HAYNES
International

SAFETY DEPARTMENT
1020 WEST PARK AVENUE
KOKOMO, INDIANA 46904-9013
INFORMATION: 317-456-6625

MATERIAL SAFETY DATA SHEET

HAYNES INTERNATIONAL, INC.
Corrosion Resistant Alloys and Heat Resistant Alloys

MSDS IDENTIFICATION NUMBER	DATE ISSUED	ISSUED BY	EMERGENCY PHONE NUMBERS
H2071-1 This replaces H2071-0 and H3095-0	11/01/85 DATE REVISED 09/01/93	SAFETY DEPARTMENT	HAYNES: 317-456-6894 CHEMTREC: 800-424-9300

This Material Safety Data Sheet (MSDS) Provides information on a specific group of manufactured metal products. Since these metal products share a common physical nature and constituents, the data presented are applicable to all alloys identifed. This document was prepared to meet the requirements of OSHA'S Hazard Communications Standard .29 CFR 1910.1200 and Superfund Amendments and Reauthorization Act of 1986, Public Law 99-499.

I. PRODUCT IDENTIFICATION

CHEMICAL NAME: See Section II for Alloy Designations	CHEMICAL FAMILY: Alloy
TRADE NAME: See Alloys listed in this Section	FORMULA: Alloys Composed of varying concentrations of elements listed in section II.

H2071-0 ALLOYS

HASTELLOY® B-2 alloy
HASTELLOY B-3™ alloy
HASTELLOY C-22™ alloy
HASTELLOY C-276 alloy
HASTELLOY C-4 alloy
HASTELLOY D-205™ alloy
HASTELLOY G-30® alloy
HASTELLOY G-50® alloy
HASTELLOY G-3 alloy
HASTELLOY H-9M™ alloy
HASTELLOY N alloy
FERRALIUM® alloy 255
ULTIMET® alloy
HAYNES® 600 alloy
HAYNES 601 alloy
HAYNES 690 alloy

H3095-0 ALLOYS

HASTELLOY S alloy
HASTELLOY X alloy
HASTELLOY W alloy
HAYNES HR-120™ alloy
HAYNES HR-160® alloy
HAYNES 214™ alloy
HAYNES 230™ alloy
HAYNES 230-W™ alloy
HAYNES 242™ alloy
HAYNES 556™ alloy
HAYNES 25 alloy
HAYNES 31 alloy
HAYNES 75 alloy
HAYNES 150 alloy
HAYNES 188 alloy
HAYNES 263 alloy
HAYNES 625 alloy
HAYNES 718 alloy
HAYNES R-41 alloy
HAYNES X-750 alloy
HAYNES 6-B alloy
HAYNES 671 alloy
HAYNES 80A alloy
HAYNES B alloy
Waspaloy
MULTIMET® alloy

II. HAZARDOUS CONSTITUENTS

Constituents(s)	NOMINAL PERCENT OF ELEMENTAL CONSTITUENTS FOR THE ALLOYS SHOWN (HAYNES METAL NUMBER, IF APPLICABLE, SHOWN IN PARENTHESIS)									CAS NUMBER	NIOSH RTECS NUMBER	EXPOSURE LIMITS (as Mg/m³)**	
	Alloy B-2 N10665	S-3™ N10675	C-22 ™ N06022	Alloy C-276 N10276	Alloy C-4 N06455	D-205™ (2916)	G-50™ Alloy N06950	G-30® Alloy N06030	G-3 Alloy N06985			OSHA LIMITS FOR AIR CONTAMINATION - TWA	ACGIH TLV-TWA
Aluminum (Al)*	-	0.5 Max	-	-	-	-	0.4 Max	-	-	7429-90-5	BD0330000	Total Dust: 15, Respirable Dust: 5,	Dust: 10 Welding Fume: 5
Aluminum (Al) + Titanium (Ti)	-	-	-	-	-	-	-	-	-	see Al & Ti	see Al & Ti	See Al & Ti	See Al & Ti
Boron (B)	-	-	-	-	-	-	-	-	-	7440-42-8	ED7350000	Metal: None Oxide Dust Total: 15	Metal: None Oxide: 10
Columbium (Cb) (Niobium) (Nb)	-	0.2 Max	-	-	-	-	0.5 Max	0.8	0.5 Max	7440-03-1	None	None	None
Columbium (Cb) +Tantalum (Ta)	-	-	-	-	-	-	-	-	-	see Cb & Ta	see Cb & Ta	See Cb & Ta	See Cb & Ta
Cobalt (Co)*	1 Max	3 Max	2.5 Max	2.5 Max	2 Max	-	2.5 Max	2 Max	5 Max	7440-48-4	GF6750000	Metal Dust & Fume as Co: 0.1	Metal Dust & Fume as Co: 0.05
Chromium (Cr)*	1 Max	1.5	22	16	16	20	20	30	22	7440-47-3	GB4200000	Metal as Cr: 1.0 (II & III) Compounds as Cr: 0.5	Metal: 0.5 (II & III) Compounds as Cr: 0.5
Copper (Cu)*	-	0.2 Max	-	-	-	2	0.5 Max	2 Max	2.5	7440-50-8	GL5325000	Dust & Mists as Cu: 1.0 Fume as Cu: 0.1	Dust: 1.0 Fume: 0.2
Iron (Fe)	2 Max	1.5	3	5	3 Max	8	17	15	19.5	7439-89-6	NO4565500	Oxide Fume as Fe: 10	Oxide Fume: 5
Lanthanum (La)	-	-	-	-	-	-	-	-	-	7439-91-0	None	None	None
Manganese (Mn)*	1 Max	3 Max	0.5 Max	1 Max	1 Max	-	1 Max	1.5 Max	1 Max	7439-96-5	OO9275000	Compounds & Fume as Mn: 5 Ceiling	Dust & Compounds: 5 Fume: 1.0(STEL: 3)
Molybdenum (Mo)	28	28.5	13	16	16	2.5	9	5.5	7	7439-98-7	QA4680000	Insoluble Compounds as Mo: 15 Soluble Compounds as Mo: 5	Insoluble Compounds as Mo: 10
Nickel (Ni)*	69	65 Min	56	57	65	65	50 Min	43	44	7440-02-0	QR5950000	Metal, Soluble & Insoluble Compounds as Ni: 1.0	Insoluble Compounds as Ni: 1.0
Silicon (Si)	0.1 Max	0.1 Max	0.08 Max	0.08 Max	0.08 Max	5	1 Max	1 Max	1 Max	7440-21-3	VW0400000	Total Dust: 15 Respirable Dust: 5	10
Tantalum (Ta)	-	0.2 Max	-	-	-	-	-	-	-	7440-25-7		Metal & Oxide Dust: 5	Metal & Oxide Dust: 5
Titanium (Ti)	-	0.2 Max	-	-	0.7 Max	-	-	-	-	7440-32-6	XR1700000	Total Oxide Dust: 15	Oxide: 10
Tungsten (W)	-	3 Max	3	4	-	-	1 Max	2.5	1.5 Max	7440-33-7	Y07175000	None	Insoluble Compounds: 5(STEL:10) as W
Vanadium (V)*	-	0.2 Max	0.35 Max	0.35 Max	-	-	-	-	-	7440-62-2	YW1355000	Respirable Dust as V_2O_5: 0.5 Ceiling, Fume as V_2O_5: 0.1 Ceiling	Respirable Dust & Fume as V_2O_5: 0.05
Yttrium (Y)	-	-	-	-	-	-	-	-	-	7440-65-5		1.0	1.0
Zirconium (Zr)	-	0.1 Max	-	-	-	-	-	-	-	7440-67-7	ZH7070000	5.0	5(STEL: 10)
Density (lb/cu in)	0.330	0.333	0.302	0.324	0.311	0.290	0.301	0.302	0.319				
Melting Point (°F)	~2425	~2500	~2480	~2375	~2445	~2100	~2326	~2370	~2375				

*Reportable ingredients per Section 313 of SARA.

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II. HAZAR[illegible] CONSTITUENTS

Constituents(s)	NOMINAL PERCENT OF ELEMENTAL CONSTITUENTS FOR THE ALLOYS SHOWN (HAYNES METAL NUMBER, IF APPLICABLE, SHOWN IN PARENTHESIS)									CAS NUMBER	NIOSH RTECS NUMBER	EXPOSURE LIMITS (as Mg/m³)**	
	H-BM™ Alloy N06920	Alloy N N10003	FERRALIUM® 255(S32550)	ULTIMET® R31233	Alloy 600 N06600	Alloy 601 N06601	Alloy 690 N06690	Alloy S N06635	Alloy X N06002			OSHA LIMITS FOR AIR CONTAMINATION - TWA	ACGIH TLV-TWA
Aluminum (Al)*	-	-	-	-	0.35 Max	1.4	-	0.25	-	7429-90-5	BD0330000	Total Dust: 15, Respirable Dust: 5,	Dust: 10 Welding Fume: 5
Aluminum (Al) + Titanium (Ti)	-	0.5 Max	-	-	-	-	-	-	-	see Al & Ti	see Al & Ti	See Al & Ti	See Al & Ti
Boron (B)	-	-	-	-	-	-	-	0.016 Max	0.008 Max	7440-42-8	ED7350000	Metal: None Oxide Dust Total: 15	Metal: None Oxide: 10
Columbium (Cb) (Niobium) (Nb)	-	-	-	-	-	-	-	-	-	7440-03-1	None	None	None
Columbium (Cb) + Tantalum (Ta)	-	-	-	-	-	-	-	-	-	see Cb & Ta	see Cb & Ta	See Cb & Ta	See Cb & Ta
Cobalt (Co)*	5 Max	0.2 Max	-	54	2 Max	-	-	2 Max	1.5	7440-48-4	GF8750000	Metal Dust & Fume as Co: 0.1	Metal Dust & Fume as Co: 0.05
Chromium (Cr)*	22	7	25	26	15.5	23	29	16	22	7440-47-3	GB4200000	Metal as Cr: 1.0 (II & III) Compounds as Cr: 0.5	Metal: 0.5 (II & III) Compounds as Cr: 0.5
Copper (Cu)*	0.5	0.35 Max	1.7	-	0.5 Max	1 Max	0.5 Max		-	7440-50-8	GL5325000	Dust & Mists as Cu: 1.0 Fume as Cu: 0.1	Dust: 1.0 Fume: 0.2
Iron (Fe)	19	5 Max	62	3	8	12	9	3 Max	18	7439-89-6	NO4565500	Oxide Fume as Fe: 10	Oxide Fume: 5
Lanthanum (La)	-	-	-	-	-	-	-	0.05	-	7439-91-0	None	None	None
Manganese (Mn)*	1 Max	0.8 Max	1.5 Max	0.8	1 Max	1 Max	0.5 Max	0.5	1 Max	7439-96-5	OO9275000	Compounds & Fume as Mn: 5 Ceiling	Dust & Compounds: 5 Fume: 1.0(STEL: 3)
Molybdenum (Mo)	9	16	3.5	5	-	-	-	15	9	7439-98-7	QA4680000	Insoluble Compounds as Mo: 15 Soluble Compounds as Mo: 5	Insoluble Compounds as Mo: 10
Nickel (Ni)*	45	71	5.5	9	72 Min	61	58 Min	67	47	7440-02-0	QR5950000	Metal, Soluble & Insoluble Compounds as Ni: 1.0	Insoluble Compounds as Ni: 1.0
Silicon (Si)	1 Max	1 Max	1 Max	0.3	0.5 Max	0.5 Max	0.5 Max	0.4	1 Max	7440-21-3	VW0400000	Total Dust: 15 Respirable Dust: 5	10
Tantalum (Ta)	-	-	-	-	0.3 Max	-	-	-	-	7440-25-7		Metal & Oxide Dust: 5	Metal & Oxide Dust: 5
Titanium (Ti)	-	-	-	-	-	-	-	-	-	7440-32-6	XR1700000	Total Oxide Dust: 15	Oxide: 10
Tungsten (W)	2	0.5 Max	-	2	-	-	-	1 Max	0.6	7440-33-7	Y07175000	None	Insoluble Compounds: 5(STEL:10) as W
Vanadium (V)*	-	-	-	-	-	-	-	-	-	7440-62-2	YW1355000	Respirable Dust as V_2O_5: 0.5 Ceiling, Fume as V_2O_5: 0.1 Ceiling	Respirable Dust & Fume as V_2O_5: 0.05
Yttrium (Y)	-	-	-	-	-	-	-	-	-	7440-65-5		1.0	1.0
Zirconium (Zr)	-	-	-	-	-	-	-	-	-	7440-67-7	ZH7070000	5.0	5(STEL: 10)
Density (lb/cu in)	0.301	0.317	0.282	0.306	0.304	.291	0.292	0.316	0.297				
Melting Point (°F)	~2325	~2300	~2600	~2505	~2470	~2470	~2600	~2435	~2300				

*Reportable Ingredients per Section 313 of SARA.

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II. HAZARDOUS CONSTITUENTS

Constituents(s)	NOMINAL PERCENT OF ELEMENTAL CONSTITUENTS FOR THE ALLOYS SHOWN (HAYNES METAL NUMBER, IF APPLICABLE, SHOWN IN PARENTHESIS)									CAS NUMBER	NIOSH RTECS NUMBER	EXPOSURE LIMITS (as Mg/m³)**	
	Alloy W N10004	HR-120™ alloy (6544)	HR-160™ alloy N12160	214™ Alloy N07214	230™ Alloy N06230	242™ Alloy (8422)	556™ Alloy R30556	Alloy 25 R30605	Alloy 31 R30031			OSHA LIMITS FOR AIR CONTAMINATION - TWA	ACGIH TLV-TWA
Aluminum (Al)*	-	0.1	-	4.5	0.3	0.5 Max	0.2	-	-	7429-90-5	BD0330000	Total Dust: 15, Respirable Dust: 5,	Dust: 10 Welding Fume: 5
Aluminum (Al) + Titanium (Ti)	-	-	-	-	-	-	-	-	-	see Al & Ti	see Al & Ti	See Al & Ti	See Al & Ti
Boron (B)	-	.004	-	0.01 Max	0.015 Max	0.006 Max	-	-	-	7440-42-8	ED7350000	Metal: None Oxide Dust Total: 15	Metal: None Oxide: 10
Columbium (Cb) (Niobium) (Nb)	-	0.7	1 Max	-	-	-	-	-	-	7440-03-1	None	None	None
Columbium (Cb) +Tantalum (Ta)	-	-	-	-	-	-	-	-	-	see Cb & Ta	see Cb & Ta	See Cb & Ta	See Cb & Ta
Cobalt (Co)*	2.5 Max	3 Max	30	-	5 Max	2.5 Max	18	51	54	7440-48-4	GF8750000	Metal Dust & Fume as Co: 0.1	Metal Dust & Fume as Co: 0.05
Chromium (Cr)*	5	25	28	16	22	8	22	20	25.5	7440-47-3	GB4200000	Metal as Cr: 1.0 (II & III) Compounds as Cr: 0.5	Metal: 0.5 (II & III) Compounds as Cr: 0.5
Copper (Cu)*	-	-	-	-	-	0.5 Max	-	-	-	7440-50-8	GL5325000	Dust & Mists as Cu: 1.0 Fume as Cu: 0.1	Dust: 1.0 Fume: 0.2
Iron (Fe)	6	33	3.5 Max	3	3 Max	2 Max	31	3 Max	2 Max	7439-89-6	NO4565500	Oxide Fume as Fe: 10	Oxide Fume: 5
Lanthanum (La)	-	-	-	-	0.02	-	0.02	-	-	7439-91-0	None	None	None
Manganese (Mn)*	1 Max	0.7	0.5	0.5 Max	0.5	0.8 Max	1	1.5	1 Max	7439-96-5	OO9275000	Compounds & Fume as Mn: 5 Ceiling	Dust & Compounds: 5 Fume: 1.0(STEL: 3)
Molybdenum (Mo)	24	2.5 Max	1 Max	-	2	25	3	-	-	7439-98-7	QA4680000	Insoluble Compounds as Mo: 15 Soluble Compounds as Mo: 5	Insoluble Compounds as Mo: 10
Nickel (Ni)*	63	37	37	75	57	65	20	10	10.5	7440-02-0	QR5960000	Metal, Soluble & Insoluble Compounds as Ni: 1.0	Insoluble Compounds as Ni: 1.0
Silicon (Si)	1 Max	0.6	2.75	0.2 Max	0.4	0.8 Max	0.4	0.4 Max	1 Max	7440-21-3	VW0400000	Total Dust: 15 Respirable Dust: 5	10
Tantalum (Ta)	-	-	-	-	-	-	0.6	-	-	7440-25-7		Metal & Oxide Dust: 5	Metal & Oxide Dust: 5
Titanium (Ti)	-	-	0.5	-	-	-	-	-	-	7440-32-6	XR1700000	Total Oxide Dust: 15	Oxide: 10
Tungsten (W)	-	2.6 Max	1 Max	-	14	-	2.5	15	7.5	7440-33-7	Y07175000	None	Insoluble Compounds: 5(STEL:10) as W
Vanadium (V)*	0.6 Max	-	-	-	-	-	-	-	-	7440-62-2	YW1355000	Respirable Dust as V_2O_5: 0.5 Ceiling, Fume as V_2O_5: 0.1 Ceiling	Respirable Dust & Fume as V_2O_5: 0.05
Yttrium (Y)	-	-	-	0.01	-	-	-	-	-	7440-65-5		1.0	1.0
Zirconium (Zr)	-	-	-	0.1 Max	-	-	0.02	-	-	7440-67-7	ZH7070000	5.0	5(STEL: 10)
Density (lb/cu in)	0.325	0.291	0.289	0.291	0.319	0.327	0.297	0.330	0.311				
Melting Point (°F)	~2400	~2500	~2500	~2450	~2375	~2375	~2340	~2425	~2445				

*Reportable ingredients per Section 313 of SARA.

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HAZARDOUS CONSTITUENTS

Constituents(s)	NOMINAL PERCENT OF ELEMENTAL CONSTITUENTS FOR THE ALLOYS SHOWN (HAYNES METAL NUMBER, IF APPL... SHOWN IN PARENTHESIS)									CAS NUMBER	NIOSH RTECS NUMBER	EXPOSURE LIMITS (as Mg/m³)**	
	Alloy 75 (2076)	Alloy 150 (1500)	Alloy 188 R30188	Alloy 263 N07263	Alloy 625 N06625	Alloy 718 N07718	Alloy R-41 N07041	Alloy X-750 N07750	Alloy 6-B R30006			OSHA LIMITS FOR AIR CONTAMINATION - TWA	ACGIH TLV-TWA
Aluminium (Al)*	-	-	-	0.6 Max	0.4 Max	0.5	1.5	0.8	-	7429-90-5	BD0030000	Total Dust: 15, Respirable Dust: 5,	Dust: 10 Welding Fume: 5
Aluminum (Al) + Titanium (Ti)	-	-	-	-	-	-	-	-	-	see Al & Ti	see Al & Ti	See Al & Ti	See Al & Ti
Boron (B)	-	-	-	-	-	0.009	0.006	-	-	7440-42-8	ED7350000	Metal: None Oxide Dust Total: 15	Metal: None Oxide: 10
Columbium (Cb) (Niobium) (Nb)	-	-	-	-	-	-	-	-	-	7440-03-1	None	None	None
Columbium (Cb) +Tantalum (Ta)	-	-	-	-	3.7	5	-	1	-	see Cb & Ta	see Cb & Ta	See Cb & Ta	See Cb & Ta
Cobalt (Co)*	-	50	39	20	1 Max	1 Max	11	1 Max	68	7440-48-4	GF8750000	Metal Dust & Fume as Co: 0.1	Metal Dust & Fume as Co: 0.05
Chromium (Cr)*	20	28	22	20	21	18	19	16	30	7440-47-3	GB4200000	Metal as Cr: 1.0 (II & III) Compounds as Cr: 0.5	Metal: 0.5 (II & III) Compounds as Cr: 0.5
Copper (Cu)*	0.5 Max	-	-	0.2 Max	-	0.1 Max	-	0.5 Max	-	7440-50-8	GL5325000	Dust & Mists as Cu: 1.0 Fume as Cu: 0.1	Dust: 1.0 Fume: 0.2
Iron (Fe)	5 Max	21	3 Max	0.7 Max	5 Max	18	5 Max	8	3 Max	7439-89-6	NO4565500	Oxide Fume as Fe: 10	Oxide Fume: 5
Lanthanum (La)	-	-	0.03	-	-	-	-	-	-	7439-91-0	None	None	None
Manganese (Mn)*	1 Max	1 Max	1.25 Max	0.6 Max	0.5 Max	0.35 Max	0.1 Max	0.35 Max	1.4	7439-96-5	OO9275000	Compounds & Fume as Mn: 5 Ceiling	Dust & Compounds: 5 Fume: 1.0(STEL: 3)
Molybdenum (Mo)	-	-	-	6	9	3	10	-	1.5 Max	7439-98-7	QA4680000	Insoluble Compounds as Mo: 15 Soluble Compounds as Mo: 5	Insoluble Compounds as Mo: 10
Nickel (Ni)*	76	-	22	52	62	52	52	70 Min	2.5	7440-02-0	QR5950000	Metal, Soluble & Insoluble Compounds as Ni: 1.0	Insoluble Compounds as Ni: 1.0
Silicon (Si)	1 Max	1 Max	0.35	0.4 Max	0.5 Max	0.35 Max	0.5 Max	0.35 Max	0.7	7440-21-3	VW0400000	Total Dust: 15 Respirable Dust: 5	10
Tantalum (Ta)	-	-	-	-	-	-	-	-	-	7440-25-7		Metal & Oxide Dust: 5	Metal & Oxide Dust: 5
Titanium (Ti)	0.4	-	-	2.4 Max	0.4 Max	0.9	3.1	2.5	-	7440-32-6	XR1700000	Total Oxide Dust: 15	Oxide: 10
Tungsten (W)	-	-	14	-	-	-	-	-	4	7440-33-7	Y07175000	None	Insoluble Compounds: 5(STEL:10) as W
Vanadium (V)*	-	-	-	-	-	-	-	-	-	7440-62-2	YW1355000	Respirable Dust as V_2O_5: 0.5 Ceiling, Fume as V_2O_5: 0.1 Ceiling	Respirable Dust & Fume as V_2O_5: 0.05
Yttrium (Y)	-	-	-	-	-	-	-	-	-	7440-65-5		1.0	1.0
Zirconium (Zr)	-	-	-	-	-	-	-	-	-	7440-67-7	ZH7070000	5.0	5(STEL: 10)
Density (lb/cu in)	0.302	0.291	0.324	0.302	0.305	0.297	0.298	0.298	0.303				
Melting Point (°F)	~2460	~2535	~2375	~2370	~2350	~2300	~2385	~2540	~2310				

*Reportable Ingredients per Section 313 of SARA

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Constituents(s)	NOMINAL PERCENT OF ELEMENTAL CONSTITUENTS FOR THE ALLOYS SHOWN (HAYNES METAL NUMBER, IF APPLICABLE, SHOWN IN PARENTHESIS)									CAS NUMBER	NIOSH RTECS NUMBER	EXPOSURE LIMITS (as Mg/m³)**	
	Alloy 671 (8671)	Alloy 80A N07080	Alloy B N10001	Waspaloy N07001	MULTIMET® R30155							OSHA LIMITS FOR AIR CONTAMINATION - TWA	ACGIH TLV-TWA
Aluminum (Al)*	-	1.5	-	1.5	-					7429-90-5	BD0330000	Total Dust: 15, Respirable Dust: 5,	Dust: 10 Welding Fume: 5
Aluminum (Al) + Titanium (Ti)	-	-	-	-	-					see Al & Ti	see Al & Ti	See Al & Ti	See Al & Ti
Boron (B)	-	0.008 Max	-	0.006	-					7440-42-8	ED7350000	Metal: None Oxide Dust Total: 15	Metal: None Oxide: 10
Columbium (Cb) (Niobium) (Nb)	-	-	-	-	-					7440-03-1	None	None	None
Columbium (Cb) +Tantalum (Ta)	-	-	-	-	1					see Cb & Ta	see Cb & Ta	See Cb & Ta	See Cb & Ta
Cobalt (Co)*	-	2 Max	2.5 Max	13.5	20					7440-48-4	GF8750000	Metal Dust & Fume as Co: 0.1	Metal Dust & Fume as Co: 0.05
Chromium (Cr)*	45	19.5	1 Max	19	21		-			7440-47-3	GB4200000	Metal as Cr: 1.0 (II & III) Compounds as Cr: 0.5	Metal: 0.5 (II & III) Compounds as Cr: 0.5
Copper (Cu)*	-	0.2 Max	0.5 Max	0.1 Max	-					7440-50-8	GL5325000	Dust & Mists as Cu: 1.0 Fume as Cu: 0.1	Dust: 1.0 Fume: 0.2
Iron (Fe)	0.35 Max	1.5 Max	5	2 Max	30					7439-89-6	NO4565500	Oxide Fume as Fe: 10	Oxide Fume: 5
Lanthanum (La)	-	-	-	-	-					7439-91-0	None	None	None
Manganese (Mn)*	0.5 Max	0.4 Max	1 Max	0.1 Max	1.5					7439-96-5	OO9275000	Compounds & Fume as Mn: 5 Ceiling	Dust & Compounds: 5 Fume: 1.0(STEL: 3)
Molybdenum (Mo)	-	-	28	4.3	3					7439-98-7	QA4680000	Insoluble Compounds as Mo: 15 Soluble Compounds as Mo: 5	Insoluble Compounds as Mo: 10
Nickel (Ni)*	54	74	67	58	20					7440-02-0	QR5950000	Metal, Soluble & Insoluble Compounds as Ni: 1.0	Insoluble Compounds as Ni: 1.0
Silicon (Si)	0.25 Max	0.8 Max	1 Max	0.15 Max	1 Max					7440-21-3	VW0400000	Total Dust: 15 Respirable Dust: 5	10
Tantalum (Ta)	-	-	-	-	-					7440-25-7		Metal & Oxide Dust: 5	Metal & Oxide Dust: 5
Titanium (Ti)	0.35	2.4	-	3	-					7440-32-6	XR1700000	Total Oxide Dust: 15	Oxide: 10
Tungsten (W)	-	-	-	-	2.5					7440-33-7	YO7175000	None	Insoluble Compounds: 5(STEL:10) as W
Vanadium (V)*	-	-	0.3	-	-					7440-62-2	YW1355000	Respirable Dust as V_2O_5: 0.5 Ceiling. Fume as V_2O_5: 0.1 Ceiling	Respirable Dust & Fume as V_2O_5: 0.05
Yttrium (Y)	-	-	-	-	-					7440-65-5		1.0	1.0
Zirconium (Zr)	-	-	-	0.06	-					7440-67-7	ZH7070000	5.0	5(STEL: 10)
Density (lb/cu in)	0.284	0.295	0.334	0.296	0.296								
Melting Point (°F)	~2385	~2480	~2375	~2425	~2350								

*Reportable ingredients per Section 313 of SARA

**Many substances do not have a unique exposure limit. The absence of an exposure limit does not lessen consideration for exposure risk. In the absence of specific information, professional judgment may be required.

III. PHYSICAL PROPERTIES

FREEZING POINT: Not Applicable	VAPOR PRESSURE (mmHg): Not Applicable
MELTING POINT: See Section II	VAPOR DENSITY (AIR=1): Not Applicable
SUBLIMES @: Not Applicable	SPECIFIC GRAVITY (H2O=1): See Section II
BOILING POINT: Not Applicable	SOLUBILITY IN WATER = None
EVAPORATION RATE: Not Applicable	% VOLATILES BY VOLUME: None
APPEARANCE AND COLOR: Solid - Silver Gray Color - No Color	

IV. FIRE, EXPLOSION AND REACTIVITY INFORMATION

FLASH POINT (WITH TEST METHOD) None	FLAMMABLE (EXPLOSIVE) LIMITS V/V% LEL: None UEL: None
EXTINGUISHING MEDIA	These alloys are noncombustible. Use extinguishing media appropriate to the surrounding fire.
SPECIAL FIREFIGHTING PROCEDURES	If these materials are reduced to powder form, caution must be used to prevent fire or explosion. To extinguish a metal powder fire use dry sand, dry graphite or other class "D" fire extinguishing powder.
UNUSUAL FIRE AND EXPLOSION HAZARDS	No unusual fire or explosion hazards are associated with these materials.
GENERAL REACTIVITY	These alloys are stable materials.
INCOMPATIBILITY (MATERIALS TO AVOID)	Avoid contact with mineral acids and oxidizing agents which may generate hydrogen gas: the evolution of hydrogen may be an explosion hazard.
HAZARDOUS DECOMPOSITION PRODUCTS	Various elemental metals and metal oxides may be generated from welding, cutting, grinding, melting or dross handling operations. Refer to Section II for permissible exposure limits. The permissible exposure limits given in MSDS H-1072 for welding products also apply.

V. HEALTH HAZARD INFORMATION

THE HEALTH HAZARDS INFORMATION GIVEN IN MSDS H-1072 FOR WELDING PRODUCTS ALSO APPLY.

PRIMARY ROUTE(S) OF EXPOSURE	INHALATION: Inhalation of metal dust, fume or powder may result from melting, dross handling, casting, welding, thermal cutting, grinding, crushing or similar operations which generate airborne metal particulate during use of these materials.
	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 drinking, smoking, nail biting, etc.
	SKIN: Skin contact with these materials may cause, in some sensitive individuals an allergic response if elements such as chrome, cobalt, copper and nickel are present. In the form of metal dust or powder, skin contact or abrasion may also cause irritation or dermatitis.
	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.

V. HEALTH HAZARD INFORMATION (CONTINUED)

TOXICITY	There is no information on the toxicity of these alloys. Under normal handling and use of the solid form of these materials there are few health hazards. Cutting, welding, melting, grinding, etc. of these materials will produce dust, fume or particulate containing the component elements of these materials. Exposure to the dust, fume or particulate may present significant health hazards which are referable to the elemental constituents in Section II.
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 chromium, cobalt, copper and nickel may cause allergic skin reactions. As dust, powders 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 and nickel 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 chromium 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 these alloys.
CARCINOGENIC REFERENCES	CHROMIUM AND NICKEL - OSHA (29 CFR 1910.1200) requires that chromium VI compounds, nickel and its compounds be considered as carcinogens because they are so classified by IARC and/or NTP. Detailed information from these sources may be obtained from the following: IARC Monographs on the evaluation of carcinogenic Risk of Chemicals to Man; and the NTP annual report on carcinogens, NTP Public Information Office, MD B204 Box 12233, Research Triangle Park, NC 27709. WELDING FUMES AND COBALT - OSHA requires that welding fumes, cobalt and its compounds be considered as suspect carcinogens because they are so classified by IARC. Many of the welding products covered by this MSDS and the fumes produced during welding contain compounds of chromium, cobalt and nickel. Welding, thermal cutting, grinding and melting these products may produce chemicals which are known to the State of California to cause cancer. State of California, Health and Welfare Agency, 1600 Ninth Street Room 460, Sacramento, CA 95914, Telephone (916) 445-6955.
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE	Individuals who may have had allergic reaction or sensitivity to metals such as chromium, copper, cobalt and nickel may encounter skin rash or dermatitis if skin contact with this product occurs. Persons with impaired pulmonary function, airway diseases and conditions such as asthma, emphysema, chronic bronchitis, etc. may incur further disability if excessive concentrations of dust or fume are inhaled. If prior damage or disease to the Neurologic (nervous), Circulatory, Hematologic (blood) or Renal (kidney) systems has occurred, proper screening or examinations should be conducted on individuals who may be exposed to further risk if handling and use of these materials cause excessive exposure.

VI. EMERGENCY AND FIRST AID PROCEDURES

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

THE INDUSTRIAL HYGIENE CONTROL MEASURES GIVEN IN MSDS H-1072 FOR WELDING PRODUCTS ALSO APPLY.

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. Use a fume respirator or an air supplied respirator where local exhaust or ventilation does not keep exposure below the OSHA limits for air contamination.	
PROTECTIVE GLOVES	Wear gloves to prevent metal cuts and skin abrasions particularly during handling of wrought forms, solid metal sheet, strip to tube.	
EYE PROTECTION	Wear safety glasses when risk of eye injury is present particularly during machining, grinding, welding, powder handling, etc.	
OTHER PROTECTIVE EQUIPMENT	Protective clothing such as uniforms, disposable coveralls, safety shoes, etc. may be required during metal handling operations as appropriate to the circumstances of exposure.	
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 BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	In solid form these materials pose no special clean-up problems. If these materials are in powder or dust form, clean-up should be conducted with a vacuum system utilizing a high efficiency particulate air filtration system. 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	Dispose of waste material in accordance with state or federal regulations. For specific labeling, packing, storage, transportation and disposal procedures. Contact an Environmental Engineer or consultant familiar with waste disposal regulations.
ENVIRONMENTAL HAZARDS	In solid form these materials pose no special environmental problems. 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 or release exists it is advisable to develop an emergency spill response plan.

IX. SPECIAL PRECAUTIONS

HANDLING PRECAUTIONS	These products must be handled according to the size, shape and quantity of materials 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 these materials pose no special 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
LABEL(S) REQUIRED	Not Applicable

XI. SECTION 313 SUPPLIER NOTIFICATION

The chemicals reportable by Section 313 of the Emergency Planning and Community Right-To-Know-Act (Title III of the Superfund Amendments and Reauthorization Act of 1986) are marked by the symbol (*) in Section II Tables. Refer to Section II for the percentage of the chemicals in a particular product.

ADDITIONAL INFORMATION

The following is the label text which accompanies these Haynes International, Inc. products during shipment:

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

- The 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 the Material Safety Data Sheet (MSDS) for this product.
- Inhalation of metal dust or fume generated from welding, cutting, grinding, melting, or dross handling 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.
- Chromium VI compounds, nickel and its compounds are considered by OSHA as carcinogens because they are so classified by NTP and/or IARC.
- Avoid breathing 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 Sheets (MSDS H2071 and H1072) for this product.

SECTION V - HEALTH HAZARD INFORMATION

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.
Medical Conditions Aggravated By Exposure: Medical conditions that warrant consideration regarding exposure to a toxic substance.

SECTION VI - EMERGENCY & FIRST AID PROCEDURES

Inhalation: Emergency action to address adverse effects due to inhalation of a hazardous material.
Ingestion: Emergency action to address adverse effects due to ingestion of a hazardous material.
Skin: Emergency action to address adverse effects due to skin contact or absorption of a hazardous material.
Eyes: Emergency action to address adverse effects or injury to the eye due to contact with a hazardous material.

SECTION VII - INDUSTRIAL HYGIENE CONTROL MEASURES

Ventilation: Recommended type of ventilation for control of gases or particulate.
Respiratory Protection: General information on the type of respiratory protection recommended.
Protective Gloves: Recommendation for protection to prevent hand contact with the material.
Eye Protection: Recommendation to protect against eye injury.
Other Protective Equipment: Other personal protective equipment (PPE) such as clothing, safety shoes, etc. that may be appropriate to protect against injury or exposure. **Recommended Monitoring Procedures:**
Environmental Surveillance: Personal air sampling or related procedures to evaluate exposure of an individual.
Medical Surveillance: Biological monitoring or related tests/examinations to evaluate the effects of exposure to an individual.

SECTION VIII - ENVIRONMENTAL PROTECTION INFORMATION

Steps To Be Taken If Material Is Released Or Spilled: Specifically refers to containment, cleanup and control.
Waste Disposal Method: Refers to recommended disposal practices or applicable regulatory requirements when known.
Environmental Hazards: Refers to information such as aquatic or vegetative toxicity, ambient air pollution concerns, etc. which are available from regulatory or published technical services.

SECTION IX - SPECIAL PRECAUTIONS

Handling Precautions: Safe movement of the product may require specific handling procedures.
Storage Precautions: Safe storage of the product may require specific storage procedures.

SECTION X - DOT SHIPPING REQUIREMENTS

Shipping Name: The approved Department of Transportation (DOT) Shipping Name where applicable.
Hazard Class: The approved DOT Hazard Class where applicable.
Identification Number: Either the United Nations or North American approved identification number referenced by DOT.
Label(s) Required: The required DOT shipping label where applicable.

ADDITIONAL INFORMATION

This section is reserved for remarks which may not be specifically addressed in preceding sections such as Product Hazard Warnings & Label Information.

CONTENT & DESCRIPTION OF HAYNES INTERNATIONAL, INC. MATERIAL SAFETY DATA SHEETS

These definitions are intended for use with Material Safety Data Sheets supplied by Haynes International, Inc. Questions concerning these sheets should be directed to:

HAYNES INTERNATIONAL, INC.
SAFETY DEPARTMENT
1020 W. PARK AVENUE
KOKOMO, INDIANA 46904-9013
(317) 456-6625

SECTION I - PRODUCT IDENTIFICATION

Chemical Name: A name consistent with the nomenclature system of the International Union of Pure & Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS).
Trade Name: The name the product is sold by, i.e., the product name.
Chemical Family: A general designation for a group of elements or compounds.
Formula: The scientific designation for an element or compound.

SECTION II - HAZARDOUS CONSTITUENTS

Constituent(s): The chemical component(s) of the product. A hazardous constituent is a chemical which is a physical hazard or health hazard.
Percent: The amount of component or range present in the product and expressed on a weight basis.
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 RTECS Number: The National Institute for Occupational Safety & Health (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS) Access Number for a specific element or compound's toxicological data.
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 at PPM (parts per million) or as Mg/M^3 (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.

SECTION III - PHYSICAL PROPERTIES

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 (H_2O=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.

SECTION IV - FIRE, EXPLOSION AND REACTIVITY INFORMATION

Flash Point (With Test Method): The lowest temperature at which a vapor/air mixture will propagate a flame above the surface of the material being tested.
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 firement from toxic products of combustion.
Unusual Fire and Explosion Hazards: Chemical changes that may occur under heat or fire conditions.
[illegible]ral Reactivity: The tendency of a material to undergo chemical reaction with the release of energy.
[illegible]patibility (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.