

Blade Tip Speed

A fair amount of noise has been made regarding blade tip speed in regard to mowing grass. Some manufacturers make a big deal out of a 19,000 feet per minute tip speed. Why 19,000 feet per minute? Well, 19,000 feet per minute has been established as the maximum tip speed lawn mowers may be run at by the ANSI B71.1 safety standard. Some customers have come to demand that any zero turn mower have a 19,000 fpm tip speed before they even consider it. But is it really all that important?

First, is the consideration of the number itself. 19,000 is the maximum. Any reputable manufacturer will keep his tip speed far enough under 19,000 to ensure that it won't be exceeded due to normal manufacturing variation. Such a reputable manufacturer would have a hard time in good conscience claiming a tip speed of 19,000 fpm since his average would be below that number.

Secondly: Is 19,000 fpm required to cut grass? The answer is no! It has been shown that tip speeds of 14,000-15,000 feet per minute will cut grass and do it at high ground speeds! Witness the Ransomes 700 series front lines and the previous Jaguar 6000 series which have tip speeds in this range. What higher speeds really do is blow more air. This does aid in discharge, but uses more horse power and wastes fuel. Higher speeds do prove useful in mulching by providing more cuts to chew up the clippings better.

To illustrate the minimal effect tip speed has on cutting performance once it is anywhere close to 19,000 fpm consider two cutterdecks, identical, but one has a tip speed of 19,000 fpm while the other runs at 18,000 fpm. Let us further assume a very fast mowing speed of 8 miles per hour and that both decks use 21" long blades.

$$(8\text{mi/hr})(5280\text{ft/mi})(1\text{hr}/60\text{min}) = 704\text{ ft/min} = 8448\text{ in/min of forward travel}$$

$$(19,000\text{ft/min})(12\text{in/ft})(1/21\text{in})(1/3.1416) = 3456\text{ blade rpm}$$

$$(18,000\text{ft/min})(12\text{in/ft})(1/21\text{in})(1/3.1416) = 3274\text{ blade rpm}$$

$$\begin{array}{rcl} \text{Those blade rpm give } & 3456 \times 2 & \text{cutting edges} = 6912 \text{ (19,000 tip speed) cuts per minute} \\ & 3274 \times 2 & 6548 \text{ (18,000 tip speed)} \end{array}$$

The 19,000 blade only gives 5-1/2% more cuts per minute. Even more telling is the machine advance per cut:

$$(8448\text{in/min of forward travel})/(6912\text{ cuts/min}) = 1.22\text{ in advance per cut}$$

$$(8448\text{in/min of forward travel})/(6548\text{ cuts/min}) = 1.29\text{ in advance per cut}$$

That is only an extra .06" advance per cut-less than 1/16 of an inch. 1/16th is hardly enough to measure, much less get concerned about. Consider that blades generally have 4 to 5 inches of sharpened area and it is clear that blade tip speeds really have to slack off dramatically by multiple thousands of rpm before you would run out of blade to cut grass.

The upshot of it all is that anyone who is selling the magic of 19,000 feet per minute is selling smoke and mirrors. You might just want to ask what other smoke and mirrors he is selling. Spending money is a fine thing, but you want to really get something for your money. The proof is what the machine does in grass. If it works, tip speed is of no consequence.

Just for the record, the Ransomes Bob-Cat 200 series ZT 61" cutterdeck runs at 18,310 feet per minute at 3400 engine rpm. It does work, it does cut grass.