MATERIAL LISTING

STANDARD ANALYSES PRODUCED BY ALLOY ENGINEERING & CASTING COMPANY
STANDARD SPECIFICATIONS FOR ASTM A297 - STEEL CASTINGS, HEAT RESISTANT, FOR GENERAL APPLICATIONS

* = maximum value, unless otherwise noted.
** = Some data on creep stress has been extrapolated from published information on comparable materials.

ACI Grades	Other Material	Nominal Composition (Phosphorus and Sulfur = 0.04 max)									High Temperature Properties Creep Stress PSI 1% 10,000 hrs**			Melting Point	Principal Features and Applications
		Ni	Cr	C	Mn*	Si*	Mo*	W	Co	Fe	1600°F	1800°F	2000°F	°F	
HC	Wrought 446	4*	28	0.5*	1.0	2.0	0.50	-	-	Bal	750	360	-	2725	Excellent resistance to oxidation and sulfur-containing atmospheres at temperatures up to 2000°F, with good wear resistance. Used for pouring spouts for copper and brass, refinery fittings, and grate bars.
HE	Wrought 312	9	28	0.35	2.0	2.0	0.50	-	-	Bal	2400	1400	400	2650	Excellent corrosion and wear characteristics up to 2000°F. Used for rollers, journals, burner nozzles and billet skids where heat and wear resistance are needed.
HF	Wrought 302B	10	20	0.3	2.0	2.0	0.50	-	-	Bal	3900	-	-	2550	Excellent strength and resistance to corrosion and heat up from 1200-1600°F, with good oxidation resistance as well. Used for grates, furnace parts, burner tips, and rabble arms.
HH, HH2	Wrought 309	12	26	0.35	2.0	2.0	0.50	-	-	Bal	3900	2100	800	2500	Excellent resistance to corrosion and heat in applications up to 1200°F. Also used up to 2000°F in applications where embrittlement from sigma formation is acceptable, and resistance to carburization is not critical. Used for furnace parts, trays, radiant tubes, and fixtures in moderate applications.
HK	Wrought 310	20	26	0.4	2.0	2.0	0.50	-	-	Bal	6000	2500	650	2550	One of the strongest heat-resistant casting alloys at temperatures above 1900°F, with good hot gas corrosion and oxidation resistance up to 2100°F. Used for furnace parts, radiant tubes, reformer tubes, and furnace rolls. Susceptible to embrittlement from sigma formation.
HL	-	20	30	0.4	2.0	2.0	0.50	-	-	Bal	4300	2200	-	2600	Similar to HK material, but with greater resistance to corrosion by hot gases, particularly those containing sulfur. Used for furnace parts, radiant tubes, and furnace rolls. Susceptible to embrittlement from sigma formation.
HN	-	25	21	0.35	2.0	2.0	0.50	-	-	Bal	6300	2400	1040	2500	Similar to HK material, but with greater strength at temperatures in excess of 1850°F and greater resistance to thermal shock. Used for furnace parts, trays, and furnace rolls.
HT	Wrought 330	35	17	0.55	2.0	2.5	0.50	-	-	Bal	4500	2000	500	2450	Excellent resistance to oxidation and carburization up to 2100°F, also good in reducing atmospheres up to 2000°F. Resists thermal shock from heating and cooling. Used for furnace parts, trays, baskets, annealing fixtures, muffles, radiant tubes, enameling fixtures, retorts, belts, and chains.
HP	-	35	26	0.55	2.0	2.5	0.50	-	-	Bal	5800	2800	1000	2450	Similar to HT material, with less resistance to thermal shock but greater strength. Not susceptible to embrittlement from sigma formation. Used for furnace parts, trays, radiant tubes, and reformer tubes.
HU	-	39	19	0.55	2.0	2.5	0.50	-	-	Bal	5000	2200	600	2450	Similar to HT material, but with greater resistance to rapid thermal shock and greater strength and carburization resistance up to 2000°F. Most useful alloy for carburization applications with an oil quench at 1600-1800°F. Used for trays, baskets, fixtures, radiant tubes, furnace parts, retorts, belts, chains, and muffles.
HW	-	60	12	0.55	2.0	2.5	0.50	-	-	Bal	3000	1400	-	2350	Has less strength than HT or HU alloy, but greater resistance to carburization and thermal shock up to 2050°F. Used for trays, fixtures, retorts, and enameling tools where severe thermal shock is present.
HX	-	66	17	0.55	2.0	2.5	0.50	-	-	Bal	3200	1600	600	2350	Similar to HW alloy, but has even greater strength and resistance to hot gas corrosion up to 2100°F. This grade is used more commonly than HW alloy for severe applications with water or synthetic quenches. Used for trays, baskets, fixtures, hearth plates, enameling tools, and retorts where thermal shock is present.

COMMON SUPER & SPECIALTY ALLOYS PRODUCED BY AECCO (Additional analyses available upon request)

Proprietary Grades	Other Material	Nominal Composition (Phosphorus and Sulfur = 0.04 max)									High Temperature Properties Creep Stress PSI 1% 10,000 hrs**			Melting Point	Principal Features and Applications
		Ni	Cr	C	Mn*	Si*	Mo	W	Co	Fe	1600°F	1800°F	2000°F	°F	
NC13	MO-RE® 1	35	28	0.55	2	2.5	-	1.4	-	Bal	-	3600	1200	-	Similar to HP alloy, but with additional strength and creep strength at temperatures of 1600-2100°F.
HU-CN	-	41	18	.4	2	2.5	.5*	-	-	Bal	1 Cb	5000	2200	600	Similar to HU material but with greater toughness, resistance to embrittlement, and enhanced service life in carbo-nitriding and similar applications. Used for trays, baskets, fixtures, radiant tubes, furnace parts, retorts, belts, chains, and muffles.
NC14	Supertherm®	35	26	0.55	2	2.5	-	5	15	Bal	-	4250	2000	-	Exceptional oxidation resistance, strength and thermal fatigue resistance at temperatures up to 2200°F. Used for radiant tubes, furnace rolls, walking beams, and furnace parts.
HUMOD	HR4	51	18	.55	2	2.5	.5*	.5	-	Bal	-	-	-	-	High-temperature alloy used in similar applications as HU but with greater resistance to cracking in salt quench applications. Used for trays, baskets, and fixtures.
RG99X	-	-	-	-	-	-	-	-	-	Bal	.5 Al	-	4250	2000	Upgraded version of NC14 to produce even greater strength at temperatures over 2000oF. Used for radiant tubes, furnace rolls, walking beams, and other furnace parts where high temperature strength is required.
NC9MO	Hastelloy X	47	22	0.4*	1.5	1.5	9	0.6	1.5	Bal	5800	1900	-	2400	Exceptional oxidation and high strength characteristics at temperatures up to 2200°F. Used for turbine engines, furnace rolls, retorts, muffles, and trays to provide greater service life in severe applications.
NC11	22H®	48	28	0.55	2	2.5	-	5	-	Bal	-	2300	1050	-	Popular alloy for high temperature applications up to 2200°F. Excellent high-temperature strength and resistance to oxidation, carburization, and creep. Used for radiant tubes, trays, fixtures, retorts, furnace parts, and baskets.
NC11C	Super 22H®	48	28	0.55	2	2.5	-	5	3	Bal	-	3200	1600	2470	Similar to NC11, but with greater strength at temperatures up to 2250°F.
HXM40	HX (MOD)	69	17	0.4	2	2.5	0.5*	-	-	Bal	3200	1600	600	2350	Similar to HX alloy, but upgraded to provide greater resistance to thermal shock.
NC18W	H230	56	22	0.55*	1	1.5	2	14	-	Bal	4400	1100	-	2400	Similar to wrought alloy 230, with excellent oxidation and carburization resistance up to 2000°F, and high strength up to 1900°F. Must be preheated for welding.
INC600	Inconel 600	72 min	16	0.15*	1	1	-	-	-	Bal	-	-	-	2470	Excellent thermal fatigue properties and resistance to oxidation, corrosion, and stress-corrosion cracking. Suitable for severe water and synthetic quench applications.

MO-RE®, Supertherm®, 22H®, and Super 22H® are registered trademarks of Duraloy Technologies, Inc.

Form 0102 Rev. D