

Machining

Nickel alloys work harden rapidly during machining and require more power to cut than does plain carbon steel. The metal is “gummy”, with chips that tend to be stringy and tough. Machine tools should be rigid and used to no more than 75% of their rated capacity. Both work piece and tool should be held rigidly; tool overhang should be minimized. Rigidity is particularly important when machining titanium, as titanium has a much lower modulus of elasticity than either steel or nickel alloys. Slender work pieces of titanium may deflect under tool pressures causing chatter, tool rubbing and tolerance problems.

Make sure that tools are always sharp. Change to sharpened tools at regular intervals rather than out of necessity. Titanium chips in particular tend to gall and weld to the tool cutting edges, speeding up tool wear and failure. Remember— cutting edges,

particularly throw-away inserts, are expendable. Don't trade dollars in machine time for pennies in tool cost.

Feed rate should be high enough to ensure that the tool cutting edge is getting under the previous cut thus avoiding work-hardened zones. Slow speeds are generally required with heavy cuts. The tool should not ride on the work piece as this will work harden the material and result in early tool dulling or breakage. Use an air jet directed on the tool when dry cutting, to significantly increase tool life.

The following speeds are for single point turning operations using high speed steel tools. This information is provided as a guide to relative machinability, higher speeds are used with carbide tooling.

Material	Speed Surface ft/min	Speed as a % of B1112
AISI B1112	165	100
AISI 12L14	325	197
AISI 1215	225	136
Nickel 200/201	170-200	103-121
416 annealed	170	103
416 hardened	80	48
AISI 1137	135	82
AISI 1018	120	73
303	100-105	61-64
304L	90	55
17-4PH [®] H1150	80	48
17-4PH “A”	75	45
17-4PH H1025	60	36
AISI 1045	75	45
H11	75	45
316L	75	45
321	75	45
RA446	75	45
RA309	70-75	42-45
RA310	70-75	42-45
AL-6XN [®]	65-75	39-45
RA400	60-70	36-42
440C	65	39
4340	65	39
20Cb-3 [®]	65	39
RA2205	50-65	30-39

Material	Speed Surface ft/min	Speed as a % of B1112
K500 annealed	60	36
K500 aged	25	15
RA330 [®]	35-45	21-27
RA85H [®]	32-40	20-24
Ti 6Al 4V annealed	30-40	18-24
aged	15-45	9-27
718	20-40	12-24
A-286	30-35	18-21
RA825	25-35	15-21
RA800AT	25-35	15-21
RA601	25-35	15-21
RA600	25-35	15-21
RA333 [®]	20-25	12-15
X	20	12
625	20	12
617	20	12
X-750	20	12
WASPALLOY™	20	12
C-276	20	12
C-22	20	12
B2	15-20	9-12
G-30	15-20	9-12
N155	15-20	9-12
188	15	9
L605 (25)	15	9
René 41 [®]	12	7