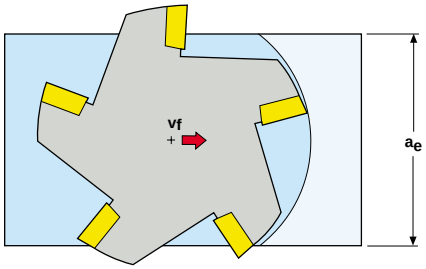
Calculating The Power Demand

$$P_c = \frac{Q}{396{,}000 \cdot \eta} \cdot k_c$$



P_c = Power HP
a_p = Depth of cut inch
a_e = Width of cut inch
v_f = Feed speed in/min
η = Efficiency
k_c = Cutting force per inch^2 (Lbf/inch^2)

Calculating Average Chip Thickness, h_m, and Cutting Force Per inch^2, k_c

Use the formula below or use the table on page 282–283.

For $a_e/D > 30\%$

$$h_m = \frac{360 \cdot f_z \cdot a_e}{\pi \cdot D \cdot \omega_e} \cdot \sin \kappa$$

For $a_e/D < 30\%$

$$h_m = f_z \cdot \sqrt{\frac{a_e}{D}} \cdot \sin \kappa$$

$$k_c = \frac{1 - .01 \cdot \gamma_o}{\left(\frac{h_m}{.04}\right)^{m_c}} \cdot k_{c1.1}$$

h_m = Average chip thickness inch
f_z = Feed per tooth inch/tooth
a_e = Width of cut inch
D = Cutter diameter inch
ω_e = Engagement angle (see table below)
κ = Cutting edge angle°

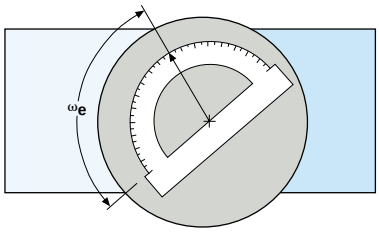
k_c = Cutting force/in^2 Lbf/inch^2
γ_o = Effective rake angle (Rake angle of cutter (γ_o) + rake angle of insert)
h_m = Average chip thickness inch
m_c = Exponent (see page 297)
$k_{c1.1}$ = Cutting force for .04 inch chip thickness Lbf/inch^2

Engagement Angle

Engagement a_e/D	Engagement Angle ω_e
Cutter Position: Center	
75%	97°
100%	180°
Cutter position: off center	
5%	26°
10%	37°
25%	60°

Effective Rake Angle, m_c-Factor and $k_{c1.1}$-Value
Effective rake angle value can be found on the insert pages. Add the value of the actual cutter.

The m_c-exponent and the $k_{c1.1}$-value for each material group can be found on page 297.



Engagement angle can be read from a simple drawing using a graduated arc.

Example

Calculate power demand for a face milling cutter:
220.13, Ø 6.30, z = 7
Insert: SEKR42AFTN-ME13 T25M.

Material group = 3
Depth of cut a_p = .197 inch
Width of cut a_e = 4.72 inch
Cutter position = center
Feed per tooth f_z = .0083 inch/tooth
Cutting speed v_c = 705 ft/min

Calculate RPM and Feed Speed
See formula on page 277

$$n = \frac{705 \cdot 12}{\pi \cdot 6.30} = 428 \text{ RPM}$$

$v_f = 7 \cdot .0083 \cdot 428 = 24.8$ in/min

Calculate Average Chip Thickness, h_m
$a_e/D = 4.72/6.30 = 75\%$ Engagement angle ω_e = 97° (see table above)

Average chip thickness $h_m = \frac{360 \cdot .0083 \cdot 4.72}{\pi \cdot 6.30 \cdot 97} \cdot \sin 45° = .0052$ inch

Calculate Cutting Force Per mm^2 k_c
See page 309 Material Group 3
$k_{c1.1}$-value = 218,000 Lbf/in^2
m_c-exponent = 0.25
Rake angle for cutter = 12° (page 42)
Rake angle for insert = 24° (page 253)
Effective rake angle γ_o = 36°

Cutting force per inch^2 $k_c = \frac{1 - 0.01 \cdot 36}{\left(\frac{.0052}{.04}\right)^{.25}} \cdot 218{,}000 = 232{,}354$ Lbs/inch^2

Calculate Power, P_c
Efficiency η = 80%

Power $P_c = \frac{23.06}{396{,}000 \cdot 0.80} \cdot 232{,}354 = 16.9$ HP