Inflation Pressures for Plus-Size Fitments

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ABSTRACT: One of the most important parameters to be established for tire operation, whether on a new vehicle being designed by a vehicle manufacturer or on a plus-size fitment, is the recommended cold inflation pressure for the tire. The tire carries a maximum inflation pressure label, but operation at lower loads and pressures is generally beneficial for overall vehicle performance. Recommended inflation pressures have historically been provided by tire standards organizations in the form of tables of load versus pressure or in the form of simple mathematical models. This paper reviews these models along with a recently developed tire-stiffness-based model. Inflation pressure increases over minimum requirements are discussed. One commercial computer program providing tire pressure recommendations along with supplemental labeling for plus-sizing is reviewed.

KEYWORDS: Inflation pressure, stiffness model

Tire pressure selection in instances where the tire loads are lower than the maximum load allowed can be done by numerous methods, and is essential since tires are only rarely fit to vehicles where operation at their ultimate maximum load capacity is the norm. However, the selection of a correct inflation pressure is critical to the successful operation of the tire. It is well-known that operation of a tire at higher than required pressures may cause uneven tread wear, degrade vehicle ride and comfort, and increase susceptibility to impact damage. Operating the tire at lower than required pressures may also cause uneven tread wear, but can potentially lead to fatigue breakdown of the tire's internal structure resulting in tread separation or other structural failure. Lower-than-optimal operating pressures also decrease fuel economy. Obviously, inflation pressure at a given load has been shown to affect a tire's deflection, contact footprint pressure distribution, and hysteretic heat generation. The correct setting of the cold inflation pressure is therefore critical to achieving the design intent of the tire in the field. For vehicles being fitted with the Original Equipment (OE) tire, the recommended operating pressure is listed on the placard, but for plus-sizing, the recommended inflation pressure must be developed.

The normal methods employed for arriving at the correct inflation pressure are by interpolation in tables published by tire regulatory bodies, like the Tire & Rim Association (T&RA), or by computation using methods published by those same regulatory bodies. This paper will survey the computational procedures as they are currently published for passenger and light truck tires, along with a newly-developed method. These models yield a minimum inflation pressure for the vehicle load, so pressure increases over the minimum requirement are discussed. One computer system for delivering inflation pressure recommendations in plus-sizing is reviewed.

Tire Pressure Determination

The placard pressure indicated on a vehicle is supposed to provide the optimal inflation pressure for the OE tires on any vehicle. This value will generally be higher than the minimum pressure required to support the maximum load on a given axle of the vehicle and lower than the tire's maximum inflation pressure rating so that there is some excess load capacity. The inflation pressure on the vehicle placard is generally the result of significant performance testing on the part of the vehicle manufacturer along with the tire manufacturer. Tire makers, on the other hand, typically subject tires to a standard set of proprietary tests which field return experience has shown to provide adequate screening for development purposes. There are many instances, however, where tire inflation pressure must be determined in the absence of significant testing. This is especially true when tires that are a different size than those supplied as OE are fitted to a vehicle, as is the case when plus-size fitments are being installed.

There are several approaches to determining the correct operating pressure for a vehicle's tires. The first is to find the tire listed in tabulated pressure-versus-load tables such as those published by the T&RA in annual Yearbooks. Tire manufacturers normally distribute these tables to tire sellers for their use. Using these tables requires locating the pressure in the table where the tire's load capacity exceeds one-half of the Gross Axle Weight Rating (GAWR) of the vehicle for the particular axle (the front and rear axle GAWRs will likely be different). Note that, if passenger tires are used on a multi-purpose vehicle (MPV), the tire load must be increased by 10% to conform to Department of Transportation (DOT) requirements. This approach will generally be followed by vehicle manufacturers when selecting an appropriate tire size and minimum inflation pressure for a given vehicle. The pressure finally adopted for the placard may likely be higher than the minimum inflation pressure in order to deal with maximum vehicle speed or to optimize handling, rolling resistance, or a number of other vehicle performances. The same values found in yearbook tables can be obtained mathematically using the Engineering Design Information (EDI) formula that underlies those tabulations, or formulae provided by organizations like the European Tyre and Rim Technical Organisation (ETRTO). These formulations are supposedly based on the deflection at the maximum load for any pressure being the same as that of the tire at the maximum load, maximum pressure condition. The pressure is then given by:

$$\text{Pressure} = \text{MaxPressure} \times \left(\frac{\text{Load}}{\text{MaxLoad}}\right)^{\frac{1}{n}} \quad [1]$$

where MaxLoad is the maximum load indicated on the tire sidewall, MaxPressure is the pressure used to determine the maximum load, and *n* is equal to a constant (assuming vehicle speeds less than 160 kph (100 mph)). Note that MaxPressure is not necessarily equal to the maximum pressure on the tire sidewall, since some standard load tires are marked with higher maximum inflation pressures to allow for operation at higher speeds, as shown in Table 1.

There are also numerous values of the exponent *n* in common use in the tire industry today. The T&RA has historically stated that the maximum load on a tire being designed to operate at a certain maximum inflation pressure could be stated as:

$$\text{MaxLoad} = G \times \text{Maxpressure}^{n} \quad [2]$$

The empirical origins of this form, where *G* represents a constant function of tire geometry, have been covered in detail by S. Padula [1]. The first formula adopted by the T&RA in 1928 established a value for *n* as 0.585. At that time, pressure at lower-than-maximum loads was obtained simply as a ratio, or using Equation 1 with *n* = 1. At some point in time, Equation 2 was deemed to apply to any pressure; the pressure-load relationship at lesser loads was then obtained by dividing the load at any pressure by the maximum load, resulting in elimination of the *G* term and yielding Equation 1. A value of 0.5 was adopted for P-metric tires in the 1970’s. A perusal of a recent edition of the T&RA’s EDI guide shows that the value of *n* is 0.7 for light truck radial tires, 0.585 for flotation tires (and bias tires), and various other values for truck tires depending upon the type and aspect ratio. Since the beginning of 2006, the T&RA has been working on harmonizing its standards with other international organizations like the ETRTO. For passenger car tires standardized after January 1, 2006, the value of *n* in Equation 1 is 0.8 for tires with Load Index (LI) less than 100, and 0.65 for tires with LI greater than 100. Yearbooks have pressures tabulated for reduced load operation, and these values were generated based on the values of n in use at the time the given tire size was first entered into the document.

More recently, Daws [2] developed a method for generating the required minimum inflation pressure for any radial tire based on an empirical tire vertical stiffness formulation by Rhyne [3]. Based on Rhyne's analysis, Daws showed that the minimum tire inflation pressure at any load can be computed as:

$$\text{Pressure} = \frac{\left(\frac{\text{Load}}{\text{Maxload}} \times (\text{Maxpressure} \times F + 3.45)\right) - 3.45}{F} \qquad [3]$$

where F is a function solely of tire geometry containing the tire parameters of section width, S_N, aspect ratio, AR, and rim diameter, D_R:

$$F = 0.00028 \times \sqrt{(1.03 - 0.004 \times AR) \times S_N \times \left(\frac{S_N \times AR}{50} + D_R\right)} \qquad [4]$$

where all the parameters are in metric units.

Obviously, all the computational approaches above will yield slightly different values, especially since there is a wide range of values for the coefficient n in Equation 1. Of interest is the fact that the stiffness formulation described above was developed from data taken from a large number of tires of different sizes and types. The stiffness data therefore can be interpreted to be a representation of how radial tires actually behave at less-than-maximum inflation pressures rather than how the maximum-inflation models of load capacity might predict that they work. The deflection of the tire is one of the more significant operating parameters in terms of the tire's resistance to long-term fatigue breakdown, since deflection generates strain in the skim rubber at the belt edge. If the tire is over-deflected, i.e., deflected more than it would be if it were loaded to its maximum load and operated at its maximum inflation pressure, then the tire may incur strains beyond those envisioned by its developers. These strains are more likely to arise in the critical belt-edge area of a steel-belted radial tire where they can contribute to heat-related issues including increased rolling resistance and the development of tread separation.

Comparison of the Various Models

In order to compare the pressure prediction of the various models, it is interesting to recast them into a ratio format. That is, Equation 1 becomes

$$\frac{\text{Pressure}}{\text{MaxPressure}} = \left(\frac{\text{Load}}{\text{MaxLoad}}\right)^{\frac{1}{n}} \qquad [5]$$

Equation 6 can be plotted for various values of *n* to see the influence of the various models on the pressure prediction. Figure 1 shows this relationship plotted for values of *n* equal to 0.65, 0.7, and 0.8. Note that the pressure ratio required to support any given load ratio increases as the value of *n* increases. For example, if a certain tire is required to support 75% of its maximum load, the pressure required would be 64.2% of the maximum inflation pressure for $n = 0.65$, 66.3% for $n = 0.7$, and 69.8% for $n = 0.8$. Again, there does not appear to be any significantly compelling reason to believe that the required inflation pressure could range between 64.2% and 69.8% of maximum inflation pressure for the same physical load on the same tire. Nor is there any compelling physical reason to believe tires of the same size (or more correctly, internal volume), but governed by different standards organizations, would have substantially different pressure requirements to support less-than-maximum loads.

The stiffness formulation shown in Equation [3] can be recast in a similar fashion, albeit with slightly more work, as:

$$\left(\frac{\text{Pressure}}{\text{MaxPressure}}\right) = \left(\frac{\text{Load}}{\text{MaxLoad}}\right) \times (1+k) - k \qquad [6]$$

Where *k* is a constant for any tire given by:

$$k = \left(\frac{3.45}{\text{MaxPressure} \times F}\right) \qquad [7]$$

where MaxPressure is given in kPa to be consistent with the original stiffness formulation. Equation 7 is, as expected, the equation of a straight line with slope 1+*k* and intercept –*k*. However, since the value of *k* depends upon the tire size and the tire’s maximum inflation pressure, the slope will vary with the tire size and type. In order to explore the significance of this variation, numerical assessments were done across a wide range of tire sizes in P-metric, light truck, and medium truck. It was found that, generally, the geometry function, *F*, ranges between about 0.07 for very small passenger car sizes to about 0.18 for large medium duty truck sizes. Table 2 shows this trend for several tire sizes. Using these extremes, the value of the *k* parameter was plotted against various maximum inflation pressures as shown in Figure 2. This shows that the value of *k* is larger for small tires at low maximum inflation pressures and becomes smaller for large tires at high maximum inflation pressures.

From Figure 2 and Table 1, the expected range of values of k is from about 0.02 for large tires having high maximum inflation pressures to about 0.22 for small tires having low maximum inflation pressures. These values were substituted into Equation 6, with the results plotted in Figure 3 against Equation 5 with $n = 0.8$. From Figure 3, it is clear that when k is close to its minimum (i.e., for very small tires at low maximum inflation pressures), Equation 5 with $n = 0.8$ and the stiffness prediction are very nearly identical down to the point where the imposed load is about 70% of the maximum rated load. However, as tire sizes increase and maximum inflation pressures increase, the stiffness prediction moves away from the $n = 0.8$ line. In fact, for large size tires at high pressures, the stiffness prediction approaches:

$$\left(\frac{\text{Pressure}}{\text{MaxPressure}}\right) = \left(\frac{\text{Load}}{\text{MaxLoad}}\right) \qquad [8]$$

which is Equation 5 with $n = 1$ (this line is also shown on Figure 3). Figure 3 shows that inflation pressures required at less than maximum loading predicted by the stiffness formulation will generally lie between that predicted by the $n = 0.8$ relationship and the pure ratio relationship given by Equation 8 ($n = 1$). This clearly shows that the stiffness formulation yields a more conservative prediction of pressure at any less-than-maximum load than do the formulae or tables of any of the standards organizations.

Discussion

The selection of an inflation pressure for tire operation at less than maximum loads is critical to the success of the tire in that service. Models of the form of Equation 2 were originally developed, as discussed by Padula [1], from empirical relationships governing the selection of a tire's maximum load capacity at some maximum inflation pressure. As Padula noted, in the early days of the T&RA, tire inflation pressure at less-than-maximum load conditions was obtained by using

Equation 9, and the move to forms of Equation 1 was not clearly explained in the record. What is of interest for the modern radial tire at this point is that it has been shown that the stiffness of the tire is linear with pressure, at least in the range of “normal” operating pressures. Establishment of the linearity of stiffness with pressure suggests that the relationship between inflation pressure and load should follow a linear relationship for a given tire even if the maximum load capacity is related in a non-linear fashion to the maximum inflation pressure across many tires of the same type.

It is intuitive that similar tire sizes at similar partial loads should require similar inflation pressures, regardless of the standards organization that is responsible for the tire. Hence, different values of n in Equation 1 across different standards organizations do not seem consistent with the physical reality that the load capacity of a tire is related to its volume and its internal pressure. Further, the stiffness-based formulation for less-than-maximum load conditions suggests that all of the power law model type formulations yield pressures that are too low for the load in question. The relationship in Equation 1 with n equal to 0.8 appears to provide appropriate minimum inflation pressure for small tires at low maximum inflation pressures. In today’s market, most passenger car tires fit on 15-inch diameter rims and larger, at a maximum inflation pressure of 240 kPa (35 psi) for standard load tires. These tires (along with all light truck tires at maximum inflation pressures of 340 kPa (50 psi) and higher, as well as all medium duty truck tires) would require higher inflation pressures, as defined by the stiffness model, than would be indicated by the use of power law models with $n = 0.8$.

In all these discussions, of course, “maximum inflation pressure” is taken to be the pressure at which the tire develops its maximum load capacity. For most tires, this is the maximum pressure shown on the tire’s sidewall. However, for passenger car tires, there are many types of tires that are labeled with a higher maximum inflation pressure that the pressure at which the tire develops its maximum load capacity. Again, Table 2 summarizes these types of labeling.

Any pressure versus load model for a tire yields the minimum cold inflation pressure that enables the tire to sustain the load applied. Theoretically, the tire’s deflection will be limited to the maximum deflection (i.e., that found at the maximum-load, maximum-inflation-pressure state). In the 1970’s, the National Highway Traffic Safety Administration (NHTSA) analyzed the frequency of tire failure as a fuction of the amount of reserve load capacity of the tires across a wide range of vehicle manufacturers and across several years in the second half of the decade. The resultant analysis showed that, when tires had about 20% or more reserve load capacity, failure was much less likely that at lower levels of reserve load capacity. These data are shown in Figure 4. Note that while there appear to be two outliers above the 20% level, as the reserve load percentage decreases, the percentage of tire failures goes up. The base report also indicated that road hazard failure had been excluded in these data. In the case of plus-size fitments, this means that a conservative approach to setting a recommended inflation pressure would be to obtain the minimum inflation pressure to hold the given vehicle load, and then increase this value by about 15-20% to set the recommended level of inflation pressure. Since NHTSA's reserve load percentage was computed using T&RA rules, this level of required reserve load capacity is not surprising given that the stiffness formulation would predict higher pressures at each load, effectively resulting in higher minimum pressures. In other words, the pressure required to make the tire successful in the field is that required to give a load capacity about 20% higher than that computed from the vehicle GAWR using T&RA methodology.

As an example, consider a vehicle having a rear GAWR of 1315 kg (2900 lb) fitted with a P235/75R15 standard-load tire (maximum load = 920 kg at 240 kPa). T&RA minimum pressure for this tire and load combination would be 123 kPa (18 psi). By DOT regulation, if the vehicle is a multipurpose type, then a 10% safety factor is required on the load capacity, yielding a pressure requirement of 148 kPa (22 psi). For a 20% safety factor on load, the required pressure would be 176 kPa (26 psi). The stiffness method would yield a minimum pressure requirement of 178 kPa (26 psi) at the DOT 10% margin point. The stiffness method would predict 200 kPa (29 psi) as the correct inflation pressure for the 20% load safety factor case.

Application to Plus-Sizing

Whatever method is used to obtain a recommended inflation pressure when plus-sized tires are being fitted, it is recommended that the operation include:

- Ensuring that the tire selected has sufficient load capacity for the vehicle,
- Ensuring that the wheel has sufficient load capacity for the vehicle,

- Ensuring that the wheel width meets tire manufacturer recommendations for the tire selected,
- Ensuring that the valve stem has sufficient pressure capacity for the tire,
- Ensuring any potential change in speedometer reading is addressed,
- Ensuring that the information about tire pressure recommendation and speedometer change is communicated to the purchaser, and
- Ensuring that a supplemental tire pressure label is affixed to the vehicle.

These recommendations, along with more detail on the potential dynamic impact of plus-size fitments on vehicle performance have been covered previously by Daws [4]. Performing these steps accurately provides a certain amount of challenge even for the most seasoned tire professional. Errors in data look-up, calculation, and transcription are not uncommon. Technicians performing these computations need to remember to apply the safety margins specified by the DOT. The wheel selected for the application must fit within width limits set by the standards body (ie., T&RA, etc). The outside diameter of the tire should be with ±3% of the OE tire, or speedometer calibration should be recommended. Even having the appropriate data for a newly released tire can be problematic. Fortunately, some of these issues can be resolved easily using computerized means.

One computer application that responds to these requirements is the Tire Pressure Computer ["TPC"] (licensed by Inflation Technology, LLC, and available on www.tirepressurecomputer.com), and there are likely many others. TPC requires information from the vehicle placard (the front and rear GAWR) and the tire selected (the tire size and its maximum load and maximum inflation pressure). Figure 5 shows the screen from TPC where vehicle data are entered. Vehicle placard data are the GAWRs for the front and rear axles and the OE tire size(s). The user is also prompted for data about the type of vehicle (passenger car or multi-purpose vehicle, single real axle tires or duals), and which axle is the drive axle (used later for speedometer calculations). Figure 6 shows the TPC screen where the user enters the new tire size(s) to be used on the vehicle. The maximum load and maximum inflation pressure come directly from the sidewall of the tire. Note that TPC allows the fitting of different size tires to the front and rear axles. TPC then computes the minimum and maximum wheel width that can be used on the tire, along with the minimum inflation pressure required for the tires on the front and rear axles. The results of the computations are shown on the TPC screen in Figure 7. TPC uses a 15% pressure margin, as discussed above, to generate a recommended inflation pressure for the front and rear tires based on the stiffness method. The speedometer offset is computed and shown for various speeds in the final report. The user may elect to raise the recommended inflation pressures for either the front or the rear axle, in order to, for example, set the front and rear tire inflation pressures equal, or to raise one or the other (or both) to the OE placard pressure recommendation if the computation results in lower values. Both of these strategies are widely recommended in tire makers Fitment Guides. TPC prints a summary of the information collected and computed, which can be saved for historical purposes, as shown in Figure 8. Finally, TPC prints out a mylar label, using common, low-cost, off-the-shelf printers, that can be affixed to the vehicle adjacent to the DOT placard. A photo of a TPC supplemental tire pressure label installed on a vehicle is shown in Figure 9. Note that, if different tire pressures are recommended for front and rear axles, then the customer should be cautioned to reset these pressures at each tire rotation. On any vehicle equipped with a Tire Pressure Monitoring System (TPMS), resetting the TPMS threshold for the new pressure range may be required (if possible). On TPMS systems having only one setpoint, setting front and rear axle inflation pressures equal is recommended.

Modern Tire Dealer’s most recent wheel survey (2010) shows that the average dealer sells about 248 wheels annually (62 sets). A system like TPC streamlines the process for plus-size fitting because there is no manual interpolation in tables, and no inflation tables need to be located for each tire. The proper inflation tables from the tire manufacturer do not need to be located each time a sale is made. Indeed, the stiffness method works for all radial tires. The opportunity for error is dramatically reduced because the system requires only the entry of values read from the vehicle and the tire. The tire fitter does not need to know if the tire, for example, is an extra-load tire or a standard load tire marked with a higher pressure, and TPC provides warnings if the tire cannot support the vehicle load with all the safety factors intact. The final report generated by the system can be copied and given to the customer showing exactly what inflation pressure is recommended, that the wheels and tires are appropriately matched, and whether or not any speedometer correction is warranted. The supplemental tire pressure label provides another indication to the customer that the tire provider is acting professionally, and provides additional evidence that the tire provider informed the customer about the proper inflation pressure for the new tires. In addition, this level of detail provides justification (and a record) for the recommendations provided should the customer ever have a tire failure.

Conclusions

1. Tire pressure required to support partial loads is predicted by the stiffness model to vary linearly with the load.
2. Power rule models, having *n* equal to or less than 0.8, put forward by tire standards organizations and indicated in tabulated values in annual yearbook publications may not provide adequate inflation pressure for certain tires at less-than-maximum load conditions.
3. The stiffness model formulation provides a conservative, but computationally more intensive, method of developing the proper inflation pressure for operation at less than maximum loads.
4. Computerized systems for the computation of inflation pressure are encouraged when fitting non-OE size tires/wheels (i.e., plus-sizing) to a vehicle. This allows the fitter to easily provide the customer with safe inflation pressure recommendations.
5. All aspects of a change of tires and wheels, including the new recommended inflation pressure, should be communicated to the customer as part of the plus-sizing service.

References

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[4] Daws, J.W., "Technical Considerations for Plus-Sizing", paper presented at the 2008 International Tire Exhibition and Conference, September 16-18, 2008, Akron, OH.

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Table 1. Various Maximum Cold Inflation Pressure Markings Permitted

Passenger Tire Type	Labeled Maximum Pressure Marking	Maximum Pressure for Load Rating
Standard Load	240 kPa (35 psi)	240 kPa (35 psi)
	300 kPa (44 psi)	240 kPa (35 psi), 250 kPa (36 psi)
	350 kPa (51 psi)	240 kPa (35 psi), 250 kPa (36 psi)
Extra Load	280 kPa (41 psi)	280 kPa (41 psi)
	340 kPa (50 psi)	280 kPa (41 psi), 290 kPa (42 psi)

Note: Tires with 250 kPa (36 psi) and 290 kPa (42 psi) reference pressures have internationally harmonized load ratings

Table 2. Parameter Values for Sample Tire Dimensions

Dimension	Pmax (kPa/psi)	F	k
155/80R13	240/35	0.071	0.204
235/75R15	240/35	0.099	0.145
325/75R20	350/50	0.136	0.074
455/55R22.5	900/130	0.176	0.022

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FIGURE 8. *Printed Report from the TPC Program.*

FIGURE 9. *Photo of TPC-generated Supplemental Tire Pressure Label.*

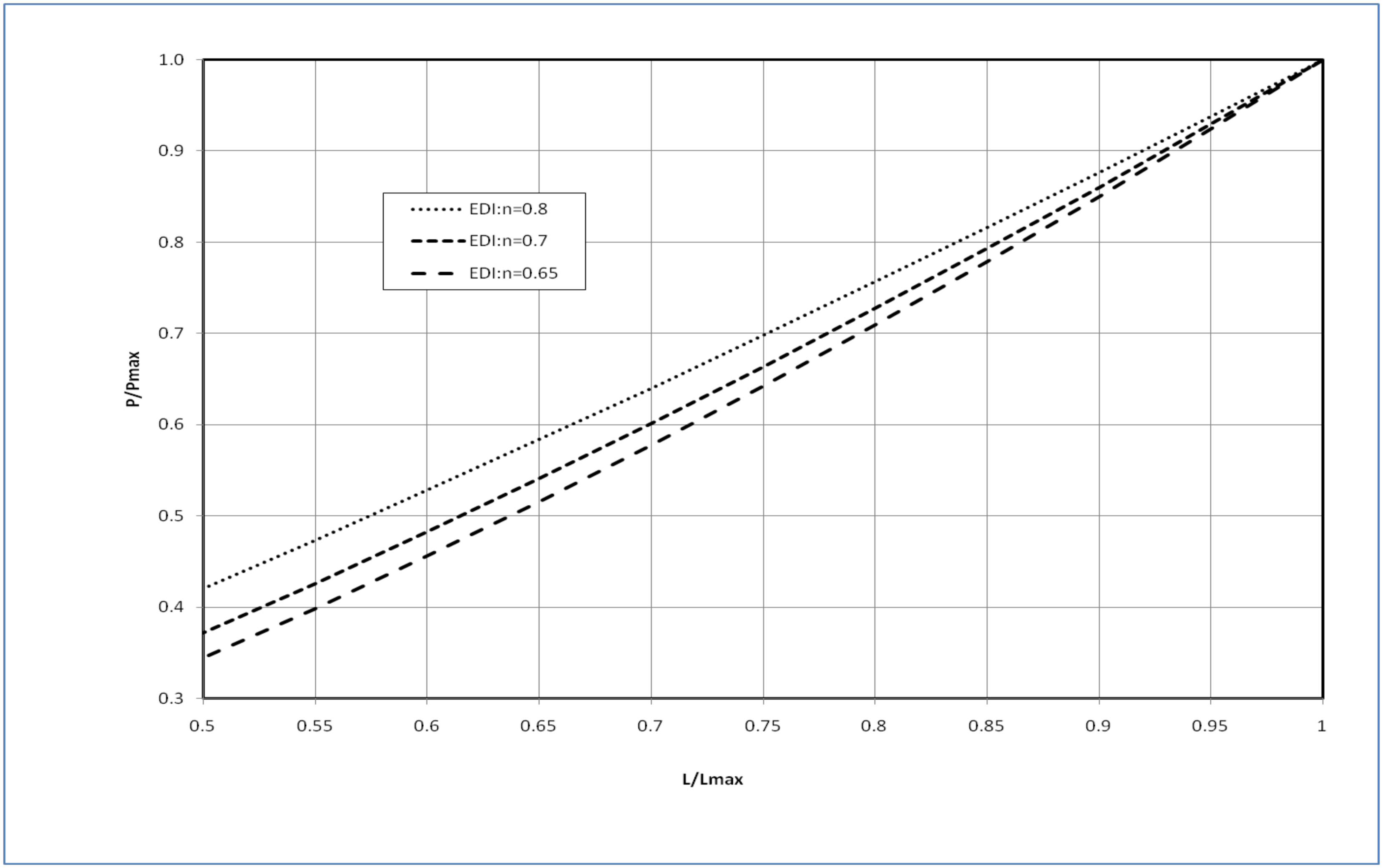


FIGURE 1. *Pressure Model Predictions – Tire Industry Standards*

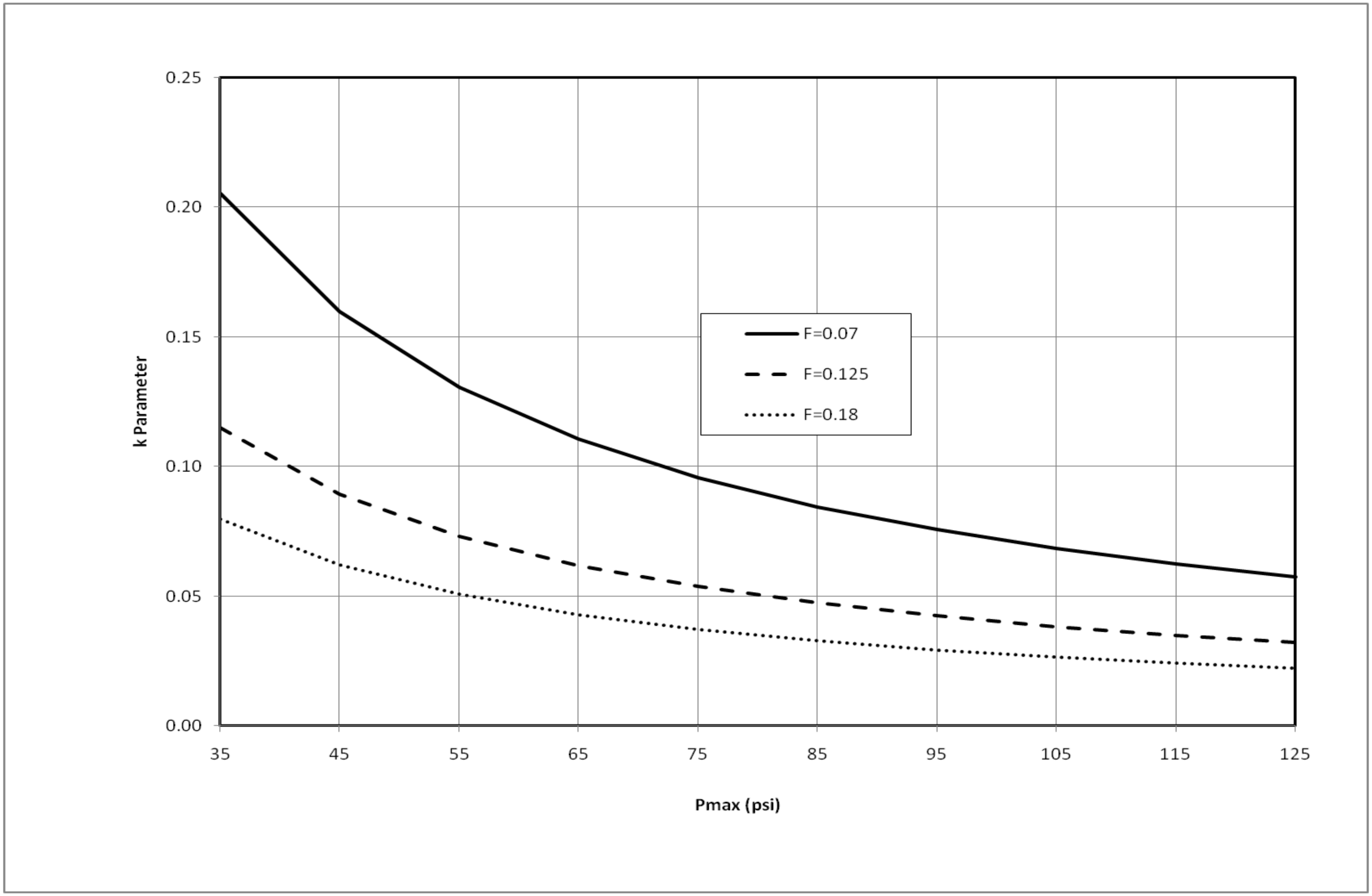


FIGURE 2. *Maximum Pressure Influence on Stiffness Model k Parameter*

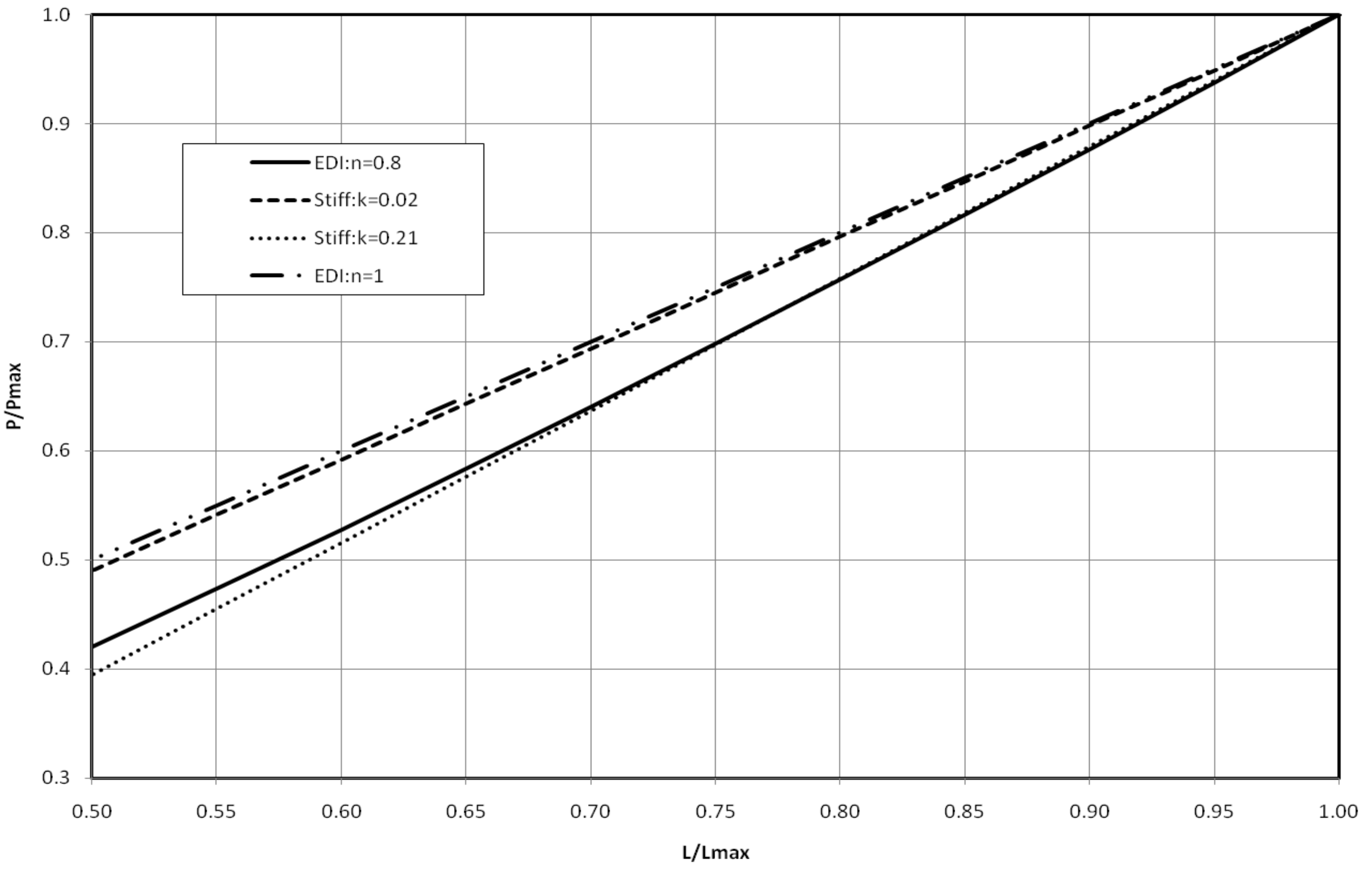


FIGURE 3. *Range of Stiffness Model Pressure Predictions Compared to Industry Standards*

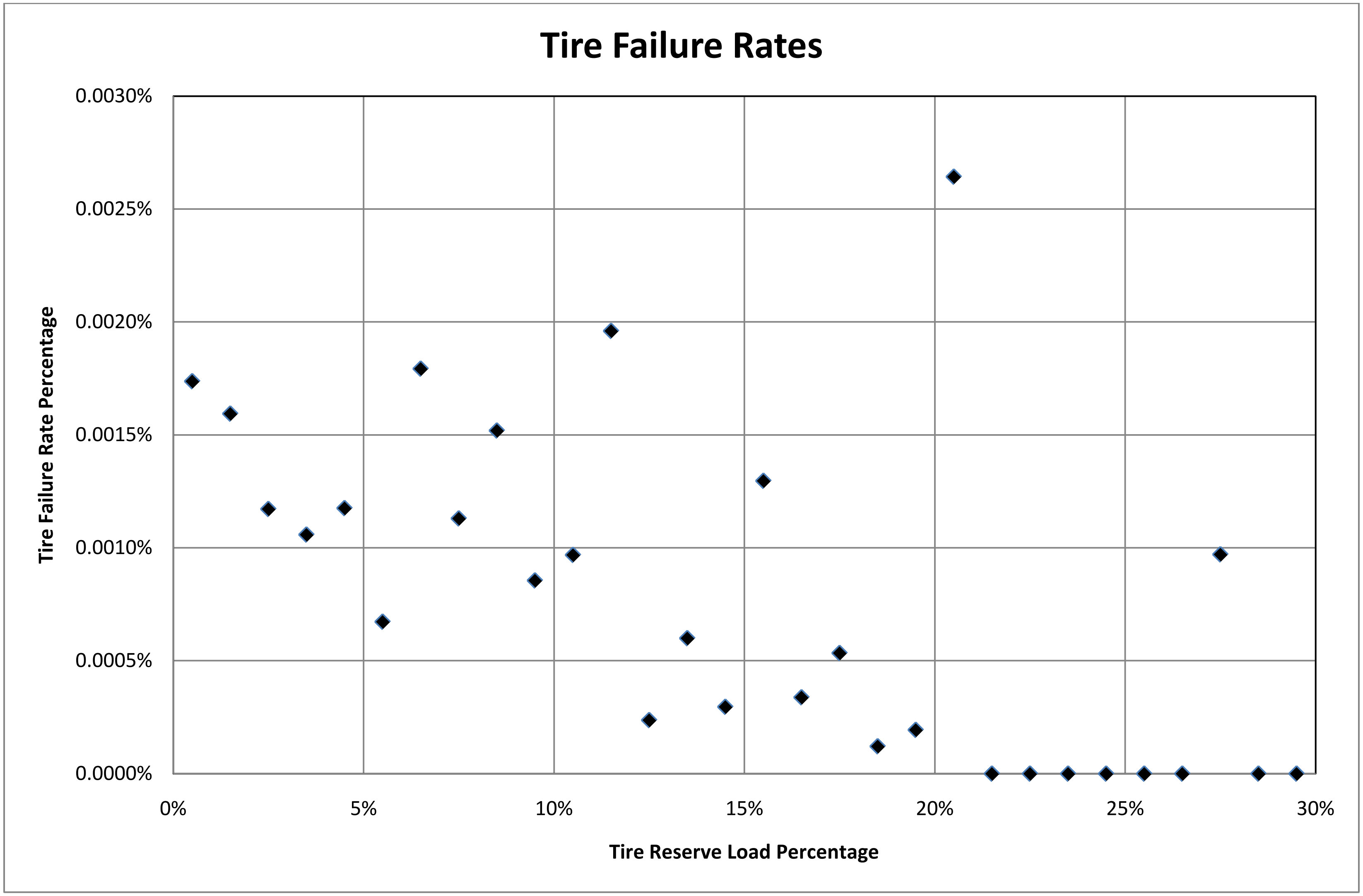
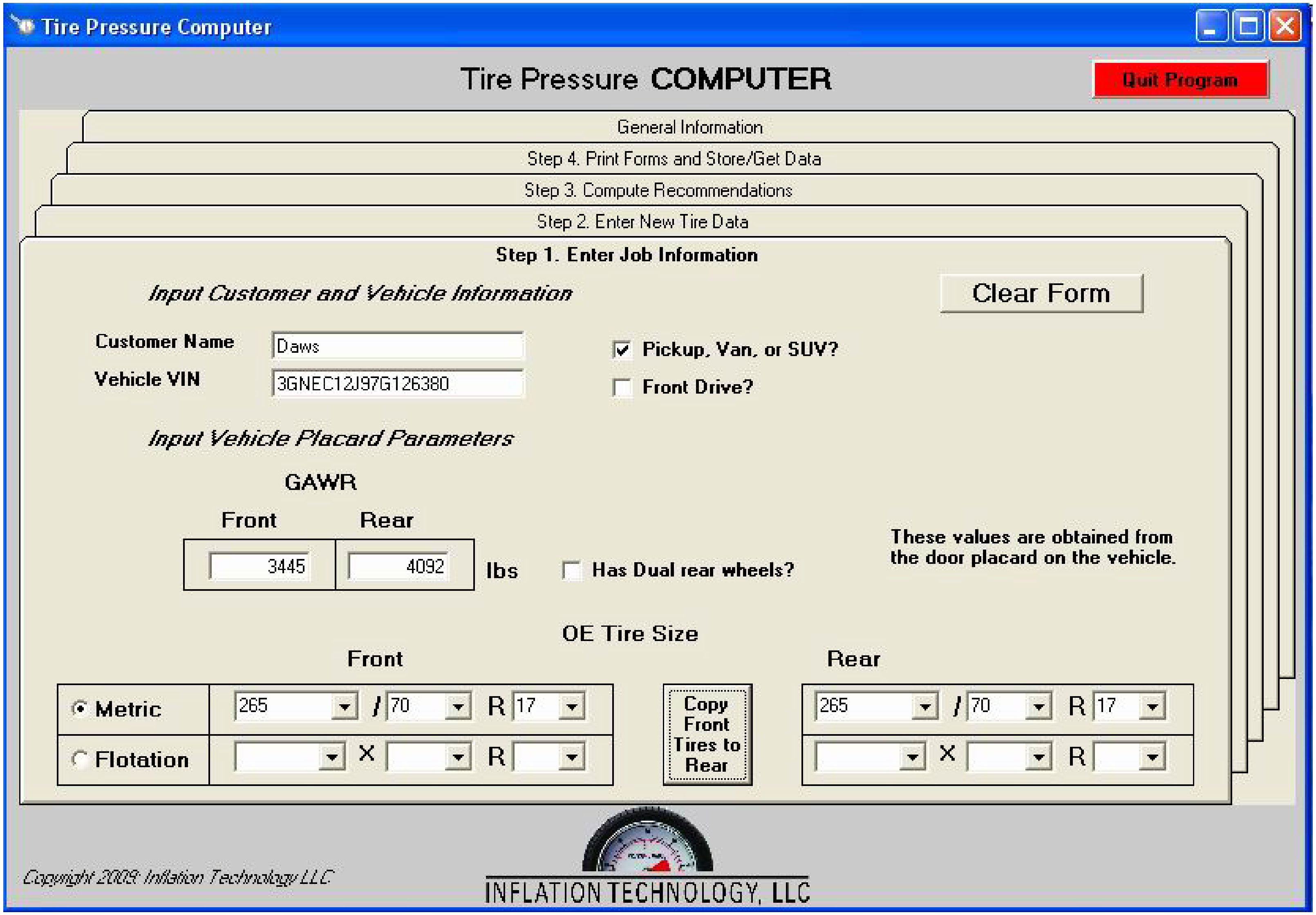


FIGURE 4. *NHTSA Data Relating Tire Failure Rate and Tire Reserve Load Percentage.*



Tire Pressure COMPUTER

Step 1. Enter Job Information

Input Customer and Vehicle Information

Customer Name: Daws

Vehicle VIN: 3GNEC12J97G126380

☑ Pickup, Van, or SUV?

☐ Front Drive?

Input Vehicle Placard Parameters

GAWR Front	GAWR Rear	
3445	4092	lbs

☐ Has Dual rear wheels?

These values are obtained from the door placard on the vehicle.

OE Tire Size

	Front			Rear		
● Metric	265 / 70	R	17	265 / 70	R	17
○ Flotation	X	R		X	R	

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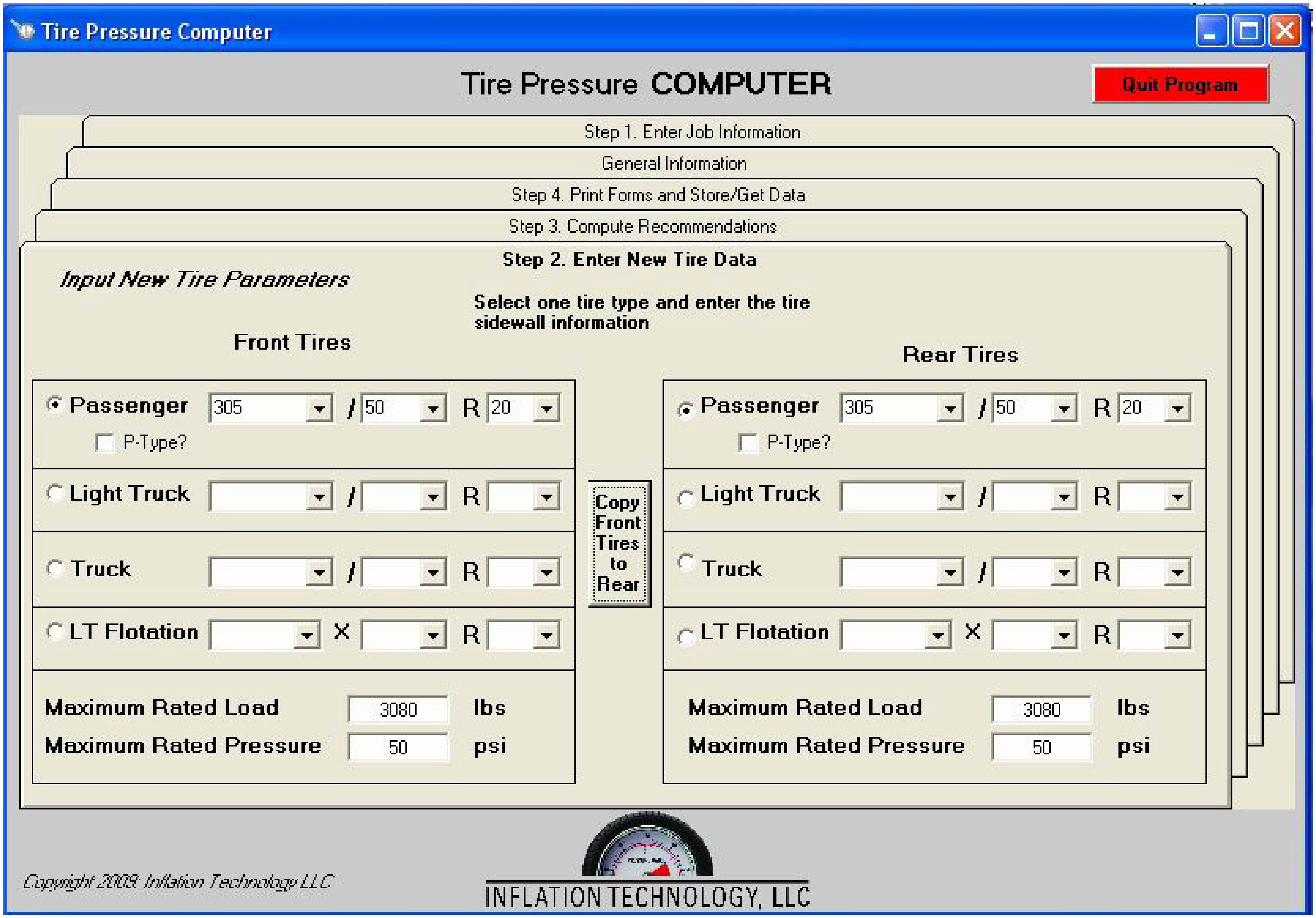
FIGURE 5. *Vehicle data screen from the TPC program.*



Input New Tire Parameters

Select one tire type and enter the tire sidewall information

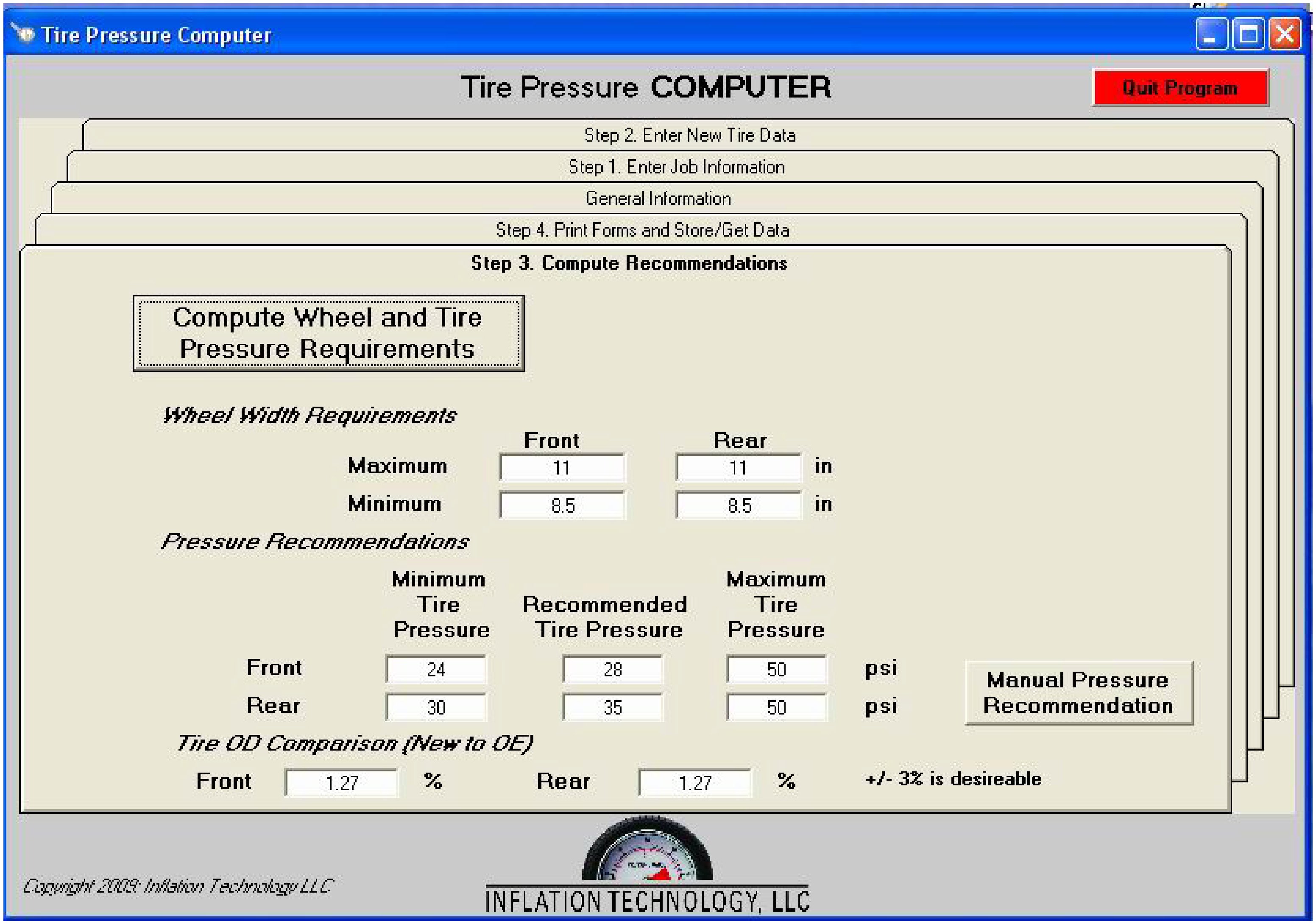
Front Tires

● Passenger 305 / 50 R 20
☐ P-Type?
○ Light Truck / R
○ Truck / R
○ LT Flotation X R
Maximum Rated Load 3080 lbs
Maximum Rated Pressure 50 psi

Rear Tires

● Passenger 305 / 50 R 20
☐ P-Type?
○ Light Truck / R
○ Truck / R
○ LT Flotation X R
Maximum Rated Load 3080 lbs
Maximum Rated Pressure 50 psi

FIGURE 6. *New tire data screen from the TPC program.*



Wheel Width Requirements

	Front	Rear	
Maximum	11	11	in
Minimum	8.5	8.5	in

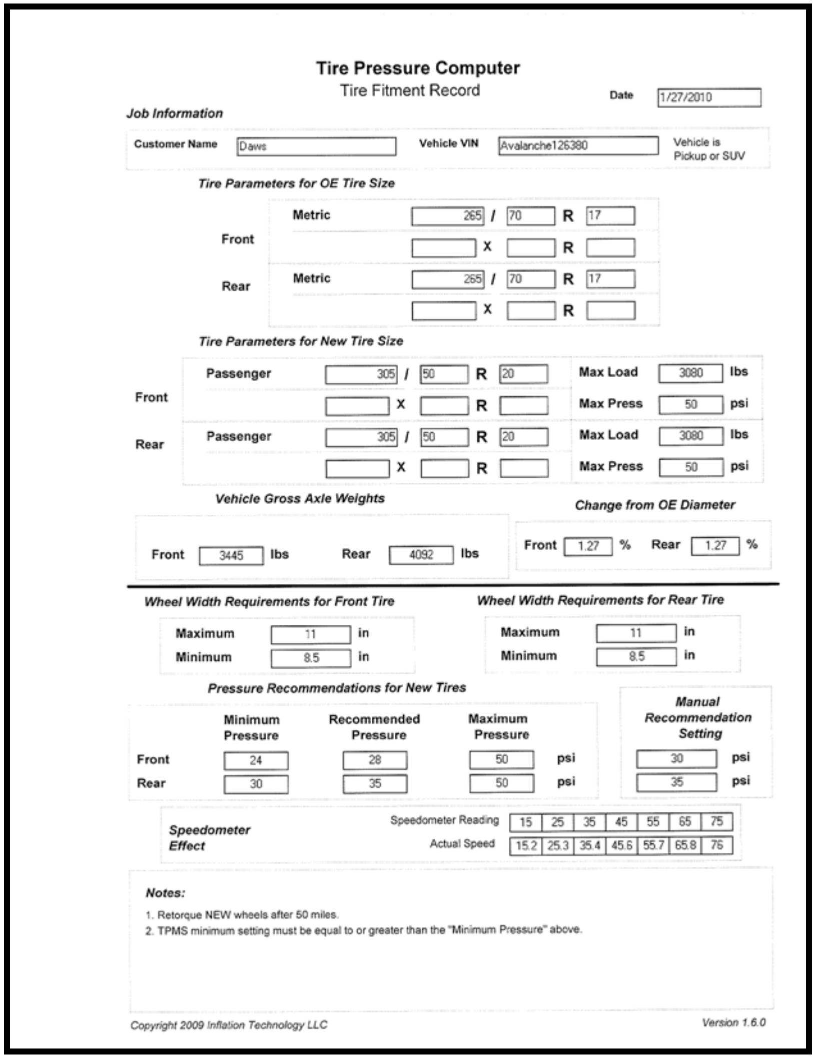
Pressure Recommendations

	Minimum Tire Pressure	Recommended Tire Pressure	Maximum Tire Pressure	
Front	24	28	50	psi
Rear	30	35	50	psi

Tire OD Comparison (New to OE)

Front 1.27 % Rear 1.27 % +/- 3% is desireable

FIGURE 7. *Computation results screen from the TPC Program.*



Tire Pressure Computer
Tire Fitment Record

Date 1/27/2010

Job Information

Customer Name Daws
Vehicle VIN Avalanche126380
Vehicle is Pickup or SUV

Tire Parameters for OE Tire Size

Front	**Metric**	265	**/**	70	**R**	17
			X		**R**	
Rear	**Metric**	265	**/**	70	**R**	17
			X		**R**	

Tire Parameters for New Tire Size

Front	**Passenger**	305	**/**	50	**R**	20	**Max Load**	3080	**lbs**
			X		**R**		**Max Press**	50	**psi**
Rear	**Passenger**	305	**/**	50	**R**	20	**Max Load**	3080	**lbs**
			X		**R**		**Max Press**	50	**psi**

Vehicle Gross Axle Weights

Front 3445 **lbs** **Rear** 4092 **lbs**

Change from OE Diameter

Front 1.27 **%** **Rear** 1.27 **%**

Wheel Width Requirements for Front Tire

Maximum 11 **in**
Minimum 8.5 **in**

Wheel Width Requirements for Rear Tire

Maximum 11 **in**
Minimum 8.5 **in**

Pressure Recommendations for New Tires

	Minimum Pressure	**Recommended Pressure**	**Maximum Pressure**		***Manual Recommendation Setting***	
Front	24	28	50	**psi**	30	**psi**
Rear	30	35	50	**psi**	35	**psi**

Speedometer Effect

Speedometer Reading	15	25	35	45	55	65	75
Actual Speed	15.2	25.3	35.4	45.6	55.7	65.8	76

Notes:

1. Retorque NEW wheels after 50 miles.
2. TPMS minimum setting must be equal to or greater than the "Minimum Pressure" above.

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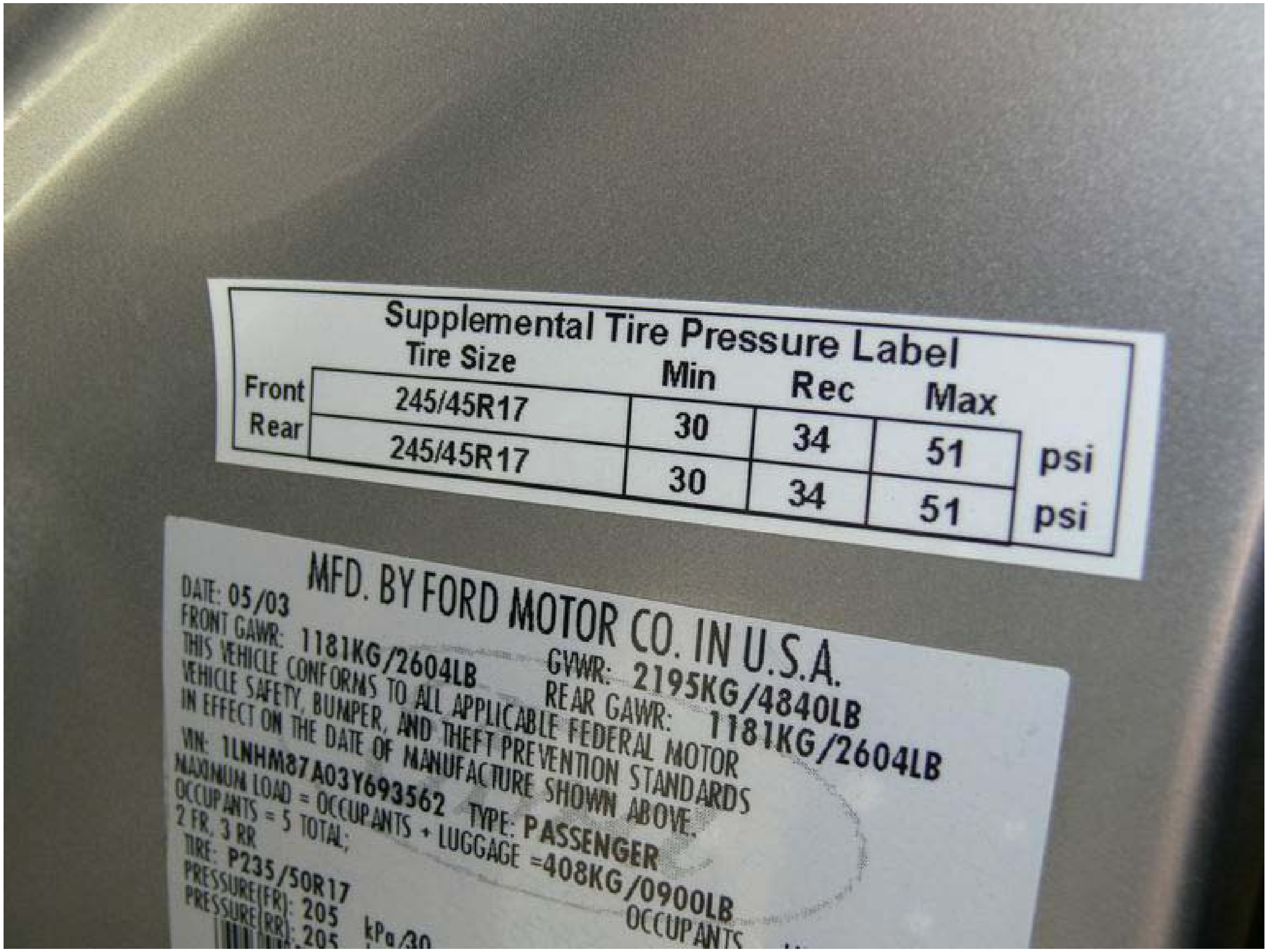
FIGURE 8. *Printed Report from the TPC Program.*



Supplemental Tire Pressure Label

	Tire Size	Min	Rec	Max	
Front	245/45R17	30	34	51	psi
Rear	245/45R17	30	34	51	psi

MFD. BY FORD MOTOR CO. IN U.S.A.
DATE: 05/03
FRONT GAWR: 1181KG/2604LB GVWR: 2195KG/4840LB
REAR GAWR: 1181KG/2604LB
THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
VIN: 1LNHM87A03Y693562 TYPE: PASSENGER
MAXIMUM LOAD = OCCUPANTS + LUGGAGE =408KG/0900LB
OCCUPANTS = 5 TOTAL; OCCUPANTS
2 FR, 3 RR
TIRE: P235/50R17
PRESSURE(FR): 205
PRESSURE(RR): 205 kPa/30

FIGURE 9. *Photo of TPC-generated Supplemental Tire Pressure Label.*