Designation: E1486M – 14 (Reapproved 2022)

Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria (Metric)[1]

This standard is issued under the fixed designation E1486M; 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 test method covers data collection and analysis procedures to determine surface flatness and levelness by calculating waviness indices for survey lines and surfaces, elevation differences of defined wheel paths, and levelness indices using SI units.

NOTE 1—This test method is the companion to inch-pound Test Method E1486.

NOTE 2—This test method was not developed for, and does not apply to clay or concrete paver units.

1.1.1 The purpose of this test method is to provide the user with floor tolerance estimates as follows:

1.1.1.1 Local survey line waviness and overall surface waviness indices for floors based on deviations from the midpoints of imaginary chords as they are moved along a floor elevation profile survey line. End points of the chords are always in contact with the surface. The imaginary chords cut through any points in the concrete surface higher than the chords.

1.1.1.2 Defined wheel path criteria based on transverse and longitudinal elevation differences, change in elevation difference, and root mean square (RMS) elevation difference.

1.1.1.3 Levelness criteria for surfaces characterized by either of the following methods: the conformance of elevation data to the test section elevation data mean; or by the conformance of the RMS slope of each survey line to a specified slope for each survey line.

1.1.2 The averages used throughout these calculations are the root mean squares, RMS (that is, the quadratic means). This test method gives equal importance to humps and dips, measured up (+) and down (−), respectively, from the imaginary chords.

1.1.3 Appendix X1 is a commentary on this test method. Appendix X2 provides a computer program for waviness index calculations based on this test method.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *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.*

2. Referenced Document

2.1 *ASTM Standard:*[2]

E1486 Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *defined wheel path traffic*—traffic on surfaces, or specifically identifiable portions thereof, intended for defined linear traffic by vehicles with two primary axles and four primary load wheel contact points on the floor and with corresponding front and rear primary wheels in approximately the same wheel paths.

3.1.2 *levelness*—described in two ways: the conformance of surface elevation data to the mean elevation of a test section, elevation conformance; and as the conformance of survey line slope to a specified slope, RMS levelness.

3.1.2.1 *elevation conformance*—the percentage of surface elevation data, h_i, that lie within the tolerance specified from the mean elevation of a test section from the mean elevation of all data within a test section. The absolute value of the distance of all points, h_i, from the test section data mean is tested against

[1] This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.21 on Serviceability.

Current edition approved Oct. 1, 2022. Published October 2022. Originally approved in 1994. Last previous edition approved in 2014 as E1486M – 14. DOI: 10.1520/E1486M-14R22.

[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.

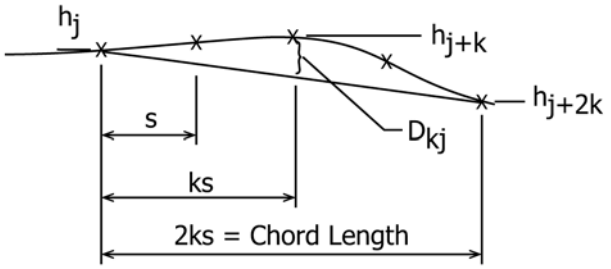

FIG. 1 Explanation of Symbols

the specification, *dmax*. Passing values are counted, and that total is divided by the aggregate quantity of elevation data points for the test section, and percent passing is reported.

3.1.2.2 *RMS levelness*—directionally dependent calculation of the RMS of the slopes of the least squares fit line through successive 4.5 m long sections of a survey line, *L*. The RMS LV_L is compared to the specified surface slope and specified maximum deviation to determine compliance.

3.1.3 *Waviness Index Terms:*

3.1.3.1 *chord length*—the length of an imaginary straight-edge (chord) joining the two end points at *j* and *j* + *2k*. This length is equal to *2ks* (see Fig. 1) where the survey spacing, *s*, is equal to 0.3 m, and where *k* is equal to 1, 2, 3, 4, and 5 to define chord lengths of 0.6 m, 1.2 m, 1.8 m, 2.4 m, and 3.0 m, respectively, unless values for *s* and for *k* are otherwise stated.

3.1.3.2 *deviation (D_{kj})*—the vertical distance between the surface and the midpoint, *j* + *ks,* of a chord of length *2ks* whose end points are in contact with the surface.

3.1.3.3 *length adjusted RMS deviation (LAD_k)*—calculated for a reference length L_r of 3 m, unless otherwise stated, in order to obtain deviations that are independent of the various chord lengths, *2ks.*

3.1.3.4 *waviness*—the relative degree to which a survey line deviates from a straight line.

3.2 *Symbols:*

A = area of test section, m^2.

d = point *i*, of the (4.5/*s* + 1) point subset of *i* = 1 to *imax,* where *d* is a point within the (4.5/*s* + 1) point subset, used to evaluate RMS levelness.

dh_L = number of elevation data points of survey line, *L,* which lie within the maximum allowable deviation from the test section elevation data mean, *dmax*.

D_{kj} = deviation from chord midpoint, *j* + *k,* to the survey line, mm.

$dmax$ = specified maximum allowable deviation from the test section elevation data mean.

EC = percentage of elevation data within a test section complying to a specified maximum deviation, *dmax*, from the mean of all elevation data points within a test section.

EC_L = percentage compliance of each survey line to a specified maximum deviation, *dmax*, from the mean of all elevation data points within a test section.

h_i = elevation of the points along the survey line, mm.

ha_i = elevation of the points along the survey line of the left wheel path of defined wheel path traffic, mm.

hb_i = elevation of the points along the survey line of the right wheel path of defined wheel path traffic, mm.

i = designation of the location of survey points along a survey line (i = 1, 2, 3 . . . $imax_L$).

$imax_L$ = total number of survey points along a survey line.

$imax_{Lx}$ = total number of survey points along one of the pair of survey lines, *Lx*, representing the wheel paths of defined wheel path traffic.

j = designation of the location of the survey point which is the initial point for a deviation calculation (j = 1, 2, 3 . . . $jmax_k$).

$jmax_k$ = total number of deviation calculations with a chord length *2ks* along a survey line.

k = number of spaces of length *s* between the survey points used for deviation calculations.

$kmax_L$ = maximum number (rounded down to an integer) of spaces of length *s* that can be used for deviation calculations for $imax_L$ survey points ($kmax_L$ = 5 unless otherwise specified).

L = designation of survey lines (L = 1, 2, 3 . . . *Lmax*).

LAD_k = length-adjusted RMS deviation based on points spaced at *ks* and a reference length of L_r.

Lg = total number of survey spaces between primary axles of a vehicle used as the basis for longitudinal analysis of each pair of survey lines representing the wheel paths of defined wheel path traffic. *Lg* equals the integer result of the primary axle spacing, in metres divided by *s*.

$Lmax$ = number of survey lines on the test surface.

L_r = reference length of 3 m, the length to which the RMS deviations, RMS D_k, from chord lengths other than 3 m are adjusted.

LD_i = longitudinal elevation difference between corresponding pairs of points separated by *Lg* of defined wheel paths, mm (i = 1, 2, 3 . . . ($imax_L$ − *Lg*)).

LDC_i = incremental change in longitudinal elevation difference, LD_i along defined wheel path traffic wheel paths, mm/m (i = 1, 2, 3 . . . ($imax_L$ − *Lg* −1)).

Lx = designation of the pair of survey lines used for defined wheel path traffic analysis.

mh_d = mean elevation of each 4.5 m section of survey line, *L*, mm (d = 1, 2, 3 . . . ($imax_L$ − 4.5/*s*)).