



NACE Standard RP0304-2004  
Item No. 21103

## Standard Recommended Practice

# Design, Installation, and Operation of Thermoplastic Liners for Oilfield Pipelines

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## Foreword

Thermoplastic liners for pipelines are being specified with increasing frequency to protect new and rehabilitated pipelines in corrosive oilfield services. Thermoplastic liner systems are described in NACE Publication 35101.<sup>1</sup> The Plastics Pipe Institute (PPI)<sup>(1)</sup> has published a report on pipeline rehabilitation by sliplining with polyethylene pipe.<sup>2</sup> Svetlik has reviewed tight-fitting liner technologies in an ASTM<sup>(2)</sup> report.<sup>3</sup> The Canadian Standards Association<sup>(3)</sup> has also addressed thermoplastic liners.<sup>4</sup> Some oil and gas companies have developed internal standards and specifications. This standard recommended practice is not intended to replace existing national or corporate standards and requirements based on specific local experience. It is intended to provide a foundation for proper use of thermoplastic liners in cases where there is no established standard. This standard is intended for use by liner installers, owners of lined pipelines and pipelines that might at some point need a liner, liner materials suppliers, and consultants and engineering firms engaged in the subject field.

The growth of interest in liners is fueling the emergence of installation contractors engaged in supplying liners for oil company operator owners. If the owner has internal specifications and performance requirements that must be met by the contractor, or if the contractor is experienced and has expertise in all aspects of liner design and installation, it is likely that the right choices will be made and the lined pipeline will operate successfully for the designed lifetime. This case implies the participation of companies with substantial technical resources that can be brought to bear on the project. Successful implementation of a lined pipeline system requires experience and expertise on the part of both the installer contractor and the operator.

The intent is that project specifications be developed based on this standard. It provides a common design basis consistent with best engineering practices. It is to the benefit of liner users and installers to have a standard for liner design, installation, and operation to help ensure that the installed product meets performance expectations. This standard represents minimum requirements and should not be interpreted as a restriction on the use of better procedures or materials.

This standard was prepared by NACE Task Group (TG) 037 on Thermoplastic Liners for Oilfield Pipelines. TG 037 is administered by Specific Technology Group (STG) 03 on Protective Coatings and Linings—Immersion/Buried, and is sponsored by STG 10 on Materials Applications, STG 33 on Oil and Gas Production—Nonmetallics and Wear Coatings (Metallic), and STG 35 on Pipelines, Tanks, and Well Casings. This standard is published under the auspices of STG 03 on Protective Coatings and Linings—Immersion/Buried.

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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<sup>(1)</sup> Plastics Pipe Institute, Inc. (PPI), 1825 Connecticut Avenue, NW, Suite 680, Washington, DC 20009.

<sup>(2)</sup> ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

<sup>(3)</sup> Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, ON L4W 5N6 Canada.

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## Section 1: General

1.1 This standard defines the process necessary to design, install, and operate a thermoplastic-lined oilfield pipeline. The design process includes an assessment of the service conditions, materials, chemical compatibilities of liner materials with any service fluids and additives, pipeline geometry, and risk analysis. The installation process includes site surveys, pipeline preparation, insertion, termination, pressure testing, reburial, and safety. Operation of a lined system must take into consideration the service fluids, materials of construction, safety, commissioning, normal operation, depressuring, and upset conditions.

1.2 This standard is not intended to replace detailed procedures specific to the particular installation method developed by installers, nor is it intended to replace pipeline operating instructions developed by operators. It is intended to set a standard for performance within the scope of these procedures and instructions. This standard is not applicable to thermoplastic pipes, often referred to as *liners*, that are required to contain the pressure of the service without the

host pipe. This standard is not intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances.

1.3 In plastic-lined steel the corrosion/erosion resistance of the inner plastic pipe and the strength/mechanical durability of the metal case are both exploited. This allows for design pressures equal to those of the host pipe.

1.4 The subject liners are installed in the field after the steel pipeline is completed. The liners may be installed in new pipelines, or in existing pipelines for rehabilitation purposes. The liners consist of a free-standing thermoplastic pipe that is inserted into the existing steel host pipe and is designed in such a way that the liner pipe does not require the use of a third material to fill any gaps between the liner and the host pipe. The liner pipe is designed to remain in close contact with the host pipe during operation.

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## Section 2: Definitions

**Annulus:** The interstitial space between the liner outer wall surface and the inside wall surface of the host pipe.

**Buckling:** The onset of elastic instability of the liner which can usually be calculated using known materials properties. Collapse may follow quickly after buckling.

**Collapse:** The large-scale deformation of a liner usually resulting in reduced flow capacity and damage to the liner. Collapse often results in a U-shaped cross-section of the liner.

**Critical buckling pressure ( $P_{crit}$ ):** The external pressure applied to a liner sufficient to initiate structural buckling.

**Expansion:** Increasing the diameter of the inserted liner so that it is in contact with the interior surface of the host pipe.

**Fusion:** The process of joining lengths of liner by melting the plastic at the joint. It also refers to the fusion joint.

**Host pipe:** The existing rigid pipe which may be steel or composite.

**Installer:** A contractor specializing in liner insertion and termination.

**Interference fit:** See *Tight fit*.

**Joint:** A length of liner when it is provided as straight pieces.

**Liner:** The plastic pipe inserted into the host pipe.

**Liner manufacturer:** The party that converts thermoplastic polymer material into liner pipe to be used by the installer.

**Loose fit:** A liner design case in which the pre-insertion liner outside diameter (OD) is smaller than the host pipe inside diameter (ID). A description can be found in "Pipeline Rehabilitation by Sliplining with Polyethylene Pipe."<sup>2</sup>

**Material supplier:** The party that manufactures the polymer material used to make the liner supplied to the installer. In some cases the liner extrusion company serves in the materials supplier role, as described in this standard.

**Neutral fit:** A liner design case in which the pre-insertion liner OD is the same as the host pipe ID.

**Owner:** The party ultimately contracting with the installer for the liner, and who has long-term responsibility for the lined pipeline.

**Pull head:** A special piece of equipment, usually made from the same polymer as the liner, containing a secure attachment point.

**Sizing plate:** A pipeline inspection device with an accurate known OD, that is normally pulled through the host pipeline prior to liner insertion, for the purpose of determining the minimum ID within the host pipe.