



Designation: E894 – 23

Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings¹

This standard is issued under the fixed designation E894; 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 procedures to be followed in testing the performance of the anchorage of all types of new and existing permanent metal railing systems (guard, stair, and ramp-rail systems), and rails (hand, grab, and transfer rails) installed in and for agricultural, assembly, commercial, educational, industrial, institutional, recreational, and residential buildings.

1.2 This test method is applicable to railing systems and rails having major structural components made of metal and secondary components made of metal or other materials such as wood, plastics, and glass.

1.3 The test method described can be used to determine whether the anchorage of permanent metal railing systems and rails complies with anticipated performance requirements.

1.4 Specifically, this test method covers procedures for determining the static tension, shear, and moment resistance of anchorages for permanent metal railing systems, and rails in structural elements made of concrete, masonry, wood, and metal as well as related products.

1.5 No consideration is given in this test method to any possible deterioration of anchorage systems, resulting from adverse environmental conditions. The performance of special tests covering this aspect may be desirable.

1.6 Should computations make it possible to provide the needed information, testing may be employed for purposes of verification.

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

1.8 *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. For specific hazard statements, see Section 6.

1.9 *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 Documents

2.1 *ASTM Standards:*²

E4 Practices for Force Calibration and Verification of Testing Machines

E488/E488M Test Methods for Strength of Anchors in Concrete Elements

E575 Practice for Reporting Data from Structural Tests of Building Constructions, Elements, Connections, and Assemblies

E631 Terminology of Building Constructions

E985 Specification for Permanent Metal Railing Systems and Rails for Buildings (Withdrawn 2015)³

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology E631 and Specification E985.

4. Significance and Use

4.1 This test method is intended to provide data from which applicable design data can be derived for a given anchorage.

5. Apparatus

5.1 *Testing Machine*—Any testing machine or loading system capable of imposing forces accurate to within $\pm 1\%$, when calibrated in accordance with Practice E4, is suitable and may

¹ This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.56 on Performance of Railing Systems and Glass for Floors and Stairs.

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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.

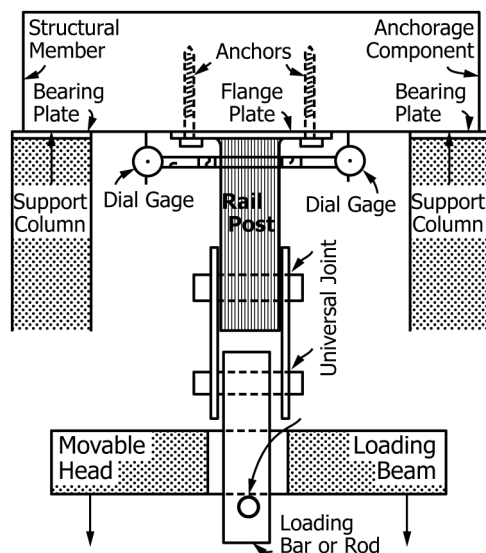
³ The last approved version of this historical standard is referenced on www.astm.org.

be used, provided the requirements of specified rate of loading and recovery are met. The testing device shall be of sufficient capacity to prevent yielding of its various components and shall ensure that the applied tension load remains parallel to the relevant axis of the anchorage assembly and that the applied shear load remains essentially parallel to the surface of the structural anchorage element or component during testing.

5.1.1 *Tension Test*—Suitable systems for applying tension forces to the anchorage assembly are shown in Fig. 1 for laboratory testing and in Fig. 2 for field testing. The bearing plates shall be of sufficient size to prevent failure of the surrounding structural members or components. The loading device shall be attached to the assembly by means of pins or a swivel connector to prevent the direct transfer of bending stresses through the connection.

5.1.2 *Shear Test*—A suitable system for applying shear forces to the anchorage assembly normal to the plane or major axis of the railing is shown in Fig. 3. The loading device shall be of sufficient strength to prevent its yielding during the ultimate capacity tests on the assembly. The bearing plates and connections shall be of sufficient size to prevent local failure of the structural member. The load shall be distributed by means of a load-distribution device which makes it possible for the force to be applied perpendicular to the long axes of the anchors. The bearing plate and other tie-down devices provide a means of holding the anchorage member or component at the required elevation throughout the test. The loading devices shall be of such material as to reduce any damage to the loading contact area of the device to a minimum during application of the shear force and shall be replaced when damaged.

5.1.3 *Flexural Test*—A suitable system for applying tensile forces to the top of the rail post is shown in Fig. 4. The necessary test devices shall fulfill the requirements given in 5.1.2 and be applicable to the flexural test.



NOTE 1—See Test Methods E488/E488M, Fig. 1 for alternative test set-up with a testing machine in the laboratory.

FIG. 1 Diagrammatic Test Set-up for Applying Tensile Force to Rail, Rail Post, Flange Plate, and Flange-Plate Anchors

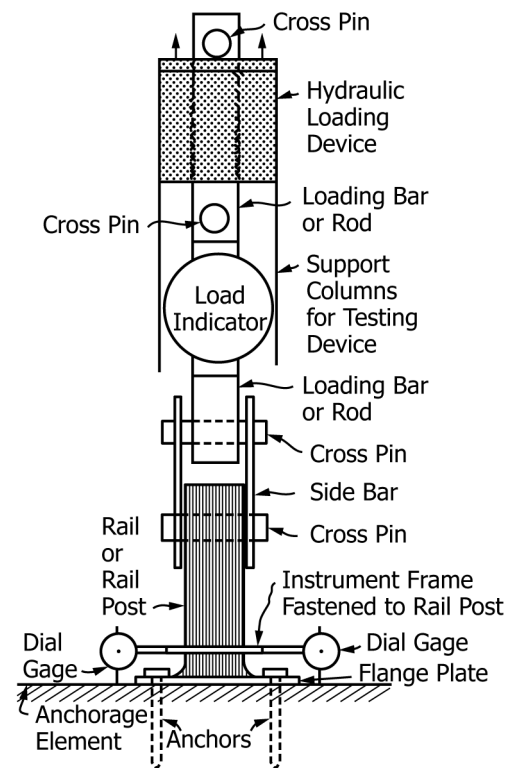


FIG. 2 Diagrammatic Test Set-up for Applying Tensile Force to Rail, Rail Post, Flange Plate, and Flange-Plate Anchors with Field-testing Device

5.2 Anchorage Slip and Railing-System or Rail Deflection Measurements:

5.2.1 *Tension Test*—Two dial gages, having a smallest division of not more than 0.025 mm (0.001 in.), or any suitable measurement device or calibrated sensor of at least comparable accuracy and sensitivity shall be used to measure slip of the anchored system relative to the anchorage elements or components. The purpose of the instruments is to measure the vertical movement of the anchored system with respect to such points on the structural members or components which can serve as reference points without being influenced by the force applied by the anchoring system (see Fig. 1 and Fig. 2). The slip to be used for the evaluation of the findings shall be the average deformation indicated by the two dial gages, measurement devices, or sensors.

5.2.2 *Shear Test*—A single dial gage, having a smallest division of not more than 0.025 mm (0.001 in.), or any suitable measurement device or calibrated sensor of at least comparable accuracy and sensitivity shall be used to measure slip of the anchored system relative to the anchorage elements or components.

5.2.3 *Flexural Test*—A single dial gage for the test shown in Fig. 4, having a smallest division of not more than 0.25 mm (0.01 in.), or any suitable measurement device or calibrated sensor of at least comparable accuracy and sensitivity shall be used to measure the horizontal displacement of the top of the rail post relative to its original location prior to load application.