



Tractor Performance - What's Best for You?

**Information on Tractor Ballasting
and Tractor Tire Pressures**

by Reed Turner

INTRODUCTION

Dual Tires. Triple Tires. Single Tires. Tire types. Tire sizes. Tire pressures. Tractor ballasting. Weight distribution. Ground Speeds. Implement loads. On and on it goes. Setup of a tractor is a balancing act between a bewildering array of choices. Correct choices increase flexibility, reduce costs and maximize the performance and life of a tractor. With all this hanging in the balance, how do farmers make sure their tractors are set to deliver the best for them?

During the past two years the Alberta Farm Machinery Research Centre has been testing the effectiveness of "on the farm" traction power delivery. We have identified three important areas where tractor performance can often be improved.

First, our tests show that many farm tractors are not optimally ballasted and are often overweight for the way they are used. What about it farmers - think about the tractors in your farm operation. How did you ballast them? Did you follow the dealer's recommended setup, did you do it the way dad did it, did you assume that since it was good enough for the last owner it was good enough for you, or did you consider what your usage was and try to optimize the weight for your conditions and loads?

Second, our tests show that most farm tractor tires are not at the correct inflation pressures for best tire performance. This is particularly true with radial tires. What about the tires on your tractor?. What is the correct pressure and how did you set it?. Did you inflate them by sight until they looked right, did you let the tire dealer set them when he sold them to you two years ago, or did you figure out the pressure using the correct load-inflation table and the weight that each tire is supporting? Once you figured out a pressure and set it, did you ever check it again? How accurate was the gauge you used? Did you measure with the valve at the top or the bottom of the tire or does that matter?.

Third, our tests show that many farmers are not effectively using their tractors available horsepower and are not operating in the most efficient engine load range. What about you? How do you select your operating point?. Do you just go at a speed that feels comfortable to you, do you pull at a specific point on the engine speed, or do you watch an engine load indicator like a pyrometer and try to keep it in a certain range? What about overload? Is it OK to pull the engine down somewhat?. How far?. How do you know when your tractor is lugged too far?.

There are many questions related to correct and efficient operation of farm tractors and the following pages provide some answers.

When setting up a tractor for efficient operation, there are three important steps:

- First, understand and adjust the total weight and the weight distribution.
- Second, set the tire pressures correctly for the tires and the weight they carry.
- Third, monitor the slip and the operating load and keep them at acceptable levels.

Go through these steps carefully, understand what is done in each of them, and keep up to date with changes in conditions or equipment. The result will be greater efficiency, reduced cost, and longer service life for the most common, most used and next to most expensive machine on a farm, the tractor.

TRACTOR BALLAST - THE HEAVY QUESTIONS

You have a big powerful expensive machine in front of you. It outweighs you by 150 times, and can pull 500 times what you can. It costs more than you or your banker really want to think about. You want to adjust its weight to what is right for your operation and your conditions. What do you do?

First, you have to have some target or desired weight. What that weight is depends on the type of tractor and how it will be used. The operators manual can help and your tractor dealer should also have ideas and suggestions. Your own experience may also help. As you balance the information from these sources, remember that tractors often wind up being heavier than they should be for their best efficiency.

Manufacturers typically give a recommended range of pounds per horsepower for a tractor. Depending on which manufacturer, the recommendation for a four wheel drive can be from 85 to 125 pounds per engine horsepower. Multiply that number by the engine power, apply experience or local information factors, and you have an idea of the total weight you want.

Now you need to decide where that weight should be. Again, the manufacturer or the manual should have a recommendation on the weight distribution. Commonly two-wheel drives are 25% on the front and 75% on the rear. Mechanical front-wheel drives should have 40% on the front and 60% on the rear. Four-wheel drives are usually 55% on the front and 45% on the rear.

Next you need to know what the tractor weighs and where the weight is. The best way to find this out is to actually weigh the tractor. It is important enough to be right that it is worth the hassle of driving the tractor to a scale to get the weights, both front and rear. A tractor too wide for a scale can be run up on blocks on the scale to raise the outside tires off the ground. For accurate front and rear weights, the tractor must be kept level. If the tractor cannot go to a scale, maybe a portable scale can come to it. If there is no other choice, estimate the weight. Make a list of what you know about the tractor. The operators manual or the dealer can give you some basic weight information. Add the weights of things you have added, fluid in the tires, cast ballast, tank mounts, blade mounts, and so on. With some figuring, you may come pretty close, but actually weighing the tractor is still best.

Once you know your present weight and weight distribution, and you know the weight and distribution that you want, you can decide what you need to add or subtract. Almost all tractors require some added ballast, typically on the rear. As far as whether to use fluid or cast iron - fluid is cheaper, cast iron is more flexible, and either will work. If you have the choice, use cast ballast rather than fluid ballast. Fluid has a stiffening effect on a tire that can accentuate some ride and performance problems.

If you are using fluid ballast, all tire manufacturers and all tractor manufacturers now strongly recommend two significant changes in the installation from what has been done in the past.

First, on any new tractors, equalize the fluid among all the tires on the axle. **THIS IS A CHANGE.** The custom in the past has been to put all or most of the fluid in the inside duals. Now both tire and tractor manufacturers recommend distributing fluid ballast equally among all the tires on an axle to improve ride and performance. On older tractors, check with the manufacturer before making this change - some older rim and axle systems may not be up to handling the overhanging loads from fluid in the outside tire.

Second, do not go over a 40% fluid fill on any of the tires if you can avoid it. This is especially recommended if you have radial tires. Additional fluid significantly stiffens the tires, can reduce the tractive performance, and may contribute to ride and power hop problems.

Correct ballasting takes figuring, legwork, and some slinging around of heavy items, but when you do it right, the payback is there. A properly ballasted tractor is a more efficient and well adjusted tractor and does good things for its owner.

TRACTOR TIRES - CAN YOURS TAKE THE PRESSURE?

All the tractive power in the world is of no use on a farm without some way to transfer it to the ground. Tires are the most common traction power transfer device and can have a major effect on tractor performance. The multitudes of tire options and choices break down to four basic areas - the type of tire, the tire size, the number of tires, and the operating inflation pressure.

As far as the type of tire, the options are radial or bias construction. Radial tires, *CORRECTLY INFLATED*, perform better and last longer than bias ply tires. However, radials require more careful pressure management than bias tires. Bias tires presently have a lower initial cost and ride better than some radials. For maximum efficiency on your farm, plan to use and *MANAGE* radials.

Tire management means setting an appropriate load for the tire and setting the proper inflation for that load. To get optimum performance, run tires at the lowest recommended pressure for the weight they carry. This translates to the maximum footprint or area of rubber in contact with the ground and allows the maximum transfer of power to the ground. It also minimizes the ground compaction for the specific tire and load.

Tire size and the number of tires, whether singles, duals, or triples, is partially determined by the tractor manufacturer and partially determined by what you as the operator want. Manufacturers sell tractors with certain options. You as the customer select the options that you and your dealer feel will work for your operation. With used tractors or with "in stock" tractors it may not always work out this way. To increase efficiency when it comes to tires, choose radials, choose the largest ones you can afford, and choose enough of them so that there is sufficient load carrying capacity to keep the tire pressures at 14 psi or less. It is possible but uncommon to have too much tire capacity on a tractor. More typically the tires are the limit to load carrying and power delivery. Ground compaction levels are reduced as the tire size and number of tires increase but at the same time the area that is compacted goes up.

When it comes to the tire pressures to use, manufacturers publish LOAD-INFLATION tables like the one shown. Use these to help you determine what pressure is correct to use.

Load and Inflation Table for Radial Tractor Tires											
(maximum speed 25 mph)											
TIRE LOAD LIMITES (LB. AT VARIOUS COLD INFLATION PRESSURES [PSI])											
Tire Size	Tire Configuration	6	8	10	12	14	16	18*	20	22	24**
18.4R38	Singles				4440	4860	5260	5680	5980	6350	6600
	Duals	2600	3090	3510	3910	4280	4630	5000	5260	5590	5810
	Triples	2430	2880	3270	3640	3990	4310	4660	4900	5210	5410
18.4R42	Singles				4680	5120	5540	6000	6300	6650	6950
	Duals	2750	3260	3700	4120	4510	4880	5280	5540	5850	6120
	Triples	2560	3030	3450	3840	4200	4540	4920	5170	5450	5700
18.4R46	Singles				4920	5400	5820	6150	6650	7000	7400
	Duals	2890	3420	3900	4330	4750	5120	5410	5850	6160	6510
	Triples	2690	3190	3630	4030	4430	4770	5040	5450	5740	6070
20.8R38	Singles				5380	5880	6350	6800	7250	7650	8050
	Duals	3150	3740	4260	4730	5170	5590	5980	6380	6730	7080
	Triples	2940	3490	3970	4410	4820	5210	5580	5950	6270	6600
20.8R42	Singles				5680	6200	6700	7150	7650	8100	8550
	Duals	3330	3940	4500	5000	5460	5900	6290	6730	7130	7520
	Triples	3100	3670	4190	4660	5080	5490	5860	6270	6640	7010
24.5R32	Singles				6450	7050	7650	8250	8700	9200	9650
	Duals	3780	4490	5100	5680	6200	6730	7260	7660	8100	8490
30.5LR32	Singles				7700	8450	9100	9650	10400	11000	11700
	Duals	4510	5360	6100	6780	7440	8010	8490	9150	9680	10300

*/** Star ratings for radial tires.

SOURCE: FIRESTONE TIRE CO.

THE LOAD AND INFLATION table for radial tires has been extended downward to accommodate lower pressures. To use the table, determine the static weight on each axle of your tractor, then each tire on the axle. Find that weight for your tire size and configuration and read the recommended minimum pressure.

To use a load-inflation table, first find the correct one for your tire type. They are different for different tire types and tire constructions and it is important to get the right one. Next, find the tire size on the chart and move over to the load the tire is carrying (you can figure this out from the weight of the tractor). Finally, read the pressure the chart shows for the tire at that load. This is the correct pressure to set for best tire performance, and is the pressure "cold" or "in the morning" or after having sat unused for a period of time. Usually front tires and rear tires will not have the same pressure since front and rear weights are not the same. Even though there may be dynamic weight transfer under load, tire manufacturers recommend that you use the static weight numbers for setting the pressures.

As an example, assume you have a 300 hp four wheel drive tractor ballasted to 120 lbs per horsepower. This would be a total weight of 36000 lbs and with a 55/45 weight split, 19800 lbs on the front and 16200 lbs on the rear. Each front tire would carry 4950 lbs and each rear tire 4050 lbs. For radial 20.8R42 duals, the load inflation table shown recommends 12 psi for the front and 8 psi for the rear.

Tires are designed to operate at maximum efficiency when they are at their *RATED DEFLECTION*. With the tractor on a hard surface, deflection is the distance from the axle center to the ground surface divided by the distance from the axle center to the top of the tire. In technical terms, deflection is the value of the loaded radius of the tire compared to the unloaded radius. Rated deflection is the amount of deflection when the tire is deformed to its optimum or design footprint. Rated deflection for radial tires is about 85%, for bias tires it is about 90%. The correct pressure to achieve rated deflection depends on the load the tire is carrying and is the pressure shown in the load-inflation table discussed above.

The load-inflation tables for radial tires show that you can operate radials at significantly lower pressures than bias ply tires. This is a much misunderstood feature of radial tires. A correctly inflated radial tire will have a significant sidewall bulge or "cheek". It may look low or flat but it is not. If you inflate a radial tire by "eyeball" until the sidewall bulge looks like that of a bias ply tire, you lose most of the performance advantages of the radial tire.

Another common practice that is no longer recommended is setting different pressures inside to outside on dual tires. In the past it was the norm to set the inside dual tires to be a couple of psi higher than the outside ones. Doing this reduces overall performance and is no longer recommended. For optimum performance and ride, set all the tires on a given axle to the same pressure.

The above recommendations assume that you can measure the tire pressures accurately. This is not a trivial problem. The tire gauge you use and the way you use it can have a big effect on what you think the tire pressure is. Always start with a good gauge, one that costs money, is easy to read, and is graduated in 1 psi increments. If your gauge cost 99 cents or came free from a feed dealer, has marks every 5 psi from 0 to 100 psi, and looks like it will break if you drop it, you are probably not going to measure pressures accurately.

Ideally, tire pressures should be measured in the morning, cold, or when the tractor has not been used for several hours. The published load-inflation tables give pressures for that condition. As a tractor is used and the tires warm up, tire pressures will increase from 1 to 3 psi.

If tires have fluid ballast in them, the pressures at the bottom of the tire can be as much as 1.5 psi higher than at the top, depending on the amount of ballast. Whether you measure at the top or the bottom doesn't matter as much as whether you are consistent in where you measure. It is less messy if you measure with the valve stem at the top but it may be slightly more accurate if you measure with the valve stem at the bottom.

Finally, measure the air pressure in all the tires. A tire with a valve stem that is hard to reach is not magically at the same pressure as one near it with a stem that is easy to reach. How often you should measure the pressures depends on your usage and on what the pressures are. Tires at 20 psi that leak down 2 psi are not nearly as serious a concern as tires at 6 psi that leak down 2 psi. Measure tire pressures

at some regular service interval as well as whenever a tire seems low. If a tire appears low, do not just add air until it looks right. First check the pressure and if needed, add air and measure until you bring it up to the correct pressure.

Knowing the correct inflation pressures and keeping your tractor tires at those pressures is a productivity booster. When tires work their best, they take a lot of pressure off of you.

CONCLUSION

That's the basics of setting a tractor for best efficiency. Follow these steps, apply judgement for your own situation, keep watching for new information, and you will get the most that you can out of your tractors.

The benefits are there - it is up to you to bring them home.

For further information, questions, comments or concerns, please contact Reed Turner of the Alberta Farm Machinery Research Centre.

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