



STORAGE TANK DIVISION

SUBJECT: Cathodic Protection Testing Criteria	DATE: 01/18/01	Operational Memorandum No. 18 Page 1 of 5
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This Operational Memorandum is intended to provide guidance to owners/operators (O/O), and cathodic protection testers regarding the testing of cathodic protection systems of underground storage tanks (USTs) and/or the attached underground piping, as required in the Michigan Underground Storage Tank Rules (MUSTR), 1999 AACS R 29.2101 et seq.

General Information About Cathodic Protection

Cathodic protection is the utilization of the electrical properties of corrosion of metallic substances to provide a system for the protection of steel USTs, metallic piping or any other buried metallic structure, to extend their useful life (in other words to prevent USTs from rusting). There are two types of cathodic protection, galvanic protection and impressed current.

A **galvanic cathodic protection system** for USTs, consists of sacrificial anode(s) fixed to the UST during manufacturing of the UST, and provides specified wiring for an inspection station installed near the surface of the ground. Galvanic systems have limited life spans during which the sacrificial anode will continue to degrade and protect the tank or piping. When the sacrificial anodes are no longer capable of protecting the tank or piping, they will lose their protection and begin to corrode.

The **impressed current cathodic protection system** usually provides electrodes of a much longer life span than a sacrificial anode. These systems include a rectifier that converts the alternating current power source to a direct current, that is properly calibrated to provide the required protection. Since the power source is delivered to the electrode and is not generated by the degradation of the electrode, the power supply to the electrode may be re-calibrated to provide additional power, when needed, as long as the electrodes are still functional.

Cathodic Protection Testing Requirements

The MUSTR provides the requirements for cathodic protection testing. These sections and definitions from MUSTR relate specifically to cathodic protection and recordkeeping.

Section 280.31. All O/Os of steel UST systems with corrosion protection must comply with the following requirements to ensure that releases due to corrosion are prevented for as long as the UST system is used to store regulated substances.

- (a) All corrosion protection systems must be operated and maintained to continuously provide corrosion protection to the metal components of that portion of the tank and piping that routinely contain regulated substances and are in contact with the ground.
- (b) All UST systems equipped with cathodic protection systems shall be inspected for proper operation by a qualified cathodic protection tester in accordance with the following requirements.
 - (1) Frequency. All cathodic protection systems shall be tested upon completion of underground piping, tank installation, and backfilling, but before placement of any permanent or hard surface over the UST system. Testing shall be done within six months of installation regardless of the surface over the UST system. Testing shall also be conducted every three years after the initial testing.
 - (2) Inspection criteria. The criteria that are used to determine that the cathodic protection is performing adequately shall be specified by the corrosion expert who designs the system. If the corrosion expert does not specify a criteria, then the criteria shall be as specified in National Association of Corrosion Engineers (NACE) International recommended practice RP-02-85-94.
- (c) All UST systems with impressed current cathodic protection systems must be inspected every 60 days to ensure that the equipment is running properly.

The above section provides the requirements for cathodic protection testing frequency. The criteria for testing is specified by the corrosion expert who designs the system. In the absence of criteria from the designer of the system, the criteria to be used are those specified in the NACE recommended practice RP 02-85-94. In addition, an impressed current system must be checked every 60 days to make sure the rectifier for the impressed current system is turned on and operational.

Section 280.12 of the MUSTR provides definitions of a corrosion expert and cathodic protection tester as follows.

Corrosion Expert – means a person who, by reason of thorough knowledge of the physical sciences and the principals of engineering and mathematics acquired by a professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metal piping systems and metal tanks. The person shall be certificated as being qualified by the NACE International as a senior corrosion technologist, a cathodic protection specialist, or a corrosion specialist or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metal piping systems and metal tanks.

Cathodic Protection Tester – means a person who can demonstrate an understanding of the principals and measurements of all common types of cathodic protection systems as applied to buried or submerged metal piping and tank systems and who has education and experience in soil resistivity, stray current, structure-to-soil potential, and component electrical isolation measurements of buried metal piping and tank systems. The person shall be certificated as being qualified by NACE International, Steel Tank Institute (STI), or any other organization that is acceptable to the department.

Records of testing and inspection of cathodic protection systems must demonstrate compliance with the testing criteria specified by the corrosion expert or corrosion engineer that designed the cathodic protection system.

Steps that were followed in arriving at whether the cathodic protection system is or is not performing adequately to protect the UST system against corrosion must be included in the documentation. This documentation must provide enough information about the testing that any qualified cathodic protection tester would be able to perform the same steps and arrive at the same conclusion, when performing the test within a reasonably short period of time. These steps must also provide an adequate number of measurements that will properly determine the adequacy of the protection provided. A simple statement to the effect that the system “passed” or did not “pass” the test is not adequate documentation for a cathodic protection system test.

For impressed current testing, the measurements should include potential (voltage) measurements made at appropriate and adequate locations in both the current-on and current-off status. These measurements must be made relative to a copper-copper sulfate reference electrode (CSE). The current-off (instant-off) measurements indicate whether the -0.85 volt criterion has been met or what is the starting point for the 100-millivolt polarization decay measurement. If the -0.85 volt current-off criterion is not met, then voltage readings tracking the polarization decay should also be conducted and recorded, unless native potential readings are available to establish that the 100-millivolt polarization change criterion has been met. Experimental results have shown that stress corrosion cracking is potential dependant, and a potential more negative than 1.1 volts may be detrimental where corrosion cracking is initiated, and a highly

negative potential can also produce hydrogen induced cracking under some soil conditions. This high negative potential will also increase the possibility of cathodic disbondment damage to protective coating. Therefore, a potential more negative than -3.0 volts is not acceptable without strong documentation of the electrochemical justification for a site-specific application.

For galvanic systems, current-on measurements are the only option possible because the anodes are permanently attached. The current-on measurements indicate the distribution of current on the structure and where the weak spots in terms of protection may be located.

Both galvanic and impressed current system testing must include continuity determination measurements. In addition, voltage measurements at a minimum for a standard-sized motor fuel tank should be made with the reference cell in at least three locations: one with the reference cell at one end of the tank, one at the other end, and one in the middle. Also, voltage measurements shall be made for each ten feet of tank or piping length.

Cathodic Protection Recordkeeping Requirements

The MUSTR provides the following requirements for cathodic protection recordkeeping.

Section 280.31(d) – For UST systems using cathodic protection, records of the operation of the cathodic protection must be maintained (in accordance with Section 280.34) to demonstrate compliance with the performance standards of this section. These records must provide the following:

- (1) The results of the last three inspections required in Section 280.31 (c); (see page 2) and:
- (2) The results of testing from the last 2 inspections required in Section 280.31 (b) (see page 2).

Section 280.34(b) Recordkeeping. Owners and operators shall maintain the following information:

- (1) Documentation of operation of corrosion protection equipment (Section 280.31 (b)(2)).
- (2) Documentation of UST system repairs. (Section 280.31 (b)(3)).

This section relates to the type and duration of the recordkeeping required for a cathodic protection system. All records related to corrosion protection upgrades are required to be kept by the O/O for the remaining operational life of the UST system. In addition, records of any repairs or replacement of any components of a cathodic protection system are required to be maintained by the O/O for the remaining operational life of the UST system.

The reporting format for the cathodic protection tests is not specified in this operational memorandum, and it is left to the professional judgement of the qualified cathodic protection tester.

This document is not intended to convey any rights to any parties, nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Questions concerning this memorandum should be directed to the Technical Review Unit staff.

Responsibility for periodic review and revisions of this memorandum lies with the Chief of the Technical Review Unit.

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