

MATERIAL SAFETY DATA SHEET

HAYNES
International

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Structural Wire

MSDS IDENTIFICATION NUMBER <p align="center">HW-7032-2</p>	PREVIOUS REVISION February 28, 2007 DATE REVISED May 11, 2009	EMERGENCY PHONE NUMBERS HAYNES: 828-692-5791 ext. 258 CHEMTREC: 800-424-9300 (24-hour contact for Health & Transportation Emergencies)
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This Material Safety Data Sheet (MSDS) provides information on a specific group of manufactured metal products. Since these metal products share a common physical nature and constituents, the data presented are applicable to all alloys identified. This document was prepared to meet the requirements of OSHA's Hazard Communication Standard, 29 CFR 1910.1200, Canadian Workplace Hazardous Materials Information System (WHMIS), and European Economic Community (EEC) Directives.

EMERGENCY OVERVIEW

Under normal handling and use of the solid form of this material there are few health hazards. Cutting, welding, melting, grinding, etc., of these materials will produce dust, fume, or particulate containing the component elements of these materials. Exposure to the dust, fume, or particulate may present significant health hazards which are referable to the elemental constituents in Section 2. Exposure to dust or fume may cause irritation of the eyes, skin, and respiratory tract. Fine particulates dispersed in air present an explosion hazard.

1. PRODUCT IDENTIFICATION

CHEMICAL NAME: See Section 2 for Alloy Designations	CHEMICAL FAMILY: Alloy
TRADE NAME: See Alloys listed in Section 2	FORMULA: Alloy wire composed of varying concentrations of elements listed in Section 2.

2. HAZARDOUS INGREDIENTS

The term "hazardous" in "hazardous ingredients" should be interpreted as a term defined in the OSHA Hazard Communication Standard and does not necessarily imply the existence of a health hazard.

The chemical ingredients of these MSDS products are shown in TABLE 1: Structural Wire Products. Ingredients reportable per Section 313 of SARA are marked with an (>); see Section 15 for an explanation. Standard chemical abbreviations and terminology are used in the tables relating to this section.

HEALTH HAZARD TABLES: TABLE 2 shows the HMIS hazard rating for each product. Complete chemical names, abbreviations, and Chemical Abstracts Service (CAS) numbers and exposure limits are given in TABLE 3. The American Conference of Governmental Industrial Hygienists (ACGIH) cautions "These limits are not fine lines between safe and dangerous concentration and should not be used by anyone untrained in the discipline of industrial hygiene."

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3. HAZARDS INFORMATION

The health hazards described in this section do not apply under normal handling and use of these products in solid form. Cutting, welding, melting, grinding, etc., of these products may produce dust, fume, or particulate containing the component elements of these materials with associated health hazards described in this section. If these products are involved in welding, the health hazards described in the Haynes Wire Company MSDS for Welding Products and Thermal Spray Wire also apply.

ACUTE HEALTH EFFECTS AND ROUTES OF EXPOSURE SEE ALSO TABLE 4

INHALATION: Inhalation of metal dust, fume, or powder may result from welding, thermal cutting, grinding, crushing, or similar operations which generate airborne metal particulate during use of these materials. Inhaled particulate may irritate the respiratory tract. Excessive inhalation of aluminum, cobalt, copper, manganese, nickel, and zinc can cause respiratory irritation, cough, bronchitis, chills, "metal fume fever," and asthma-like symptoms.

INGESTION: Amounts ingested incidental to industrial handling are not likely to cause injury. Avoid hand, clothing, food, and drink contact with metal dust, or fume by washing hands before hand to mouth activities such as drinking, smoking, nail biting, eating, etc. Ingestion of large doses may cause nausea, vomiting, and diarrhea.

SKIN: Skin contact with these materials may cause irritation and in some sensitive individuals an allergic dermatitis when elements such as chrome, cobalt, copper, and nickel are present.

EYES: Contact with particulate metal (dust, fume, or powder) may inflame the conjunctiva. Airborne particulate (chips, dust, or powder) is always a potential problem as well as inserting fingers into the eye if the hand or clothing is contaminated with metal particulate.

CHRONIC HEALTH EFFECTS OF OVEREXPOSURE SEE ALSO TABLE 4

Respiratory disease with symptoms ranging from shortness of breath and cough to permanent disability due to loss of lung function; sensitization or hypersensitivity and fibrosis or subsequent effects on the heart may be caused by excessive exposure to dust or fumes containing cobalt, nickel, titanium, and tungsten. Central nervous system depression has been identified with excessive manganese exposure. Insoluble nickel compounds and hexavalent chromium compounds have been linked to nasal, bronchial, and lung cancers. Aluminum and iron have been indicated to cause gastro-intestinal disorders and non-significant changes in the lung. Chronic health effects specific to an element(s) may be difficult to detect due to the numerous elemental constituents in these alloys.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Individuals who may have had an allergic reaction or sensitivity to metals such as chromium, copper, cobalt, and nickel may encounter skin rash or dermatitis if skin contact with this product occurs. Persons with impaired pulmonary function, airway diseases and conditions such as asthma, emphysema, chronic bronchitis, etc., may incur further disability if excessive concentrations of dust or fume are inhaled. If prior damage or disease to the Neurologic (nervous), Circulatory, Hematologic (blood) or Renal (kidney) systems has occurred, proper screening or examinations should be conducted on individuals who may be exposed to further risk if handling and use of these materials cause excessive exposure.

4. EMERGENCY AND FIRST AID PROCEDURES

INHALATION

Breathing difficulty caused by inhalation of dust or fume requires removal to fresh air. If breathing has stopped, perform artificial respiration and obtain medical assistance at once.

INGESTION

Never give anything by mouth to an unconscious person. Contact a poison control center. Unless the poison control center advises otherwise, have that conscious person slowly drink 1 to 2 glasses of water to dilute, inducement of vomiting is not necessary. Obtain medical assistance at once.

SKIN

Skin cuts and abrasions can be treated by standard first aid. Quickly remove contaminated clothing but do not shake clothing. Skin contamination with dust or powder can be removed by washing with soap and water. If irritation or reddened, blistered skin occurs, obtain medical assistance.

EYES

Do not allow victim to rub or keep eyes tightly shut. Dust or powder should be flushed from the eyes with copious amounts of clean water, for at least 15 minutes, or until transported to an emergency medical facility. Consult a physician at once.

5. FIRE AND EXPLOSION INFORMATION

As shipped, these products are nonflammable and nonexplosive. However, welding arcs and sparks can ignite combustibles, and can initiate fires and explosions. Be sure you read and understand American National Standard Institute standard ANSI Z49.1 *Safety in Welding and Cutting* and National Fire Protection Association standard 51B for fire prevention in *Cutting and Welding Processes* before using these products.

Extinguishing Media N/A	Flash Point (Method Used) N/A	Unusual Fire and Explosive Hazards N/A
Flammable Limit N/A		Special Fire Fighting Procedures N/A

6. STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

In solid form this material poses no special clean-up problems. If this material is in powder or dust form, notify safety personnel, isolate the area and deny entry. Do not sweep. Clean-up should be conducted with a vacuum system utilizing a high efficiency particulate air (HEPA) filtration system. Caution should be taken to minimize airborne generation of powder or dust and avoid contamination of air and water. Cleanup personnel should protect against exposure. Properly label all materials collected in waste container. Follow applicable emergency response regulations, such as OSHA (29 CFR 1910.120), and Canadian Workplace Hazardous Materials Information System (WHMIS) Regulations.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS	This product must be handled according to the size, shape and quantity of material involved. Dusts and powders should be moved or transported to minimize spill or release potential. Avoid dust inhalation and eye or skin contact. Wear personal protective equipment to prevent contact with skin and eyes (Section 8). Practice good housekeeping techniques that minimize accumulation of dust. Practice good personal hygiene after handling dust or powder forms of this material, especially before eating, drinking, smoking, or applying cosmetics.
STORAGE PRECAUTIONS	In solid form this material poses no special problems. Store metal powder in a dry area away from heat, ignition sources, and incompatibles (Section 10).

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS	Local exhaust ventilation should be used to control exposure to airborne dust and fume emissions near the source (during crushing, grinding, welding, etc.) below the exposure limits cited in Section 2.		
RESPIRATORY PROTECTION	Use NIOSH approved respirators as specified by an Industrial Hygienist or qualified Safety Professional. Lung function tests are recommended for users of negative pressure devices. Use a respirator where local exhaust or ventilation does not keep exposure below the exposure limits for air contamination.		
SKIN PROTECTION	Wear gloves to prevent metal cuts and skin abrasions. Protective clothing such as uniforms, disposable coveralls, safety shoes, etc., may be required during metal handling operations as appropriate to the circumstances of exposure.		
EYE PROTECTION	Wear safety glasses when risk of eye injury is present particularly during machining, grinding, welding, powder handling, etc. Contact lenses should not be worn if working with metal dusts and powders.		
RECOMMENDED MONITORING PROCEDURES	<table border="0"> <tr> <td>ENVIRONMENTAL SURVEILLANCE: Exposure to the elements identified in Section 2 can be best determined by having air samples taken in the employee breathing zone, work area, or department.</td> <td>MEDICAL SURVEILLANCE: Lung function tests, chest x-rays and routine physical examinations may be useful to determine effects of dust or fume exposure.</td> </tr> </table>	ENVIRONMENTAL SURVEILLANCE: Exposure to the elements identified in Section 2 can be best determined by having air samples taken in the employee breathing zone, work area, or department.	MEDICAL SURVEILLANCE: Lung function tests, chest x-rays and routine physical examinations may be useful to determine effects of dust or fume exposure.
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9. PHYSICAL PROPERTIES	
MELTING POINT: >2100EF <2600EF	VAPOR DENSITY (AIR=1): Not Applicable
SUBLIMES @: Not Applicable	SPECIFIC GRAVITY: (H ₂ O=1) 7-9
BOILING POINT: Not Applicable	pH = Not Applicable
EVAPORATION RATE: Not Applicable	SOLUBILITY IN WATER = None
VAPOR PRESSURE (mmHg): Not Applicable	% VOLATILES BY VOLUME: None
APPEARANCE AND COLOR: Solid – Silver gray color or no color	
10. STABILITY AND REACTIVITY	
GENERAL REACTIVITY	Stability – These wire alloy products are stable, non-reactive materials.
INCOMPATIBILITY (MATERIALS TO AVOID)	These structural wire alloys were designed for use in, and possess outstanding resistance to, mineral acids. Be aware, however, that if corrosion does occur, hydrogen might be evolved, causing a potentially explosive environment in confined, closed systems.
HAZARDOUS DECOMPOSITION PRODUCTS	Various elemental metals and metal oxides may be generated from welding, cutting, grinding, melting, or dross handling operations. Refer to Table 3 for occupational exposure limits.
HAZARDOUS POLYMERIZATION	Does not occur.
11. TOXICOLOGICAL INFORMATION	
TOXICITY DATA	Eye: Rabbit (cobalt) unknown amount produced severe reaction with abscess involving lens, ciliary body, vitreous humor, and retina.
	Skin: No data.
	Ingestion: Guinea Pig (nickel): LD _{Lo} : 5 mg/kg Rat (cobalt): LD ₅₀ : 6171 mg/kg Rabbit (cobalt): LD ₅₀ : 750 mg/kg Human (copper): TD _{Lo} : 120 µg/kg affects the gastrointestinal tract (nausea or vomiting). Human (chromium): LD _{Lo} : 71 mg/kg
	Inhalation: Rabbit (nickel): TC _{Lo} : 130 Φg/m ³ 35 weeks (intermittent-6 hours) Pig (cobalt) TC _{Lo} : 100 Φg/m ³ /6 hours for 13 weeks - (intermittent) Human (chromium VI): TC _{Lo} : 110 Φg/m ³ 3 years (continuous) tumorigenic (carcinogenic per RTECS) Human (manganese): TC _{Lo} : 2,300 Φg/m ³
	Subchronic: Rat (molybdenum) inhalation: 12-16 g/m ³ /1 hour/30 days, resulted in slight growth depression, and thickening of the intraaveolar septa, which contained connective tissue fibers.
	Other: Intravenous; Dog (nickel) LD _{Lo} : 10 mg/kg Implant; Rat (chromium) TD _{Lo} : 1200 Φg/kg intermittent over 6 weeks. Rat (cobalt) intramuscular: 126 mg/kg, tumorigenic at site of application.

11. TOXICOLOGICAL INFORMATION (continued)	
CHRONIC/ CARCINOGENICITY (See Table 4)	Teratology: Rat (molybdenum) oral: 5800 Φ g/kg given to female 30 weeks prior to mating and during days 1-20 of pregnancy caused specific musculoskeletal system development abnormalities.
	Reproduction: Rat (cobalt) unspecified exposure route, 0.05 mg/kg continuous, administered throughout gestation to female was embryotoxic.
	Mutagenicity: Hamster (chromium III) lung cell: 34 mg/L caused sister chromatid exchange. Human (cobalt) DNA damage: Human Leukocyte 3 mg/L. Human (Chromium VI) DNA damage: Human Leukocyte 50 Φ mol/L.
12. ECOLOGICAL INFORMATION	
<p>In solid form this material poses no special environmental problems. Metal powders, fumes, or dusts may have significant impact on air and water quality. Airborne emissions, spills, and releases to the environment (discharge to streams, sewer systems, ground water, surface soil, etc.) should be controlled immediately.</p> <p>Ecotoxicity: Few plants accumulate cobalt at greater than 100 ppm, the level at which severe phytotoxicity would occur. There is little tendency for chromium III bioaccumulation along the food chain.</p> <p>Molybdenum; (fathead minnow), LC_{50}: 370 mg/L/96 hours. Terrestrial plants can contain enough molybdenum to be toxic to animals but still grow normally.</p> <p>Environmental Degradation: In water, cobalt is adsorbed greatly to hydrolysate or oxidate sediments. It may be taken into solution in small amounts through bacteriological activity. In water, chromium III oxide is expected to eventually precipitate to sediments. In air, chromium III oxide is primarily removed by fallout and precipitation. Soils with a high chromium content (>0.2%) are expected to be infertile. The half-life of chromium in soils may be several years.</p>	
13. DISPOSAL CONSIDERATIONS	
<p>WASTE DISPOSAL: Whenever possible, recover scrap for reuse or recycling. If necessary, dispose of waste material in accordance with local, state, or federal regulations. For specific labeling, packing, storage, transportation, and disposal procedures, contact an Environmental Engineer or consultant familiar with waste disposal regulations.</p>	
14. TRANSPORT INFORMATION (Not Meant to be All Inclusive)	
<p>The following information should be used by individuals with ΔFunction-specific Training@ required by 49 CFR 172.704, and Dangerous Goods Regulations published by the International Air Transport Association (IATA).</p>	
SHIPPING NAME	Not Applicable
IDENTIFICATION NUMBER	Not Applicable
HAZARD CLASS	Not Applicable
LABEL(S) REQUIRED	Not Applicable

15. REGULATORY INFORMATION	
U.S. FEDERAL REGULATIONS	OSHA: Listed as air contaminants (29 CFR 1910.1000). Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).
	TSCA (Toxic Substance Control Act): Components of this material are listed on the TSCA inventory.
U.S. FEDERAL REGULATIONS	CERCLA: Hazardous Substance (40 CFR 302.4): Chromium, Copper, Nickel. Extremely Hazardous Substance (40 CFR 355): Not Listed
	SARA HAZARD CATEGORY: Listed below are the hazard categories for Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III):
	Immediate Hazard: X Delayed Hazard: X Fire Hazard: - Pressure Hazard: - Reactivity Hazard: -
U.S. FEDERAL REGULATIONS	Chemicals subject to the reporting requirements of Section 313 or Title III of SARA and 40 CFR Part 372: Aluminum (as a fume or dust), cobalt, chromium, copper, manganese, nickel.
U.S. STATE REGULATIONS	California=s ASafe Drinking Water and Toxic Enforcement Act of 1986" (Proposition 65) During welding, and thermal cutting these products may produce cobalt oxide, nickel compounds, and hexavalent chromium compounds which are known to the State of California to cause cancer. State of California, Health and Welfare Agency, 1600 Ninth Street, Room 450, Sacramento, CA 95914, Telephone (961) 455-6955.
	Pennsylvania Worker and Community Right to Know: Aluminum, Cobalt, Copper, Chromium, Manganese, Nickel, and Vanadium (fume or dust) are designated environmental hazards on the Hazardous Substance List. Title 34, Part XIII, Chapter 323.
EUROPEAN/ INTERNATIONAL REGULATIONS	European Labeling in Accordance with EC Directives The following hazard classification and risk phrases required by directive 67/548/EEC apply only to these products as a manufactured article. Classification: Not applicable. Canada WHIMS These products have been classified in accordance with the hazard criteria of the CPR, and the MSDS contains all of the information required by the CPR. WHIMS Classification: Not applicable

16. OTHER INFORMATION**MSDS STATUS**

This MSDS replaces the February 28, 2007 revision for steel wire & rod.

The above information has been prepared by Shaw Environmental, Inc., under contract with Haynes International and is a compilation of information from various sources believed to be accurate. As the conditions or methods of use are beyond our control, we do not assume any responsibility and expressly disclaim any liability for any material described herein. Information contained herein is believed to be true and accurate, but all statements or suggestions are made without warranty, expressed or implied, regarding accuracy of the information, the hazards connected with the use of the material or the results to be obtained from the use thereof. Compliance with all applicable Federal, State, Provincial, and local laws and regulations remain the responsibility of the user.

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Table 1 Structural Wire Products

ALLOY	AWS/UNS	Normal Composition, Weight Percent												
	Alloy No.	<u>Ni</u> >	<u>Co</u> >	<u>Cr</u> >	<u>Mo</u>	<u>W</u>	<u>Fe</u>	<u>Si</u>	<u>Mn</u> >	<u>Al</u> >	<u>Ti</u>	<u>Cu</u> >	<u>B</u>	<u>Others (V>)</u>
HASTELLOY [®] HYBRID-BC1 [®] alloy	2362**	62	--	15	22	--	2*	0.08*	0.25	0.5*	--	--	--	
HASTELLOY [®] C-4 alloy	N06455	65	2*	16	16	0.5*	3*	0.08*	<1	--	0.7*	0.5*	--	--
HASTELLOY [®] C-22 [®] alloy	N06022	56	2.5*	22	12	13	3	0.02	0.5*	--	--	0.5*	--	V-0.35*
HASTELLOY [®] C-22HS [®] alloy	2321**	61	1*	21	17	1*	2*	0.08*	0.8*	0.5*	--	0.5*	0.006*	--
HASTELLOY [®] C-276 alloy	N10276	57	2.5*	16	16	3	5	0.08*	<1	--	--	0.5*	--	V-0.35*
HASTELLOY [®] C-2000 [®] alloy	N06200	59	2*	23	16	--	3*	0.08*	0.5*	0.5*	--	1.6	--	--
HASTELLOY [®] G-30 [®] alloy	N06030	43	5*	30	5.5	2.5	15	0.8*	1.5*	--	--	2	--	Cb-0.8
HASTELLOY [®] G-35 [®] alloy	N06035	58	<1	33.2	8.1	0.6*	2*	0.6*	0.5*	0.4*	--	0.3*	--	--
HASTELLOY [®] S alloy	N06635	67	2*	16	15	<1	3*	0.4	0.5	0.25	0.35*	--	0.015*	La-0.02
HASTELLOY [®] W alloy	N10004	63	2.5*	5	24	<1	6	<1	<1	--	--	0.5*	--	V- <0.6*
HASTELLOY [®] X alloy	N06002	47	1.5	22	9	0.6	18	<1	<1	<0.5	0.15*	0.5	0.008*	Cb-0.5*
HAYNES [®] C-263 alloy	N07263	52	20	20	6	--	0.7*	0.2	0.4	0.6*	2.4*	0.2*	0.005*	Zr-0.04*, (Al+Ti)-2.6
HAYNES [®] GTD222 alloy	2220**	50	19	22.5	<1	2	<1	0.25*	0.1*	1.3	2.3	0.1*	0.004	Cb-0.8, Ta-1
HAYNES [®] HR-120 [®] alloy	N08120	37	3.0	25	<1	<0.5	33	0.6	0.7	0.1	0.2*	<0.5	<0.1	Cb-0.7
HAYNES [®] HR-160 [®] alloy	N12160	37	29	28	<1	<1	3.5*	2.75	1*	0.4	0.5	0.5*	-	Cb+Ta-0.3*
HAYNES [®] HR-224 [™] alloy	2224**	47	2*	20	0.5*	0.5*	27.5	0.3	0.5*	3.8	0.3	--	0.004*	Cb-0.15*, La-0.01*, Zr-0.025*
HAYNES [®] NS-163 [®]	1630**	8	40	28	--	--	21	0.5*	0.5*	0.5*	1.3	--	0.015*	Cb-1
HAYNES [®] Waspaloy	N07001	58	13.5	19	4.3	--	2*	0.1*	0.1*	1.5	3	0.1*	0.006	Zr-0.04*
HAYNES [®] X-750 alloy	N07750	70 ^b	1*	16	--	--	8*	0.35*	0.35*	0.8	2.5*	0.5*	--	Cb+Ta-1
HAYNES [®] 25 alloy	R30605	10	51	20	<1	15	3*	0.4*	1.5	--	--	--	--	--
HAYNES [®] 82 alloy	N06082	73	<0.1	20	--	--	0.9	0.1	3	<0.1	0.3*	<0.1	--	Cb-2.4, Ta-<0.1
HAYNES [®] 188 alloy	R30188	22	39	22	--	14	3*	0.35	1.25*	--	--	--	0.015*	La-0.03
HAYNES [®] 214 [®] alloy	N07214	75	2*	16	0.5*	0.5*	3	0.2*	0.5*	4.5	0.5*	--	0.01*	Y-0.01, Zr-0.1*, Cb-0.15*
HAYNES [®] 230-W [®] alloy	N06231	57	5*	22	2	14	3*	0.4	0.5	0.3	0.1*	0.5*	0.003*	La-0.02

Table 1 Structural Wire Products (continued)

ALLOY	AWS/UNS	Normal Composition, Weight Percent												
	Alloy No.	<u>Ni</u> >	<u>Co</u> >	<u>Cr</u> >	<u>Mo</u>	<u>W</u>	<u>Fe</u>	<u>Si</u>	<u>Mn</u> >	<u>Al</u> >	<u>Ti</u>	<u>Cu</u> >	<u>B</u>	<u>Others (V)</u> >
HAYNES [®] 242 [®] alloy	N10242	65	<1	8	25	--	2*	0.8*	0.8*	0.5*	--	0.5*	0.006*	--
HAYNES [®] 282 [®] alloy	2082**	57	10	20	8.5	--	1.5*	0.15*	0.3*	1.5	2.1	--	0.005	--
HAYNES [®] 556 [®] alloy	R30556	20	18	22	3	2.5	31	0.4	1	0.2	--	--	0.02*	Zr-0.02,La-0.02,Ta-0.6, Cb-0.3*
HAYNES [®] 617 alloy	N06617	54	12.5	22	9	-	2*	0.2*	0.2*	1.2	0.4	0.5*	0.006*	Cb-0.08
HAYNES [®] 625 alloy	N06625	62	1*	22	9	--	5*	0.5*	0.5*	0.4*	0.4*	0.5*	--	Cb & Ta-3.7
HAYNES [®] 625 (Low Iron) alloy	2653**	62	<1	21	9	--	0.75*	0.5*	0.5*	0.4*	0.4*	0.5*	--	Cb+Ta-3.7
HAYNES [®] 718 alloy	N07718	52	<1	18	3	--	19	0.35*	0.35*	0.5	0.9	0.1*	0.0004	Cb+Ta-5
I-36 alloy	K93601	36	<0.1	<0.1	--	--	63	0.14	0.3	0	--	<0.1	--	--
L605 alloy	R30605	10	51	20	<1	15	3*	0.4*	1.5	--	--	--	--	--
M-400 alloy	N04400	67*	0.2*	--	--	--	1.4*	0.2*	1*	<0.1	--	33*	--	--
M-413 alloy	C71581	31	<0.1	-	-	-	0.6	<0.1	0.7	<0.1	0.3	68	-	--
MULTIMET [®] alloy	R30155	20	20	21	3	2.5	30	<1	1.5	--	--	0.5*	--	Cb-1, N 0.15, Ta-0.05*
N 61 alloy	N02061	96	<0.1	<0.1	<0.1	--	<0.1	0.4*	0.4	0.4*	3	<0.1	--	Cb-<0.1, Ta-<0.1
NFE 258 alloy	W82002	56*	<0.1	<0.1	<0.1	--	43	0.1*	0.7	<0.1	<0.1	<0.1	--	--
NIT 32 alloy	S20000	1.5	<0.1	18	0.2	<0.1	69	0.4	12	--	<0.1	0.2	--	Cb-<0.1 V-<0.1
NIT 50 alloy	S20000	12	0.3*	21	2	--	59	0.5*	5	--	--	0.4	--	Cb-.016, V-0.15
NIT 60 alloy	S21800	8	<0.1	16	0.2	<0.1	63	4	8	<0.1	<0.1	0.2	--	V-<0.1
MP35N alloy	R30035	37*	34*	20*	10*	<0.1	0.3*	0.1*	0.1*	<0.1	0.7*	<0.1	<0.1	--
ULTIMET [®] alloy	R31233	9	54	26	5	2	3	0.3	0.8	--	--	--	--	N-0.08
17/7 PH alloy	S17700	8*	0.1*	16	0.5*	--	73	0.5*	1*	1*	<0.1	0.4*	--	--
20 alloy	N08904	25	0.1	21	4.5	--	46	0.4*	2*	0.1	--	1.9	--	--
20Cb3 alloy	N08020	33	<0.1	20	3*	--	71	0.4*	2*	<0.1	<0.1	3.4	<0.1	Cb-.06*, V-<0.1, Ta-<0.1
52 alloy	N14052	50	<0.1	<0.1	--	--	49	0.1	0.5*	<0.1	<0.1	<0.1	--	--
72 alloy	N06072	55	<0.1	44	<0.1	--	0.3	<0.1	<0.1	0.2*	0.5	<0.1	<0.1	--
80/20 alloy	N06003	78	<0.1	20	--	--	0.7	1.3	<0.1	0.2	--	<0.1	--	--
80/20 Cb alloy	N06003	77	--	19	--	--	0.7	1.3	0.3	--	--	--	--	Cb-0.8
95/5 alloy	N03301	94	<0.1	--	--	--	<0.1	0.5*	0.3	5	0.7*	0.1*	--	Cb-<0.1, Ta-<0.1
200 alloy	N02200	99.4	--	<0.1	<0.1	--	0.2	<0.1	<0.1	--	<0.1	<0.1	--	--

Table 1 Structural Wire Products (continued)

AWS/UNS		Normal Composition, Weight Percent												
ALLOY	Alloy No.	<u>Ni</u> >	<u>Co</u> >	<u>Cr</u> >	<u>Mo</u>	<u>W</u>	<u>Fe</u>	<u>Si</u>	<u>Mn</u> >	<u>Al</u> >	<u>Ti</u>	<u>Cu</u> >	<u>B</u>	<u>Others (V>)</u>
202 alloy	S20200	5*	--	18*	--	--	69*	0.6*	8	--	--	--	--	
302 alloy	S30200	8	--	18	0.3*	--	72	0.6*	1.8*	--	--	0.4*	--	
302 HQ alloy	S30430	9	--	17	--	--	70	0.5	0.7	--	--	3	--	
302 MO alloy	S30200	9	0.1	17	1.3	--	71	0.5	1.2	<0.1	--	0.1	--	
302 N alloy	S30200	9	--	18	--	--	70	0.6*	1.9	--	--	0.4	--	
302 NC alloy	S30200	8	--	17	<0.1	<0.1	74	0.4	0.3	<0.1	<0.1	<0.1	<0.1	V-0.1, Ta-<0.1
302 V alloy	S30200	8	<0.1	18	0.4	--	72	0.4	1	<0.1	--	0.2	--	
304 alloy	S30400	9	--	18	0.3*	--	71	0.5*	1.8*	--	--	0.3*	--	
304 L alloy	S30403	9	0.2*	18	0.4*	--	70	0.7*	1.8*	<0.1	--	0.5*	--	Y-<0.1
304 V alloy	S30400	8	0.15	18	0.2*	--	72	0.6*	0.7*	--	--	0.3*	--	
305 alloy	S30500	12*	--	18	0.3*	--	68	0.5*	1.4*	--	--	0.4*	--	
308 L alloy	S30800	10	--	21	--	--	66	0.8	1.9	--	--	--	--	
316 alloy	S31600	10	--	17*	2	--	69	0.5*	1.5*	--	--	0.5*	--	
316 LVM alloy	S31603	15*	<0.1	18*	3*	<0.1	62	0.5*	1.7	<0.1	<0.1	0.3*	<0.1	Cb-<0.1; V-0.3*;
316 L alloy	S31603	10	--	16	2	--	70	0.5*	1.5*	--	--	<0.1	--	
320 alloy	N08020	33	<0.1	20	3*	--	71	0.4*	2*	<0.1	<0.1	3.4	<0.1	
347 alloy	S34700	9	<0.1	17	0.3	--	70	0.6	1.5	<0.1	<0.1	0.2	<0.1	Cb-0.6, V-<0.1, Ta-<0.1
416 alloy	S41600	0.3*	--	13	<0.1	--	85	0.5*	0.9*	<0.1	--	0.1	--	
420 alloy	S42000	0.1	--	13	--	--	86	0.2	0.5*	<0.1	--	0.1	--	
420 VMH alloy	S42000	0.3*	--	14*	<0.1	--	85	0.5*	0.4*	<0.1	--	<0.1	--	
420 VML alloy	S42000	0.2*	--	14*	<0.1	--	85	0.5	0.4	<0.1	--	<0.1	--	
420 DMV alloy	S42000	0.3*	--	14*	<0.1	--	85	0.5*	0.4*	<0.1	--	<0.1	--	
420 NWH alloy	S42000	0.3*	--	14*	<0.1	--	85	0.5*	0.4*	<0.1	--	<0.1	--	
430 alloy	S43000	0.2*	--	17	<0.1	--	82	0.5*	0.5*	<0.1	--	0.1	--	
455 alloy	S45500	8	--	11	<0.1	--	77	<0.1	<0.1	--	1.2	2.2	--	Cb-0.2
600 alloy	N06600	74	0.05*	16	0.3	<0.1	9	0.4*	0.8	0.2	0.3*	0.02*	--	
601 alloy	N06601	60	--	23	--	--	16	0.3*	0.6	1.5	0.3	<0.1	0.003	
800 alloy	N08800	32	0.2*	19.5	0.2*	--	46*	0.8*	1.0	0.6*	0.5	0.2*	--	
825 alloy	N08825	41*	0.06*	23*	3*	--	31*	0.3*	0.6*	0.1	1*	2.5*	--	
875 alloy	--	--	--	22*	--	--	71	0.3*	0.2*	6*	--	<0.1	--	

(>) Reportable ingredients per Section 313 of SARA - See Section 15 for additional information. XX* - indicates maximum value. XX^b - indicates minimum value. XX** - Haynes metal No.

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Table 2 Product Hazard Rating
Hazardous Materials Identification System (HMIS)
H = Health Rating F = Flammability Rating R = Reactivity Rating

Alloy	Solid Article			Metal Dust			Metal Oxide Fume		
	H	F	R	H	F	R	H	F	R
HASTELLOY [®] HYBRID-BC1 [®] alloy	0	0	0	2*	2	2	3*	0	0
HASTELLOY [®] C-4 alloy	0	0	0	2*	2	2	3*	0	0
HASTELLOY [®] C-22 [®] alloy	0	0	0	2*	2	2	3*	0	0
HASTELLOY [®] C-22HS [®] alloy	0	0	0	2*	2	2	3*	0	0
HASTELLOY [®] C-276 alloy	0	0	0	2*	1	2	3*	0	0
HASTELLOY [®] C-2000 [®] alloy	0	0	0	2*	2	2	3*	0	0
HASTELLOY [®] G-30 [®] alloy	0	0	0	2*	4	1	3*	4	3
HASTELLOY [®] G-35 [®] alloy	0	0	0	2*	4	1	3*	0	0
HASTELLOY [®] S alloy	0	0	0	2*	2	2	3*	0	0
HASTELLOY [®] X alloy	0	0	0	2*	2	1	3*	0	0
HASTELLOY [®] W alloy	0	0	0	2*	2	3	3*	0	0
HAYNES [®] C-263 alloy	0	0	0	2*	4	3	3*	4	3
HAYNES [®] GTD 222 alloy	0	0	0	2*	4	3	3*	4	3
HAYNES [®] HR-120 [®] alloy	0	0	0	2*	2	1	3*	0	0
HAYNES [®] HR-160 [®] alloy	0	0	0	2*	4	3	3*	4	3
HAYNES [®] Waspaloy alloy	0	0	0	2*	4	3	3*	4	3
HAYNES [®] HR-224 [™] alloy	0	0	0	2*	3	1	3*	0	0
HAYNES [®] NS-163 [®] alloy	0	0	0	2	4	3	3*	4	3
HAYNES [®] X-750 alloy	0	0	0	2*	1	1	3*	0	0
HAYNES [®] 25 alloy	0	0	0	2*	4	3	2*	4	3
HAYNES [®] 82 alloy	0	0	0	2*	2	1	3*	0	0
HAYNES [®] 188 alloy	0	0	0	2*	4	3	3*	4	3
HAYNES [®] 214 [®] alloy	0	0	0	2*	2	1	3*	0	0
HAYNES [®] 230-W [®] alloy	0	0	0	2*	2	1	3*	0	1
HAYNES [®] 242 [®] alloy	0	0	0	2*	2	3	3*	0	0
HAYNES [®] 282 [®] alloy	0	0	0	2*	4	3	3*	4	3
HAYNES [®] 556 [®] alloy	0	0	0	2*	3	1	3*	2	2

Table 2 Product Hazard Rating (continued)
Hazardous Materials Identification System (HMIS)
H = Health Rating F = Flammability Rating R = Reactivity Rating

Alloy	Solid Article			Metal Dust			Metal Oxide Fume		
	H	F	R	H	F	R	H	F	R
HAYNES [®] 617 alloy	0	0	0	2*	3	3	3*	2	2
HAYNES [®] 625 alloy	0	0	0	2*	2	1	3*	0	0
HAYNES [®] 625 (Low Iron) alloy	0	0	0	2*	2	1	3*	0	0
HAYNES [®] 718 alloy	0	0	0	2*	2	1	3*	0	0
I-36 alloy	0	0	0	2*	2	1	2*	0	0
L605 alloy	0	0	0	2	4	3	2*	4	3
M-400 alloy	0	0	0	2*	1	1	2*	0	0
M-413 alloy	0	0	0	2*	1	1	2*	0	0
MULTIMET [®] alloy	0	0	0	2*	3	1	3*	2	2
N 61 alloy	0	0	0	2*	1	1	2*	0	0
NFE 258 alloy	0	0	0	2*	2	1	2*	0	0
NIT 32 alloy	0	0	0	2	2	1	3*	0	0
NIT 50 alloy	0	0	0	2	2	1	3*	0	0
NIT 60 alloy	0	0	0	2	2	1	3*	0	0
MP35N alloy	0	0	0	2*	4	3	3*	4	3
ULTIMET [®] alloy	0	0	0	2*	4	3	2*	4	3
17/7 PH alloy	0	0	0	2	2	1	3*	0	0
20 alloy	0	0	0	2*	2	1	3*	0	0
20 Cb 3 alloy	0	0	0	2*	2	1	3*	0	0
52 alloy	0	0	0	2*	2	1	2*	0	0
72 alloy	0	0	0	2*	2	1	3*	0	1
80/20 alloy	0	0	0	2*	2	1	3*	0	0
80/20 Cb alloy	0	0	0	2*	2	1	3*	0	0
95/5 alloy	0	0	0	2*	1	1	2*	0	0
200 alloy	0	0	0	2*	1	1	2*	0	0
202 alloy	0	0	0	2*	2	1	3*	0	0
302 alloy	0	0	0	2*	2	1	3*	0	0
302 HQ alloy	0	0	0	2*	2	1	3*	0	0
302 MO alloy	0	0	0	2*	2	1	3*	0	0
302 N alloy	0	0	0	2*	2	1	3*	0	0

Table 2 Product Hazard Rating (continued)
Hazardous Materials Identification System (HMIS)
H = Health Rating F = Flammability Rating R = Reactivity Rating

Alloy	Solid Article			Metal Dust			Metal Oxide Fume		
	H	F	R	H	F	R	H	F	R
302 NC alloy	0	0	0	2*	2	1	3*	0	0
302 V alloy	0	0	0	2*	2	1	3*	0	0
304 alloy	0	0	0	2*	2	1	3*	0	0
304 L alloy	0	0	0	2*	2	1	3*	0	0
304 V alloy	0	0	0	2*	2	1	3*	0	0
305 alloy	0	0	0	2*	2	1	3*	0	0
308 L alloy	0	0	0	2*	2	1	3*	0	0
316 alloy	0	0	0	2*	2	1	3*	0	0
316 LVM alloy	0	0	0	2*	2	1	3*	0	0
316 L alloy	0	0	0	2*	2	1	3*	0	0
320 alloy	0	0	0	2*	2	1	3*	0	0
347 alloy	0	0	0	2*	2	1	3*	0	0
416 alloy	0	0	0	2	2	1	3*	0	0
420 alloy	0	0	0	2	2	1	3*	0	0
420 VMH alloy	0	0	0	2	2	1	3*	0	0
420 VML alloy	0	0	0	2	2	1	3*	0	0
420 DMV alloy	0	0	0	2	2	1	3*	0	0
420 NWH alloy	0	0	0	2	2	1	3*	0	0
430 alloy	0	0	0	2	2	1	3*	0	0
455 alloy	0	0	0	2	2	1	3*	0	0
600 alloy	0	0	0	2*	1	1	3*	0	0
601 alloy	0	0	0	2*	2	1	3*	0	0
800 alloy	0	0	0	2*	2	1	3*	0	0
825 alloy	0	0	0	2*	2	1	3*	0	0
875 alloy	0	0	0	2	2	1	3*	0	0

As a solid article, all Haynes alloys are rated 0 for health, flammability, and reactivity. Metal dust may be created by grinding operations. Metal oxide fume may be created during welding, thermal cutting, or melting operations.

Note: Ratings applicable for the metal oxide components of each product. Metal oxides are typically found in welding fume.

* = Chronic health effects, see Table 4. HAYNES and HASTELLOY are trademarks of Haynes International, Inc.

Summary of Hazardous Material Information System (HMIS) rating numbers:

H = Health Hazard rating; 0 = minimal hazard; 1 = slight hazard; 2 = moderate hazard; 3 = serious hazard; 4 = severe hazard

F = Flammability hazard rating; 0 = minimal hazard; 1 = slight hazard; 2 = moderate hazard; 3 = serious hazard; 4 = severe hazard

R = Reactivity hazard rating; 0 = minimal hazard; 1 = slight hazard; 2 = moderate hazard; 3 = serious hazard; 4 = severe hazard

Table 3 Exposure Limits for Potentially Hazardous Constituents in Structural Wire

Metal or Chemical, Symbol	CAS Number	Exposure Limits as 8-hour TWA (as mg/m ³)	
		OSHA - Permissible Exposure Limit (PEL) ⁽¹⁾	ACGIH - Threshold Limit Value (TLV [®]) ⁽¹⁾
Aluminum (Al/Al ₂ O ₃)	7429-90-5/ 1344-28-1	Aluminum Oxide as Al: 15, total Aluminum Oxide as Al: 5, Respirable	Welding Fume as Al: 10
Barium compounds (Ba X)	7440-39-3	Soluble compounds as Ba: 0.5	Soluble compounds as Ba: 0.5
Boron Oxide (B ₂ O ₃)	1303-86-2	Oxide Dust Total: 15	Oxide Dust Total: 10
Calcium (Ca)	7440-70-2	None	None
Calcium Oxide (CaO)	1305-78-8	5	2
Carbon Monoxide ⁽²⁾ (CO)	630-08-0	55 (50 ppm)	29 (25 ppm)
Chromium VI Soluble Compounds	(3)	0.005	0.05 (as Cr)
Chromium VI Insoluble Compounds	(3)	0.005	0.01(as Cr)
Chromium oxide Cr III (Cr ₂ O ₃)	1308-38-9	0.5 (as Cr)	0.5 (as Cr)
Chromium oxide Cr II (CrO)	12018-00-7	0.5 (as Cr)	-
Chromium metal (Cr)	7440-47-3	1 (as Cr)	0.5 (as Cr)
Cobalt (Co) and inorganic compounds	7440-48-4	0.1 metal dust and fume (as Co)	0.02 (as Co)
Columbium (Niobium) (Cb/Cb ₂ O ₈ , Nb/Nb ₂ O ₈)	7440-03-1/ 1313-96-8	None	None
Copper oxide fume (CuO)	1317-38-0	0.1 (as Cu)	0.2 (as Cu)
Copper (Cu)	7440-50-8	1 (as Cu)	1 (as Cu)
Iron oxide (dust and fume) (Fe ₂ O ₃)	1309-37-1	10 (as Fe)	5 ⁽⁵⁾ (as Fe)
Lanthanum (La)	7439-91-0	None	None
Lithium (Li/Li ₂ O)	7439-92-2/ 12057-24-8	None	1 (as Li ₂ O) (ceiling) ^{(4), (6)}
Magnesium (Mg)	7439-95-4	None	None
Magnesium Oxide (MgO)	1309-48-4	Fume as MgO: 15	Fume as MgO: 10 ⁽⁷⁾
Manganese (Mn, MnO)	7439-96-5	5 (ceiling) ⁽⁴⁾ (as Mn)	0.2 (as Mn)
Molybdenum compounds (Mo X)	7439-98-7	Soluble Compounds as Mo: 5	Soluble Compounds as Mo: 0.5 ⁽⁵⁾ Insoluble Compounds as Mo: 3 ⁽⁵⁾ ; 10 ⁽⁷⁾
Nickel (Ni, NiX)	7440-02-0	1 (elemental, soluble and insoluble compounds) (as Ni)	1.5 ⁽⁷⁾ elemental, 0.1 ⁽⁷⁾ soluble, 0.2 ⁽⁷⁾ insoluble compounds as Ni

Table 3 Exposure Limits for Potentially Hazardous Constituents in Structural Wire (continued)

Metal or Chemical, Symbol	CAS Number	Exposure Limits as 8-hour TWA (as mg/m ³)	
		OSHA - Permissible Exposure Limit (PEL) ⁽¹⁾	ACGIH - Threshold Limit Value (TLV [®]) ⁽¹⁾
Nitric Oxide ⁽²⁾ (NO)	10102-43-2	30	31
Nitrogen Dioxide ⁽²⁾ (NO ₂)	10102-44-2	9 (ceiling)	5.6; 9.4 (STEL) ⁽⁸⁾
Ozone ⁽²⁾ (O ₃)	10028-15-6	0.2 (0.1 ppm)	0.1 (0.05 ppm), Heavy workload ⁽⁹⁾
Silicon (Si)	7440-21-3	Total Dust: 15, Respirable Dust: 5	None
Strontium (Sr/SrO)	7440-24-6/ 1314-11-0	None	None
Tantalum (Ta)	7440-25-7	Metal and Oxide Dust: 5	Metal and Oxide Dust as Ta: 5
Titanium Dioxide (TiO ₂)	13463-67-7	15	10
Titanium (Ti)	7440-32-6	None	None
Tungsten (W) compounds	7440-33-7	None	Insoluble compounds as W: 5; 10 (STEL) ⁽⁸⁾ Soluble compounds as W: 1; 3 (STEL) ⁽⁸⁾
Vanadium Pentoxide (V ₂ O ₅)	1314-62-1	0.5 ceiling - respirable dust 0.1 ceiling - fume	0.05 Respirable Dust or Fume ⁽⁵⁾
Yttrium (Y)	7440-65-5	1	Metal and Compounds as Y: 1
Zirconium compounds (Zr X)	7440-67-7	Compounds as Zr: 5	Zr Metal and Compounds as Zr: 5; 10 (STEL) ⁽⁸⁾

⁽¹⁾ All limits are Total Dust unless indicated otherwise.

⁽²⁾ Gases generated by arc welding processes.

⁽³⁾ Varies with compound.

⁽⁴⁾ Ceiling limit - shall not be exceeded instantaneously.

⁽⁵⁾ Respirable fraction of particulate - refer to the ACGIH-TLV[®] booklet for a definition.

⁽⁶⁾ Workplace Environmental Exposure Levels (WEEL), published by the American Industrial Hygiene Association.

⁽⁷⁾ Inhalable fraction of particulate - refer to the ACGIH-TLV[®] booklet for a definition.

⁽⁸⁾ STEL = Short-term exposure limit - A 15-minute TWA exposure limit.

⁽⁹⁾ See additional TLV[®] listings for moderate or light workloads.

⁽¹⁰⁾ National Institute For Occupational Safety and Health (NIOSH) Recommended Exposure Limit (REL).

Table 4 Health Hazards

The following table shows the compounds and gases which have been discussed previously, and which may be encountered, their names and formulas, their CAS number, and briefly describes possible known short term and long term health effects which may result from excessive exposure.

Name of Compound, Formula and CAS Number	On Any Carcinogens List? If So, Which Ones?	Health Effects Resulting From Excessive Exposure	
		Acute (Short Term)	Chronic (Long Term)
Metal Dust and Welding Fumes			
Welding Fumes (not otherwise classified) CAS No. - none	Yes IARC	May include metallic taste, nausea, tightness of chest, fever, dizziness, dryness or irritation of eyes, nose or throat	Excessive levels may cause bronchial asthma, lung fibrosis, pneumoconiosis or Asiderosis.®
Hexavalent Chromium (Cr VI)	Yes IARC NTP OSHA	Inhalation and Skin Contact: Irritation of mucous membranes	Inhalation: Perforation of the nasal septum. Increased incidence of lung cancer. Skin Contact: Skin ulceration, dermatitis.
Chromium Metal-Cr CAS No. 7740-47-3 Chromium oxide (Cr II) CrO CAS No. 12018-00-7 Chromium oxide (Cr III) Cr ₂ O ₃	Yes IARC	Skin Contact: Allergic reactions (dermatitis) in some people.	None known.
Nickel-Ni CAS No. 7440-02-0 Nickel oxide-NiO CAS No. 1313-99-1	Yes IARC NTP	Inhalation: Respiratory irritation. Allergic reactions in some people. Metallic taste, nausea, tightness in chest, metal fume fever. Skin Contact: Contact dermatitis with permanent sensitization.	Inhalation: Chronic pulmonary irritation. Perforation of nasal septum. Increased incidence of lung and larynx cancer.
Cobalt-Co CAS No. 7440-48-4 Cobalt Oxide - CoO CAS no. 1307-96-6	No	Inhalation: Pulmonary irritant, cough. Eye Contact: Irritation, conjunctivitis Skin: Mild irritation sensitization, allergic dermatitis. Ingestion: Pain, nausea, vomiting, hypotension (low blood pressure).	Chronic exposure to cobalt is more dangerous than isolated exposures. Possible lung fibrosis and respiratory hypersensitivity. Heart disease, elevated red blood cell counts, chest pain and edema.
Copper-Cu CAS No. 7440-50-8 Copper oxide-CuO CAS No. 1317-38-0	No	Inhalation: Metal fume fever, muscle ache, respiratory irritant. Skin: Irritation, Ingestion: Nausea, vomiting, abdominal pain; large doses may cause stomach and intestine ulceration, and kidney and liver damage.	Mild dermatitis and degeneration of mucous membranes. Repeated inhalation can cause chrome respiratory disease.
Manganese-Mn CAS No. 7439-96-5 Manganese dioxide-as Mn for fume MnO ₂	No	Can include metal fume fever, dry throat, coughing, tight chest, low back pain, vomiting, fatigue, headache	ΔManganism.® SENSITIVITY VARIES. Affects central nervous system. Muscular weakness, tremors, symptoms similar to Parkinson=s disease. Exposed employees should get quarterly medical examinations for manganism.

Table 3 Exposure Limits for Potentially Hazardous Constituents in Structural Wire (continued)

Name of Compound, Formula and CAS Number	On Any Carcinogens List? If So, Which Ones?	Health Effects Resulting From Excessive Exposure	
		Acute (Short Term)	Chronic (Long Term)
CAS No. 1313-13-9			
Vanadium Pentoxide (V ₂ O ₅)	No	Irritant to mucous membranes. Metallic taste, cough, throat and eye irritation, eczema.	Nasal catarrh, nose bleeds, chronic respiratory problems.
Iron-Fe CAS No. 7439-89-6 Iron Oxide-FeO CAS No. 1345-25-1 Iron Oxide-Fe ₂ O ₃ CAS No. 1309-37-1 Iron Oxide-Fe ₃ O ₄ CAS No. 1309-38-2	No	Probably none, except as nuisance dust.	Possible siderosis if exposures are excessive and long term. Regarded as benign. Lungs clear gradually after exposure is ended.