

MATERIAL SAFETY DATA SHEET

Product Name: Nickel Anodes

SECTION I. MATERIAL IDENTIFICATION

Metal and Metal Alloys of Aluminum, Copper, Lead, Nickel and Steel

SECTION II. HAZARDOUS INGREDIENTS

	CAS-Number	OSHA PEL	ACGIH TLV
Aluminum #	(7429-90-5)	15 mg/m ³ /5mg/m ³ (R)	10 mg/m ³ /5mg/m ³ (fume)
Antimony #	(7440-36-0)	0.5 mg/m ³	0.5 mg/m ³
Arsenic #	(7440-38-2)	0.01 mg/m ³	0.01 mg/m ³
Beryllium #	(7440-41-7)	0.002 mg/m ³	0.002 mg/m ³ :0.01 mg/m ³ (STEL)
Cadmium #	(7440-43-9)	0.005 mg/m ³	0.01 mg/m ³ /0.002 mg/m ³ (R)
Carbon	(7440-44-0)	—————	—————
Chromium #	(7440-47-3)	1 mg/m ³	0.5 mg/m ³
Cobalt #	(7440-48-4)	0.1 mg/m ³	0.02 mg/m ³
Columbium	(7440-03-1)	—————	—————
Copper #	(7440-50-8)	1 mg/m ³ /0.1 mg/m ³ (fume)	1 mg/m ³ /0.2 mg/m ³ (fume)
Iron	(7439-89-6)	10 mg/m ³ (fume)	5 mg/m ³
Lead #	(7439-92-1)	0.05 mg/m ³	0.05 mg/m ³
Magnesium	(7439-95-4)	15 mg/m ³	10 mg/m ³ (fume)
Manganese #	(7439-96-5)	5 mg/m ³ (C)	0.2 mg/m ³
Molybdenum	(7439-98-7)	15 mg/m ³	10 mg/m ³ /3 mg/m ³ (R)
Nickel #	(7440-02-0)	1 mg/m ³	1.5 mg/m ³
Phosphorous #	(7723-14-0)	0.1 mg/m ³	0.02 mg/m ³
Silicon	(7440-21-3)	15 mg/m ³ /5 mg/m ³ (R)	10 mg/m ³
Silver #	(7740-22-4)	0.01 mg/m ³	0.1 mg/m ³
Sulfur	(7704-34-9)	—————	—————
Tantalum	(7440-25-7)	5 mg/m ³	5 mg/m ³
Tellurium	(13494-80-9)	0.1 mg/m ³	0.1 mg/m ³
Tin	(7440-31-5)	2 mg/m ³	2 mg/m ³
Titanium	(7440-32-6)	—————	—————
Tungsten	(7440-33-7)	—————	5 mg/m ³ /10 mg/m ³ (STEL)
Vanadium #	(7440-62-2)	—————	—————
Yttrium	(7440-65-5)	1 mg/m ³	1 mg/m ³
Zinc #	(7440-66-6)	15 mg/m ³ /5 mg/m ³ (R)	10 mg/m ³ /5mg/m ³ (fume)

Note: Arsenic, beryllium, cadmium, cobalt, chromium VI compounds, lead and nickel have been listed by IARC and/or NTP as carcinogenic or potentially carcinogenic to humans. Iron oxide, magnesium oxide, and zinc oxide exposure limits are referenced above. (C) Ceiling Limit. (R) Respirable fraction. (STEL) Short-term exposure limit. # Denotes a toxic chemical subject to reporting requirements for section 313 of Title III of S.A.R.A.

Date: January 1, 2002

SECTION III. PHYSICAL DATA

Physical Form: Solid

Odor: None

	ALUMINUM	COPPER	LEAD	STEEL	NICKEL
Specific Gravity (H ₂ O = 1)	2.5+	7.5+	8+	7+	8-9
Melting Point (C)	480+	1000+	180+	1300+	>1400
Color	Silver	Yellow to Red	Soft Gray	Gray-Black	Silver
Solubility in H ₂ O	None	None	None	None	None

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point: (Method Used) Not Applicable

Extinguishing Media: See Below

Flammable Limits (LEL-UEL): Not Applicable

Auto Ignition Temp.: Not Applicable

Special Fire Fighting Procedures: Solid massive form is not combustible. Fire and explosion hazard is high for alin the form of dust and exposed to heat, flames, chemical reaction, or in contact with powerful oxidizers. Use class D extinguishing agents. Firefighters should wear self-contained breathing apparatus and protective clothing.

SECTION V. REACTIVITY DATA

Stability: Stable under normal conditions of transport and storage as shipped.

Conditions to Avoid: Strong acids and bases can produce flammable/explosive gas. Molten metal may react violently with water.

Incompatibility (Materials to Avoid): Acids, bases, and oxidizers.

Hazardous Decomposition or by-products: Metal fume. Welding/cutting operations may generate ozone and oxides of nitrogen.

Hazardous Polymerization: Will not occur.

SECTION VI. HEALTH HAZARD DATA

Permissible Exposure Limits and Threshold Limit Values. See Section II.

Route(s) of Entry: Inhalation: Yes; Skin: Yes; Ingestion: Yes

Under normal handling conditions the solid alloy presents no significant health hazards. Processing of the alloy by dust or fume producing operation (grinding, buffing, heating, welding, etc.) may result in the potential for exposure to airborne metal particulates or fume. The exposure levels in Section II are relevant to fumes and dusts.

Effects of Overexposure:

Aluminum – Low health risk by inhalation - ACGIH: listed as nuisance dust.

Antimony – Overexposure to antimony can irritate the eyes and lungs and cause stomach pain, diarrhea, vomiting, stomach ulcers, heart and lung problems.

Arsenic – Arsenic compounds can be absorbed in to the body from industrial exposures, especially by inhalation and ingestion. Signs of toxicity are dermal lesions, conjunctivitis, upper respiratory tract irritation, nausea, vomiting, peripheral neuritis and occasionally anemia. Arsenic has been listed as a Group 1 carcinogen by IARC (carcinogenic to humans) and NTP (known to be human carcinogen).

Beryllium – Inhalation of beryllium dust or fume may result in the production of an acute or chronic systemic disease depending upon the level of exposure and the beryllium compound involved. Granulomatous lesions of the skin, liver, kidneys, spleen and lymph nodes have been reported. Damage to the lungs may be in both the acute and chronic forms, both of which have similar signs and symptoms. These include a relatively non-productive cough, progressive difficulty in breathing, loss of appetite, and loss of weight. In the acute form, the symptoms appear in several hours to several weeks after exposure and there is usually rapid progression of signs including dyspnea, anorexia, and extreme weight loss. Complete recovery is possible and fatal cases usually result from acute heart disease. In chronic beryllium disease, the symptoms or signs are progressive and can be fatal. In the progression of the disease, symptoms of heart disease may occur. Beryllium is listed as a Group 1 carcinogen by IARC (carcinogenic to humans) and Group 2 carcinogen by NTP (reasonably anticipated human carcinogen).

Cadmium – Inhalation of cadmium fumes may cause respiratory irritation with a sore, dry throat and a metallic taste followed by a cough, chest pain, and difficulty in breathing. Bronchitis, pneumonitis, pulmonary edema, headaches, dizziness, loss of appetite, and weight loss have been reported. Liver, kidneys and bone marrow may be injured by the presence of the metal. Continued exposure to lower levels of cadmium have resulted in chronic poisoning characterized by irreversible lung damage and kidney damage. A single, high-level exposure to cadmium can cause severe lung irritation which may be fatal. Cadmium is listed as a Group 1 carcinogen by IARC (carcinogenic to humans) and Group 2 carcinogen by NTP (reasonably anticipated human carcinogen).

Chromium – Chromium dust can cause irritation of the eyes, skin, and respiratory tract. Additional chromium compounds can be formed during processing and cause dermatitis, allergic reactions, and skin ulcers. Chronic overexposures can cause perforation of the nasal septum, respiratory sensitization, asthma, lung damage, kidney damage, and cancer. Chromium VI compounds are listed as a Group 1 carcinogen by IARC (carcinogenic to humans) and NTP (known to be human carcinogen).

Cobalt – Acute and chronic overexposures can cause respiratory sensitization, asthma, scarring of the lungs, and damage to heart muscle (cardiomyopathy). IARC lists cobalt as a Group 2B carcinogen (possibly carcinogenic to humans).

Columbium – Also known as Niobium, there is limited information on the toxicity of this metal or its fumes.

Copper – Acute overexposures to fumes of copper may cause metal fume fever with flu-like symptoms. Copper dust and fume can cause irritation of the upper respiratory tract, metallic taste in the mouth, and nausea. Chronic overexposures can cause reduction in red blood cells, skin abnormalities, and hair discoloration.

Iron – The inhalation of iron oxide fumes or dust may cause an apparent benign pneumoconiosis which is called siderosis. Can cause irritation of gastrointestinal tract, bleeding, changes in the pH of body fluids, and liver damage.

Lead – Chronic overexposure can cause weakness in the extremities (peripheral neuropathy), gastrointestinal tract effects, kidney damage, liver damage, central nervous system damage, damage to the blood forming organs, blood cell damage, and reproductive harm. Can cause reduced fertility and fetal toxicity in pregnant woman. Inorganic lead and lead compounds are listed as Group 2B carcinogen (possibly carcinogenic to humans) by IARC.

Magnesium – Exposure to magnesium may cause metal fume fever with flu-like symptoms. Particles imbedded in the skin may cause severe lesions.

Manganese – Chronic manganese overexposures can cause inflammation of the lung tissue, scarring of the lungs (pulmonary fibrosis), central nervous system damage, secondary Parkinson's disease and reproductive harm in males.

Molybdenum – Can cause irritation of mucous membranes, skin, and respiratory tract. Acute overexposures can lead to headaches, backache, and sore joints. Chronic overexposures can cause blood disorders, kidney damage, lung and liver damage.

Nickel – The most common ailment arising from nickel or its compounds is an allergic dermatitis known as 'nickel-itch'. Generally, nickel and most salts of nickel do not cause systemic poisoning, but nickel has been identified as a Group 2B carcinogen (possibly carcinogenic to humans) by IARC and Group 2 carcinogen by NTP (reasonably anticipated to be human carcinogen). There can also be adverse effects to the lungs and nasal cavities.

Phosphorus – The dusts and fumes can act as minor irritants to the eyes, throat, and respiratory tract. Long-term excessive inhalation of phosphorus compounds may lead to cough, bronchitis and pneumonia.

Silicon – Chronic overexposures can cause chronic bronchitis and narrowing of the airways. Studies with experimental animals by injection have found lesions on the lungs.

Silver – Chronic occupational exposure to silver results in argyria, a permanent pigmentation (gray to purple) of the skin and eyes. Inhalation of silver may localize the argyria in the respiratory tract with chronic bronchitis as the only symptom. Exposure to high levels has resulted in respiratory problems and stomach pains.

Sulfur – In fumes may irritate: skin, eyes, lungs and gastrointestinal tract.

Tantalum – Can cause mechanical irritation of the eyes, skin, and upper respiratory tract. Generally of low toxicity.

Tellurium – Inhalation of tellurium fume can result in a metallic taste and garlic breath, gastrointestinal disease, dry-mouth and somnolence.

Tin – The inhalation of inorganic tin fumes or dust may cause an apparent benign pneumoconiosis called stannosis which is reported to be not disabling.

Titanium – Titanium is considered a physiologically inert dust. However, high concentration of oxides can cause mechanical irritation of eyes, nose and throat. Inhalation of titanium could cause mild irritation to the respiratory tract. Inhalation of titanium dioxide dust or fume could produce lung fibrosis and chronic bronchitis.

Tungsten – Inhalation of tungsten dust may cause irritation of the respiratory tract. Skin or eye contact could cause abrasion or irritation of the respective surfaces. No hazards have been identified for tungsten fume except that it may aggravate an existing chronic respiratory disease.

Vanadium – High level exposure to vanadium can irritate the eyes, throat, and lungs. Symptoms generally subside shortly after the exposure is removed.

Yttrium – Short-term inhalation in large amounts could cause discomfort, coughing and nasal discharge similar to the symptoms of a bad cold. Drying of the mucous membranes might be experienced. After intratracheal administration in rats, emphysema and diffused modular fibrosis in the lungs have been reported. The oral toxicity of this material is low as it is poorly absorbed from the gastrointestinal tract. Skin and eye contact should produce no problems other than mechanical irritation.

Zinc – Zinc is low in toxicity, but inhalation of fumes/oxides may cause metal fume fever. Onset of symptoms may be delayed 4-12 hours and include irritation of the mouth and throat, coughing, stomach pain, headache, nausea, vomiting, metallic taste, chills, fever, pains in the muscles and joints, thirst, bronchitis or pneumonia and a bluish tint to the skin. These symptoms go away in 24 to 48 hours and leave no effect.

Note: Arsenic, beryllium, cadmium, cobalt, chromium VI compounds, lead and nickel have been listed by IARC and/or NTP as carcinogenic or potentially carcinogenic to humans. Arsenic, cobalt, lead, and nickel alloys contain a chemical(s) known in the state of California to cause cancer. Lead containing alloys contain a chemical known in the state of California to cause reproductive effects.

Emergency First Aid Procedures:

Eye Contact – Flush for 15 minutes with running water to remove particulate. Consult a physician.
Skin Contact – Wash well with soap and water for 15 minutes. Consult a physical if irritation persists.
Inhalation – Remove individual to place of fresh air. Obtain medical attention.
Ingestion – Seek medical attention if large quantities of materials have been ingested.

SECTION VII. PRECAUTIONS FOR SAFE HANDLING OR USE

Steps to be Taken in Case Material is Released or Spilled: No special precautions are necessary for spills of bulk material. If large quantities of dust are spilled, remove by vacuuming or wet-sweeping to prevent elevated concentration of airborne dust. Vacuum systems must be designed for explosive dusts. Avoid all ignition sources.

Waste Disposal Method: Dispose of waste in accordance with federal, state and local regulations. Clean-up personnel should wear respirators and protective clothing. Local ventilation is recommended to maintain dust levels below the applicable PEL's and TLV's. Ventilation systems must be designed for explosive dusts.

Precautions to be Taken in Handling and Storing: Store materials away from incompatible materials and keep dust from sources of ignition.

Other Precautions: See all other sections of this MSDS.

SECTION VIII. CONTROL MEASURES

Respiratory Protection: If exposure is above the PEL or TLV, use a NIOSH-approved respirator for fume or dust as specified by an industrial hygienist or other qualified health professional.

Ventilation: Use explosion proof local exhaust ventilation to meet the limits specified in section II.

Protective Gloves: Gloves are required for melt, grind, cut, weld, or manual handling operations. Select a glove approved for the specific operation.

Eye Protection: Safety glasses with side shields/goggles are recommended. Melting and welding may require special eye protection including face shields and specially tinted glass. Grinding operations may also require face shields.

Other Protective clothing or equipment: Other protection or equipment may be required depending upon the work being done on or with the material. Consult OSHA 29 CFR 1910 for chemical specific requirements.

Work/Hygiene Practices: Observe good hygiene practices following handling. Always evaluate alloy processing activities in accordance with OSHA or relevant federal, state or local standards.

IMPORTANT LIABILITY DISCLAIMER

The information contained in this Material Safety Data Sheet (MSDS) is believed to be correct as it was obtained from sources which we believe are reliable, including: "Threshold Limit Values & Biological Exposure Indices for 2001" (American Conference of Governmental Industrial Hygienists), Air Contaminants - Permissible Exposure Limits (Title 29, CFR, part 1910.1000 - OSHA), International Agency for Research on Cancer (IARC), and National Toxicological Program (NTP - PHS/DHHS). However, no representations, guarantees or warranties of any kind are made as to its accuracy, suitability for particular applications, hazards connected with the use of the material, or the results to be obtained from the use thereof. User assumes all risks and liability of any use, processing or handling of any material, variations in methods, conditions and equipment used to store, handle, or process the material, and hazards connected with the use of the material are solely the responsibility for the user and remain at his sole discretion.

Compliance with all applicable federal, state and local laws and regulations remains the responsibility of the user, and the user has the responsibility to provide a safe work place, to examine all aspects of its operations and to determine if or where precautions, in addition to those described herein, are required.

Note: For actual compositions, please refer to "Certified Material Test Report" or specific grade specification sheets.

The information contained in the alloy composition sheets should not be used for ordering or specification purposes. Data supplied is referenced from alloy specification ranges/limits and is intended to provide the general chemical composition of the alloy.

MATERIAL SAFETY DATA ALLOY % COMPOSITION -- CARBON STEEL

CARBON STEEL ALLOYS	CARBON	CHROMIUM	COPPER	IRON	LEAD	MANGANESE	MOLYBDENUM	NICKEL	PHOSPHORUS	SILICON	SULFUR	VANADIUM
1008	0.1			*		0.3-0.5			0.04		0.05	
1018	0.15-0.2			*		0.6-0.9			0.04		0.05	
1020	0.18-0.23			*		0.3-0.6			0.04		0.05	
1022	0.18-0.23			*		0.7-1			0.04		0.05	
1026	0.22-0.28			*		0.6-0.9			0.04		0.05	
1029	0.25-0.31			*		0.6-0.9			0.04		0.05	
1030	0.28-0.34			*		0.6-0.9			0.04		0.05	
1035	0.32-0.38			*		0.6-0.9			0.04		0.05	
1040	0.37-0.44			*		0.6-0.9			0.04		0.05	
1042	0.4-0.47			*		0.6-0.9			0.04		0.05	
1045	0.43-0.5			*		0.6-0.9			0.04		0.05	
1050	0.48-0.55			*		0.6-0.9			0.04		0.05	
1060	0.55-0.65			*		0.6-0.9			0.04		0.05	
1070	0.65-0.75			*		0.6-0.9			0.04		0.05	
1117	0.14-0.2			*		1-1.3			0.04		0.08-0.13	
1117	0.14-0.2			*		1.0-1.3			0.4		0.08-0.13	
1137	0.32-0.39			*		1.35-1.65			0.04		0.08-0.13	
1141	0.37-0.45			*		1.35-1.65			0.04		0.08-0.13	
1144	0.4-0.48			*		1.35-1.65			0.04		0.24-0.33	
1213	0.13			*		0.7-1			0.07-0.12		0.24-0.33	
1214	0.15			*		0.85-1.15			0.04-0.09		0.26-0.35	
1215	0.09			*		0.75-1.05			0.04-0.09		0.26-0.35	
1541	0.36-0.44			*		1.35-1.65			0.04		0.05	
4130	0.28-0.33	0.8-1.1		*		0.4-0.6	0.15-0.25		0.035	0.15-0.35	0.04	
4140	0.38-0.43	0.8-1.1		*		0.75-1	0.15-0.25		0.035	0.15-0.35	0.04	
4142	0.4-0.45	0.8-1.1		*		0.75-1	0.15-0.25		0.035	0.15-0.35	0.04	
4145	0.43-0.48	0.8-1.1		*		0.75-1	0.15-0.25		0.035	0.15-0.35	0.04	
4147	0.45-0.5	0.8-1.1		*		0.75-1	0.15-0.25		0.035	0.15-0.35	0.04	
4150	0.48-0.53	0.8-1.1		*		0.75-1	0.15-0.25		0.035	0.15-0.35	0.04	
4320	0.17-0.22	0.4-0.6		*		0.45-0.65	0.2-0.3	1.65-2	0.035	0.15-0.35	0.04	
4330	0.42-0.49	0.85-1.20	0.35	*		0.85-1.20	0.25-0.35	0.25	0.025	0.15-0.35	0.04	
4340	0.38-0.43	0.7-0.9		*		0.6-0.8	0.2-0.3	1.65-2	0.35	0.15-0.35	0.04	
4815	0.13-0.18			*		0.4-0.6	0.2-0.3	3.25-3.75	0.35	0.15-0.35	0.04	
4817	0.15-0.2			*		0.5-0.7	0.2-0.3	3.25-3.75	0.35	0.15-0.35	0.04	
4820	0.18-0.23			*		0.7-0.9			0.35	0.15-0.35	0.04	
5150	0.48-0.53	0.7-0.9		*		0.75-1			0.35	0.15-0.35	0.04	
5160	0.58-0.64	0.7-0.9		*		0.7-0.9			0.35	0.15-0.35	0.04	
8620	0.18-0.23	0.4-0.6		*		0.27-0.93	0.15-0.25	0.4-0.7	0.35	0.15-0.35	0.04	
A106	0.25			*		0.86-1.24	1.10-1.60		0.048	0.1	0.055	0.01-0.11
A588	0.09-0.20	0.37-0.68	0.22-0.43	*		0.20-0.50			0.045	0.13-0.32	0.055	0.30-0.60
H-11	0.33-0.43	4.75-5.50		*		1.9			0.03		0.03	
J-55	0.43			*		1.9			0.03		0.03	
K-55	0.43			*		1.9			0.03		0.03	
L-60	0.38-0.43	0.8-1.1		*		0.75-1.00	0.15-0.25		0.035	0.15-0.35	0.04	
M-80	0.38-0.43	0.8-1.1		*		0.75-1.00	0.15-0.25		0.035	0.15-0.35	0.04	
P-110	0.38-0.43	0.8-1.1		*		0.75-1.00	0.15-0.25		0.035	0.15-0.35	0.04	
Stress Proof	0.4-0.48			*		1.35-1.65			0.04		0.24-0.33	

Concentrations specified as limits or ranges.

*Remainder

MATERIAL SAFETY DATA ALLOY % COMPOSITION - NICKEL

NICKEL ALLOYS		A L U M I N I U M	B O R O N	C A R B O N	C H R O M I U M	C O B A L T	C O L U M B I U M	C O P P E R	I R O N	P H O S P H O R U S	M A N G A N E S E	M O L Y B D E N U M	N I C K E L	N I T R O G E N	S I L I C O N	S U L F U R	T I T A N I U M	T U N G S T E N
20					20			4	37			3	35	1				
25-G MO					20			1	47			7	25		1			
36									64				36					
42									58				42					
59	0.4			0.01	22-24	0.3			1.5	0.015	0.5	16.5		0.1	0.005			
200				0.15				0.25	0.4		0.35		99 min		0.35	0.01		
201				0.02				0.25	0.4		0.35		99 min		0.35	0.01		
211				0.2				0.25	0.75		4.25 - 5.25		93.7 min		0.15	0.015		
258									44				56					
301	4.0 - 4.75			0.3				0.25	0.6		0.5		93 min		1	0.01	0.25 - 1.0	
330					19				43		1		35		1			
365									52				44	3			1	
400				0.3				*	2.5		2							
404	0.05			0.15				*	0.5		0.1				0.5	0.024		
600				0.15	14.00 - 17.00			0.5	5.00 - 10.00		1				0.1	0.024		
601	1.0 - 1.7			0.1	21.0 - 25.0			1	*		1		72 min		0.5	0.015		
617	0.80 - 1.50			0.05 - 0.15	20.0 - 24.0	10.0 - 15.0		0.5	3		1	8.00 - 10.0	58.0 - 65.0		0.5	0.015		
622					20				5		1	14	44.5 min		1	0.015	0.6	3
625	0.4			0.1	20.0 - 23.0				5	0.015	0.5	8.0 - 10.0	58		0.5	0.015	0.4	
686					21				1			16						4
690				0.05	27.0 - 31.0			0.5	7.0 - 11.0		0.5		58 min		0.5	0.015		
718	0.20 - 0.80			0.08	17.0 - 21.0	1		0.3	*	0.015	0.35	2.80 - 3.30	50.0 - 55.0		0.35	0.015	0.65 - 1.15	
725					21				8			8	57	3				
800	0.15 - 0.6			0.1	19.0 - 23.0			0.75	*		1.5		30.0 - 35.0		1	0.015	0.15 - 0.6	
800H	0.15 - 0.6			0.05 - 0.1	19.0 - 23.0			0.75	*		1.5		30.0 - 35.0		1	0.015	0.15 - 0.6	
800-HT	0.15 - 0.60			0.06 - 0.1	19.0 - 23.0			0.75	39.5 min		1.5		30.0 - 35.0		1	0.015	0.15 - 0.60	
801				0.1	19.0 - 22.0			0.5	*		1.5		30.0 - 34.0		1	0.015	0.75 - 1.5	
825	0.2			0.05	19.5 - 23.5			1.5 - 3.0	*		1	2.5 - 3.5	38.0 - 46.0		0.5	0.03	0.6 - 1.2	
902	0.3 - 0.8			0.06	4.90 - 5.75				*	0.04	0.8		41.0 - 43.5		1	0.04	2.2 - 2.75	
925	0.1 - 0.5			0.03	19.5 - 23.5			1.5 - 3.0	22.0 min		1	2.5 - 3.5	38.0 - 46.0		0.5	0.03	1.9 - 2.4	
A-286					15			57					26				2	
C-276					16	1		6			1	16	57				4	
K-500	3							30	1		1		66				1	
R-405								32	1		1		67				3	
X-750	1				16			7	7		1		73	1				

Concentrations specified as limits or ranges.
*Remainder

MATERIAL SAFETY DATA ALLOY % COMPOSITION - STAINLESS STEEL

STAINLESS STEEL ALLOYS	ALUMINUM	CARBON	CHROMIUM	COBALT	COPPER	IRON	MANGANESE	MOLYBDENUM	NICKEL	NITROGEN	PHOSPHORUS	SILICON	SULFUR	TANTALUM	TUNGSTEN
3CR12		0.03	10.5 - 12.0			*	1.5		1.5	0.03	0.04	1	0.03	0.6	
11CR-CB	0.00 - 2.0		10.0 - 27.0	0.0 - 5.0	0.0 - 4.0	*	0.0 - 15.0	0.0 - 4.0		0.0 - 22.0		0.0 - 5.0			0.0 - 4.0
15-5 PH		0.07	14 - 15.5	0.15 - 0.45	2.5 - 4.5	*	1		3.5 - 5.5		0.04	1	0.03		
17-4 PH		0.07	15.5 - 17.5	0.15 - 0.45	3.0 - 5	*	1		3.0 - 5		0.04	1	0.03		
16CR-CB	0.00 - 2.0		10.0 - 27.0	0.00 - 5.0	0.00 - 4.0	*	0.0 - 15.0	0.0 - 4.0		0.0 - 22.0		0.0 - 5.0			0.0 - 4.0
29-4C		0.03	28 - 30	0.2 - 1		*	1	3.6 - 4.2	1	0.045	0.04	1	0.03	0.2 - 1	
201		0.15	16 - 18			*	5.5 - 7.5		3.5 - 5.5	0.25	0.06	1	0.03		
301		0.15	16 - 18			*	2		6.0 - 8.0	0.1	0.045	1	0.03		
303		0.15	17 - 19			*	2	0.6	8.0 - 10		0.2	1	0.15		
304		0.08	18 - 20			*	2		8.0 - 10.5	0.1	0.045	0.75	0.03		
304L		0.03	18 - 20			*	2		8.0 - 12		0.045	0.75	0.03		
304H		0.04 - 0.1	18 - 20			*	2		8.0 - 10.5		0.045	0.75	0.03		
305		0.12	17 - 19			*	2		10.5 - 13		0.045	1	0.03		
308		0.08	19 - 22			*	2		10.0 - 12		0.045	1	0.03		
309		0.02	22 - 24			*	2		12.0 - 15		0.045	1	0.03		
309S		0.08	22 - 24			*	2		19.0 - 22		0.045	1.5	0.03		
310		0.25	24 - 26			*	2		19 - 22.0		0.045	1.5	0.03		
310S		0.08	24 - 26			*	2		10.0 - 14	0.1	0.045	0.75	0.03		
316		0.08	16 - 18			*	2	2.0 - 3	10.0 - 14		0.045	0.75	0.03		
316L		0.03	16 - 18			*	2	2.0 - 3	10.0 - 14		0.045	0.75	0.03		
317L		0.08	18.0 - 20			*	2	3.0 - 4	11.0 - 15	0.1	0.045	0.75	0.03		
321		0.08	17.0 - 19			*	2		9.0 - 12	0.1	0.045	0.75	0.03	0.7	
347		0.08	17.0 - 19	0.8 - 1		*	2		9.0 - 13		0.045	0.75	0.03		
405	0.1 - 0.3	0.08	11.5 - 14.5			*	1		0.6		0.04	1	0.03		
410		0.08 - 0.15	11.5 - 13.5			*	1		0.75		0.04	1	0.03		
410A		0.15	11.5 - 13.5			*	1		0.5		0.04	1	0.03		
410S		0.08	11.5 - 13.5			*	1		0.6		0.04	1	0.03		
414		0.15	11.5 - 13.5			*	1		1.5 - 2.5		0.04	1	0.03		
416		0.15	12.0 - 14			*	1.25	0.6			0.06	1	0.15		
420		0.15	12.0 - 14			*	1				0.04	1	0.03		
430		0.12	16.0 - 18			*	1		0.75		0.04	1	0.03		
431		0.2	15.0 - 17			*	1		1.25 - 2.5		0.04	1	0.03		
434		0.12	16.0 - 18			*	1	0.75 - 1.25			0.04	1	0.03		
440C		0.95 - 1.2	16.0 - 18			*	1	0.75			0.04	1	0.03		
444		0.025	17.5 - 19.5	0.8		*	1	1.75 - 2.5	1	0.035	0.04	1	0.03		
448		0.025	23.0 - 27			*	1.5			0.25	0.04	1	0.03		
206		0.03	21 - 23			*	2	2.5 - 3.5	4.5 - 6.5	0.08 - 0.2	0.03	1	0.02		
ER 2208		0.03	21.5 - 23.5			*	0.5 - 2.0	2.5 - 3.5	7.5 - 9.5	0.08 - 0.2	0.03	0.9	0.03		
Nitronic 30	0.00 - 2.0		10.0 - 27.0	0.0 - 5.0	0.0 - 4.0	*	0.0 - 15.0	0.0 - 4.0		0.0 - 22.0		0.0 - 5.0			0.0 - 4.0

Concentrations specified as limits or ranges.
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MATERIAL SAFETY DATA ALLOY % COMPOSITION – COPPER

COPPER ALLOYS	ALUMINUM	ANTIMONY	ARSENIC	BERYLLIUM	BISMUTH	CADMIUM	COPPER	IRON	LEAD	MANGANESE	MERCURY	NICKEL	PHOSPHORUS	SELENIUM	SILICON	SULFUR	TELLURIUM	TIN	TITANIUM	ZINC	
101					0.001	0.0001	99.99 min	0.001	0.001		0.0001		0.0003	0.001		0.0018	0.001			0.0001	
102							99.95 min														
110							99.99 min														
122							99.9 min														
145							99.90 min														
147							99.90 min														
172	1.80 - 2.00						99.5 min		0.20 - 0.6							0.20 - 0.50					
173	1.80 - 2.00						99.5 min														
210							94.0 - 96.0	0.05	0.03												
220							89.0 - 91.0	0.05	0.05												
230							84.0 - 86.0	0.05	0.06												
240							78.5 - 81.5	0.05	0.05												
260							68.5 - 71.5	0.05	0.07												
280							59.0 - 63.0	0.07	0.3												
314							87.5 - 90.5	0.1	1.3 - 2.5			0.7									
316							87.5 - 90.5	0.1	1.3 - 1.2			0.7 - 1.2	0.04 - 0.10								
353							60.0 - 63.0	0.1	1.5 - 2.5												
360							60.0 - 63.0	0.35	2.5 - 3.7												
385							56.0 - 59.0	0.35	2.5 - 3.5												
443			0.02 - 0.06				70.0 - 73.0	0.06	0.07									0.8 - 1.2			
464							59.0 - 62.0	0.1	0.2									0.50 - 1.0			
485							59.0 - 62.0	0.1	1.3 - 2.2									0.50 - 1.0			
510							99.5 min	0.1	0.05				0.03 - 0.35					4.2 - 5.8			0.3
642			0.15				99.5 min	0.1	0.05				0.03 - 0.35					7.0 - 9.0			0.2
651							99.5 min	0.1	3.5 - 4.5				0.01 - 0.50					3.5 - 4.5			1.5 - 4.5
655	8.5 - 10.0						*	2.0 - 4.0	0.5			1			0.25			0.6			
624	10.0 - 11.5						*	2.0 - 4.5	0.2			4.0 - 5.5			0.25			0.2			
630	9.0 - 11.0						*	2.0 - 4.0	1.5						0.25			0.2			0.3
642	6.3 - 7.6						*	0.3	0.05	0.1		0.25			1.5 - 2.2			0.2			
651							*	0.8	0.05	0.7					0.8 - 2.0			0.2			1.5
655							*	0.8	0.05	0.50 - 1.3		0.6			2.8 - 3.8			0.3			1.5
673	0.25						58.0 - 63.0	0.5	0.40 - 3.0	2.0 - 3.5		0.25			0.50 - 1.5						*
694							80.0 - 83.0	0.2	0.3						3.5 - 4.5						*
706							86.5 min	1.0 - 1.8	0.05	1		9.0 - 11.0									1
715							99.5 min	0.40 - 1.0	0.05	1		29.0 - 33.0									1
932	0.005	0.35					81.0 - 85.0	0.2	6.0 - 8.0			1	0.15		0.005	0.08		6.3 - 7.5			2.0 - 4.0
954	10.0 - 11.5						83.0 min	3.0 - 5.0		0.5		1.5									

ALUMINUM ALLOYS ALLOY % COMPOSITION – ALUMINUM

ALUMINUM ALLOYS	ALUMINUM	CHROMIUM	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	SILICON	TITANIUM	ZINC
1100			0.05 - 0.2				0.05	0.95		0.1
1145	99 min		0.05			0.05	0.05	0.55	0.03	0.05
2011	99.45 min		5 - 6					0.4		0.3
2014	*	0.1	3.9 - 5.0	0.7		0.2 - 0.8	0.4 - 1.2	0.2 - 1.2	0.15	0.25
2017	*	0.1	3.5 - 4.5	0.7		0.4 - 0.8	0.4 - 1.0	0.5 - 0.8	0.15	0.25
2024	*	0.1	3.8 - 4.9	0.5		1.2 - 1.8	0.3 - 0.9	0.5	0.15	0.25
2124	*	0.1	3.8 - 4.9	0.3		1.2 - 1.8	0.3 - 0.9	0.2	0.15	0.25
3003	*		0.05 - 0.2	0.7		1.0 - 1.5	1.0 - 1.5	0.6	0.1	0.1
3004	*		0.25	0.7		0.8 - 1.3	1.0 - 1.5	0.3	0.1	0.25
3005	*	0.1	0.3	0.7		0.2 - 0.6	1.0 - 1.5	0.6	0.1	0.25
3105	*	0.2	0.2	0.7		0.2 - 0.8	0.3 - 0.8	0.6	0.1	0.4
5005	*	0.1	0.3	0.7		0.5 - 1.1	0.2	0.3	0.2	0.25
5052	*	0.15 - 0.35	0.1	0.4		2.2 - 2.8	0.1	0.25	0.1	0.1
5454	*	0.05 - 0.2	0.1	0.5		3.5 - 4.5	0.5 - 1.0	0.25	0.2	0.25
5086	*	0.05 - 0.25	0.1	0.4		3.5 - 4.5	0.2 - 0.7	0.4	0.15	0.25
6061	*	0.04 - 0.35	0.15 - 0.4	0.7		0.8 - 1.2	0.15	0.4 - 0.8	0.15	0.25
6063	*	0.1	0.1	0.35		0.45 - 0.9	0.1	0.2 - 0.6	0.1	0.1
6101	*	0.03	0.1	0.5		0.35 - 0.8	0.03	0.3 - 0.7	0.1	0.1
6262	*	0.04 - 0.14	0.15 - 0.4	0.7	0.4 - 0.7	0.8 - 1.2	0.15	0.4 - 0.8	0.15	0.25
6463	*		0.2	0.15		0.45 - 0.9	0.05	0.2 - 0.6	0.15	0.05
7050	*	0.04	2.0 - 2.6	0.15		1.9 - 2.6	0.1	0.12	0.06	5.7 - 6.7
7075	*	0.18 - 0.28	1.2 - 2.0	0.5		2.1 - 2.9	0.3	0.4	0.2	5.1 - 6.1

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