (natural, respirable dust); 6 mg/m³ (synthetic, total inhalable dust)
Copper	ACGIH	TLV-TWA (8-HR)	0.2 mg/m³ (fume)
	NIOSH, US California OSHA, US OSHA	8-hour TWA, PEL-TWA 8-Hr	1 mg/m³ (dust and mist); 0.1 mg/m³ (fume)
	NIOSH	IDLH	100 mg/m³ (dust, fume, and mist)
	Austria	8-hour TWA	1 mg/m³ (inhalable fraction); 0.1 mg/m³ (respirable fraction, smoke)
	Austria	STEL (4 x 15 min)	4 mg/m³ (inhalable fraction); 0.4 mg/m³ (respirable fraction, smoke)

Control Parameters/Occupational Exposure Limit Values

…continued

Compound	Issuer	Type	OEL
Copper	Belgium	8-hour TWA	0.2 mg/m³; 1 mg/m³ (dust and mist)
	Bulgaria	8-hour TWA	0.1 mg/m³ (metal vapor)
	Czech Republic, Denmark, Finland, Hungary, Slovak Republic	8-hour TWA	1 mg/m³ (dust); 0.1 mg/m³ (fume)
	Czech Republic, Slovak Republic	Ceiling	2 mg/m³ (dust); 0.2 mg/m³ (fume)
	Estonia	8-hour TWA	1 mg/m³ (total dust); 0.2 mg/m³ (respirable dust)
	France, Greece, Ireland, Portugal, Spain	8-hour TWA	1 mg/m³ (total dust); 0.2 mg/m³ (fume)
	France, Greece, Ireland	STEL	2 mg/m³
	Germany, Netherlands	8-hour TWA	0.1 mg/m³ (inhalable fraction)
	Germany	Ceiling	0.2 mg/m³
	Hungary, Slovenia	STEL	4 mg/m³ (dust); 0.4 mg/m³ (fume)
	Italy, Poland	8-hour TWA	0.2 mg/m³ (fume)
	Latvia, Romania	8-hour TWA	0.5 mg/m³
	Latvia	STEL	1 mg/m³
	Lithuania, Slovenia	8-hour TWA	1 mg/m³ (inhalable fraction); 0.2 mg/m³ (respirable fraction)
	Romania	STEL	1.5 mg/m³ (dust); 0.2 mg/m³ (fume)
	Sweden	8-hour TWA	1 mg/m³ (total dust); 0.2 mg/m³ (respirable dust)
	United Kingdom	8-hour TWA	1 mg/m³ (dust and mist); 0.2 mg/m³ (fume)
	United Kingdom	STEL	2 mg/m³ (dust and mist); 0.6 mg/m³ (fume)

Control Parameters/Occupational Exposure Limit Values
…continued

Compound	Issuer	Type	OEL
Chromium	ACGIH	TLV-TWA (8-HR)	0.5 mg/m³
	NIOSH	8-hour TWA	0.5 mg/m³
	NIOSH	IDLH	250 mg/m³
	US California OSHA	PEL-TWA 8-Hr	0.5 mg/m³
	US OSHA	PEL-TWA 8-Hr	1 mg/m³
	Czech Republic	Ceiling	1.5 mg/m³
	United Kingdom	STEL	1.5 mg/m³
	Other EU Countries	8-hour TWA (range)	0.5-2 mg/m³
Nickel	ACGIH	TLV-TWA	1.5 mg/m³ (inhalable fraction)
	NIOSH	TWA-8 HR	0.015 mg/m³
	NIOSH	IDLH	10 mg/m³
	US OSHA	PEL-TWA 8-Hr	1 mg/m³
	US California OSHA	PEL-TWA 8-Hr	0.5 mg/m³
	Austria	STEL (4 x 15 min)	2 mg/m³ (dust, inhalable fraction)
	Austria	TWA-8 HR	0.5 mg/m³ (dust, inhalable fraction)
	Czech Republic	Ceiling	1 mg/m³
	Hungary	Ceiling	0.1 mg/m³
	Romania, Slovak Republic. Slovenia, United Kingdom	STEL (range)	0.5-2.5 mg/m³
	Other EU Countries	8-hour TWA (range)	0.05-1.5 mg/m³

Control Parameters/Occupational Exposure Limit Values
…continued

Compound	Issuer	Type	OEL
Manganese	ACGIH	TLV-TWA (8-HR)	0.02 mg/m³ (respirable fraction); 0.1 mg/m³ (inhalable fraction)
	NIOSH	8-hour TWA	1 mg/m³ (fume)
	NIOSH	STEL	3 mg/m³
	NIOSH	IDLH	500 mg/m³
	US California OSHA	PEL-TWA 8-Hr	0.2 mg/m³ (fume)
	US OSHA	PEL (vacated)	1 mg/m³ (fume)
	US OSHA	PEL (vacated)	3 mg/m³ (fume)
	US OSHA	Ceiling	5 mg/m³ (fume)
	Austria	8-hour TWA	0.5 mg/m³ (inhalable fraction)
	Austria	STEL (inhalable fraction, 4 x 15 min)	2 mg/m³
	Belgium, Italy, Portugal, Spain	8-hour TWA	0.2 mg/m³
	Czech Republic	8-hour TWA	1 mg/m³
	Czech Republic	Ceiling	2 mg/m³
	Denmark, Estonia, Sweden, Finland	8-hour TWA	0.2 mg/m³ (total dust); 0.1 mg/m³ (respirable dust)
	France	8-hour TWA	1 mg/m³ (fume)
	Germany	8-hour TWA	0.2 mg/m³ (inhalable fraction); 0.02 mg/m³ (respirable fraction
	Lithuania	8-hour TWA	1 mg/m³ (inhalable fraction); 0.5 mg/m³ (respirable fraction)
	Germany	Ceiling	1.6 mg/m³
	Hungary, Ireland, Romania, Slovenia	STEL (range)	2-20 mg/m³
	Other EU Countries	8-hour TWA (range)	0.2-5 mg/m³

Control Parameters/Occupational Exposure Limit Values
…continued

Compound	Issuer	Type	OEL
	United Kingdom	STEL	1.5 mg/m³
Silicon	NIOSH	8-hour TWA	10 mg/m³ (total dust); 5 mg/m³ (respirable dust)
	US OSHA	8-hour TWA	15 mg/m³ (total dust); 5 mg/m³ (respirable fraction)
	Belgium, Denmark, France	8-hour TWA	10 mg/m³
	Estonia, Greece	8-hour TWA	10 mg/m³; 5 mg/m³ (respirable dust/fraction)
	Ireland, United Kingdom	8-hour TWA	10 mg/m³ (total inhalable dust); 4 mg/m³ (respirable dust)
	United Kingdom	STEL	30 ppm (calculated, inhalable dust); 12 mg/m³ (calculated, respirable dust)

Exposure/Engineering controls
Control exposures to below the OEL (if available). Selection and use of containment devices and personal protective equipment should be based on a risk assessment of exposure potential. Use local exhaust and/or enclosure at dust-generating points. Emphasis is to be placed on closed material transfer systems that prevent dispersion of dust into work areas. High-energy operations should be done within an approved emission control or containment system.

Respiratory protection
Choice of respiratory protection should be appropriate to the task and the level of existing engineering controls. OSHA considers effective engineering controls to be the primary means to control worker exposure. If engineering controls do not maintain airborne concentrations below recommended exposure limits, an approved NIOSH/MSHA respirator must be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations.

Hand protection
Cut resistant gloves and sleeves should be worn when working with steel products. For operations, which result in elevating the temperature of the product to or above its melting point, or which result in the generation of airborne particulates, use protective clothing and gloves to prevent skin contact. Protective gloves should be worn as required for welding, burning or handling operations.

Skin protection
Wear appropriate personal protective clothing to prevent skin contact. Wear appropriate gloves or other protective overgarment if skin contact is likely. Base the choice of skin protection on the job activity, potential for skin contact and potential for generation of dusts or fumes.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION …continued

Eye/face protection	Should not be required during normal handling of solid material. Wear safety glasses with side shields, goggles, or full face shield, if necessary during processing operations. Base the choice of protection on the job activity and potential for contact with eyes or face. An emergency eye wash station should be available.
Environmental Exposure Controls	Should not be required during normal handling of material. In case of spill, do not release to drains. Avoid release to the environment.
Other protective measures	Wash hands in the event of contact with this product, and after processing, especially before eating, drinking or smoking. Protective equipment is not to be worn outside the work area (*e.g.*, in common areas or out-of-doors).

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Steel pallets
Color	Metallic gray
Melting point/freezing point	No information identified.
Flammability (solid, gas)	Finished product is not flammable.
Decomposition temperature	No information identified.
Explosive properties	See Section 5.
Oxidizing properties	Several ingredients present in steel dust (*e.g.*, nickel, zinc) can react with oxygen to form more hazardous, oxidized particles.

Other information

Molecular weight	Not applicable (Mixture).
Molecular formula	Not applicable (Mixture).

SECTION 10 - STABILITY AND REACTIVITY

Reactivity No information identified.

Chemical stability No information identified.

Possibility of hazardous reactions No specific information identified for the mixture. If there are concerns surrounding specific components, refer to the OSHA list of regulated toxic metals for more information.

Conditions to avoid No information identified.

Incompatible materials No specific information identified for the mixture. If there are concerns surrounding specific components, refer to the OSHA list of regulated toxic metals for more information.

Hazardous decomposition products No information identified.

SECTION 11 - TOXICOLOGICAL INFORMATION

Note The following data describe the toxicity of individual ingredients. Due to the composition of steel (*e.g.*, metal alloy), toxicity of finished product is likely to be much less than that of individual constituents.

Information on toxicological effects

Route of entry As a finished solid metal product, steel poses little or no immediate health or fire hazard in the natural solid state. When product is subjected to welding, burning, melting, sawing, brazing, grinding or other similar processes, potentially hazardous airborne particulate and fumes may be generated.

Acute toxicity

Compound	Type	Route	Species	Dose
Iron	LD_{50}	Intraperitoneal	Mouse	5400 mg/kg
	LD_{50}	Intraperitoneal	Rat	5500 mg/kg
	LD_{50}	Oral	Rat	>10,000 mg/kg
Carbon	LD_{50}	Oral	Mice	>5 g/kg
	LD_{50}	Oral	Rat	>5 g/kg
	LD_{50}	Oral	Dog	>5 g/kg
Copper	LD_{50}	Oral	Rat	470 mg/kg
	LD_{50}	Oral	Mouse	413 mg/kg
Chromium	LD_{50}	Oral	Rat	13-28 mg/kg (sodium chromate)
	LD_{50}	Oral	Rat	108-249 mg/kg (calcium chromate)
Nickel	LD_{50}	Oral	Rat	9 g/kg
	LD_{50}	Intraperitoneal	Rat	250 mg/kg
	LC_{50} (Nickel carbonyl)	Inhalation	Mice	10 ppm
	LC_{50} (Nickel carbonyl)	Inhalation	Rats	35 ppm
Manganese	LD_{50}	Oral	Rat	9 g/kg
Silicon	LD_{50}	Oral	Rat	3160 mg/kg

Irritation/Corrosion	Contact with dust can cause mechanical irritation or drying of skin. Contact with oils used with these products during processing may case irritation and with prolonged or repeated skin contact may defat the skin and produce dermatitis.
Sensitization	Repeated or prolonged skin contact may cause allergic reactions in susceptible individuals. Product contains nickel.
STOT-single exposure	No studies identified.
STOT-repeated exposure/Repeat-dose toxicity	Repeated overexposure to iron may result in siderosis (accumulation of iron in the lung). Rats exposed to iron oxide doses of 8.5 mg/kg body weight twice daily over three days exhibited damage to liver and lungs. However, increased levels of liver enzymes were observed in rats given iron oxide orally at doses up to 150 µg/kg, over a period of fifteen days. Hamsters exposed to iron oxide dust with a mean particle size of 0.11 µm at a concentration of 40 mg/m^3, 6 hours/day, 5 days/week, accumulated iron in the lung. Microscopical examination of lung specimens obtained from hamsters exposed to iron for long periods of time revealed respiratory tract cell injury and alveolar fibrosis. Although copper is an essential element, repeated overexposure may cause hemolytic anemia with methemoglobinemia, jaundice and hemoglobinuria. Symptoms of copper toxicity (500 ppm) in pigs were reduced feed intake, reduced growth, and low hemoglobin; continued ingestion of this amount of copper results in degenerative changes in liver, kidney, and spleen. Pigs fed 600-700 ppm dietary copper have high serum aspartate amino transferase and ornithine carbamyl transferase activities indicative of general tissue damage. The primary targets of manganese toxicity are the brain and central nervous system. Manganese has been shown to be deposited in certain regions of the brain, and exposure to high concentrations has been associated with permanent damage, with symptoms of impaired neurological and neuromuscular control, mental and emotional disturbances, muscle stiffness, lack of coordination, tremors, difficulties with breathing or swallowing, and other neuromuscular problems. However, male mice were exposed to manganese oxide dust for 7 hours/day, 5 days/week for 32 weeks. The concentration of manganese in the dust was 49.1 mg/m^3 for the first 12 weeks and 85.3 mg/m^3 thereafter. No histopathological changes or grossly visible signs of neurotoxicity, such as those seen in monkeys or humans, were observed in the treated mice throughout the study period. Breathing high levels of chromium (VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium (VI) compared to chromium (III). Kidney damage was seen in rats injected with 10-20 mg/kg chromium (VI). In dogs, exposures to chromium (VI) in the diet over 2-3 months (0.1 g/day) was fatal. In rats, 134 ppm chromium (VI) in drinking water over 2-3 months caused kidney and liver lesions.

STOT-repeated exposure/Repeat-dose toxicity…continued

Lung inflammation and damage to the nasal cavity have been observed in animals exposed to nickel compounds. At high concentrations, lung damage is severe enough to affect lung function. Chronic inhalation studies of rats and mice exposed to nickel sulfate hexahydrate (at 0.7-13.5 mg/m^3 during a 6-hour period over 12 days) produced pulmonary inflammation, degeneration of bronchiolar mucosa, and atrophy of olfactory epithelium at all concentrations tested. Rats and mice exposed to similar concentrations of nickel subsulfide exhibited degeneration of the respiratory epithelium at 0.9 mg/m^3, and pulmonary inflammation (rats only) at 0.4 mg/m^3.

Rabbits administered nickel chloride at 0.3 mg/m^3 for 6 hours/day, 5 days/ week over one month exhibited degenerative changes within the lungs. Animals exposed to nickel carbonyl by inhalation for 5 days, 12 hours/day exhibited signs of dyspnea, fever, vomiting, diarrhea, apathy, anorexia, tachypnea, cyanosis, and occasionally hind-limb paralysis with generalized convulsions followed by death.

Reproductive toxicity

Intraperitoneal injection of 0.4 mmol/kg of iron (in the form of iron sulfate) induced necrosis of germinal epithelium in the testes of male rats and resulted in increased numbers of nuclei and axonemes in spermatids, or cases where axonemes were absent altogether; overall sperm counts were reduced.

In rats, copper was found to affect female fertility index and pre- and post-implantation mortality; it also produced fetotoxicity and developmental abnormalities of the central nervous system and musculoskeletal system.

Manganese chloride tetrahydrate did not affect the total number of implants, early resorptions, sex ratio, or fetal death in experimental animals. Late resorptions were increased at doses of 4 to 16 mg/kg/day. Fetotoxicity was increased at a dose of 8 and 16 mg/kg/day when signs of maternal toxicity were present. The NOAEL for embryo- or fetotoxicity was 2 mg/kg/day. Oral doses of 800 mg/kg were associated with decreased viability in newborn rabbits, decreased body weight and dilated brain ventricles with decreased water maze ability. Manganese at doses up to 1,000 ppm in the diet did not affect female fertility; oral manganese dosed at 15 and 30 mg/kg/day in mice caused a decrease in sperm motility and sperm counts; there were no alterations in fertility or pathology of testicular tissue.

Female mice given drinking water containing chromium (either III or VI) for 12 weeks produced fewer viable fetuses than control animals. Exposure levels were 2000 and 5000 ppm. In another study, alterations in ovarian follicles occurred after 20 days treatment with chromium VI 250 ppm in drinking water. Male rats given oral (gavage) doses of chromium VI at 40 or 60 mg/kg/day displayed clear testicular toxicity. At 20 mg/kg/day, weight gain was not affected, but there was a significant decrease in serum testosterone. In adult male rats treated via intraperitoneal injection with chromium III or chromium VI at doses of 1, 2, or 4 mg/kg/day for 5 days, only chromium VI produced testicular toxicity and a reduction in sperm count. Administration of 0.5 mg/kg/day for 5 days did not affect weight or sperm count, although plasma testosterone and sperm motility were decreased and serum gonadotropin concentrations were increased.
Male monkeys treated with chromium VI in drinking water at 100 ppm or higher concentrations had obstructive lesions of the epididymis.

Reproductive toxicity…continued

There were no treatment-related adverse effects on sperm count, morphology, motility, nor disturbances in estrus-cycle in rats or mice following inhalation of nickel sulfate, nickel oxide, or nickel subsulfide at concentrations of up to 7.9 mg/m^3 for 13 weeks. Oral administration of nickel sulfate to rats caused decreased testicular, prostate, and seminal vesicle size, as well as abnormalities of sperm and decreased sperm counts. Exposure to nickel subsulfide at 1.8 mg/m^3 produced testicular degeneration in both rats and mice, while no degeneration was observed in either species at 0.9 mg/m^3.

Developmental toxicity

Animal teratology studies using iron have produced inconsistent results. No increase in the frequency of malformations was observed in the offspring of mice or rats treated during pregnancy in doses 1-100 times those used therapeutically in humans. No teratogenic effect was observed among the offspring of rats or rabbits treated during pregnancy with iron protein succinylate in doses of 100-900 mg/kg/day. In contrast, malformations have been observed in the offspring of rabbits and mice treated with maternally toxic doses of iron during pregnancy. In these studies the most frequently observed fetal anomalies involved the central nervous system and skeleton.

Hamsters developed cardiac abnormalities when treated in utero with copper salts. This effect was more regularly seen with copper citrate (up to 4 mg/kg) than with copper sulfate (up to 10 mg/kg). Pregnant rats gavaged with copper chloride throughout gestation had an increase in jaundiced and runt pups at 20 mg/kg/day and above, a dose that was also maternally toxic. Copper treatment was also embryolethal and teratogenic in mice. 24-hour exposure of pregnant rats to copper chloride (concentration 0.02 mg/m^3) over 21 days was associated with increased number of intrauterine deaths. However, at a concentration of 0.003 mg/m^3, copper chloride had no adverse effect on the reproduction processes in female rats.

Embryonic death was increased in pregnant hamsters given single intravenous doses of 20-35 mg/kg of manganese chloride during pregnancy, although the frequency of fetal malformations was not increased. No teratogenic effect was observed in another study among the offspring of pregnant hamsters treated orally with manganese sulfate in doses of 1.36-136 mg/kg/day. Similarly, no teratogenic effect was observed among the offspring of pregnant rabbits treated orally with manganese sulfate using doses of 1.12-112 mg/kg/day. Chronic dietary ingestion of manganese in rats (up to 3500 ppm) did not produce teratogenesis; in another study, manganese at doses up to 1,000 ppm in the diet was not teratogenic in rats.

In mice given chromium VI in drinking water at 250, 500, or 1000 ppm throughout pregnancy, there were no fetuses at the highest dose. At the lower doses, there were fetal losses and the remaining fetuses were smaller than in the control group. There was a reduction in ossification of the bones and an increase in subcutaneous hemorrhage and tail malformations. Similar findings were reported when mice were given up to 750 ppm chromium VI in drinking water for a portion of pregnancy or for 20 days prior to mating, and when rats were treated with the same drinking water levels prior to mating.

Developmental toxicity…continued

Nickel salts are reported to be animal teratogens. Increased incidence of stillbirth and neonatal mortality of rat offspring were associated with maternal consumption of nickel chloride solutions prior to mating and gestation. Nickel chloride produced skeletal defects in mice. Nickel acetate caused multiple malformations and death in hamster embryos and birth defects in sheep. The offspring of pregnant rats exposed to high concentrations of nickel carbonyl exhibited congenital eye defects. Nickel carbonyl was both teratogenic and embryotoxic in hamsters.

Genotoxicity

Iron oxide did not produce morphological transformation in hamster cells, and was negative the Ames bacterial cell mutagenicity assay. Similarly, no genotoxicity has been found in a battery of *in vivo* studies in which nickel and its insoluble and soluble inorganic compounds have been tested. However, *in vitro* studies that have tested for DNA damage, sister-chromatid exchanges, chromosomal aberrations, and cell transformation have frequently been positive for genotoxic effects.

In a reverse mutation assay, mutagenic effects were reported with copper sulfate. However, negative results were obtained with copper sulfate or copper chloride in assays using S. cerevisiae and Bacillus subtilis. Chromosomal aberrations were induced in isolated rat hepatocytes when incubated with copper sulfate. High concentrations of copper compounds have been reported to induce mitosis in rat ascites cells and recessive lethals in Drosophila melanogaster.

Manganese sulfate was negative for mutagenicity in Ames assay, but positive for genotoxic effects in the *in vitro* chromosomal aberration and sister chromatid exchange assays. Manganese did not cause dominant lethal mutations in male mice and did not cause mutations in Drosophila.

Hexavalent chromium induced dominant lethal mutations, chromosomal aberrations and micronuclei in rodents treated *in vivo*. In cultured rodent cells, it induced transformation, chromosomal aberrations, sister chromatid exchanges, mutation and DNA damage. It induced aneuploidy in drosophila and mitotic recombination in yeast. It was mutagenic and caused DNA damage in bacteria .In human cells *in vitro*, it caused chromosomal aberrations, sister chromatid exchanges and DNA damage.

Carcinogenicity

IARC, NTP, and OSHA do not list steel products as carcinogens. However, IARC identifies welding fumes as a Group 2B carcinogen, a mixture that is possibly carcinogenic to humans. Iron oxide is listed as a Group 3 (not classifiable) carcinogen by IARC.

IARC identifies nickel and certain nickel compounds and welding fumes as Group 2B carcinogens that are possibly carcinogenic to humans. ACGIH classifies elemental nickel as A5: "Not suspected as a human carcinogen", but classifies insoluble nickel compounds and nickel subsulfide as A1: "Confirmed human carcinogens". ACGIH considers soluble nickel compounds to be A4, "Not classifiable as a human carcinogen".

Carcinogenicity …continued

IARC lists chromium metal and trivalent chromium compounds as Group 3 carcinogens, not classifiable as to their human carcinogenicity. Hexavalent chromium compounds are listed by IARC as Group 1 carcinogens that are carcinogenic to humans. NTP Fourth Annual report on Carcinogens cites "certain Chromium compounds" as human carcinogens. ACGIH has reviewed the toxicity data and concluded that chromium metal is not classifiable as a human carcinogen

Based mainly on the discovery of lung tumors in rats exposed chronically to high concentrations of carbon black *via* inhalation, IARC considers carbon (black) as possibly carcinogenic to humans (Group 2B); limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals.

Rats and hamsters administered concomitant doses of iron oxide and benzo(a)pyrene exhibited an increased incidence of lung cancer. In hamsters given a series of 15 once-weekly intratracheal injections containing 3 mg iron oxide, more than 50% of the animals survived for 1 year and a few for over 2 years, while none of the animals developed tumors of lung.

Rats were administered intramuscular (IM) or oral (gavage) doses of manganese powder, manganese dioxide, and manganese (II) acetylacetonate (MAA). Treatment consisted of either multiple IM doses of 10 mg each of manganese powder or manganese dioxide, multiple doses of 10 mg manganese powder by gavage, or multiple IM doses of 50 mg of MAA. In addition, female mice were exposed intramuscularly to manganese powder (*e.g.*, single 10 mg dose) and manganese dioxide (multiple doses of 3 or 5 mg each). There was an increased incidence of fibrosarcomas at the injection site in male and female rats exposed intramuscularly to MAA. No difference in tumor incidence was found between rats and mice exposed to manganese powder and manganese dioxide and controls.

Several hexavalent chromium compounds have been shown to be carcinogenic in cancer bioassay studies. Only calcium chromate has consistently produced lung tumors in rats by several routes of administration. Animal cancer bioassay studies suggest that hexavalent chromium compounds are probably the etiologic agent in chromium related human cancer. Under the IARC criteria, animal bioassay studies constitute sufficient evidence of the carcinogenicity of hexavalent chromium compounds.

Following intraperitoneal injection or intratracheal instillation, nickel powder, nickel oxide, and nickel subsulfide were carcinogenic in rats (doses not identified).

Aspiration hazard No studies identified

Human health data See "Section 2 - Other Hazards"

Additional information Mixture not fully tested.

SECTION 12 - ECOLOGICAL INFORMATION

Toxicity

Compound	Type	Species	Concentration
Iron	--	--	--
Carbon	--	--	--
Copper	EC_{50}/72h	Algae (Pseudokirchneriella subcapitata)	0.0426-0.0535 mg/L [static]
	EC_{50}/96h	Algae (Pseudokirchneriella subcapitata)	0.031-0.054 mg/L [static]
	EC_{50}/48h	Daphnia Magna	0.03 mg/L [static]
	LC_{50}/96h	Pimephales promelas, fathead minnow	0.0068-0.0156 mg/L
	LC_{50}/96h	Pimephales promelas, fathead minnow	<0.3 mg/L [static]
	LC_{50}/96h	Pimephales promelas, fathead minnow	0.2 mg/L [flow-through]
	LC_{50}/96h	Oncorhynchus mykiss, rainbow trout	0.052 mg/L [flow-through]
	LC_{50}/96h	Lepomis macrochirus, bluegill sunfish	1.25 mg/L [static]
	LC_{50}/96h	Poecilia reticulata, freshwater fish	0.112 mg/L [flow-through]
	LC_{50}/96h	Cyprinus carpio	0.3 mg/L [semi-static]
	LC_{50}/96h	Cyprinus carpio	0.8 mg/L [static]
Chromium	LC_{50}/96h	Oncorhynchus mykiss, rainbow trout	4.4 mg/L (juvenile) [Chromium, ion (Cr 3+)]
	LC_{50}/96h	Pimephales promelas, fathead minnow	5.07 mg/L [Chromium, ion (Cr 3+)]
	EC_{50}/96h	Daphnia magna	2 mg/L [Chromium, ion (Cr 3+)]
	EC_{50}/24h	Daphnia magna	435 µg/L [Chromium, ion (Cr 6+)]
	LC_{50}/96h	Oncorhynchus mykiss, rainbow trout	7.6 mg/L [Chromium, ion (Cr 6+)]
	LC_{50}/96h	Pimephales promelas, fathead minnow	36.2 mg/L [Chromium, ion (Cr 6+)]

SECTION 12 - ECOLOGICAL INFORMATION …continued

Toxicity …continued

Compound	Type	Species	Concentration
Nickel	EC_{50}/72h	Algae (Pseudokirchneriella subcapitata)	0.18 mg/L
	EC_{50}/96h	Algae (Pseudokirchneriella subcapitata)	0.174-0.311 mg/L [static]
	LC_{50}/96h	Brachydanio rerio (zebrafish)	>100 mg/L
	LC_{50}/96h	Cyprinus carpio	1.3 mg/L[semi-static]
	LC_{50}/96h	Cyprinus carpio	10.4 mg/L [static]
	EC_{50}/48h	Daphnia magna	>100 mg/L
	EC_{50}/48h	Daphnia magna	1 mg/L [static]
Manganese	--	--	--
Silicon	--	--	--

Additional toxicity information No data available.

Persistence and Degradability No data available.

Bioaccumulative potential No data available.

Mobility in soil No data available.

Results of PBT and vPvB assessment No data available.

Other adverse effects No data available.

Note Due to lack of data, avoid release to the environment.

SECTION 13 - DISPOSAL CONSIDERATIONS

Waste treatment methods Steel scrap metal should be recycled if feasible. Used product should be disposed of according to local, state, and federal regulations. Do not send particulate wastes from processing steel down the drain and/or release to sewer. All wastes containing the material should be properly labeled. Dispose of wastes in accordance to prescribed federal, state, and local guidelines, *e.g.*, appropriately permitted incinerator. Rinse waters resulting from spill cleanups should be discharged in an environmentally safe manner, *e.g.*, collected and sent to permitted incinerator.

SECTION 14 - TRANSPORT INFORMATION

Transport	Based on the available data, this mixture is not regulated as a hazardous material/ dangerous good under EU ADR/RID, US DOT, Canada TDG, IATA, or IMDG.
UN number	None assigned.
UN proper shipping name	None assigned.
Transport hazard classes and packing group	None assigned.
Environmental hazards	Based on the available data, this product/mixture is not regulated as an environmental hazard or a marine pollutant.
Special precautions for users	Mixture not fully tested - avoid exposure. Due to lack of data, avoid release to the environment.
Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code	Not applicable.

SECTION 15 - REGULATORY INFORMATION

Safety, health and environmental regulations/legislation specific for the substance or mixture	This SDS complies with the requirements under US, EU and GHS (EU CLP - Regulation EC No 1272/2008) guidelines. Consult your local or regional authorities for more information.
Chemical safety assessment	Not conducted.
OSHA Hazardous	Yes. May cause damage to respiratory system and gastrointestinal tract based on animal and human data. Possible cancer hazard: contains nickel and chromium which may cause cancer based on animal and human data.
WHMIS classification	This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all of the information required by those regulations.
WHMIS symbol(s)	 Class D - 2B
TSCA status	The compounds as contained in steel products are considered to be regulated under the CAS # 65997-19-5.
SARA section 313	Chromium, copper, manganese, and nickel are listed.
California proposition 65	Chromium and nickel are listed.

SECTION 16 - OTHER INFORMATION

Full text of R phrases and EU Classifications

Xi - Irritant. T - Toxic. R23/24/25 - Toxic by inhalation, in contact with skin and if swallowed. R48/23/24/25 - Toxic: Danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed. R48/ 23 - Danger of serious damage to health by prolonged exposure through inhalation. Xn - Harmful. R22 - Harmful if swallowed. R48/20/22 - Harmful: Danger of serious damage to health by prolonged exposure through inhalation and if swallowed. R40 - Limited evidence of a carcinogenic effect. R36/37/38 - Irritating to eyes, respiratory system and skin. R42/43 - May cause sensitization by inhalation and skin contact. R43 - May cause sensitization by skin contact. R62 - Possible risk of impaired fertility. R63 - Possible risk of harm to the unborn child. N - Dangerous for the Environment. R50/53 - Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. R52/53 - Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Full text of H phrases, P phrases and GHS classification

ATO2 - Acute Toxicity (Oral) Category 2. H300 - Fatal if swallowed. ATI2 - Acute Toxicity (Inhalation) Category 2. H330 - Fatal if inhaled. ATD3 - Acute Toxicity (Dermal) Category 3. H311 - Toxic in contact with skin. ATO4 - Acute Toxicity (Oral) Category 4. H302 - Harmful if swallowed. STOT-RE2 - Specific Target Organ Toxicity Following Repeated Exposure Category 2. H373 - May cause damage to the respiratory system and gastrointestinal tract through prolonged or repeated exposure. Carc2 - Carcinogenicity Category 2. H351 - Suspected of causing cancer. STOT-S3 - Specific Target Organ Toxicity Following Single Exposure Category 3. H335 - May cause respiratory irritation. SI2 - Skin irritant Category 2. H315 - Causes skin irritation. SS1 - Skin sensitizer Category 1. H317 - May cause an allergic skin reaction. EI2 - Eye irritant Category 2. H319 - Causes serious eye irritation. RT2 - Reproductive toxicity Category 2. H361fd - Suspected of damaging fertility. Suspected of damaging the unborn child. CA1 - Chronic Aquatic Toxicity Category 1. H410 - Very toxic to aquatic life with long lasting effects. CA3 - Chronic Aquatic Toxicity Category 3. H412 - Harmful to aquatic life with long lasting effects. RS1 - Respiratory Sensitizer Category 1. H334 - May cause allergic or asthmatic symptoms or breathing difficulty if inhaled. STOT-RE1 - Specific Target Organ Toxicity Following Repeat Exposure Category 1. H372 - Causes damage to kidney and liver through prolonged or repeated exposure. STOT-SE1 - Specific Target Organ Toxicity Following Single Exposure Category 1. H370 - Causes damage to respiratory system and lungs.

Sources of data

Information from published literature and internal company data.

Revisions

This is the first version of this SDS.

Disclaimer

The above information is based on data available to us and is believed to be correct. Since the information may be applied under conditions beyond our control and with which we may be unfamiliar, we do not assume any responsibility for the results of its use and all persons receiving it must make their own determination of the effects, properties and protections which pertain to their particular conditions.

Disclaimer…continued

No representation, warranty, or guarantee, express or implied (including a warranty of fitness or merchantability for a particular purpose), is made with respect to the materials, the accuracy of this information, the results to be obtained from the use thereof, or the hazards connected with the use of the material. Caution should be used in the handling and use of the material because it is comprised of various chemical substances. The above information is offered in good faith and with the belief that it is accurate. As of the date of issuance, we are providing all information relevant to the foreseeable handling of the material. However, in the event of an adverse incident associated with this product, this Safety Data Sheet is not, and is not intended to be, a substitute for consultation with appropriately trained personnel.