Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels

API RECOMMENDED PRACTICE 5LW
THIRD EDITION, SEPTEMBER 2009

REAFFIRMED, MAY 2015

AMERICAN PETROLEUM INSTITUTE

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Upstream Segment

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Contents

Introduction

This recommended practice (RP) shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution. This RP is under the jurisdiction of the API Subcommittee on Standardization of Tubular Goods. Line pipe shipments on inland and marine waterways should be designed to assure that the pipe will arrive at the destination undamaged. The minimum mandatory rules in force for such shipments shall be followed. The rule of governing regulatory agencies shall be considered as basic, with the recommendations given herein as supplementary thereto. These supplementary recommendations are the result of line pipe shippers' experience that damage to the pipe during shipment can consist of three principal types as follows.

a) End Damage—End damage to pipe can occur during loading and unloading, or from a longitudinal load shift against a bulkhead or an adjacent pipe.

b) Abrasions or Peening—These result from a rubbing or pounding action against some protrusion such as the weld reinforcement of the adjacent pipe. This condition may result in initiation of fatigue cracks at the damaged areas during transit.

c) Longitudinal Fatigue Cracks—These are initiated in the pipe by vertical cyclical forces with no apparent local abrasion or denting. Fatigue cracks result from a combination of static and cyclic stresses produced by the weight of upper layers of pipe and/or other cargo giving a static load, and a cyclic load caused by the vertical movement.

The third edition of this RP incorporates revisions in light of an identification of inaccuracies in the equations for static load stress, which were derived by numerical methods decades ago. These inaccuracies were discovered when finite element analysis methods were used to check the equations. API is working to update and revise these equations for a future edition. Notwithstanding these inaccuracies, there have been no confirmed transit fatigue failures reported in pipe loaded in accordance with previous editions of this document.

Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels

1 Scope

The recommendations in this document apply to transportation of API Specification 5L steel line pipe by ship or barge on both inland and marine waterways, unless the specific requirement of a paragraph in this document references only marine or only inland waterway transport. Inland waterways are defined as those waterways with various degrees of protection, such as rivers, canals, intracoastal waterways, and sheltered bays. These waterways can be fresh or saltwater but are usually traversed by barges. Marine waterways are defined as waterways over open seas with limited or no protection from wind, current, waves, and the like. These areas are normally traversed by sea-going vessels. These recommendations apply to steel line pipe that has 2 3/8-in. outside diameter (OD) and larger.

These recommendations cover coated or uncoated pipe, but they do not encompass loading practices designed to protect pipe coating from damage. These recommendations are not applicable to pipe-laying vessels or supply vessels. They must be considered as supplementary to the existing rules of governing agencies.

These recommendations are supplemental to shipping rules for the convenience of purchasers and manufacturers in the specification of loading and shipping practices and are not intended to inhibit purchasers and manufacturers from using other supplemental loading and shipping practices by mutual agreement.

2 Acronyms, Abbreviations and Symbols

D	specified outside diameter
GMAW	gas metal arc welding
OD	outside diameter
SAW	submerged arc welding
t	specified wall thickness

3 General Requirements

3.1 Vessel Condition

Cargo compartments should be reasonably free from any foreign objects or material likely to cause either physical damage, contamination, or chemical reaction with the pipe.

The bilge pumping system shall be in working order to remove standing water from the cargo hold.

3.2 Shipping Space

Pipe may be laid longitudinally or athwart the vessel to make the best use of available space. A clearance of 1 ft must be left between the ends of the pipe and the vessel (or other cargo) to facilitate unloading. Dimensions of hatchways should be large enough to allow the pipe to pass in a horizontal position unless special precautions are taken.

3.3 Handling Equipment

When end hooks are used for handling pipe, they shall be designed to prevent end damage and should be lined in the area of land (bevel face) contact with a cushioning material (e.g. a nonmetallic material such as rubber or a metallic material such as aluminium, but brass or copper shall be excluded). These hooks shall also have sufficient width and depth to fit the internal curvature of the pipe. Rubber aprons should be attached to pipe hooks to protect the pipe ends unless adequate end protectors are used. Lifting shall be carried out in such a manner that impact loads sufficient to

cause local denting or out-of-roundness of pipe body or pipe ends will not occur. When the pipe is loaded by loose lifts, all necessary precautions shall be taken during loading and unloading to prevent surface or other damage to the pipe.

3.4 Stacking Arrangement

3.4.1 Stowage

When stacking, one should consider the maximum weight that the bottom layer of pipe can withstand before deformation will occur. Short lengths should be placed on the top of the stack.

Pipe in the hold of a vessel during marine shipments shall be cantline stowed.

Cantline stowage shall be defined as stowage without separator strips (e.g. nesting or pyramid fashion) but including wood blocking every other tier on both sides of the hull as illustrated in Figure 1. If the top tier is a partial load, separator strips shall be used to secure additional blocking, which is used to secure the top tier of pipe.

For inland waterway transit, pipe may be cantline stowed, or separator strips may be used between successive tiers of pipe.

Loaded pipe shall not contact the sides or bottom of the vessel. However, each length of pipe shall be in contact throughout its entire length with all adjacent pipe or blocking, and precautions should be taken to minimize any lateral movement.

Pipe with filler metal weld seams (SAW and GMAW) shall be positioned or padded in such a manner that the weld does not contact the blocking or adjacent pipe. When horizontal stripping (permissible only for transportation on inland waterways) is used to load pipe with longitudinal seam welds made with filler metal (SAW and GMAW), the weld seam shall be positioned at 45°, ± 5°, from vertical. When nested, pipe with longitudinal seam welds made with filler metal (SAW and GMAW) shall be positioned with the seam at 0 ° (in other words, 12 o’clock).

3.4.2 Loading on Deck

The pipe shall be placed on a horizontal surface, and the building of a wooden floor is recommended to eliminate contact of the pipe with metallic protrusions and to compensate for inclined planes. There shall be a sufficient number of stanchions for the pipe to rest against. If the stanchions are metallic, wood or rubber strips shall be interposed between them and the pipe. Stowing cables or chains shall be isolated from any contact with pipe through a protection medium such as rubber strips. During transportation, the tension of stowing cables or chains should be checked daily.

3.5 Bearing and Separator Strips

Wood-bearing and separator strips shall be a minimum size of 1 in. × 2 in. Metallic-bearing strips are prohibited. Bearing strips shall be used to keep the bottom layer of pipe above the hold bottom. The spacing of these strips should be as small as necessary but no greater than 4 ft and at least four bearing strips per pipe stack must be used unless otherwise agreed as allowed in Section 4. For inland-waterway shipments, horizontal separator strips may be used when the pipe is not nested. These horizontal strips should be located directly above the bottom bearing strips.

Additional blocking, if necessary, shall be used to minimize lateral movement of pipe.

3.6 Side Protection

To prevent stress concentrations, wooden side-bearing strips or wood blocking shall be provided to prevent contact with the hull of the vessel or any protrusion.

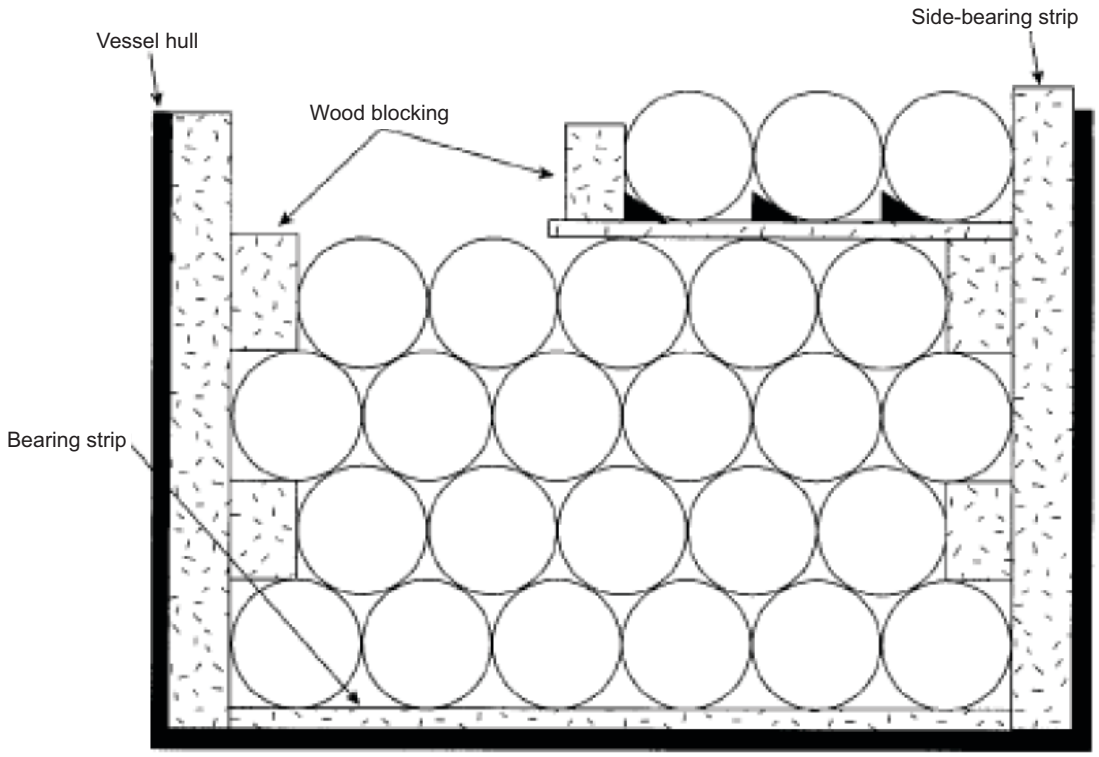

Figure 1—Cantline Stowage

3.7 Inspection

3.7.1 General

Purchaser's inspector shall have access to loading and unloading facilities, with reasonable advance notice of loading and unloading.

3.7.2 Loading

Damaged pipe shall not be loaded on board. If damaged pipe is detected on board, it should be noted on the bill of lading and the pipe marked by the carrier to indicate pretransit damage.

3.7.3 Unloading

Pipe damage detected during transit or unloading should be promptly reported to the carrier and/or manufacturer and appropriately marked and set aside for further inspection.

4 Transit Fatigue

Transit fatigue has been reported in pipe with diameter-to-thickness ratios as low as 12.5 and in line pipe grades from Grades B through X70 [1]. Cracks have been found at three general locations: along the edge of submerged-arc welds; in the pipe base metal at areas of denting, metal-to-metal contact, or abrasion; and at the pipe ends.

The variables that influence transit fatigue include the magnitude of the static stress, the number and magnitude of the cyclic stresses, the size of the contact area, the nature of the bearing surface, the degree of surface damage, and the ambient environment. Contact with hard surfaces, such as nailheads, bolts or other debris, steel stanchions, wire

cables, and so forth, can lead to transit fatigue even when stresses are properly controlled. Corrosive atmospheres such as might be encountered in humid coastal or industrial areas can accelerate fatigue damage.

Transit fatigue generally causes multiple cracks emanating from the area of surface contact. A distinctive feature of transit fatigue is that cracks will usually be found at both the inside and outside surfaces.

In order to minimize the possibility of fatigue damage on pipe having a D/t ratio of 50 or more, consideration shall be given to both the static and dynamic forces that act upon the pipe during transportation. The dynamic stress induced in the pipe is dependent on the height of the waves, the speed of the vessel, the length of the vessel, the response of the vessel to the water surface, and the location of the pipe along the axis of the vessel.

Pipe shall be loaded in accordance with loading procedures that minimize risk of transit fatigue. The procedures may be based on the items below.

a) Analyses of the static and dynamic stresses, number of stress cycles, and other variables that influence fatigue.

b) Practices that can be documented as being effective in preventing transit fatigue. Documentation shall include shipping records for pipe of the same diameter and similar grade and wall thickness as covered by the procedure.

c) Other practices that are mutually agreed between the purchaser and supplier.

Bibliography

[1] T.V. Bruno, “How To Prevent Transit Fatigue To Tubular Goods,” *Pipe Line Industry*, July 1988, pp 31 to 34

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