
Standard Method of Test for Comparative Qualitative Corrosion Characterization of Steel Bars Used for Concrete Reinforcement (Linear Polarization Resistance and Potentiodynamic Polarization Tests)

AASHTO Designation: T 373M/T 373-17 (2021)¹

Adopted with Revisions: 2017 Reviewed but Not Updated: 2021

Technical Subcommittee: 4f, Metals



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This test method describes procedures to evaluate the comparative qualitative corrosion performance of uncoated Corrosion Resistant Reinforcing (CRR) M 334M/M 334 alloy steel bars to those of M 31M/M 31 or other selected reference bars, utilizing electrochemical polarization resistance and potentiodynamic polarization measurements in various test solutions. The test methods evaluate the corrosion performance of the uncoated CRR bars as a function of (1) pH of the environment and (2) concentration of chloride ions, in particular the $[Cl^-]/[OH^-]$ threshold ratio.
- 1.2. *Bars tested in accordance with these test procedures shall be characterized as corrosion-resistant when both of the conditions below are met:*
 - 1.2.1. The ratio of the polarization resistance (R_p) measured at pH = 10 to the polarization resistance measured at pH = 13 is greater than or equal to ($\geq$) 0.5, i.e., $[R_p \text{ at (pH = 10)}]/[R_p \text{ at (pH = 13)}] \geq 0.5$, and
 - 1.2.2. The measured pitting potential is greater than or equal to ($\geq$) 250 mV vs. Ag/Ag Cl reference electrode at a $[Cl^-]/[OH^-]$ ratio equal to 2.
- 1.3. The values stated in either SI or inch-pound units shall be regarded separately as standard. The inch-pound units are shown in brackets. The values stated might not be exact equivalents; therefore, each system must be used independently of the other.
- 1.4. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*
- 1.5. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that*

compliance with [R 18](#) alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of [R 18](#) or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

2. REFERENCED DOCUMENTS

2.1. AASHTO Standards:

- [M 31M/M 31](#), Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
- [M 334M/M 334](#), Uncoated, Corrosion-Resistant, Deformed and Plain Chromium Alloyed, Billet-Steel Bars for Concrete Reinforcement and Dowels
- [R 18](#), Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

2.2. ASTM Standards:

- [G3](#), Standard Practice for Conventions Applicable to Electrochemical Measurements in Corrosion Testing
- [G5](#), Standard Reference Test Method for Making Potentiodynamic Anodic Polarization Measurements
- [G59](#), Standard Test Method for Conducting Potentiodynamic Polarization Resistance Measurements
- [G102](#), Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements

3. TEST EQUIPMENT AND MATERIALS

- 3.1. *Containers*—500-mL capacity polypropylene (PP) beaker, or equivalent. The solutions used are characterized by a high pH value, hence, glass containers shall not be used.
- 3.2. *Voltmeter*—High impedance voltmeter (at least one Mohm), measuring to 0.001 mV.
- 3.3. *Potentiostat*—Potentiostat with 20 V compliance voltage (e.g., Gamry Instruments series G 750).
- 3.4. *Reference Electrode* (i.e., saturated Ag/AgCl reference electrode or Accumet #13-620-52 Calomel Reference Electrode)—The reference electrode should be used with a salt bridge or luggin probe to prevent contamination and to allow it to be placed closer to the working electrode to minimize IR drops at high current densities.
- 3.5. *Conductive Threaded Rod*—316SS or equivalent threaded rod is used to make the electrical connections to the bars.
- 3.6. *Test Solution*—Test solution, compatible with material under test (see Section 5.4 for solution preparation).
- 3.7. *Counter Electrode*—Shall be a noncorrosive mixed oxide coated titanium, platinum or similar material or at least two distinct noncorrosive electrodes placed symmetrically in the vessel.

4. TEST METHOD

- 4.1. *Description of Tests*—Two well-established types of corrosion tests are included Linear Polarization Resistance and Potentiodynamic Polarization curves. This section presents a brief