Recommended Practice for Railroad Transportation of Line Pipe

API RECOMMENDED PRACTICE 5L1
SEVENTH EDITION, SEPTEMBER 2009

REAFFIRMED, MAY 2015

AMERICAN PETROLEUM INSTITUTE

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Upstream Segment

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Contents

Introduction

API Recommended Practice (RP) 5L1 is under jurisdiction of the API Subcommittee on the Standardization of Tubular Goods. Line pipe shipped by rail is loaded either in gondola cars or on flatcars. In either case, the loading practice shall be designed to assure that pipe, when transported under normal conditions by all rail carriers involved, will arrive at the destination undamaged. These supplementary recommendations have resulted from experience of the shippers of line pipe showing that damage to pipe during rail shipments consists of the three principal types listed below.

a) End Damage—Pipe end damage can result from longitudinal shifting of the load into the end of the car body or the pipe pile on an adjacent car.

b) Abrasions or Peening—These result from rubbing or pounding action against some protrusion, such as weld reinforcement of adjacent pipe or a rivet head in the car bottom or side wall. This condition may also be followed by the initiation of fatigue cracks at the damaged areas during transit.

c) Longitudinal Fatigue Cracks—Longitudinal fatigue cracks can be initiated in the pipe by vertical vibrations and forces, repeated many times during long rail trips. These fatigue cracks are the result of a combination of static and cyclic stresses produced by the static load of upper layers of pipe and a cyclic load caused by the vertical movement of the transportation equipment. Fatigue cracks are often associated with local abrasion or denting but may arise with no apparent surface damage.

The seventh 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 Railroad Transportation of Line Pipe

1 Scope

1.1 General

The recommendations provided herein apply to the transportation on railcars of API 5L steel line pipe in sizes 2 3/8 and larger in lengths longer than single random. These recommendations cover coated or uncoated pipe, but they do not encompass loading practices designed to protect pipe coating from damage.

1.2 Basic Rules and Requirements

Certain minimum mandatory rules governing the loading practices are prescribed by the Association of American Railroads (AAR) as referenced in the next section.

The recommendations given herein are supplementary to the AAR loading practices. If any recommendations are in conflict with AAR loading practices, those of AAR shall govern.

NOTE If the AAR loading rules are not applicable to the railroad transportation of line pipe in the country of origin, the basic loading practice shall be as prescribed in the applicable nationally recognized loading rules and requirements for the type of railroad cars used in the country of origin and that document becomes the reference to which these supplementary recommendations apply.

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

2 References

The following referenced documents are indispensable for the application of this document. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Specification 5L, *Specification for Line Pipe*

AAR [1], *General Rules Governing the Loading of Commodities on Open Top Cars*

AAR, *General Rules Governing the Loading of Pipe on Open Top Cars*

3 Acronyms, Abbreviations, and Symbols

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

[1] Association of American Railroads, 50 F Street, NW, Washington, DC 20001, www.aar.org.

4 General Requirements (for All Pipe Sizes 2 3/8 and Larger)

4.1 Railcar Condition

Cars used to ship pipe shall be reasonably free of all foreign materials, particularly those of such size and hardness that could damage pipe during shipment by abrasion or that could contribute to movement of the pipe in the car during shipping or humping. Cars that have metallic protrusions on the bed or sides (such as bent or torn parts) that would require excessive thickness of bearing strips or of side stakes to prevent contact of the protrusion with the pipe during shipment shall not be used.

4.2 Bearing Strips and Blocking

Metallic bearing strips are prohibited. Side protection shall be provided for pipe shipped in gondola cars where the pipe may contact the sides of the car. Blocking, where required because of uneven car sides, should be introduced between car sides and stakes, and firmly attached to stakes.

The thickness of the bearing strips shall be sufficient to prevent the pipe from touching the bed or protrusions thereon, but in no case less than 2 in. (50 mm) nominal thickness and 4 in. (100 mm) nominal width. Furthermore, the following situations shall require 2 in. (50 mm) nominal thickness and 6 in. (150 mm) nominal width for bearing strips, except where AAR stipulates greater dimensions: pipe size $\geq$ 6 floating loads, and pipe size $\geq$ 20 in. loads other than floating. Strip height shall not exceed strip width. A minimum of four bearing strips shall be used, and an even number of bearing strips should be used for each pipe stack. Bearing strips shall be evenly spaced.

The bearing strips shall be aligned so that the load on individual bearing members is not excessive. All intermediate bearing members should be level with respect to the end bearing members within approximately 1/2 in. for pipe of size 6 5/8 to size 16 exclusive, and within approximately 1/4 in. for pipe of sizes 16 and larger or for any pipe having a D/t ratio of 50 or more. The blocking used for leveling shall be firmly attached to the bearing members.

4.3 Separator Strips

Horizontal separator strips shall be used when the pipe is not nested. For single or double overhanging loads using separator strips, such strips shall also be used on the overhanging portion, and this portion shall be steel banded, regardless of the D/t ratio. Overhanging shall meet the requirements of Table 1.

Table 1—Distance from Pipe Ends to End-bearing Strips

Pipe Size	Minimum Distance	Maximum Distance
< 16	1.5 OD	5 ft (1.5 m)
16 to 30, inclusive	1.5 OD	6 ft (1.8 m)
> 30	4 ft (1.2 m)	6 ft (1.8 m)

4.4 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 (i.e. a nonmetallic material such as rubber or a metallic material such as aluminum, but brass, copper, bronze, and any copper alloy shall be excluded). They shall also have sufficient width and depth to fit the internal curvature of the pipe. Elastomeric aprons shall be attached to pipe hooks to protect the pipe ends unless pipe ends are provided with adequate end protectors. 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 handled by loose lifts, all necessary precautions should be taken during handling to prevent pipe damage, and consideration should be given to selection of slings that will prevent surface damage. Where fork lifts are used, the fork ends shall be rounded or properly padded to minimize damage to the pipe.

4.5 Pipe with Filler Metal Weld Seams

Pipe with filler metal weld seams (SAW and GMAW) shall be positioned or padded in such a manner that the weld does not contact either the blocking or the adjacent pipe. When horizontal stripping is used for straight filler metal weld seam pipe (SAW and GMAW), the weld seam shall be positioned at 45°, ± 5°, from vertical. Pipe with a straight filler metal weld seam (SAW and GMAW) shall be positioned with the seam at 0 ° or 180 ° (in other words, 12 or 6 o'clock position) when nested, in order to prevent pipe-to-weld seam contact. Furthermore, weld seams should be oriented to avoid contact with steel banding straps.

4.6 End Protection (Gondolas)

If any of the pipe ends are closer than 5 ft (1.5 m) to the end of the car, a minimum of 1 in. (25 mm) nominal thickness rough lumber, or its equivalent, shall be securely attached to the end of the car to prevent the pipe ends from contacting the end gates. Permanently wood-lined end gates are considered suitable for end protection. At the time of loading, a minimum clearance of 1 ft (0.3 m) shall be provided between the end gates and each end of the pipe to facilitate handling.

4.7 Banding and Tying-down

Emphasis should be placed on minimizing load shifting and subsequent damage to the pipe by unitizing the entire load, or specific portions thereof, with steel bands of at least 1 in. (25 mm) width. The bands should be properly spaced, of sufficient number, and properly tensioned to reduce the tendency of the pipe to move separately from the unitized load itself.

While tie-down bands may be advantageous for some loads, rail handling or humping may loosen or break tie-down bands. Where flat tie-down bands are used, they shall have a minimum width of 1 in. (25 mm). Where wire rope or chains are used, adequate padding shall be used at points of contact with pipe.

4.8 Inspection

4.8.1 General

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

4.8.2 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 pre transit damage.

4.8.3 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.

5 Transit Fatigue

5.1 General

Transit fatigue has been reported in pipe with diameter-to-thickness ratios as low as 12.5 and, even though transit fatigue does not appear to be grade related, it has been reported on pipe in Grades B through X70 [1]. Cracks have been found at three general locations:

a) along the edge of submerged arc welds,

b) in the pipe base metal at areas of denting or abrasion, and

c) 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. Transit fatigue is prevented by assuring that the static and dynamic stresses are below the fatigue limit of the pipe. However, contact with hard surfaces, such as rivet heads, nails, 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.

5.2 Loading Procedures

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

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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