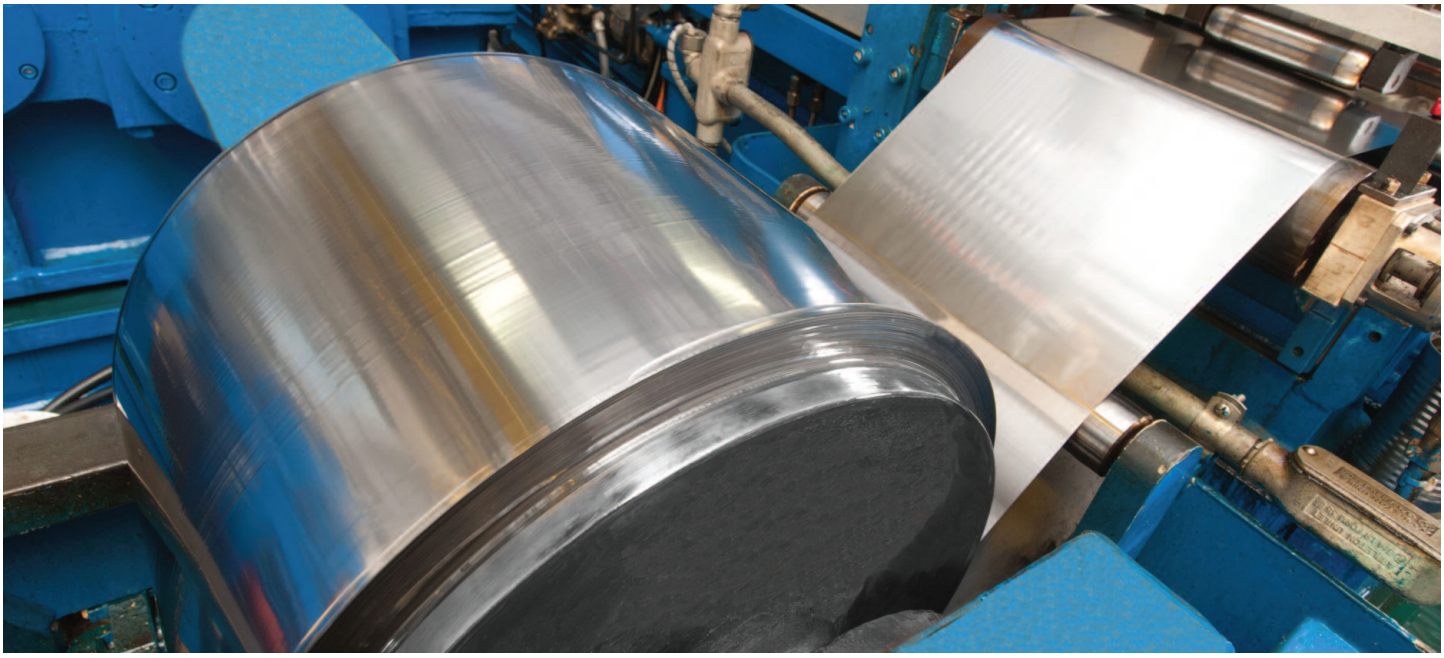
Material Safety Data Sheets



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Introduction

These Material Safety Data Sheets (MSDS) provide 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.

Several materials described in these Material Safety Data Sheets are proprietary alloys produced under license from various manufacturers. They are identified by the following subscript numbers:

[1]Registered Trademark of AK Steel Corporation

[2]Registered Trademark of Carpenter Technology Corporation

[3]Registered Trademark of Special Metals Corporation group of companies

[4]Registered Trademark of ATI Allegheny Companies

[5]Registered Trademark of Haynes International, Inc.

[6]Registered Trademark of United Technologies Corporation

Ulbrich Stainless Steels & Special Metals, Inc.

Corporate Headquarters

153 Washington Avenue, P.O. Box 294, North Haven, CT USA, 06473
(203) 239-4481 • (800) 243-1676 • FAX: (203) 239-7479
E-mail: information@ulbrich.com

Manufacturing Facilities
North America

Ulbrich Specialty Strip Mill
1 Dudley Avenue, P.O. Box 610
Wallingford, CT 06492
(203) 239-4481
FAX: (203) 239-7479
E-mail: information@ulbrich.com

Ulbrich Shaped Wire, Inc.
55 Defco Park Road
North Haven, CT 06473
(203) 239-4481
(800) 243-1676
FAX: (203) 239-6744
E-mail: ShapedWire@ulbrich.com

Ulbrich Specialty Wire Products
692 Plant Road
P.O. Box 619
Westminster, SC 29693
(864) 647-6087
FAX: (864) 647-1549
E-mail: FlatWire@ulbrich.com

Solar Technologies
North America

Corporate Headquarters
692 Plant Road
Westminster SC 29693
(864) 647-6087
FAX: (864) 647-0482
E-mail: Solar@Ulbrich.com

Ulbrich Solar Technologies Oregon [LLC]
22975 NW Evergreen Pkwy Ste 404
Hillsboro, OR 97124
(503) 597-6880
E-mail: salesoregon@ulbrich.com

Europe

Ulbrich of Austria
Industriestrasse 1
Mullendorf 7052, Austria
+43-676-729-4230
E-mail: Austria@ulbrich.com

Service Centers
North America

Ulbrich of Illinois, Inc.
12340 South Laramie Avenue
Alsip, IL 60803
(708) 489-9500
(800) 323-7035
FAX: (708) 371-1802
E-mail: Illinois@ulbrich.com

Ulbrich of New England
153 Washington Avenue
North Haven, CT 06473
(203) 239-4481
(800) 243-1676
FAX: (203) 239-7479

Ulbrich of California, Inc.
5455 East Home Avenue
Fresno, CA 93727
(559) 456-2310
(800) ULBRICH
(800) 237-2888
FAX: (559) 456-2321
E-mail: California@ulbrich.com

Diversified Ulbrich of Canada
98 Norfinch Drive
Downsview Ontario, Canada
M3N1X1
(416) 663-7130
(800) 268-1233 (Within Canada)
FAX: (416) 663-7792
E-mail: Diversified@ulbrich.com

Diversified Ulbrich du Canada
20 Hymus Boulevard
Pointe Claire, Quebec,
Canada H9R1C9
(514) 694-6522
(800) 361-5950 (Within Canada)
FAX: (514) 694-0266
E-mail: Diversified@ulbrich.com

Ulbrinox
Avenida La Canada, #25
Parque Industrial
Bernardo Quintana
Queretaro, Mexico 76246
+52-442-2215500
FAX: +52-442-2215501
E-mail: Ulbrinox@ulbrich.com

Asia Pacific Sales

Ulbrich Shanghai Office
Room 1103, Calderon Dream Plaza,
No. 6088 Huming Road, Minhang,
Shanghai, 201199 China
+86-021-64060850
Email: Asiametals@ulbrich.com,
Asiawiregroup@ulbrich.com

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
SS-001	March 1, 1989 Revised 2013	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I.PRODUCT IDENTIFICATION **CHEMICAL NAME:** See Section II for Alloy Designations	**CHEMICAL FAMILY**: Alloy

II. HAZARDOUS CONSTITUENTS

STAINLESS AND RELATED ALLOYS GROUP I

201; 301; 302, 303; 303SE; 304; 304L; 304LV; 304V; 3049, 305-12; 305; 308; 309; 309S; 309SCB; 310; 310S; 316; 316L; 316LN; 317; 317L; 321; 330; 347; 384; 405; 409; 410; 414; 416; 416SE; 420; 430; 434; 436; 439; 440A; 440C; 442; 444; 446; 18 SR1; Carpenter 20 CB32[2]; Capenter 455[2]; 18-9LW1[3]; 19-9DL4[3]; Greek Ascoloy2; AL-6XN[4]

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

NOTICE: SECTION 313

Some of the previously listed chemicals are subject to annual reporting of releases into the environment under Section 313 of the Emergency Planning and Community Right-To-Know-Act. It is the responsibility of the user to verify whether or not his or her facility is in compliance with all Federal and State Environmental regulations.

NOTICE: HEXAVALENT CHROME

Hexavalent Chromium is not a constituent component of Stainless and Specialty Steels. Stainless Steels are iron-based alloys that contain a minimum of approximately 11 % chromium by weight. It is this addition of chromium that gives stainless steel its unique corrosion resistant properties through the formation of an invisible and adherent chromium-rich oxide surface film.

The vast majority of chromium in stainless and other specialty steels is in the metallic/elemental form *(zero valence state). A small amount oftrivalent chromium (oxide) is formed on the surface of specialty steels and is crucial for protecting the alloy from corrosion. Hexavalent chromium, which is associated with certain adverse health effects, is not a constituent of stainless or other specialty steels.

Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

Ulbrich Stainless Steels & Special Metals, Inc.

Material Safety Data Sheets

Stainless & Related Alloys Group I Sheet 1

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Si	Cr	Ni	Mo	Fe	Cb + Ta	Ti	Se	Other	(approx.) DENSITY lbs/cuin	MELTING PT. -degree (F)
201	S20100	.15	5.5/7.5	1.0	16.0/18.0	3.5/5.5		BAL				N .25	.280	2550
301	830100	.15	2.0	1.0	16.0/18.0	6.0/8.0		BAL					.290	2550
302	S30200	.15	2.0	1.0	17.0/19.0	8.0/10.0		BAL					.290	2550
303	S30300	.15	2.0	1.0	17.0/19.0	8.0/10.0		BAL				S .15	.290	2550
303 SE	S30323	.15	2.0	1.0	17.0/19.0	8.0/10.0		BAL			.15min		.290	2550
304	S30400	.08	2.0	1.0	18.0/20.0	8.0/10.5		BAL					.290	2550
304 L	S30403	.03	2.0	1.0	18.0/20.0	8.0/12.0		BAL					.290	2550
3049		.10	2.0	.75	18.0/20.0	9.0/10.5		BAL				P.045	.290	2550
304LV		.03	2.0	1.0	18.0/20.0	8.0/10.5		BAL					.290	2550
304V		.08	2.0	1.0	18.0/20.0	8.0/9.5		BAL				P.04	.290	2550
305	S30500	.12	2.0	1.0	17.0/19.0	10.5/13.0		BAL					.290	2550
30512		.12	2.0	1.0	17.0/19.0	12.0/13.0	0.75	BAL				P.04 CU 0.75	.290	2550
308	S30800	.08	2.0	1.0	19.0/21.0	10.0/12.0		BAL					.290	2550
309	S30900	.20	2.0	1.0	22.0/24.0	12.0/15.0		BAL					.290	2550
309 S	S30908	.08	2.0	1.0	22.0/24.0	12.0/15.0		BAL					.290	2550
309 SCB	N/L	.08	2.0	.75	22.0/24.0	12.0/16.0		BAL	10XCmin/1.10			CU 0.75	.290	2550
310	S31000	.25	2.0	1.5	24.0/26.0	19.0/22.0		BAL					.290	2550
310S	S31008	.08	2.0	1.5	24.0/26.0	19.0/22.0		BAL					.290	2550
316	S31600	.08	2.0	1.0	16.0/18.0	10.0/14.0	2.0/3.0	BAL					.290	2550
316L	S31603	.03	2.0	1.0	16.0/18.0	10.0/14.0	2.0/3.0	BAL					.290	2550
316LN		.02	2.0	.75	16.0/18.0	10.0/14.0	2.0/3.0	BAL					.290	2550
317	S31700	.08	2.0	1.0	18.0/20.0	11.0/15.0	3.0/4.0	BAL					.290	2550
317L	S31703	.03	2.0	1.0	18.0/20.0	11.0/15.0	3.0/4.0	BAL					.290	2550
321	S32100	.08	2.0	1.0	17.0/19.0	9.0/12.0		BAL		TiSXCmin			.290	2550
CAS Number		7440-44-0	7439-96-5	7740-21-3	7740-47-3	7740-02-0	7439-98-7	7439-89-6	Ta7440-03-1 Cb7440-25-7	7440-32-6	7782-49-2	S 7446-09-5 N 7727-37-9 P 7723-14-0 CU 7440-50-8		

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Si	Cr	Ni	Mo	Fe	Cb + Ta	Cu	Ti	AL	W	Se	V	Other	DENSITY lbs/cuin	(approx.) MELTING PT. -degree (F)
330	N08330	.08	2.0	0.75/1.5	17.0/20.0	34.0/37.0		BAL									.289	2550
347	S34700	.08	2.0	1.0	17.0/19.0	9.0/13.0		BAL	10XCmin								.290	2550
384	S38400	.08	2.0	1.0	15.0/17.0	17.0/19.0		BAL									.290	2550
405	S40500	.08	1.0	1.0	11.5/14.5			BAL				.10/.30					.280	2700
409	S40900	.08	1.0	1.0	10.5/11.75			BAL			6XCmin/0.75						.276	2600
410	S41000	.15	1.0	1.0	11.5/13.5			BAL									.280	2700
414	S41400	.15	1.0	1.0	11.5/13.5	1.25/2.5		BAL									.280	2700
416	S41600	.15	1.25	1.0	12.0/14.0			BAL								S. 15min	.280	2700
416 SE	S41623	.15	1.25	1.0	12.0/14.0			BAL						0.15 min			.280	2700
420	S42000	over. 15	1.0	1.0	12.0/14.0	.5	.5	BAL									.280	2650
430	S43000	.12	1.0	1.0	16.0/18.0			BAL			.5	.15					.280	2600
434	S43400	.12	1.0	1.0	16.0/18.0		.75/1.25	BAL									.280	2600
436	S43600	.12	1.0	1.0	16.0/18.0		.75/1.25	BAL	5XCmin/0.70								.280	2600
439		.04	1.0	0.6	17.0/18.0	.5		BAL			.2/.6						.280	2600
440 A	S44002	.60/.75	1.0	1.0	16.0/18.0		0.75	BAL									.280	2500
440C	S44004	.95/1.2	1.0	1.0	16.0/18.0		0.75	BAL								P .04	.277	2770
442	S44200	.20	1.0	1.0	18.0/23.0			BAL									.280	2600
444		.025	1.0	1.0	17.5/19.5	1.0	1.75/2.5	BAL	0.8							P .04	.280	2600
446	S44600	.20	1.50	1.0	23.0/27.0			BAL								N .25	.280	2600
18 SR[1]	N/L	.20	.50	1.0	17.0/19.0	.50		BAL			3.0/6.0	1.50/2.50					.280	2600
CARPENTER 20 CB3[2]	N08020	.06	2.0	1.0	9.0/21.0	32.5/35.0	2.0/3.0	BAL	8XCmin/1 .0	3.0/4.0							.292	2600
CARPENTER 455[2]		.10	1.0	1.0	11.5	8.0/9.0	.50	BAL		2.0/3.0	1.0/2.0						.292	2600
18-9LW1	N/L	.10	2.0	1.0	17.0/19.0	8.0/10.0		BAL		3.0/4.0							.290	2600
19-90L4	K63198	.28/.35	.75/1 .5	.3/.8	18.0/21.0	8.0/11.0	1.0/1.75	BAL	.25/.60	.50	.10/.35		1.0/1.75			P .04	.286	2600
AL-6XN[4]	N08367	.03	2.0	1.0	20.0/22.0	23.5/25.5	6.0/7.0	BAL		.75							.286	2600
GREEK ASCOLLOY	F41800	.15/.20	.50	.50	12.0/14.0		.50	BAL					2.5/3.5		1.8/2.2		.286	2700
CAS Number		7440-44-0	7439-96-5	7740-21-3	7740-47-3	7740-02-0	7439-98-7	7439-89-6	Ta7440-03-1 Cb7440-25-7	7440-50-8	7440-32-6	7429-90-5	7440-33-7	7782-49-2	V 7440-62-2 1313-62-1	S 7446-09-5 N 7727-37-9		

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
HM-002	March 1, 1989 Revised 2012	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: See Section II for Alloy Designations

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

CONSTITUENTS HIGH MANGANESE ALLOYS GROUP II

Nitronic 32[1]; Nitronic 33[1]; Nitronic 40 (21-6-9)[1]; Nitronic 50[1]; Nitronic 60[1].

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

NOTICE: SECTION 313

Some of the previously listed chemicals are subject to annual reporting of releases into the environment under Section 313 of the Emergency Planning and Community Right-To-Know-Act. It is the responsibility of the user to verify whether or not his or her facility is in compliance with all Federal and State Environmental regulations.

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The vast majority of chromium in stainless and other specialty steels is in the metallic/elemental form *(zero valence state). A small amount oftrivalent chromium (oxide) is formed on the surface of specialty steels and is crucial for protecting the alloy from corrosion. Hexavalent chromium, which is associated with certain adverse health effects, is not a constituent of stainless or other specialty steels.

Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Si	Cr	Ni	Mo	Fe	N	Cb	V	Other	(approx.) DENSITY lbs/cuin	MELTING PT. -degree (F)
NITRONIC 32[1]	S24100	10	12.0	5	1B.O	1.6		BAL	.35				.281	2550
NITRONIC 33[1]	S24000	.06	13.0	.5	18.0	3.0		BAL	.30				.280	2550
NITRONIC 40[1] 21-6-9	S21904	.08	8.0/10 0	1.0	18.0-20.0	5.0/7.0		BAL	.15/.40				.283	2550
NITRONIC 50[1]	S20910	.06	4.0/60	10	20 5/23.5	11.5/13.5	1.5/3.0	BAL	.2/.4	01/03	0.1/0.3		.285	2550
NITRONIC 60[1]	S21800	.10	7.0/9.0	3.5/4.5	16.0/1B.O	BO/9.0	BAL						.276	2550
CAS Number		7440-44-0	7439-96-5	7740-21-3	7740-47-3	7740-02-0	7439-98-7	7439-89-6	7727-37-9	7440-25-7	V7440-62-2 1313-62-1			

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
HR-003	March 1, 1989 Revised 2012	March 19, 2013	Environmental Engineering Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: See Section II for Alloy Designations

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

PRECIPITATION HARDENING AND HIGH IRON ALLOYS GROUP III

A 286[4]; AM-350[4]; 17-4PH[1]; 17-7PH[1]; PH 15-7MO[1].

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
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	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

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Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown.													DENSITY	(approx.) MELTING PT.
		C	Mn	P	S	Si	Cr	Ni	Mo	Fe	Al	Ti	V	Other	lbs/cuin	-degree (F)
A 286[4]	K66286	.08	2.0	.04	.035	1.0	13.5/16.0	24.0/27.0	1.0/1.75	BAL	.35	1.9/2.3	0.1/0.5	B .003/.01	.286	2600
AM-350[4]	S35000	.07/.11	.5/1.25	.04	.03	.50	16.0/17.0	4.0/5.0	2.5/3.25	BAL				N.07/.13	.286	2500
17-4 PH[1]	S17400	.07	1.0	.04	.03	1.0	15.0/17.5	3.0/5.0		BAL	.75/1.50			CU 3.0/5.0 Cb .3	.282	2560
17-7 PH[1]	S17700	.09	1.0	.04	.03	1.0	16.0/18.0	6.5/7.75		BAL	.75/1.50				.282	2560
PH 15-7M0[1]	S15700	.09	1.0	.04	.03	1.0	14.0/16.0	6.5/7.75	2.0/3.0	BAL	.75/1.50				.282	2550
CAS Number		7440-44-0	7439-96-5	7723-14-0	7704-34-9	7740-21-3	7740-47-3	7740-02-0	7439-98-7	7439-89-6	7429-90-5	7440-32-6	7440-62-2 1313-62-1	7440-42-8 7727-37-9		

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
NI-004	March 1, 1989 Revised 2012	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: See Section II for Alloy Designations

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

NICKEL AND NICKEL-IRON-CHROME ALLOYS GROUP IV

Incoloy 800[3]; Incoloy 801[3]; Incoloy 825[3]; Ni-Span-C 902[3].

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.

- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

NOTICE: SECTION 313

Some of the previously listed chemicals are subject to annual reporting of releases into the environment under Section 313 of the Emergency Planning and Community Right-To-Know-Act. It is the responsibility of the user to verify whether or not his or her facility is in compliance with all Federal and State Environmental regulations.

NOTICE: HEXAVALENT CHROME

Hexavalent Chromium is not a constituent component of Stainless and Specialty Steels. Stainless Steels are iron-based alloys that contain a minimum of approximately 11 % chromium by weight. It is this addition of chromium that gives stainless steel its unique corrosion resistant properties through the formation of an invisible and adherent chromium-rich oxide surface film.

The vast majority of chromium in stainless and other specialty steels is in the metallic/elemental form *(zero valence state). A small amount oftrivalent chromium (oxide) is formed on the surface of specialty steels and is crucial for protecting the alloy from corrosion. Hexavalent chromium, which is associated with certain adverse health effects, is not a constituent of stainless or other specialty steels.

Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Fe	Si	Cu	Cr	Al	Ti	Ni	Mo	Other	(approx.) DENSITY lbs/cuin	MELTING PT. -degree (F)
INCOLOY 800[3]	N08800	.05	.75	460	.50	.38	21.0	38	.36	BAL			.287	2475
INCOLOY 801[3]	N08801	05	.75	44.5	.50	.25	20.5		1.13	BAL			.287	2475
INCOLOY 825[3]	N08B25	03	.50	300	.25	2.25	21.5	.10	.90	BAL	3 0		.294	2500
Ni-Span-C 902[3]	N09902	06	80	BAL	1.0		4.9/5.75	0.3/0.8	2 2/2.75	41.0/43.5			.293	2650
CAS Number		7440-44-0	7439-96-5	7439-89-6	7740-21-3	7440-50-8	7740-47-3	7429-90-5	7440-32-6	7740-02-0	7439-98-7	B7440-42-8 N7727-37-9		

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
NI-005	March 1, 1989 Revised 2012	March 19, 2013	Environmental Engineering Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: See Section II for Alloy Designations

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

NICKEL AND NICKEL BASED ALLOYS GROUP V SHEET 1 and 2

Inconel 600[3]; 601[3]; 617[3]; 625[3]; 702[3]; 718; 722[3]; X-750[3]; Hastelloy B[5]; B2[5]; B3[5]; C-276[5]; C22[5]; X[5]; G-30[5]; Haynes 214[5]; 230[5]; 242[5]; Waspaloy[6]; 80 Ni-20 Cr; Nickel 200; 201; 233; 270; Nimonic 75[3]; Permanickel 300[3]; Monel 400[3]; Monel 401[3]; R405[3]; K500[3],500[5].

DANGER

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- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

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Ulbrich Stainless Steels & Special Metals, Inc.

Material Safety Data Sheets

Nickel & Nickel-Based Alloys Group V Sheet No. 1

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Fe	Si	Cu	Cr	Al	Ti	Ni	Mo	Cb + Ta	Co	W	V	Zr	Other	(approx.) DENSITY lbs/cuin	MELTING PT. -degree (F)
INCONEL 600[3]	N06600	.08	.5	8.0	.25	.25	15.5			BAL								.304	2470
INCONEL 601[3]	N06601	.05	.5	14.1	.25	.50	23.0	1.35		BAL								.291	2375
INCONEL 617[3]	N06617	.07	.5	1.5	.5	.20	22.0	1.20	.3	52.0	9.0		1.25					.302	2430
INCONEL 625[3]	N06625	.05	.25	2.5	.25		21.5	.2	.2	BAL	9.0	3.65						.305	2350
INCONEL 702[3]	N/L	.05	.5	1.0	.35	.25	15.5	3.25	.63	BAL								.304	2450
INCONEL 718[3]	N07718	.08	.35	BAL	.35	.30	17.0/21.0	.2/.8	.65/1.15	50.0/55.0	2.8/3.3	4.75/5.5	1.0				B .006	.297	2300
INCONEL 722[3]	N/L	.08	1.0	5.0/9.0	.70	.50	14.0/17.0	.4/1.0	2.0/2.75	70.0 min			1.0					.298	2450
INCONEL X-750[3]	N07750	.08	.35	5.0/9.0	.35	.50	14.0/17.0	.4/1.0	2.25/2.75	*70.0min		.7/1.2	*1.0					.298	2540
HASTELLOY B3[5]	N10675	.02	3.0	1.5	.10	.50	1.0/3.0		.20	BAL	27.0/32.0	.2	1.0	3.0	.2	.01		.314	2475
HASTELLOY B[5], B2[5]	N10665	.02	1.0	2.0	.10	.20	1.0			BAL	26.0/30.0		1 .0					.333	2420
HASTELLOY C[5], C276[5]	N10276	.01	1.0	4.0/7.0	.08		14.5/16.5			BAL	15.0/17.0		2.5	3.0/4.5	V.35			.321	2415
HASTELLOY C22[5]	W86022	.015	.50	2.0/6.0	.08		20.0/22.5			BAL	12.5/14.5		2.5	2.5/3.5	V.35			.314	2475
HASTELLOY.G-30[5]	N06030	.03	1.5	13.0/17.0	.80	1.0/2.4	28.0/31.5			BAL	4.0/6.0	.3/1.5	5.0	1.5/4.0				.297	2300
HASTELLOY X[5]	N06002	.05/.15	1.0	17.0/20.0	1.0	.50	20.5/23.0	.50	.15	BAL	8.0/10.0		.5/2.50	17.0/20.0			B .008	.297	2300
HAYNES 214[5]	N/L	.15	.20	2.0/6.0	.10		15.0/17.0	4.0/5.0	.10	BAL	.10		.10	.10			Y .003/.04	.291	2450
HAYNES 230[5]	N/L	.05/.15	1.0	17.0/20.0	1.0		20.5/23.0			BAL	8.0/10.0		.5/2.5	.2/1 .0			B.005	.319	2375
HAYNES 242[5]	N10242	.03	.80	2.0	.4	.5	7/9	.5		BAL	24.0/26.0		1.0				B.006	.327	2450
HAYNES 282[5]	N07718	.06	.3	1.5	.15		19.0/21.0	1.0/2.0	3.0	BAL	8.0/9.0		9.0/11.0	.50			B.005	.299	2375
HR 120	N08120	.10	.1.0	BAL	.8	.5	20.0/30.0	.2		35/40	2.5	1.0	3.0	2.5			B.005	.291	2375
WASPALOY[6]	N07001	.02/.10	.10	2.0	.15	.10	18.0/21.0	1.2/1.6	2.75/3.25	BAL	3.5/5.0		12.0/15.0			.02/.08	B.003/.01	.296	2425
80Ni-20Cr	N/L	.15	2.5	1.0	.75/1.60		19.0/21.0			BAL									
CAS Number		7440-44-0	7439-96-5	7439-89-6	7740-21-3	7440-50-8	7740-47-3	7429-90-5	7440-32-6	7440-02-0	7439-98-7	Ta7440-03-1 Cb 7440-25-7	7440-48-4	7440-33-7	V7440-62-2 1313-62-1	7440-67-7	7440-42-8		

Ulbrich Stainless Steels & Special Metals, Inc.

Material Safety Data Sheets

Nickel & Nickel-Based Alloys Group V Sheet No. 2

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown.												(approx.)
		C	Mn	Fe	S	Si	Cu	Cr	Al	Ti	Ni	Mg	Other	DENSITY lbs/cuin	MELTING PT. -degree (F)
Ni 200	N0220	.08	.18	.2	.005	.18	.13				BAL			.321	2615
Ni 201	N02201	.01	.18	.2	.005	.18	.13				BAL			.321	2615
NI 233	N/L	.10	.30	.10	.008	.10	.10			.005	BAL			.321	2650
Ni 270	N02270	.01	<0.001	.003	<0.001	<0.001	<0.001	<0.001		<0.001	BAL	<.001	Co<.001	.321	2650
NIMONIC 75[3]	N06Q75	.12	1.0	3.0		1.0	.25	19.0/21.0			BAL			.301	2450
PERMANICKEL 300[3]	N/L	.20	.25	.30	.005	.18	.13			.40	BAL	.35		.316	2650
MONEL 400[3]	N04400	.30	2.0	2.5	.024	.5	28/34				BAL			.319	2370
MONEL 401[3]	N04400	.10	2.25	.75	.015	.25	BAL				40/45			.319	2370
MONEL R405[3]	N04405	.15	1.0	1.25	.043	.25	31.5				BAL			.319	2370
MONEL K500[3]	N05500	.13	.75	1.0	.005	.25	29.5		2.73	.60	BAL			.305	2400
CAS Number		7440-44-0	7439-96-5	7439-89-6	7704-34-9	7740-21-3	7440-50-8	7740-47-3	7429-90-5	7440-32-6	7740-02-0	1309-48-4	7440-48-4		

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVISED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
SA-006	March 1, 1989	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I.PRODUCT IDENTIFICATION **CHEMICAL NAME:** See Section II for Alloy Designations	**CHEMICAL FAMILY**: Alloy

II. HAZARDOUS CONSTITUENTS

COBALT BASED SUPERALLOYS AND RELATED ALLOYS GROUP VI

L-605 (Haynes 25)[5]; Haynes 188[5]; N 155; ULMET

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- The cobalt based superalloys and related alloy products identified above may contain in varying concentrations, the following elemental constituents chromium, cobalt, iron, manganese, molybdenum, nickel, silicon and tungsten.
- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

NOTICE: SECTION 313

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NOTICE: HEXAVALENT CHROME

Hexavalent Chromium is not a constituent component of Stainless and Specialty Steels. Stainless Steels are iron-based alloys that contain a minimum of approximately 11 % chromium by weight. It is this addition of chromium that gives stainless steel its unique corrosion resistant properties through the formation of an invisible and adherent chromium-rich oxide surface film.

The vast majority of chromium in stainless and other specialty steels is in the metallic/elemental form *(zero valence state). A small amount oftrivalent chromium (oxide) is formed on the surface of specialty steels and is crucial for protecting the alloy from corrosion. Hexavalent chromium, which is associated with certain adverse health effects, is not a constituent of stainless or other specialty steels.

Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	P	S	Si	Cr	Ni	Co	Fe	W	La	Cu	Mo	Cb + Ta	Other	DENSITY lbs/cuin	(approx.) MELTING PT. -degree (F)
L-605 HAYNES 25[5]	R30605	.05/.15	1.0/2.0	.04	.03	.40	19.0/21.0	9.0/11.0	BAL	3.0	14.0/16.0						.330	2425
HAYNES 188[5]	R30188	.05/.15	1.25	.02	.015	.2/.5	20.0/24.0	20.0/24.0	BAL	3.0	13.0/16.0	.02/.12				B.015	.324	2375
N-155	R30155	.08/.16	1.0/2.0	.04	.04	1.0	20.0/22.5	19.0/21.0	18.5/21.0	BAL	2.0/3.0		.50	2.5/3.5	.75/1.25	N.10/.20	.298	2350
ULMET	231233	.06	.08			.3	26	9	BAL	3.0	2			5			.297	2450
CAS Number		7440-44-0	7439-96-5	7723-14-0	7704-34-9	7440-21-3	7740-47-3	7740-02-0	7440-48-4	7439-89-6	7440-33-7	N/L	7440-50-8	7439-98-7	Cb 7440-25-7 Ta 7440-03-1	B7440-42-8 N7727-37-9		

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
EA-007	March 1, 1989 Revised 2012	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I. PRODUCT IDENTIFICATION **CHEMICAL NAME:** See Section II for Alloy Designations	**CHEMICAL FAMILY**: Alloy

II. HAZARDOUS CONSTITUENTS

ELECTRONIC ALLOYS GROUP VII

Ulbraseal 36; 42; 46; 48; 52; Ulbravar 29-17; Sealmet HC-4.

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.

- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
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Ulbrich Stainless Steels & Special Metals, Inc.

Material Safety Data Sheets

Electronic Alloys Group VII

ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Si	Cr	Ni	Co	Cu	Fe	Al	Mo	Ti	Mg	Zr	Other	DENSITY lbs/cuin	(approx.) MELTING PT. -degree (F)
ULBRASEAL36	K93601	.03	.30	.20	.10	36.0	.05	.15	BAL	.01						.291	2600
ULBRASEAL42	K94100	.05	.80	.30	.25	41.0			BAL	.10						.293	2600
ULBRASEAL46	N/L	.05	.80	.30	.25	46.0			BAL	.10						.294	2600
ULBRASEAL48	K94800	.0	.80	.30	.25	48.0			BAL	.10						.295	2600
ULBRASEAL52	K95050	.05	.60	.30	.25	50.5			BAL	.10						.300	2600
ULBRAVAR29-17	K94610	.04	.50	.20	.20	29.0	17.0	.20	53.0	.10	0.20	0.10	0.10	0.10		.302	2640
SEALMETHC-4	N/L	.50	.50	.25	5.75	42.5			BAL							.293	2600
CAS Number		7440-44-0	7439-96-5	7740-21-3	7740-47-3	7740-02-0	7440-48-4	7440-50-8	7439-89-6	7429-90-5	7439-98-7	7440-32-6	1309-48-4	7440-67-7			

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
TA-008	March 1, 1989 Revised 2012	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I.PRODUCT IDENTIFICATION **CHEMICAL NAME:** See Section II for Alloy Designations	**CHEMICAL FAMILY**: Alloy

II. HAZARDOUS CONSTITUENTS

TITANIUM AND TITANIUM BASED ALLOYS GROUP VIII

Titanium Grade IA25/A35; Grade IIA40; Grade III A55; Grade IV A70/A75; 6A1-4V; 3A1-2.5V.

DANGER

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	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
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Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

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ALLOY	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	N	Fe	H	O	V	Al	Ti	Other	DENSITY lbs/cuin	(approx.) MELTING PT. -degree (F)
GRADE IA25/A35	N/L	.10	.03	.20	.01	.18			BAL		.163	3000
GRADE II A 40	R50400	.08	.03	.30	.0125	.20			BAL		.163	3000
GRADE III A 55	R50550	.08	.05	.30	.015	.30			BAL		.163	3000
GRADE IV A70/A75	R50700	.08	.05	.50	.015	.40			BAL		.164	3000
6Al-4V	R56400	.08	.05	.25	.015	.20	3.5/4.5	5.75/6.75	BAL		.160	3000
3Al-2.5V	R56320	.05	.02	.30	.015	.18	2.0/3.0	2.5/3.5	BAL		.160	3000
CAS Number		7440-44-0	7727-37-9	7439-89-6	1333-74-0	7782-44-7	7440-62-2	7429-90-5	7440-32-6			

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVISED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
AA-009	March 1, 1989	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I.PRODUCT IDENTIFICATION **CHEMICAL NAME:** See Section II for Alloy Designations	**CHEMICAL FAMILY**: Alloy

II. HAZARDOUS CONSTITUENTS

COMMON WROUGHT ALUMINUM ALLOYS GROUP IX

Aluminum 1100; 3003; 5005; 5052; 6061.

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- The common wrought aluminum alloy products identified above may contain, in varying concentra¬tions, the following elemental constituents: aluminum, chromium, copper, magnesium, manganese and silicon. For specific concentrations of these and other elements present, refer to the Material Safety Data Sheet (MSDS) for this product.
- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
- Chrome, nickel and some of their compounds are listed in the 3rd Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both. For additional information refer to the Material Safety Data Sheet (MSDS) for this product.

NOTICE: SECTION 313

Some of the previously listed chemicals are subject to annual reporting of releases into the environment under Section 313 of the Emergency Planning and Community Right-To-Know-Act. It is the responsibility of the user to verify whether or not his or her facility is in compliance with all Federal and State Environmental regulations.

NOTICE: HEXAVALENT CHROME

Hexavalent Chromium is not a constituent component of Stainless and Specialty Steels. Stainless Steels are iron-based alloys that contain a minimum of approximately 11 % chromium by weight. It is this addition of chromium that gives stainless steel its unique corrosion resistant properties through the formation of an invisible and adherent chromium-rich oxide surface film.

The vast majority of chromium in stainless and other specialty steels is in the metallic/elemental form *(zero valence state). A small amount oftrivalent chromium (oxide) is formed on the surface of specialty steels and is crucial for protecting the alloy from corrosion. Hexavalent chromium, which is associated with certain adverse health effects, is not a constituent of stainless or other specialty steels.

Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

ALLOY AA Number	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. Mg	Mn	Cr	Cu	Al	Other	DENSITY lbs/cuin	(approx.) MELTING PT. -degree (F)
1100	A91100				0.12	99.00 min		.098	1215
3003	A93003		1.2		0.12	98.6 min.		.099	1210
5005	A95005	0.8				99.2 min.		.097	1205
5052	A95052	2.5		0.25		97. 2 min.		.097	1200
6061	A96061	.8/1.2	.15	.04/.35	.15/.4	95.8/98.6	Zn .25	.097	1220
CAS Number		1309-48-4	7439-96-5	7740-47-3	7440-50-8	7429-90-5			

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
SM-010	November 9, 2012	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: Special Metal Alloys Designated as Zirconium 702 and Niobium	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: Zirconium 702 and Niobium

CHEMICAL FAMILY: Alloy; See Section II for Alloy Constituents

II. HAZARDOUS CONSTITUENTS

TITANIUM AND TITANIUM BASED ALLOYS GROUP VIII

Zirconium 702, Niobium (Synonym - Columbium)

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

•Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

		CONSTITUENT(S)% Ranges unless otherwise shown	
ALLOY	UNS No.	Zr	Niobium
Zirconium 702	S20100	99/100	
Niobium			99/100

SPECIFIC GRAVITY (H20 = 1):6.49 for Zirconium; 8.57 for Niobium
FREEZING/MELTING POINT: Above 1800°C

HMIS HAZARD RATING: HEALTH = 0 FIRE = 0 REACTIVITY = 0
HMIS RATING: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic

EXPOSURE LIMITS

			OSHA/ACGIH EXPOSURE LIMITS mg/m3 or ppm*	
CHEMICAL COMPONENTS	**%**	**CAS NO.**	**PEL**	**TLV**
Zirconium	>99	7440-67-7	5 mg/m3	5 mg/m3
Niobium	>99	7440-03-1	10 mg/m3 (PNOR)	10 mg/m3 (PNOR)

PNOR = Particles Not Otherwise Regulated

FIRE FIGHTING MEASURES

IGNITION POINT: The solid metal will not ignite. High surface area materials such as 10 micron or smaller powder may auto-ignite at room temperature.

FLAMMABLE LIMITS: Varies with Particle Size.

EXTINGUISHING MEDIA: Type D fire extinguisher.

FIRE FIGHTING PROCEDURES: Isolate any burning material. Allow fires to burn out while preventing the fire from spreading. Wear reflective heat resistant suits. Small fires are controllable by smothering with dry table salt or using Type D dry powder fire extinguishing material.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Do not spray water on burning fines, chips, or powder as a violent explosion may result. The hazard increases with finer particles. Carbon dioxide is not effective in extinguishing burning alloys. An explosion may follow a fire initiated in a mass of wet metal fines. Do not attempt to extinguish the fire. The explosive characteristics of such material is caused by the steam and hydrogen generated within the burning mass.

HANDLING AND STORAGE

PRECAUTIONS TO TAKE DURING HANDLING AND STORAGE:
Machining of alloys may result in fine turnings, chips, dust, or fumes. Any material with a dimension less than 0.008 inches square is flammable. Keep this material away from any source of ignition. Keep fine turnings completely dry or very wet If wet, keep the water content at more than 25% by weight for handling safety. Explosions result from ignition of powder or machining fines containing moisture in the concentration of 5 to 10%. Do not allow material with a dimension fewer than 0.012 inches to accumulate. It is considered pyrophoric.

Niobium and Zirconium metals are a very dangerous fire hazard in the form of dust when exposed to heat, flame or by chemical reaction with oxidizing agents. May be an explosion hazard in the form of dust by chemical reaction with air, alkali hydroxides, alkali metal chromates, dichromates, molybdates, sulfates, tungstates, borax, CCl4, copper oxide, lead, lead oxide, phosphorous, KClO3, KNO3, nitryl fluoride. May be extremely sensitive to shock, and static electricity may cause spontaneous ignition.

In some cases, when the chemical corrosion resistance exceeds the limit, an ignitable corrosion product containing fine particulate forms on the surface of the metal. This film can be rendered non-flammable by simple oxidation treatments such as heating to 250°C for one hour or 100°C for 7 days.

INCOMPATIBILITY (Materials to Avoid): Hydrofluoric acid or hydrofluoric-nitric acid mixtures rapidly dissolve alloys. Niobium and Zirconium alloys will ignite in cold fluorine and above 200°C will react exothermically with chlorine, bromine, fluorine, iodine, and halocarbons such as carbon tetrachloride, carbon tetrafluoride and freons. Nitryl-fluoride, FNO2 will initiate a reaction at room temperature to produce a glowing or white incandescence.

HAZARDOUS DECOMPOSITION PRODUCTS: These alloys will not decompose. However, the above reactions with incompatible materials will generate reaction products such as flammable hydrogen, toxic fumes of nitrogen oxide, or corrosive metal halide vapors.

TOXICOLOGICAL INFORMATION

TARGET ORGANS: None known for solid metal. Dust and fumes may affect the respiratory system and skin.

TOXICITY DATA: Alloys have no known toxicity in the solid metallic form. However, if the alloy is dissolved, vaporized, or otherwise treated to release the alloying elements in a chemically active form, consider the possible inhalation toxicity of vanadium pentoxide and other metal oxide dusts or fumes.

COMMENTS: Grinding of these alloys produces significant volumes of extremely fine oxide dusts. The health hazards of mixed and combined oxides containing vanadium are not well known. Good ventilation practice and/or personnel respiratory protection is suggested when grinding these alloys.

ACUTE EFFECTS FROM EXPOSURE: None known for the solid metal.

CHRONIC EFFECTS FROM EXPOSURE: None known for the solid metal. May cause skin granulomas. No other chronic health effects recorded.

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVISED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
CS-011	March 1, 1989	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: High performance, heat resistant alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I.PRODUCT IDENTIFICATION **CHEMICAL NAME:** See Section II for Alloy Designations	**CHEMICAL FAMILY**: Alloy

II. HAZARDOUS CONSTITUENTS

STANDARD CARBON STEELS GROUP X

AISI-SAE 1050; 1065; 1070; 1074; 1075; 1095; 1006; 1008; 1040.

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- The standard carbon steels alloy products identified above may contain, in varying concentrations, the following elemental constituents: carbon, iron and manganese. For specific concentrations of these and other elements present, refer to the table below.
- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
- Chrome, nickel and some of their compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. The following information is a summary of findings reported to date:

	Element or Certain Compounds Evaluated or Both (Identified by Element Shown)	
Determination/Evaluation	CHROME	NICKEL
Evidence of carcinogenicity to humans:	Sufficient	Limited
Evidence of carcinogenicity to animals:	Sufficient	Sufficient

- Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

NOTICE: SECTION 313

Some of the previously listed chemicals are subject to annual reporting of releases into the environment under Section 313 of the Emergency Planning and Community Right-To-Know-Act. It is the responsibility of the user to verify whether or not his or her facility is in compliance with all Federal and State Environmental regulations.

NOTICE: HEXAVALENT CHROME

Hexavalent Chromium is not a constituent component of Stainless and Specialty Steels. Stainless Steels are iron-based alloys that contain a minimum of approximately 11 % chromium by weight. It is this addition of chromium that gives stainless steel its unique corrosion resistant properties through the formation of an invisible and adherent chromium-rich oxide surface film.

The vast majority of chromium in stainless and other specialty steels is in the metallic/elemental form *(zero valence state). A small amount oftrivalent chromium (oxide) is formed on the surface of specialty steels and is crucial for protecting the alloy from corrosion. Hexavalent chromium, which is associated with certain adverse health effects, is not a constituent of stainless or other specialty steels.

Accordingly, stainless and specialty steels are in conformance with the requirements of the European Union's legislation on waste electrical and electronic equipment ("WEEE"; Directive 2002/53/EC) and its companion directive on the restriction on hazardous substances used in EEE ("ROHS": Directive 2002/95/EC and 2003/11/EC), as well as EU Directive 2000/53EC on End of Life Vehicles, and the Japanese Green Procurement Initiative.

ALLOY AISI-SAE	UNS No.	CONSTITUENT(S) % Maximum unless otherwise shown. C	Mn	Fe	Other	DENSITY lbs/cuin	(approx.) MELTING PT. -degree (F)
1006	G10060	.08	.25/.40	BAL	P .04	.284	2700
1008	G10080	.10	.30/.50	BAL	P .05	.284	2700
1040	G10400	.36/.44	.60/.90	BAL	P .04	.284	2700
1050	G10500	.4B/.55	.60/.90	BAL		.283	2700
1065	G10650	.60/.70	.60/.90	BAL		.283	2700
1070	G10700	.65/75	.60/.90	BAL		.283	2700
1074	G10740	.70/.80	.50/.80	BAL		.283	2700
1075	61 0750	.70/.80	.40/.70	BAL		.283	2700
1095	G10950	.90/1.03	.30/.50	BAL		.283	2700
CAS Number		7440-44-0	7439-96-5	7439-89-6			

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
CN-012	November 9, 2012	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: Copper Nickel Alloys	**FORMULA:** Alloy composed of varying concentrations of elements listed in Section II.
I.PRODUCT IDENTIFICATION **CHEMICAL NAME:** CN-715	**CHEMICAL FAMILY**: Alloy; See Section II for Alloy Constituents

II. HAZARDOUS CONSTITUENTS

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

CN175

- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.
- Avoid breathing dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

Carcinogenicity:

- Nickel and nickel compounds are listed in the Annual Report on Carcinogens as prepared by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) Monograph Series. IARC, NTP, and OSHA do not list steel products as carcinogens. IARC identifies nickel and certain nickel compounds and welding fumes as Group 2B carcinogens that are possibly carcinogenic to humans. ACGIH lists insoluble nickel compounds as confirmed human carcinogens.

ALLOY	CONSTITUENT(S) % Maximum unless otherwise shown									(approx.)	Melting Point
	C	Mn	Ni	Fe	Cu	Co	Pb	Zn	Other	Density	lbs/cu in
CN 715	0.05	1.0	33	1.0	BAL	1.0	.05	1.0	P .02	.322	2040F
CAS Number	7440-44-0	7439-96-5	7740-02-0	7439-89-6	7740-50-8	7740-48-4	7439-92-1	7740-66-6	7723-14-0		

All commercial metals may contain small amounts of various elements in addition to those specified. These small quantities (less than 0.1%), frequently referred toas "trace" or "residual" elements, generally originate in the raw material used. These elements may include, but are not limited to the following: Sulfur, Nitrogen, Aluminum, Arsenic, Boron, Cadmium, Calcium, Chromium, Molybdenum, Columbium, Tin, Titanium, Vanadium, and Zirconium.

HMIS HAZARD RATING: HEALTH = 0 FIRE = 0 REACTIVITY = 0
HMIS RATING: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic

FIRE FIGHTING MEASURES

IGNITION POINT: The solid metal will not ignite. High surface area materials such dust and fines may auto-ignite at room temperature.

FLAMMABLE LIMITS: Varies with Particle Size.

EXTINGUISHING MEDIA: Type D fire extinguisher.

FIRE FIGHTING PROCEDURES: Isolate any burning material. Allow fires to burn out while preventing the fire from spreading. Wear reflective heat resistant suits. Small fires are controllable by smothering with dry table salt or using Type D dry powder fire extinguishing material.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Do not spray water on burning fines, chips, or powder as a violent explosion may result. The hazard increases with finer particles. Carbon dioxide is not effective in extinguishing burning alloys. An explosion may follow a fire initiated in a mass of wet metal fines. Do not attempt to extinguish the fire. The explosive characteristics of such material is caused by the steam and hydrogen generated within the burning mass.

HANDLING AND STORAGE

PRECAUTIONS TO TAKE DURING HANDLING AND STORAGE:

Machining of alloys may result in fine turnings, chips, dust, or fumes. Any material with a dimension less than 0.008 inches square is flammable. Keep this material away from any source of ignition. Keep fine turnings completely dry or very wet If wet, keep the water content at more than 25% by weight for handling safety. Explosions result from ignition of powder or machining fines containing moisture in the concentration of 5 to 10%. Do not allow material with a dimension fewer than 0.012 inches to accumulate. It is considered pyrophoric.

Some alloys are a fire hazard in the form of dust when exposed to heat, flame or by chemical reaction with oxidizing agents. Dust and fines may be an explosion hazard by chemical reaction with air, acetylene, acids, oxidizers and chlorine. May be extremely sensitive to shock, and static electricity may cause spontaneous ignition.

INCOMPATIBILITY (Materials to Avoid): Hydrofluoric acid or hydrofluoric-nitric acid mixtures rapidly dissolve alloys.

Metals may react exothermically with acids and oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS: These alloys will not decompose. However, the above reactions with incompatible materials will generate reaction products such as flammable hydrogen, toxic fumes of nitrogen oxide, or corrosive metal halide vapors.

SECTION 11, TOXICOLOGICAL INFORMATION

TARGET ORGANS: None known for solid metal. Dust and fumes may affect the respiratory system and skin.

TOXICITY DATA: Alloys have no known toxicity in the solid metallic form. However, if the alloy is dissolved, vaporized, or otherwise treated to release the alloying elements in a chemically active form, consider the possible inhalation toxicity of vanadium pentoxide and other metal oxide dusts or fumes.

COMMENTS: Grinding of these alloys produces significant volumes of extremely fine oxide dusts. The health hazards of mixed and combined oxides containing vanadium are not well known. Good ventilation practice and/or personnel respiratory protection is suggested when grinding these alloys.

ACUTE EFFECTS FROM EXPOSURE: None known for the solid metal.

CHRONIC EFFECTS FROM EXPOSURE: None known for the solid metal. May cause skin granulomas. No other chronic health effects recorded.

TARGET ORGANS: Medical Conditions Generally Aggravated by Exposure: Pre-existing respiratory disorders.

MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE: Individuals with chronic respiratory disorders (i.e., asthma, chronic bronchitis, emphysema, etc.) may be adversely affected by any fume or airborne particulate matter exposure.

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
CU-013	March 19, 2013	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: ETP and OFHC Copper	**FORMULA:** >99.9% Copper

I.PRODUCT IDENTIFICATION

CHEMICAL NAME: Copper UNS C11000, UNS C10200

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

COPPER

DANGER

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

		CONSTITUENT(S) % Maximum unless otherwise shown
ALLOY	UNS No.	Cu
ETP Copper	C11000	>99.9
Oxygen Free Copper	C10200	>99.9

HMIS HAZARD RATING: HEALTH = 1 FIRE = 0 REACTIVITY = 0
HMIS RATING: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic

EXPOSURE LIMITS

CHEMICAL COMPONENTS	%	CAS NO.	OSHA/ACGIH EXPOSURE LIMITS mg/m3 or ppm* PEL	TLV
Copper	>99.9	7440-50-8	Dust 1.0 mg/m3 Fume 0.1 mg/m3	1.0 mg/m3 0.2 mg/m3

SEE SECTION III FOR PHYSICAL PROPERTIES, ADDITIONAL PROPERTIES INCLUDE:

MELTING POINT: 1984 degrees F APPEARANCE AND ODOR: Solid, Red Metallic, No Odor
SPECIFIC GRAVITY (H2O=1, 60°F): 8.94

HAZARDOUS DECOMPOSITION PRODUCTS: excessive heating will vaporize some of the metal which can create excessive fumes. Use of a cutting torch on this material may generate copper fumes in excess of accepted exposure limits (TLV and PEL).

ADDITIONAL INFORMATION
This material contains up to 99.99 % copper which is Listed under SARA title III, and on the New Jersey Environmental Hazardous substance list.

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
BR-014	March 19, 2013	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: Brass

FORMULA: Mixture

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: Brass UNS C21000, C22000, C22600, C23000, C24000

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

Brass

DANGER: *INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.*

Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

		CONSTITUENT(S) % Maximum unless otherwise shown	
ALLOY	UNS No.	Cu	Zn
210	C21000	94-96	4-6
220	C22000	89-91	9-11
226	C22600	86-89	11-14
230	C23000	84-86	14-16
240	C24000	78.5-81.5	18.5-21.5

HMIS HAZARD RATING: HEALTH = 1 FIRE = 0 REACTIVITY = 0
HMIS RATING: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic

EXPOSURE LIMITS

CHEMICAL COMPONENTS	%	CAS NO.	OSHA/ACGIH EXPOSURE LIMITS mg/m3 or ppm* PEL	TLV
Copper	78.5-96	7440-50-8	Dust 1.0 mg/m3 Fume 0.1 mg/m3	1.0 mg/m3 0.2 mg/m3
Zinc	4-21.5	7440-66-6	Fume 5.0 mg/m3	2.0 mg/m3

SEE SECTION III FOR PHYSICAL PROPERTIES, ADDITIONAL PROPERTIES INCLUDE:
MELTING POINT: 1710-1950 degrees F SPECIFIC GRAVITY (H2O=1, 60°F): 8.4-8.8
APPEARANCE AND ODOR: Solid, Gold Metallic, No Odor

INCOMPATIBILITY (Materials to Avoid): Contact with Mercury, Ammonia, Acetylene acids, strong acids, strong alkalies, oxidizers, such as hydrogen peroxide, chlorine, bromine, chlorates, bromates.

HAZARDOUS DECOMPOSITION PRODUCTS: excessive heating will vaporize some of the metal which can create excessive fumes. Use of a cutting torch on this material may generate copper and zinc oxide fumes in excess of accepted exposure limits (TLV and PEL).

ADDITIONAL INFORMATION
This material contains up to 96 % copper which is Listed under SARA title III, and on the New Jersey Environmental Hazardous substance list.

This material contains up to 21.5% zinc which is Listed under SARA title III, and on the New Jersey Environmental Hazardous substance list.

MSDS IDENTIFICATION NUMBER	DATE ISSUED	REVIEWED DATE	ISSUED BY	EMERGENCY PHONE NUMBER
PB-015	March 19, 2013	March 19, 2013	Environmental Health & Safety Dept.	Ulbrich 203-239-4481 Chemtrec 800-424-9300

TRADE NAME: PHOSPHOR BRONZE

FORMULA: Mixture

I.PRODUCT IDENTIFICATION

CHEMICAL NAME: Phosphor Bronze UNS C50500, C50700, C51000, C51100, C51900, C52100 C52400

CHEMICAL FAMILY: Alloy

II. HAZARDOUS CONSTITUENTS

TIN AND COPPER

DANGER: *INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.*

Avoid breathing of dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

		CONSTITUENT(S) % Maximum unless otherwise shown	
ALLOY	UNS No.	Cu	Sn
505	C50500	98.75	1.25
507	C50700	98	2
510	C51000	95	5
511	C51100	96	4
519	C51900	94	6
521	C52100	92	8
524	C52400	90	10

HMIS HAZARD RATING: HEALTH = 1 FIRE = 0 REACTIVITY = 0
HMIS RATING: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic

EXPOSURE LIMITS

CHEMICAL COMPONENTS	%	CAS NO.	OSHA/ACGIH EXPOSURE LIMITS mg/m3 or ppm* PEL	TLV
Copper	90-98.75	7440-50-8	Dust 1.0 mg/m3 Fume 0.1 mg/m3	1.0 mg/m3 0.2 mg/m3
Tin	1.25 -10	7440-31-5	2.0 mg/m3	2.0 mg/m3

SEE SECTION III FOR PHYSICAL PROPERTIES, ADDITIONAL PROPERTIES INCLUDE:
MELTING POINT: 1710-1950 degrees F SPECIFIC GRAVITY (H2O=1, 60°F): 8.4-8.8
APPEARANCE AND ODOR: Solid, Gold Metallic, No Odor

HAZARDOUS DECOMPOSITION PRODUCTS: excessive heating will vaporize some of the metal which can create excessive fumes. Use of a cutting torch on this material may generate copper and tin fumes in excess of accepted exposure limits (TLV and PEL).

ADDITIONAL INFORMATION
This material contains up to 98.75 % copper which is Listed under SARA title III, and on the New Jersey Environmental Hazardous substance list.

III. PHYSICAL PROPERTIES

FREEZING POINT: Not Applicable
MELTING POINT: See Section II
BOILING POINT: Not Applicable
ODOR THRESHOLD: Not Applicable
EVAPORATION RATE: Not Applicable
VAPOR PRESSURE (mmHg): Not Applicable
VAPOR DENSITY (AIR = 1): Not Applicable
SUBLIMES @: Not Applicable
SOLUBILITY IN WATER = Negligible
% VOLATILES BY VOLUME: Not Applicable
APPEARANCE AND ODOR: Solid, Silver Gray Color, No Odor
SPECIFIC GRAVITY (H2O=1, 60°F): 6-9

IV. FIRE, EXPLOSION AND REACTIVITY INFORMATION

FLASH POINT: The solid metal will not ignite. High surface area materials such as 10 micron or smaller powder or fines may auto-ignite at room temperature. Materials that pose a significant auto-ignition hazard include titanium, niobium and zirconium.

FLAMMABLE LIMITS: Varies with Particle Size.
LEL: Not Applicable to solid metal UEL: Not Applicable to solid metal

EXTINGUISHING MEDIA: Solid coils are not combustible. Use extinguishing media appropriate to the surrounding fire. If this material is reduced to powder form or other high surface area such as fines, caution must be used to prevent fire or explosion. Use a Type-D fire extinguisher or table salt to control small fires.

SPECIAL FIREFIGHTING PROCEDURES: Machining of some alloys such as titanium, niobium and zirconium will generate fine turnings, chips or dust. Warning: May Form Combustible (Explosive) Dust - Air Mixtures. Keep away from all ignition sources including heat, sparks, and flame. Keep container closed and grounded. Prevent dust accumulations to minimize explosion hazard. Isolate any burning material. Allow fires to burn out while preventing the fire from spreading. Wear reflective heat resistant suits. Small fires are controllable by smothering with dry table salt or using Type D dry powder fire extinguishing material.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Do not spray water on burning fines, chips, or powder as a violent explosion may result. The hazard increases with finer particles. Carbon dioxide is not effective in extinguishing burning alloys. An explosion may follow a fire initiated in a mass of wet metal fines. Do not attempt to extinguish the fire. The explosive characteristics of such material is caused by the steam and hydrogen generated within the burning mass.

GENERAL REACTIVITY This alloy is a stable material.

INCOMPATIBILITY (MATERIALS TO AVOID) Avoid contact with mineral acids and oxidizing agents which may generate hydrogen gas. Contact with strong alkalis, chlorine, bromine, bromates, chlorates; the evolution of hydrogen may be an explosion hazard.

HAZARDOUS DECOMPOSITION PRODUCTS Various elemental metals and metal oxides may be generated from melting or dross handling operations which can create overexposure conditions. Refer to Section II for permissible exposure limits.

V. HEALTH HAZARD INFORMATION

PRIMARY ROUTE(S) OF EXPOSURE

INHALATION: Inhalation of metal dust, fume or powder may result from melting, dross handling, casting, welding, grinding, crushing or similar operations which generate airborne metal particulate during use of this material.

INGESTION: Hand, clothing, food and drink contact with metal dust, fume or powder can cause ingestion of particulate during hand to mouth activities such as eating, drinking, smoking, nail biting, etc.

OCCUPATIONAL EXPOSURE LIMITS (OELS): This product in its physical form as sold does not present an inhalation, ingestion or contact hazard, nor would any of the following exposure data apply. However, operations such as high temperature (burning, welding), sawing, brazing, machining and grinding may produce fumes and/or particulates. The following exposure limits are offered as reference, for an experienced industrial hygienist to review.

V. HEALTH HAZARD INFORMATION (continued)

Ingredients	OSHA PEL[1]	ACGIH TLV[2]
Nickel (Ni)	1.0 mg/m³ (as Ni metal & insoluble compounds) 0.2 mg/m³ (as inhalable fraction Ni inorganic	1.5 mg/m³ (as inhalable fraction Ni metal) only insoluble and soluble compounds)
Chromium (Cr)	0.5 mg/m³ (as Cr II & III, inorganic compounds) 1.0 mg/m³ (as Cr, metal) 0.005 mg/m³ (as Cr VI, inorganic compounds & certain water insoluble) "AL" 0.0025 mg/m³ (as Cr VI, inorganiccompounds & certain water insoluble)	0.5 mg/m³ (as Cr III, inorganic compounds) 0.5 mg/m³ (as Cr, metal) 0.05 mg/m³ (as Cr VI, inorganic compounds) 0.01 mg/m³ (as Cr VI, inorganic compounds & certain water insoluble)
Cobalt (Co)	0.1 mg/m³	0.02 mg/m3
Iron (Fe)	10 mg/m³ (as iron oxide fume)	5.0 mg/m³ (as iron oxide dust and fume)
Molybdenum (Mo)	15 mg/m³ (as total dust, PNOR) 5.0 mg/m³ (as respirable fraction, PNOR)	10 mg/m³ (as Mo insoluble compounds, inhalable fraction) 3.0 mg/m³ (as Mo insoluble compounds, respirable fraction)[7] 0.5 mg/m³ (as Mo soluble compounds, respirable fraction)
Columbium (Cb)	15 mg/m³, total dust (PNOR) 5.0 mg/m³, respirable fraction (PNOR)	10 mg/m³ (as inhalable fraction, PNOS)[8] 3.0 mg/m³ (as respirable fraction, PNOS)
Aluminum (Al)	15 mg/m³ (as total dust, PNOR) 5.0 mg/m³ (as respirable fraction, PNOR)	10 mg/m³ (as metal dust) 5.0 mg/m³ (as welding fume)
Tungsten (W)	NE	5.0 mg/m³
Tantalum (Ta)	5.0 mg/m³	5.0 mg/m³
Copper (Cu)	0.1 mg/m³ (as fume, Cu) 1.0 mg/m³ (as dusts & mists, Cu)	0.1 mg/m³ (as fume) 1.0 mg/m³ (as dusts & mists, Cu)
Titanium (Ti)	15 mg/m³ (as TiO2, total dust)	10 mg/m³ (as TiO2)
Manganese (Mn)	"C" 5.0 mg/m³ (as Fume & Mn compounds)	0.2 mg/m³
Silicon (Si)	15 mg/m³ (total dust, PNOR)	10 mg/m³ 5.0 mg/m³ (as respirable fraction, PNOR)
Titanium (Ti)	15 mg/m³ (as TiO2, total dust)	10 mg/m³ (as TiO2)
Lead (Pb)	50 µg/m3 TWA (as Pb) 30 µg/m3 Action Level (as Pb)	ACGIH: 0.05 mg/m3 TWA
Selenium (Se)	0.2 mg/m3	0.2 mg/m3
Magnesium (Mg)	15 mg/m³ (as magnesium oxide)	10 mg/m³ (as magnesium oxide)
Boron (B)	15 mg/m³ (as boron oxide)	10 mg/m³ (as boron oxide)
Sulphur (S)	13 mg/m³ Sulpur Dioxide	5 mg/m³ Sulpur Dioxide
Niobium (Nb)	10 mg/m³ (PNOR)	10 mg/m³ (PNOR)
Yttrium	1 mg/m3 Yttrium Oxide	1 mg/m³ (as Y)
Vanadium (V)	"C" 0.5 mg/m³ (as V2O5, respirable dust)	0.05 mg/m³ (as V2O5, inhalable fraction)
Zirconium (Zr)	5.0 mg/m³	5.0 mg/m³
Phosphorus Yellow (P)	0.1 mg/m³	0.02 ppm (0.1mg/m³)
Zinc (Zn)	5.0 mg/m³	2.0 mg/m³
Tin, inorganic compounds	2.0 mg/m³	2.0 mg/m³

Notes:

1. OSHA PELs (Permissible Exposure Limits) are 8-hour TWA (time-weighted average) concentrations unless otherwise noted. A ("C") designation denotes a Ceiling Limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday.
2. Threshold Limit Values (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) are 8-hour TWA concentrations unless otherwise noted. ACGIH TLVs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes.
3. Inhalable fraction. The concentration of inhalable particulate for the application of this TLV is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH 2009 TLVs ® and BEIs ® (Biological Exposure Indices).
4. PNOR (Particulates Not Otherwise Regulated). All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the PNOR limit which is the same as the inert or nuisance dust limit of 15 mg/m3 for total dust and 5.0 mg/m3 for the respirable fraction (containing less than 1% crystalline silica).
5. Respirable fraction - The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined by ACGIH
6. PNOS (Particles Not Otherwise Specified). Inhalable fraction - The concentration of inhalable particulate for the application of this TLV is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH TLVs and BEIs. Respirable fraction - The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined in ACGIH TLVs and BEIs.

V. HEALTH HAZARD INFORMATION (continued)

PRIMARY ROUTE(S) OF EXPOSURE

EYES: Particulate metal (dust, fume or powder) may be dangerous to the eye and surrounding tissue. Airborne particulate (chips, dust or powder) is always a potential problem as well as inserting fingers into the eye socket if the hand or clothing is contaminated with metal particulate.

SKIN CONTACT/ABSORPTION: Not Applicable (if dust or fume is generated, yes)

TOXICITY

Under normal handling and use of the solid form of this material there are a few health hazards. Cutting, welding, melting, grinding, dissolving, etc. of this material will produce dust, fume, vapor or particulate containing the component elements of this material. Exposure to the dust, fume or particulate may present significant health hazards based on the elemental constituents in Section II. Exsessive inhalation of dust and fume may cause metal fume fever with flu like symptons and discoloration.

EFFECTS OF OVEREXPOSURE

ACUTE: The metal dust and fumes of those elements in Section II can cause irritation to the skin, eye and mucous membranes. Contact with chrome, cobalt, copper and nickel may cause allergic skin reactions. As dust, powder or fume, exposure which abrades the skin can cause irritation and dermatitis. Injury to the eyes is generally a result of particulate irritation or mechanical injury to the cornea or conjunctiva by dust or particulate. Excessive inhalation of aluminum, cobalt, copper, manganese, nickel and vanadium can cause respiratory irritation, cough, bronchitis, chills, "fume fever" and asthma-like symptoms.

CHRONIC: Respiratory disease with symptoms ranging from shortness of breath and cough to permanent disability due to loss of lung function, 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. Nickel and chrome metal and certain 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 this alloy.

CARCINOGENIC REFERENCES

The National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC) and OSHA do not list steel products as carcinogens. Nickel, chromium and some of their compounds and welding fumes have been listed by NTP and IARC as materials that are possibly carcinogenic to humans. ACGIH lists insoluble nickel compounds as confirmed human carcinogens.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Individuals who may have had allergic reaction or sensitivity to metals such as chrome, 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 this material causes excessive exposure. Individuals with chronic respiratory disorders (i.e., asthma, chronic bronchitis, emphysema, etc.) may be adversely affected by any fume or airborne particulate matter exposure.

VI. EMERGENCY AND FIRST AID PROCEDURES

INHALATION

Avoid breathing dust and fumes by getting into fresh air. 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

Swallowing metal powder or dust can be treated by having the affected person swallow large quantities of water and attempting to induce vomiting if conscious. Obtain medical assistance at once.

SKIN

Skin cuts and abrasions can be treated by standard first aid. Skin contamination with dust or powder can be removed by washing with soap and water. If irritation persists obtain medical assistance.

EYES

Use normal procedure for foreign objects. Dust or powder should be flushed from the eyes with copious amounts of clean water. If irritation persists obtain medical assistance. Contact lenses should not be worn if working with metal dusts and powders.

VII. INDUSTRIAL HYGIENE CONTROL MEASURES

VENTILATION

Local exhaust ventilation should be used to control exposure to airborne dust and fume whenever possible.

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.

PROTECTIVE GLOVES

Wear gloves to prevent metal cuts and skin abrasions particularly during handling of wrought forms, solid metal sheet, strip or tube. Wear gloves to prevent contact with chrome, cobalt, copper, nickel and other components.

EYE PROTECTION

Wear safety glasses when risk of eye injury is present particularly during machining, grinding, welding, powder handling, etc.

OTHER PROTECTIVE EQUIPMENT

Wear safety glasses or goggles and face shield when risk of eye or face injury is present particularly during machining, grinding, welding, powder handling, etc.

RECOMMENDED MONITORING PROCEDURES

ENVIRONMENTAL SURVEILLANCE: Exposure to the elements identified in Section II 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.

VIII. ENVIRONMENTAL PROTECTION INFORMATION

STEPS TO BETAKEN 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, use North American Emergency Response Guidebook No. 133 for cleanup of flammable solids. Keep finely divided powder away from any source of ignition and cleanup immediately. During cleanup, avoid generation of dust and respiratory or body exposure. Caution should be taken to minimize airborne generation of powder or dust and avoid contamination of air and water. Properly label all materials collected in waste container.

WASTE DISPOSAL METHOD

Comply with Federal, State and Local requirements for waste disposal. Powder or fines are considered a hazardous flammable solid. State or federal regulations may require specific labeling, packing, storage, transportation and disposal procedures. Contact an Environmental professional who specializes in waste disposal, storm water, waste water and permit regulations.

ENVIRONMENTAL HAZARDS

Metal powders 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. If such potential for a spill exists it is advisable to develop an emergency spill response plan.

IX. SPECIAL PRECAUTIONS

HANDLING PRECAUTIONS

This product must be handled accordingly to the size, shape and quantity of material involved. Solid metal may require use of hoists, cranes, etc. Powders should be moved or transported to minimize spill or release potential.

STORAGE PRECAUTIONS

In solid form this material poses no special storage problems. Store metal and metal powder in a dry area. Do not store adjacent to mineral acids. Fine metal powder should be kept away from flames and sources of ignition.

X. DOT SHIPPING REQUIREMENTS

SHIPPING NAME: Not Applicable

IDENTIFICATION NUMBER: Not Applicable

HAZARD CLASS: Not Applicable

DOT LABEL(S) REQUIRED: Not Applicable

ADDITIONAL INFORMATION

STAINLESS STEEL LABEL

The following is the label text which accompanies this product during shipment:

STAINLESS STEEL AND RELATED ALLOYS GROUP

INHALATION OF DUST OR FUME MAY CAUSE SERIOUS LUNG INJURY. SKIN, EYE AND MUCOUS MEMBRANE IRRITATION MAY OCCUR.

- The heat resistant alloy products identified above may contain, in varying concentrations, the following elemental constituents: aluminum, cobalt, chromium, copper, iron, manganese, molybdenum, nickel and tungsten. For specific concentrations of these and other elements present, refer to Section II for each material.
- Inhalation of metal dust or fume generated by the use of these alloys may cause adverse health effects such as reduced lung function, nasal and mucous membrane irritation. Exposure to dust or fume generated by the use of these alloys may also cause eye irritation, skin rash and effects on other organ systems.
- Chrome, nickel and some of their compounds are listed by the National Toxicology Program (NTP) as well as the International Agency for Research on Cancer (IARC) as potential human carcinogens.
- Avoid breathing dust or fume. If the use of this material produces dust or fume, use appropriate ventilation controls, personal protective equipment or both.

REGULATORY INFORMATION

See ingredients listed in Section 2, such as Metallic Nickel, etc. for materials considered by the State of California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) as causing cancer or reproductive toxicity.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1990, Sec102 (40 CFR 302) requires that any "release" into the "environment" of these hazardous substances contained in a product in excess of the "reportable quantity" in any 24-hour period must be immediately reported to the National Response Center (800-424-8802): Reporting is not required under certain circumstances such as a federally permitted release or the release of certain metal solid particles with a diameter larger than 100 micrometers.

TSCA (Toxic Substances Control Act): Components of this product are listed on the TSCA Inventory.

Components on Canadian "Ingredient Disclosure List":

The Superfund Amendments and Reauthorization Act of 1986 (40 CFR 355) specifies certain emergency planning and notification requirements if these hazardous substances are present in concentrations of greater than 1% at a facility in amounts greater than the threshold planning quantity. If discarded, this material may be considered a flammable solid. Site specific testing recommended.

DEFINITIONS

CAS Number: A specific chemical identification number assigned by the Chemical Abstracts Service. The lack of a CAS Number for any given chemical or mixture indicates that a number may not have been assigned.

NIOSH: The National Institute for Occupational Safety & Health (NIOSH)

OSHA PEL: The Occupational Safety & Health Administration (OSHA) Permissible Exposure Limit (PEL) - usually a time weighted average (TWA) ceiling limit (C) or maximum peak exposure limit (P) expressed as PPM (parts per million) or as Mg/M3 (milligrams per cubic meter).

ACGIH TLV: The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) - in many cases, identical to the OSHA PEL. ACGIH also recommends a short term exposure limit (STEL) for certain substances that should not be exceeded at any time.

Freezing Point: The temperature at which a liquid changes to a solid. A range may be given.

Melting Point: The temperature at which a solid changes to a liquid. A range may be given.

Boiling Point: The temperature at which a liquid changes to a vapor. Usually expressed at sea level pressure (760mmHg).

Sublimes @: The temperature at which a solid changes directly to vapor.

Evaporation Rate: Indicated as faster or slower than Ethyl Ether unless stated.

Appearance and Odor: A description of the product in terms of form, color, odor, etc.

Vapor Pressure (mmHg): The pressure of a saturated vapor above a liquid expressed as mmHg at 20°C, unless stated at a different temperature.

Vapor Density (Air=1): The relative density of a vapor or gas compared to an equal volume of air. Air is equivalent to 1.0.

Specific Gravity (H2O=1): The ratio of the weight of a volume of material to the weight of an equal volume of water. Water is equivalent to 1.0 @ 4°C. The term "DENSITY" describes the concentration of matter as the mass per unit volume, e.g., pounds/cubic inch.

Solubility In Water: The degree to which a material is capable of dissolving in water.

% Volatiles By Volume: The volumetric percentage of volatile compounds in a product.

Flash Point (With Test Method): The lowest temperature at which a vapor/air mixture will propagate a flame.

Flammable (Explosive) Limits V/V%:

LEL: LOWER EXPLOSION LIMIT: The lowest vapor concentration in air at which ignition by spark or flame will occur.

UEL: UPPER EXPLOSION LIMIT: The highest vapor concentration in air at which ignition by spark or flame will occur. Extinguishing Media: The type of fire extinguishing media to be used taking into account the type of chemical and its flammable characteristics.

Special Firefighting Procedures: Indicates equipment to protect firemen from toxic products of combustion.

Unusual Fire and Explosion Hazards: Chemical changes that may occur under heat or fire conditions.

General Reactivity: The tendency of a material to undergo chemical reaction with the release of energy.

Incompatibility (Materials to Avoid): Materials which could cause dangerous reactions.

Hazardous Decomposition Products: The breakdown of a material into compounds or elements that may have specific hazard properties different than the original material.

Primary Route(s) Of Exposure:

Inhalation: The breathing in of a gas, dust, fume, vapor, or mist as a contribution to exposure.

Ingestion: The swallowing of a substance as a contribution to exposure.

Skin: The contribution to exposure by the cutaneous route, either skin absorption or skin contact.

Eyes: The effect of chemical exposure on the eye.

Toxicity: The available toxicological data usually expressed as lethal dose or lethal concentration of the material or its components Most toxicity test results are from exposure tests conducted on animals such as rats or mice and caution is recommended in making direct comparison to human beings.

Effect of Overexposure:

Acute: Rapid effects of exposure with severe symptoms.

Chronic: Effects due to exposure that develop slowly over a long period of time or which recur frequently.

Carcinogenic References: Available references which indicate the potential for a material to cause cancer in man or animals.

COATED MATERIALS: This MSDS is for uncoated materials. Ulbrich occasionally has material coated for customers. The coated material would not be included in this MSDS. Customers should request an MSDS for the coated material.

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Ulbrich Stainless Steels & Special Metals, Inc.
153 Washington Avenue, P.O. Box 294, North Haven, CT USA, 06473-1191
(203) 239-4481 • (800) 243-1676 • FAX: (203) 239-7479 • E-Mail: information@ulbrich.com