HOW TO GET THE MOST FROM RADIAL PLY TRACTOR TIRES: A Guide to Selecting the Correct Inflation Pressure

TABLES

CONSULTANT REPORT

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How to get the most from RADIAL PLY TRACTOR TIRES

A guide to selecting the correct inflation pressure

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*Correct/low** inflation pressure for radial ply tires can result in significant savings in money, time, and reduce soil compaction problems. Moreover, it also helps control powerhop in mechanical front wheel drive (MFWD) and four wheel drive (4WD) tractors.*

** Also FCA-UNESP-Botucatu/FAPESP-SP-Brazil*
*** This term refers to inflation pressures correctly selected based on the tire load which are usually lower compared to the commonly used pressures on radial ply tires.*

Introduction

*It has long been recognized that **radial ply tires** perform better than **bias ply tires** at the same axle load because of the belt stiffening effect which reduces lug deflection. Moreover, they also lead to increased tire deflection compared to their bias ply counterparts, which increases soil-tire contact area and hence their pulling ability.*

*In recent years, engineers discovered that radial ply tires can perform even better at **lower inflation pressures that correctly match the axle loads** since they have much more supple carcasses.*

*When radial ply tires are properly inflated to low inflation pressure values, based on axle load, we can obtain **higher tractive and fuel efficiencies** (see table 1), **enhance productivity** (see table 2) and **reduce the extent of soil compaction** (see figure 1). Implications on fuel consumption and time savings in the production of processing tomato, rice and cotton in California are quite substantial (see table 3 and 4). Moreover, it also helps control **power hop** in MFWD and 4WD tractors.*

Purpose

The purpose of this handbook is to provide guidelines to select correct inflation pressure for radial ply tires based on axle load.

Procedure

Follow these steps to select the correct inflation pressure based on axle load for radial ply tires:

1) Determine the static load (weight) on front and rear axles of the tractor*. For drawn or trailed implements this is the load to use in selecting tire pressure. However, for mounted implements (or three point hitch) the rear axle weights should be obtained with the implement in raised position. The front axle weight should be obtained with the implement lowered.

2) Use the appropriate pressure versus load curves shown in figures 2 through 23 to determine the correct inflation pressure**. Note that each of these curves corresponds to a specific tire in a particular configuration (i. e. Single or Dual). The curves are identified with a combination of tire name and either “/S” (for *singles)* or “/D” (for *duals).* For singles, divide the axle load by *two* and use the appropriate graph for singles. For duals divide axle load by *four* and use the corresponding graph.

** This information should be available from your tractor dealer. Some of the newer tractors come with a manual containing this information. If not, a truck scale can be used to weigh the axle.*

*** Derived from the Farm Tire Handbook published by Goodyear Tire and Rubber Co. Akron. OH. 1992.*

Examples:

a) Tire: Row crop tractor with 18.4R42 rear singles. Mounted implements.
Rear axle weight with implement raised = 10000 lbs.
Load per Tire = 10000 / 2 = 5000 lbs
From figure 12 the correct inflation pressure = 13.5 => 14 psi

b) Tire: Articulated four wheel drive (4WD) tractor with 20.8R42 duals. Towed implements. Front axle load=20000 lbs. Rear axle load=16000 lbs. Front axle load per tire = 20000 / 4 = 5000 lbs From figure 14 the correct front inflation pressure = 12 psi. Rear axle load per tire =16000 /4 = 4000 lbs. From figure 14 the correct rear inflation pressure = 8 psi.

Some Do's and Don'ts

Do's:

1) Always use radial ply tires at low inflation pressures which are correctly adjusted to axle loads (see figures 2 through 23 or refer to tables published by the tire manufacturers). When correctly inflated, tire sidewall will have a visible cheek. This is normal for radial ply tires.

2) For integral mounted implements always obtain the rear axle load with the implement in raised position. The front axle load is obtained with the implement lowered.

3) Always check the inflation pressure early in the morning before you go to the field. This should be routine like checking engine oil. For optimal performance check and maintain tire inflation pressures once every two weeks.

4) Use only *low pressure tire gauges* to check the tire pressure.

5) If you use tubes, use natural rubber tubes only. Most natural rubber tubes have a white stripe on them. Some tire manufacturers recommend that no tube be used with radial ply tires (i.e. tubeless).

Don'ts:

1) Do not over inflate a radial ply tire.

2) If you have **bias ply tires** on the tractor **do not use this procedure.** These tires require higher inflation pressures compared to similarly sized radial ply tires. Serious tire damage can occur due to sidewall buckling.

3) Do not use liquid ballast in your radial ply tires since it has a stiffening effect that degrades ride and reduces ability to control power hop. Always use cast iron weight. If liquid ballast has to be used in the rear of a MFWD or 4WD tractor, *all tires on the same axle should be filled to the same level which should not exceed 40% fill (4 o'clock valve stem position).*

4) Do not use butyl (artificial rubber) tubes. Use natural rubber tubes.

Some Common Concerns

1) Will the tire life be reduced if inflation pressure is reduced?

   If the tire is always kept at the correct pressure for the load, then it will last at least as long or perhaps longer. Lower pressure leads to higher contact area that reduces road wear.

2) Will the tire companies honor the warranty if lower inflation pressures are used?

   Yes. All major agricultural tire manufacturers recommend the use of lower correct pressures for radial ply tires. They have published handbooks that provide tables for selecting correct pressures for radial ply tires. These tables were used in developing figures 2 through 23.

3) Do I need to change the tire inflation pressures every time I change the equipment?

   If you are switching between trailed implements only there is no need to change tire inflation pressures. This is the preferred

situation for large tractors used in primary tillage operations.

If you are switching between trailed and mounted implements or the vice versa, the inflation pressures in the tires mounted on the rear axle must be changed according to the axle load. As mentioned previously, for mounted implements rear axle load must be determined with the implement in raised position. Since implements differ in weight, rear axle load changes as implement is changed.

4) I am concerned about how radial ply tires would work on my old MFWD tractors. I'm afraid they'll slip on the rim.

Rim slip is no longer a significant problem on newer radial ply tires when they are properly mounted on rims. This is because of the tire and rim design at the bead seat area where fit is very important and is closely controlled. Moreover, the high power tractors should use 32, 38, 42, or even 46 in. diameter rims. Rim slip is seldom a problem when these large rims are used.

5) Is there a danger of overloading the power train when lower inflation pressures which are correctly adjusted to axle loads are used?

When lower inflation pressures which are properly adjusted to the axle loads are used, larger contact areas are obtained which can lead to higher tractive forces at lower slip values compared to over-inflated tires. If low travel speeds are used, it is possible that these high tractive forces may lead to high torque loads which may overload the power train. *It is important to maintain proper travel speed during heavy tillage operations. The tractor power should be used to obtain higher travel speed and increase productivity and not lug the engine. For example, a certain manufacturer recommends a minimum forward speed of 4.1 mph on all their tractors. Adjust the depth of operation of the implement such that proper ground speed is maintained in hard locations of the field. In the lighter regions, it may be desirable to shift up to enhance productivity. Sustained operations of these tractors at low ground speeds can be detrimental to their power trains.*

6) Do we need to worry about ballasting if we employ lower inflation pressures which are properly adjusted to axle loads?

Proper ballasting is necessary to obtain optimum performance from your tractor. The amount of ballast and the proper split between the front and rear axle depend on the type of tractor [two wheel drive (2WD), MFWD, or 4WD], type of implement to be used with the tractor, and soil type and conditions. Your dealer should be able to provide the necessary information for your specific situation (tractor and intended application).

7) Will low pressure adjusted correctly to the tire load always overcome a **power** hop problem?

In general, use of low/correct pressure helps control power hop. However, under certain soil conditions when operating towed implements, power hop may still occur. Under such circumstances you may need to adjust (increase) inflation pressure of tires on one of the axles while keeping the tires on the other axle at the low/correct pressure and/or change the type of ballast. For additional details on how to control power hop please contact your tractor or tire dealer.

Acknowledgments

The authors are grateful to Dr. Jack Wiley, Principal Engineer, Deere and Co., and Mr. Andrew Shorter, Agricultural Tire Engineer, The Goodyear Tire and Rubber Co. for providing many valuable suggestions in developing these guidelines.

T A B L E S:

Table 1:

Savings in fuel consumption due to correctly inflated radial ply tires compared to over-inflated radial ply tires*.

Tillage Operation	Soil Conditions	24 psi (gal/acre)	Correct/Low (gal/acre)	Savings gal/acre	(%)
Disking	Untilled Capay clay soil with an average mc of 38.5% and a specific gravity of 1.21	1.75	1.43(1)	0.32	18.3
Disking	Tilled Capaycaly soil with an average mc of 35.9% and a specific gravity of 1.22.	1.35	1.08(1)	0.27	20.0
Chiseling	Stubble dished Ricon silty clay and Yolo silt loam soil with an average mc of 10.6% and a specific gravity of 1.59	2.82	2.65(2)	0.17	6.0

Table 2:

Improvement in productivity due to correctly inflated radial ply tire compared to over-inflated radial ply tire*.

Tillage Operation	Soil Conditions	24 psi (acre/h)	Correct/Low (acre/h)	Increase (acre/h)	(%)
Disking	Untilled Capay clay soil with an average mc of 38.5% and a specific gravity of 1.21	12.24	13.16(1)	0.92	7.5
Disking	Tilled Capaycaly soil with an average mc of 35.9% and a specific gravity of 1.22.	11.72	12.39(1)	0.67	5.7
Chiseling	Stubble dished Ricon silty clay and Yolo silt loam soil with an average mc of 10.6% and a specific gravity of 1.59	7.37	7.71(2)	0.34	4.6

** Tables 1 and 2*
mc = moisture content on a dry basis.
All tests were conducted with a 350 hp 4WD tractor (JD8870) equipped with 20.8R42 dulas on front and rear axles.
(1) 13 psi in the front tires and 11 psi in the rear tires (drawn implement)
(2) 13 psi in the front tires and 14 psi in the rear tires (mounted implement)

Source: Lancas, K.P., S. K. Upadhyaya, and M. Sime.1994. Traction and soil compaction due to low pressure tire. Unpublished report. Bio. and Agr. Eng. Dept., University of California, Davis, CA 95616.

Table 3:

Savings in fuel consumption and time due to correctly inflated compared to over-inflated radial ply tires in primary tillage operations employed in the production of processing tomato, rice and cotton in California.

	Tomato [1]	Rice [2]	Cotton [3]
Operations evaluated	Chisel(2x) + 1St Disc (lx) + 2ndDisc (2x)	Chisel(lx) + 1St Disc (lx) + 2ndDisc (2x)	Chisel(lx) + 1St Disc (lx) + 2ndDisc (3x)
Savings in Fuel[4]:			
a) Gallon/acre	1.74	1.03	1.30
b) Gallon/ section*	1,114	659	832
c) Dollar/section**	$ 791	$ 468	$ 591
Savings in Time[4]:			
a) Hours/acre	0. 063	0.027	0.031
b) Hours/section	40.27	17.28	19.84
c) Dollar/section	$ 376	$ 57	$ 113
Total Savings: Dollar/section	$ 1,167	$ 525	$ 704

[1]Source: STRANGE, M. et al. 1992. Sample costs to produce processing tomatoes in the San Joaquin valley. UC Cooperative Extension, University of California.
[2]Source: WILLIANS, J. et al. 1992. Sample cost to produce rice. UC Cooperative Extension, University of California.
[3]Source: KERBY, T. et al. 1992. Sample costs to produce 40 inch row cotton in the San Joaquin valley. UC Cooperative Extension, University of California.
[4]See Tables 1 and 2 and Sources (2), (3), and (4).
**One section is equal to 640 acres*
***Diesel: assumed price: $ 0.71 / gal.*

Table 4:

Potential savings for California in fuel consumption and time due to correctly inflated compared to over-inflated radial ply tires in primary tillage operations employed in the production of processing tomato, rice and cotton.

	Tomato [2]	Rice [3]	Cotton [4]	Total
Area harvested in California[1], acres	240,000	392,000	1,105,000	1,737,000
Savings in Fuel[5]:				
Gallons	417,600	403,800	1,436,500	2,257,900
Dollars*	$ 296,500	$ 286,700	$ 1,019,900	1,6 03,100
Savings in times:				
Total hours	15,101	10, 580	34,260	59,941
Dollars**	$ 140,900	$ 34,900	$ 195,700	$ 371,500
Total savings: [Fuel and time]	$ 437,400	$321,600	$ 1,215,600	$ 1,974,600

[1]Source:California Statistical Abstracts, 1993, and California Agriculture, Statistical Review, 1992.
[2]Source: STRANGE, M. et al. 1992. Sample costs to produce processing tomatoes in the San Joaquin valley. UC Cooperative Extension, University of California.
[3]Source: WILLIANS, J. et al. 1992. Sample cost to produce rice. UC Cooperative Extension, University of California.
[4]Source: KERBY, T. et al. 1992. Sample costs to produce 40 inch row cotton in the San Joaquin valley. UC Cooperative Extension, University of California.
[5] See Tables 1 and 2 and Sources (2), (3), and (4).
** Diesel: assumed price: $ 0.71 / gal.*

** See (2), (3), and (4) for cost per hour (calculated for each operation)*

Implications of Tire Inflation Pressure on Soil Compaction

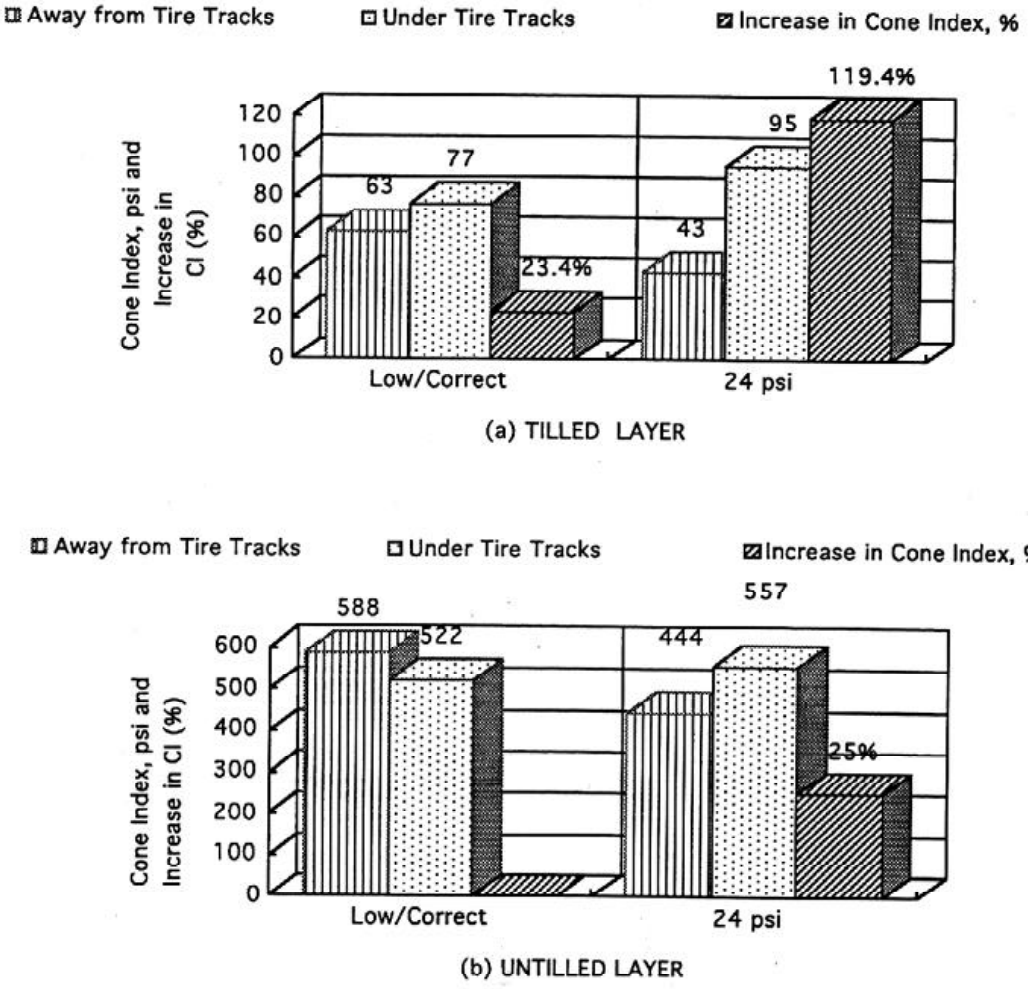

Figure 1 : Comparision of soil compaction (cone index values*) for low/correct and high inflation pressure (24 psi) tires in tire tracks and away from tire tracks in a stubble disked field containing Ricon silty clay and Yolo silt loam soil at a mean moisture of 10.6% and a specific gravity of 1.59. All tests were conducted using a JD 8870 tractor equipped with 20.8R42 duals on front and rear axles.

* Cone index is a standard measure of soil hardness or soil compaction.

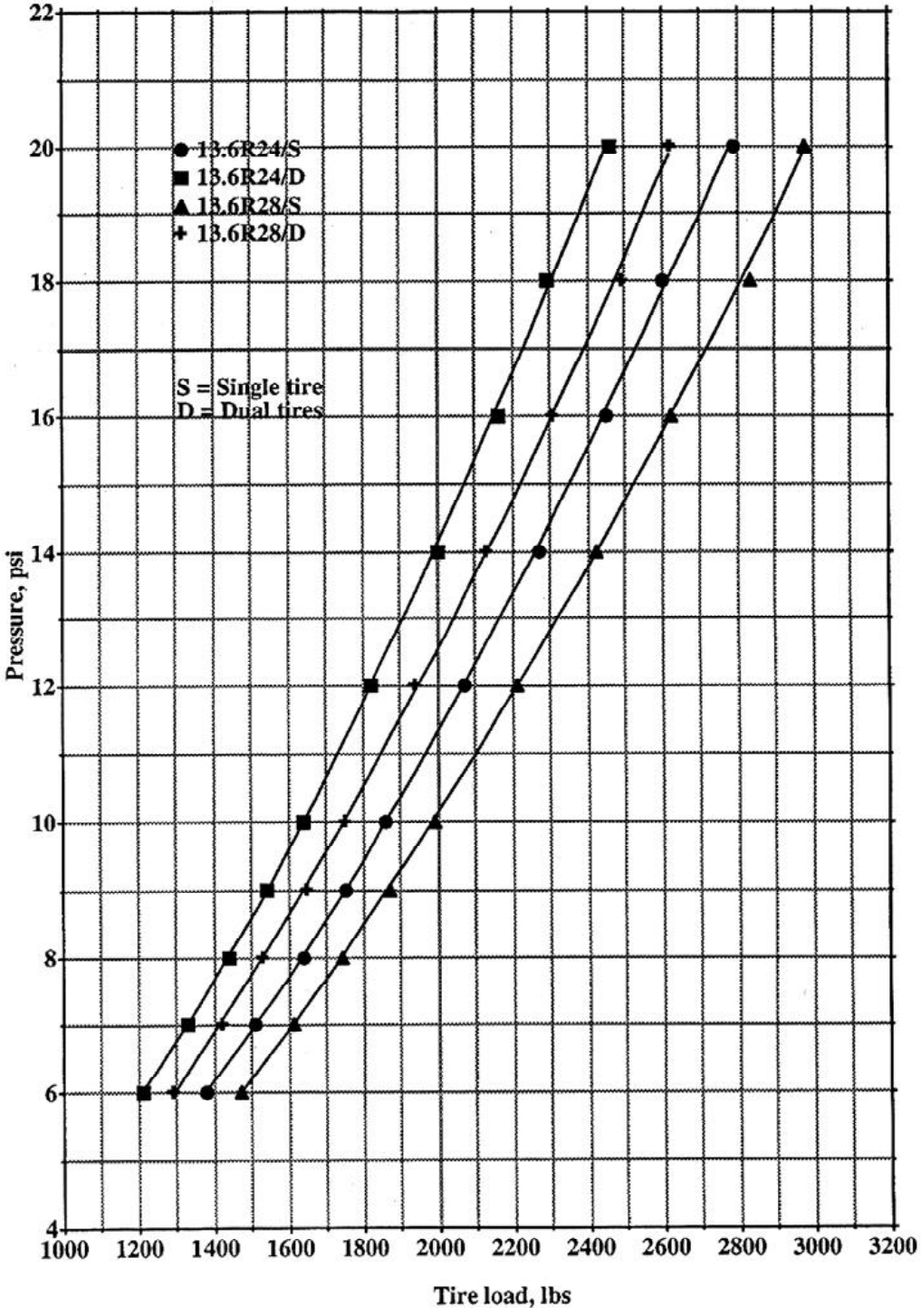

Figure 2. Correct/low pressure selection chart for 13.6R24 and 13.6R28 tires

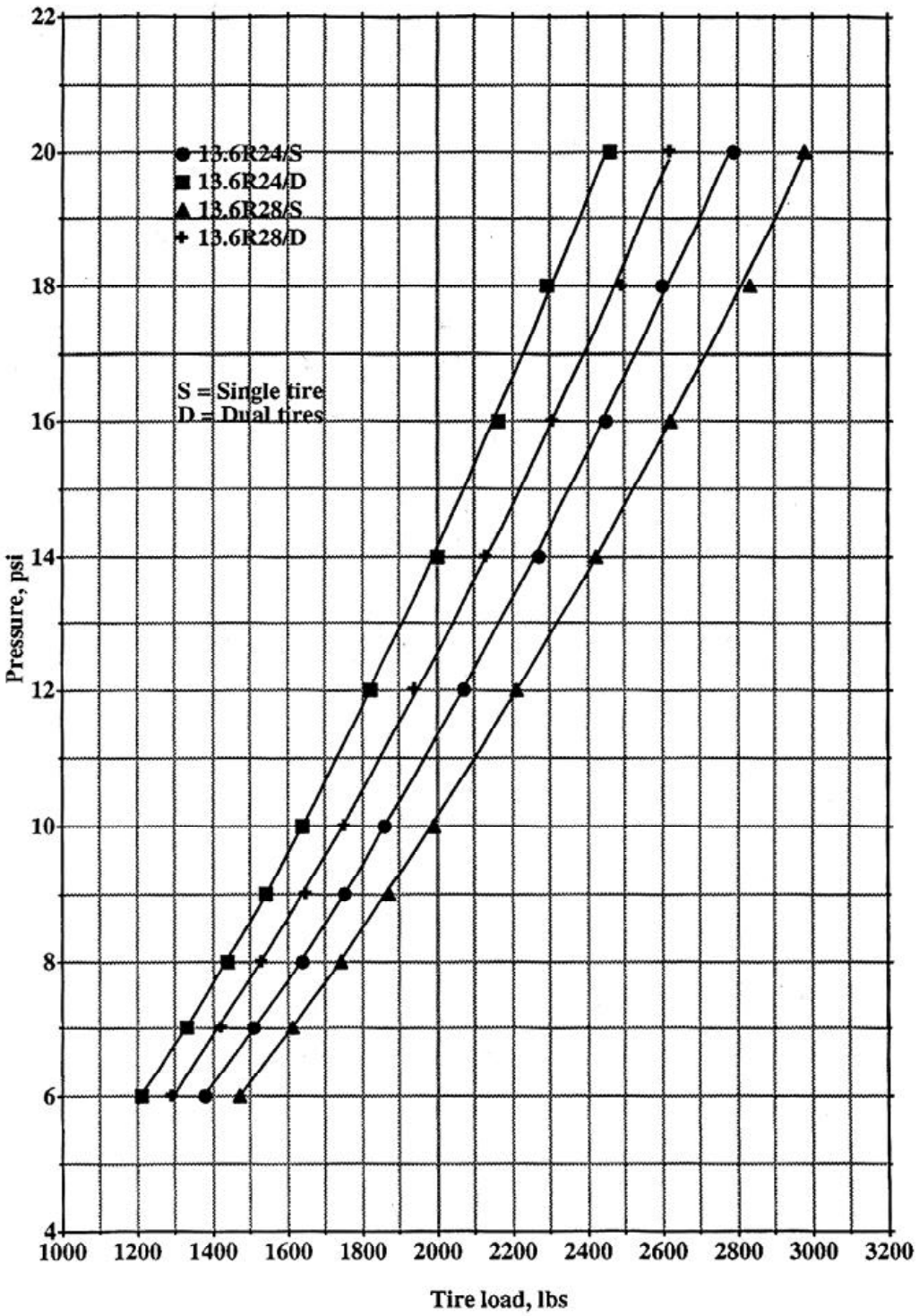

Figure 2. Correct/low pressure selection chart for 13.6R24 and 13.6R28 tires

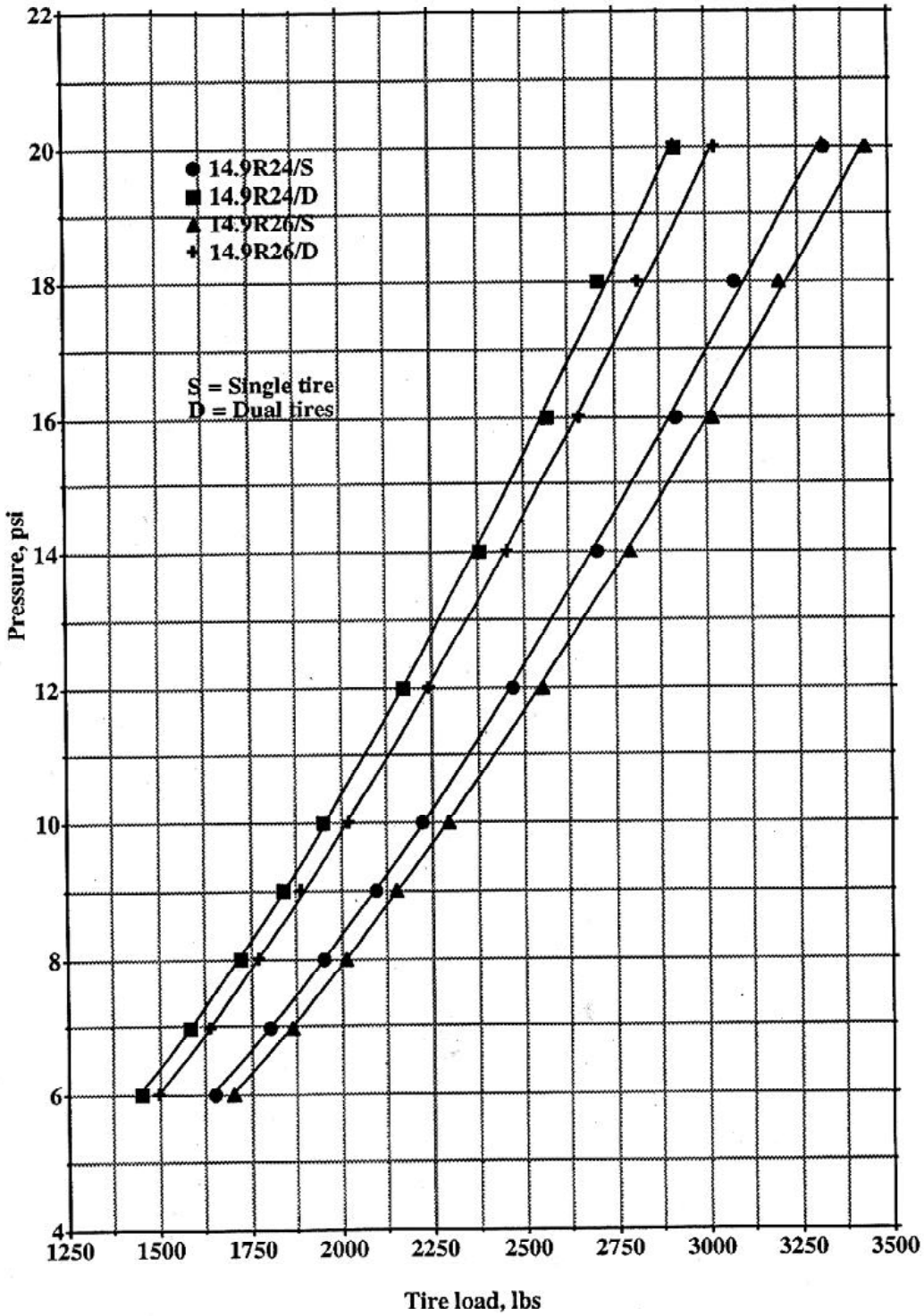

Figure 3. Correct/low pressure selection chart for 14.9R24 and 14.9R26 tires

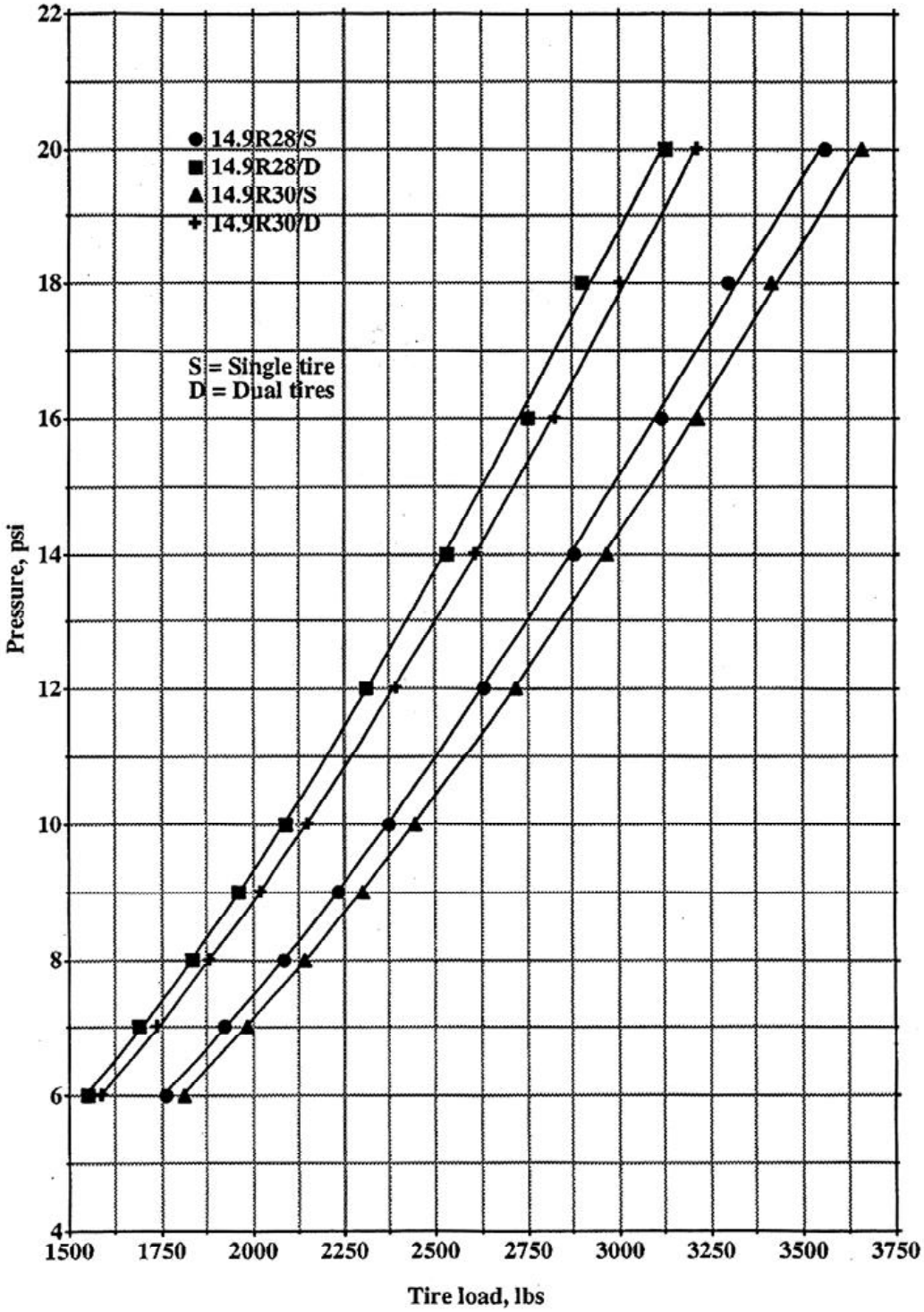

Figure 4. Correct/low pressure selection chart for 14.9R28 and 14.9R30 tires

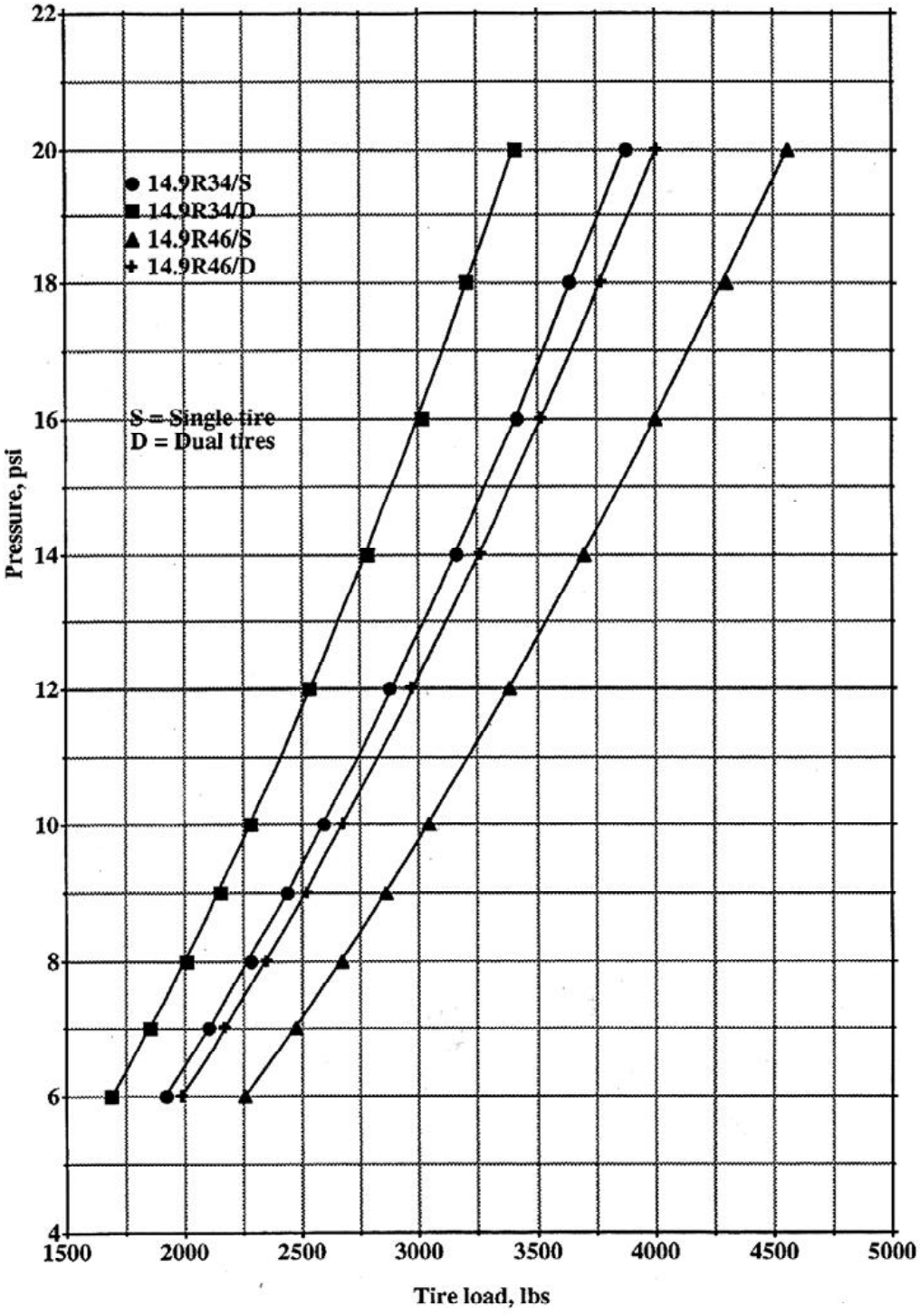

Figure 5. Correct/low pressure selection chart for 14.9R34 and 14.9R46 tires

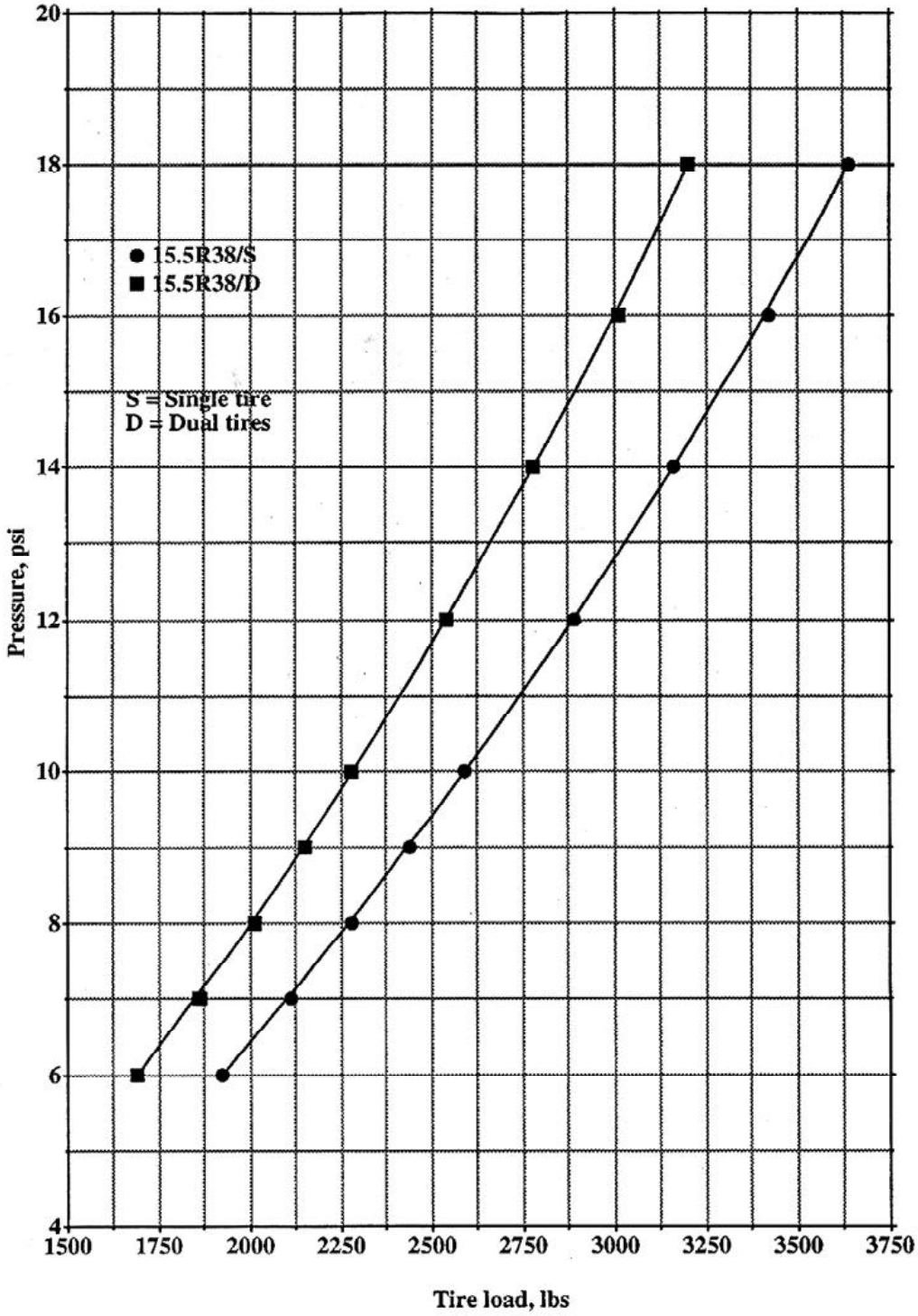

Figure 6. Correct/low pressure selection chart for 15.5R38 tires

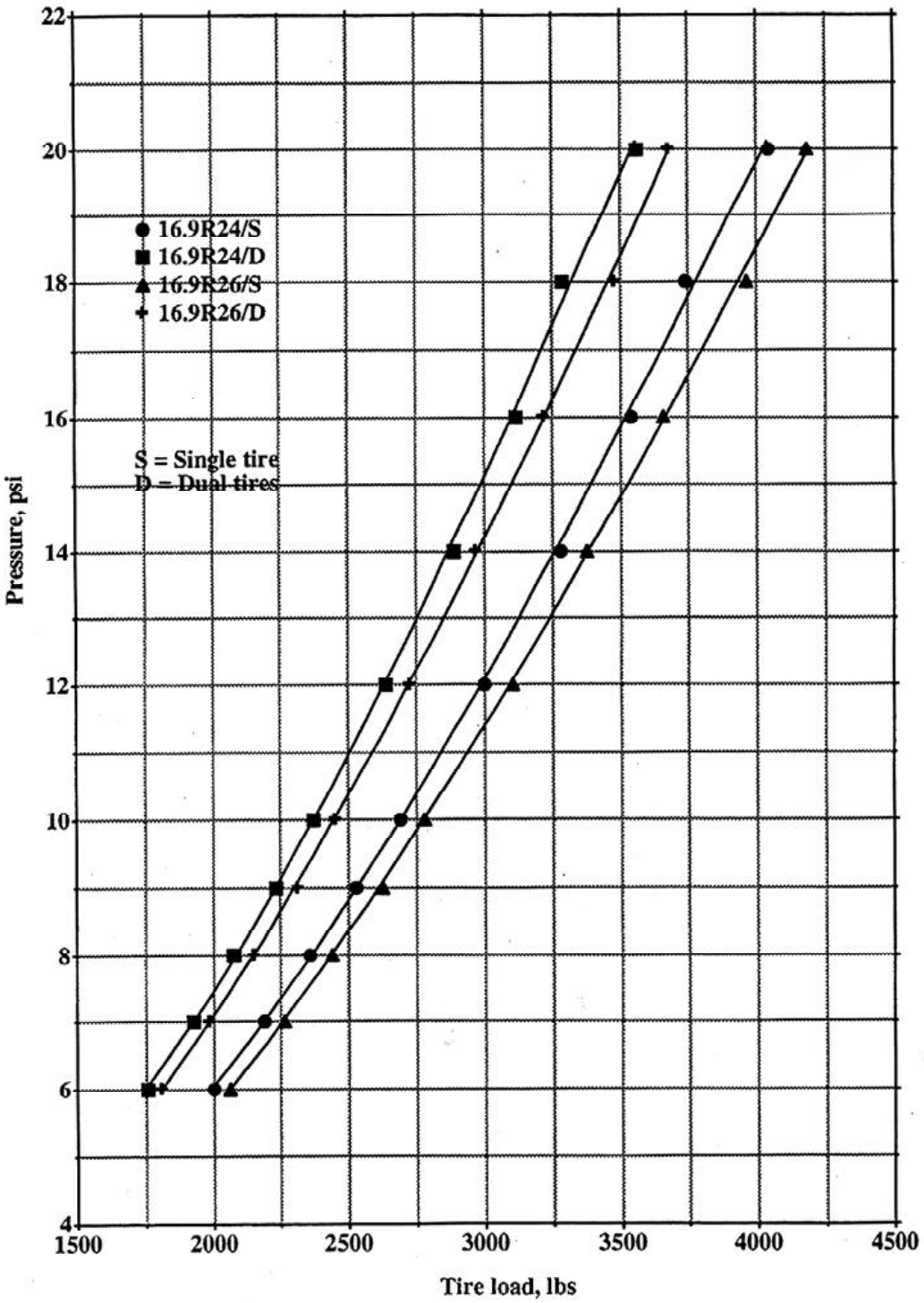

Figure 7. Correct/low pressure selection chart for 16.9R24 and 16.9R26 tires

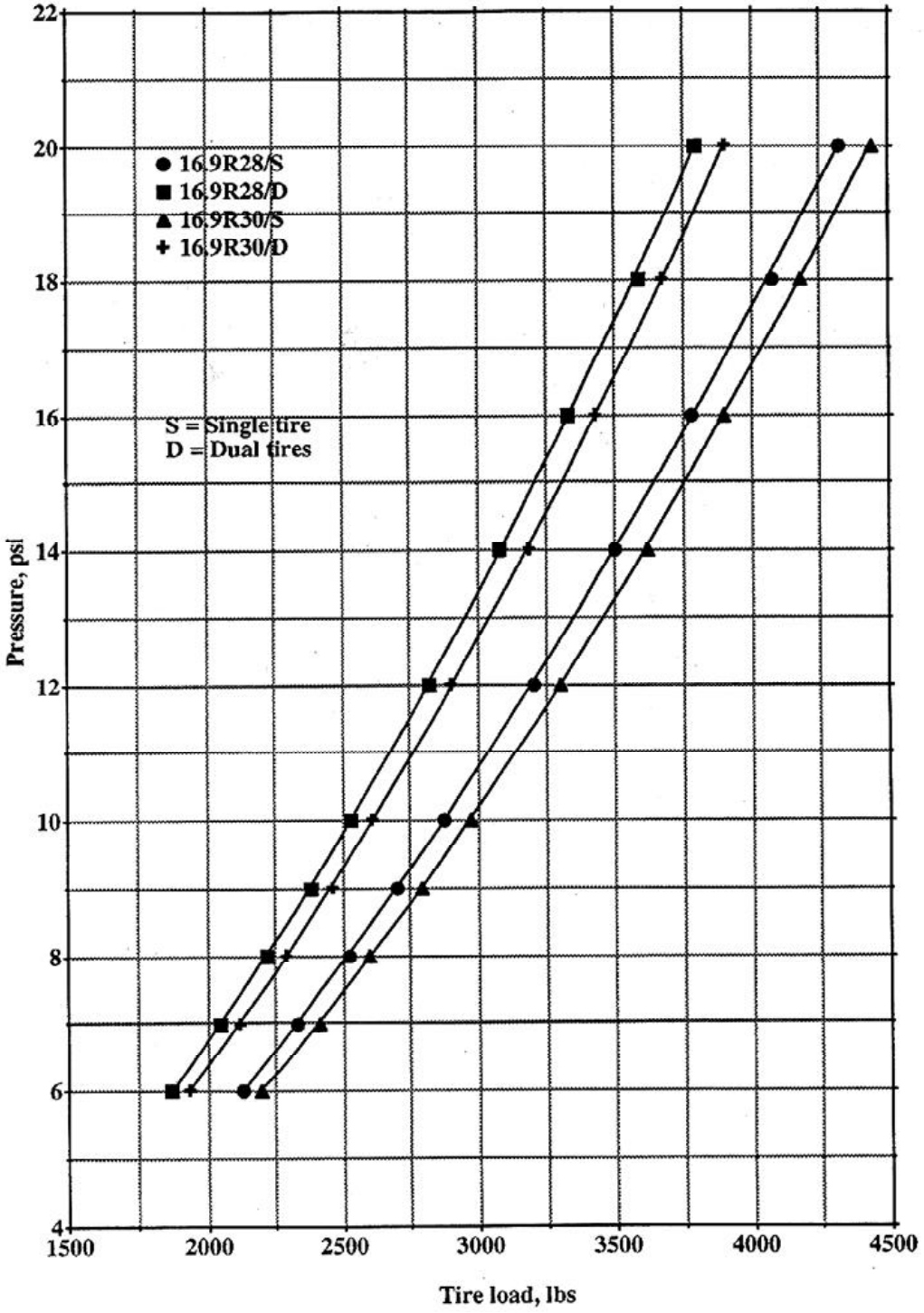

Figure 8. Correct/low pressure selection chart for 16.9R28 and 16.9R30 tires

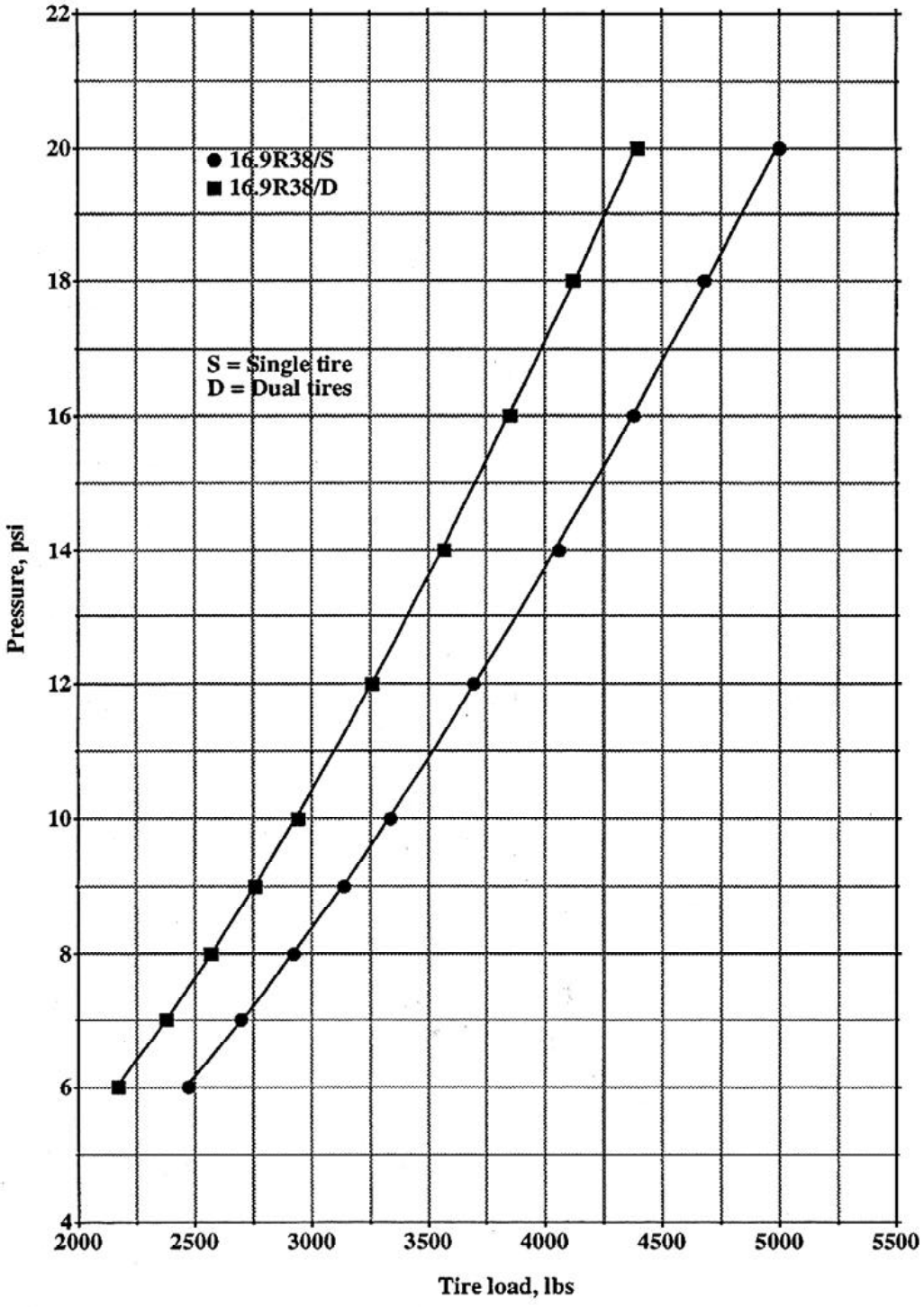

Figure 9. Correct/low pressure selection chart for 16.9R38 tires

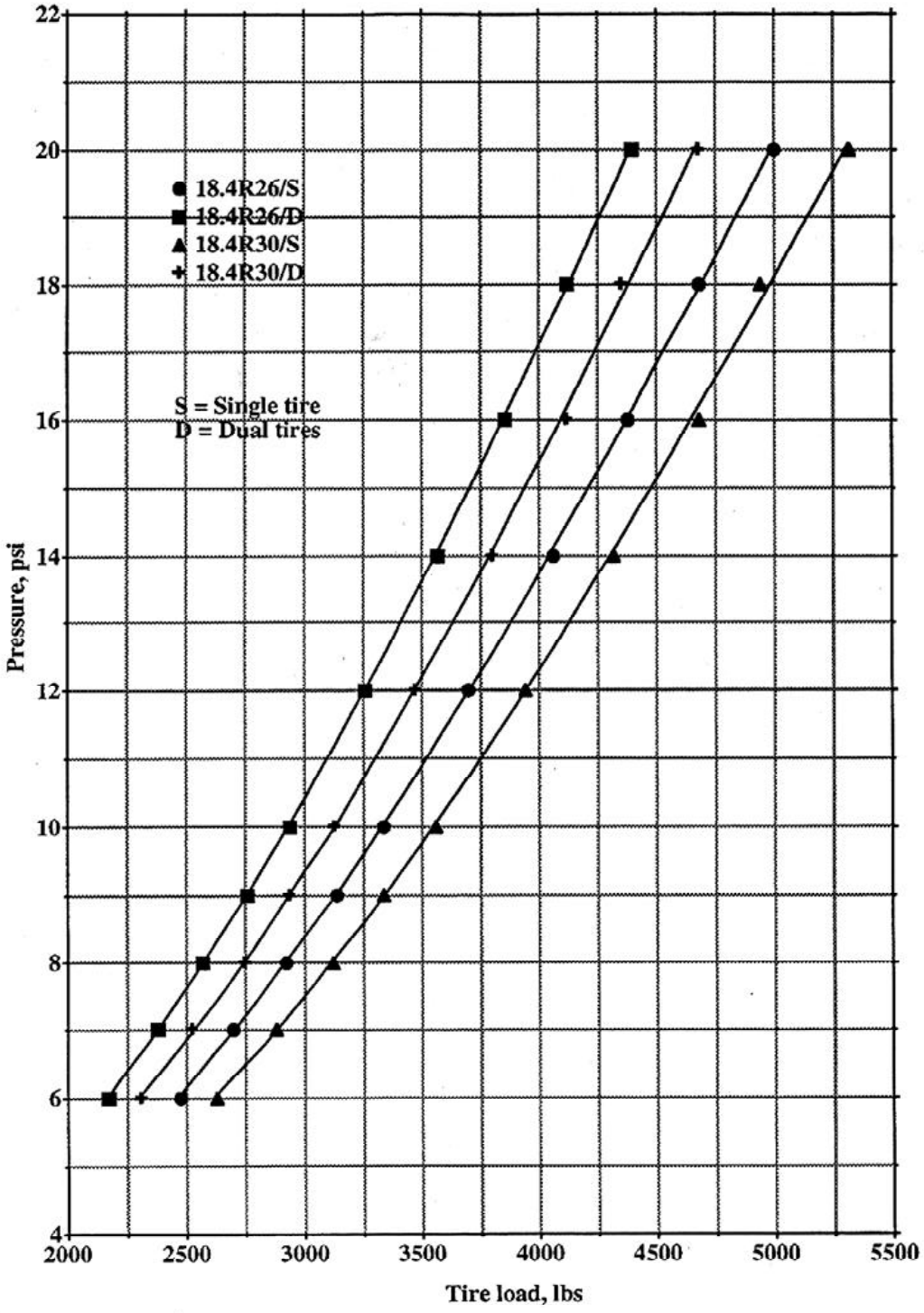

Figure 10. Correct/low pressure selection chart for 18.4R26 and 18.4R30 tires

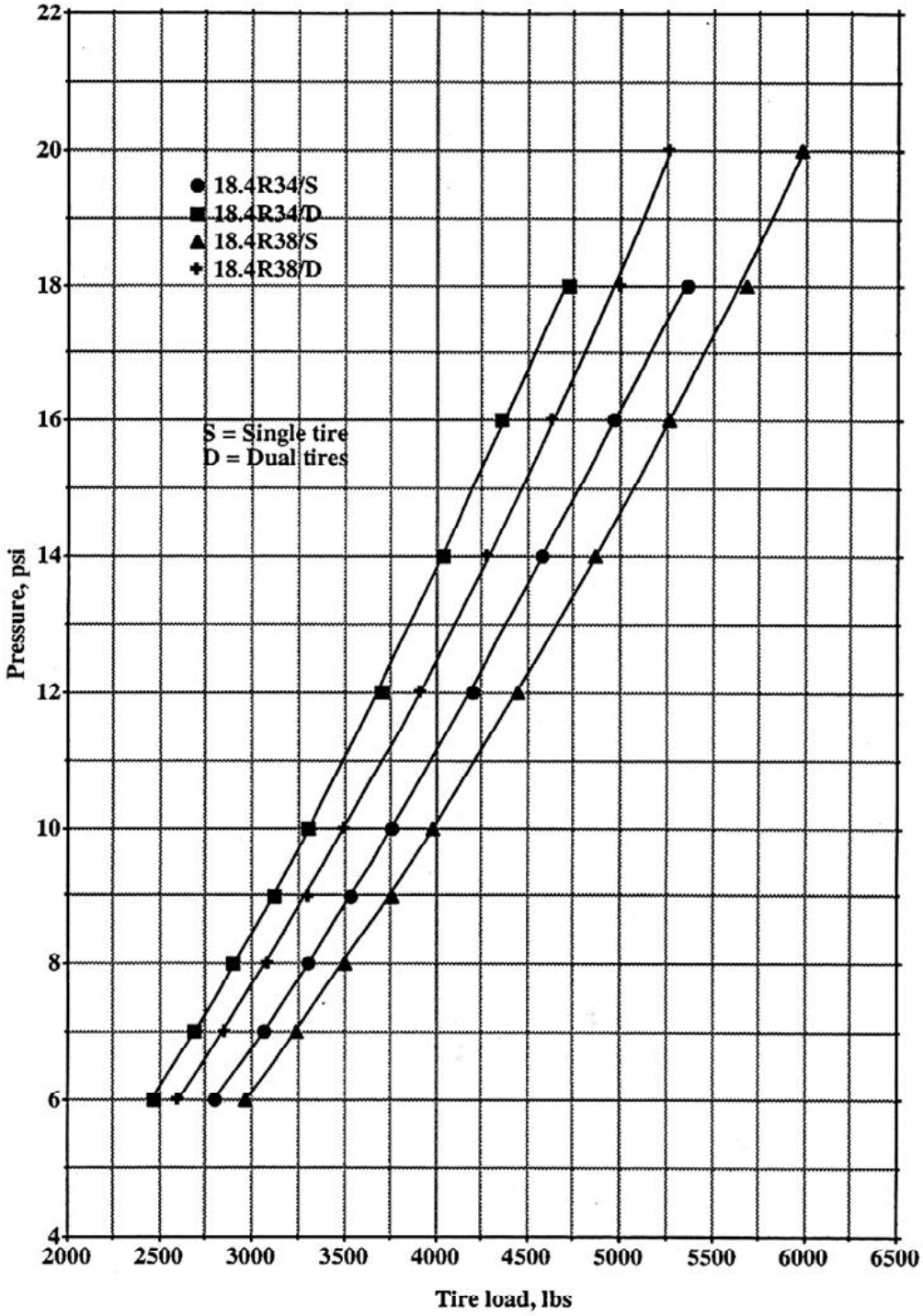

Figure 11. Correct/low pressure selection chart for 18.4R34 and 18.4R38 tires

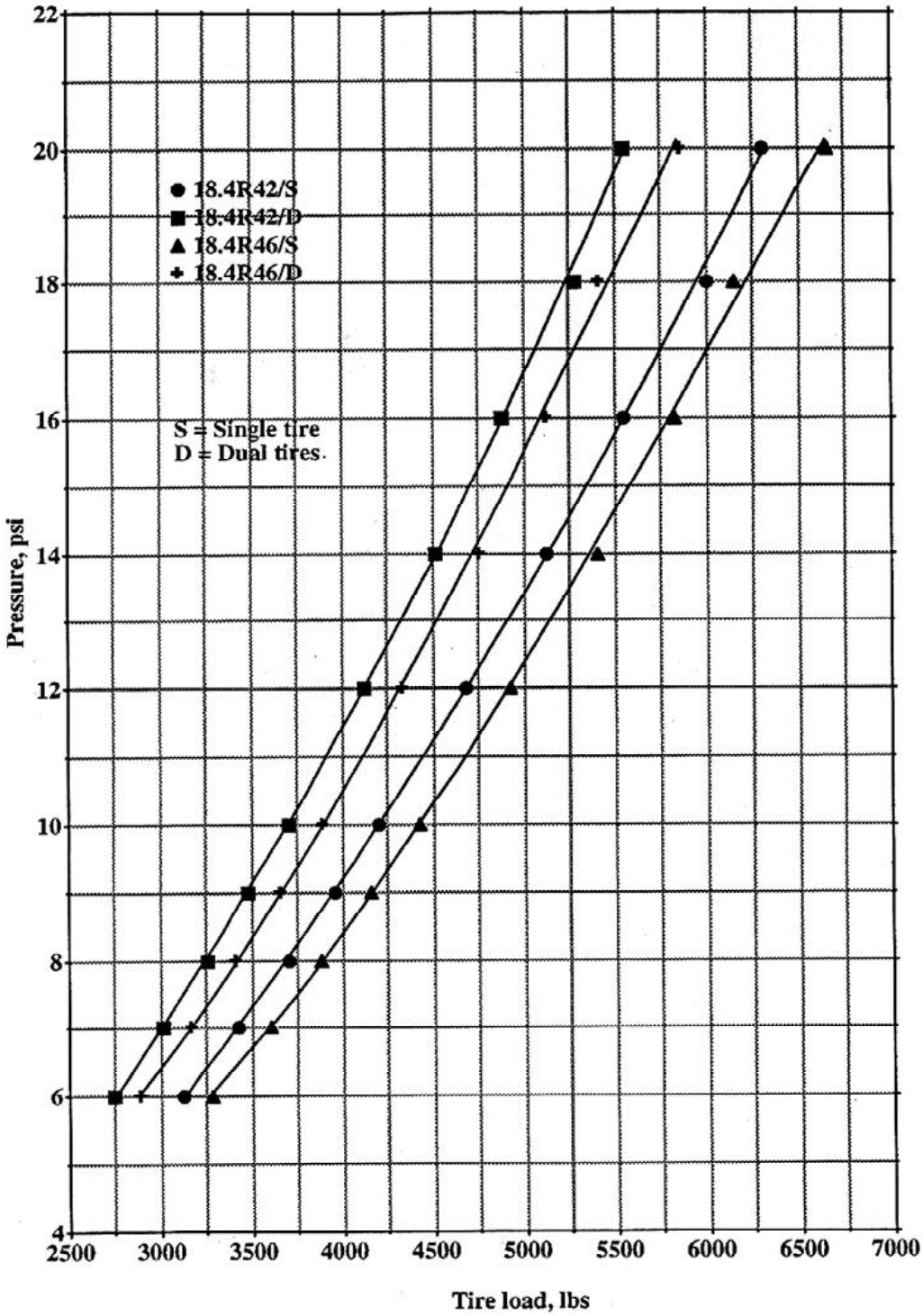

Figure 12. Correct/low pressure selection chart for 18.4R42 and 18.4R46 tires

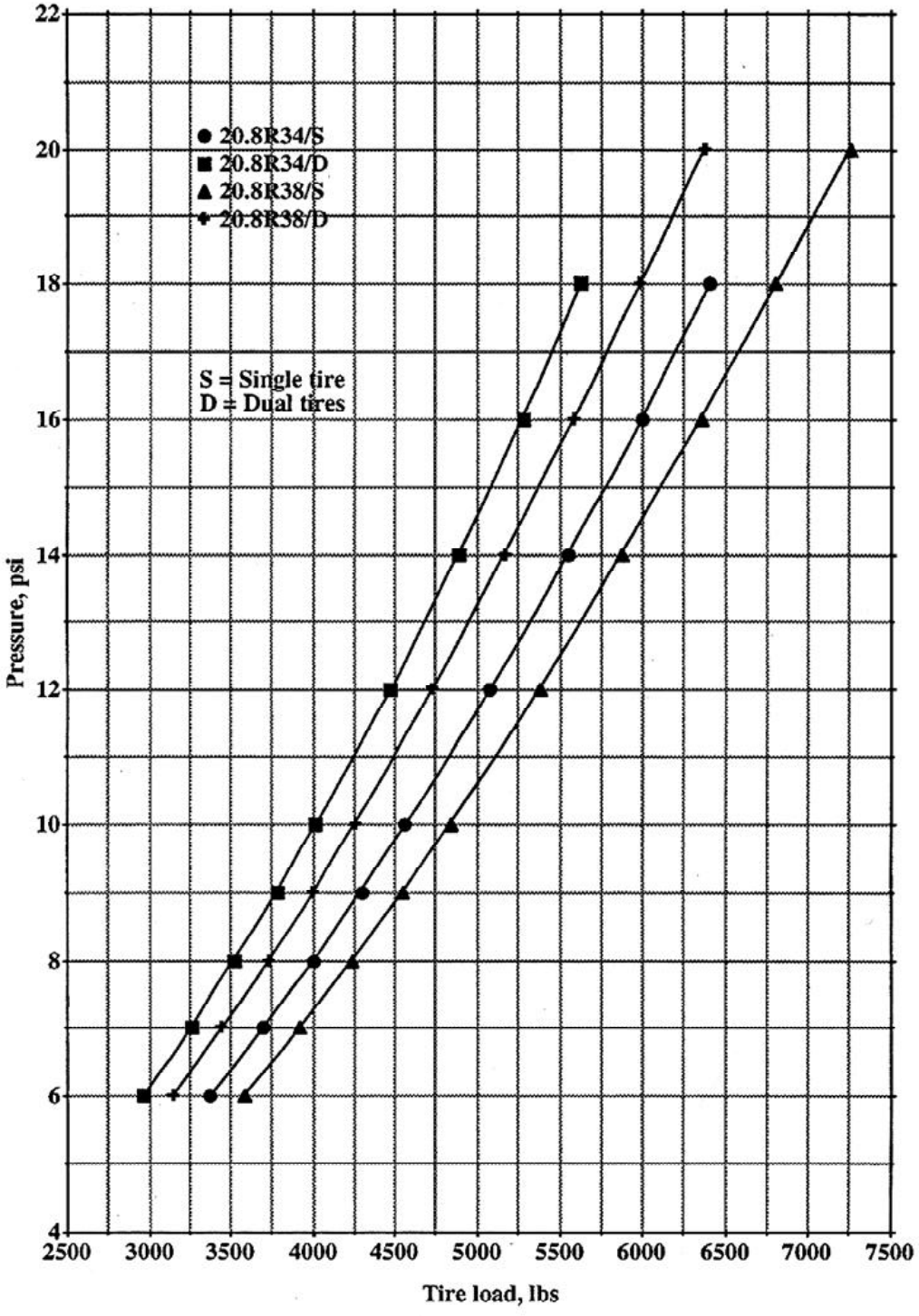

Figure 13. Correct/low pressure selection chart for 20.8R34 and 20.8R38 tires

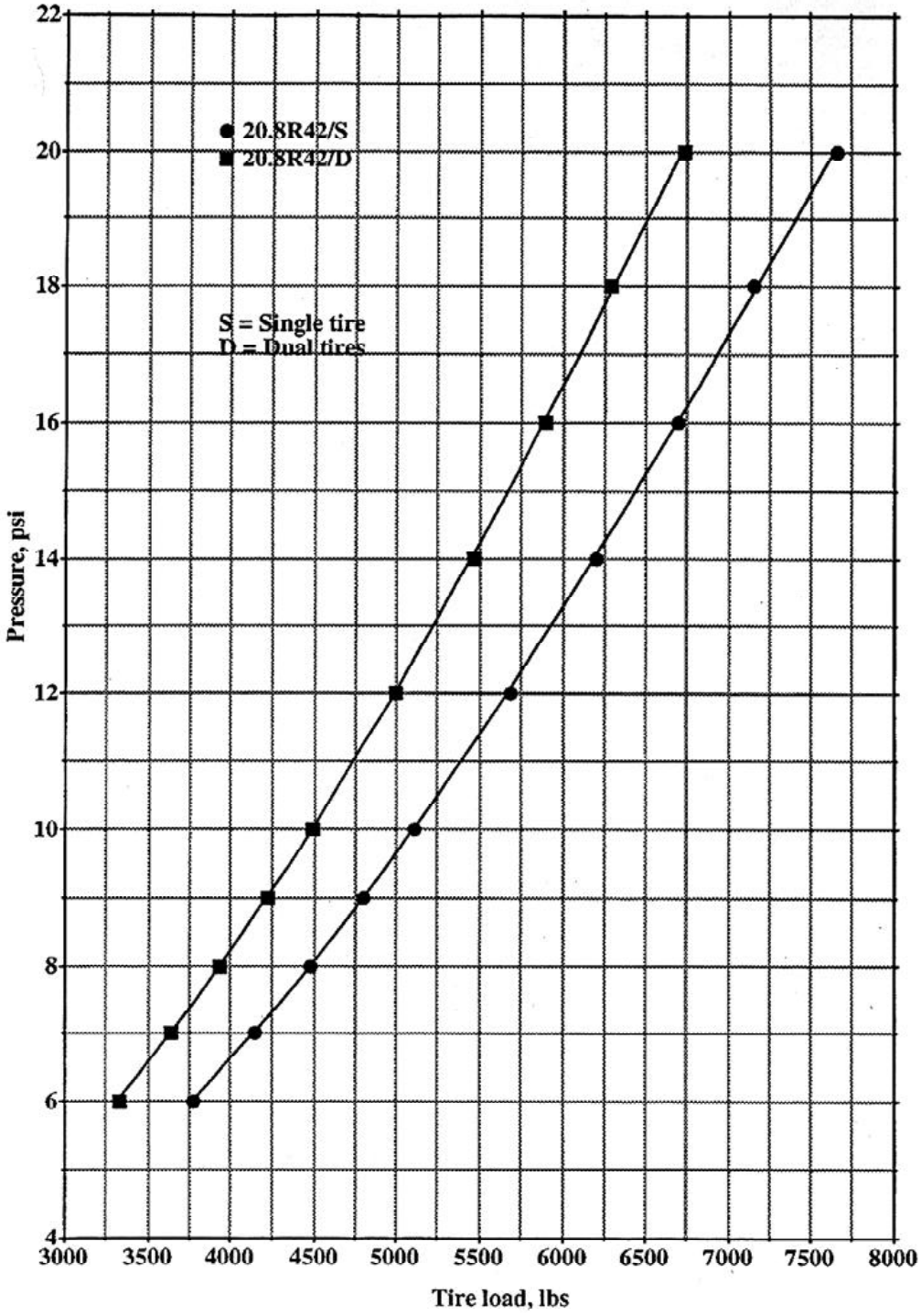

Figure 14. Correct/low pressure selection chart for 20.8R42 tire

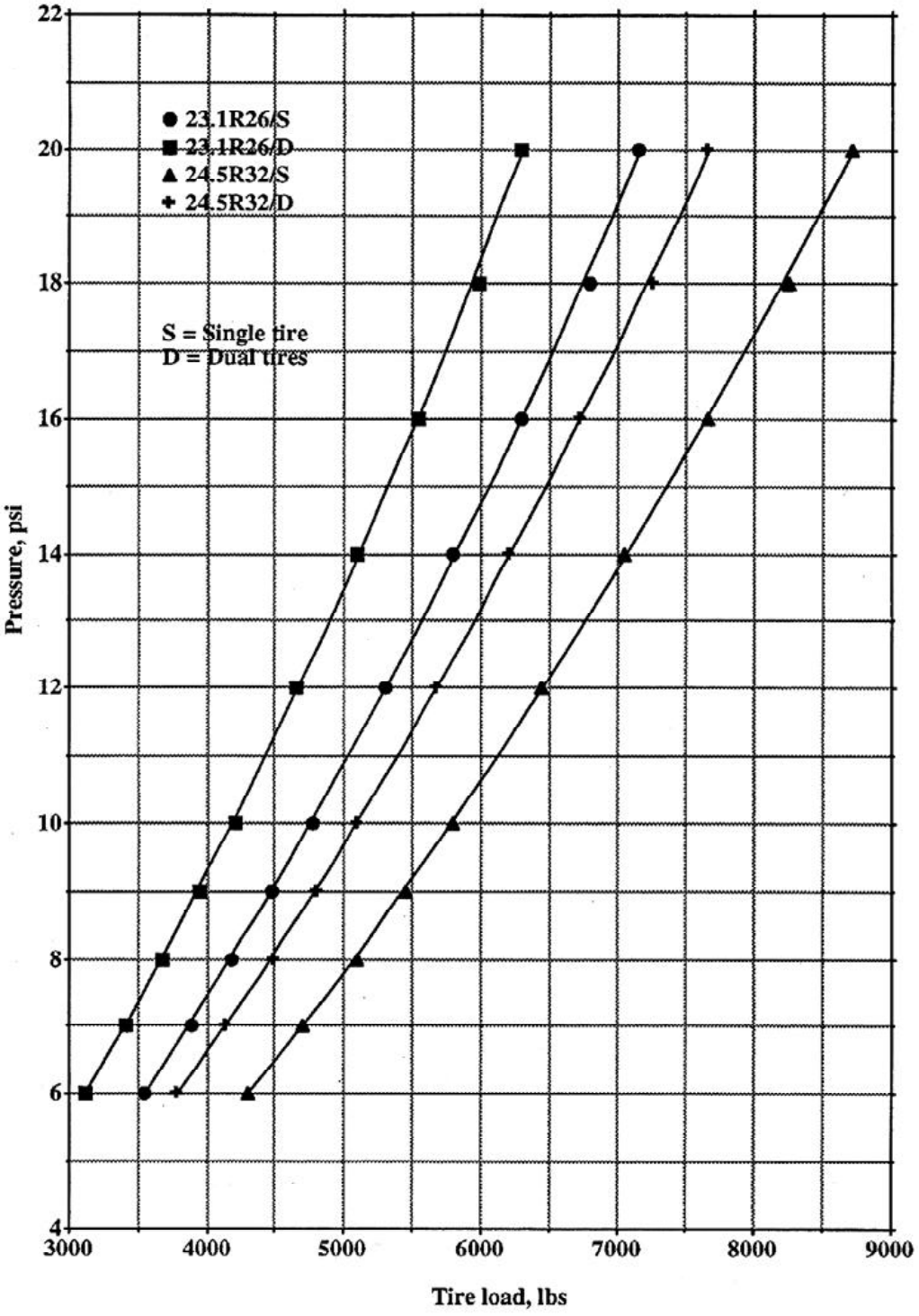

Figure 15. Correct/low pressure selection chart for 23.1R26 and 24.5R32 tires

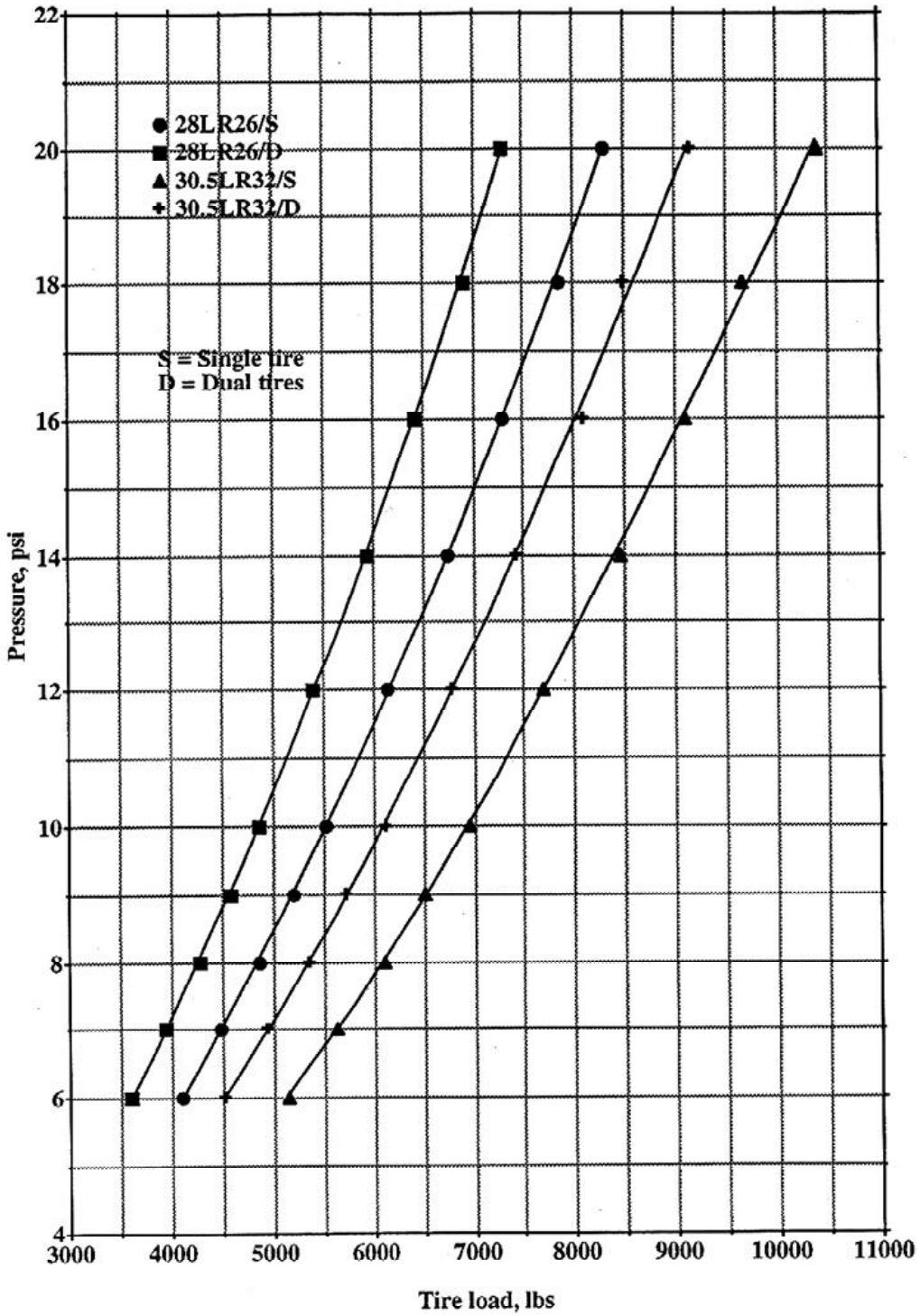

Figure 16. Correct/low pressure selection chart for 28LR26 and 30.5LR32 tires

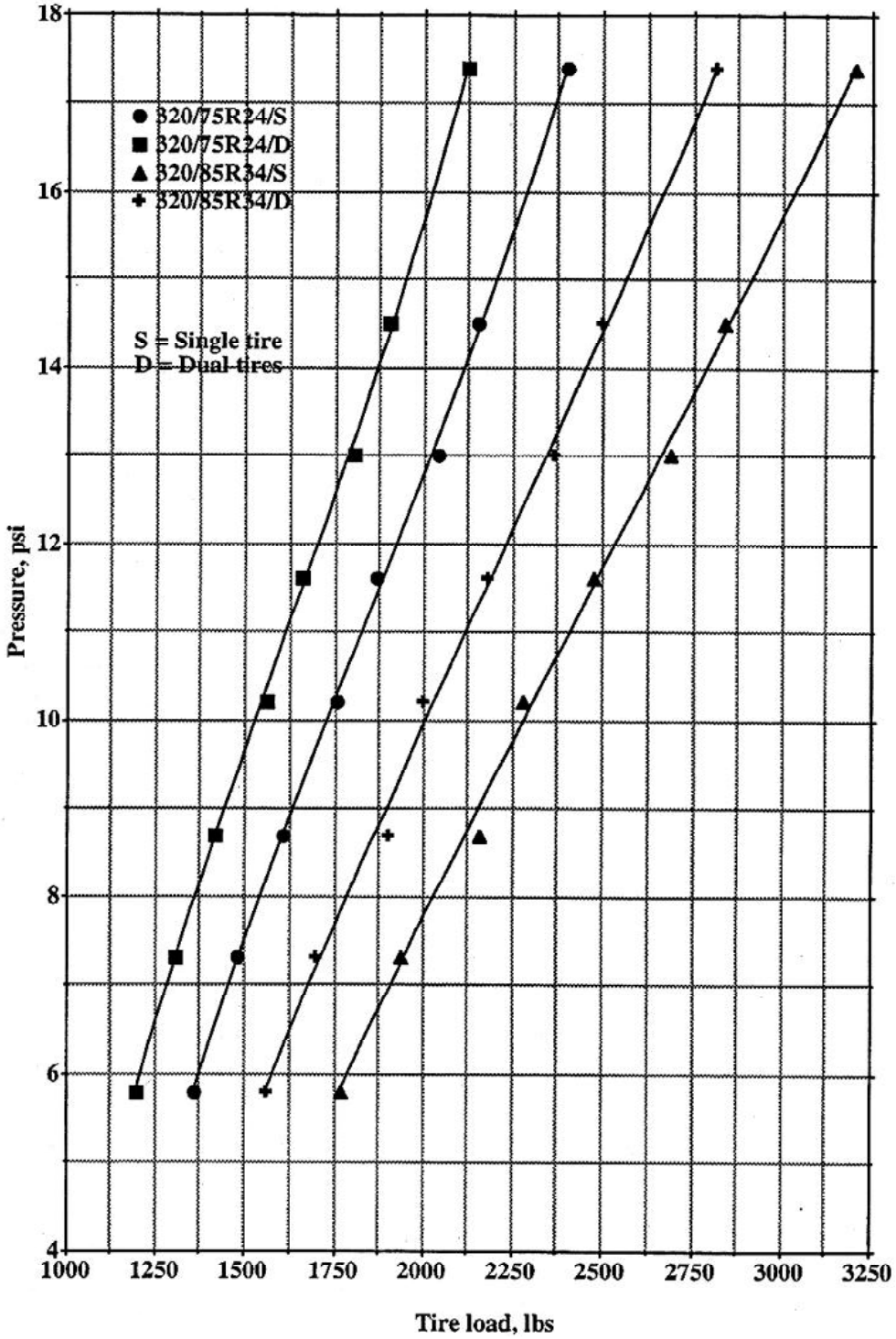

Figure 17. Correct/low pressure selection chart for 320/75R24 and 320/85R34 tires

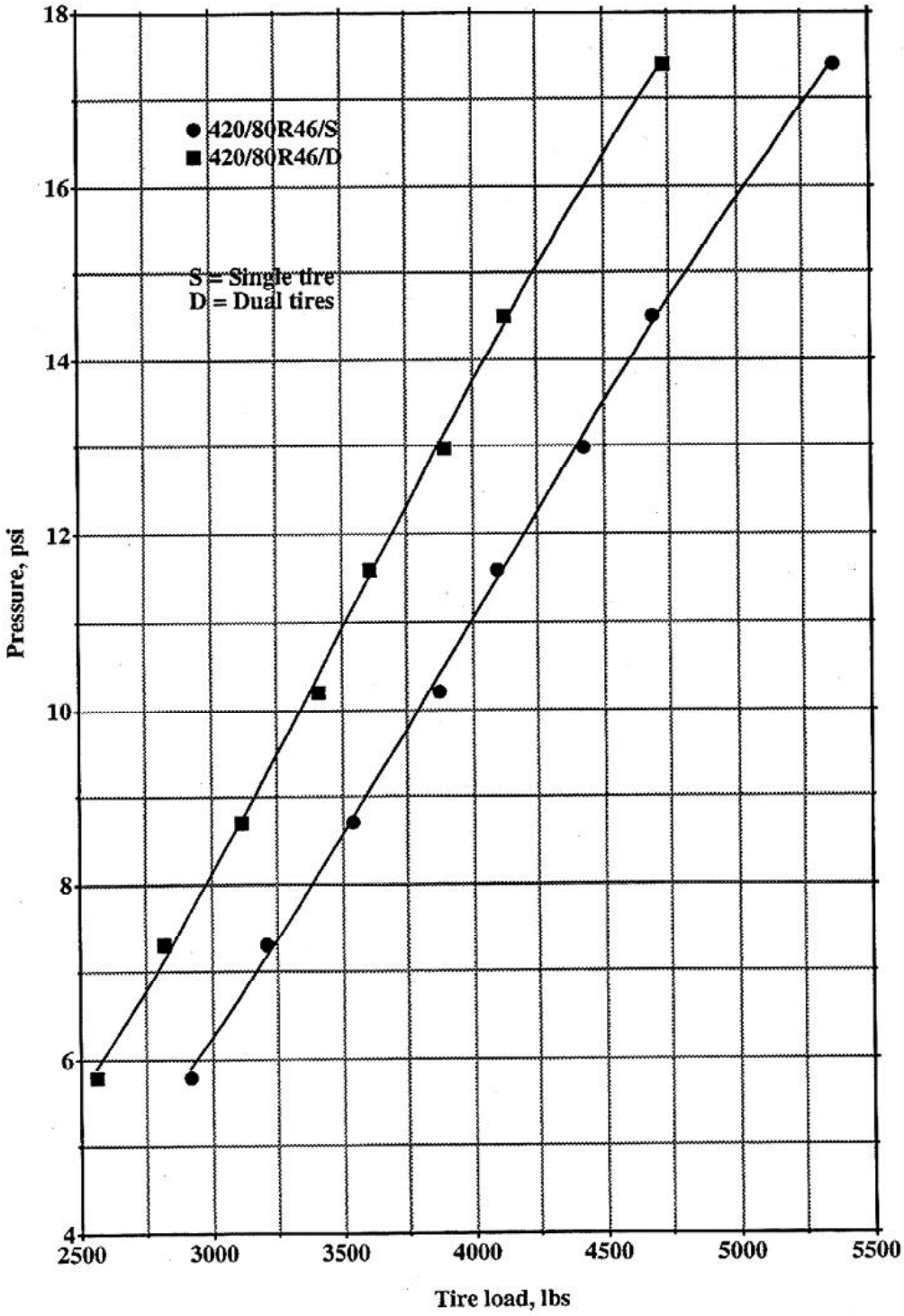

Figure 18. Correct/low pressure selection chart for 420/80R46 tires

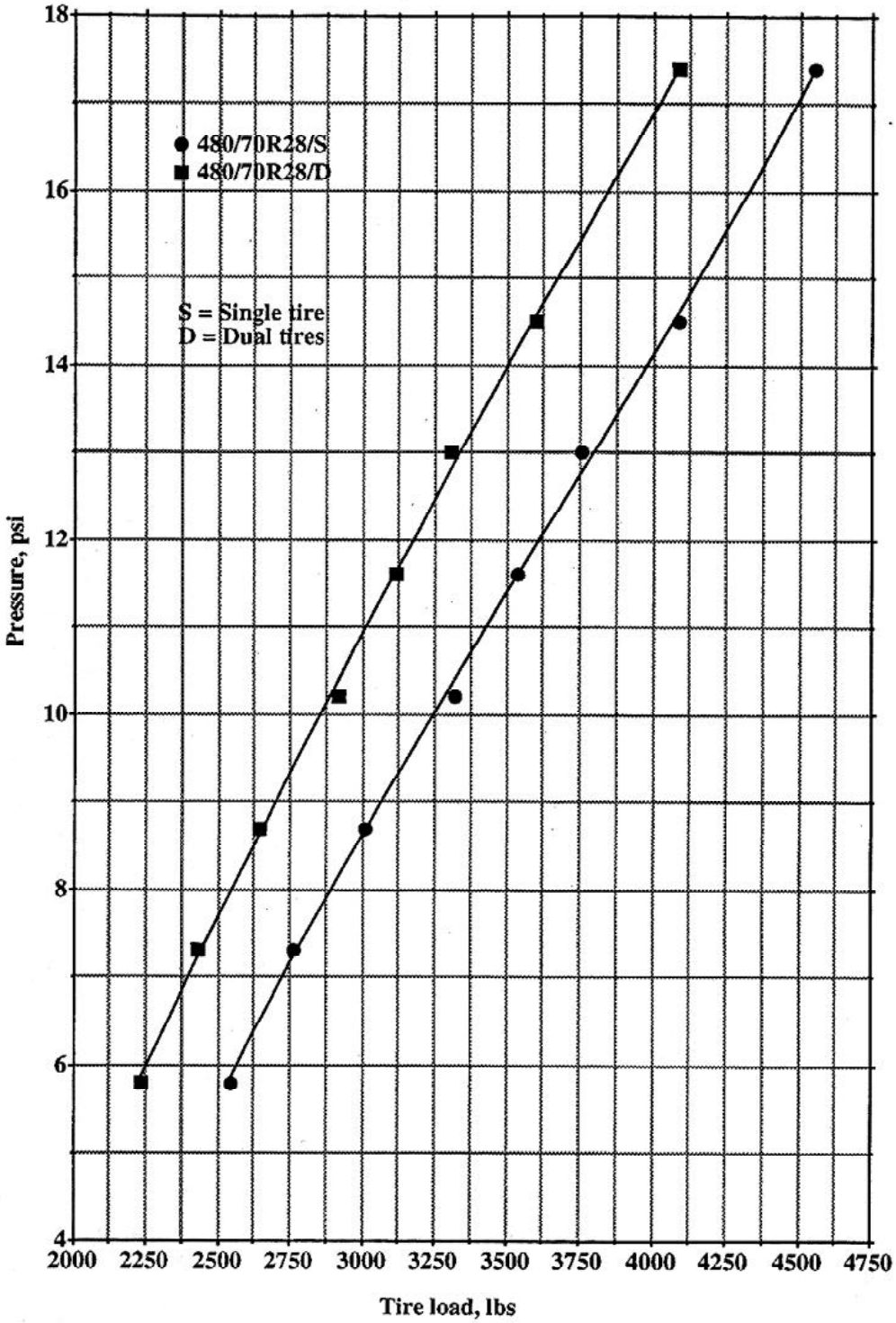

Figure 19. Correct/low pressure selection chart for 480/70R28 tires

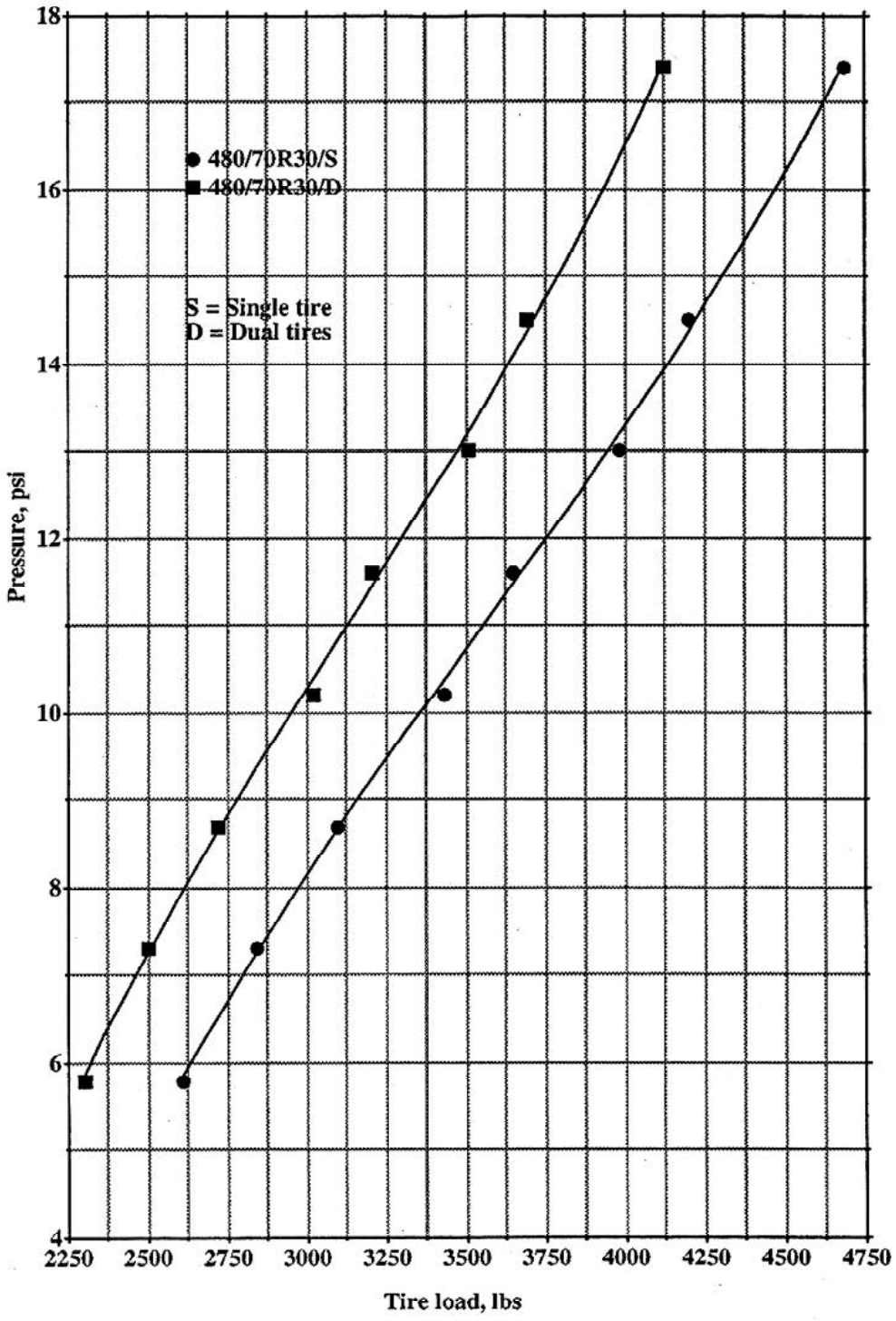

Figure 20. Correct/low pressure selection chart for 480/70R30 tires

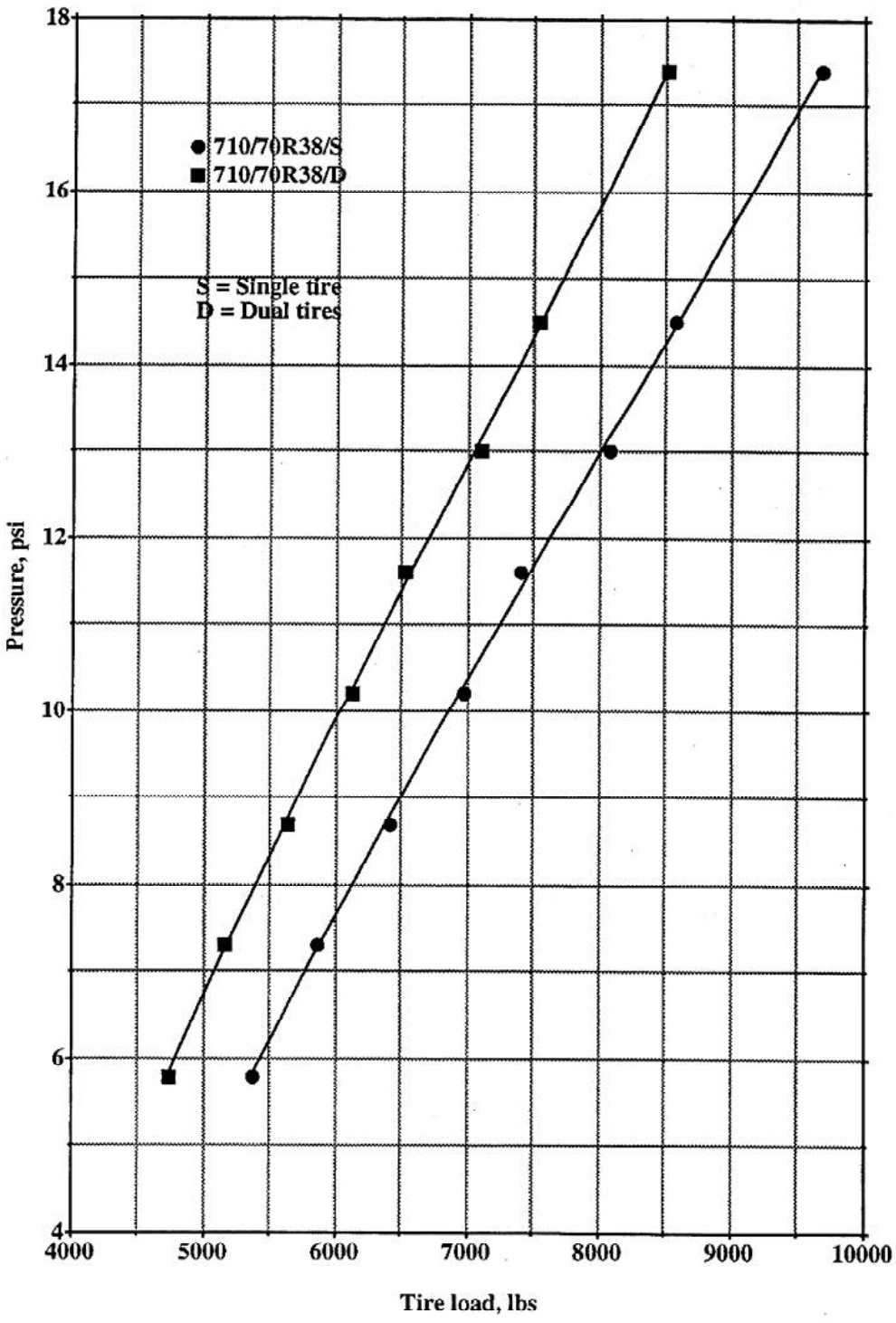

Figure 22. Correct/low pressure selection chart for 710/70R38 tires

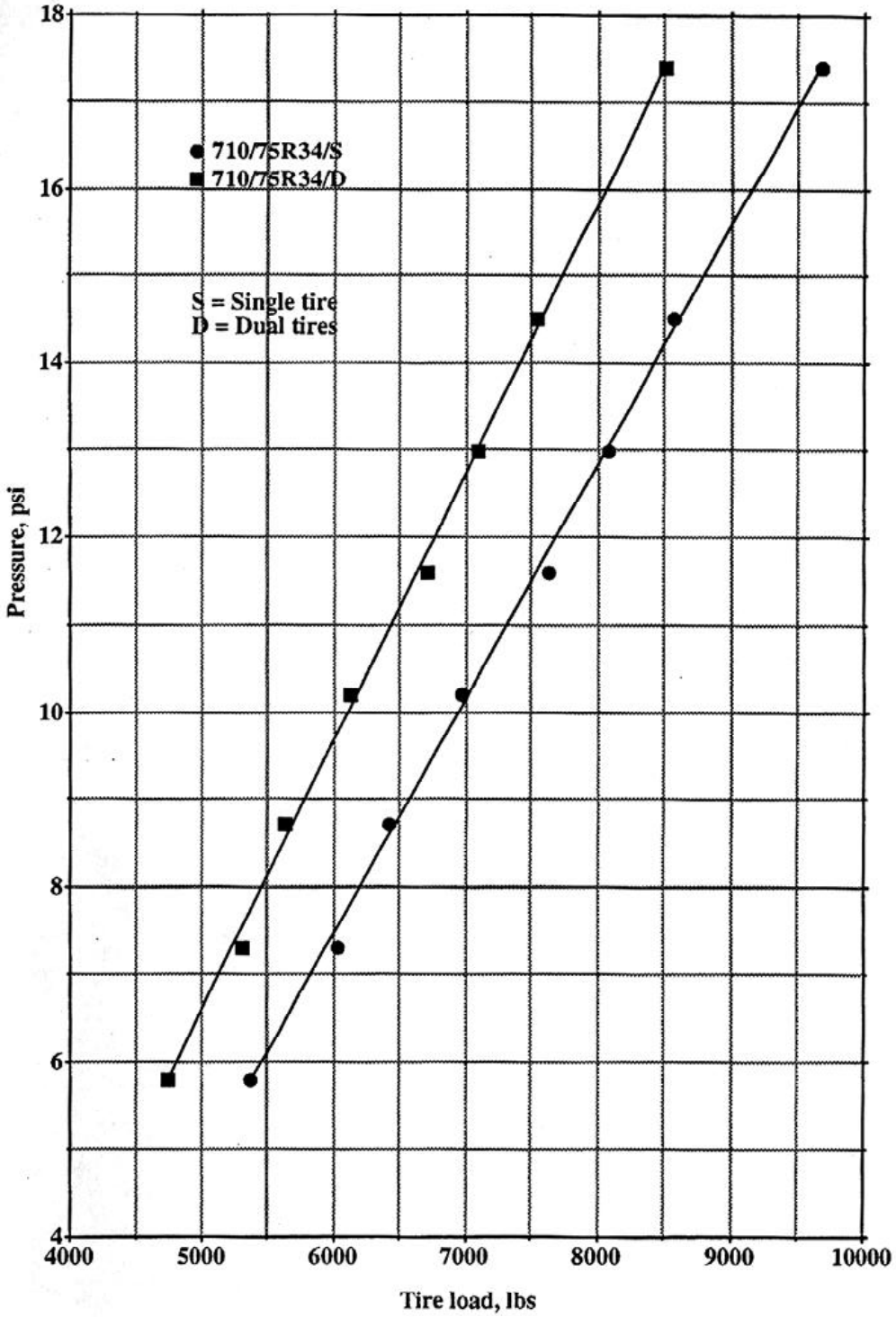

Figure 23. Correct/low pressure selection chart for 710/75R34 tires