OFFICE OF ASSISTANT VICE PRESIDENT – ENGINEERING DESIGN

General Specifications for
Sub-grade and Above Grade Utility Crossings of
Railroad's Right-of-Way

I. General Provisions

A. **Plan and cross-section (profile of crossing) drawings** (see example drawing ES 8090.2 and ES 8090.4) containing all pertinent details for the proposed crossing shall be submitted to the Engineering Department for approval prior to the preparation of any agreement. Plans shall illustrate the profile in relation to actual ground, track, and other facilities at the project site. All crossings (above grade/sub-grade) shall be substantially perpendicular to the Railroad Main Line and shall not be placed within a culvert or under bridges. The location of crossing shall be limited to crossing as few tracks as possible.

B. The plan will show all information for the proposed crossing installation with reference to the nearest railroad mile post or centerline of nearest street intersection.

C. The method of construction **will be detailed in the application.** Measurements should be made perpendicular to the track.

D. Request for installation shall be accompanied with a letter signed by the owner, company officer, or government agent.

E. The railroad will make the sole determination when flagmen are required and when railroad construction inspection may be required. Costs for these services are at the sole expense of the lessee. Advanced payment for the estimated costs of these services may be required.

F. The lessee will be responsible for any and all costs of repairs or maintenance of the Railroad's property and structures disturbed or damaged due to the installation or construction aftereffects.

G. The lessee of an installation approved by agreement will be required to provide proof of protective insurance for and during construction.

H. All power and communication lines constructed over, under or parallel to the railroad shall meet or exceed the requirements of the National Electric Safety Code (Canadian Standards Association in Canada), latest revision and all applicable state/province and local codes.

I. Where laws or orders of public authority prescribe a higher degree of protection than specified herein, then the higher degree of protection shall be deemed a part of these specifications.

II. Sub-grade Pipelines and Cables

A. General

1. **Plan and cross-section (profile of pipe) drawings** for pipeline crossings shall include the following information: (see example drawing ES 8090.4)
   - Distance from nearest mile post or road crossing
   - Distance from base of rail to top of outer most pipe
   - Minimum distance from natural ground or ditch line to top of outer most pipe
   - Casing length as dimensioned from the center of main track
   - Angle of crossing
   - Railroad right-of-way boundaries including distances from centerline of main track
   - Bore pit locations (including distances from the nearest track)
   - Carrier and casing pipe dimensions
   - Right of way warning sign locations
   - Vent pipe locations
   - Shut-off valve locations
   - GPS Coordinates

2. The method of installation **will be detailed in the application,** including the location of jacking pits and receiving pits as measured from centerline of nearest track. Measurements should be made perpendicular to the track.

3. All sub-grade carrier pipelines conveying liquids and wirelines shall be installed within a casing pipe (See exception for HDPE housing fiber-optic and other communication lines – Paragraph 7 below). Gas pipelines may be installed without casing provided that installation is 10 feet (3.05 m) or more below the base of rail to the top of pipe at its closest point and steel carrier pipe is used (see section II D below and see Table 1). The casing pipe may be omitted for non-pressure sewer or drainage crossing, where installation can be made by open cut (not normally allowed) or where reinforced concrete pipe can be jacked under the railroad.

4. Bore pit locations must be outside of Railroad right-of-way lines. Normally no open-cut crossings will be allowed. The pit will be protected with adequate sheeting, bulkheads, and sidewalls to protect the Railroad's roadbed. Proper barricades and lights, if necessary will be set around the pit for positive protection.

5. **All pipelines** (except those in streets) shall be prominently marked at right-of-way lines (on both sides of track for crossings) by durable, weatherproof signs located over the centerline of the pipe. Signs shall show the following:

   Name and address of owner
   Contents of pipe
   Pressure in pipe
   Pipe depth below graded at point of a sign
   Emergency telephone number in event of pipeline rupture

   Location of signs must be shown on both the plan and cross-section (profile of pipe) drawings.

6. Owner must maintain all signs on Railroad's right-of-way as long as the occupational agreement is in effect.

7. **Schedule 80 HDPE pipe** (SDR11 pipe is acceptable for pipes 2" in (50.8 mm) diameter or greater) is acceptable (with no casing pipe) for use when housing fiber optic or other communication lines. A metallic ribbon or wire must be included in the pipe to allow for radio locating at a later date.

8. At no time will construction interfere with the normal and safe operation of the Railroad. No construction, manpower, or equipment will enter or operate on the right-of-way within a safety clearance of 25.0 feet (7.6 m) from the centerline of near track. A railroad flagman must be present during any work on the railroad right-of-way. For pipes greater than 48 inches in diameter the following requirements apply:

9. All casing or pipe installations where the diameter is greater than 72 inches (1.83) will require a pre-construction conference with all parties, at the project location.

10. Pre-construction arrangements will be made with the Railroad at least one week prior to construction. A Railroad inspector must be present during the entire installation of the casing pipe. The inspector will have complete authority over the project on the Railroad's right-of-way.

11. All Construction Inspection Costs will be borne by the lessee.

12. Pipelines shall, where practicable, cross the railroad where tracks are carried on an embankment.

13. Pipeline shall not be placed within the limits of a turnout (switch) when crossing the track. The limits of the turnout extend from the point of switch to 15 feet (4.6 m) beyond the last long timber.

14. Pipeline shall not be placed within 50 feet (15.25 m) of a railroad bridge, building or other important structure.

B. Pipeline Casing Requirements:

1. All casing pipes will extend from right-of-way line to right-of-way line protecting the entire R/W crossing.

2. The Railroad will not permit casing installation by open-cut method through the track(s) roadbed.

3. The casing pipe may be omitted for non-pressure sewer or drainage crossings where class V, reinforced concrete pipe can be jacked under the railroad.

4. All electrical wirelines and gas pipelines (less than 10 feet (3.05 m) below base of rail) shall be encased with steel pipe.

5. The casing pipe must be installed at least 5.5 feet (1.7 m) below base of rail or a minimum of 3 feet (0.91 m) from natural ground grade or bottom of ditches (whichever is greater)(see Table 1).

6. Steel casing pipe: For carrier pipe less than 6 inches (168.3 mm) in diameter, the inside diameter of the casing pipe shall be at least 2 inches (50.8 mm) greater than the largest outside diameter of the carrier pipe joints or couplings. For carrier pipe 6 inches or greater in diameter, the inside diameter of the casing pipe shall be at least 4 inches (101.6 mm) greater than the largest outside diameter of the carrier pipe joints or couplings. Steel pipe shall have a specified minimum yield strength, SMYS, of at least 35,000 psi (241 Mpa). The ASTM or API specification and grade for the pipe are to be shown on the application form.

7. All joints or couplings, supports, insulators or centering devices for the carrier pipe shall be considered in the selection of the casing diameter.

8. Casing pipe shall have a **minimum** wall thickness as shown in the table provided below, unless computations indicate that a thicker wall is required (see paragraph 9). 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 greater than the thickness required except for diameters under 12-3/4 inches. Wall thickness designations for steel casing pipe for Cooper E-80 loading including impact are as follows:

Nominal Diameter (inches)	Min. Thickness for Coated (inches)	Non Coated (inches)
12-3/4 and under (324 mm)	0.188 (4.77 mm)	0.188 (4.77 mm)
14 (356 mm)	0.188 (4.77 mm)	0.250 (6.35 mm)
16 (406 mm)	0.219 (5.59 mm)	0.281 (7.14 mm)
18 (457 mm)	0.250 (6.35 mm)	0.312 (7.92 mm)
20 and 22 (508 & 559 mm)	0.281 (7.14 mm)	0.344 (8.74 mm)
24 (610 mm)	0.312 (7.92 mm)	0.375 (9.53 mm)
26 (660 mm)	0.344 (8.74 mm)	0.406 (10.31 mm)
28 (711 mm)	0.375 (9.53 mm)	0.438 (11.13 mm)
30 (762 mm)	0.406 (10.31 mm)	0.469 (11.91 mm)
32 (813 mm)	0.438 (11.13 mm)	0.500 (12.70 mm)
34 and 36 (864 & 914 mm)	0.469 (11.91 mm)	0.531 (13.49 mm)
38 (965 mm)	0.500 (12.70 mm)	0.563 (14.27 mm)
40 (1016 mm)	0.531 (13.49 mm)	0.594 (15.09 mm)
42 (1067mm)	0.563 (14.27 mm)	0.625 (15.88 mm)
44 and 46 (1118 & 1168 mm)	0.594 (15.09 mm)	0.656 (16.66 mm)
48 (1219 mm)	0.625 (15.88 mm)	0.688 (17.48 mm)
50 (1270 mm)	0.656 (16.66 mm)	0.719 (18.26 mm)
52 (1321 mm)	0.688 (17.48 mm)	0.750 (19.05 mm)
54 (1372 mm)	0.719 (18.26 mm)	0.781 (19.84 mm)
56 and 58 (1422 & 1473 mm)	0.750 (19.05 mm)	0.813 (20.62 mm)
60 (1524 mm)	0.718 (19.84 mm)	0.844 (24.61 mm)
62 (1575 mm)	0.813 (20.62 mm)	0.875 (22.23 mm)
64 (1626 mm)	0.844 (21.44 mm)	0.906 (23.01 mm)

66 and 68 (1676 & 1727 mm)	0.875 (22.23 mm)	0.938 (23.83 mm)
70 (1778 mm)	0.906 (23.01 mm)	0.969 (24.61 mm)
72 (1829 mm)	0.938 (23.83 mm)	1.000 (25.40 mm)

(*) = Casing Pipe diameters exceeding 72 inches require review and approval from Railroad AVP - Design prior to use.

9. If casing pipe wall thickness deviates from the table in Subsection B.8, all casing thickness determinations will be based on Cooper E-80 Railroad Loading, using applicable formulas and computations performed by a registered professional engineer, registration must be in the project State. The (Signed/Sealed) computation results will accompany the plans for review by the Engineering Department.

10. All casing pipe joints will be welded in accordance with AISC Specifications, Section 1-7-2. All joint welds will be full penetration.

11. The inside diameter of the casing pipe shall be such as to allow the carrier pipe to be removed subsequently without disturbing the casing or the roadbed.

12. Casing Pipe Vents - All casing pipes, with the exception of electrical, communication or sewer lines, shall be properly vented. Vent pipes shall be of sufficient diameter, but in no case less than two (2) inches in diameter and shall be attached near each end of casing, projecting through ground surface and located a minimum of 45 feet from the centerline of the nearest track but preferably outside of Railroad property limits. Vent pipes shall extend not less than four (4) feet above ground surface. Top of vent pipes shall be fitted with a down-turned elbow, properly screened; or a relief valve installed.

13. All Casing pipe ends that are below ground level shall be constructed as to prevent leakage of any substance from the casing throughout its length. Each end of the casing shall require a sufficient seal to prevent the potential for leakage of any substance from the casing pipe. Grout fill is an acceptable method installed by pressure grouting. If used, the grout material should consist of non-shrink sand cement slurry or Railroad approved equivalent, and sufficiently seal the casing pipe ends to the satisfaction of the Railroad. If deemed necessary, and at the sole discretion of the AVP - Design, the entire void between the carrier pipe and casing pipe throughout the entire length of the casing pipe may be required to be filled upon notification from the Railroad. In this case vent pipes are not required.

C. Carrier Pipeline Specifications:

1. Reinforced concrete pipe:

   - Materials: Modified bell and spigot or tongue and groove in accordance with current ASTM Specification C76 Class V for Railroad strength pipe or current specification for pre-stressed concrete pipe.

   - Joints: Rubber and steel joint for pre-stressed pipe in accordance with current Lock Joint Pipe Company Specification on SP5, or equivalent. Joints for bell and spigot and tongue and groove pipe to be in accordance with current standard practice. Joints may be made using confined continuous rubber gasket.

2. Cast iron pipe:

- Materials: Pipe must conform to current ASTM Specification A142 for "Standard Pipe."

- Joints: Bell and spigot, caulked with lead and oakum, or approved mechanical type joint.

3. Plastic Pipe: The use of plastic carrier pipe for sewer, water, natural gas and other liquids is acceptable under specific circumstances per AREMA. The use of plastic pipe is satisfactory if the pipe is designed to meet all applicable federal and state codes, and if the carrier pipe is encased within a steel casing pipe per AREMA standards. The casing must extend the full width of the right-of-way. 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.

4. Polyethylene pipe (HDPE): Pipe must conform to the current ASTM Specifications D2104, Schedule 40, for standard pipe when encased with steel casing.

5. Steel pipe:

    - Materials: Pipe must conform to current ASTM Specification A120.

    - Joints: All joints must be welded or of an approved mechanical type.

        - Steel pipe shall not be used to convey sewage, storm water or other liquids which could cause corrosion.

6. Carrier Pipe Shut-Off Valves - Carrier pipe under pressure shall have a sufficient shut-off valve(s) at each end outside of Railroad's right-of-way limits. Accessible emergency shut-off valves shall be installed within effective distances (normally within 2000 feet) each side of the railway 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.

D. Uncased Gas Pipelines

1. Carrier line pipe under railroad tracks must be a **minimum 10 feet below base of rail** to top of pipe at its closest point. At all other locations on the rights-of-way the minimum ground cover must be 6 feet (see Table 1). Where it is not possible to secure the above depths, casings as specified in section II, B will be required.

2. Carrier pipe must be steel and conform to the requirements of ANSI B 31.8 Gas Transmission and Piping Systems, and other applicable ANSI Codes. All steel carrier pipes must be coated and cathodically protected to industry standards.

3. Joints for the 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. The nominal wall thickness for the steel carrier pipe, SMYS, maximum allowable operating pressure (MAOP), and outside pipe diameter (D), are given in Appendix A.

4. Uncased gas pipelines shall be installed by boring or jacking or horizontal directional drilling (HDD).

E. Longitudinal Pipelines

1. Pipelines laid longitudinally on the Railroad's right-of-way shall be located as far as practicable from any tracks or other important structures and as close to the property line as possible. Longitudinal pipelines must not be located in earth embankments or within ditches located on the right-of-way. They must not be within 25 feet of any track and must have a minimum of 6 feet ground cover for flammable substances and 4 feet for non-flammable substances over the pipeline up to 50 feet, measured from the track centerline. Where pipeline is laid more than 50 feet from centerline of track, minimum cover shall be at least 5 feet for flammable substances and 3 feet for non-flammable substances. 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 ANSI specifications, current OSHA regulations, or local regulatory agency specifications.

2. Allowable hoop stresses must comply with AREMA requirements and all applicable federal, state and local codes.

3. If Horizontal Directional Drilling (HDD) is used as the method of installation for the longitudinal occupancy, the minimum required depths in paragraph 1 above are increased by 2 feet.

4. For pipelines running longitudinally on the Railroad's property, signs shall be placed over the pipe (or offset and appropriately marked) at all changes in direction of the pipeline. Such signs should also be located so that when standing at one sign the next adjacent marker in either direction is visible. In no event shall they be placed more than 500 feet apart. Right of way warning signs must be shown on the plan view drawing.

F. Tunnel Liner Requirements:

1. All applicable preceding sections will govern tunnel liner usage.

2. Tunnel liner plate will be 12-gauge, galvanized, and all bolts and nuts will be galvanized.

3. Live load will be based on Cooper E-80 Railroad Loading, using applicable formulas and computations performed by a registered professional engineer, registration must be in the Project State. The (signed/Sealed) computation results will accompany the plans for review by the Engineering Department.

4. Grout holes, if required will be provided at 10-foot intervals along the roof and sides.

5. The tunnel liner-jacking shield will protect 180 degrees of the upper section and material removed to allow for a minimum 1:1 slope, with a minimum 2.0 feet of undisturbed soil supporting the overburden.

6. The tunnel liner installation will progress with sufficient manpower and supervision for around-the-clock construction until the liner is completed, through the limits of the right-of-way.

G. Abandoned Facilities

1. The owner of all pipe crossings proposed for abandonment shall notify the Railroad, in writing, of the intention to abandon.

2. Abandoned pipelines (carrier or casings) with an outer diameter greater than 2 inches shall be completely filled with cement grout, compacted sand, or other methods, as approved by the Railroad.

3. Abandoned manholes and other structures shall be removed to a minimum depth of 2 feet below finished grade and completely filled with cement grout, compacted sand, or other methods as approved by the Railroad.

4. The location of abandoned facilities shall be recorded and records maintained by the pipeline owner.

H. Guidelines for Horizontal Directional Drilling (HDD) Under Tracks

1. For pipelines conveying gas or liquid substances, steel pipe only may be installed under track(s) and/or right-of-way utilizing horizontal directional drilling.

2. For outermost pipe diameters 6 inches or less, the depth below natural ground or railroad ditch will be 1 ft greater than that allowed using the jack and bore method for each commodity. For outermost pipe diameters greater than 6 inches, the depth below natural ground or railroad ditch will be 2 ft greater than that allow using the jack and bore method for each commodity (see Table 1). For longitudinal occupancies, see E.3 above for the required depths.

3. For wireline installations, including fiber optic cable, HDPE Sch 80 or stronger pipe may be installed as the outermost pipe. Bundling is prohibited. All innerducts must have an outer casing pipe.

4. Minimum cover for all pipelines with outside diameter of 6 inches or less, regardless of product, shall be 10 feet minimum below base of rail. For all liquid or gas installations regardless of product, with nominal pipe sizes exceeding 6 inches outside diameter, minimum cover (measured from base of rail to top of pipe) shall be a minimum of 25 feet. For fiber optics or electrical installations, with casing/conduit nominal size exceeding 6 inches, minimum cover shall be 15 feet (see Table 1).

5. Applicant submittal shall include actual planned depth of pipe under each railroad track. The plan and profile views must show the entire bore, including the sending and receiving pits, regardless of the right-of-way limits.

6. Applicant must provide pipe specifications for casing and carrier pipes. Pipe must satisfy all applicable government and industry regulations.

7. Applicant must provide qualifications of drilling contractor, including specific instances of previous successful experience in drilling under railroad and other sensitive surface facilities.

8. Prior to commencement of drilling:

    a. The contractor must submit a Boring Plan that describes the anticipated rig capacity, the proposed equipment and the method for advancing the bore hole through expected soil conditions, angles, depth and exact location of the exit ditch, the pilot hole diameter, the proposed reaming plan, including the diameter of the pre-reams/back-reams and diameter of the final reamed bore hole, and the contingency equipment and plans for dealing with soil conditions that a soils engineer could reasonably expect to be encountered at the proposed HDD installation site. The Boring Plan should also address the anticipated hours of operation during the HDD bore hole drilling and installation process, the minimum number of personnel and their responsibilities on-duty and on-site during all HDD drilling operations. Consideration for working hours must be given to minimize risk to railroad operations during drilling operations. See "Additional Guidelines" (Item 10) for additional bore guidelines.

    b. The contractor must provide a detailed Fracture Mitigation (frac-out) Plan, including method of monitoring quantity and capturing the return of drilling fluids with particular attention to variation from proposed plan (i.e. volumes, pressure, or consistency).

    c. The contractor must establish a Survey Grid Line and provide a program of monitoring and documenting the actual location of the bore hole during drilling operations.

9. An engineering inspector is required to monitor the ground and track for movement during drilling, reaming, and pullback processes. The engineering inspector shall be provided by the applicant at their sole cost and expense. The installation process and all train movement must be immediately stopped if ground or track movement is detected. The damaged area must be immediately repaired. The installation process must be reviewed and modified as required before the installation can proceed. Applicant must pay all expenses for review and inspection.

10. Bore Plan Additional Requirements
    In addition to all the requirements outlined in the above guidelines, the bore plan should include the following:

    - Pre-bore survey grid line with angles and depths defined
    - Statement that once the bore enters railroad property, the work will be continuous until the drilling is complete and the pipe is pulled into place.
    - Statement that the bore will be tracked constantly, with the location and depth marked every 10 feet.
    - If the commodity to be conveyed permits the use of HDPE pipe, it must be schedule 80 (SDR11 pipe is acceptable for pipes 2" in (50.8 mm) diameter or greater) or better (thicker wall).
    - The maximum size of the bore hole may not exceed Outside Diameter (OD) X 1.5 if OD is 10 inches or less. If the OD is greater than 10 inches, the bore hole may not exceed OD X 1.3.
    - A defined slurry recovery method. Disposal on railroad property or within railroad ditches and facilities is prohibited.

- The launching and receiving pits must be situated at minimum outside the railroad right-of-way. In cases where the slope of the railroad grade extends beyond the right-of-way, pits must be located beyond the toe of the slope so as not to compromise the railroad grade.
- Statement of expected soil conditions and statement of all drill heads on site for expected and unexpected soil conditions.
- Specifications and capacities of the bore machine. This includes:
  - Maximum capacities
  - Intended capacities
  - Maximum drilling RPM
  - Intended drilling RPM
  - Maximum drilling PSI
  - Intended drilling PSI
  - Maximum GPM
  - Intended GPM

Table 1. UNDERGROUND PIPE DEPTH REQUIREMENTS

REQUIRED DEPTHS FROM BASE OF RAIL TO TOP OF PIPE				
	Jack and Bore		Horizontal Direction Drill	
Commodity	Outermost Dia 6 Inch or less	Outermost Dia Greater than 6 Inch	Outermost Dia 6 Inch or less	Outermost Dia Greater than 6 Inch
Electrical	5.5 ft (1.68 m)	5.5 ft (1.68 m)	10 ft (3.05 m)	15 ft (4.57 m)
Fiber Optic	5.5 ft (1.68 m)	5.5 ft (1.68 m)	10 ft (3.05 m)	15 ft (4.57 m)
Non-Pressurized Liquid	5.5 ft (1.68 m)	5.5 ft (1.68 m)	10 ft (3.05 m)	25 ft (7.62 m)
Pressurized Liquid	5.5 ft (1.68 m)	5.5 ft (1.68 m)	10 ft (3.05 m)	25 ft (7.62 m)
Gas	5.5 ft (1.68 m) or 10 ft (3.05 m) if uncased	5.5 ft (1.68 m) or 10 ft (3.05 m) if uncased	10 ft (3.05 m)	25 ft (7.62 m)
Oil	5.5 ft (1.68 m)	5.5 ft (1.68 m)	10 ft (3.05 m)	25 ft (7.62 m)

REQUIRED DEPTHS FROM NATURAL GROUND OR BOTTOM OF DITCH TO TOP OF PIPE				
	Jack and Bore		Horizontal Direction Drill	
Commodity	Outermost Dia 6 Inch or less	Outermost Dia Greater than 6 Inch	Outermost Dia 6 Inch or less	Outermost Dia Greater than 6 Inch
Electrical	3 ft (0.92 m)	3 ft (0.92 m)	4 ft (1.22 m)	5 ft (1.52 m)
Fiber Optic	3 ft (0.92 m)	3 ft (0.92 m)	4 ft (1.22 m)	5 ft (1.52 m)
Non-Pressurized Liquid	3 ft (0.92 m)	3 ft (0.92 m)	4 ft (1.22 m)	5 ft (1.52 m)
Pressurized Liquid	3 ft (0.92 m)	3 ft (0.92 m)	4 ft (1.22 m)	5 ft (1.52 m)
Gas	3 ft (0.92 m) or 6 ft (1.83 m) if uncased	3 ft (0.92 m) or 6 ft (1.83 m) if uncased	4 ft (1.22 m) or 7 ft (2.13 m) if uncased	5 ft (1.52 m) or 8 ft (2.44 m) if uncased
Oil	3 ft (0.92 m)	3 ft (0.92 m)	4 ft (1.22 m)	5 ft (1.52 m)

III. Above Grade Structures (Please see Genesee and Wyoming, Inc. Public Projects Manual for all highway overpasses and other public projects)

A. Standard overhead clearances for fixed structures, such as bridges and other overhead fixed structures shall provide a minimum of 23 feet vertical clearance above top of rail (T/R).

B. The bridge or other structure shall completely span the railroad right-of-way. Piers, columns or other structures must be located off the right-of-way.

C. Pre-design conference with the Engineering Department will set forth horizontal clearance of subgrade, grade, and above grade construction and structural limits.

D. The railroad shall be furnished as-built drawings showing the actual clearances as constructed.

E. Crashwalls, per AREMA Specifications, Chapter 8, Article 2.1.5, are required when the face of pier is closer than 25' 0" from the centerline of track, measured perpendicular to the track.

F. Drainage from the bridge shall be preferably collected with drain pipes and drained away from the railroad's right-of-way. Scuppers from the bridge must not drain on to railroad right-of-way.

G. Projects involving stormwater systems shall be designed for a 100 year storm event as a minimum.

H. All highway structures shall have a protective barrier fence that extends at least 8'-0" from the top of sidewalk or driving surface adjacent to the barrier wall. The fence may be placed on top of barrier wall and should also include anti-climb shields or be of a configuration to minimize the likelihood of climbing on the outside of the protective fencing.

I. For guidelines and specifications for progressing project such as highway overpasses, please see Public Projects Manual available at www.GWRR.com

IV. Above Grade Wirelines

A. All installations of aerial lines and cables will provide a minimum clearance above top of rail (T/R) of highest track. Standard overhead clearance for all aerial line crossings, both power and non-power line crossings, shall provide the following clearances (Clearances are based upon the maximum sag conditions, whether sag is created by thermal or physical conditions. refer to drawing ES 8090.2):

Nominal Voltage	Overhead Clearance
0 – 750	27' – 0"
To 15,000	28' – 0"
To 50,000	30' – 0"
69,000	30' – 8"
115,000	32' – 2"
138,000	33' – 0"
345,000	39' – 10"
500,000	45' – 0"
745,000	53' – 2"
765,000	53' – 10"

Nominal Voltage	Canadian Clearance
0 – 750	7.3 m (7.6 m)
To 22,000	7.6 m (7.9 m)
To 50,000	8.1 m (8.4 m)
90,000	8.4 m (8.7 m)
120,000	8.7 m (9.0 m)
150,000	9.0 m (9.3 m)
200,000	9.5 m (9.8 m)
220,000	9.7 m (10.0 m)
318,000	10.7 m (11.0 m)
442,000	11.9 m (12.2 m)

B. At Roadway Grade Crossings, provide safe clearances between warning devices and electrical transmission, distribution cables (including messenger and neutral wires), and all communication lines. All overhead utility crossings shall provide the minimum vertical clearance from top of rail (T/R) of highest track as shown in Subsection A above plus additional clearances necessary to obtain operational clearances from crossing warning device assemblies

1. 6'0" (1.8 m) vertical clearance from Gate tips in vertical position or structure mast (whichever is greater).
2. 13'-6" vertical clearance from Cantilever arm or structure mast (whichever is greater).
3. The minimum clearance from crossing gate tips, cantilever structures, signal masts, signal and other bridges, etc. shall conform to the National Electric Safety Code, section 23, rule 234, but in no case shall the overhead clearances shown in the table above or the additional clearances as outlined in 1 and 2 above be reduced.
4. For Canadian railroads, an additional 0.3 m of vertical clearance above rails shall be provided to account for rail lift per CSA 5.3.1.1 paragraph C.

C. The poles or towers supporting the crossing span should be located outside the railroad's right-of-way. If locating poles or towers outside the right-of-way is not possible, the side clearance of poles and towers from the nearest track shall be not less than 25 feet.

D. Wireline crossings not to be installed within 500 feet of the end of any railroad bridge or 300 feet from the centerline of any culvert or turnout (switch).

E. Wires and cables running longitudinally along the railroad's right-of-way shall be constructed as close to the property lines as possible, except in cases where doing so will interfere with Railroad operations, surface drainage or soil stability.

F. Poles and towers near public road crossings shall be located so as to not interfere with the sight-distance along the railroad from motorists on the public roadway.

G. Should the Railroad add or modify existing crossing warning devices or facilities at any highway grade crossings, existing wire lines or cables shall be raised or relocated immediately on notice from Railroad to lessee and at the sole cost and expense of the lessee.

V. Miscellaneous

A. Cathodic protection of pipelines, cables, or casings:

1. When cathodic protection is provided, it shall be installed so as not to induce currents, which will interfere with the signal apparatus of the Railroad. Any change required in the manner, method, or location of such cathodic protection shall be made at the sole cost and expense of the lessee and to the satisfaction of the Engineering Department of the Railroad.

2. Cathodic protection shall be applied to all pipelines carrying flammable substances on the Railroad's right-of-way.

B. Proposed structures must maintain a minimum 10-foot horizontal clearance to the face of any signal, post, crossing gate or other above grade obstruction.

VI. Standard Drawings

A. The following Standard Reference drawings in reference to these written specifications are available upon request:

1. **ES8049.1** – Mainline Design & Installation of CMP
2. **ES8090.2** – Information Required for Utility Crossing Applications (Overhead)
3. **ES8090.3** – Overhead Bridge Permit Information
4. **ES8090.4** – Information Required for Utility Crossing Applications (Underground)

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

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP $\leq$ 100 psi					MAOP $\leq$ 200 psi				
$\leq$ 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

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	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
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

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

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 500 psi — Continued					MAOP ≤ 600 psi — Continued				
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
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

Table 1-5-3. Minimum Nominal Wall Thickness (in.) 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				
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
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

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

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 1100 psi - Continued					MAOP ≤ 1200 psi - Continued				
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
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

Table 1-5-3. Minimum Nominal Wall Thickness (in.) 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				
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
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

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

D (in.)	SMYS (psi)					SMYS (psi)				
	35000	42000	52000	60000	70000	35000	42000	52000	60000	70000
	MAOP ≤ 1700 psi - Continued					MAOP ≤ 1800 psi - Continued				
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
	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 ANSI Code if lower allowable percentage of hoop stress applies.