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SECTION 5.1 GUIDELINES FOR PIPELINES CONVEYING FLAMMABLE SUBSTANCES

5.1.1 SCOPE (1993) R(2017)

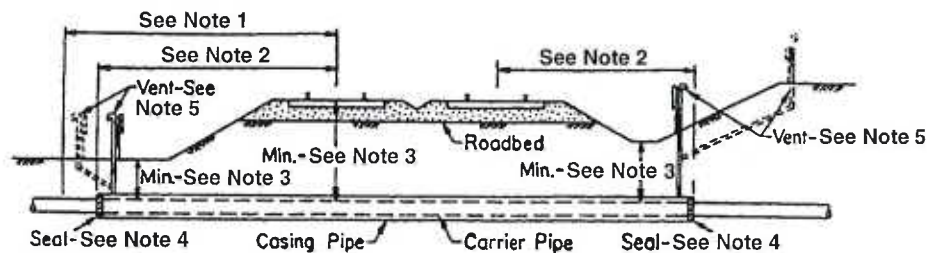
These guidelines cover minimum requirements for pipelines installed on or adjacent to railroad rights-of-way to carry liquid flammable products or highly volatile substances under pressure. The term "Engineer" used herein means the chief engineer of the railroad company or the authorized representative. These guidelines may be increased when risks from any of the following conditions are increased:

- a. Track speed.
- b. Traffic density.
- c. Traffic sensitivity.
- d. Terrain conditions, cuts/fills, etc.
- e. Curvature and grade.
- f. Bridges and other structures.
- g. Pipe size, capacity and material carried.
- h. Environmental risks/damages.

5.1.2 GENERAL REQUIREMENTS (2002) R(2017)

- a. Pipelines under railroad tracks and across railroad rights-of-way shall be encased in a larger pipe or conduit called the casing pipe as indicated in Figure 1-5-1. Except for plastic carrier pipe, casing pipe may be omitted in the following locations:
 - (1) Under secondary or industry tracks as approved by the Engineer.
 - (2) On pipelines in streets where the stress in the pipe from internal pressure and external loads does not exceed 40 percent of the specified minimum yield strength (multiplied by longitudinal joint factor) of the steel pipe material, as approved by the Engineer.
 - (3) On gas pipelines as provided in Section 5.2.
 - (4) On pipelines installed by HDD as described in Section 5.7.

- b. Pipelines and casing pipe shall be installed under tracks by boring, or jacking, or HDD, if practicable.
- c. Pipelines shall be located, where practicable, to cross tracks at approximately right angles thereto but preferably at not less than 45 degrees and shall not be placed within a culvert, under railroad bridges nor closer than 45 feet (13.72 meters) to any portion of any railroad bridge, building or important structure, except in special cases and then by special design as approved by the Engineer.
- d. Pipelines carrying flammable substances shall, where practicable, cross any railroad where tracks are carried on an embankment.
- e. Emergency response procedures should be developed to handle a situation in which a pipeline leak or railroad derailment or incident may jeopardize the integrity of the pipeline. Local conditions should be considered when developing these procedures.
- f. Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree of protection so prescribed shall be deemed a part of these guidelines.



- Note 1: See Article 5.1.3
- Note 2: See Article 5.1.5.2
- Note 3: See Article 5.1.6.2
- Note 4: See Article 5.1.6.4
- Note 5: See Article 5.1.6.5

Figure 1-5-1. Casing Pipe Installation

- g. Pipelines and casing pipe shall be suitably insulated from underground conduits carrying electric wires on railroad rights-of-way. All pipelines, except those in streets, shall be prominently marked at the rights-of-way (on both sides of track for undercrossings) by signs substantially worded thus:

“High pressure...main...in vicinity. Call...”

- h. Additional signing may be required by the Engineer where above signs are not readily visible from the track.

5.1.2.1 Pipeline Inspection and Maintenance

- a. Pipeline owners engaged in the transport of liquid flammable or highly volatile substances are subject to regulations of the Federal Government. These regulations require certain inspection routines that, in the general case, are conducted from within the carrier pipe or by non-destructive methods not requiring it be exposed.
- b. It is the responsibility of the pipeline owner to conduct the necessary inspections without interference to the operations of the Railroad Company. Should it become necessary to expose a pipe for an inspection, or for its replacement, the owner shall design a procedure that does not interfere with railroad operations, and shall make prior arrangements with the railroad as may be necessary to permit safe conduct of the work.

- c. Pipeline maintenance shall be limited to the installation of a new carrier pipe in an existing casing, renewal of carrier and casing pipe separators or the installation of a new crossing. In all cases, the work shall be conducted in the same manner as in the installation of a new crossing, which is subject to the requirements of these guidelines. Casings abandoned or replaced by new location work shall be backfilled by methods and materials as directed by the Engineer. The location of abandoned facilities shall be recorded and records maintained by the pipeline owner.
- d. The owners of pipelines not subject to regulation requiring inspection are expected to inspect their facilities as a matter of due diligence in the conduct of its business. The railroad may, as a right but not a duty, require an inspection of the construction, to include receiving a written report of findings certified by a registered professional engineer. Maintenance of these facilities shall be conducted as above described.

5.1.3 STEEL CARRIER PIPE (2002) R(2017)

- a. Pipelines carrying oil, liquefied petroleum gas and other flammable liquid products shall be of steel and conform to the requirements of the current ASME B31.4 Pipeline Transportation Systems for Liquids and Slurries, and other applicable ASME codes, except that the maximum allowable stresses¹ for design of steel pipe shall not exceed the following percentages of the specified minimum yield strength (multiplied by longitudinal joint factor) of the pipe as defined in the above codes.
- b. Requisites for steel carrier line pipe under railroad tracks shall apply for a minimum distance of 50 feet (15.24 meters (measured at right angles) from centerline of outside tracks or 2 feet (0.61 meters) beyond toe of slope or 25 feet (7.62 meters) beyond the ends of casing (when casing is required), whichever is greater.
- c. The pipe shall be laid with sufficient slack so that it is not in tension.

5.1.3.1 Allowable Hoop Stress Due to Internal Pressure

5.1.3.1.1 With Casing Pipe

The following percentages apply to hoop stress in steel pipe within a casing under railroad tracks and across railroad rights-of-way:

- a. Seventy-two percent on oil pipelines.
- b. Fifty percent for pipelines carrying condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, and other liquid petroleum products.
- c. Sixty percent for gas pipelines.

5.1.3.1.2 Without Casing Pipe

The following percentages apply to hoop stress in steel pipe without a casing under secondary or industry tracks:

- a. Sixty percent for oil pipelines.
- b. Forty percent for pipelines carrying condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, and other liquid petroleum products.
- c. For gas pipelines see Section 5.2.

5.1.3.1.3 On Right-of-Way

The following percentages apply to hoop stress in steel pipe laid longitudinally on railroad rights-of-way:

¹ If the maximum allowable stress in the carrier pipe on either side of the crossing is less than specified above, the carrier pipe at the crossing shall be designed at the same stress as the adjacent carrier pipe.

- a. Sixty percent for oil pipelines.
- b. Forty percent for pipelines carrying condensate, natural gasoline, natural gas liquids, liquefied petroleum gas, and other liquid petroleum products.
- c. For gas pipelines see Section 5.2.

5.1.4 PLASTIC CARRIER PIPE CONVEYING NON LIQUID FLAMMABLE SUBSTANCES (2002) R(2017)

- a. Plastic carrier pipelines shall be encased according to Article 5.1.5.
- b. Plastic carrier pipe material includes thermoplastic and thermoset plastic pipes. Thermoplastic types include Polyvinyl Chloride (PVC), Acrylonitrile Butadiene Styrene (ABS), Polyethylene (PE), Polybutylene (PB), Cellulose Acetate Butyrate (CAB) and Styrene Rubber (SR). Thermoset types include Reinforced Plastic Mortar (RPM), Reinforced Thermosetting Resin (RTRP) and Fiberglass Reinforced Plastic (FRP).
- c. Plastic pipe material shall be resistant to the chemicals with which contact can be anticipated. Plastic carrier pipe shall not be utilized where there is potential for contact with petroleum contaminated soils or other non-polar organic compounds that may be present in surrounding soils.
- d. Plastic carrier pipe can be utilized to convey flammable gas products provided the pipe material is compatible with the type of product conveyed and the maximum allowable operating pressure is less than 100 psi (689.5 kPa). Carrier pipe materials, design and installation shall conform to Code of Federal Regulation 49 CFR Part 178 to 199, specifically Part 192 and ASME B31.3 and B31.8 and ASTM D2513. Codes, specifications and regulations current at time of constructing the pipeline shall govern the installation of the facility within the railroad rights-of-way. The proof testing of the strength of carrier pipe shall be in accordance with ASME requirements. Plastic carrier pipelines will be encased according to Article 5.1.5.

5.1.5 CASING PIPE (2002) R(2017)

- a. Casing pipe and joints shall be steel in conformance with ASTM A1097 and of leakproof construction, such as butt welded or interlocking joints which are capable of withstanding railroad loading. Pipe shall have a specified minimum yield strength, SMYS, of at least 35,000 psi (241,317 kPa). The inside diameter of the casing pipe shall be large enough to allow the carrier pipe to be removed subsequently without disturbing the casing pipe. All joints or couplings, supports, insulators or centering devices for the carrier pipe within a casing under railroad tracks shall be taken into account.
- b. When casing is installed without benefit of a protective coating or said casing is not cathodically protected, the wall thickness shall be increased to the nearest standard size which is a minimum of 0.063 inches (1.6 millimeters) greater than the thickness required except for diameters under 12-3/4 inches (323.8 millimeters).

Table 1-5-1. Minimum Wall Thickness for Steel Casing Pipe for E80 Loading

Nominal Diameter (inches)	When coated or cathodically protected Nominal Thickness (inches)	When not coated or cathodically protected Nominal Thickness (inches)
12-3/4 and under	0.188	0.188
14	0.188	0.250
16	0.219	0.281
18	0.250	0.312
20 and 22	0.281	0.344

Table 1-5-1. Minimum Wall Thickness for Steel Casing Pipe for E80 Loading (Continued)

Nominal Diameter (inches)	When coated or cathodically protected Nominal Thickness (inches)	When not coated or cathodically protected Nominal Thickness (inches)
24	0.312	0.375
26	0.344	0.406
28	0.375	0.438
30	0.406	0.469
32	0.438	0.500
34 and 36	0.469	0.531
38	0.500	0.562
40	0.531	0.594
42	0.562	0.625
44 and 46	0.594	0.656
48	0.625	0.688
50	0.656	0.719
52	0.688	0.750
54	0.719	0.781
56 and 58	0.750	0.812
60	0.781	0.844
62	0.812	0.875
64	0.844	0.906
66 and 68	0.875	0.938
70	0.906	0.969
72	0.938	1.000

5.1.5.1 Flexible Casing Pipe

For flexible steel casing pipe, a maximum vertical deflection of a casing pipe of 3 percent of its diameter plus 1/2 inches (12.7 millimeters) clearance shall be provided so that no loads from the roadbed, track, traffic or casing pipe itself are transmitted to the carrier pipe. When insulators are used on the carrier pipe, the inside diameter of flexible casing pipe shall be at least 2 inches (50.8 millimeters) greater than the outside diameter of the carrier pipe for pipe less than 8 in. in diameter; at least 3-1/4 inches (82.5 millimeters) greater for pipe 8 inches (203.2 millimeters) to 16 inches (406.4 millimeters), inclusive, in diameter and at least 4-1/2 inches (114.3 millimeters) greater for pipe 18 inches (457.2 millimeters) in diameter and over.

5.1.5.2 Length of Casing Pipe

Casing pipe under railroad tracks and across railroad rights-of-way shall extend to the greater of the following distances, measured at right angles to centerline of track. If additional tracks are constructed in the future or *if* the railroad determines that the roadbed should be widened, the casing shall be extended or other special design incorporated:

- a. 2 feet (0.61 meters) beyond toe of slope.
- b. 3 feet (0.91 meters) beyond ditch.

- c. A minimum distance of 30 feet. (9.14 meters) each side from centerline of outside track when casing is sealed at both ends.
- d. A minimum distance of 45 feet. (13.72 meters) each side from centerline of outside track when casing is open at both ends.
- e. Plastic carrier pipe conveying flammable substances shall be encased the entire limits of the right-of-way. If special conditions exist which prevent encasement within the entire limits of the right-of-way, the minimum encased lengths must be approved by the Engineer.

5.1.6 CONSTRUCTION (2002) R(2017)

- a. Casing pipe shall be so constructed as to prevent leakage of any substance from the casing throughout its length, except at ends of casing where ends are left open, or through vent pipes when ends of casing are sealed. Casing shall be so installed as to prevent the formation of a waterway under the railroad, and with an even bearing throughout its length, and shall slope to one end (except for longitudinal occupancy).
- b. Where casing and/or carrier pipe is cathodically protected, the engineer shall be notified and a suitable test made to ensure that other railroad structures and facilities are adequately protected from the cathodic current in accordance with the recommendation of current Reports of Correlating Committee on Cathodic Protection, published by the National Association of Corrosion Engineers.

5.1.6.1 Method of Installation

- a. Installations by open-trench methods shall comply with Part 4, Culverts, Section 4.17, Assembly and Installation of Pipe Culverts, of this Chapter.
- b. Bored or jacked installations shall have a bored hole diameter essentially the same as the outside diameter of the pipe plus the thickness of the protective coating. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (including coating) by more than approximately 1 inch (25.4 millimeters), remedial measures as approved by the Engineer shall be taken. Boring operations shall not be stopped if such stoppage would be detrimental to the railroad.
- c. Tunneling operations shall be conducted as approved by the Engineer. If voids are caused by the tunneling operations, they shall be filled by pressure grouting or by other approved methods which will provide proper support.

5.1.6.2 Depth of Installation

5.1.6.2.1 Casing Pipe

Casing pipe under railroad tracks and across railroad rights-of-way shall be not less than 5-1/2 feet (1.68 meters) from base of railroad rail to top of casing at its closest point, except that under secondary or industry tracks this distance may be 4-1/2 feet (1.37 meters) On other portions of rights-of-way where casing is not directly beneath any track, the depth from ground surface or from bottom of ditches to top of casing shall not be less than 3 feet (0.91 meters).

5.1.6.2.2 Carrier Pipe

Steel carrier pipe installed under secondary or industry tracks without benefit of casing shall be not less than 10 ft. from base of railroad rail to top of pipe at its closest point nor less than 6 ft. from ground surface or from bottom of ditches. Plastic carrier pipe must be encased under secondary or industry tracks within the limits of the right-of-way.

5.1.6.3 Inspection and Testing

ASME Codes current at time of constructing the pipeline, shall govern the inspection and testing of the facility within the railroad rights-of-way except as follows:

Roadway and Ballast

- a. One-hundred percent of all steel pipe field welds shall be inspected by radiographic examination, and such field welds shall be inspected for 100 percent of the circumference.
- b. The proof testing of the strength of carrier pipe shall be in accordance with ASMI requirements.

5.1.6.4 Seals

- a. Where ends of casing are below ground they shall be suitably sealed.
- b. Where ends of casing are at or above ground surface and above high-water level they may be left open, provided drainage is afforded in such manner that leakage will be conducted away from railroad tracks or structure. Where proper drainage is not provided, the ends of casing shall be sealed.

5.1.6.5 Vents

Casing pipe, when sealed, shall be properly vented. Vent pipes shall be of sufficient diameter, but in no case less than 2 inches (50.8 millimeters) in diameter, shall be attached near end of casing and project through ground surface at right-of-way lines or not less than 45 feet (13.72 meters) (measured at right angles) from centerline of nearest track. Vent pipe, or pipes, shall extend not less than 4 feet (1.22 meters) above ground surface. Top of vent pipe shall be fitted with down-turned elbow properly screened, or a relief valve. Vents in locations subject to high water shall be extended above the maximum elevation of high water and shall be supported and protected in a manner that meets the approval of the engineer. Vent pipes shall be no closer than 4 feet (1.22 meters) (vertically) from aerial electric wires.

5.1.6.6 Shut-Off Valves

Accessible emergency shut-off valves shall be installed within effective distances each side of the railroad as mutually agreed to by the Engineer and the pipeline company. These valves should be marked with signs for identification. Where pipelines are provided with automatic control stations at locations and within distances approved by the Engineer, no additional valves shall be required.

5.1.6.7 Longitudinal Pipelines

Longitudinal pipelines should be located as far as possible from any track. They must not be within 25 feet (7.62 meters) of any track and must have a minimum of 6 feet (1.83 meters) ground cover over the pipeline up to 50 feet (15.24 meters), measured from the track centerline. Where pipeline is laid more than 50 feet (15.24 meters) from centerline of track, minimum cover shall be at least 5 feet (1.52 meters). Pipelines must be marked by a sign approved by the Engineer every 500 feet (152.39 meters) and at every road crossing, streambed, other utility crossing, and at locations of major change in direction of the line. Longitudinal carrier pipeline shall be steel. Plastic carrier pipe may be utilized for longitudinal installation with approval by the Engineer, but shall be encased within the limits of the right-of-way. Casing may be omitted with approval of the Engineer, provided that minimum burial depth is increased to comply with the most conservative requirements of either: the Engineer's instructions, current ASME specifications, current OSHA regulations, or local regulatory agency specifications.

5.1.7 APPROVAL OF PLANS (2002) R(2017)

- a. Plans for proposed installation shall be stamped and sealed by a registered engineer and submitted to and meet the approval of the Engineer before construction is begun.
- b. Plans shall be drawn to scale showing the relation of the proposed pipeline to railroad tracks, angle of crossing, location of valves, railroad survey station, right-of-way lines and general layout of tracks and railroad facilities. Plans should also show a cross section (or sections) from field survey, showing pipe in relation to actual profile of ground and tracks. If open-cutting or tunneling is necessary, details of sheeting and method of supporting tracks or driving tunnel shall be shown.
- c. In addition to the above, plans should contain the following data:

Table 1-5-2. Plan Data

	Carrier Pipe	Casing Pipe
Contents to be handled		
Outside Diameter		
Pipe Material, minimum yield strength		
Specification and grade		
Wall thickness		
Actual Working pressure		
Type of Joint, butt welded, fusion welded, or interlocking joint		
Coating		
Method of installation		
Vents: Number: Size: Height above ground:		
Seals: Both ends: One end: Type:		
Bury: Base of rail to top of casing: feet inches (meters)		
Bury: (Not beneath tracks) feet inches (meters)		
Bury: (Roadway ditches) feet inches (meters)		
Type, size and spacing of insulators or supports:		
Distance C.L. track to face of jacking/receiving pits ft. in. (meters)		
Bury: Base of rail to bottom jacking/receiving pits ft. in. (meters)		
Cathodic protection: Yes <input type="checkbox"/> No <input type="checkbox"/>		

5.1.8 EXECUTION OF WORK (1993) R(2017)

The execution of work on railroad rights-of-way, including the supporting of tracks, shall be subject to the inspection and direction of the Engineer.

SECTION 5.2 GUIDELINES FOR UNCASED GAS PIPELINES WITHIN THE RAILROAD RIGHT-OF-WAY

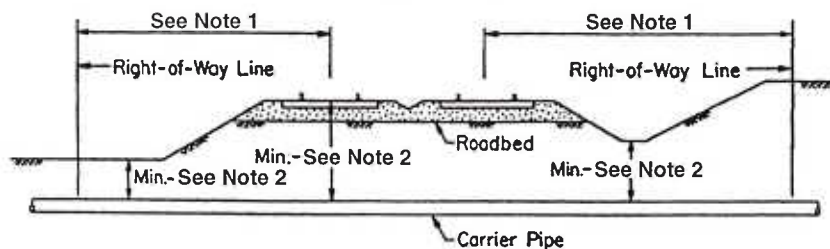
5.2.1 SCOPE (1993) R(2017)

These guidelines cover minimum requirements for pipelines installed on or adjacent to railroad rights-of-way to carry flammable and nonflammable gas products which, from their nature or pressure, might cause damage if escaping on or in the vicinity of railroad property. The term “Engineer” as used herein means the chief engineer of the railroad company or the authorized representative. These guidelines may be increased when risks from any of the following conditions are increased:

- a. Track Speed.
- b. Traffic density.
- c. Traffic sensitivity.
- d. Terrain conditions, cuts/fills, etc.
- e. Curvature and grade.
- f. Bridges and other structures.
- g. Pipe size, capacity and material carried.
- h. Environmental risks/damages.

5.2.2 GENERAL REQUIREMENTS (2002) R(2017)

- a. Pipelines shall be installed under tracks by boring or jacking, if practicable.
- b. Pipelines shall be located, where practicable, to cross tracks at approximately 90 degrees but not less than 45 degrees, and shall not be placed within a culvert, under railroad bridges, nor closer than 45 feet (13.72 meters) to any portion of any railroad bridge, building or other important structure, except in special cases and then by special design as approved by the Engineer.
- c. Pipelines carrying flammable gas products shall, where practicable, cross any railroad where tracks are carried on an embankment.
- d. Emergency response procedures should be developed to handle a situation in which a pipeline leak or railroad derailment or incident may jeopardize the integrity of the pipeline. Local conditions should be considered when developing these procedures.
- e. Uncased gas pipelines under railroad track and on right-of-way shall be installed as indicated in Figure 1-5-2.



Note 1: See Article 5.2.3.2

Note 2: See Article 5.2.4.2

Figure 1-5-2. Uncased Gas Pipelines Installation

- f. Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree of protection so prescribed shall be deemed a part of these guidelines.
- g. Pipelines and casing pipe shall be suitably insulated from underground conduits carrying electric wires on railroad rights-of-way. All pipelines, except those in streets, shall be prominently marked at the rights-of-way (on both sides of track for undercrossings) by signs substantially worded thus:

“High pressure...main...in vicinity. Call...”

- h. Additional signing may be required by the Engineer where above signs are not readily visible from the track.

5.2.2.1 Pipeline Inspection and Maintenance

- a. Pipeline owners engaged in the transport of flammable and non-flammable gas products are subject to regulations of the Federal Government. These regulations require certain inspection routines that, in the general case, are conducted from within the carrier pipe or by non-destructive methods not requiring it be exposed.
- b. It is the responsibility of the pipeline owner to conduct the necessary inspections without interference to the operations of the Railroad Company. Should it become necessary to expose a pipe for an inspection, or for its replacement, the owner shall design a procedure that does not interfere with railroad operations, and shall make prior arrangements with the railroad as may be necessary to permit safe conduct of the work.
- c. Pipeline maintenance shall be limited to the installation of a new carrier pipe at a new crossing location, which is subject to the requirements of these guidelines. Carrier pipes abandoned by new location work shall be backfilled by methods and materials as directed by the Engineer. The location of abandoned facilities shall be recorded and records maintained by the pipeline owner.
- d. The owners of pipelines not subject to regulation requiring inspection are expected to inspect their facilities as a matter of due diligence in the conduct of its business. The railroad may, as a right but not a duty, require an inspection of the construction, to include receiving a written report of findings certified by a registered professional engineer. Maintenance of these facilities shall be conducted as above described.

5.2.3 CARRIER PIPE (2002) R(2017)

- a. Pipelines carrying flammable and nonflammable gas products shall be of steel and shall conform to the requirements of the current ASME B 31.8 Gas Transmission and Distribution Piping Systems, and other applicable ASME codes.
- b. Carrier line pipe construction shall be approved by the engineer. Joints for carrier line pipe must be of an approved welded type. Steel pipe must have a specified minimum yield strength, SMYS, of at least 35,000 psi (241,317 kPa). The nominal wall thickness for the steel carrier pipe, specified minimum yield strength, SMYS, maximum allowable operating pressure, MAOP, and outside pipe diameter, D, are given in Table 1-5-3.
- c. These Table 1-5-3 wall thicknesses are based on four design criteria. These design criteria consider:
- (1) The maximum allowable hoop stress due to internal pressure as specified in regulatory codes;
 - (2) The maximum combined multiaxial stress due to external and internal loads;
 - (3) Fatigue in girth welds due to external live loads;
 - (4) Fatigue in longitudinal seam welds due to external live loads.
- d. The greatest wall thickness resulting from each of the design conditions are shown in Table 1-5-3.
- e. Design parameter assumptions used to calculate the Table 1-5-3 wall thicknesses are as follows:
- Depth of carrier from base of rail is 10 feet (3.05 meters).
 - Double Track condition is assumed.
 - Modulus of Soil Reaction $E' = 500$ psi (3,447 kPa).
 - Soil Resilient Modulus $E_r = 10,000$ psi (68,948 kPa).

- Girth weld is located at centerline of track.
 - Overbore of 2 inches (50.8 millimeters) over pipe diameter during installation.
 - Class location design factor $F = 0.6$ used in design criterion paragraph c(1) given above.
 - Factor of Safety $FS = 1.5$ used in design criteria b, c, and d given above.
- f. See “Design of Uncased Pipeline at Railroad Crossings” as referenced in Article 5.2.7 for additional details on the design parameters used to determine the wall thickness.
- g. If actual crossing conditions fall outside these parameters, tending to require a thicker walled pipe, a detailed analysis must be performed using the design methodology referenced in Article 5.2.7. Design calculations must be provided for railroad review when conditions outside those above are present.

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 100 psi					MAOP ≤ 200 psi				
≤ 18.0	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
20.0	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219	0.219
22.0	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226
24.0	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
26.0	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281	0.281
28.0	0.281	0.281	0.281	0.281	0.281	0.312	0.281	0.281	0.281	0.281
30.0	0.312	0.312	0.312	0.312	0.312	0.344	0.312	0.312	0.312	0.312
32.0	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344	0.344
34.0	0.344	0.344	0.344	0.344	0.344	0.406	0.344	0.344	0.344	0.344
36.0	0.375	0.375	0.375	0.375	0.375	0.406	0.375	0.375	0.375	0.375
38.0	0.406	0.406	0.406	0.406	0.406	0.438	0.406	0.406	0.406	0.406
40.0	0.406	0.406	0.406	0.406	0.406	0.469	0.406	0.406	0.406	0.406
42.0	0.438	0.438	0.438	0.438	0.438	0.500	0.438	0.438	0.438	0.438
	MAOP ≤ 300 psi					MAOP ≤ 400 psi				
≤ 12.75	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
14.0	0.188	0.188	0.188	0.188	0.188	0.203	0.188	0.188	0.188	0.188
16.0	0.188	0.188	0.188	0.188	0.188	0.281	0.188	0.188	0.188	0.188
18.0	0.219	0.188	0.188	0.188	0.188	0.281	0.219	0.188	0.188	0.188
20.0	0.250	0.219	0.219	0.219	0.219	0.312	0.250	0.219	0.219	0.219

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe (Continued)

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 300 psi - Continued					MAOP ≤ 400 psi - Continued				
22.0	0.281	0.226	0.226	0.226	0.226	0.344	0.281	0.226	0.226	0.226
24.0	0.312	0.250	0.250	0.250	0.250	0.375	0.281	0.250	0.250	0.250
26.0	0.344	0.281	0.281	0.281	0.281	0.406	0.312	0.281	0.281	0.281
28.0	0.375	0.312	0.281	0.281	0.281	0.438	0.344	0.281	0.281	0.281
30.0	0.406	0.312	0.312	0.312	0.312	0.469	0.375	0.312	0.312	0.312
32.0	0.438	0.344	0.344	0.344	0.344	0.500	0.406	0.344	0.344	0.344
34.0	0.469	0.375	0.344	0.344	0.344	0.531	0.438	0.344	0.344	0.344
36.0	0.500	0.406	0.375	0.375	0.375	0.562	0.469	0.375	0.375	0.375
38.0	0.531	0.438	0.406	0.406	0.406	0.625	0.500	0.406	0.406	0.406
40.0	0.562	0.469	0.406	0.406	0.406	0.656	0.531	0.406	0.406	0.406
42.0	0.594	0.500	0.438	0.438	0.438	0.688	0.562	0.438	0.438	0.438
	MAOP ≤ 500 psi					MAOP ≤ 600 psi				
≤ 8.625	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
10.75	0.188	0.188	0.188	0.188	0.188	0.203	0.188	0.188	0.188	0.188
12.75	0.219	0.188	0.188	0.188	0.188	0.250	0.203	0.188	0.188	0.188
14.0	0.250	0.188	0.188	0.188	0.188	0.281	0.210	0.188	0.188	0.188
16.0	0.281	0.219	0.188	0.188	0.188	0.312	0.250	0.188	0.188	0.188
18.0	0.312	0.250	0.188	0.188	0.188	0.344	0.281	0.219	0.188	0.188
20.0	0.344	0.281	0.219	0.219	0.219	0.375	0.312	0.250	0.219	0.219
22.0	0.375	0.312	0.250	0.226	0.226	0.438	0.344	0.281	0.226	0.226
24.0	0.406	0.344	0.281	0.250	0.250	0.469	0.375	0.312	0.250	0.250
26.0	0.469	0.375	0.281	0.281	0.281	0.500	0.406	0.344	0.281	0.281
28.0	0.500	0.406	0.312	0.281	0.281	0.562	0.469	0.375	0.312	0.312
30.0	0.531	0.438	0.344	0.312	0.312	0.594	0.500	0.406	0.344	0.312
32.0	0.562	0.469	0.375	0.344	0.344	0.625	0.531	0.406	0.375	0.344
34.0	0.625	0.500	0.406	0.344	0.344	0.688	0.562	0.438	0.375	0.344
36.0	0.656	0.531	0.438	0.375	0.375	0.719	0.594	0.469	0.406	0.375
38.0	0.688	0.562	0.469	0.406	0.406	0.750	0.625	0.500	0.438	0.406
40.0	0.719	0.594	0.500	0.406	0.406	0.781	0.688	0.531	0.469	0.438
42.0	0.750	0.656	0.500	0.438	0.438	0.844	0.719	0.562	0.500	0.469
	MAOP ≤ 700 psi					MAOP ≤ 800 psi				
≤ 6.625	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
8.625	0.188	0.188	0.188	0.188	0.188	0.203	0.188	0.188	0.188	0.188
10.75	0.219	0.188	0.188	0.188	0.188	0.250	0.203	0.188	0.188	0.188

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe (Continued)

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 700 psi - Continued					MAOP ≤ 800 psi - Continued				
12.75	0.281	0.219	0.188	0.188	0.188	0.312	0.250	0.188	0.188	0.188
14.0	0.312	0.250	0.188	0.188	0.188	0.344	0.281	0.219	0.188	0.188
16.0	0.344	0.281	0.219	0.188	0.188	0.375	0.312	0.250	0.219	0.188
18.0	0.375	0.312	0.250	0.219	0.219	0.438	0.344	0.281	0.226	0.219
20.0	0.438	0.344	0.281	0.226	0.226	0.469	0.406	0.312	0.250	0.250
22.0	0.469	0.406	0.312	0.281	0.226	0.500	0.438	0.344	0.281	0.250
24.0	0.500	0.438	0.344	0.281	0.250	0.562	0.469	0.375	0.312	0.281
26.0	0.562	0.469	0.375	0.312	0.281	0.625	0.500	0.406	0.344	0.312
28.0	0.594	0.500	0.406	0.344	0.281	0.656	0.562	0.438	0.375	0.312
30.0	0.656	0.531	0.438	0.375	0.312	0.719	0.594	0.469	0.406	0.344
32.0	0.688	0.562	0.469	0.406	0.344	0.750	0.625	0.500	0.438	0.375
34.0	0.750	0.625	0.500	0.438	0.375	0.812	0.688	0.531	0.469	0.406
36.0	0.781	0.656	0.531	0.469	0.375	0.844	0.719	0.562	0.500	0.438
38.0	0.844	0.688	0.562	0.500	0.406	0.906	0.750	0.625	0.531	0.438
40.0	0.875	0.750	0.594	0.500	0.438	0.938	0.812	0.656	0.562	0.469
42.0	0.938	0.781	0.625	0.531	0.469	1.000	0.844	0.688	0.594	0.500
	MAOP ≤ 900 psi					MAOP ≤ 1000 psi				
≤ 6.625	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
8.625	0.219	0.188	0.188	0.188	0.188	0.250	0.188	0.188	0.188	0.188
10.75	0.279	0.219	0.188	0.188	0.188	0.307	0.250	0.188	0.188	0.188
12.75	0.312	0.281	0.219	0.188	0.188	0.344	0.281	0.250	0.188	0.188
14.0	0.344	0.312	0.250	0.203	0.188	0.375	0.312	0.250	0.219	0.188
16.0	0.406	0.344	0.281	0.219	0.188	0.438	0.375	0.312	0.250	0.219
18.0	0.469	0.375	0.312	0.250	0.219	0.500	0.406	0.344	0.281	0.250
20.0	0.500	0.438	0.344	0.281	0.250	0.562	0.469	0.375	0.312	0.281
22.0	0.562	0.469	0.375	0.312	0.281	0.625	0.500	0.406	0.344	0.281
24.0	0.625	0.500	0.406	0.344	0.312	0.688	0.562	0.438	0.375	0.312
26.0	0.656	0.562	0.438	0.375	0.312	0.750	0.594	0.469	0.406	0.344
28.0	0.719	0.594	0.469	0.406	0.344	0.750	0.656	0.531	0.438	0.375
30.0	0.750	0.625	0.500	0.438	0.375	0.812	0.688	0.562	0.469	0.406
32.0	0.812	0.688	0.562	0.469	0.406	0.875	0.719	0.594	0.531	0.438

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe (Continued)

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 900 psi - Continued					MAOP ≤ 1000 psi - Continued				
34.0	0.875	0.719	0.594	0.500	0.438	0.938	0.781	0.625	0.562	0.469
36.0	0.906	0.781	0.625	0.531	0.469	1.000	0.812	0.688	0.594	0.500
38.0	0.969	0.812	0.656	0.562	0.500	1.062	0.875	0.719	0.625	0.531
40.0	1.031	0.875	0.688	0.625	0.531	1.125	0.906	0.750	0.656	0.562
42.0	1.062	0.906	0.750	0.656	0.562	1.188	0.969	0.781	0.688	0.594
	MAOP ≤ 1100 psi					MAOP ≤ 1200 psi				
≤ 5.563	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
6.625	0.188	0.188	0.188	0.188	0.188	0.203	0.188	0.188	0.188	0.188
8.625	0.250	0.203	0.188	0.188	0.188	0.277	0.219	0.188	0.188	0.188
10.75	0.307	0.250	0.203	0.188	0.188	0.344	0.277	0.219	0.188	0.188
12.75	0.375	0.312	0.250	0.219	0.188	0.406	0.330	0.281	0.226	0.188
14.0	0.406	0.344	0.281	0.226	0.219	0.438	0.375	0.312	0.250	0.219
16.0	0.469	0.406	0.312	0.281	0.219	0.500	0.406	0.344	0.281	0.250
18.0	0.531	0.438	0.344	0.312	0.250	0.562	0.469	0.375	0.344	0.281
20.0	0.594	0.500	0.406	0.344	0.281	0.625	0.531	0.438	0.375	0.312
22.0	0.625	0.531	0.438	0.375	0.312	0.688	0.562	0.469	0.406	0.344
24.0	0.688	0.594	0.469	0.406	0.344	0.750	0.625	0.500	0.438	0.375
26.0	0.750	0.625	0.500	0.438	0.375	0.812	0.688	0.562	0.469	0.406
28.0	0.812	0.688	0.562	0.469	0.406	0.875	0.719	0.594	0.500	0.438
30.0	0.875	0.750	0.594	0.531	0.438	0.938	0.812	0.625	0.562	0.469
32.0	0.938	0.781	0.625	0.562	0.469	1.000	0.875	0.688	0.594	0.500
34.0	1.000	0.844	0.688	0.594	0.500	1.062	0.875	0.719	0.625	0.531
36.0	1.062	0.875	0.719	0.625	0.531	1.125	0.938	0.750	0.656	0.562
38.0	1.125	0.938	0.750	0.656	0.562	1.188	1.000	0.812	0.719	0.594
40.0	1.156	0.969	0.812	0.688	0.594	1.250	1.031	0.844	0.750	0.625
42.0	1.250	1.031	0.844	0.750	0.625	1.312	1.094	0.906	0.781	0.656
	MAOP ≤ 1300 psi					MAOP ≤ 1400 psi				
≤ 5.563	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
6.625	0.219	0.188	0.188	0.188	0.188	0.250	0.188	0.188	0.188	0.188
8.625	0.277	0.250	0.188	0.188	0.188	0.312	0.250	0.219	0.188	0.188
10.75	0.344	0.307	0.250	0.203	0.188	0.365	0.307	0.250	0.219	0.219

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe (Continued)

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 1300 psi - Continued					MAOP ≤ 1400 psi - Continued				
12.75	0.438	0.344	0.281	0.256	0.219	0.438	0.375	0.312	0.256	0.250
14.0	0.469	0.375	0.312	0.279	0.226	0.500	0.406	0.344	0.281	0.281
16.0	0.531	0.438	0.375	0.312	0.281	0.562	0.469	0.375	0.344	0.312
18.0	0.594	0.500	0.406	0.344	0.312	0.625	0.531	0.438	0.375	0.344
20.0	0.656	0.562	0.438	0.375	0.344	0.688	0.594	0.469	0.406	0.375
22.0	0.719	0.594	0.500	0.438	0.406	0.750	0.656	0.531	0.469	0.375
24.0	0.812	0.656	0.531	0.469	0.406	0.844	0.688	0.562	0.500	0.438
26.0	0.844	0.719	0.594	0.500	0.438	0.906	0.750	0.625	0.531	0.469
28.0	0.906	0.781	0.625	0.531	0.469	0.969	0.812	0.656	0.594	0.500
30.0	0.969	0.812	0.688	0.594	0.500	1.031	0.875	0.719	0.625	0.531
32.0	1.031	0.875	0.719	0.625	0.531	1.094	0.938	0.750	0.656	0.562
34.0	1.125	0.938	0.750	0.656	0.562	1.156	1.000	0.812	0.719	0.594
36.0	1.188	1.000	0.812	0.719	0.625	1.250	1.062	0.875	0.750	0.656
38.0	1.250	1.062	0.844	0.750	0.656	1.312	1.094	0.906	0.781	0.688
40.0	1.312	1.094	0.906	0.781	0.688	1.375	1.156	0.938	0.844	0.719
42.0	1.375	1.156	0.938	0.844	0.719	1.469	1.219	1.000	0.875	0.750
	MAOP ≤ 1500 psi					MAOP ≤ 1600 psi				
≤ 4.5	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
5.563	0.219	0.188	0.188	0.188	0.188	0.219	0.188	0.188	0.188	0.188
6.625	0.250	0.203	0.188	0.188	0.188	0.280	0.219	0.188	0.188	0.188
8.625	0.312	0.277	0.219	0.188	0.188	0.344	0.277	0.250	0.219	0.188
10.75	0.406	0.344	0.279	0.226	0.219	0.438	0.344	0.279	0.250	0.219
12.75	0.469	0.406	0.312	0.281	0.250	0.500	0.406	0.344	0.312	0.250
14.0	0.500	0.438	0.344	0.312	0.250	0.562	0.469	0.375	0.312	0.281
16.0	0.594	0.500	0.406	0.344	0.312	0.625	0.531	0.438	0.375	0.312
18.0	0.656	0.562	0.469	0.406	0.344	0.688	0.594	0.469	0.406	0.344
20.0	0.719	0.625	0.494	0.438	0.375	0.781	0.656	0.531	0.469	0.406
22.0	0.812	0.688	0.562	0.469	0.406	0.844	0.719	0.594	0.500	0.438
24.0	0.875	0.750	0.594	0.531	0.438	0.938	0.781	0.625	0.562	0.469
26.0	0.938	0.812	0.656	0.562	0.500	1.000	0.844	0.688	0.594	0.500
28.0	1.031	0.875	0.688	0.625	0.531	1.062	0.906	0.750	0.656	0.562

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe (Continued)

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 1500 psi - Continued					MAOP ≤ 1600 psi - Continued				
30.0	1.094	0.938	0.750	0.656	0.562	1.156	0.969	0.781	0.688	0.594
32.0	1.156	0.969	0.812	0.688	0.594	1.219	1.031	0.844	0.719	0.625
34.0	1.250	1.031	0.844	0.750	0.625	1.312	1.094	0.906	0.781	0.656
36.0	1.312	1.094	0.906	0.781	0.688	1.375	1.156	0.938	0.812	0.719
38.0	1.375	1.156	0.938	0.844	0.719	1.469	1.219	1.000	0.875	0.750
40.0	1.438	1.219	1.000	0.875	0.750	1.531	1.281	1.062	0.906	0.781
42.0	1.531	1.281	1.062	0.938	0.781	—	1.344	1.094	0.969	0.844
	MAOP ≤ 1700 psi					MAOP ≤ 1800 psi				
≤ 4.0	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
4.5	0.188	0.188	0.188	0.188	0.188	0.203	0.188	0.188	0.188	0.188
5.563	0.258	0.188	0.188	0.188	0.188	0.258	0.219	0.188	0.188	0.188
6.625	0.280	0.250	0.188	0.188	0.188	0.312	0.250	0.219	0.188	0.188
8.625	0.375	0.312	0.250	0.219	0.188	0.375	0.312	0.250	0.219	0.188
10.75	0.438	0.365	0.312	0.256	0.219	0.469	0.406	0.312	0.279	0.250
12.75	0.531	0.438	0.375	0.312	0.281	0.562	0.469	0.375	0.344	0.281
14.0	0.594	0.500	0.406	0.344	0.312	0.625	0.500	0.406	0.375	0.312
16.0	0.656	0.562	0.438	0.406	0.344	0.688	0.594	0.469	0.406	0.344
18.0	0.750	0.625	0.500	0.438	0.375	0.781	0.656	0.531	0.469	0.406
20.0	0.812	0.688	0.562	0.500	0.406	0.875	0.719	0.594	0.500	0.438
22.0	0.906	0.750	0.625	0.531	0.469	0.969	0.781	0.656	0.562	0.500
24.0	1.000	0.812	0.656	0.594	0.500	1.031	0.875	0.719	0.625	0.531
26.0	1.062	0.906	0.719	0.625	0.531	1.125	0.938	0.750	0.656	0.562
28.0	1.156	0.969	0.781	0.688	0.594	1.219	1.000	0.812	0.719	0.625
30.0	1.219	1.031	0.844	0.719	0.625	1.312	1.094	0.875	0.750	0.656
32.0	1.312	1.094	0.875	0.781	0.656	1.375	1.156	0.938	0.812	0.688
34.0	1.375	1.156	0.938	0.812	0.688	1.500	1.219	1.000	0.875	0.750
36.0	1.469	1.219	1.000	0.875	0.750	1.562	1.312	1.062	0.906	0.781
38.0	1.562	1.312	1.062	0.906	0.781	—	1.375	1.125	0.969	0.844
40.0	—	1.375	1.094	0.969	0.844	—	1.438	1.156	1.000	0.875
42.0	—	1.438	1.156	1.000	0.875	—	1.500	1.219	1.062	0.906

Table 1-5-3. Minimum Nominal Wall Thickness (inches) for Uncased Carrier Pipe (Continued)

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 1900 psi					MAOP ≤ 2000 psi				
≤ 3.5	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
4.0	0.188	0.188	0.188	0.188	0.188	0.219	0.188	0.188	0.188	0.188
4.5	0.219	0.188	0.188	0.188	0.188	0.219	0.188	0.188	0.188	0.188
5.563	0.258	0.219	0.188	0.188	0.188	0.281	0.250	0.188	0.188	0.188
6.625	0.312	0.250	0.219	0.188	0.188	0.344	0.280	0.219	0.188	0.188
8.625	0.406	0.344	0.281	0.277	0.219	0.438	0.344	0.281	0.250	0.219
10.75	0.500	0.406	0.344	0.312	0.250	0.531	0.438	0.375	0.312	0.256
12.75	0.594	0.500	0.406	0.344	0.312	0.625	0.531	0.438	0.375	0.312
14.0	0.656	0.531	0.438	0.375	0.344	0.688	0.562	0.469	0.406	0.344
16.0	0.750	0.625	0.500	0.438	0.375	0.781	0.656	0.531	0.469	0.406
18.0	0.812	0.688	0.562	0.500	0.438	0.875	0.719	0.594	0.500	0.438
20.0	0.906	0.781	0.625	0.531	0.469	0.969	0.812	0.656	0.562	0.500
22.0	1.000	0.844	0.688	0.594	0.500	1.062	0.875	0.719	0.625	0.531
24.0	1.094	0.906	0.750	0.656	0.562	1.156	0.969	0.781	0.688	0.594
26.0	1.188	1.000	0.812	0.688	0.594	1.250	1.062	0.844	0.750	0.625
28.0	1.312	1.062	0.875	0.750	0.656	1.344	1.125	0.906	0.781	0.688
30.0	1.375	1.156	0.938	0.812	0.688	1.438	1.219	0.969	0.844	0.719
32.0	1.469	1.219	1.000	0.844	0.750	1.531	1.281	1.031	0.906	0.781
34.0	1.562	1.312	1.062	0.906	0.781	—	1.375	1.094	0.969	0.812
36.0	—	1.375	1.125	0.969	0.844	—	1.438	1.156	1.000	0.875
38.0	—	1.438	1.188	1.031	0.875	—	1.531	1.219	1.062	0.906
40.0	—	1.531	1.219	1.062	0.906	—	—	1.312	1.125	0.969
42.0	—	—	1.281	1.125	0.969	—	—	1.375	1.188	1.000

5.2.3.1 Allowable Hoop Stress Due to Internal Pressure

The maximum allowable hoop stress due to internal pressure shall be sixty percent of SMYS or per ASME Code if lower allowable percentage of hoop stress applies.

5.2.3.2 Length of Special Carrier Pipe

Carrier pipe, with nominal wall thickness greater than or equal to those shown in Table 1-5-3, shall extend from right-of-way line to right-of-way line, or 30 feet (9.14 meters) from centerline track, whichever distance is greater, unless special conditions exist which prevent this from occurring or as approved by the Engineer.

5.2.3.3 Cathodic Protection

- a. Carrier pipes must be coated and cathodically protected to industry standards and test sites for monitoring pipeline provided within 50 feet (15.24 meters) of crossing.
- b. Where carrier pipe is cathodically protected, the Engineer shall be notified and a suitable test made to ensure that other railroad structures and facilities are adequately protected from the cathodic current in accordance with the recommendation of current Reports of Correlating Committee on Cathodic Protection, published by the National Association of Corrosion Engineers.

5.2.4 CONSTRUCTION (1993) R(2017)

5.2.4.1 Special Protection

When the Engineer determines there is a possibility of having foreign materials in the subgrade, unusual potential for third party damage exists, or for other reasons, special protection of the carrier pipe will be required. Special protection may require concrete jacketed steel pipe be used, or protection slabs be placed above the pipe, the depth of burial increased, or other means. Soil borings may also be required to determine soil characteristics and to identify if foreign material is present in the bore.

5.2.4.2 Depth of Burial

- a. Carrier line pipe under railroad tracks shall not be less than 10 feet (3.05 meters) from the base of railroad rail to the top of the pipe at its closest point. At all other locations on the rights-of-way the minimum ground cover must be 6 feet (1.83 meters). Where it is not possible to secure the above depths, casings as specified in Section 5.1, Guidelines for Pipelines Conveying Flammable Substances, or other means of protection, will be required.
- b. The Inspection and Testing, and Shutoff Valves specifications are the same as in Section 5.1, Guidelines for Pipelines Conveying Flammable Substances, Article 5.1.6.3 and Article 5.1.6.6 respectively.

5.2.4.3 Longitudinal Pipelines

Longitudinal pipelines should be located as far as possible from any track. They must not be within 25 feet (7.62 meters) from the centerline of any track and must have a minimum of 6 feet (1.83 meters) ground cover over the pipeline up to 50 feet (15.24 meters) from centerline of track. Where pipeline is laid more than 50 feet (15.24 meters) from centerline of track, minimum cover shall be at least 5 feet (1.52 meters). Pipelines must be marked by a sign approved by the Engineer every 500 feet (152.39 meters) and at every road crossing, streambed, other utility crossing, and at locations of major change in direction of the line. The nominal wall thickness of the pipeline is to be in accordance with Table 1-5-3.

5.2.4.4 Method of Installation

Installations shall be bored or jacked, and shall have a bored hole diameter essentially the same as the outside diameter of the pipe plus the thickness of the protective coating. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe (including coating) by more than approximately 1 inch (25.4 millimeters), remedial measures as approved by the Engineer shall be taken. Boring operations shall not be stopped if such stoppage would be detrimental to the railroad.

5.2.5 APPROVAL OF PLANS (2002) R(2017)

- a. Plans for proposed installation shall be sealed and signed by a registered engineer and submitted to and meet the approval of the Engineer before construction is begun.
- b. Plans shall be drawn to scale showing the relation of the proposed pipeline to railroad tracks, angle of crossing, location of valves, railroad survey station, right-of-way lines and general layout of tracks and railroad facilities. Plans should also show a cross section (or sections) from field survey, showing pipe in relation to actual profile of ground

and tracks. If open-cutting or tunneling is necessary, details of sheeting and method of supporting tracks or driving tunnel shall be shown.

- c. In addition to the above, plans should contain the following data found in Table 1-5-4.

Table 1-5-4. Plan Data

Description	Carrier Pipe
Contents to be handled	
Outside Diameter	
Pipe Material, minimum yield strength	
Specification and grade	
Wall thickness	
Actual Working pressure	
Type of Joint, butt welded	
Coating	
Method of installation	
Bury: Base of rail to top of carrier	feet inches (meters)
Bury: (Not beneath tracks)	feet inches (meters)
Bury: (Roadway ditches)	feet inches (meters)
Distance C.L. track to face of jacking/receiving pits	feet inches (meters)
Bury: Base of rail to bottom jacking/receiving pits	feet inches (meters)
Cathodic protection? Yes <input type="checkbox"/> No <input type="checkbox"/>	

5.2.6 EXECUTION OF WORK (1993) R(2017)

The execution of work on railroad rights-of-way, including the supporting of tracks, shall be subject to the inspection and direction of the Engineer.

5.2.7 COMMENTARY (1993) R(2017)

A commentary on the “Design of Uncased Pipelines at Railroad Crossings” and the “Guidelines for Pipelines Crossing Railroads” outline the design methodology as developed by Cornell University under the sponsorship of the Gas Research Institute. This information is published in AREA Bulletin No. 738 Vol. 93, 1992.