Technical Datasheet CARPENTER TECHNOLOGY

CarTech® 355 Alloy

Identification

UNS Number

- S35500

AISI Number

- 634

Type Analysis

Single figures are nominal except where noted.

Carbon	0.10 to 0.15 %	**Manganese**	0.50 to 1.25 %
Phosphorus (Maximum)	0.040 %	**Sulfur (Maximum)**	0.030 %
Silicon (Maximum)	0.50 %	**Chromium**	15.00 to 16.00 %
Nickel	4.00 to 5.00 %	**Molybdenum**	2.50 to 3.25 %
Nitrogen	0.07 to 0.13 %	**Iron**	Balance

General Information

Description

CarTech 355 alloy is a chromium-nickel-molybdenum stainless steel which can be hardened by martensitic transformation and/or precipitation hardening.

Depending upon the heat treatment, CarTech 355 alloy may have an austenitic structure and formability similar to other austenitic stainless steels or a martensitic structure and high strength comparable to other martensitic stainless steels. High strengths may also be attained by cold working, and are maintained (whether produced by heat treatment or by cold work) at temperatures up to 1000°F (538°C). Corrosion resistance of the alloy is superior to that of other quench-hardenable martensitic stainless steels and approaches that of the chromium-nickel austenitic stainless steels.

The alloy is usually supplied in either the annealed or in the equalized and over-tempered condition.

Applications

It has been used for gas turbine compressor components such as blades, discs, rotors and shafts and similar parts where high strength is required at intermediate elevated temperatures.

Corrosion Resistance

Pyromet alloy 355 has corrosion resistance superior to that of other quench-hardenable martensitic stainless steels. It offers good resistance to atmospheric corrosion and to a number of other mild chemical environments. Material in the double-aged or equalized and overtempered condition is susceptible to intergranular corrosion because of grain boundary precipitation of carbides. When this alloy is hardened by sub-zero cooling, it is not subject to intergranular attack.

The treatment for optimum stress-corrosion resistance is as follows: Heat to 1875/1900°F (1024/1038°C), water quench, sub-zero cool 3 hours at -100°F (-73°C); reheat to 1700°F (927°C), air cool, sub-zero cool to -100°F (-73°C) for 3 hours, and then temper at 1000°F (538°C) for 3 hours.

For optimum corrosion resistance, surfaces must be free of scale, lubricants, foreign particles, and coatings applied for drawing and heading. After fabrication of parts, cleaning and/or passivation should be considered.

Important Note: *The following 4-level rating scale is intended for comparative purposes only. Corrosion testing is recommended; factors which affect corrosion resistance include temperature, concentration, pH, impurities, aeration, velocity, crevices, deposits, metallurgical condition, stress, surface finish and dissimilar metal contact.*

Nitric Acid	Good	Sulfuric Acid	Restricted
Phosphoric Acid	Restricted	Acetic Acid	Moderate
Sodium Hydroxide	Moderate	Salt Spray (NaCl)	Good

Sea Water	Restricted	Humidity	Excellent

Properties

Physical Properties

Specific Gravity		
Annealed	7.92	
Sub-zero Cooled, Tempered 850°F	7.81	
Density		
Annealed	0.2860	lb/in^3
Sub-zero Cooled, Tempered 850°F (454°C)	0.2820	lb/in^3
Mean Specific Heat (32 to 212°F)	0.1200	Btu/lb/°F
Mean CTE		
68 to 212°F, Annealed	8.30	x 10^{-6} in/in/°F
68 to 572°F, Annealed	7.90	x 10^{-6} in/in/°F
68 to 752°F, Annealed	8.30	x 10^{-6} in/in/°F
68 to 932°F, Annealed	9.40	x 10^{-6} in/in/°F
68 to 1150°F, Annealed	9.20	x 10^{-6} in/in/°F
68 to 1350°F, Annealed	9.70	x 10^{-6} in/in/°F
68 to 1500°F, Annealed	10.2	x 10^{-6} in/in/°F
68 to 1700°F, Annealed	10.6	x 10^{-6} in/in/°F
68 to 212°F, Sub-zero Cooled, Tempered 850°F (454°C)	6.40	x 10^{-6} in/in/°F
68 to 572°F, Sub-zero Cooled, Tempered 850°F (454°C)	6.80	x 10^{-6} in/in/°F
68 to 752°F, Sub-zero Cooled, Tempered 850°F (454°C)	7.00	x 10^{-6} in/in/°F
68 to 932°F, Sub-zero Cooled, Tempered 850°F (454°C)	7.20	x 10^{-6} in/in/°F
68 to 1150°F, Sub-zero Cooled, Tempered 850°F (454°C)	7.20	x 10^{-6} in/in/°F
68 to 1350°F, Sub-zero Cooled, Tempered 850°F (454°C)	6.50	x 10^{-6} in/in/°F
68 to 1500°F, Sub-zero Cooled, Tempered 850°F (454°C)	6.70	x 10^{-6} in/in/°F
68 to 1700°F, Sub-zero Cooled, Tempered 850°F (454°C)	7.10	x 10^{-6} in/in/°F

Mean Coefficient of Thermal Expansion

Temperature		Annealed 1875°F (1024°C)		Sub-zero cooled, tempered 850°F (454°C)	
68°F to	20°C to	10^{-6}/°F	10^{-6}/K	10^{-6}/°F	10^{-6}/K
212	100	8.3	14.9	6.4	11.5
572	300	7.9	14.2	6.8	12.2
752	400	8.3	14.9	7.0	12.6
932	500	9.4	16.9	7.2	13.0
1150	621	9.2	16.6	7.2	13.0
1350	732	9.7	17.5	6.5	11.7
1500	816	10.2	18.4	6.7	12.1
1700	927	10.6	19.1	7.1	12.8

Thermal Conductivity		
100°F, Sub-zero Cooled, Tempered 850°F (454°C)	105.0	BTU-in/hr/ft^2/°F
200°F, Sub-zero Cooled, Tempered 850°F (454°C)	110.0	BTU-in/hr/ft^2/°F
300°F, Sub-zero Cooled, Tempered 850°F (454°C)	114.0	BTU-in/hr/ft^2/°F
400°F, Sub-zero Cooled, Tempered 850°F (454°C)	114.0	BTU-in/hr/ft^2/°F
500°F, Sub-zero Cooled, Tempered 850°F (454°C)	124.0	BTU-in/hr/ft^2/°F
600°F, Sub-zero Cooled, Tempered 850°F (454°C)	128.0	BTU-in/hr/ft^2/°F
700°F, Sub-zero Cooled, Tempered 850°F (454°C)	134.0	BTU-in/hr/ft^2/°F
800°F, Sub-zero Cooled, Tempered 850°F (454°C)	139.0	BTU-in/hr/ft^2/°F
900°F, Sub-zero Cooled, Tempered 850°F (454°C)	144.0	BTU-in/hr/ft^2/°F

Thermal Conductivity
Sub-zero cooled, tempered 850°F (454°C)

Test Temperature		Btu•in/ft²•h•°F	W/m•K
°F	°C		
100	38	105	15.1
200	93	110	15.9
300	149	114	16.5
400	204	114	16.5
500	260	124	17.8
600	316	128	18.5
700	371	134	19.4
800	427	139	20.1
900	482	144	20.8

Modulus of Elasticity (E)		
80°F, Sub-zero Cooled, Tempered 850°F (454°C)	29.3	x 10 ³ ksi
400°F, Sub-zero Cooled, Tempered 850°F (454°C)	27.3	x 10 ³ ksi
600°F, Sub-zero Cooled, Tempered 850°F (454°C)	26.3	x 10 ³ ksi
700°F, Sub-zero Cooled, Tempered 850°F (454°C)	25.3	x 10 ³ ksi
800°F, Sub-zero Cooled, Tempered 850°F (454°C)	24.6	x 10 ³ ksi
Modulus of Rigidity (G)		
80°F, Sub-zero Cooled, Tempered 850°F (454°C)	11.4	x 10 ³ ksi
400°F, Sub-zero Cooled, Tempered 850°F (454°C)	10.5	x 10 ³ ksi
600°F, Sub-zero Cooled, Tempered 850°F (454°C)	9.90	x 10 ³ ksi
700°F, Sub-zero Cooled, Tempered 850°F (454°C)	9.60	x 10 ³ ksi
800°F, Sub-zero Cooled, Tempered 850°F (454°C)	9.40	x 10 ³ ksi
Electrical Resistivity		
82°F, Sub-zero Cooled, Tempered 850°F (454°C)	456.0	ohm-cir-mil/ft
113°F, Sub-zero Cooled, Tempered 850°F (454°C)	461.0	ohm-cir-mil/ft
211°F, Sub-zero Cooled, Tempered 850°F (454°C)	480.0	ohm-cir-mil/ft
320°F, Sub-zero Cooled, Tempered 850°F (454°C)	498.0	ohm-cir-mil/ft
470°F, Sub-zero Cooled, Tempered 850°F (454°C)	522.0	ohm-cir-mil/ft
607°F, Sub-zero Cooled, Tempered 850°F (454°C)	549.0	ohm-cir-mil/ft
734°F, Sub-zero Cooled, Tempered 850°F (454°C)	570.0	ohm-cir-mil/ft
885°F, Sub-zero Cooled, Tempered 850°F (454°C)	597.0	ohm-cir-mil/ft
1052°F, Sub-zero Cooled, Tempered 850°F (454°C)	623.0	ohm-cir-mil/ft
1208°F, Sub-zero Cooled, Tempered 850°F (454°C)	650.0	ohm-cir-mil/ft
1394°F, Sub-zero Cooled, Tempered 850°F (454°C)	660.0	ohm-cir-mil/ft

Electrical Resistivity
Sub-zero cooled, tempered 850°F (454°C)

Test Temperature		Ohm—cir mil/ft	Microhm-mm
°F	°C		
82	28	456	758
113	45	461	766
211	99	480	798
320	160	498	828
470	243	522	868
607	319	549	913
734	390	570	948
885	474	597	992
1052	568	623	1036
1208	651	650	1081
1394	757	660	1097

Melting Range	2500 to 2550	°F

Moduli of elasticity (E) and rigidity (G)
Sub-zero cooled, tempered 850°F (454°C)

Test Temperature		E		G	
°F	°C	ksi x 10³	MPa x 10³	ksi x 10³	MPa x 10³
80	27	29.3	202	11.4	79
400	204	27.3	188	10.5	72
600	316	26.0	179	9.9	68
700	371	25.3	174	9.6	66
800	427	24.6	170	9.4	65

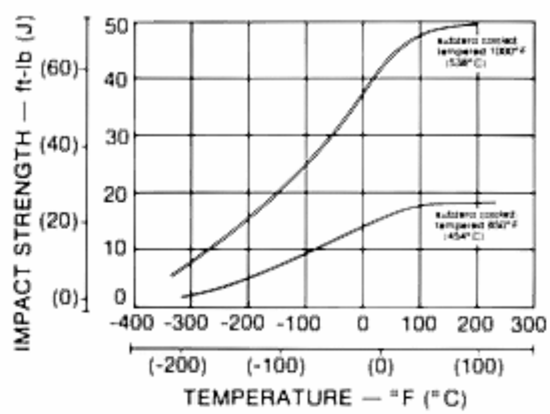
Magnetic Properties

Magnetic Properties
Sub-zero cooled, tempered 1000°F (538°C)

Test Temperature		Maximum Permeability	Residual Induction Gauss	Coercive Force Oersteds	B max. at 200H Gauss
°F	°C				
Room Temperature		150	6400	28.0	11508
200	93	156	6300	26.4	11408
300	149	155	6200	25.5	11208
500	260	161	5800	22.4	10608

Typical Mechanical Properties

Typical Charpy V-Notch Impact Strength



Typical Elevated Temperature Tensile Properties of Bar
Sub-zero cooled, tempered

Test Temperature		Tempering Temperature		Yield Strength 0.02% Offset		Yield Strength 0.2% Offset		Ultimate Tensile Strength		% Elongation in 2" (50.8mm)	% Reduction of Area
°F	°C	°F	°C	ksi	MPa	ksi	MPa	ksi	MPa		
70	21	850	454	142	979	182	1255	216	1489	19	39
		1000	538	147	1014	171	1179	186	1282	19	57
400	204	850	454	123	848	163	1124	207	1427	16	45
		1000	538	128	883	152	1048	166	1145	16	60
600	316	850	454	110	758	152	1048	210	1448	12	36
		1000	538	123	848	143	986	159	1096	14	49
800	427	850	454	98	676	139	958	198	1365	11	36
		1000	538	107	738	128	883	140	965	15	54
1000	538	850	454	65	448	97	669	144	993	16	57
		1000	538	70	483	96	662	115	793	19	65

Typical Fatigue Strength
Sub-zero cooled, tempered

Test Temperature		Tempering Temperature		Stress for failure in							
				10^5 cycles		10^6 cycles		10^7 cycles		10^8 cycles	
°F	°C	°F	°C	ksi	MPa	ksi	MPa	ksi	MPa	ksi	MPa
Room*		850	454	—	—	130	896	112	772	104	724
Room*		1000	538	120	827	106	731	105	717	—	—
Room**		850	454	67	462	55	379	54	372	—	—
800	427	850	454	—	—	79	545	68	469	57	393

*Bar 1" (25.4 mm) round—0.250" (6.35 mm) round rotating beam tests.
**Notched specimen $K_t = 3.5$.

Typical Longitudinal Charpy V-Notch Impact Strength of Bar
Sub-zero cooled, tempered

Test Temperature		Impact Strength			
		Tempered		Tempered	
°F	°C	850°F	454°C	1000°F	538°C
		ft-lb	J	ft-lb	J
-320	-196	2	3	9	12
-100	-73	9	12	24	33
10	-12	15	20	38	52
70	21	17	23	46	62
212	100	19	26	50	68

Typical Room Temperature Mechanical Properties
Sub-zero cooled, tempered

Product	Tempering Temperature		Specimen Orientation*	Yield Strength				Ultimate Tensile Strength		% Elongation in 2" (50.8 mm)	% Reduction of Area	Rockwell C Hardness
				0.02% Offset		0.2% Offset						
	°F	°C		ksi	MPa	ksi	MPa	ksi	MPa			
Bar	850	454	L	142	979	182	1255	216	1489	19	38	48
Bar	850	454	T	148	1020	185	1276	220	1517	12	21	
Bar	1000	538	L	147	1014	171	1179	185	1276	19	57	40
Bar	1000	538	T	148	1020	169	1165	185	1276	15	40	
Billet	850	454	T	—	—	185	1276	220	1517	12	21	48
Billet	1000	538	T	—	—	169	1165	185	1276	15	40	40
Billet	850	454	L	—	—	185	1276	220	1517	12	29	47
Pancake (Capability)	1000	538		147	1014	167	1151	182	1255	16	45	40

*T (Transverse) L (Longitudinal)

Typical Room Temperature Tensile Properties After Exposure to Elevated Temperatures

Bar, sub-zero cooled, tempered

Section Size	Tempering Temperature		Exposure Temperature		Exposure Time	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation in 4D	% Reduction of Area
	°F	°C	°F	°C	Hours	ksi	MPa	ksi	MPa		
5¼" sq. (133.4 mm)	1000	538	—	—	—	160	1103	168	1158	18	52
			500	260	1000	161	1110	169	1165	18	54
			700	371	1000	187	1289	195	1344	15	47
4" sq. (101.6 mm)	1000	538	—	—	—	156	1076	164	1131	18	57
			500	260	100	155	1069	163	1124	19	58
			500	260	1000	159	1096	163	1124	18	58
			700	371	100	165	1138	172	1186	18	54
			700	371	1000	175	1207	178	1227	17	54
1" rd. (25.4 mm)	850	454	—	—	—	175	1207	204	1407	16	50
			850	454	24	181	1248	203	1400	16	52
			850	454	100	190	1310	205	1413	15	50
			850	454	1000	201	1386	209	1441	16	50
1" rd. (25.4 mm)	1000	538	—	—	—	160	1103	167	1151	19	57
			850	454	24	170	1172	176	1213	19	59
			850	454	1000	180	1241	184	1269	18	55
			850	454	100	189	1303	199	1372	17	49

Test piece diameter 0.357" (9.07 mm)

Typical Room Temperature Tensile Properties After Exposure to Elevated Temperatures Under Stress

1" (25.4 mm) round bar, sub-zero cooled, tempered 850°F (454°C)

Exposure Temperature		Exposure Stress		Exposure Time	0.2% Yield Strength		Ultimate Tensile Strength		% Elongation	% Reduction of Area
°F	°C	ksi	MPa	Hours	ksi	MPa	ksi	MPa		
					167	1151	212	1462	21	54
700	371	98	676	5400	201	1386	216	1489	15	51
					154	1062	176	1213	18	60
700	371	93	641	5400	159	1096	204	1407	16	51
					176	1213	191	1317	9	54
(2)	—	60	414	—	198	1365	207	1427	11	53
(2)	—	120	827	—	218	1503	218	1503	(1)	50
					182	1255	199	1372	7	53
(2)	—	60	414	—	215	1482	224	1544	5	50
(2)	—	20	138	—	—	—	225	1551	5	49

(1) Broke on gauge mark.

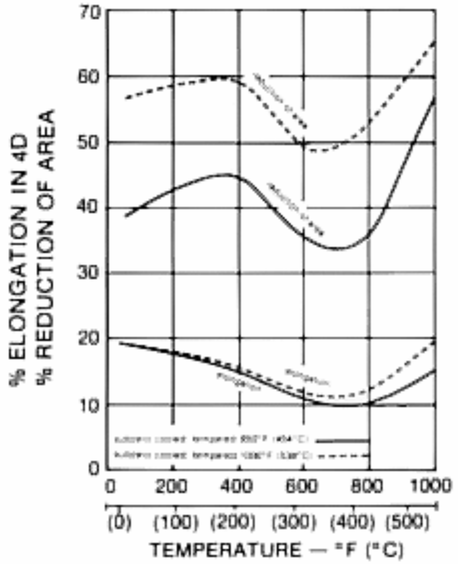
(2) Cycled daily for 15 days between -100 and 800°F (-73 and 427°C) held at 800°F (427°C) about 15 hours during each cycle.

Typical Stress Rupture Strength Bar

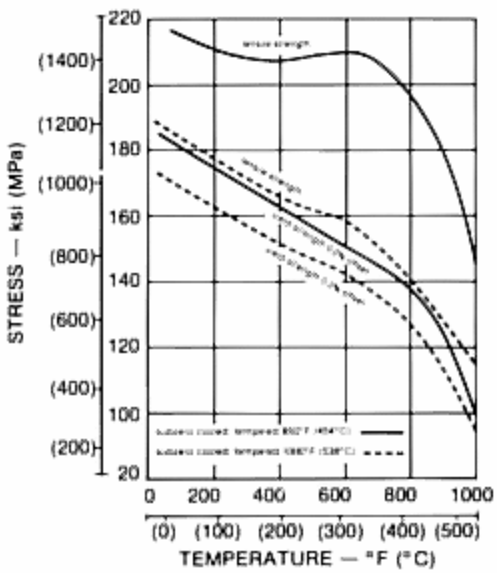
Sub-zero cooled, tempered

Tempering Temperature		Test Temperature		Stress for rupture in 10 hours		Stress for rupture in 100 hours		Stress for rupture in 1000 hours	
°F	°C	°F	°C	ksi	MPa	ksi	MPa	ksi	MPa
850	454	800	427	188	1296	185	1276	182	1255
		900	482	141	972	120	827	98	676
		1000	538	88	607	72	496	58	400
1000	538	800	427	140	965	138	951	135	931
		900	482	110	758	105	724	99	683
		1000	538	84	579	71	490	60	414

Typical Tensile Ductility at Elevated Temperatures
Bar



Typical Yield and Tensile Strengths at Elevated Temperatures
Bar



Heat Treatment

Annealing

Heat to 1850/1900°F (1024/1038°C) and cool rapidly.

Hardening

The alloy can be hardened by either sub-zero cooling or by a double-aging treatment. Hardening by sub-zero cooling will result in higher strength than that attained by double aging. "Conditioning" of the alloy by rapid cooling from 1710/1750°F (932/954°C) is required before either hardening treatment.

Double Age

1350/1400°F (732/760°C) for 3-4 hours, rapid cool; 825/875°F (440/468°C) for 2-3 hours, air cool. The 1350/1400°F (732/760°C) treatment results in carbide precipitation so that the material will completely transfer to martensite when rapidly cooled to room temperature. The treatment at 825/875°F (440/468°C) after transformation provides further increases in strength and hardness.

Sub-Zero Cooling

After conditioning, the alloy is held at -100°F (-73°C) for a minimum of 3 hours and then tempered at 850°F (454°C) for the best combination of strength and ductility. If, however, applications require better finish machining characteristics, higher impact strengths, or higher ductilities than are provided by an 850°F (454°C) temper, tempering temperatures up to 1000°F (538°C) may be employed. Optimum stress-corrosion-cracking resistance is provided by the 1000°F (538°C) temper.

Equalized and Overtempered

In this variation of double-age, treat at 1375/1475°F (732/801°C) for 3-4 hours, rapid cool, then treat at 1000/1100°F (538/593°C), air cool. This treatment imparts higher ductility and lower hardness than double aging. It is the condition in which this alloy is most readily machined.

Bars and billets are normally equalized and overtempered before being "conditioned" for hardening. Surface conditions such as nitriding, carburization, or decarburization are to be avoided as they will inhibit the response of the material to hardening.

Workability

Hot Working

The hot working characteristics of Pyromet alloy 355 are similar to those of other chromium-nickel stainless steels. It is worked from a maximum temperature of 2100°F (1149°C) and finished in the range 1700/1800°F (927/982°C). The use of starting temperatures higher than 2100°F (1149°C) results in an increased amount of delta ferrite in the alloy. A relatively low finishing temperature prevents subsequent grain coarsening and promotes homogeneous precipitation of carbides. Cool forgings in air to room temperature. Then equalize and over-temper.

Cold Working

In the annealed condition Pyromet alloy 355 is handled in much the same manner as AISI Type 300 series stainless steels. It has, however, a high rate of work hardening, about the same as AISI Type 301. When desirable the rate of work hardening may be lowered slightly by heating the material to 600/700°F (316/371°C) before cold working.

In the hardened condition this alloy has sufficient ductility for limited forming and straightening operations.

Machinability

Successful machining of Pyromet alloy 355 requires the same practices used for other stainless steels; i.e., rigid tool and work supports, slower speeds, positive cuts, absence of dwelling or glazing, and adequate amounts of coolant.

In the annealed condition this alloy has a high rate of work hardening and a tendency to be gummy. Machining this alloy in the annealed condition is not, therefore, recommended.

If machining is to be done after sub-zero hardening, tempering at 1000°F (538°C), hardness Rockwell C40, is suggested. This will provide improved machinability compared to that obtained after lower tempering treatments.

Optimum machinability of this alloy is obtained when the material is in the equalized and overtempered condition.

Following are typical feeds and speeds for Pyromet alloy 355.

Typical Machining Speeds and Feeds – Pyromet® Alloy 355

The speeds and feeds in the following charts are conservative recommendations for initial setup. Higher speeds and feeds may be attainable depending on machining environment.

Turning—Single-Point and Box Tools

Depth of Cut (Inches)	High Speed Tools			Carbide Tools (Inserts)				
	Tool Material	Speed (fpm)	Feed (ipr)	Tool Material	Speed (fpm) Brazed	Speed (fpm) Throw Away	Speed (fpm) Coated	Feed (ipr)
Equalized and Overtempered								
.150	T15, M33, M41/M47	70	.015	C6	250	280	400	.015
.025		75	.007	C7	300	350	475	.007
Aged HRC 38 - 40								
.150	T15, M41, M42, M43, M44	60	.015	C6	240	270	350	.010
.025		70	.007	C7	290	325	400	.005
Aged over HRC 40								
.150	T15, M41, M42, M43, M44	40	.010	C6	150	190	250	.010
.025		45	.005	C7	190	225	280	.005

Turning—Cut-Off and Form Tools

Tool Material		Speed (fpm)	Feed (ipr)						
			Cut-Off Tool Width (Inches)				Form Tool Width (Inches)		
High Speed Tools	Carbide Tools		1/16	1/8	1/4	1/2	1	1 ½	2
Equalized and Overtempered									
M2 T15		45	.001	.001	.0015	.0015	.001	.001	.0005
	C6	175	.0025	.0025	.003	.003	.0025	.0025	.0015
Aged HRC 38 - 40									
M2 T15		40	.001	.001	.001	.0015	.001	.001	.0005
	C6	170	.0025	.0025	.003	.003	.002	.002	.002
Aged over HRC 40									
M2 T42		25	.001	.001	.0015	.0015	.001	.0005	.0005
	C6	110	.0025	.0025	.0035	.0025	.0015	.0015	.0015

Rough Reaming

High Speed		Carbide Tools		Feed (ipr) Reamer Diameter (inches)					
Tool Material	Speed (fpm)	Tool Material	Speed (fpm)	1/8	1/4	1/2	1	1 ½	2
Equalized and Overtempered									
M7	60	C2	190	.003	.005	.008	.011	.015	.018
Aged HRC 38 - 40									
T15	30	C2	100	.001	.001	.001	.001	.001	.001
Aged over HRC 40									
T15	-	C2	-	-	-	-	-	-	-

Drilling

Tool Material	Speed (fpm)	High Speed Tools — Feed (inches per revolution) Nominal Hole Diameter (inches)							
		1/16	1/8	1/4	1/2	3/4	1	1 ½	2
Equalized and Overtempered									
M1, M10	50	.001	.002	.004	.007	.008	.010	.012	.015
Aged HRC 38 - 40									
T15, M42	35	-	.002	.004	.006	.008	.009	.011	.012
Aged over HRC 40									
T15, M42	20	-	.001	.002	.003	.004	.004	.004	.004

Die Threading

Tool Material	FPM for High Speed Tools — 7 or less, tpi	8 to 15, tpi	16 to 24, tpi	25 and up, tpi
Equalized and Overtempered				
M1, M2, M7, M10	5 – 12	8 – 15	10 – 20	15 – 25
Aged				
T15, M42	4 – 8	6 – 10	8 – 12	10 – 15

Milling, End-Peripheral

Depth of Cut (inches)	High Speed Tools — Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (in) 1/4	1/2	3/4	1-2	Carbide Tools — Tool Material	Speed (fpm)	Feed (ipt) Cutter Diameter (in) 1/4	1/2	3/4	1-2
Equalized and Overtempered												
.050	M2, M7	85	.001	.002	.003	.004	C2	230	.001	.002	.004	.006
Aged HRC 38 - 40												
.050	M2, M7	65	.0005	.001	.002	.003	C2	190	.001	.002	.003	.004
Aged over HRC 40												
.050	T15	60	.0005	.001	.002	.003	C2	90	.001	.002	.003	.004

Tapping

High Speed Tools — Tool Material	Speed (fpm)
Equalized and Overtempered	
M1, M7, M10	12 – 25
Aged HRC 38 - 40	
M1, M7, M10	10 - 20
Aged over HRC 40	
M1, M7, M10 Nitrided	5 – 15

Broaching

High Speed Tools — Tool Material	Speed (fpm)	Chip Load (ipt)
Equalized and Overtempered		
T15, M42	10	.002
Aged HRC 38 - 40		
T15, M42	8	.002
Aged over HRC 40		
-	-	-

When using carbide tools, surface speed feet/minute (SFPM) can be increased between 2 and 3 times over the high-speed suggestions. Feeds can be increased between 50 and 100%.

Figures used for all metal removal operations covered are average. On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Additional Machinability Notes

When using carbide tools, surface speed feet/minute (sfpm) can be increased between 2 and 3 times over the high speed suggestions. Feeds can be increased between 50 and 100%.

Figures used for all metal removal operations covered are average. On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Weldability

Carpenter Pyromet alloy 355 can be satisfactorily welded by the shielded fusion and resistance welding processes. Oxyacteylene welding is not recommended, since carbon pickup in the weld may occur. When a filler metal is required, a matching analysis should be used to provide welds with properties approximately the same as the base metal. When designing the weld joint, care should be exercised to avoid stress concentrators, such as sharp corners, threads, and partial-penetration welds. When high weld strength is not needed, a standard austenitic stainless filler, such as E/ER 308, should be considered.

Preheating is not required to prevent cracking. If possible, the weldment should be annealed after welding to provide the optimum combination of strength, ductility and corrosion resistance.

Brazing

All common silver- or nickel-base brazing alloys with flow points between 1600/1900°F (871/1038°C) can be used successfully on Pyromet alloy 355. If the brazing temperature is above 1710°F (932°C), the material should be cooled to 1710°F (932°C) and held for a short time before cooling to room temperature.

Other Information

Applicable Specifications

Carpenter Pyromet alloy 355 meets specifications:
AMS 5743 (bars, equalized and over-tempered)
AMS 5744 (bars, sub-zero cooled and tempered)

- AMS 5743
- AMS 5744

Forms Manufactured

- Bar-Flats
- Bar-Rounds
- Billet
- Wire

Technical Articles

- How to Passivate Stainless Steel Parts
- Passivating and Electropolishing Stainless Steel Parts

Disclaimer:
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