## Standard Practice for

# Assessment of Corrosion of Steel Piling for Non-Marine Applications

AASHTO Designation: R 27-01 (2019)

Technical Subcommittee: 1a, Soil and Unbound Recycled Materials

Release: Group 3 (July)

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

1.1. This standard practice is focused on corrosion of steel piling for non-marine soil applications.

1.2. This standard practice is divided into two parts: Part I—Environmental Conditions Causing Corrosion of Steel Piling, and Part II—Corrosion Considerations for New and Existing Piling.

1.2.1. Part I of the standard practice describes the current knowledge of the mechanism of underground corrosion to aid the reader in better understanding the controlling factors and identifies the known factors that cause corrosion of piling in non-marine applications.

1.2.2. Part II of the standard practice describes procedures that should be followed to assess the soil corrosivity at a specific site and offers guidance in the selection of corrosion mitigation procedures for new piling installations. Methods are described to evaluate the present condition of existing steel piling. Guidance is provided in the continued use of existing steel piling or reuse of steel piling in new or rehabilitated structures.

1.3. This standard practice does not preclude testing and test methods used to assess design parameters for the placement or continued use of piling.

1.4. Test methods not currently available as AASHTO or ASTM Methods are included in the Appendices of NCHRP Report 408 (Beavers and Durr, 1997).

1.5. *This standard practice may involve hazardous materials, operations, and equipment. This standard practice 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.*

## 2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- T 206, Penetration Test and Split-Barrel Sampling of Soils
- T 207, Thin-Walled Tube Sampling of Soils
- T 255, Total Evaporable Moisture Content of Aggregate by Drying
- T 291, Determining Water-Soluble Chloride Ion Content in Soil

2.2. *ASTM Standards*:

- D512, Standard Test Methods for Chloride Ion in Water
- D516, Standard Test Method for Sulfate Ion in Water
- D1452/1452M, Standard Practice for Soil Exploration and Sampling by Auger Borings
- D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)
- D4220/4220M, Standard Practices for Preserving and Transporting Soil Samples
- D4972, Standard Test Method for pH of Soils
- G51, Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing
- G57, Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method

## 3. SIGNIFICANCE AND USE

3.1. This standard practice identifies the factors that cause corrosion of steel piles subjected to subsurface, non-marine environment in underground conditions. It provides procedures to assess the corrosion potential of the piles and offers recommendations on the ways to mitigate the corrosion. By determining the existing condition, the remaining life of the piles can be predicted.

# PART I—ENVIRONMENTAL CONDITIONS CAUSING CORROSION OF STEEL PILING

## 4. MECHANISM OF UNDERGROUND CORROSION

4.1. Corrosion of structural steel in soils is electrochemical in nature. When steel corrodes, the iron atoms in the steel undergo oxidation and lose electrons (Equation 1). Other components in the soil are reduced and gain the lost electrons (some combination of Equations 2, 3, and 4). The electrochemical reaction associated with oxidation is the anodic reaction and the electrochemical reaction associated with reduction is the cathodic reaction. The sites where the anodic and cathodic reactions take place are termed the anode and cathode, respectively. The combination of the anode and the cathode, coupled with current flow between the two, is called a corrosion cell.

4.2. Figure 1 is a schematic of a corrosion cell. As shown in Figure 1, the electrons produced by the oxidation reaction flow from the anode to the cathode in the steel where they are consumed by the reduction reaction. Note that the direction of current flow is opposite to the direction of electron flow since, by definition, current is the flow of positive charge. In the soil, current must flow from the anode to the cathode to maintain charge neutrality. Current flow in the soil is carried by ions, moving through the water in pore spaces between the soil particles.