SAE International	SURFACE VEHICLE RECOMMENDED PRACTICE	SAE J695 JUN2011
		Issued 1954-10 Stabilized 2011-06 Superseding J695 DEC1998

Turning Ability and Off Tracking - Motor Vehicles

RATIONALE

The Vehicle Characterization Committee which owned the report has become inactivated and the technical expertise for the subject report within the Truck-Bus Council is not available at this time.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Truck and Bus Total Vehicle Steering Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. ***Scope***—This SAE Recommended Practice sets forth a method by which the turning ability and off tracking of motor vehicles can be determined.

2. ***References***

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE SP-374—The Truck Steering System from Hand Wheel to Road Wheel

3. ***Definitions***

3.1 Turning Center—That point about which all parts of a vehicle or combination of vehicles revolve in describing a turn of constant radius. For ideal steering, free of tire scrubbing, the extended axis of all wheel spindles passes through this center. In the case of two-axled bogies or tandems in which the axles are constrained to parallelism, the turning center is assumed to fall on a line parallel to and midway between these axle centerlines (see Figure 1).

3.2 Turning Radius—The distance from the turning center to the center of tire contact with the road of the wheel describing the largest circle, while the vehicle is executing its sharpest practicable turn (usually to the outside front wheel) (see Figure 1).

3.3 Turning Diameter—Twice the turning radius (see Figure 1).

3.4 Turning Diameter—Wall-to-Wall—The diameter of the smallest circle, which will enclose the outermost points of projection of the vehicle while executing its sharpest practicable turn. This is equal to the minimum turning diameter plus twice the radial overhang beyond the turning radius (see Figure 1).

3.5 Turning Diameter—Curb-To-Curb—The diameter of the smallest circle within which the vehicle will clear a curb 150 mm high, while the vehicle is executing its sharpest practicable turn. This is equal to the turning diameter plus twice the horizontal distance from the center of tire contact with the road to the arc subtended by a chord drawn between the points of intersection of the outermost projection of the tire shoulder on a horizontal plane 150 mm above the surface on which the tire rests (see Figure 1).

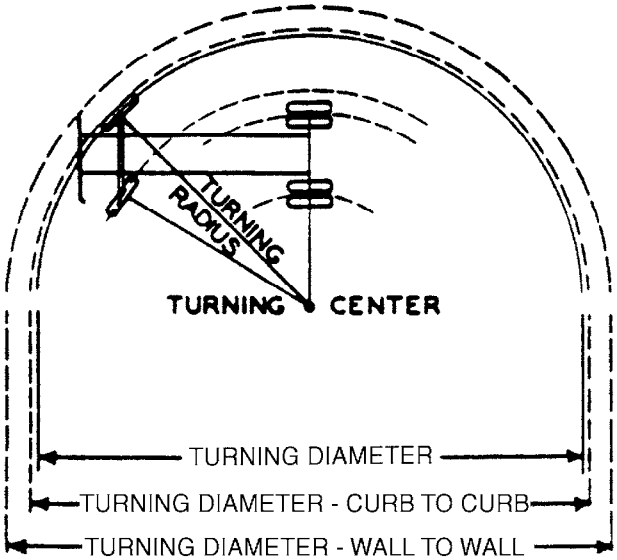

FIGURE 1—

4. Determinations—The following determinations, based on Ackerman steering geometry (see Figures 2 and 3), may be made mathematically as explained in detail as follows:

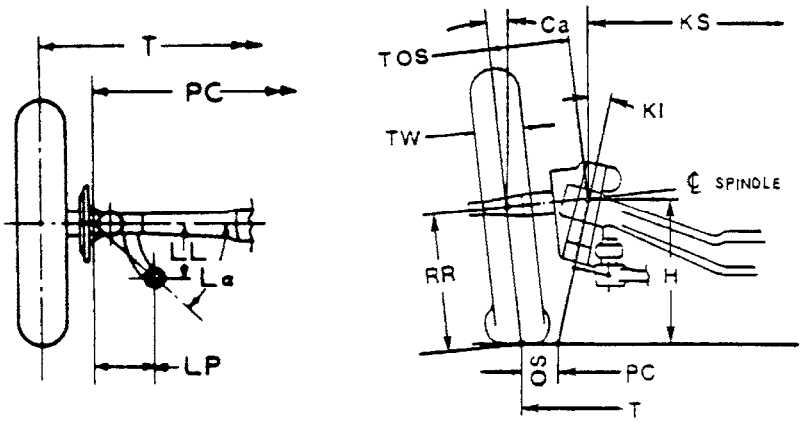

FIGURE 2—DIAGRAM ILLUSTRATING FACTORS OF FRONT AXLE CONFIGURATION

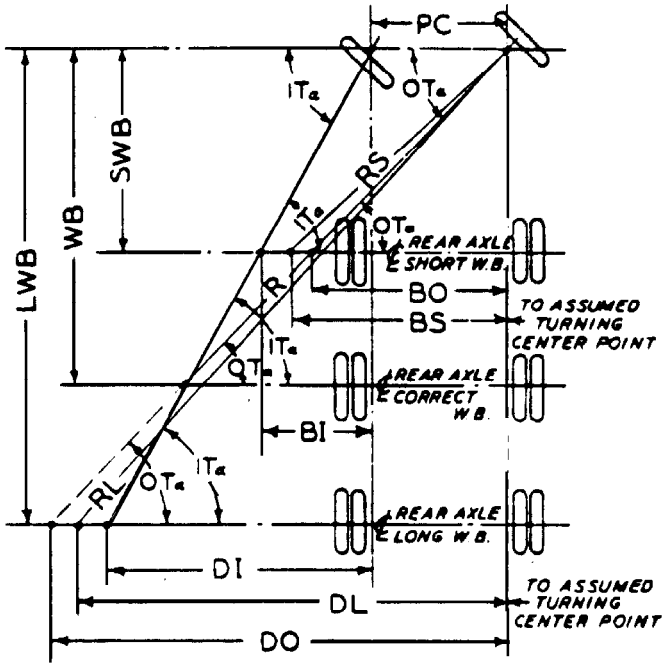

FIGURE 3—DIAGRAM ILLUSTRATING EFFECT OF WHEELBASE ON TURNING RADIUS WITH A GIVEN FRONT AXLE CONFIGURATION

4.1 Turning diameter[1] with a given wheelbase[2] and front axle configuration.

4.2 Configuration required to provide a given turning diameter[1].

1. At the maximum turning angle, there is normally Ackerman geometry error between the front wheels that can be described as shown in the equation in 6.2.2 or 6.2.3. This error will result in tire scrub of both front tires. If equal slippage of both front wheels is assumed, the theoretical turning center will lie midway between the intersections of the turning angle lines of outside and inside front wheels with the centerline of the rear axle. Due to the centrifugal force, the greater pressure on the outer wheel due to this centrifugal force, and other influences, the true turning center will actually lie closer to the outer intersection than to the inner.
2. To determine the turning ability of a three-axled vehicle, it is customary to measure the wheelbase from the front axle center to a point midway between the two rear axles and to consider a transverse line through this point as the equivalent of the center of the rear axle of a two-axled vehicle. Since these rear axles are constrained to parallelism, a moment is created during a turn that must be overcome by the front tires. This moment increases the front tire slip angle or tire scrub, and results in a larger turning diameter or a turning diameter equivalent to a vehicle with a longer wheelbase. Tests have shown that the true location of the turning center is somewhat further to the rear than midway between the axles. The actual location of the turning center depends on whether the tire equipment is single or dual, whether the tires are radial or biased ply construction, the load distribution between the two rear axles, the load on the front axle, and the Ackerman error in the tie-rod linkage. Calculations to accurately predict the effects of these various factors would be quite complex.