



Tire Revolutions per Kilometer

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This standard is written to describe, in general terms, the methods used by General Motors to determine Revolutions per Kilometer (RPK) of passenger car, light truck, and compact spare tires using a 1.7 m (67 in) Revolutions per Kilometer test dynamometer under controlled laboratory conditions.

1.2 Applicability. The discussion in this standard is restricted to controlled laboratory tests on passenger car, light truck, and compact spare tires. Operating conditions are limited to free rolling tires at dynamic thermal equilibrium with zero slip and inclination angles.

1.3 Remarks. RPK data are used for various purposes including tire validation, odometer calibration, vehicle torque steer modeling and development, analysis of vehicle lead/pull performance, and calibration of Anti-lock Brake System (ABS) based low tire pressure warning systems, as well as others.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

SAE J2452

2.2 GM Standards/Specifications.

GMW14996

GMW16590

2.3 Additional References.

Tire Component Technical Specification (CTS)

3 Resources

3.1 Facilities. Laboratory Test facilities capable of running equipment in 3.2.

3.2 Equipment. Equipment required for RPK testing consists of a 1.7 m to 2.0 m diameter laboratory test dynamometer, as well as the associated controllers and instrumentation as required for the test method in use. See SAE J2452 for more detail. The SAE J2452 procedure is written for tire rolling resistance testing, but RPK measurements are made on similar equipment, hence much of the equipment related discussion applies to RPK as well. Indeed, some test facilities acquire RPK data as part of a rolling resistance test using the same test equipment.

3.2.1 The road wheel surface dimensions and tolerances must conform to SAE J2452 standards in order to produce RPK data that will correlate well with General Motors RPK measurements.

3.2.2 The test equipment must conform at all times to the machine control and alignment specifications (Table 1) in order to minimize variation in RPK test data. See SAE J2452 for details.

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Table1: Machine Control and Alignment Specifications

Parameter	Tolerance (±)
Tire Load	Greater of 20 N (5 lbf) or 0.5%
Inflation Pressure	1.5 kPa (0.2 psi)
Test Wheel Speed	1.5 km/h (1 mph)
Ambient Temperature	4 °C (7 °F)
Loaded Radius	1 mm (0.04 in)
Tire Load Fore Aft Offset	0.2 mm (0.01 in)
Tire Load Angular Offset	0.3 degree
Tire Slip Angle	0.1 degree
Tire Inclination Angle	0.2 degree

3.2.3 Machine control accuracy must adhere to standards set in SAE J2452. Maintaining these criteria will contribute to precise and unbiased RPK measurements.

3.2.4 The test drum diameter, without surface treatment, must be 1.708 m (67.23 in).

3.2.4.1 The width of the drum test surface must be sufficient to accommodate the full tread width of the test tire/wheel assembly.

3.2.4.2 The surface of the test drum should be covered with 3M's 80 grade 3M-ite surface treatment.

3.2.5 Wheel width must be reported with test results. The test wheel must have a contour and width as specified on the work request.

3.2.6 Tire loaded radius values must be measured and recorded with all test data, since these data are later used to estimate flat surface RPK values.

3.3 Test Vehicle/Test Piece.

3.3.1 A minimum sample of five (5) tires per construction should be used to determine RPK_{Bias} for production validation. Samples of two (2) are often used for development.

3.3.2 A minimum sample of two (2) tires per construction should be used to determine RPK magnitudes.

3.4 Test Time. Per tire:

Calendar time: 1 day

Test time: 2 h

Coordination time: 1 h

3.5 Test Required Information. Exact list of required information is determined by the local test site. Required information includes tires' size, construction number, load rating, service description and wheel width.

3.6 Personnel/Skills.

3.6.1 Test operators must be trained in the safe operation of the measurement equipment. The measurement equipment, by necessity, involves moving parts and loading mechanisms which must be understood and operated using proper safety precautions.

3.6.2 Operators must be trained in the selection of test components and fixtures to facilitate the proper testing of the tires.

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4 Procedure

4.1 Preparation. Included in instructions in 4.3.

4.2 Conditions.

4.2.1 Environmental Conditions. The ambient temperature in the test room must be maintained at a steady $24\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ ($75\text{ }^{\circ}\text{F} \pm 7\text{ }^{\circ}\text{F}$). Room ambient temperature must be monitored over time to ensure test equipment is at thermal equilibrium before testing takes place.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 Specific test step conditions are described in Appendix A, Table A1.

4.3 Instructions.

4.3.1 All RPK measurements are made using a test tire mounted on the wheel specified in the work request. The test is conducted on a 1.7 m (67 in) dynamometer which has a test surface covered with a surface treatment in order to provide a first approximation to outdoor public highway surfaces.

4.3.2 Test tires must be mounted on wheels representative of expected usage and whose width and flange type is as specified on the test request.

4.3.3 Tire Installation on the Test Wheel.

4.3.3.1 For Standard Tread Tires: Tires must be installed on the test wheel such that the cosmetic sidewall of the tire corresponds to the cosmetic face of the test wheel. The cosmetic face can usually be distinguished by the presence of ornamental features such as white lettering, a white stripe, or more ornate sidewall stamping and patterns. The non-cosmetic side usually has more small text, disclaimers, warning labels, and an absence of ornamental features.

4.3.3.2 For Directional Tread Tires. Tires must be installed on the test wheel such that the arrow on the sidewall, indicating direction of rotation, is going in the Clockwise (CW) direction, looking at the front of the assembly.

4.3.4 Assemblies to be tested must be inflated to the maximum pressure shown on the tire sidewall, then placed in an environment maintained at a constant ambient temperature of $24\text{ }^{\circ}\text{C} \pm 4\text{ }^{\circ}\text{C}$ ($75\text{ }^{\circ}\text{F} \pm 7\text{ }^{\circ}\text{F}$) for a minimum of 24 h for bias tires, and 3 h for all other tires, prior to testing. This step is required for two (2) reasons: the tire must be allowed to grow to its maximum dimensions, and tire temperature must be close to $24\text{ }^{\circ}\text{C}$ ($75\text{ }^{\circ}\text{F}$) at the start of the test.

4.3.5 Tires must be tested at test conditions per Table A1, Appendix A.

4.3.6 After the tire/wheel assembly is installed on the test machine, the tire must be inflated to the first step point inflation pressure and the tire Overall Diameter (OD) measured with a Pi tape or another suitably accurate method.

4.3.7 The initial tire stabilization will take place with the tire rotating in the clockwise direction at a speed of 80 km/h (50 mph).

4.3.8 The preferred initial tire stabilization time is 40 minutes, but other times are acceptable if supporting evidence can be provided to indicate the test tire has reached dynamic thermal equilibrium. One accepted example of an optional stabilization method is running the RPK test condition immediately following a GMW14996 rolling resistance test, but with an additional warmup at the RPK test condition prior to collecting the RPK data. This additional warmup should be 10 minutes for passenger tires, and 15 minutes for light truck tires.

4.3.9 Data Collection.

4.3.9.1 For a Standard RPK Test.

4.3.9.1.1 Standard Tread Tire. Once the initial stabilization is complete, RPK data is acquired in the CW and Counterclockwise (CCW) direction under the same load, inflation and speed conditions so that RPK_{Bias} may eventually be calculated.

4.3.9.1.2 Directional Tread Tire. Once the initial stabilization is complete, RPK data is only required in the CW direction (the tire's intended direction of rotation). The CCW direction data collection is not needed for a directional tire, and bias is not applicable. CCW data and bias is not reported in this case.

4.3.9.2 Non-standard Case. In the non-standard case that the test has multiple test step conditions for load or pressure, a secondary stabilization period is required before additional RPK data are recorded.

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