

FACT SHEET

GEAR SELECTION AND ENGINE SPEED

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Fuel consumption is largely determined by the way a tractor is operated. Drawbar load, engine speed, the gear used, amount of turning and amount of engine idle time can cause fuel consumption to vary more than 30 percent for a given task.

To operate efficiently, a tractor engine should be operated at its rated capacity. Diesel, gasoline and LP-gas tractors all operate most efficiently under heavy loads when the throttle is wide open. Diesel tractors have the added advantage of greater "lugging" ability, the ability to pull at slower engine speeds when the tractor and implement are bogged down. The gear selection process for diesel tractors is the same as the gasoline or LP-gas tractors. Select the highest gear at which the engine will operate at its rated speed when pulling heavy loads.

Excessive black smoke from a diesel engine means that it is lugging too hard and wasting fuel. Overloading any tractor causes excessive fuel consumption and rapid engine and drive-train wear. Overloads occur when the tractor engine cannot reach its full rated speed. In these situations, shift to a lower gear.

To determine if the tractor is overloaded, slow the engine to half throttle while the tractor is moving across the field under load. Then move the throttle to its wide-open position. If the engine quickly reaches its rated operating speed, the tractor is not overloaded.

Many field operations, such as spraying and planting, do not require full-rated tractor horsepower. A similar situation exists when implements sized for a smaller tractor are used with high horsepower tractors. Additionally, many operations must be performed at a fixed field speed. For light or part-load operations, consider shifting to a higher gear and slowing the engine speed to maintain the desired field speed. Slower engine speeds improve fuel efficiency.

The "gear up — throttle down" concept can be demonstrated with Nebraska Tractor Test data.¹ In the Nebraska tests, the tractor was tested for maximum drawbar horsepower in a gear selected by the tractor manufacturer. In the same gear, the tractor was tested pulling 50 percent of the maximum power run load. Then, the tractor was tested in a higher gear and at a reduced engine speed to maintain the same pull and travel speed as in the second run.

During the third run, most tractors tested used between 15 and 30 percent less fuel than during the second run, even though the same amount of work was performed. Throttle setting and gear selection were the only factors changed.

The "gear up — throttle down" practice usually can be used when loads require less than two-thirds of the tractor's power. Generally, it is safe to reduce engine speed by 20 to 25 percent of the rated speed. Check the operator's manual for specific recommendations for your tractor.

When using the practice of "gear up — throttle down," remember not to overload or lug the engine. A simple rule for diesel tractors pulling light loads is to select a gear and engine speed in which the exhaust smoke is not excessive. You can also test for an overload by using the throttle test mentioned previously. Most diesel engines can stand moderate overloads at part speed. Remember, however, the drawbar power required remains the same when you shift up and reduce speed. Power is a combination of speed and torque. Sustained high torque loads, resulting from either excessive load and weight or incorrect gear and speed selection, can damage transmission and other drive-train components.

Also, remember that when engine speed is reduced, power take off (PTO) speed is correspondingly reduced. In addition, with reduced engine speed, reaction time of the tractor hydraulic system is slower.

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¹ "Nebraska Tractor Test Data," Department of Agricultural Engineering, University of Nebraska, Lincoln, NE 68583.

Table 1. Tractor and operation comparison

	Small tractor	Large tractor	Large tractor
Throttle setting	Full	Full	Reduced
Percent load	100%	50%	50%
Drawbar horsepower	55.79	56.67	56.72
Fuel consumption (gallons/hour)	4.49	5.23	4.20
Fuel efficiency (horsepower hours/gallon)	12.54	10.91	13.55

Nebraska tractor tests indicate that a large diesel tractor operated at reduced engine speed for light drawbar loads may actually use less fuel than a smaller tractor working at its rated capacity.

Table 1 compares the performance of a large tractor rated at 110 drawbar horsepower and a smaller tractor rated at 56 drawbar horsepower on a load requiring 55 drawbar horsepower. Data in Table 1 indicate that the large tractor geared up and throttled down had the highest fuel efficiency —

13.55 horsepower hours per gallon. This is a reduction of about 1 gallon per hour over full throttle operation of the large tractor and 0.29 gallon per hour over the small tractor. A large tractor properly matched to a light load may save fuel compared to a smaller tractor operating at full load.

Many tractor operators think that because a diesel tractor is turbocharged it should be operated at full-rated speed. If full drawbar horsepower is not required, this is not justified.

Fuel consumption and fuel efficiency vary widely for specific tractors. Fuel efficiency (horsepower hours per gallon) is the amount of work the tractor produces per gallon of fuel used. This measure is not influenced by engine size and can be used to compare efficiencies of tractors with different horsepower.

By keeping accurate records of the fuel usage of your tractors under a variety of operating conditions, you can make decisions concerning the most efficient operation of the machine. Also, good records can indicate when tune ups or repairs are needed.

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