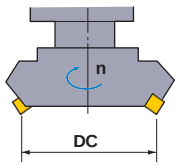
FORMULAE FOR FACE MILLING

yCUTTING SPEED (vc)

$$vc = \frac{u \bullet DC \bullet n}{1000}$$

vc (m/min) : Cutting Speed
DC(mm) : Cutter Diameter
n (min^{-1}) : Main Axis Spindle

∗Divide by 1000 to change to m



(Problem What is the cutting speed when main axis spindle speed is 350min^{-1} and the cutter diameter is &125 ?

(Answer

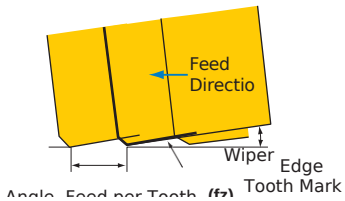
$$vc = \frac{u \bullet DC \bullet n}{1000} = \frac{3.14 \times 125 \times 350}{1000} =$$

The cutting speed is

yFEED PER TOOTH (fz)

$$fz = \frac{vf}{z \bullet} \text{ (mm/tooth)}$$

fz (mm/tooth): Feed per **z:** Insert
vf (mm/min) : Table Feed per Min.
n (min^{-1}) : Main Axis Spindle Speed (Feed per Revolution **f = z x fz**)



(Problem What is the feed per tooth when the main axis spindle speed is 500min^{-1}, number of insert is 10, and table feed is 500mm/min ?

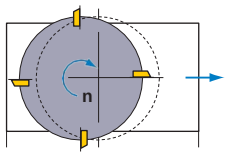
$$fz = \frac{vf}{z \times n} = \frac{500}{10 \times 500} = 0.1\text{mm/tooth}$$

The answer is

yTABLE FEED (vf)

$$vf = fz \bullet z \bullet n$$

vf (mm/min) : Table Feed per Min. **z :** Insert
n (min^{-1}) : Main Axis Spindle Speed



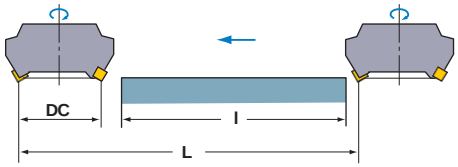
(Problem) What is the table feed when feed per tooth is 0.1mm/tooth, number of insert is 10, and main axis spindle speed is 500min^{-1}?
Substitute the above figures into the formula.

vf = fz×z×n = 0.1×10×500 = 500mm/min

yCUTTING TIME (Tc)

$$Tc = \frac{L}{vf} \text{ (min)}$$

Tc (min) : Cutting
vf (mm/min) : Table Feed per
L (mm) : Total Table Feed Length (Workpiece Length: (**l**)+Cutter Diameter : (**DC**))



(Problem What is the cutting time required for finishing 100mm width and 300mm length surface of a cast iron (JIS FC200) block when the cutter diameter is &200mm, the number of inserts is 16, the cutting speed is 125m/min, and feed per tooth is 0.25mm. (spindle speed is 200min^{-1}) Calculate table feed per min vf=0.25×16×200=800mm/min

(Answer

$$Tc = \frac{500}{800} = 0.625 \text{ (min)}$$

0.625×60=37.5 (sec). The answer is

yCUTTING POWER (Pc)

$$Pc = \frac{ap \cdot ae \cdot vf \cdot}{60 \times 10^6 \times}$$

Pc (kW) : Actual Cutting Power
ae (mm) : Cutting Width
Kc (MPa)
ap (mm) : Depth of
vf (mm/min) : Table Feed per Min.

(Problem) What is the cutting power required for milling tool steel at a cutting speed of 80m/min. With depth of cut 2mm, cutting width 80mm, and table feed 280mm/min by & 250 cutter with 12 inserts. Machine coefficient 80%.

(Answer) First, calculate the spindle speed in order to obtain feed per tooth.

$$n = \frac{1000vc}{_1\ uDC} = \frac{1000 \times 80}{3.14 \times 250} = 101.91min^{-}$$

Feed per Tooth

$$fz = \frac{vf}{z \times n} = \frac{280}{12 \times 101.9} = 0.228mm/tooth$$

Substitute the specific cutting force into the formula.

$$Pc = \frac{2 \times 80 \times 280 \times 1800}{60 \times 10^6 \times 0.8} = 1.68\ kW$$

a
Kc

Work Material	Tensile Strength (MPa) and Hardness	Specific Cutting Force Kc (MPa)				
		0.1mm/tooth	0.2mm/tooth	0.3mm/tooth	0.4mm/tooth	0.6mm/tooth
Mild Steel	**520**	2200	1950	1820	1700	1580
Medium Steel	**620**	1980	1800	1730	1600	1570
Hard Steel	**720**	2520	2200	2040	1850	1740
Tool Steel	**670**	1980	1800	1730	1700	1600
Tool Steel	**770**	2030	1800	1750	1700	1580
Chrome Manganese Steel	**770**	2300	2000	1880	1750	1660
Chrome Manganese Steel	**630**	2750	2300	2060	1800	1780
Chrome Molybdenum Steel	**730**	2540	2250	2140	2000	1800
Chrome Molybdenum Steel	**600**	2180	2000	1860	1800	1670
Nickel Chrome Molybdenum Steel	**940**	2000	1800	1680	1600	1500
Nickel Chrome Molybdenum Steel	**352HB**	2100	1900	1760	1700	1530
Austenitic Stainless Steel	**155HB**	2030	1970	1900	1770	1710
Cast Iron	**520**	2800	2500	2320	2200	2040
Hard Cast Iron	**46HRC**	3000	2700	2500	2400	2200
Meehanite Cast Iron	**360**	2180	2000	1750	1600	1470
Grey Cast Iron	**200HB**	1750	1400	1240	1050	970
Brass	**500**	1150	950	800	700	630
Light Alloy (Al-Mg)	**160**	580	480	400	350	320
Light Alloy (Al-Si)	**200**	700	600	490	450	390
Light Alloy (Al-Zn-Mg-Cu)	**570**	880	840	840	810	720

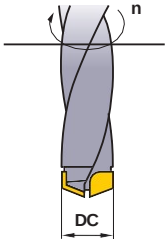
FORMULAE FOR DRILLING

yCUTTING SPEED (vc)

$$vc = \frac{) \bullet DC \bullet n}{1000}$$

vc (m/min) : Cutting
) : Pi
DC (mm) : Drill Diameter
n (min^{-1}) : Main Axis Spindle

∗Divide by 1,000 to change to m



(Problem) What is the cutting speed when main axis spindle speed is 1350min^{-1} and drill diameter is 12mm ?

(Answer) Substitute)=3.14, DC=12, n=1350 into the formula

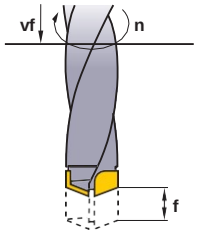
$$vc = \frac{) \bullet DC \bullet n}{1000} = \frac{3.14 \times 12 \times 1350}{1000} =$$

The cutting speed is

yFEED OF THE MAIN SPINDLE (vf)

$$vf = fr \bullet$$

vf (mm/min) : Feed Speed of the Main Spindle (Z axis)
fr (mm/rev) : Feed per Revolution



(Problem) What is the spindle feed (vf) when the feed per revolution is 0.2mm/rev and main axis spindle speed is 1350min^{-1} ?

(Answer) Substitute f=0.2, n=1350 into the formula

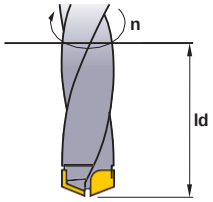
vf = f×n = 0.2×1350 = 270mm/min

The spindle feed is 270mm/min.

yDRILLING TIME (Tc)

$$Tc = \frac{ld \bullet i}{n \bullet fr}$$

Tc (min) : Drilling Time
n (min^{-1}) : Spindle Speed
ld (mm) : Hole Depth
fr (mm/rev) : Feed per
i : Number of



(Problem) What is the drilling time required for drilling a 30mm length hole in alloy steel (JIS SCM440) at a

(Answer) Spindle Speed $n = \frac{50 \times 1000}{15 \times 3.14} =$

$$Tc = \frac{30 \times 1}{1061.57 \times 0.15} = 0.188$$

$$= 0.188 \times 60 \blacksquare 11.3$$

TECHNICAL DATA