June 1980

FOREST PRODUCTS UTILIZATION

TECHNICAL REPORT No. 10

How to Calculate Required Horsepower for Circular Saws

The horsepower required for a circular saw is determined by several interrelated factors: tooth style; number of teeth; saw speed; kerf width; bite; wood hardness; and cant face width.

A formula developed by Hiram Hallock, retired, U.S. Forest Service, can be used to determine horsepower requirements. The formula is:

HP = gullet area of one tooth X number of teeth in saw X saw speed X bite factor X wood hardness factor X kerf width factor X face width factor X 0.003.

Gullet Area

The gullet area of commonly used inserted sawteeth is:

Tooth Style	Gullet Area In.^{2}
2-1/2	1.5
F	2.0
3, B	2.5
3-1/2	3.0
D, 4-1/2	4.0

Graph paper can be used to make a tracing of the outline of a solid tooth and the gullet area can easily be determined by counting the squares.

Number of Teeth in Saw

Simply count the number of teeth in the saw.

Saw Speed

The saw speed, or RPM, should be that while in the cut. A speed indicator should be used to determine saw speed but calculations can be made provided the motor speed is known. The basic relationship is:

$$\frac{\text{Diameter of drive}}{\text{Diameter of driven}} = \frac{\text{Speed of driven}}{\text{Speed of drive}}$$

Bite Factor

To obtain the Bite Factor, the feed-per-tooth must first be determined. Feed-per-tooth can be determined depending on what you know.

If you know the carriage speed in FPM, then you can calculate feed-per-tooth as follows:

$$\text{Feed-per-tooth, in.} = \frac{\text{carriage speed, fpm x 12}}{\text{saw rpm X number of teeth in saw}}$$

or, if you know carriage feed, in. per one saw revolution, then you can calculate feed-per-tooth as follows:

$$\text{Feed-per-tooth, in.} = \frac{\text{feed per 1 revolution of saw}}{\text{number of teeth}}$$

Then calculate the Bite Factor, which is used in the HP formula, as follows:

Bite Factor = 0.5 + (4 X feed-per-tooth, in.)

Wood Hardness Factor

The Wood Hardness Factor is found by multiplying the average green specific gravity of the wood (based on ovendry weight and green volume) times 2.2.

Kerf Width Factor

The Kerf Width Factor is found by multiplying the kerf width times 2.91.

Face Width Factor

The Face Width Factor must also be calculated. It takes into account the width of the face being sawn as it relates to the maximum face width that can be sawn under given conditions. It is further assumed that the gullet can chmaber and hold sawdust without complications from a solid wood amount equivalent to 70 percent of the total gullet area.

The maximum cant face width is calculated as follows:

$$\text{Maximum cant face width} = \frac{\text{gullet area of 1 tooth, in.}^2}{\text{feed-per-tooth, in.}} \times .70$$

Normally, for inserted tooth saws 3 inches is added to the above answer. To obtain the Face Width Factor, divide the cant face width desired by the maximum cant-face width as determined above.

The following example will illustrate the use of the HP formula:

Saw type	F style, inserted tooth
Gullet area	2.0 in.^{2}
Number of teeth	48
Saw speed	650 RPM
Carriage speed	271 FPM
Kerf width	.281 inches
Specific gravity of wood sawn	.45
Maximum cant face width sawn	12 inches

$$\text{Feed-per-tooth, in.} = \frac{271 \times 12}{650 \times 48} = .10$$

$$\text{Bite Factor} = .5 + (4 \times .10) = .9$$

$$\text{Wood Hardness Factor} = .45 \times 2.2 = .99$$

$$\text{Kerf Width Factor} = .281 \times 2.91 = .82$$

$$\text{Maximum Cant Face Width, in.} = \left(\frac{2.0}{.1} \times .70\right) + 3 = 17$$

$$\text{Face Width Factor} = \frac{12}{17} = .71$$

Now insert all of the required information into the HP formula and calculate required HP:

$$HP = 2.0 \times 48 \times 650 \times .9 \times .99 \times .82 \times .71 \times .003 = 97$$

STANFORD J. LUNSTRUM, Forest Products Technologist
Forest Products Utilization

USDA, Forest Service, State & Private Forestry
Division of Cooperative Forestry, P.O. Box 5130, Madison, Wis. 53705