

*4/11/06***TOYOTA**  
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April 10, 2006

Mr. Jeffrey Quandt  
Chief - Vehicle Controls Division  
Office of Defects Investigation  
National Highway Traffic Safety Administration  
400 Seventh St., SW  
Washington, DC 20590

Re: NVS-213car, PE06-010

Dear Mr. Quandt:

This letter is being sent in response to your March 16, 2006 letter regarding PE06-010, an investigation into the Toyota Sienna. As specified in your inquiry, Toyota is submitting the response to questions 10 and 14 at this time.

Per our agreement of March 22, 2006, no response for the requested peer vehicles has been provided. In addition, the subject vehicles to which we refer in our response are the 2004 - 2006 MY Toyota Sienna vehicles.

Enclosed you will find two copies of this response and two CD-ROM's containing electronic versions of the attachments. Should you have any questions about this response, please contact Mr. Chris Santucci at (202) 775-1707.

Sincerely,



Chris Tinto  
Vice President  
TOYOTA MOTOR NORTH AMERICA, INC.

CT:cs  
Attachment

10. Provide a description of how each subject and peer system functions within each of its respective subject and peer vehicles, by make, model, and model years. This includes, but is not limited to, the following for each subject and peer system:
- a. Identify whether the subject or peer system is indirect or direct;
  - b. Describe how the subject or peer system functions in all normal operating modes;
  - c. State the highest tire pressure at which the TPWS warning light will illuminate in the normal operating mode;
  - d. State how long after the tire pressure reaches the pressure defined in 10.c. it takes for the TPWS light to illuminate;
  - e. What warnings, if any, the operator would have that the subject or peer system was malfunctioning;
  - f. Describe the conditions or circumstances, other than components failing, under which each subject or peer system may not function properly (i.e. the low pressure warning light may not come on even if the tire pressure is low or the low pressure warning light may come on when the tire pressure is actually normal);
  - g. State why the conditions listed in 10.f. cause the subject or peer system to not function properly;
  - h. Describe the effect on vehicle braking distance and steering should the tire pressure in at least one of the tires fall to 25 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the tires while the vehicle is moving;
  - i. Describe the effect on the subject or peer systems if the tread on one or more tires wears unevenly;
  - j. Describe the effect on the subject or peer systems if one or more of the tires is out of balance;
  - k. State all the TPWS diagnostic trouble codes associated with the subject vehicles;
  - l. Describe any differences in how the subject and peer systems function for subject and peer vehicles, respectively, which use run-flat tires and those that use non-run flat tires;
  - m. State whether non-run flat tires may be fitted on the same wheels as the run-flat tires without any modifications to the subject or peer system or subject or peer vehicle. (Note: This assumes that the consumer replaces all four tires with either all non-run flat or all run flat tires and that the tires are of comparable size.);
  - n. List any modifications required to make the conversion referenced in 10.m.;
  - o. Describe the conditions or circumstances under which the subject system needs to be reset, re-initialized, or re-calibrated;
  - p. Describe the procedure required to reset, re-initialize, or re-calibrate the subject system, including the length of time and the speed at which the vehicle must be driven after the TPWS has been reset, re-initialized, and/ or re-calibrated before the TPWS is capable of detecting a loss of tire pressure; and
  - q. Explain why the length of time and speed described in 10.p. are required before the TPWS will detect a loss of tire pressure.

**Response 10**

- a. The Tire Pressure Warning System ("TPWS") installed on all 2004 through 2006 model year Sienna vehicles is an indirect system.
- b. There are two types of TPWS installed in the 2004 through 2006 model year Toyota Sienna vehicles. Vehicles equipped with Vehicle Stability Control (VSC) have a TPWS that uses two methods to detect low tire pressure:
- a resonance frequency method that determines low tire pressure by analyzing the signals from all four wheels, and;
  - a relative wheel speed difference method that determines low tire pressure according to the rotational speed of each wheel.

For vehicles equipped with the Anti-lock Brake System ("ABS") only (i.e., no VSC), the TPWS only uses the relative wheel speed difference method to detect low tire pressure.

We are including a section of the New Car Features for the 2004 model year Sienna, which explains the TPWS functionality in all normal operating modes, as Attachment-Response 10-1(PE06-010) stored on CD-ROM.

- c. When the tire pressure is adjusted to the Toyota's recommended cold tire inflation pressure and the initialization is performed properly, the highest tire pressure at which the TPWS warning light will illuminate in the normal operating mode is:
- 200 kPa for the non run-flat tires; and;
  - 180 kPa for the run-flat tires.
- d. The length of time it takes for the TPWS light to illuminate after the tire pressure reaches the pressure defined in Response 10.c. varies with the road and/or driving conditions. However, if the initialization is performed properly and the vehicle is driven straight ahead on a flat surface with no turns at a vehicle speed above 30 km/h, it takes about 5 minutes for the TPWS to gather the necessary amount of data to detect the low pressure and illuminate the light. However, if the vehicle is operated in normal driving conditions, such as driving and turning the steering wheel, braking and/or accelerating, it may take 20 to 30 minutes.
- e. When the TPWS is malfunctioning, the TPWS light in the combination meter illuminates or blinks to inform the driver as follows:

TPWS light condition	Malfunctions
Blinks once every second	Malfunction of speed sensor, stop light switch and TPWS ECU
Blinks twice every second	Failure to initialize during driving
Comes on	The tire pressure warning light circuit is open or shorted

- f. The conditions or circumstances, other than components failing, under which the TPWS may not function properly are provided in the table as Attachment-Response 10-2(PB06-010) stored on CD-ROM.
- g. The reasons that the conditions or circumstances listed in Response 10 f. cause the TPWS to not function properly are also provided in the table as Attachment-Response 10-2(PB06-010).
- h. Toyota has not specifically evaluated the effect on vehicle braking distance and steering should the tire pressure in at least one of the tires fall to 25 percent or more below the vehicle manufacturer's recommended cold inflation pressure for the tires while the vehicle is moving. However, we believe that when one or more tires fall to about 25 percent below the recommended cold inflation pressure, it may not cause a significant effect to vehicle operation/control, especially for vehicles equipped with run-flat tires.
- i. Please refer to Response 10 g.
- j. Please refer to Response 10 g.
- k. The TPWS diagnostic trouble codes (DTCs) associated with the subject vehicles are as follows:

DTC		Detection Item
2-digit	5-digit	
11	C2106	Stop light switch signal malfunction
13	-	ABS malfunction

- l. The difference of the TPWS between the vehicles that use run-flat tires and those that use non run-flat tires is as follows:
- Vehicles equipped with VSC that use non run-flat tires have the same TPWS as those vehicles equipped with run-flat tires.
  - Vehicles equipped without VSC that use non run-flat tires have a TPWS that uses only the relative wheel speed method to detect low tire pressure.

It is important to note that all vehicles equipped from the factory with run-flat tires are also equipped with VSC.

- m. The non run-flat tires can be fitted on the same wheels as the run-flat tires without any modifications to the TPWS and the vehicle, if the tire size is identical. This response applies only to the actual fitting of the tires onto the wheels. Some models of the 2WD Sierra have been equipped from the factory with non run-flat tires on the same wheels as the AWD model, which uses run-flat tires.

In light of the differences in the TPWS explained above, it is important to note that Toyota only installs run-flat tires on those vehicles equipped with VSC. Non run-flat tires can be installed on a vehicle regardless of VSC.

- n. Not applicable.
- o. The tire pressure warning system needs to be initialized in the following conditions:
- When the low tire pressure warning light blinks two times every second.
  - After replacing or rotating tires or wheels.
- p. To initialize the TPWS, proceed as follows:
1. Turn the ignition switch to "OFF" position.
  2. Adjust the pressure of all the installed tires to the specified tire inflation pressure.
  3. Turn the ignition switch to "ON" position.
  4. On the vehicles with VSC, if the low tire pressure warning light comes on immediately, push the Tire Pressure Warning Initialization Switch for a few seconds and make sure the warning light goes off.
  5. Push and hold the Tire Pressure Warning Initialization Switch until the low tire pressure warning light blinks three times.

After the above initialization, the vehicle must be driven at speeds of 30 km/h or greater for about 30 to 60 minutes before the TPWS is capable of detecting a loss of tire pressure. While the system is initialized at this point, it is still refining the calculation of the initial condition in order to increase the system accuracy. As such, 8 hours of driving may be necessary for the TPWS to obtain the most accurate initial condition.

- q. When the vehicle is driven at speeds less than 30 km/h, the data obtained from the wheel speed sensors is not accurate enough to properly initialize the system. Also, it takes about 30 to 60 minutes to store enough sampling data to obtain a calculation that approximates the properly inflated tire condition (initial condition). Afterwards, the TPWS continues to sample the data in order to refine the calculation of the initial condition. It takes about 8 hours to complete the refinement and obtain the most accurate initial condition.

14. State whether the TPWS for MY 2000 Toyota Sienna vehicles contain the same subject system as the subject vehicles. If not, list the differences between the two TPWS systems, including the supplier's name, address, and appropriate point of contact (name, title, and telephone number).

#### **Response 14**

The 2000 model year Sienna vehicles are equipped with ABS only and a TPWS that uses the relative wheel speed difference method. This system has the same functionality as the TPWS for 2004 to 2006 model year Sienna vehicles equipped with ABS only (not the same as vehicles equipped with VSC).

Information regarding the suppliers of components for the 2000 MY Toyota Sienna that differ from the subject vehicles is included as Attachment-Response 14 (PE06-010), stored on CD-ROM.

## Attachment-Response 10-2(PE06-010)

	10 f.	10 g.
1	The tread wear is uneven among the tires.	TPWS may not make an accurate judgment due to possible tire slippage caused by uneven tread wear. Also TPWS may not make an accurate judgment due to a possible deviation from the initialized tire condition caused by uneven tread wear.
2	A compact spare tire, snow tires, or tire chains are used.	TPWS may not make an accurate judgment because each wheel may have different or possibly unstable tire rotation speeds. Also it is difficult to determine the resonance frequency.
3	The tire inflation pressure is excessively higher than specified, or tire inflation pressure suddenly drops due to bursting or other causes.	With excessively high tire pressure, the tire tends to slip more than at normal pressure so the TPWS may not make an accurate judgment. In the event of bursting, the TPWS may not make an accurate judgment due to unstable tire rotation speeds, as well as the length of driving time required before detection (driver may stop vehicle before TPWS detects low tire pressure).
4	The vehicle is driven on a slippery road surface such as rough or frozen roads.	TPWS may not make an accurate judgment due to possible tire slippage.
5	The vehicle speed is less than 30 km/h (19 mph) or more than 100 km/h (62mph), and the driving duration is less than 5 minutes.	When the vehicle speed is below 30 km/h, or over 100 km/h, the TPWS can not collect the necessary data to detect a tire pressure decrease because the data collected at these speeds is not accurate enough for the calculations. Also, the TPWS can not detect a tire pressure decrease when the driving duration is less than 5 minutes because there is not enough data collected to make an accurate calculation.
6	The tires differ in tread pattern or manufacturer.	TPWS may not make an accurate judgment because each tire may have different resonance frequency.
7	The tread wear is very different among the installed tires.	TPWS may not make accurate judgment due to a possible tire slippage difference caused by the tread wear.
8	The pressure of two or more tires drops at the same time.	TPWS may not make accurate judgment if there is not a significant difference in tire rotational speed, even though tire pressure has decreased.

	10. f.	10. g
9	Rapid acceleration/deceleration or sharp turns.	These conditions tend to cause tire slip and the TPWS may not make an accurate judgment.
10	Towing a trailer.	These conditions tend to cause tire slip and the TPWS may not make an accurate judgment.
11	Initialization was not performed correctly after replacing or rotating tires or wheels.	Since the TPWS operates by calculating a difference from the initialized condition, TPWS could not make accurate judgment if initialization is not completed.
12	One of more tires is out of balance	TPWS may not make an accurate judgment because each wheel may have different or possibly unstable tire rotational speeds.
13	The loading is over the limit or improperly balanced.	An overloaded condition may affect the calculation of the tire resonance frequency. It may also affect the tire rotational speeds. If the loading is unbalanced, wheel slip may occur and the TPWS may not make an accurate judgment.
14	Vehicles with VSC only -- The outside temperature is below 32°F or above 104°F.	TPWS may not make an accurate judgment because the resonance frequency varies with the tire temperature, even when tire pressure is normal.
15	The tires are not the specified size.	TPWS may not make an accurate judgment because resonance frequency differs with tire size and the threshold value in the system was developed for the standard tire.