



NACE Standard RP0178-2003  
Item No. 21022

## Standard Recommended Practice

# Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to Be Lined for Immersion Service

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## Foreword

When specifying tanks for immersion service that are to be internally lined to control corrosion and prevent product contamination, special design, fabrication details, and surface finishing requirements must be taken into consideration to obtain the desired performance of these linings. As the corrosiveness of the product increases, the design of the vessel becomes more critical, relative to the performance of the lining.

This standard is issued to present recommended practices for the design, fabrication, and surface finish of metal tanks and vessels that are to be lined for corrosion resistance and to prevent product contamination. The standard explains how the suggested practices govern the quality of lining applications. The intended audience includes, but is not limited to, owners, specifiers, fabricators, and inspectors. Appendix A depicts both good and bad design practices on tanks, while Appendix B contains a list of suggested responsibilities for the coating applicator to ensure the best protective coating available. Appendix C is a visual and written description of the degree of surface preparation of welds in tanks and vessels prior to lining.<sup>(1)</sup>

The written descriptions of the various degrees of surface preparation of welds in Appendix C of this standard take precedence over the graphics and the companion visual comparator. The graphics are only pictorial representations of welds and grinding finishes and are not intended to be representative of the integrity of the welds. The "as is" original weld is not a typical weld; it is only intended to illustrate defects in welds that must be corrected prior to coating and lining.

Good welding practices and welding codes govern the integrity of the weld; this standard only addresses surface preparation of the welds for the purpose of coating and lining for immersion service.

This standard recommended practice was originally prepared in 1978 by NACE International Task Group T-6A-29, a component of Unit Committee T-6A on Coating and Lining Materials for Immersion Service, in collaboration with Unit Committee T-6H on Application and Use of Coatings for Atmospheric Service. The standard was revised in 1989 by Task Group T-6G-27, a component of Unit Committee T-6G on Surface Preparation for Protective Coatings, and was reaffirmed in 1991 and 1995. The standard was reaffirmed in 2003 by Specific Technology Group (STG) 04 on Protective Coatings and Linings—Surface Preparation. The standard is issued by NACE International under the auspices of STG 04.

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<sup>(1)</sup> The visual comparator mentioned in Appendix C is a molded plastic replica that illustrates various degrees of surface finishing for welds prior to coating or lining. Full-seam welds, skip welds, butt welds, lap welds, and others are depicted. For more information contact the NACE Membership Services Department, 1440 South Creek Drive, Houston, TX 77084-4906.

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NACE gratefully acknowledges the contributions of the following companies in the preparation of the welding samples and the fabrication of the die from which plastic replicas have been molded:

- Ausimont,<sup>(2)</sup> Thorofare, NJ
- CenterPoint Energy,<sup>(3)</sup> Houston, TX
- S.G. Pinney & Associates Inc.,<sup>(4)</sup> Port St. Lucie, FL
- The Sherwin-Williams Company,<sup>(5)</sup> Cleveland, OH

NACE also gratefully acknowledges the assistance of KTA-Tator Inc.,<sup>(6)</sup> Pittsburgh, PA, in developing the weld pattern that was used to mold the plastic replica of weld samples.

In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 4th ed., Paragraph 7.4.1.9. *Shall* and *must* are used to state mandatory requirements. The term *should* is used to state something good and is recommended but is not mandatory. The term *may* is used to state something considered optional.

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## Section 1: General

### 1.1 Scope

This standard provides requirements for the design, fabrication, and surface finish of tanks to be lined for immersion service. Tanks may be lined for corrosion control or to prevent product contamination. Appendix B lists suggested

responsibilities of the purchaser (user), fabricator, and lining applicator regarding design specifications and inspections.

1.2 The recommended practices in this standard can also be used in the design, fabrication, and surface finish of tanks or vessels for services other than immersion, such as dry bulk storage of solid materials.

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## Section 2: Definitions

**Lining:** A coating or layer of sheet material adhered to or in intimate contact with the interior surface of a container used to protect the container against corrosion by its contents and/or to protect the contents of the container from contamination by the container material. For the purposes of this standard, *lining* refers to a surface barrier, usually a thin film less than 500  $\mu\text{m}$  (20 mils) thick applied as either a lining or a coating. In common usage, the terms *coatings* and *linings* are interchangeable, but in this standard, only the term *linings* is used. The requirements contained herein may or may not apply to heavier, thick-film coatings, sheet linings,

trowel-applied and shotcreting finishes, plasma, flame-sprayed coatings, fiber-reinforced plastic linings, or similar lining materials.

**Surface Finish:** The degree of smoothness of a surface produced by the removal of sharp edges and the appropriate surface preparation of welds and other rough areas. The term *surface finish* is also used to characterize the degree of smoothness that is necessary to attain a surface to which the lining can be applied satisfactorily in accordance with the lining specification.

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## Section 3: Design Requirements

### 3.1 Accessibility

3.1.1 All surfaces of the tank interior shall be readily accessible for surface preparation and lining application (see Appendix A, Figures A1 through A10).

3.1.2 The manway diameter for working entrance and safety reasons during the lining application shall be as large as practical for the vessel being lined.

3.1.2.1 If possible, at least one manway shall be located near ground (work) level, except in tanks designed to be buried below grade.

3.1.3 Additional manways and openings should be provided as needed to facilitate ventilation. These must meet safety requirements.

### 3.2 Joints

3.2.1 Butt-welded joints shall be used whenever possible (see Appendix A, Figure A5).

3.2.2 Rivets shall not be used.

3.2.3 The use of internal bolted connections shall be avoided.

3.2.4 Continuous lap-welded joints are permissible but not preferred. For sheet lining material, this type of construction may not be acceptable.

### 3.3 Connections

3.3.1 All connections to the tank shall be flanged.

3.3.2 Threaded connections shall not be used in vessels operating in corrosive environments (see Appendix A, Figure A4). If threaded connections cannot be avoided in corrosive environments, these parts shall be fabricated of corrosion-resistant materials, or constructed as shown in Figure A10.

3.3.2.1 CAUTION: Dissimilar metal (galvanic) corrosion occurs when, for example, an alloy is used to replace the steel bottom of a tank, or in a similar circumstance when alloy appurtenances must be part of the construction of the vessel. If a lining is then applied to the steel and part of the alloy (usually 15 to 61 cm [5.9 to 24 in.]), any discontinuity in the lining exposes a small anode surface. Once corrosion starts, it progresses rapidly because of the large exposed alloy cathodic area to the much smaller anodic area. Without the lining, galvanic corrosion causes the steel to corrode at the weld area, but at a much slower rate. The recom-