This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: E2300 – 09 (Reapproved 2017)

Standard Specification for Highway Traffic Monitoring Devices[1]

This standard is issued under the fixed designation E2300; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification describes the recommended procedure for identifying the performance and operating requirements to be included in a purchase order for Traffic Monitoring Devices. As such, the specification can be referenced by the user and seller when determining compliance with each specified requirement. It is the intent of this specification to have the user require the seller to provide evidence that the brand and model of TMD offered by the seller has passed an applicable Type-approval Test. If the TMD has not previously passed a Type-approval Test, then it is the intent of this specification to have the device type-approved before it is accepted by the user. If the TMD has previously passed a Type-approval Test, then this specification requires that the production version of the device provided by the seller pass an On-site Verification Test before being accepted by the user.

1.2 *Traffic Monitoring Device*—A Traffic Monitoring Device (TMD) is equipment that counts and classifies vehicles and measures vehicle flow characteristics such as vehicle speed, lane occupancy, turning movements, intervehicle gaps, and other parameters typically used to portray traffic movement. TMDs usually contain a sensing element that converts the signal-generating phenomenon (such as, air pulse generated by a vehicle tire passing over a pneumatic tube) into an electrical signal and electronics that amplify, filter, and otherwise condition the signal. Some TMDs provide outputs as relay or solid-state switch closures, while others contain signal processing that translates the signal into the required vehicle and vehicle flow data. TMDs whose outputs are relay or solid state switch closures may be connected to roadside controllers, which process the switch-closure information and convert it into vehicle flow data.

1.3 *Characterization of Traffic Monitoring Devices*—This specification classifies Traffic Monitoring Devices by the functions they perform, the data they provide, the required accuracy of the data, and the conditions under which the device is expected to operate in conformity with the requirements developed through this specification.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E867 Terminology Relating to Vehicle-Pavement Systems

E1318 Specification for Highway Weigh-In-Motion (WIM) Systems with User Requirements and Test Methods

E2532 Test Methods for Evaluating Performance of Highway Traffic Monitoring Devices

3. Terminology

3.1 Definitions of terms and definitions of terms specific to this specification are given below.

3.2 *Definitions:*

3.2.1 *axle, n*—axis oriented transversely to the nominal direction of vehicle motion, and extending the full width of the vehicle, about which the wheels at both ends rotate. **(E867, E1318)**

3.2.2 *axle count, n*—number of vehicle axles enumerated at a point on a lane or roadway during a specified time interval. **(E867)**

3.2.3 *vehicle, n*—one or more mobile units coupled together for travel on a highway; a vehicle contains one powered unit and may include one or more non-powered full-trailer or semi-trailer units. **(E867)**

3.3 *Definitions of Terms Specific to This Standard:*

[1] This specification is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.52 on Traffic Monitoring.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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3.3.1 *accepted reference value, n*—a particular quantity (number of vehicles in a particular class defined by number of axles and interaxle spacings, vehicle count, lane occupancy, or vehicle speed) that is agreed upon by the user and seller in advance of testing of a TMD, which has an uncertainty appropriate for the given purpose.

3.3.2 *accuracy, n*—closeness of agreement between a value indicated by a TMD and an accepted reference value.

3.3.3 *correct detection, n*—an indication by a TMD that a vehicle actually passing over the detection area of the TMD is detected by the TMD.[3]

3.3.4 *data item, n*—characteristic associated with individual vehicles (count, class, and speed) or the continuum of vehicles at a location (density, flow rate, and queue length).

3.3.5 *detection area, n*—road surface area above which a sensor detects a vehicle or vehicle component.

3.3.6 *device identifier, n*—information output by a TMD that includes, as a minimum, the model and serial number of the device.

3.3.7 *electronics unit, n*—device that provides power to one or more sensors, filters and amplifies the signals produced by the sensors, and may perform other functions such as sensitivity adjustment, failure indication, and delayed actuation of traffic control signals.[4]

3.3.8 *false detection, n*—an indication by a TMD that a vehicle not actually passing over the detection area of the TMD is detected by the TMD.[3]

3.3.9 *flow rate, n*—number of vehicles passing a given point or section of a lane or roadway during a designated time interval, usually 15 min, but expressed as an equivalent hourly rate in vehicles/h.

3.3.10 *lane occupancy, n*—percent of selected time interval that vehicles are detected in the detection area of a sensor; the time interval during which the lane occupancy is measured is usually 20 s to 30 s.[5]

3.3.11 *missed detection, n*—an indication by a TMD that a vehicle actually passing over the detection area of the TMD is not detected by the TMD.[3]

3.3.12 *sensor, n*—device for acquiring a signal that provides data to indicate the presence or passage of a vehicle or of a vehicle component over the detection area with respect to time (for example, flow rate or number of axles and their spacing), or one or more distinctive features of the vehicle such as height or mass.

3.3.13 *speed, n*—rate of vehicle motion expressed as distance per unit of time.

3.3.14 *time stamp, n*—recorded date and time at which a measurement was made; information and format may be tailored to the application, but usually consists of month, day, year, hour, minute, second, and subsecond.

3.3.15 *tolerance, n*—allowable deviation of a value indicated by the device under test or a device in service from an accepted reference value.

3.3.16 *traffic monitoring device, n*—equipment that counts and classifies vehicles and measures vehicle flow characteristics such as vehicle speed, lane occupancy, turning movements, and other items typically used to portray traffic movement.

3.3.17 *vehicle class by axle, n*—characterization of a vehicle by its number of axles and interaxle spacing.

3.3.18 *vehicle class by length, n*—characterization of vehicles by their total length.

3.3.19 *vehicle count (volume), n*—total number of vehicles observed or predicted to pass a point on a lane or roadway during a specified time interval.

3.3.20 *vehicle passage, n*—sensor output pulse signal produced when an initial vehicle detection is made in the detection area of the sensor.

3.3.21 *vehicle presence, n*—sensor output signal produced the entire time a vehicle is detected in the detection area of the sensor.

4. Significance and Use

4.1 The accuracy required of a TMD for data acquisition and characterization of vehicles and traffic flow parameters is related to the traffic management or data reporting task supported by the device. The TMD to be procured shall be specified by designating a Type from Table 1, a tolerance for each data item required, and the conditions under which the device is expected to operate within the requirements developed through this specification. For example, if a Traffic Counting device is desired to provide axle counts to within ±5 % tolerance, then specify a Type I-1, 5 % tolerance device. If a Speed Monitoring device is desired to provide the number of vehicles correctly detected to within ±5 % tolerance and speed to within ±10 % tolerance, then specify a Type IV-1 device with a 5 % tolerance on the number of individual vehicles correctly detected and a 10 % tolerance on vehicle speed measurement. If a combination Speed Monitoring and Traffic Signal Control device is desired to provide the number of vehicles correctly detected to within ±5 % tolerance, speed to within ±10 % tolerance, vehicle presence to within ±10 % tolerance, and lane occupancy to within ±20 % tolerance, then specify a combination Type IV-1 device with a 5 % tolerance on the number of individual vehicles correctly detected and a 10 % tolerance on vehicle speed measurement and Type VI-1 device with a 10 % vehicle presence tolerance and a 20 % lane occupancy tolerance. The associated operating conditions shall

[3] The terms 'correct detection,' 'false detection,' and 'missed detection,' rather than the aggregated vehicle count metric, are recommended as metrics for determining the ability of a TMD to accurately detect vehicles. Aggregated measurements, such as vehicle count over a time interval, can obscure the actual accuracy of a TMD since failures to detect are often canceled by false detections. Therefore, evaluation methods based upon aggregated metrics can provide misleading conclusions concerning the ability of a TMD to correctly detect vehicles.

[4] Klein, L. A., Gibson, D., and Mills, M. K., *Traffic Detector Handbook: Third Edition*, FHWA-HRT-06-108 (Vol. I) and FHWA-HRT-06-139 (Vol. II), U.S. Department of Transportation, Federal Highway Administration, Washington, DC, Oct. 2006. Also available at: http://www.tfhrc.gov/its/pubs/06108/ and http://www.tfhrc.gov/its/pubs/06139/.

[5] Different sensor models or technologies used to measure lane occupancy may have different detection area sizes and, hence, produce different occupancy values, although all devices are operating properly.

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