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Proper Ballast and Tire Inflation

Tim Stombaugh, Scott Shearer, John Wilhoit, and Sam McNeill

Two keys to getting the best traction out of a tractor are proper ballasting and correct tire inflation. These two must be adjusted together to get the best performance. In addition to wasting fuel, improper inflation and ballast can cause excessive tire wear, excessive wear on the tractor drive train, and even power hop. This publication will help you as producers to better understand proper ballasting and tire inflation techniques.

When setting up a tractor, always consult your tractor and tire manufacturers' recommendations first. The manufacturers have a vested interest in your tractor performing at its best, so you should be able to trust the information you get from them. An example of one of these resources is Goodyear's Farm Tire Handbook at www.goodyear.ca/tires/farm/pdf/GoodyearFarmHandbook.pdf. The guidelines below will help you to verify and fine tune the manufacturer's information.

The Goal

The key tractive performance indicator for tractors is wheel slip. Many operators are not comfortable operating with the amount of wheel slip that they should have. In most soil conditions, your tractor is operating at its best tractive efficiency when you have about 10 percent wheel slip for MFWD and 4WD tractors; 13-15 percent for 2WD tractors; and around 6 percent for track tractors. Adjust ballast and inflation to get as close to these goals as possible.

Ballasting

Ballasting is the art and science of putting the right amount of weight on each axle of your tractor to get the best tractive performance. If you don't have enough weight on a powered axle, the wheels will spin out and you will not be able to develop enough tractive effort; too much weight will cause excessive strain on the driveline. Both situations will cause excessive or unusual tire wear and will lower fuel efficiency.

Two factors contribute to the proper ballasting of a tractor: determining the optimum weight of the tractor and the proper distribution of that weight between the front and rear axles.

Tractor Weight

For best performance, most MFWD and 2WD tractors should weigh between 120 and 145 lb/HP; 4WD tractors should be between 85 and 125 lb/HP. Simply multiply the desired weight per horsepower by the rated horsepower for your tractor to determine the optimum tractor weight. The tractor should be on the lighter end of the range for higher speed operation, and it should be heavier for lower speed, high draft loads.

Weight Distribution

The next step is to determine how the weight is to be distributed between the front and rear axles. Again, this distribution will vary by tractor type and hitch configuration. MFWD and 4WD tractors require more weight on the front to better utilize the powered front axles. Mounted implements also require more weight on the front for vehicle stability. (See Table 1.)

Table 1. Approximate weight splits as %front/%rear.

Tractor Type	Towed	Mounted
2WD	25/75	35/65
MFWD	35/65	40/60
4WD	55/45	60/40

Use scales to weigh each axle of the tractor independently. If the duals are too wide for the scale, put blocks under the inside duals to just lift the outside duals off of the ground. Keep the tractor as level as possible when weighing.

You may need to adjust the ballast and weight distribution once you get in the field. Most newer tractors have performance monitors that will display wheel slip. Add more weight to an axle to reduce slip, remove weight to increase slip. Be

If your tractor does not have a performance monitor that shows wheel slip, it is relatively simple to measure. Put some kind of visible mark on the sidewall of your tire. Place two flags or stakes in the field about 200 feet apart along the work swath. You will want to count the number of revolutions of the tire as the tractor travels between the two flags. Do it once with the implement up to get the unloaded revolutions. Then do it again with the implement down to get the loaded revolutions. The percentage of slip can be calculated as follows:

$$\left(\frac{Loaded\ \mathrm{Re}v.}{Unloaded\ \mathrm{Re}v.} - 1 \right) * 100$$

aware that as you add ballast you may need to increase tire inflation pressures accordingly! Read the section below on proper tire inflation.

Tire Inflation

Most producers have a tendency to overinflate their tires. They do not like to see the "sidewall cheek" as the tire squashes. A little cheek is actually a good thing, especially with radial tires. In general, radial tires will give you better fuel efficiency than bias ply tires; however, radial tires require more careful air pressure management.

Your goal in managing tire pressure should be to use the lowest allowable pressure in your tires. Tire manufacturers provide inflation tables like Table 2 below that are based on the weight that the tire must support.

Calculate how much weight is on each tire, then look up the proper inflation pressure from the table for your specific tire and load.

Warning: Not adhering to manufacturer's recommendations can void tire warranties!

Example

Let's suppose you are setting up a 200 HP MFWD tractor with 20.8R42 duals on the rear to pull a mounted subsoiler. The tractor will probably be operating at a relatively low speed, so the optimum ballasted weight for the tractor will be somewhere around 140 lb/HP. The total tractor weight, then, should be 140*200=28,000 lb. The mounted implement on the MFWD tractor would call for a 40/60 weight split front to back, which means you want:

0.40*28,000=11,200 lb on the front, and
0.60*28,000=16,800 lb on the rear.

Because there are four tires on the rear axle, each tire will be supporting 16,800/4=4,200 lb. From the table below, with duals, an 8 psi inflation pressure would only support 4,000 lb, but a 9 psi inflation pressure would support 4,220 lb, so your minimum (and best) inflation pressure for the rear tires would be 9 psi.

Table 2. Tire load limits (lb) at various cold inflation pressures (psi).

Tire Size	Inflations (psi)	6	7	8	9	10	12	14	16	18	20	22	24	26	28	30	35
	Symbol									★			★★			★★★	
20.8R42	Ll/ss									149 AB			155 AB				
	Single (lbs)	3740	4180	4540	4800	5080	5680	6150	6800	7150	7600	8050	8550				
	Dual (lbs)	3290	3680	4000	4220	4470	5000	5410	5980	6290	6690	7080	7520				
	Triple (lbs)	3070	3430	3720	3940	4170	4660	5040	5580	5860	6230	6600	7010				

Reprinted from the Goodyear Farm Tire Handbook.