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LET THE AIR OUT! Advantages of Properly Adjusted Radial Tire Pressures

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Proper tire inflation pressure plays a key role in optimum traction and long tire life. Yet, it is often ignored by the tractor operator. Ballast and tire inflation pressure have been shown to significantly affect tractive performance, tire wear, power hop and surface soil compaction. Tractive advantages of radial tires compared to bias-ply tires have also been well documented. Managing ballast and tire inflation pressure is a cost effective way to improve production efficiency.

Over-inflating a 20.8R42 radial tire by as little as 8 psi can decrease the footprint area by 33% and increase tire stiffness by 40%. A farmer in Pickaway County realized a 9% improvement in field capacity by reducing pressures to 8 psi from 14 psi in the rear dual 18.4R46 radials on a 200 hp tractor. This means more dollars in your pocket and more time saved.

A field demonstration was held at an August,1991 field day in Pickaway County, Ohio, to communicate the effects of proper inflation pressure management. Two cooperating farmers provided nearly identical equipment for the side-by-side comparisons. Two 370 hp John Deere1 8960 four-wheel drive tractors equipped with dual 20.8R42 radial tires were provided. Front and rear axle static loads on the tractors were measured by weighing prior to the field day to determine total weight and front-to-rear weight distribution. Each tractor was attached to a DMI Tiger-Two, 7-shank subsoiler. Tire inflation pressures were set at 24 psi and 22 psi for the inner and outer duals, respectively, for one tractor, and 14 psi and 12 psi for the inner and outer duals, respectively, for the other tractor. The 14/12 psi settings were consistent with recommendations of the Tire and Rim Association in 1991 for the actual load per tire. The 24/22 psi settings were more consistent with typical farming practices in the area. The two tractor operators agreed on an appropriate operating

gear and throttle setting and were instructed to: travel to the end of the field with implements raised; turn around and run parallel to each other while establishing gear and throttle settings; lower the implements to maximum operating depth and proceed through the test distance without making any adjustments to throttle setting or operating depth. The tractor with the correct pressures operated at significantly less slip and completed the test distance of approximately 800 ft well ahead of the tractor operating at higher pressures. No actual measurements were made to quantify differences in performance.


Figure 1. Tire pressure makes a difference in field performance.

One confounding factor in the demonstration that raised some question with the audience was the difference in tire brands. One tractor was equipped with Armstrong tires, the other with Goodyear tires. A more complete demonstration would have repeated the test with the tire pressure settings reversed. It would be desirable to have all tires from one manufacturer in this type of a demonstration. Also, a more complete demonstration would repeat the test with the pressure settings reversed, even with identical tires, in order to cancel any differences in tractor engine performance. Alternatively, one tractor could be used for the demonstration by making two passes at different pressures. This is actually the easiest approach since it requires only one tractor and implement and removes questions about differences in engines, tires, etc. For example, at an August, 1993 field demonstration, a 200 hp MFWD tractor with 18.4R42 rear duals pulled a 13.5 ft, 11-shank disk chisel in firm wheat stubble. The rear tire pressures were set at 24 psi and a distance of 400 ft was chiseled in 73 sec. The rear tire pressures were then set to the recommended level of 8 psi and the tractor travelled 453 ft in 73 sec. This 13% increase in performance demonstrated the potential of setting correct tire pressures.

The original 1991 demonstration raised awareness of the importance of managing tire inflation pressures, but quantitative information was needed to show the real advantages. Five cooperators from Pickaway County agreed to operate tractors with radial tires at two levels of tire pressure during 1991 fall tillage. The participants weighed their tractors to determine actual loads/tire. The recommended pressure settings for the actual loads were determined for the given tire size from a chart similar to Table 1. A higher pressure setting of 24 psi was chosen for comparison. The cooperators were asked to record acreage, operating hours, wheel slip and fuel usage for each pressure setting evaluated. The data collection process was left to the individual farmers. While this may not have produced scientific accuracy, it provided on-farm comparisons from individual farmer records that effectively communicate the principle of managing tire inflation pressure to the intended audience of farmers and equipment operators. It was recognized that variations in soil and operating conditions would affect the comparisons.

Operating four-wheel drive tractors at the recommended pressures for the actual tire load(14 psi compared to 24 psi) resulted in average fuel savings (gal/acre) of 8%,increased field capacity (acre/h) of 4%, reduced wheel slip and improved ride. One mechanical front-wheel drive assisted tractor

(MFWD) showed an 11% increase in field capacity and a 26% increase in fuel efficiency. Additional detail on these experiences is given by Wood and Mangione (1994).


Figure 2. Properly inflated radials should have a sidewall "cheek" or bulge.

New tire pressure recommendations for radial tires were released by the tire industry in January, 1992 (Armstrong, 1992; Firestone,1992; Goodyear, 1992). These guidelines focus on setting the tire pressure to the minimum required to carry the load on the axle. This maximizes the tire deflection (bulge) and tire footprint for optimum traction, compaction, wear, fuel efficiency and ride. With large enough tires, the radial tire Load/Inflation chart (Table 1) may allow tire pressures as low as 6 psi. The tractor should have the correct total weight and weight distribution for the primary tillage implement, field speed and expected soil conditions. Tractor manufacturers have recommended ranges for typical operating conditions. The operator must know how much load is carried by each tire in order to adjust the tire pressure for rated deflection. This can be determined by weighing or from tables available from tractor manufacturers. Be sure the axle weight includes any spray tanks or high hitch loads like grain carts or land scrapers. Be sure to weigh the rear axle with 3-point hitch implements in the raised position to account for additional axle weight from the implement.

All tires on a given axle should be adjusted to the same pressure. Load and inflation pressure guidelines are given in Table 1 for selected tires. Additional information is available from tire manufacturers. Here is how you can determine the correct pressures:

Example 1: MFWD Tractor

200 PTO hp with 18.4R42 rear duals
Total weight = 22,100 lbs = 110 lbs/PTO hp
Rear axle weight = 13,000 lbs = 59%
Weight/tire = 3250 lbs.

The correct pressure for a 3250 lb load per tire is determined by looking in Table 1 in the row for dual 18.4R42 tires. The table indicates a pressure of 8 psi for a load of 3260 lbs. Note that if the duals were 20.8R42s the pressure would be set at 6 psi. Similarly, if the duals were 18.4R38s the pressure would be set at 10 psi to carry the load of 3250 lbs.

Example 2: 4WD Tractor

350 Engine hp with 20.8R42 duals
Total weight = 32,800 lbs = 94 lbs/hp

Front weight = 20,400 lbs = 62%
Rear weight = 12,400 lbs = 38%

Desired weight split on a 4WD is closer to 55% front and 45% rear. Consider adding ballast to the rear axle to improve the weight split. Suggest adding 3120 lbs to the rear axle. This could be in the form of cast weights or about a 40% liquid fill (4 o'clock valve stem position) in each of the four rear tires. Cast weight is the preferred option from a dynamic stability standpoint.

New total weight = 35,920 lbs = 103 lbs/hp
Front weight = 20,400 lbs = 57%
Rear weight = 15,520 lbs = 43%
Weight/tire Front = 5100 lbs/tire Rear = 3880 lbs/tire

The correct pressures are selected from the 20.8R42 dual row of Table 1 as 14 psi for the front and 8 psi for the rear. It is important to recognize that the front tires of a 4WD will generally require higher pressures than the rear.


Figure 3. Checking for proper pressure.

Although some farmers often question the effect of lower tire pressure on road performance and rim slip, they can be assured that tire manufacturers test tires under severe loading conditions to ensure performance at rated deflection. Tires are also tested for rim slip under high drawbar loads. All 3 major tire manufacturers back their tires if the correct pressure is used for the load.

Basic Guidelines for Radial Tire Pressure

Understanding the loads placed on a tire in different situations allows the operator to make appropriate adjustments in pressure to improve performance. The following guidelines are important for proper traction and maximum tire life.

1. Adjust pressure to match the actual tire load.
2. Use a gauge that measures pressures in the 1-20 psi range in 0.5 psi increments. It is recommended to have two gauges that you use alternately to check for consistent readings.
3. Proper procedures for mounting and inflating tires are essential.
4. Check pressure regularly; when the tires are cold.
5. Inspect tires frequently for evidence of wear or damage.
6. The more worn the tire the more important it is to maintain proper inflation pressure.

Table 1. Load and inflation tables for selected radial drive tires for speeds up to 25 mph.								
Tire Size Designation	**Load (lbs.)**							
		6psi	**8psi**	**10psi**	**12psi**	**14psi**	**18psi**	**24psi**
18.4R34	Single				4200	4580	5360	
	Dual	2460	2900	3310	3700	4030	4720	
18.4R38	Single				4440	4860	5680	6600
	Dual	2600	3080	3500	3910	4280	5000	5810
18.4R42	Single				4680	5120	6000	6950
	Dual	2750	3260	3700	4120	4510	5280	6120
18.4R46	Single				4920	5400	6150	7400
	Dual	2890	3410	3890	4330	4750	5410	6510
20.8R34	Single				5080	5560	6400	
	Dual	2970	3520	4010	4470	4890	5630	
20.8R38	Single				5380	5880	6800	8050
	Dual	3150	3730	4260	4730	5170	5980	7080
20.8R42	Single				5680	6200	7150	8550
	Dual	3330	3940	4490	5000	5460	6290	7520
710/70R38	Single				7590	8550	9650	11700
	Dual	4720	5380	6110	6670	7520	8490	10300

Summary

Tractive benefits of properly adjusted inflation pressures have been effectively demonstrated in side-by-side field demonstrations. On-farm comparisons of recommended inflation pressures and higher pressures have shown significant improvements in field capacity and fuel use at the recommended settings.

References

Firestone. 1992. *Maximize tractive performance of radial rear tractor tires with proper inflation*. Bridgestone/Firestone, INC. February.

Goodyear. 1992. *Optimum tractor tire performance handbook*. The Goodyear Tire and Rubber Company. January.

Wood, R. K. and D. A. Mangione. 1994. *Tractive benefits of properly adjusted inflation pressures: farmer experiences*. Applied Engineering in Agriculture 10(1):13-16.

1. Use of a specific product name is for the reader's information only and does not infer endorsement by The Ohio State University over other suitable products.

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