

IV. INDUSTRIAL TRACK DESIGN

4.01 GENERAL

The following sections govern the criteria to be used in the designing of industry tracks served, or to be served, by the Railway Company. Any deviation from these requirements must be approved by the Railway's Chief Engineer or designated representative.

4.02 HORIZONTAL CURVATURE

Degree of curve

Tracks should be designed utilizing the minimum degree of curvature practicable, but must be limited to a maximum of 12 degrees (radius = 478.34 feet) on spur tracks and 10 degrees (radius = 573.69 feet) on lead tracks. **Calculations for horizontal curves must be based on the chord definition.**

Tracks for rail cars exceeding a coupler to coupler length of 73 feet should be designed with a maximum of 10 degrees curvature (radius=573.69 feet).

Reverse curves

Where reverse curves are to be used, it will be necessary to provide preferably 100 feet, but a minimum of 70 feet, of tangent between the point of tangency of the preceding curve and the point of curvature of the next curve (see insert on page 9).

Spirals and superelevation

Spiral curves and/or superelevation shall only be required where the speed of operation so dictates. Designs for lead tracks one mile or longer will be evaluated by the Company on an individual basis to determine if spirals and superelevation are required.

Additional curve limitations

Horizontal curves must not begin on the long ties of a turnout. Horizontal curves should not exist inside a Double Switch Point Derail (DSPD). Horizontal curves should not be less than 50 feet in length.

4.03 VERTICAL CURVATURE

Vertical curve limitations

Vertical curves must be provided at break points in the profile of the track and should be as long as practicable.

Vertical curves must not begin or end on the long ties of a turnout. The grade from the switch point through the long ties of the proposed turnout must be the same as the existing track from which it springs.

What is the *chord* definition, and why does the railroad use it?

Railroad use of chord definition for curves comes from the low-tech practice of *string-lining* to lay out and maintain curves in the field, which is still practiced by both main line railroad maintenance personnel and industrial rail contractors today.

Geometrically, the chord definition is simply:

$$R = 50 / (\sin (D/2))$$

where: R = radius in feet
D = Degree of Curve

What is *rate of change* (r) and why does the railroad use it?

Railroad use of r, instead of “k” as is used in highway design, dates back to design parameters set during the 1860s.

$$r = \frac{|G_2 - G_1|}{L}$$

r = Rate of Change

L = Length of Curve in 100' Stations

G₁ = Entrance Grade

G₂ = Exit Grade

Vertical Curve Length for Lead Tracks

Lead Track minimum vertical curve length, in feet, will be 100 times the algebraic difference of grades in percent for summits and sags, i.e., maximum rate of change for summits and sags = 1.0.

Vertical curve length for spur tracks up to 1500 feet in length

Minimum vertical curve length, in feet, for spur tracks up to 1500 feet in length will be 33.3 times the algebraic difference of grades in percent for summits and 40 times the algebraic difference for sags, i.e., maximum rate of change for summits = 3.0 and maximum rate of change for sags = 2.5.

Vertical curve length for spur tracks over 1500 feet in length

Minimum vertical curve length, in feet, for spur tracks over 1500 feet in length will be 40 times the algebraic difference of grades in percent for summits and 50 times the difference for sags, i.e., maximum rate of change for summits = 2.5 and maximum rate of change for sags = 2.0.

4.04 GRADES

Track grades should be kept to a minimum and shall be restricted to a maximum of 2 percent (compensated) on lead tracks, and 3 percent (compensated) on individual spur tracks.

Grade compensation for curvature will be a 0.04 percent reduction per degree of curvature. For example, the maximum grade on a spur track with a 10° horizontal curve is: 3.0% – (0.04 x 10) = 2.6%.

4.05 LOADING & UNLOADING TRACKS

Industry tracks where rail cars are loaded and unloaded must be on a 0% (flat) grade.

Industry tracks should have minimum 30 feet, or one half the length of a rail car, whichever is greater, of track from the end of any vertical curve immediately before the loading or unloading area to the start of the first car spot.

Industry tracks shall have minimum 30 feet, or one half the length of a rail car, whichever is greater, of track from the end of the last car spot on the unloading track before the End of Track Device (see section **4.09**).

4.06 TRACK CENTERS

Industry track centers for multiple parallel and concentric tracks within the industry facility must be no closer than 14 feet, centerline to centerline, compensating (increasing) for curvature in accordance with Railroad *MW&S Standard Procedure 040*, assistance for which may be obtained by contacting the Railroad's Design & Construction Department when appropriate.

Note: Where individual states public law or regulation has track center or clearance requirements more restrictive than the Company standard, such laws or regulations will govern.

Industry tracks, both leads and spurs, parallel to Company railroad tracks may be no closer than 15 feet, centerline to centerline, compensating (increasing) for curvature in accordance with Railroad *MW&S Standard Procedure 040*, assistance for which may be obtained by contacting the Railroad's Design & Construction Department.

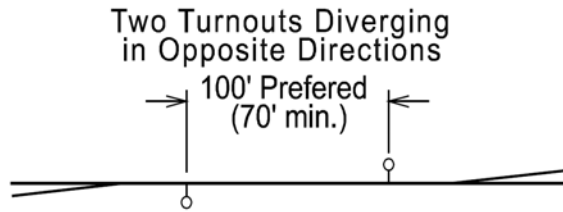
Track centers should be increased to accommodate adequate side clearances to any unloading apparatus, such as a pipe rack, between parallel tracks. See section **4.10** of this chapter for more information on clearances.

4.07 TURNOUTS

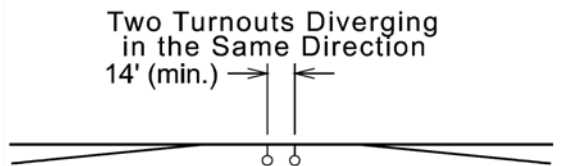
All main track turnouts will be No. 10 or larger. Turnouts in side tracks will also be No. 10. The Assistant Chief Engineer – Design may consider the use of No. 8 turnouts in side tracks where site constraints will not permit a No. 10 turnout on a case by case basis. Reference **Standard Plan 2-17** and the **Turnout Design Schematic** for turnout geometry. Standard No. 8 and No. 10 turnouts are shown on **Plans No. 2 – 4, No. 2 – 6, and No. 2 – 7** in the attachments.

Turnouts will not be placed on curved or spiraled track.

Two turnouts in the same track diverging in opposite directions, thereby creating a reverse curve situation, will be separated by preferably 100 feet, but at a minimum of 70 feet, between the point of switches of the two turnouts.

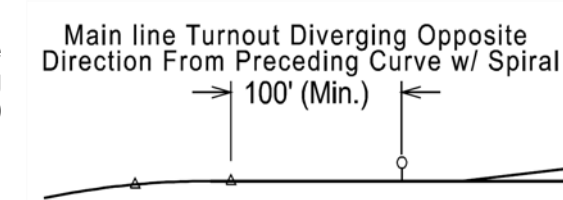


Two turnouts in the same track diverging in the same direction will be separated, point of switch to point of switch, by a minimum of 14 feet.



A turnout diverging in the same direction as a preceding curve or spiral will have as much tangent as possible from the end of the curve or spiral to the point of switch.

A main track turnout diverging in the opposite direction from a preceding curve cannot be placed less than 100 feet beyond the end of the curve spiral.



All work on Company tracks, including main track turnouts, shall be accomplished by the Railway Company.

Turnouts in the main line should not be placed within 100 feet of an at-grade road crossing.

Turnouts in the main line will not be placed within 50 feet of a railroad signal.

Turnouts in the main line should not be placed on a railroad bridge or within 100 feet of a railroad track bridge face or back-wall.

Turnouts in the main line will not be placed underneath an overpass.

4.08 DERAILS

A derail is a mechanical device installed on a track to derail rail cars, engines, and on-track equipment for one of several reasons:

Derails are *always* installed on Industry tracks at the 15' **Clear Point** (see II. Definitions) before the main line turnout to derail away from the main line anything moving on the Industry tracks that does not have permission to be on Company Tracks.

Derails can also be used where safety is a concern. For example, derails can be placed before tracks cross public or private streets at grade or at the top of steep grades to prevent "run-away" situations.

All derails to be operated by Company personnel must be equipped with a Company supplied lock and key. These locks will be operated by Company personnel **only**.

A Double Switch Point Derail, also known as a DSP Derail, will be installed, by the Company, with the non-switch end of the derail at the Clear Point of a track which has a descending grade towards the Company track. The entire Double Switch Point Derail (43' long) should be designed in tangent track. See Derails in the attachments for details of a Double Switch Point Derail.

Hayes Model HB Derails will be installed, by the Company, at the Clear Point of tracks which have no grade or a descending grade away from the Company track.

A Double Switch Point Derail (DSPD) will be installed at the Clear Point on *any* track that handles hazardous materials (NS MW&S Standard Procedure 100).

Derails are to be painted international orange. Glass beads should be sprinkled on after painting while paint is still wet to increase night time visibility (NS MW&S Standard Procedure 100).

Company Transportation and/or Design and Construction Engineering personnel have the right to require additional derails where safety is a concern on tracks operated over by the Company.

4.09 END OF TRACK DEVICES

Earth Mounds or Bumping Posts shall be placed at the open end of all stub-ended tracks. Earth Mounds are the preferred Company choice of end of track (EOT) device.

Earth Mounds (see attached **Detail: Earth Mounds**) should be of an approved design sufficient to stop a moving car and should be protected against erosion.

Bumping posts will be used on all stub end tracks which end at a structure, dock, road, or where public or private safety is required. Bumping posts shall be either new or second-hand, of good quality and approved design.

Use of Wheel Stops is to be avoided and will only be allowed with the expressed consent of the Company.

4.10 SIDE AND OVERHEAD CLEARANCES

Standard vertical and horizontal clearances from the centerline of industry tracks at top of rail to adjacent and overhead structures are shown on **Plan 7-1**, attached to these guidelines. All substandard clearances must have the approval of the responsible operating officer of the Company provided that the Company Clearance Engineer determines that there are no equipment restrictions for the proposed plans.

Design of all Structures, such as buildings, loading racks, stairways, and overhead fall arrest protection supports, etc., to be built adjacent or over Industry tracks should be designed with Railroad clearance envelope shown in **Plan 7-1** in mind. *It is advised that the Industry investigate Federal, State and local safety and environmental regulations to determine what structures and/or appurtenances will be required for their particular method of operation and commodity early in the design process.*

Although the maximum vertical distance from the proposed top of rail to a platform, loading dock, or building finished floor elevation is shown as 4.00 feet on **Plan 7 - 1**, the Company recommends a design distance of 3.75 feet. This is the average finished floor height of a standard box car. The industry's designer should coordinate rail car information with the Company's engineer to verify the proper design distance between the top of rail and the finished floor elevation of the dock or building.

Standard vertical clearances from the centerline of track at top of rail for overhead electric lines are shown on **SP-1621**, attached to these guidelines.

Side clearances for storage of rail cars and storage tanks for Hazardous Commodities can be found in chapter **12** of this manual.

"Close Clearance" signs, if required, will be posted as directed by the Company. Close Clearance signage will be as shown in **Plan 6-14**, attached.

4.11 ROADBED SECTION

Requirements for roadbed shoulder width, ditches, and slopes are shown on **Plans 1-21** (heavy tonnage tracks other than main tracks), and **1-22** (industrial tracks), attached to these guidelines. Industry should note the importance of constructing these typical roadbed sections which will provide an adequate walkway for both Company and Industry personnel. This is especially true in the area between switch stands and derails and any other areas as dictated by local, State or Federal regulations.

Consideration of operating and tonnage requirements must be taken into account when designing the typical roadbed section for a new track. Most spur tracks typically can make use of the section shown on **Plan 1–22**. Heavy tonnage spur tracks, such as those serving coal facilities and lead tracks of considerable length, such as those serving an industrial park, for example, should utilize **Plan 1–21** for roadbed design. See “**Chapter VI. SITE WORK**” of these guidelines for more information concerning civil site design for industrial railroad applications.

4.12 GRADE CROSSINGS AND ROADS

Roads Crossing or Paralleling Company Tracks

New at-grade road crossings which cross Company Tracks should be avoided. Design, permitting, and approval for new grade crossings over Company tracks can be an extensive and time consuming process. The applicant should initiate the crossing permit application early in the conceptual phase of project planning. The Industry should work closely with the Company engineering department on design and location of the proposed crossing and preparation of plans for final approval submittal to the Division Superintendent.

Safety is always the controlling factor in design of new at-grade road crossings. Factors such as sight distance of train and vehicle operators, type of vehicles utilizing the proposed crossing, grade of the proposed road, vehicle braking ability, and accessibility of the location to be served by the crossing if the crossing is blocked by a stopped train are examples of factors which must be considered, to name a few. It is the Industry’s responsibility to incorporate any local, State or Federal regulations, guidelines or mandates which may govern grade crossing design at their proposed location. This is often, but not always, governed by the type (e.g. local, state or federal highway) of road.

Grade crossing warning devices such as Cross Buck Signs (Passive Warning) or Flashing Light Signals with or without Gates (Active Warning) are Highway Traffic Control Devices. The Division Superintendent shall determine the level of warning or device to be installed for a crossing over a Private Road. For a crossing over a Public Road or Street the State Agency or Local Authority (Road Authority) with jurisdiction over the road shall evaluate and determine the level of warning or device for that crossing. The Industry should work closely with both the Road Authority and the Company to assist in determining the adequate level of warning for the proposed crossing.

If the governmental agency having jurisdiction requires that automatic warning devices be installed at the crossing, before industry purchases and installs said devices, it will be necessary that the plans for installation for such control apparatus and equipment be submitted to the Company’s Signal and Electrical Department for review and approval. Engineering plans for installation of the grade crossing warning devices must also be reviewed and approved by the governmental agency prior to installation. This level of involvement may vary depending on the type of Company owned track involved, i.e. main line vs. lead track serving an industrial park.

Asphalt Paving with Rubber Flange Way (a.k.a. Rubber Rail Seal) is the current standard crossing surface for at-grade road crossings over Company Tracks (see **Plan 7– 05B**). Any desired use of alternative surface types, such as Concrete Panels (see **Plan 7 – 6 and 7 – 6A**), by any party should be discussed with the Company’s Engineering personnel and will be covered in the Crossing Agreement.

Roads paralleling Company tracks on Company property should be designed to provide for the safety of all parties using the proposed road. Many factors contribute to roadway design and the Industry should work closely with the Company in this regard. This type of use of the Company's property almost always requires a formal agreement with the Company.

Roads Crossing Industry Tracks

Private at-grade road crossings and roads parallel to Industry tracks beyond a track's Division of Ownership and Maintenance on Industry property must meet Company standards and will be covered under an operating agreement.

Crossing surface types for private at-grade crossings are at the discretion of the Industry but must be built in accordance with Company standards. Attached **Plans 7- 05, 7- 05a, and 7- 05b** govern timber and rubber rail seal crossings while **Plans 7 - 6 and 7 - 6A** govern concrete crossings.

Safety of rubber tired vehicular traffic around railroad tracks inside industrial facilities is the responsibility of the Industry. Design of proper side clearances to tracks from adjacent roads, site distances at grade crossings, and proper signage must be in accordance with Company standards.

4.13 AT-GRADE TRACK CROSSINGS

Rail crossings should be used as little as possible. All rail crossings must be approved by the Company. The angle of the rail crossing must be that shown on the approved plans and/or as further defined as staked in the field. Detailed manufacturer's plans and specifications must be furnished for approval by the Company.