



## Hitchiner Vacuum and Air Melt Alloys

Among the many attributes of the investment casting process are the substantial number of alloys that can be produced. The charts and tables on the following pages present only the most popular alloys and alloy families, showing in many instances the minimum mechanical properties which are obtainable. If an alloy to meet your requirements is not included please contact your nearest Hitchiner sales representative or our main office in Milford, New Hampshire at (603) 673-1100. New alloys are constantly being developed by Hitchiner to meet special requirements. Remember that the process is not limited to special or costly alloys. Your selection can range from the cast irons to the superalloys.

### CARBON AND LOW ALLOY STEELS

Alloy (UNS Nbr)	Similar Designation	Castability	Condition	TYPICAL MECHANICAL PROPERTIES				Remarks
				Strength PSI Tensile	Yield	% Elong	Min Hardness	
1010 (G10100)	IC 1010	Fair	As Cast	50,000	30,000	30	HRB50	Electrical components, weldable; no post heat
1015 (G10150)	IC 1015	Fair	As Cast	50,000	30,000	25	HRB55	High impact strength weldable; no post heat
1018 (G10180)	QQ S 681	Fair	As Cast	65,000	45,000	20	HRB60	
			Annealed	65,000	35,000	25	HRB60	High impact, carburizing, weldable; no post heat
			Norm & Draw 300°F	70,000	45,000	25	HRB70	
1020 (G10200)	IC 1020	Fair	As Cast	60,000	45,000	20	HRB60	
	MIL S 22141		Annealed	57,500	37,500	28	HRB60	High impact, carburizing, weldable; no post heat
			Norm & Draw 300°F	65,000	45,000	20	HRB60	
1030 (G10300)	IC 1030	Good	As Cast	70,000	45,000	12	HRB70	Fusion welding or flame hardening grade
	MIL S 22141		Annealed	65,000	40,000	25	HRB70	
1040 (G10400)	IC 1040	Good	As Cast	85,000	55,000	7	HRB85	
	MIL S 22141		Annealed	70,000	40,000	22	HRB70	Medium strength structural parts
			Quench & Draw 300°F	135,000	90,000	8	HRC28	
			Quench & Draw 1000°F	100,000	90,000	10	HRC24	
1045 (G10450)	QQ S 681	Good	Annealed	75,000	40,000	20	HRB75	Medium strength structural parts
			Quench & Drawn	140,000	95,000	7	HRC30	
1050 (G10500)	IC 1050	Good	Annealed	90,000	45,000	14	HRB85	Induction hardening
	MIL S 22141		Quench & Drawn	150,000	100,000	6	HRC35	
1060 (G10600)	IC 1060	Good	Annealed	100,000	55,000	12	HRB90	Good strength and impact combination
			Quench & Draw	160,000	140,000	3	HRC57	
1095 (G10950)	IC 1095	Good	Annealed	100,000	70,000	20	HRB95	General purpose, high carbon tool steel
	SAE 1095		Quench & Drawn	200,000	150,000	9	HRC52	
4130 (G41300)	AMS 5336	Very Good	Annealed	80,000	60,000	18	HRB85	Structural parts requiring welding, high fatigue resistance and strength
	MIL S 22141		Quench & Temper 350°F	200,000	170,000	6	HRC38	
	QQ S 681		Quench & Temper 1250°F	105,000	85,000	18	HRC42	
	AMS 5338		Annealed	90,000	60,000	17	HRB85	Structural parts; Good combination of fatigue, wear resistance and hardness
4140 (G41400)	MIL S 22141	Very Good	Quench & Temper 350°F	220,000	200,000	4	HRC43	
	QQ S 681		Quench & Temper 900°F	180,000	155,000	9	HRC33	surface hardenable
			Quench & Temper 1250°F	110,000	90,000	17	HRB91	
	AMS 5330		Annealed	90,000	70,000	15	HRB85	Structural parts; good combination of fatigue, wear resistance and hardness; better hardenability than 4140
4340 (G43400)	IC 4340	Very Good	Quench & Temper 350°F	220,000	205,000	4	HRC44	
	MIL S 22141		Quench & Temper 900°F	180,000	160,000	6	HRC34	
			Quench & Temper 1250°F	110,000	90,000	16	HRB91	
6150 (G61500)	IC 6150	Very Good	Annealed	100,000	60,000	12	HRB90	High strength and hardness
	MIL S 22141		Quench & Temper 350°F	230,000	210,000	2	HRC45	
			Quench & Temper 1250°F	110,000	90,000	10	HRC33	
8620 (G86200)	MIL S 22141	Good	Annealed	70,000	50,000	22	HRB80	Carburizing alloy steel for stressed parts
	QQ S 681		Quench & Temper 1200°F	100,000	80,000	16	HRC28	
8730 (G87300)	IC 8730	Good	Annealed	80,000	60,000	18	HRB85	Structural parts; good combination of fatigue and hardness
	MIL S 22141		Quench & Temper 350°F	200,000	170,000	6	HRC38	
	QQ S 681		Quench & Temper 1250°F	105,000	85,000	18	HRC42	
52100 (G51986)	IC 52100	Good	Annealed				HRC25 Max	
	MIL S 22141		Quench & Temper 800°F	230,000	220,000	1	HRC46	High hardness and abrasion resistance
			Quench & Temper 1000°F	180,000	170,000	5	HRC58	
Nitralloy (J24056)	MIL S 22141	Fair	Annealed	90,000	45,000	12	HRB91	Nitriding steel
			Quench & Temper 1100°F	140,000	125,000	8	HRC25	

## TOOL STEELS

Alloy	UNS Nbr	Castability	Approximate Tempered Hardness	Distortion in Heat Treating	Toughness	Wear Resistance	Resistance To Softening At High Heat
A-2	T30102	Good	HRC55	Best	Poor to Fair	Good	Good
A-6	T30106	Fair	HRC55	Best	Poor to Fair	Good	Fair
D-2	T30402	Good	HRC60	Best	Poor	Very Good	Good
D-3	T30493	Good	HRC60	Very Good	Poor	Very Good	Good
H-11	T20811	Fair	HRC52	Very Good	Poor	Fair	Good
H-12	T20812	Fair	HRC53	Very Good	Fair	Fair	Good
H-13	T20813	Good	HRC50	Very Good	Fair	Fair	Good
L-6	T61206	Fair	HRC62	Good	Fair	Poor	Poor
M-2	T11302	Fair	HRC63	Fair	Poor	Very Good	Very Good
M-4	T11304	Fair	HRC64	Fair	Poor	Best	Very Good
M-42	T11342	Fair	HRC68	Fair	Poor	Very Good	Best
M-52	T11352	Good	HRC62	Fair	Poor	Very Good	Very Good
0-1	T31501	Good	HRC60	Very Good	Poor to Fair	Fair	Poor
0-2	T31502	Good	HRC60	Very Good	Poor to Fair	Fair	Poor
0-7	T31507	Good	HRC62	Very Good	Poor to Fair	Fair	Poor
S-1	T41901	Very Good	HRC50	Fair	Good	Poor	Fair
S-2	T41902	Very Good	HRC56	Poor	Good	Poor	Poor
S-4	T41904	Good	HRC56	Poor	Good	Poor	Poor
S-5	T41905	Very Good	HRC58	Fair	Good	Poor	Poor
S-7	T41907	Very Good	HRC55	Fair	Good	Poor	Fair
T-1	T12001	Fair	HRC63	Fair	Poor	Very Good	Very Good

## PRECIPITATION HARDENING STAINLESS STEEL

Alloy (UNS Nbr)	Similar Designation	Castability	Condition	TYPICAL MECHANICAL PROPERTIES				Remarks
				Strength PSI Tensile	Yield	% Elong	Min Hardness	
15-5 PH (J92110)	AMS 5347 ASTM A 747 IC 15-5PH	Good	Normalize & Solution Anneal plus Aging	160,000	130,000	8	HRC38	Same as 17-4 except greater ductility in thick sections
17-4 PH (J92180)	AMS 5355 ASTM A 747 IC 17-4PH MIL S 81591	Very Good	Normalize & Solution Anneal or Dble Solution Anneal	180,000	160,000	6	HRC40	Age hardening alloy; best combination of corrosion resistance and hardness; most popular
CD-4MCU (J93370)	ASTM A 351 ASTM A 743	Good	Solution Anneal plus Aging	100,000	70,000	12	HRC30	Best combination of strength corrosion resistance

### 300 SERIES STAINLESS

Alloy (UNS Nbr)	Similar Designation	Castability	Condition	TYPICAL MECHANICAL PROPERTIES			Min Hardness	Remarks
				Strength PSI Tensile	Yield	% Elong		
302 CF-20 (J92501)	AMS 5358 ASTM A 743 MIL 5 81591	Excellent	As Cast or Solution Annealed	65,000	30,000	35	HRB85	Best combination of castability and corrosion resistance
303 CF-16F (J92511)	AMS 5341 ASTM A 743 MIL 5 81591	Good	As Cast or Solution Annealed	65,000	30,000	35	HRB85	Free machining stainless
304 CF-8 (J92600)	ASTM A 743 MIL 5 867	Excellent	As Cast or Solution Annealed	65,000	30,000	35	HRB85	Better corrosion resistance than 302 or 303
304L CF-3 (J92700)	AMS 5370 ASTM A 351 MIL S 22216	Excellent	As Cast or Solution Annealed	63,000	28,000	35	HRB85	Cryogenic applications, weldable
310 CK-20 (S31000)	AMS 5366 ASTM A 351 MIL S 22216	Good	As Cast or Solution Annealed	60,000	30,000	35	HRB85	Oxidation resistance to 2,000°F
316 CF-8M (J92900)	AMS 5360 ASTM A 351 MIL S 867	Excellent	As Cast or Solution Annealed	65,000	30,000	35	RB85	Food equipment; paper making equipment, marine use
347 CF-8C (J92710)	AMS 5362 ASTM A 351 MIL S 81591	Very Good	As Cast or Solution Annealed	70,000	32,000	30	HRB85	Weldable grade, stable to 1500°F
CN-7M (J95150)	ASTM A 351 ASTM A 743	Good	As Cast or Solution Annealed	65,000	25,000	35	HRB80	Sulfuric acid resistant

### 400 SERIES STAINLESS

Alloy (UNS Nbr)	Similar Designation	Castability	Condition	TYPICAL MECHANICAL PROPERTIES			Min Hardness	Remarks
				Strength PSI Tensile	Yield	% Elong		
410 CA-15 (J91150)	AMS 5350 ASTM A 217 MIL S 81591	Very Good	Annealed Air or Oil Quench Hardened & Tempered	70,000 160,000 180,000 200,000	45,000 120,000 140,000 150,000	20 12 8 6	HRB90 Max HRC36 HRC40 HRC42	Good combination of hardness and corrosion resistance
416 (S41600)	AMS 5349 IC 416 MIL S 81591	Fair	Annealed Air or Oil Quench Hardened & Tempered	70,000 95,000 160,000	40,000 75,000 130,000	15 12 5	HRB95 Max HRB95 HRC38	Free machining grade of 410; not as tough as 410
420 CA-40 (J91153)	ASTM A 743 MIL S 81591	Good	Annealed Low Carbon Hardened & Tempered High Carbon Hardened & Tempered	90,000 200,000 200,000	60,000 150,000 150,000	12 3 3	HRC28 Max HRC46 HRC48	Similar to 410; higher hardness but less tough; better wear resistance
430 (S4300)		Good	Annealed	60,000	45,000	15	HRB95 Max	Better corrosion and heat resistance of series
431 CB-30 (J91803)	AMS 5353 ASTM A 743 MIL S 81591	Good	Annealed Hardened & Tempered	90,000 170,000	60,000 130,000	12 5	HRC28 Max HRC38	Best corrosion resistance of series
436 Greek Ascology (J91631)	AMS 5354	Very Good	Hardened & Tempered	90,000	65,000	3	HRC36 Max	Heat resistant to 1000°F
440A (S44002)	IC 440A MIL S 22216 MIL S 81591	Fair	Annealed Hardened & Tempered	90,000 —	60,000 —	2 Nil	HRC30 Max HRC50	Cutlery and molds; high hardness
440C (S44004)	AMS 5352 MIL S 22216 MIL S 81591	Fair	Hardened, Deep Frozen & Tempered Annealed	— — 90,000	— — 60,000	Nil Nil 2	HRC52 HRC30 Max	Highest hardness; best cutlery grade
440F (S44020)	IC 440F	Fair	Hardened & Tempered	—	—	Nil	HRC55	Free machining grade of 440C

## MAGNETICALLY HARD ALLOYS

Alloy Type	Castability	Condition	Residual Flux	Coercive Force	Energy Product	Hardness
			Density (Gauss)	(Oersteds)	BH X 106	
Alnico 2	Fair	As Cast	7,500	550	1.65	HRC45
Alnico 4	Fair	As Cast	6,300	630	1.40	HRC45
Alnico 5	Poor	As Cast	12,700	640	5.25	HRC50
Alnico 7	Poor	As Cast	7,000	1,170	3.00	HRC60

## COBALT BASE ALLOYS

Alloy (UNS Nbr)	Similar Designation	Castability	Condition	TYPICAL MECHANICAL PROPERTIES				Remarks
				Strength PSI		%	Min	
				Tensile	Yield	Elong	Hardness	
Cobalt 6 (R30006)	AMS 5387	Good	As Cast	100,000	85,000	3	HRC40	Best impact. Oxidation resistant to 1600°F
Cobalt 12 (R30012)	MIL C 24248	Good	As Cast	—	—	Nil	HRC42	More wear resistant, not as tough as 6
Cobalt 21 (R30021)	AMS 5385 ASTM A 732	Very Good	As Cast Tested at 1500°F	75,000	60,000	8	HRC34 Max	High strength up to 1500°F and oxidation resistance to 2100°F
Cobalt 31 (R30031)	AMS 5382	Very Good	As Cast	110,000	70,000	6	HRC34 Max	Resistant to oxidizing and reducing atmospheres to 2100°F
Cobalt 36		Good	As Cast	90,000	60,000	15	HRC30	Good strength up to 1800°F
Cobalt J		Fair	As Cast	—	—	Nil	HRC55	Wear resistant with low impact
Alloy 93		Fair	As Cast	—	—	Nil	RC61	Best wear resistance
N-155 (R30155)	AMS 5376	Good	As Cast Tested at 1500°F	45,000	—	15	HRC21 Max	High strength up to 1500°F and oxidation resistance to 2000°F

## NICKEL BASE ALLOYS

Alloy (UNS Nbr)	Similar Designation	Castability	Condition	TYPICAL MECHANICAL PROPERTIES				Remarks
				Strength PSI		%	Min	
				Tensile	Yield	Elong	Hardness	
Alloy B (N10001)	AMS 5396 ASTM A 494	Good	As Cast	75,000	50,000	12	HRB200	Resistant to hydrochloric acid
Alloy C (N10002)	AMS 5388 ASTM A 494	Fair	AS Cast Tested at 1500°F	75,000	45,000	12	HRB200	Resistant to wet chlorine gas. Oxidation resistant to 1800°F
Alloy X (N06002)	AMS 5390	Poor	As Cast Tested at 1500°F	35,000	—	12	HRB96 Max	Oxidation resistant to 2200°F
Inconel 600 (N06040)		Fair	As Cast	65,000	35,000	10	HRB80	Resists oxidation up to 2000°F corrosive vapors above 800°F
Monel 410 (N04400)	ASTM A 494	Fair	As Cast	65,000	32,000	25	HRB65	Corrosion resistance and toughness

## VACUUM CAST — NICKEL BASE ALLOYS

Alloy Type	Similar Designation	Castability	Weldable	TYPICAL MECHANICAL PROPERTIES				MIN. STRESS RUPTURE PROPERTIES			
				Tensile	Yield	% Elong	Reduction In Area	Temp °F	Stress PSI	Hours Life	% Elong
Inconel 100	AMS 5397	Fair	No	115,000	95,000	5		1800	29,000	23	4
Inconel 625	AMS 5401	Good	Yes	85,000	45,000	25					
Inconel 713C	AMS 5391	Excellent	No	110,000	100,000	3		1800	22,000	30	5
Inconel 713LC	AMS 5377	Excellent	No	110,000	100,000	5	8	1800	22,000	30	5
Inconel 718	AMS 5383	Excellent	Yes	125,000	110,000	5	10	1300	65,000	23	3
Inconel 792	PWA 1467	Fair	No					1400	94,000	23	2.5
								1800	27,000	28	4
Inconel 939	MTS 1348	Good	No					1598	29,000	23	3
Rene 41	AMS 5399	Very Good	Yes	110,000	90,000	3	5	1650	25,000	25	5
Rene 80	C50TF28	Good	No	90,000	60,000		15	1800	27,500	23	5
Rene 108	B50TF262	Poor	No	135,000	100,000	8	10	1800	30,000	20	
Rene 125	C50TF60	Good	No	145,000	120,000		6	1800	30,000	40	4
Haynes 230	PWA 1474	Good	Yes	75,000	40,000	25	25	1700	9,000	23	5
B1900 + Hf	PWA 1455	Very Good	No	120,000	105,000	5.0		1800	29,000	23	55
	PWA 1475	Very Good	No					1900	15,000	17	1

## VACUUM CAST — COBALT BASE ALLOYS

Alloy Type	Similar Designation	Castability	Weldable	TYPICAL MECHANICAL PROPERTIES				MIN. STRESS RUPTURE PROPERTIES			
				Tensile	Yield	% Elong	Reduction In Area	Temp °F	Stress PSI	Hours Life	% Elong
X-40	C50TF21,C1B	Good	Yes					1800	12,000	18	15
MAR M 509	B50TF89	Good	No	100,000	70,000	2.0	2.4	2000	9,000	23	6
	PWA 647										