Solutions of ME 355 Home Work No. 4

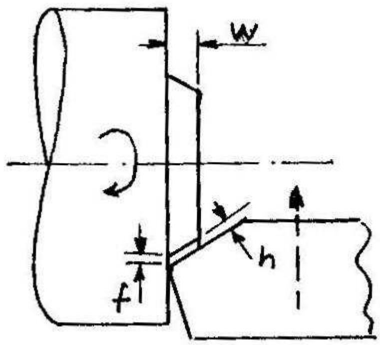
1. 16C-2

From Table 16-1 (p632)

Material	*hp· min/in^3*	*in^3/(hp· min)*	*in^3/min for 5 hp*	*mm^3/s for 3.73 kW*
Steel (HB 270)	0.9	1.11	5.55	1554
Al alloy	0.2	5.0	25	7460
Super alloy	1.6	0.63	3.13	829

2. 16C-8

(a) *w* depth of cut; *f* feed; *h* underformed chip thickness.
(Refer to Fig. 16-32 instead of Fig. 10)



(b) From Fig. 16-45 (p686): $v_s = 1.5$m/s; $f_s = 0.5$mm
From Table 16-5 (p688): $Z_v = 1.2$; $Z_f = 0.5$
Thus v = (1.2)(1.5) = 1.8 m/s and
f = (0.5)(0.5) = 0.25 mm

(c) Distance to center: 100 mm at f = 0.25 mm;
Number of revolutions = 100/0.25 = 400
Time/r = circumference/speed = 0.2π/1.8 = 0.349 s
Total time = (400)(0.349) = 140 s = 2.33 min

3. 16C-12

(a) First, the hardness of the workpiece material must be found. The metallurgical condition is not defined; assume either annealed or, for greater strength, cold-worked. It is similar to 302 SS; from Table 8-2 (p282), TS = 600 MPa, thus HB = 3(600)/9.8 = 183. (*refer to p318*)

Common twist drills are made of HSS.
From Fig. 16-45, taking HB = 183, and taking into account a 25% reduction for austenitic stainless steel

$$v_s = 0.5 \text{ m/s/ from Sec. 16-7-1, } v = 0.7v_s = 0.35 \text{ m/s}$$

(b) Drill r/min v/πD = (0.35)(1000)/(6) π = 18.75 r/s = 1114 r/min
(c) From Sec. 16-7-1, feed = 0.01D/r = 0.06 mm/r
(d) Feed rate = (feed)(r/min) = (0.06)(1114) = 66.87 mm/min = 1.1142 mm/s
(e) The drill has two cutting edges, therefore (*refer to p633*)

h = feed/2 = 0.06/2 = 0.03 mm

Note that in Eq. (16-15) the reference thickness is 1 mm; thus:

$h^a = (0.03)^{-0.4} = 4.07$

From Table 16-1, $E_1 = 2.3$ W.s/mm^3

Eq. (16-16a): W= (E Vt)/η

$V_t = (\pi D^2/4)$(feed rate) = $(6^2\pi/4)$ (1.1142) = 31.5 mm^3/s

Taking η = 0.7

Power = (9.36)(31.5)/(0.7) = 421 W (= 0.56 hp)

4. 16C-14

From Eq. (16-19)

$vt^n = C$

$v(60)^{0.25} = 1000$

v = 360 fpm

5. 16C-18

A 30 percent increase in production rate can be obtained by increasing (a) speed, (b) feed, or (c) depth of cut by 30 percent, leaving the other two variables at their base value; the base value can be taken as unity.

For HSS tools, from Eq. (16-21) (p643), with K = 100

	Relative tool life
Basic tool life for v = f = w = 1	100/1 = 100
For v = 1.3	$100/1.3^{1/0.1} = 7.25$
For f = 1.3	$100/1.3^{1/0.18} = 23.3$
For w = 1.3	$100/1.3^{1/0.45} = 55.82$

Thus, tool life drops, from its original value, by a factor of 100/7.25 = 14 for speed, 100/23.3 = 4.3 for feed, 100/55.82 = 1.8 for depth of cut.

(d) Obviously, if production rates must be increased, one should first increase depth of cut, then feed, and only lastly speed.