SOCIETY OF AUTOMOTIVE ENGINEERS, INC. • TWO PENNSYLVANIA PLAZA • NEW YORK, NEW YORK 10001

LAND SEA AIR SPACE

TECHNICAL REPORT J332

TESTING MACHINES FOR MEASURING THE UNIFORMITY OF PASSENGER CAR TIRES—SAE J332

SAE Recommended Practice

Report of Vehicle Dynamics Committee and Tire Committee approved January 1969.

Scope—In recent years the comfort and fatigue of passengers in vehicles has become a major engineering consideration. Among the many factors involved are vibratory and auditory disturbances. Tires participate, among other elements of the vehicle, in exciting vibrations and noises. Furthermore, tires also may generate forces leading to lateral drift of the vehicle.

This recommended practice describes the design requirements of equipment for evaluating some of the characteristic excitations of passenger tires causing disturbances in vehicles. The kinds of excitations treated result from nonuniformities in the structure of the tire and have their effect when a vehicle bearing the tire travels on a smooth road.

This recommended practice also describes some broad aspects of the use of the equipment and lists precautionary measures that have arisen out of current experience.

The intention underlying these recommendations is to establish the best standardized measurement for use by the engineering community that our present state of knowledge allows.

There is a considerable body of evidence that supports the statistical relevance of data obtained from the type of equipment and the procedures described. However, the mechanical instability of the materials of a tire responding to the effects of temperature, storage conditions, and surface contamination, as well as the previous history of usage, etc., all produce variations in vibratory excitations. For these reasons the measurements of individual tires are often cloaked in a degree of uncertainty. Nevertheless, larger values of vibratory excitations are usually well identified, and statistical evaluations of the data usually serve to indicate properly the quality of production lots of tires.

Criteria of quality which might be based on measurements made under this recommended practice follow from the needs of individual engineering applications and are consequently not sufficiently general to be specified here.

Basic Form of Measurement—The measurement detects the variations in force components produced by a mounted and inflated tire while the tire runs unsteered against a smooth road drum at constant axle height over that drum and at a constant speed.

The varying and constant force components of the tire requiring evaluation are generally four in number. These components of force, as illustrated in Fig. 1, are termed:

1. The variation in radial force.
2. The variation in lateral force.
3. The variation in tractive force.
4. The constant component of the lateral force.

Apparatus

General—The equipment is essentially an axle or spindle supporting a rim on which tires may be readily mounted, a means for loading the tire against a drum at a specified load and for holding a fixed tire-to-drum center distance during measurements, and a system for measuring the excitation forces equivalent to those at the tire's spindle as the tire and drum are rotated at prescribed speeds. Rotation can be accomplished by driving either the tire or the drum. There should be provisions for both clockwise and counterclockwise directions of rotation to account for use of tires on left or right sides of the vehicle. The equipment also requires a means for rapid inflation and deflation of the tire, and for control of inflation pressure during rotation.

Structure—The supporting structure and components of the machine must be sufficiently rigid to insure that natural frequencies of the machine assemblies (which may be ultimately detected in the measurement of forces) are above 40 times the wheel rotational frequency used in the measurement. For special types of instrumentation that are matched to machine resonances, this requirement may be waived. The drum and wheel spindles are to be rigidly supported with no lash in radial, axial, or tractive directions.

The structure and rims are to accept tires of 22-36 in. in diameter and 5-13 in. in section width. The equipment is to be capable of rotating tires at speeds of 15-60 rpm during the measuring operation and at 300-400 rpm for stabilization before measurement. The design should be based on a maximum force between tire and rim of 2000 lb in the radial direction, 500 lb laterally, and 500 lb in the tractive direction.

Drum, Axles and Rims—The drum is to be standardized at 33.625 ±0.100 in. in diameter. The total indicator runout of this member as measured at a reference band is to be less than 0.001 in. The maximum acceptable unbalance is 1 in.-lb. The drum should feature a high-friction, textured surface, such as provided by knurling, sprayed tungsten carbide, adhered tungsten carbide crystals, etc. The surface texturing, however, must be sufficiently uniform so that the average radius of the drum per 2.0 in. of circumference meets the specifications for runout. The parallelism of the rim axis and the drum axis while under 2000 lb of radial load and 100 lb of lateral load should be within a tolerance of 0.003 in./ft.

The machine should be adaptable for accommodating different sizes of tires. This is best accomplished through interchangeable rims. Rims for force variation measurement should abide by the recommended diameter and taper of the Tire and Rim Association. Regardless of the

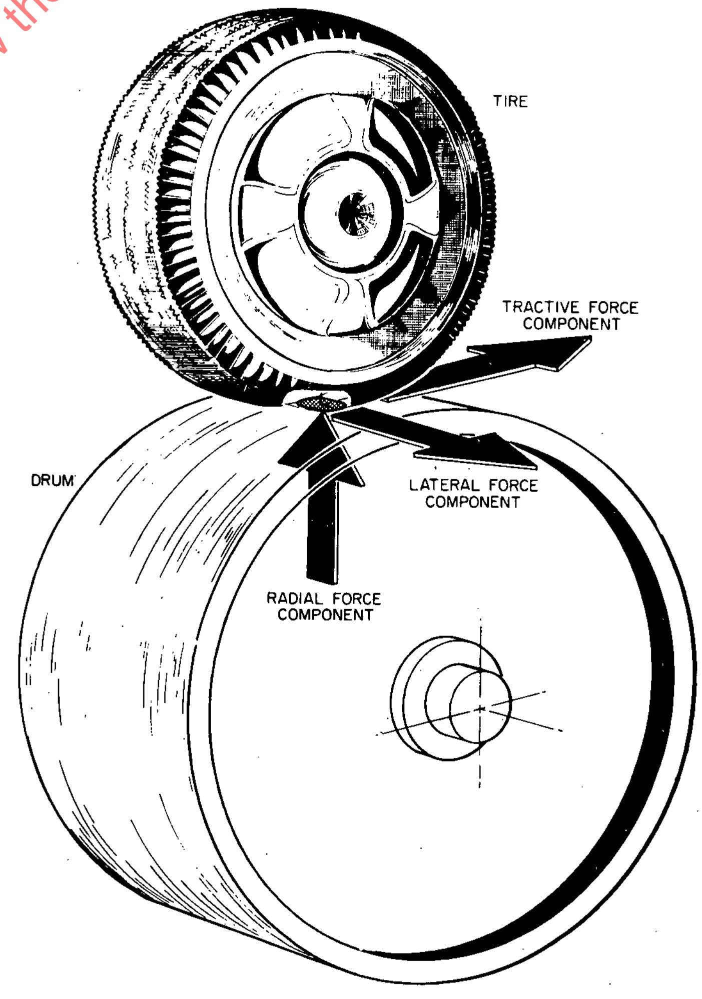

FIG. 1