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Terminology Relating to Vehicle-Pavement Systems[1]

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1. Scope

1.1 This terminology covers definitions for approved standards under the jurisdiction of ASTM Committee E-17 on Vehicle-Pavement Systems. Definitions of terms specific to an individual standard are listed in the appendix. For additional information, see Terminology D 8, Terminology F 538, Special Report 1132.2, and SAE J 2047.

1.2 Other publications may reference this terminology for terms used therein.

1.3 The standard containing the term and the responsible subcommittee of Committee E-17 is listed at the end of each definition. Revision of the listed standard by that subcommittee will include review of the definition and approved changes or additions will be incorporated herein.

1.4 The terms in this terminology are listed in categories of the five groups of Committee E-17. These are Administration, Skid Resistance, Roughness, Pavement Management, and Intelligent Vehicle/Highway Systems.

1.5 This terminology lists the definition as presented in the approved standards. Variation of any term is also listed and referenced to the defined term (for example the term *hydroplaning, viscous* is also listed and referenced to the defined **viscous hydroplaning**).

2. Referenced Documents

2.1 *ASTM Standards:*

D 8 Terminology Relating to Materials for Roads and Pavements[2]

E 556 Test Method for Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform (User Level)[2]

E 950 Test Method for Measuring Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference[2]

E 965 Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique[2]

E 1166 Guide for Network Level Pavement Management[2]

E 1170 Practices for Simulating Vehicular Response to Longitudinal Profiles of a Vehicular Traveled Surface[2]

E 1215 Specification for Trailers Used for Measuring Vehicular Response to Road Roughness[2]

E 1274 Test Method for Measuring Pavement Roughness Using a Profilograph[2]

E 1318 Specification for Highway Weigh-in-Motion (WIM) Systems with User Requirements and Test Method[2]

E 1337 Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire[2]

E 1364 Test Method for Measuring Road Roughness by Static Level Method[2]

E 1442 Practice for Highway-Traffic Monitoring[2]

E 1448 Practice for Calibration of Systems Used for Measuring Vehicular Response to Pavement Roughness[2]

E 1489 Practice for Computing Ride Number of Roads from Longitudinal Profile Measurements Made by an Inertial Profile Measuring Device[2]

E 1500 Practice for Computing Mean Square Numerics from Road Surface Profile Records[2]

E 1572 Practice for Classifying Highway Vehicles from Known Axle Count and Spacing[2]

E 1656 Guide for Classification of Automated Pavement Condition Survey Equipment[2]

E 1703 Test Method for Measuring Rut-Depth of Pavement Surfaces Using a Straightedge[2]

E 1778 Terminology Relating to Pavement Distress[2]

E 1845 Practice for Calculating Pavement Macrotexture Mean Profile Depth[2]

E 1889 Guide for Pavement Management Implementation[2]

E 1926 Practice for Computing International Roughness Index from Longitudinal Profile Measurements[2]

E 1927 Guide for Conducting Subjective Pavement Ride Quality Ratings[2]

F 538 Terminology Relating to Characteristics and Performance of Tires[3]

2.2 *Transportation Research Board Standard:* Special Report 113,Standard Nomenclature and Definitions for Pavement Components and Deficiencies[4]

2.3 *SAE Standard:*

SAE J2047 Tire Performance Terminology[5]

[1] This terminology is under the jurisdiction of ASTM Committee E-17 on Vehicle-Pavement Systems and is the direct responsibility of Subcommittee E17.14 on Terminology.

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[2] *Annual Book of ASTM Standards*, Vol 04.03.

[3] *Annual Book of ASTM Standards*, Vol 09.02.

[4] Available from Transportation Research Board, 2101 Constitution Ave., NW, Washington, DC, 20418.

[5] Available from Society for Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

3. Definitions of Administrative Group

index, *n—(synonymous with "number in Committee E-17 usage, for example; PSI, RN)*, a number or formula expressing some property, form, ratio, etc. of the relation or proportion of one amount or dimension to another. **(E 867, E 17.14)**

DISCUSSION—"Numeric" and "metric" also have meanings which are synonymous with index. However, either number or index is the preferred term for use in Committee E-17 standards.

pavement characteristic, *n*—a physical feature or property of a pavement surface such as type, roughness, texture, and skid resistance **(E 867, E 17.14)**

present serviceability, *n*—the current condition of a pavement (traveled surface) as perceived by the traveling public. **(E 867, E 17.14)**

present serviceability rating (PSR), *n*—a mean rating of the serviceability of a pavement (traveled surface) established by a rating panel under controlled conditions. The accepted scale for highways is 0 to 5, with 5 being excellent. **(E 867, E 17.14)**

traveled surface, *n*—any man-made, solid surface for vehicular travel, for example, highways, runways, rails, guideways. **(E 867, E 17.14)**

4. Definitions of Technical Group on Skid Resistance

baselength, *n*—the length of a segment of a pavement macrotexture profile being analyzed required to be 100 mm. **(E 1845, E 17.23)**

chirp test, *n*—the progressive application of brake torque required to produce the maximum value of longitudinal braking force that will occur prior to wheel lockup, with subsequent brake release to prevent any wheel lockup (tire slide). **(E 1337, E 17.21)**

dynamic hydroplaning, *n*—hydroplaning of pneumatic tires with separation caused by a thick fluid film due principally to the generation of fluid inertial forces. **(E 867, E 17.14)**

estimated texture depth, *n*—the estimate of mean texture depth, by means of a linear transformation of mean profile depth. **(E 1845, E 17.23)**

hydroplaning (aquaplaning) of pneumatic tires, *n*—a phenomenon that occurs when the load-bearing surface of a pneumatic tire is separated from a solid surface by a substance (usually a fluid and usually water). **(E 867, E 17.14)**

hydroplaning, dynamic—see **dynamic hydroplaning**.

hydroplaning, rubber reversion—see **rubber reversion hydroplaning**.

hydroplaning, viscous—see **viscous hydroplaning**.

hydroplaning speed, *n*—the initial speed at which a pneumatic tire begins to full dynamic hydroplaning under a given set of conditions. **(E 867, E 17.14)**

mean profile depth (MPD), *n*—the average of all mean segment depths of all segments of the profile. **(E 1845, E 17.23)**

mean segment depth, *n*—the average value of the profile depth of the two halves of a segment having a given baselength. **(E 1845, E 17.23)**

mean texture depth (MTD), *n*—the mean depth of the pavement macrotexture profile determined by the volumetric technique of Test Method E 965. **(E 1845, E 17.23)**

pavement macrotexture, *n*—the deviations of a pavement surface from a true planar surface with the characteristic dimensions of wavelength and amplitude from 0.5 mm up to those that no longer affect tire-pavement interaction. **(E 965, E 17.23)**

pavement-micro texture (micro-rugosity), *n*—the deviations of a pavement surface from a true planar surface with characteristic dimensions of wavelength and amplitude less than 0.5 mm. It is suggested that the symbol *mitx* be used. **(E 867, E 17.14)**

profile depth, *n*—the difference between the pavement macrotexture profile and a horizontal line through the top of the highest peak within a given baselength. **(E 1845, E 17.23)**

rubber reversion hydroplaning, *n*—hydroplaning of pneumatic tires with separation caused by devulcanized rubber. **(E 867, E 17.14)**

skid number (friction number), *n*—the number that is used to report the results of a pavement skid test conducted in accordance with Test Method E 274. **(E 867, E 17.14)**

skid number-percent normalized gradient, *n*—the speed gradient divided by the skid number, both at the same speed and multiplied by 100. The percent normalized gradient is usually designated by the symbol PNG_v where v is the speed at which the percent normalized gradient is determined. **(E 867, E 17.14)**

$$PNG_v = 100(G/SN)_v \quad (1)$$

skid number-speed gradient, *n*—the slope of skid number versus speed multiplied by −1. The gradient is normally designated by the symbol G_v, where v is the speed at which the slope is determined, SN is the skid number, and V is the speed:

$$G_v = -(dSN/dV), \text{ that may be approximated by:} \quad (2)$$

$$-(SN_1 - SN_2)/(V_1 - V_2)$$

(E 867, E 17.14)

skid resistance, *n*—the ability of the traveled surface to prevent the loss of tire traction. **(E 867, E 17.14)**

texture shape factor, *n*—average of weighted sum of the ratios of amplitude to wavelength, as determined from an amplitude versus wavenumber (reciprocal of wavelength) spectrum. **(E 867, E 17.14)**

tire-wet pavement interaction, zone concept, *n*—a division of the load-bearing surface of a moving pneumatic tire into three basic zones; noncontact, partial contact, and contact. **(E 867, E 17.14)**

viscous hydroplaning, *n*—hydroplaning of pneumatic tires with separation caused by a thin fluid film due principally to the generation of fluid viscous forces. **(E 867, E 17.14)**

water depth-nominal, *n*—the nominal thickness of the water layer, that is, the volume of water divided by the area of the wetted pavement surface. **(E 867, E 17.14)**

water depth-positive, *n*—the distance from the water surface to the reference plane which is the top of the pavement asperities. **(E 867, E 17.14)**

5. Definitions of Technical Group on Roughness

aliasing, *n*—the spectrum of a digitized data record exists over

the range of frequencies from zero to one half the sampling frequency. If the spectrum of the original signal extends beyond one half the sampling frequency, then those components of the signal at frequencies higher than one half the sampling frequency will, when digitized, be folded back into the spectrum of the digitized signal. The excessive high frequency components will thus be "aliased" into low frequency components. **(E 1500, E 17.33)**

anti-aliasing filter, *n*—a low-pass analog filter applied to the original analog profile signal to suppress those components of the signal at frequencies higher than one half the intended digital sampling frequency. **(E 1500, E 17.33)**

frequency domain filtering, *n*—a filtering operation performed by first calculating the spectrum of the profile record and then multiplying the spectral components by the frequency response transfer function of the filter. **(E 1500, E 17.33)**

half-car roughness index (HRI), *n*—an index resulting from a mathematical simulation of vehicular response to the longitudinal profile of a pavement using the half-car simulation model described in Practice E 1170 and a measured speed of 50 mph (80 km/h). **(E 1448, E 17.31)**

DISCUSSION—Units are in inches per mile or metres per kilometre.

international roughness index (IRI), *n*—an index computed from a longitudinal profile measurement using a quarter-car simulation at a simulation speed of 50 mph (80 km/h). **(E 1448, E 17.31 and E 1926, E 17.33)**

DISCUSSION—IRI is reported in either inches per mile (in./mile) or metres per kilometre (m/km). (Note—1 m/km = 63.36 inches/mile).

international roughness index, true—see **true international roughness index.**

longitudinal profile, *n*—the perpendicular deviations of the pavement surface from an established reference parallel to the lane direction, usually measured in the wheel tracks. **(E 867, E 17.14) (E 1656, E 17.52)**

longitudinal profile measurement, *n*—a series of elevation values taken at a constant interval along a wheel track. **(E 1926, E 17.33)**

DISCUSSION—Elevation measurements may be taken statically, as with rod and level (see Test Method E 1364) or inclinometer, or dynamically, as with an inertial profiler (see Test Method E 950).

mean roughness index (MRI), *n*—the average of the international roughness index (IRI) values for the right and left wheel tracks. **(E 867, E 17.14 and E 1926, E 17.33)**

DISCUSSION—Units are in inches per mile or metres per kilometre.

mean panel rating (MPR), *n*—the average value, for each section of highway pavement, of ride quality ratings assigned by a ride rating panel. **(E 1927, E 17.33)**

profile, longitudinal—see **longitudinal profile.**

profile, transverse—see **transverse profile.**

profile record, *n*—a data record of the surface elevation, slope or acceleration, of arbitrary length. **(E 1500, E 17.33)**

profile segment, *n*—that part of a profile record for which the profile index will be calculated. **(E 1500, E 17.33)**

profilometer, *n*—equipment used to measure profile of traveled surface roughness. **(E 867, E 17.14)**

response-type system number (RTSN), *n*—the raw measured output from a response-type system. **(E 867, E 17.14) (E 1448, E 17.31)**

DISCUSSION—Units are arbitrary, being whatever the road meter in the response-type systems measures.

rideability, *n*—a subjective judgement of the comparative discomfort induced by traveling over a specific section of highway pavement in a vehicle. **(E 1927, E 17.33)**

rideability index (RI), *n*—an index derived from controlled measurements of the longitudinal profile in the wheel tracks and correlated with panel ratings of rideability. **(E 1489, E 17.33)**

ride number (RN), *n*—rideability index of a pavement using a scale of 0 to 5, with 5 being perfect and 0 being impassable. **(E 1489, E 17.33)**

ride quality rating, *n*—a numerical value subjectively assigned to a section of highway pavement by an individual quantifying his judgement of the level of ride quality for that section based on a psychophysical scale. **(E 1927, E 17.33)**

ride rating panel, *n*—a group of highway users, statistically representative of the total expected highway user population, in rating the ride quality of pavements. **(E 1927, E 17.33)**

road meter, *n*—equipment that measures the vehicle axle vertical motion relative to the vehicle frame during travel to yield a measure of roughness, for example, Mays, PCA, Soiltest, Cox. **(E 867, E 17.14)**

roughness index, half-car (HRI)—see **half-car roughness index.**

roughness index, international (IRI)—see **international roughness index.**

roughness index, mean (MRI)—see **mean roughness index**.

roughometer, *n*—a road meter that measures the unidirectional vertical movement of damped, leaf-sprung wheel relative to the road meter's trailer frame during travel to yield a measure of roughness. **(E 867, E 17.14)**

spatial domain filtering, *n*—a filtering operation performed directly on the profile record. **(E 1500, E 17.33)**

transverse profile, *n*—the vertical deviations of the pavement surface from a horizontal reference perpendicular to the lane direction. **(E 867, E 17.14)**

traveled surface roughness, *n*—the deviations of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads, and drainage, for example, longitudinal profile, transverse profile, and cross slope. **(E 867, E 17.14 and E 1926, E 17.33)**

true international roughness index, *n*—the value of international roughness index that would be computed for a longitudinal profile measurement with the constant interval approaching zero. **(E 1926, E 17.33)**

wave number, *n*—the inverse of wavelength. **(E 1926, E 17.33)**

DISCUSSION—Wave number, sometimes called spatial frequency, typically has units of cycle/m or cycle/ft.

wheel track , *n*—a line or path followed by the tire of a road vehicle on a traveled surface. **(E 1926, E 17.33)**

6. Definitions of Technical Group on Pavement Management

alligator (crocodile) cracking, *n*—interconnected or interlaced cracks forming a pattern which resembles an alligator's hide. **(E 1778, E 17.41)**

DISCUSSION—This pattern initiates within the wheelpaths and, when completed, forms polygons where the cracks are within 0.3 m (12 in.) of each other.

bituminous bleeding, *n*—excess bitumen on the surface of the pavement, usually found in the wheel paths. **(E 1778, E 17.41)**

bituminous pavement, *n*—a pavement comprising an upper layer or layers of aggregate mixed with a bituminous binder, (such as asphalt, coal tars and natural tars) and surface treatments such as chip seals, slurry seals, sand seals, and cape seals are also included. **(E 1778, E 17.41)**

block cracking, *n*—a pattern of cracks that divide the pavement into approximately rectangular pieces, ranging in size from approximately 0.1 m^2 to 10 m^2 (1 to 100 ft^2). **(E 1778, E 17.41)**

blowups, *n*—localized upward movement of the pavement surface at transverse joints or cracks, often accompanied with shattering of the concrete in that area. **(E 1778, E 17.41)**

champion, *n*—an advocate, or small group of advocates, in an agency that recognizes the need for a pavement management system and works to get it adopted and implemented. **(E 1889, E 17.41)**

continuously reinforced concrete pavement (CRCP), *n*—Portland cement concrete pavement with sufficient longitudinal steel reinforcement to control transverse crack spacings and openings in lieu of transverse contraction joints for accommodating concrete volume changes and load transfer. **(E 1778, E 17.41)**

corner breaks, *n—(JCP only)* a portion of the slab separated by a crack which intersects the adjacent transverse and longitudinal joints, describing approximately a 45° angle with the direction of traffic, where the length of the sides is from 0.3 m (1 ft) to one half the width of the slab. **(E 1778, E 17.41)**

corrugation, *n*—transverse undulations at regular intervals in the surface of the pavement consisting of alternate valleys and crests not more than 1 m (3 ft) apart. **(E 1778, E 17.41)**

crack, *n*—fissure or discontinuity of the pavement surface not necessarily extending through the entire thickness of the pavement. **(E 1778, E 17.41)**

cracking, alligator (crocodile)—see **alligator (crocodile) cracking.**

cracking, block—see **block cracking.**

cracking, durability "D"—see **durability "D" cracking.**

cracking, edge—see **edge cracking.**

cracking, longitudinal—see **longitudinal cracking.**

cracking, map—see **map cracking.**

cracking, reflection, at joints—see **reflection cracking at joints.**

cracking, slippage—see **slippage cracking.**

cracking, transverse—see **transverse cracking.**

depression, *n*—localized pavement surface areas at a lower elevation than the adjacent paved areas. **(E 1778, E 17.41)**

durability "D" cracking, *n*—closely spaced crescent-shaped hairline cracking pattern that initiates adjacent to joints, cracks, or free edges, first manifesting itself at the intersection of joints, cracks, or free edges; dark coloring of the cracking pattern and surrounding area often exists with "D" cracking. **(E 1778, E 17.41)**

edge cracking, *n*—crescent-shaped cracks or fairly continuous cracks that are located within 0.6 m (2 ft) of the pavement edge. **(E 1778, E 17.41)**

faulting of joints and cracks, *n*—difference in elevation across a joint or crack. **(E 1778, E 17.41)**

free edge, *n*—an unrestrained pavement boundary. **(E 1778, E 17.41)**

jet-blast erosion, *n—(airfields only)* darkened areas on the pavement surface where bituminous binder has been burned or carbonized; localized burned areas may vary in depth up to approximately 15 mm (½ in.) **(E 1778, E 17.41)**

joint, *n*—a discontinuity made necessary by design or by interruption of a paving operation. **(E 1778, E 17.41)**

jointed concrete pavement (JCP), *n*—Portland cement concrete pavement which has transverse joints placed at planned intervals. **(E 1778, E 17.41)**

joint seal deterioration, *n*—any condition which enables incompressible materials or water to infiltrate into the joint from the surface. **(E 1778, E 17.41)**

joint spalling, *n*—cracking, breaking, or chipping of concrete pavement edges within 0.6 m (2 ft) of a joint. **(E 1778, E 17.41)**

lane-to-shoulder dropoff, *n*—(*highways, roads and streets only*) difference in elevation between the traveled surface and the shoulder surface. **(E 1778, E 17.41)**

lane-to-shoulder separation, *n*—(*highways, roads and streets only*) widening of the joint between the edge of the slab and the shoulder. **(E 1778, E 17.41)**

longitudinal cracking, *n*—cracks in the pavement predominantly parallel to the direction of traffic. **(E 1778, E 17.41)**

map cracking, *n*—a series of interconnected cracks that extend only into the upper portion of the slab. **(E 1778, E 17.41)**

network level analysis, *n*—evaluation of a network of pavement to enable selection of candidate projects, project scheduling, and budget estimates. **(E 1166, E 17.41)**

oil spillage, *n*—a localized deterioration or softening of a bituminous pavement surface caused by the spilling of oil, fuel, or other solvents. **(E 1778, E 17.41)**

patch, *n*—a portion of pavement surface which has been replaced or additional material has been applied to the pavement after original construction. **(E 1778, E 17.41)**

DISCUSSION—Each agency must stipulate maximum patch dimensions which differentiate a patch from an overlay.

pavement, bituminous—see **bituminous pavement.**

pavement, continuously reinforced concrete (CRCP)—see **continuously reinforced concrete pavement.**

pavement, jointed concrete (JCP)—see **jointed concrete pavement.**

pavement, Portland cement concrete—see **Portland cement concrete pavement.**

pavement condition, *n*—a quantitative representation of distress in pavement at a given point in time. **(E 1166, E 17.41)**

pavement distress, *n*—external indications of pavement defects or deterioration. **(E 1778, E 17.41)**

pavement management section/segment, *n*—a contiguous pavement area considered to have uniform construction, maintenance, usage history, and condition. **(E 1166, E 17.41)**

pavement performance, *n*—ability of a pavement to fulfill its purpose over time. **(E 1166, E 17.41)**

polished aggregate, *n*—exposed aggregate worn smooth sufficiently to affect frictional characteristics. **(E 1778, E 17.41)**

popouts, *n*—small holes in the pavement surface, normally ranging in diameter from 25 mm (1 in.) to 100 mm (4 in.) and depth from 13 mm (0.5 in.) to 50 mm (2 in.). **(E 1778, E 17.41)**

Portland cement concrete pavement, *n*—a pavement having a surface of aggregate mixed with Portland cement paste binder or a mixture of Portland cement and other pozzolans. **(E 1778, E 17.41)**

potholes, *n*—bowl-shaped holes in the pavement surface, grater than 100 mm (4 in.) in diameter, and more than 25 mm (1 in.) in depth. **(E 1778, E 17.41)**

project level pavement analysis, *n*—evaluation of a pavement section to select the type and timing of corrective actions. **(E 867, E 17.14)**

pumping, *n*—ejection of water, material or both from beneath the pavement through a crack or joint. **(E 1778, E 17.41)**

punchouts, *n*—(*CRCP only*) a broken area of a concrete slab bounded by closely spaced cracks (usually less than 1 m (3 ft)). **(E 1778, E 17.41)**

raveling, *n*—loss of pavement surface material involving the dislodging of aggregate particles and degradation of the bituminous binder. **(E 1778, E 17.41)**

reflection cracking at joints, *n*—cracks in bituminous overlay surfaces that occur over concrete pavements at joints. **(E 1778, E 17.41)**

rut, *n*—a contiguous longitudinal depression deviating from a surface plane defined by transverse cross slope and longitudinal profile. **(E 1778, E 17.41)**

scaling, *n*—the deterioration of the upper concrete slab surface, normally 3 mm (0.125 in.) to 13 mm (0.5 in.) in depth, resulting in the loss of surface mortar. **(E 1778, E 17.41)**

shoving, *n*—the displacement of a localized area of the pavement surface generally associated with turning, braking or accelerating vehicles. **(E 1778, E 17.41)**

slippage cracking, *n*—crescent or half-moon-shaped cracks having two ends pointed opposite to the direction of traffic. **(E 1778, E 17.41)**

swell, *n*—a hump in the pavement surface that may occur over a small area or as a longer, gradual wave; either type of swell can be accompanied by surface cracking. **(E 1778, E 17.41)**

transverse construction joint deterioration, *n*—(*CRCP only*) series of closely spaced transverse cracks or a large number of interconnecting cracks occurring near a construction joint. **(E 1778, E 17.41)**

transverse cracking, *n*—cracks in the pavement that are predominantly perpendicular to the direction of traffic. **(E 1778, E 17.41)**

weigh-in-motion, *n*—the process of estimating a moving vehicle's gross weight and the portion of that weight that is carried by each wheel, axle, and axle group, or both, by measurement and analysis of dynamic vehicle tire forces. (See E 1318, E 17.52 and E 1442, E 17.52). **(E 867, E 17.14)**

7. Keywords

7.1 definitions; terminology; vehicle-pavement systems

APPENDIX

(Nonmandatory Information)

X1. CATEGORIES FOR DEFINITIONS OF TERMS SPECIFIC TO COMMITTEE E-17

X1.1 Scope

X1.1.1 This appendix lists definition of terms specific to a standard for approved standards under the jurisdiction of ASTM Committee E-17 on Vehicle-Pavement Systems.

X1.1.2 The definition of terms specific to a standard are listed in categories of the four groups of Committee E-17. There are Skid Resistance, Roughness, Pavement Management, and Intelligent Vehicle/Highway Systems. Each group is further subdivided by each standard that contains definition of terms specific to a standard.

X1.2 Definitions of Terms Specific to a Standard of Technical Group on Skid Resistance

X1.2.1 *E 556, Test Method for Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform (User Level)*:

(E 17.21)

calibration platform—a moving platform for applying a force in the contact plane of a tire, and associated means for measuring the applied force. The calibration platform consists of a rigid plate with a high friction surface, in contact

with the tire footprint, supported on a frictionless, preferably air, bearing. It may also be instrumented to measure vertical forces (loads).

calibration reference signals—repeatable signals in the range of expected wheel-force transducer system loading. These signals could either be constant voltages or preferably produced by a strain-gage calibration shunt resistor.

crosstalk—the undesired effect of force readings appearing on an unloaded axis of a transducer while applying force to another.

horizontal traction (traction)—a force acting in a horizontal axis through the wheel transducer; that is, locked wheel drag force.

hysteresis—the maximum difference between corresponding transducer outputs (of the wheel force transducer system) at increasing and decreasing applied calibration force, expressed as a percentage of maximum output. Proven outliers are excluded.

nonlinearity—the maximum deviation of the transducer output(s) (of the wheel force transducer system) from the best-fit linear relation to the applied calibration force, expressed as a percentage of full scale. Proven outliers are excluded.

test wheel—a wheel and test tire assembly mounted to a test vehicle by means of a force or torque transducer.

vertical load (load)—force acting in a vertical axis through the wheel transducer; that is, weight.

wheel force transducer system—a force-to-electrical signal converter system including transducer(s), associated signal condition, zeroing, amplifying, recording, and monitoring instrumentation.

X1.2.2 *E 1337, Test Method for Determining Longitudinal Peak Braking Coefficient of Paved Surfaces Using a Standard Reference Test Tire*:

braking force, tire—the negative longitudinal force resulting from braking torque application.

braking force coefficient, tire—the ratio of braking force to vertical load.

braking force coefficient, tire, peak—the maximum value of tire braking force coefficient that occurs prior to wheel lockup as the braking torque is progressively increased.

braking force coefficient, tire, slide—the value of the braking force coefficient obtained on a locked wheel.

braking torque—the negatively directed wheel torque. (See **torque (T), wheel**).

longitudinal force, tire (F_x)—the component of a tire force vector in the X' direction.

tire-axis system—the origin of the tire-axis system is the center of the tire contact. The X′ axis is the intersection of the wheel plane and the road plane with a positive direction forward. The Z′ axis is perpendicular to the road plane with a positive direction downward. The Y′ axis is in the road plane, its direction being chosen to make the axis system orthogonal and right-hand.

tire forces—the external forces acting on the tire by the road.

torque (T), wheel—the external torque applied to a tire from a vehicle about the wheel spin axis. Driving torque is positive wheel torque; braking torque is negative wheel torque.

vertical load (F_z)—the downward vertical component of force between the tire and the road.

X1.3 Definitions of Terms Specific to a Standard of Technical Group on Roughness

X1.3.1 *E 1215, Specification for Trailers Used for Measuring Vehicular Response to Road Roughness*:

(E 17.31)

sprung mass—the total mass minus the unsprung mass.

suspension deflection—the change in the vertical distance between the axle at its centerline and a hypothetical reference line directly above the axle centerline on the rigid frame structure.

X1.3.2 *E 1274, Test Method for Measuring Pavement Roughness Using a Profilograph*:

(E 17.32)

blanking band—a band of uniform height with its longitudinal center positioned optimally between the highs and lows of the surface record depicting at least 100 ft (30 m) of pavement.

cutoff height—a specified distance of a high on the surface record from a chord representing 25 ft (7.5 m) on the longitudinal scale. The chord may represent less than 25 ft (7.5 m) if it is from the lows on each side of the high.

rate of roughness—sum of the roughness divided by longitudinal distance covered by the blanking band.

roughness—height of each continuous scallop rounded to the nearest 0.05 in. (1 mm), except those less than 0.03 in. (0.8 mm) vertically and 2 ft (0.6 m) longitudinally.

scallops—excursions of the surface record above and below the blanking band.

X1.3.3 *E 1448, Practice for Calibration of Systems Used for Measuring Vehicular Response to Pavement Roughness*:

(E 17.31)

response type system number (RTSN)—the raw measured output from a response type system being calibrated. Units are arbitrary, being whatever the road meter in the response type system measures. (See Terminology E 867, Section 5).

(E 17.31)

X1.3.4 *E 1703, Test Method for Measuring Rut-Depth of Pavement Surfaces Using a Straight Edge*:

(E 17.31)

rut-depth—the maximum measured perpendicular distance between the bottom surface of the straightedge and the contact area of the gage with the pavement surface at a specific location.

trueness—the lack of significant curvature, inclination, noteworthy elevations, or depressions.

X1.4 Definitions of Terms Specific to a Standard of Technical Group on Intelligent Vehicle/Highway Systems

X1.4.1 *E 1318, Specification for Highway Weigh-in-Motion Systems With User Requirements and Test Method*:

(E 17.52)

accuracy—the closeness or degree of agreement (within a stated tolerance and probability of conformity) between a

quantity measured or estimated by a WIM system and an accepted reference value.

axle-group load—the sum of all tire loads on a group of adjacent axles.

axle load—the sum of all tire loads on an axle. An axle is comprised of two or more wheel assemblies lying approximately on a common axis oriented transversely to the nominal direction of motion of the vehicle.

gross-vehicle weight—the total mass of the vehicle or the vehicle combination including all connected components.

tire-load—the portion of the gross-vehicle weight imposed upon the static tire at the time of weighing, expressed in units of mass, pounds (kilograms), due only to the vertically-downward force of gravity acting on the mass of the static vehicle.

tolerance—the defined limit of allowable departure from the true value of a quantity measured or estimated by a WIM system.

weigh—to measure the tire load on one or more tires by using a vehicle scale, an axle-load scale, a portable axle-load weigher, or a wheel-load weigher. These devices are usually subjected to field standard test weights at each locality of use and are adjusted to indicate units of mass.

weigh-in-motion (WIM)—the process of estimating a moving vehicle's gross weight and the portion of that weight that is carried by each wheel, axle, or axle group, or combination thereof, by measurement and analysis of dynamics forces applied by its tires to a measuring device.

weight—synonymous with mass. The mass of a body is a measure of its inertia, or resistance to change in motion.

wheel load—the sum of the tire loads on all tires included in the wheel assembly which comprises a half-axle.

WIM system—a set of sensors and supporting instruments which measures the presence of a moving vehicle and the related dynamic tire forces at specified locations with respect to time; estimates tire loads, speed, axle spacing, vehicle class according to axle arrangement, and other parameters concerning the vehicle; and processes, displays, and stores this information.

X1.4.2 *E 1442, Practice for Highway Traffic Monitoring*:

(E 17.52)

adjustment factors, *n*—traffic summary statistic corrections for multiple axle vehicles, weekday traffic variation, seasonal traffic variation, and regional traffic characteristics; and, the estimate of annual growth or decline for traffic summary statistics on road segments not recounted during a year.

annual average daily traffic, (AADT), *n*—the estimate of typical traffic on a road segment for all days of the week, Sunday through Saturday, over the period of one year and calculated from permanent counter data as the sum of Monthly Average Daily Traffic (MADTs) divided by the number of MADTs, and for short term counts by using adjustment factors.

annual average days of the week, (AADW), *n*—a traffic volume mean statistic for each day of the week, over the period of one year, and calculated from included permanent counter data as the sum of Monthly Average Days of the Week (MADWs) for a year divided by the number of MADWs.

annual average weekday traffic, (AAWDT), *n*—the estimate of typical traffic over the period of one year, for the days Monday through Thursday, calculated from permanent counter data as the sum of Monthly Average Weekday Traffic (MAWDTs) divided by the number of MAWDTs.

DISCUSSION—Friday traffic may be included in AAWDT calculation at a permanent counter site or for summary statistics from permanent counters by functional or operational classification if the inclusion of these data does not increase AAWDT coefficient of variation.

annual average weekend traffic, (AAWET), *n*—the estimate of typical traffic over the period of one year, for the days Saturday through Sunday, calculated from permanent counter data as the sum of Monthly Average Weekend Traffic (MAWETs) divided by the number of MAWETs.

DISCUSSION—Friday traffic may be included in AAWET calculation at a permanent counter site or for summary statistics from permanent counters by functional or operational classification if the inclusion of these data does not increase AAWET coefficient of variation.

annual summary statistics, *n*—yearly estimates of the central tendency of traffic volume, vehicle classification, and Equivalent Single Axle Load (ESALs) by vehicle classification, based on traffic measurements during the weekday combinations of Sunday through Saturday, Monday through Thursday, and Friday through Sunday.

DISCUSSION—Calendar year is the most common and recommended basis for the count year.

annual vehicle miles traveled (AVMT), *n*—average annual traffic on a road segment, expressed as AADT multiplied by the number of days in the year, multiplied by the length of the road segment.

approach, *n*—a set of lanes accommodating all left turn, through, and right turn movements arriving at an intersection from a given direction.

axle correction factor, *n*—an adjustment of vehicle axle sensor summarized base data for incidence of multiple axle vehicles.

DISCUSSION—The purpose of the axle correction factor is to account for the incidence of multiple axle vehicles in the traffic stream.

base data, *n*—the unedited and unadjusted measurements of traffic volume, vehicle classification, and vehicle or axle weight.

count, *n*—the activity of measuring and recording traffic characteristics such as vehicle volume, classification, speed, weight, or a combination of these characteristics.

count period, *n*—the beginning and ending time of traffic characteristic measurement.

count type, *n*—the traffic characteristic being measured, the measurement device, and period.

daily vehicle miles traveled, (DVMT), *n*—average daily traffic on a road segment, expressed as AADT, multiplied by the length of the road segment.

edit-accepted, *adj*—having the unadjusted base data compliant with standards of practice.

DISCUSSION—The standards of practice are those described in Practice E 1442 combined with edit routines related to specific types and models of traffic measurement devices and data retrieval procedures.

edit-rejected, *adj*—having the unedited base data noncompliant with standards of practice.

DISCUSSION—The standards of practice are those described in Practice E 1442 combined with edit routines related to specific types and models of traffic measurement devices and data retrieval procedures.

equivalent single axle load, (ESAL), *n*—a numerical factor that expresses the relationship of a given axle load to another axle load in terms of their effect on the serviceability of a pavement structure.

DISCUSSION—In common usage, all axle loads are equated in terms of the equivalent number of repetitions of an 18 000 lb single axle.

excluded counters, *n*—permanent traffic counters for which monthly traffic adjustment factors may not be calculated for a given year.

functional classification, *n*—the grouping of streets and highways into classes, or systems, according to the character of service they are intended to provide.

DISCUSSION—Basic to functional classification is the recognition that individual roads do not serve travel independently in any major way. Most travel involves movement through a network of roads. It is helpful and necessary to determine how travel can be channelized within the road network in a logical and efficient manner. Functional classification is a way of describing how travel is channelized and the part that a particular road or street plays in serving the flow of trips through the road network.

included counters, *n*—permanent traffic counters for which monthly traffic adjustment factors may be calculated for a given year, based on the quantity of edit-accepted data.

isolated ramps, *n*—an interstate interchange ramp at which the traffic flow is not influenced by upstream or downstream ramps.

MADT—see **monthly average daily traffic.**

manual count, *n*—measurement of traffic characteristics based on human observation, which may or may not be electronically recorded.

mechanical count, *n*—measurement of traffic characteristics by sensors and electronic recording of the measurements, independent of human observation.

monthly average daily traffic, (MADT), *n*—the mean traffic volume for a month, calculated by the sum of Monthly Average Days of the Week (MADWs) divided by seven; or, in the absence of a MADW for each day of the week, divided by the number of MADWs during the month.

monthly average days of the week, (MADWs), *n*—a traffic volume mean statistic for each day of the week, over the period of one month, calculated from included permanent counter data as the sum of all traffic for each day of the week (Sunday, Monday, and so forth through the week), during a month, divided by the occurrences of that day during the month.

monthly average weekday traffic, (MAWDT), *n*—the four day average of traffic for the period Monday through Thursday in each month, calculated as the sum of MADWs for Monday through Thursday, divided by four.

DISCUSSION—Friday traffic may be included in MAWDT calculation if the inclusion of these data does not increase the coefficient of variation. If Friday traffic is included, MAWDT is the five day average of traffic for the period Monday through Friday in each month, calculated as the sum of MADWs for Monday through Friday, divided by five.

monthly average weekend traffic, (MAWET), *n*—the two-day average of traffic for the period Saturday through Sunday in each month, calculated as the sum of MADWs for Saturday through Sunday, divided by the number of MADWs for Saturday through Sunday during the month.

DISCUSSION—Friday traffic may be included in MAWET calculation if the inclusion of these data does not increase the coefficient of variation. If Friday traffic is included, MAWET is the three day average of traffic for the period Friday through Sunday in each month, calculated as the sum of MADWs for Friday through Sunday, divided by three.

monthly classification ratio, (MCR), *n*—the monthly average volume by vehicle classification divided by the annual average volume by vehicle classification, calculated for vehicle classification annual summary statistics.

monthly traffic ratio, (MTR), *n*—the monthly average traffic volume divided by the annual average traffic volume, calculated for traffic volume annual summary statistics.

monthly weight ratio, (MWR), *n*—the monthly average ESALs by vehicle classification divided by the annual average ESALs by vehicle classification, calculated for the vehicle weigh annual summary statistics.

operational classification, *n*—the grouping of permanent-counter sites, and roadways, on the basis of observed variation in traffic measurements, rather than designed purpose of the roadway.

permanent counter, *n*—a device intended to continuously measure and periodically record traffic volume, vehicle classification, or weigh, or combination thereof.

polling, *n*—automated transfer of traffic measurements from permanent counters to a computer for editing and summarization.

portable counter, *n*—a device which may be moved to various locations and periodically measures and records traffic volume, vehicle classification, or weigh, or combination thereof.

rural areas, *n*—individual agencies may have a political boundary definition of rural, which would be the definition for traffic-monitoring purposes; in the absence of such an individual agency definition, a rural area is defined as an area outside of a community with a population of 5000 persons or more.

DISCUSSION—If an agency's political definition differs from this definition of rural, the exception must be documented.

seasonal factor, *n*—a summarized short term count adjustment for variability by period of year, which can be based on monthly, weekly or daily factors when estimating typical annual traffic characteristics.

DISCUSSION—An alternative to defining seasonal factors as months or weeks is to use edit-accepted data variability during the year. This alternative may result in separate seasons for traffic volume, vehicle classification, and weigh.

thirtieth highest hour, *n*—for all edit-accepted hours of data during a one-year period, the thirtieth highest hourly traffic volume; this volume is commonly used as a representative hour of traffic volume in roadway design.

traffic volume, *n*—the number of motorized highway vehicles with two or more axles passing a point on a roadway in a unit of time.

urban area, *n*—individual agencies may have a political boundary definition of urban, which would be the definition for traffic monitoring purposes; in the absence of such an individual agency definition, an urban area is defined as a community with a population of 5000 persons or more.

validation count, *n*—measurement of traffic characteristics for acceptance testing of a separate traffic measurement on the same road segment.

vehicle classification, *n*—the identification, summarization and reporting of traffic volume by vehicle configuration.

vehicle miles traveled, (VMT), *n*—average Sunday through Saturday vehicle movement on a specific road segment multiplied by the length of the road segment, reported in the form of daily and annual VMT; this statistic is also referred to as "vehicle miles of travel."

weekday traffic factor, *n*—the relationship of MAWDT to MADT and MAWET, from permanent counters, used to adjust short-term weekday counts to MADT and MAWET.

DISCUSSION—In operational classification this short term count adjustment factor may be based on the relationship of periods of time other than day, week, or month.

weight in-motion, (WIM), *n*—the process of estimating a moving vehicle's gross weight and the portion of that weight that is carried by each wheel, axle, or axle group, or combination thereof, by measurement and analysis of dynamic tire forces.

X1.4.3 *E 1572, Practice for Classifying Highway Vehicles from Known Axle Count and Spacing*:

(E 17.52)

axle configuration code, *n*—alphanumeric code, up to nine characters long, defining the number and type of units in a vehicle, number of axle groups in each unit, and number of axles in each axle group.

axle count, *n*—the total number of a vehicle's axles in contact with the pavement.

axle group, *n*—one or more adjacent axles, usually sharing a common connection to the body of a vehicle, which jointly support a portion of the vehicle's weight.

axle spacing, *n*—for each axle, the horizontal distance between the center of that axle and that of the preceding axle; the axle spacing for the vehicle's front axle is assumed to be zero.

classification, *n*—see **vehicle classification.**

commercial vehicle, *n*—a vehicle with heavy duty chassis and suspension designed for commercial freight haulage.

dolly, *n*—an assembly equipped with a hitch and one or more axles, typically used to support the forward end of a semitrailer.

full trailer, *n*—a freight trailer supported at both ends by attached axles.

group delta, *n*—the maximum allowable difference between axle spacings within an axle group and the average axle spacing within the group.

group limit, *n*—the maximum axle spacing permitted for axles within the axle group.

group spacing, *n*—for each axle group, the horizontal distance between the midpoint of that axle group and the preceding axle group; the group spacing of the vehicle's front axle group is assumed to be zero.

modifier code, *n*—a character code appended to the axle configuration code to define the approximate load carrying capacity of the vehicle.

recreational vehicle, *n*—a vehicle with light or medium duty chassis and suspension designed for recreational living or hauling.

semitrailer, *n*—a freight trailer supported at its forward end by a truck tractor or another trailer and at its rearward end by attached axles.

tractor, *n*—a powered unit capable of propelling itself and towing other (unpowered) units on a highway.

unit, *n*—an individual, detachable assembly of chassis, body, and axles comprising part of a complete vehicle; units include tractors, full trailers, and semitrailers.

utility trailer, *n*—a full trailer, typically used for light duty hauling and towed by passenger vehicles or light trucks.

vehicle, *n*—an assembly of one or more units coupled together for travel on a highway; vehicles include one powered unit and may include one or more unpowered full trailer or semitrailer units.

vehicle classification, *n*—the process of characterizing vehicles by axle or unit configuration.

X1.4.4 *E 1656, Guide for Classification of Automated Pavement Condition Survey Equipment*:

(E 17.52)

characteristic—a directly measurable distinguishing property of the pavement surface. Examples are pavement longitudinal profile, transverse profile, and separations in the continuity of a pavement surface. (See Terminology E 867).

dynamic intermediate precision—the precision of the measurement of a characteristic determined under dynamic intermediate precision conditions in which the same equipment moving at operating speed measures the characteristic at the same location repeatedly.

longitudinal profile—the perpendicular deviations of the pavement surface from an established reference parallel to the lane direction, usually measured in the wheel tracks. (See Terminology E 867).

resolution—the smallest increment that a characteristic measuring process must distinguish and display.

stationary repeatability precision—the precision of the measurement of a characteristic determined under repeatability condition with the instrumented equipment stationary.

tolerance—the defined limits of allowable (acceptable) departure from the true value of a measured quantity.