BUILDING AMERICA®

ENGINEERING TRACK MAINTENANCE

Field Handbook

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1.1 Cross Section

The ideal roadbed section conforms with Standard Drawing Nos. 0001, 0002 and 0003.

Many historical cross sections exist due to the design techniques available when the track was constructed and thus cannot conform exactly to Standard Drawing Nos. 0001, 0002 or 0003. The key is that these historical cross sections be maintained to allow water to freely drain away from the track structure.

1.2 Drainage

1.2.1 General Drainage

Roadbed drainage is the most important component of good track maintenance. The railroad track structure is designed to be permeable and allow water to freely flow through and away, it is not intended to act as a dam or barricade for water. To achieve proper drainage that diverts water away from the track, either direct the water parallel to and/or across the roadbed, or intercept and divert the water before it reaches the roadbed.
To provide adequate drainage, consider the following:

- Maximum expected runoff from rain, melting snow, or other sources
- Track and roadbed conditions that will develop during freezing temperatures

Follow these guidelines:

1. Water carrying devices can become blocked by debris which may reduce their ability to carry water.
2. Obstructions outside of the right of way can also interfere with waterflow.
3. During heavy rainfall or runoff, monitor water-carrying devices to make sure they handle the flow of water. Report any devices that cannot handle the water flow to the Manager Track Maintenance. If devices cannot handle the water flow the Engineering Design Department or Sr. Manager Special Projects (402-544-3672) can assist with H&H evaluation to determine correct sizing.
4. Do not allow adjacent land owners or other parties to divert water from their property into existing water-carrying devices or to construct such devices on the railroad right of way. Immediately report such activities to the Manager Track Maintenance.

1.2.2 Grade

The slope and grade of the track structure and surrounding adjacent grade should direct water away from the track toward natural or man-made water-carrying devices.

Follow these guidelines to ensure the correct grade:

1. Construct and maintain subgrade to a 2% cross slope when possible. Existing railroad grades on track historically constructed may not conform to the 2% grade. They must be maintained to allow water to flow away from the track to water carrying devices such as ditches, culverts, etc. Ditches, subsurface drains, perforated pipe, rock drains, or other water-carrying devices should be installed and maintained at a minimum slope of 3 inches in every 100 feet of length.
2. When water-carrying devices run parallel to the track, make sure they are sloped in a manner that will carry water in the intended direction. Ideal slope of 3 inches every 100 feet of length should be targeted, however, minimal slopes can still carry water.

1.3 Surface Drainage

1.3.1 Ditch Construction and Maintenance

IMPORTANT: At least 48 hours before performing work, call Union Pacific's *Call Before You Dig* hotline (800-336-9193) to determine if there are any fiber optic cables or other utilities in the work area.

After the UPRR Hotline has been contacted, each State has a one-call hotline that must also be contacted at least 48 hours before performing any work. Call the North American One Call Referral System (888-258-0808) to obtain the appropriate state one-call number. Call the state one-call center, who will notify all utility owners within the work area. Visit http://Call811.com to determine your states one call number.

***Do not* begin excavation or construction along the railroad's right-of-way until all utilities in the work area have been located and protected by their owners.**

Utilize the following guidelines when constructing and maintaining ditches:

1. The ideal ditch that parallels the track has a depth a minimum of 3 feet below the top of the sub-grade shown in Figure 1.3.1-A. In certain instances, a depth of 3 feet is not achievable, the goal is to keep the ditch below the top of the sub-grade as much as possible.
2. Flat bottom ditches are ideal as shown in Figure 1.3.1-A, however, alternative profiles can be utilized.

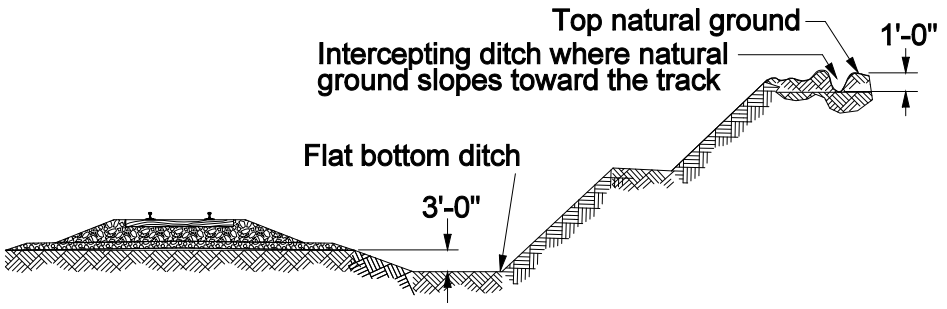

Figure 1.3.1-A

3. Intercepting ditches can be utilized in situations where water needs to be kept at the top or middle of a slope to keep it away from the track structure. These ditch types can help prevent erosion in certain applications. Ideal intercepting ditches are 1 foot in depth and flat bottomed. Direct the outlet end away from the track structure when possible.
4. Cut ditches through heavy snow wherever a sudden thaw could cause excessive runoff toward the track structure.
5. Many historical ditch sections exist that do not conform to modern requirements/design due to clearance concerns, bedrock depth, etc. Historical ditch sections should be maintained to allow for maximum water flow and may not be able to be upgraded to the latest profile.

NOTE: If grading or disturbing the soil will affect 1 acre or more; construction permits are required. Consult the Environmental Policy Guide prior to performing work to ensure that all requirements are met. Direct questions about grading/dirt work affecting storm water run-off to the Environmental Engineering Group.

1.3.2 Culverts

Follow these guidelines to ensure that culverts provide adequate drainage:

NOTE: Ensure the cover thickness over the top of the culvert to the bottom of the tie is at least one-half the thickness of the culvert diameter.

1. The Track Department inspects and maintains culverts less than 48 inches in diameter. For irregular rectangular culverts, the Track Department maintains those with an entry area less than 16 square feet.
2. Inspect culverts per the following; refer to the Work Procedure Document on Culvert Inspection for additional information.

   - Tier 1 Culverts

     Any Culvert (Large and Small) that is within a mile (either side) of a repeat water event location.

     or

     A single culvert Washout location.

     or

     Regional AVP Maintenance designation.

   - Tier 2 Culverts

     All other culverts that do not meet Tier 1 requirements.

1.3.3 Culvert Installation

Prior to installing a new culvert or increasing the size of a culvert, consult with the Engineering Environmental Group and Engineering Design to determine if any permitting requirements exist and that the culvert is designed correctly to handle the anticipated water flow. Refer to the WPD on Culvert Installation.

1. When the open cutting method of installation is used, UPRR trenching and shoring standards must be complied with. Refer to CE Bulletin 124.0.
2. Establish flow line elevations to ensure proper drainage. Outlet elevation must be lower than inlet elevation.
3. Bedding for pipe needs to be an engineered select material (i.e. approved road base material) and well compacted in place.
4. If continuous length pipe cannot be used and the use of bands and/or connectors would be needed consult the Manager Bridge Maintenance for proper material and procedures.
5. Backfill pipe evenly with a select, compactable material such as SB-2 base rock.

1.3.4 Culvert Identification

All culverts on main tracks, sidings or industrial leads less than 48 inches in diameter must be identified per the following guidelines. Refer to UPRR Standard Drawing No. 0510.

1. Tie closest to the center of a culvert location to be painted blue. In locations with multiple culverts, tie closest to the center of the culvert group is to be painted.
2. Krylon OSHA blue paint to be utilized to paint tie. Paint can be ordered in one gallon buckets in e-procurement item number 353-1450.
3. Entire exposed top surface of the tie to be painted. Do not paint the plates or rail.
4. Upon completion of Track Program work or maintenance, ensure the culverts are properly identified.

1.3.5 Grade Crossing Drainage

Maintaining drainage around Grade Crossings is critical to their long term performance. Water trapped in the Grade Crossing structure can lead to premature breakdown of the ties, fastening components and sub-grade. When installing road crossings, the use of sub-grade underlayment is recommended, and drainage tile should be used if conditions warrant or if required by state or local agencies. See the WPD on Grade Crossing Drainage for additional information.

1.3.6 Berms and Levees

Berms or Levees can be used to divert water away from the roadbed or toward water-carrying devices in areas with high runoff. They will be designed by a professional engineer and properly permitted.

1.3.7 Erosion Control

Erosion on fills/cuts can lead to fouling of the track or loss of stability. In addition erosion around culverts, bridges, etc. during periods of heavy water flow can lead to long term risk. Follow these guidelines to control erosion:

1. Seed embankments or other locations graded on the right of way with native grasses.
2. Use an apron of concrete or rock to protect the outlet ends of perforated pipes that direct water onto embankments.
3. Do not excavate material from the slopes of embankments.
4. Place rock or riprap at locations where material is being eroded and the water flow cannot be slowed or diverted.
5. When selecting the best size of material for controlling erosion, consider the following:
    - The amount and force of the water the material will be exposed to.
    - The equipment available for handling the material after it is unloaded.

See Table 1.3.7-A for stock materials for erosion control.

Stock Materials for Erosion Control	
Size	**Description**
2 to 5 in.	B stone
12 in. minus	A stone
4” x 12” minus	Class 1 riprap
12” x 24” minus	Class 2 riprap
24” x 36” minus	Class 3 riprap
36” x 36” minus	Class 4 riprap

Table 1.3.7-A

1.4 Subsurface Drainage

Install underground drainage systems in locations where side ditches cannot be effectively maintained, such as wet or narrow cuts, tunnels, station platforms or yard tracks.

Follow these guidelines to install devices for subsurface drainage:

1. When laying pipe as part of a subsurface drainage system, place the pipe at true grade so that the pipe outlet will drain water away from track structure.
2. When installing catch basins, risers, or manholes that are tied to drainage systems, set them at an elevation to adequately drain the intended area.
3. Place subsurface drainpipe at least 18 inches (where practicable) below ground level or the bottom of the rail.
4. When placing pipe into an excavated ditch:
   - Line the bottom of the ditch with compacted material.
   - Place the pipe on top of the compacted material and center it between the ditch sidewalls.
   - Backfill the ditch entirely with coarse ballast and place at least 24 inches of ballast (where practicable) on top of the pipe.

1.5 Track Stability

Water in the track structure can lead to premature breakdown of everything from the subgrade layer to the ballast layer, and eventually the track components themselves, such as ties and rail. Even the weakest soils can perform when well compacted and kept dry. In areas where repeated chronic geometry conditions occur it is important to consider if water infiltration is causing the issue. It is important to look for the root cause and not resort to repeatedly surfacing the location.

Trench drains, perforated pipe, shear keys and track injection are ways that water can be kept out of the track structure. Refer to the WPD on Trench Drains and Shear Keys for additional information.

1.5.1 Slope Stability

In many cases the railroad is built on locations of high fill. When constructing track on fill material it is critical to monitor and control the compaction and to keep water away from the fill when possible. On existing fill locations it is important to monitor for signs of slope stability loss. Examples of slope stability loss include:

1. Chronic loss of cross-level or profile at a location.
2. Evidence of trapped water such as heaving/bulging on the slope.
3. Signs of movement of the slope such as leaning trees or signs.

It is important to avoid placing additional weight on the top of a slope, such as unloaded rip-rap material, to avoid putting additional pressure on the slope. Refer to the WPD on Slope Stability for additional instructions.

See Table 1-A for rip-rap material sizing and types for slope stabilization.

1.6 Ballast

1.6.1 Purpose

Ballast serves the following purposes:

1. Uniformly transmits and distributes the load of track and railroad rolling stock to the subgrade.
2. Restrains the longitudinal, lateral, and vertical displacement of track under loads imposed by railroad rolling stock and forces exerted by the rail.
3. Allows the track to drain quickly and prevents water from accumulating around the track structure.

4. Retards the growth of vegetation.
5. Reduces frost heaving of track caused by water from the subgrade.
6. Allows employees to correct irregularities in track surface and alignment.

1.6.2 Ballast Section

The ideal ballast section is shown in Standard Drawing No. 0001 for wood tie track, No. 0002 for concrete tie track and No. 0003 for industrial track.

Follow these guidelines to establish and maintain the ballast section:

1. Maintain tie cribs with ballast to a level 1 inch below the rail base. Maintain the ballast line on an even plane for the full length of the tie.
2. Maintain the side slope of the ballast line from the outermost edge of the shoulder to the top of the subgrade or subballast with a uniform 3 to 1 slope as shown in Figure 1.6.2-A.

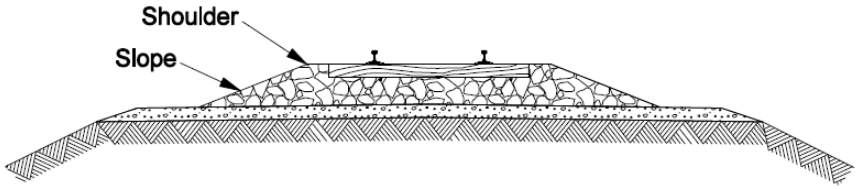

Figure 1.6.2-A

3. Construct the intersection of the ballast side slope lines between multiple tracks in a “V” shape as shown in Figure 1.6.2-B.

NOTE: This area may be leveled off between the body tracks of yards in terminals or other switching locations where employees frequently perform work between tracks.

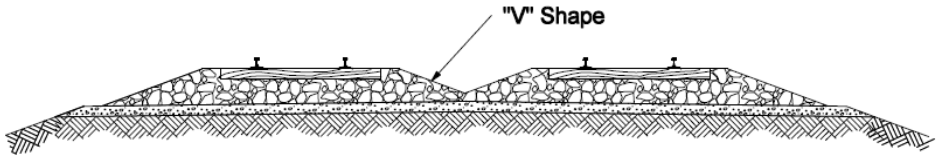

Figure 1.6.2-B

4. Keep flangeways clear of ballast through switches, derails, crossing frogs, and grade crossings.
5. Remove ballast from tie cribs to provide a minimum 3-inch clearance between the ballast and the operating linkage of turnouts and other devices. Maintain this clearance for the entire area through which the linkage travels during its operation.
6. Maintain the ballast shoulder to the specified width in Table 1 as measured outward from the ends of ties.

Tie Type	Rail Type	Minimum Width
Wood/Composite	Jointed	9 in.
Wood/Composite	CWR	12 in.
Steel	CWR	
Concrete	CWR	

Table 1.6.2-A

7. Maintain ballast to the specified depth as measured below the horizontal surface of the tie bottom. See Table 1B.

Tie Type	Traffic Density	Minimum Depth
Wood/Composite	Less than 10 MGT	8 in.
Wood/Composite	10 MGT or more	12 in.
Steel	All locations	12 in. *
Concrete	All locations	12 in.

Table 1.6.2-B

** NOTE: Measure downward from the center section of the tie and not from tie ends.*

1.6.3 Sources and Gradation

Obtain ballast from approved ballast pits. Determine the correct ballast size according to track type as shown in Table 1.6.3-A. Refer to the Work Procedure Document on Ballast Distribution for additional information on Approved Sources.

In emergency situations the UP Material group may approve sources that do not meet standard gradation or specification requirements.

Track Type	Gradation	Ballast Type
Main, Sidings and CNRT	3/4 to 2-1/4 in.	1 or Mainline (D)
All others	3/8 to 1-3/8 in.	2 or Yard (C)

Table 1.6.3-A

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1.7 Subgrade Underlayment

Subgrade underlayment is an effective way to increase the strength of the track structure. It is primarily utilized in areas where the sub-grade layer is weak or requires additional reinforcement due to high loading. Areas requiring additional reinforcement include but are not restricted to:

1. Track Transitions
2. Road Crossings
3. Railroad Crossing Diamonds
4. Turnouts
5. Areas with historically poor sub-grade performance (chronic slow order locations)

Union Pacific utilizes two primary methods for sub-grade underlayment, Asphalt and Geo-Web/Grid. Both perform very similarly. See the WPD on Sub-grade Underlayment for additional information.

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2 Track Geometry

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2.1.1 Determine Designated Rail

When reading geometry or detector car reports and trying to determine which rail is the right rail and which rail is the left rail, position yourself with your back to the lower MP. While facing the higher MP, the rail on your right is the right rail and on your left is the left rail.

2.2 Track Alignment

Track alignment consists of tangent segments of track connected by curves. One rail of each track is designated as the line rail.

For instructions on restoring track alignment to standard, refer to the WPD on Restoring Track to Standard.

2.2.1 Designated Line Rail for Curved Track

The outer or high rail of curves is the line rail for referencing alignment.

2.2.2 Designated Line Rail for Tangent Track

Designate the line rail for referencing alignment on tangent track as follows:

- **Single Main Track**—Use the north rail of east/west tracks and the west rail of north/south tracks.
- **Two Main Tracks**—Use the outside rail of each track.
- **Three Main Tracks**—Use the outside rail of the outer tracks. Use the north rail of east/west tracks and the west rail of north/south tracks as the line rail for referencing alignment on the center track.
- **Four Main Tracks**—Use the outside rail of the outer tracks. Use the inside rail of the inner tracks as the line rail for referencing alignment on the center tracks.
- **All Other Applications**—Use the most practical line rail. Use this same rail throughout the tangent segment.

When lining tangent track between two curves of the same direction that are less than 1/4 mile apart, use the same line reference rail.

When lining into a fixed object that is less than 1/4 mile from the curve, use the same line reference rail as used in a curve.

NOTE: Examples of fixed objects are open deck bridges, crossing frogs, or other immovable objects.

2.2.3 Designated Line Rails for Turnouts and Crossovers

Use the straight side of turnouts as the designated line rail for referencing alignment through the straight side of switches when turnouts exist entirely on tangent track as shown in Figure 2.2.3-A.

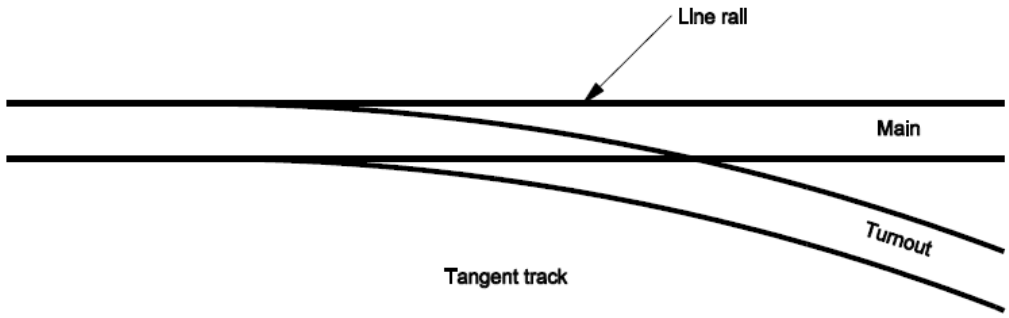

Figure 2.2.3-A

When any portion of a turnout is located on a curve, use the high or outer rail of the curve as the designated line rail as shown in Figure 2.2.3-B.

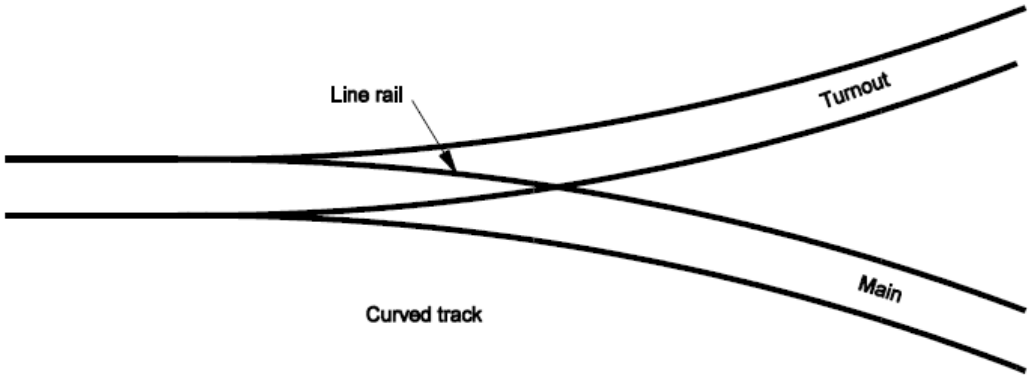

Figure 2.2.3-B

2.2.4 Measuring Alignment

Follow these requirements when measuring alignment:

1. Measure alignment on the designated line rail on the gauge side of the rail head. Measure at a point 5/8 inch below the top of the rail head as shown in Figure 2.2.4-A.

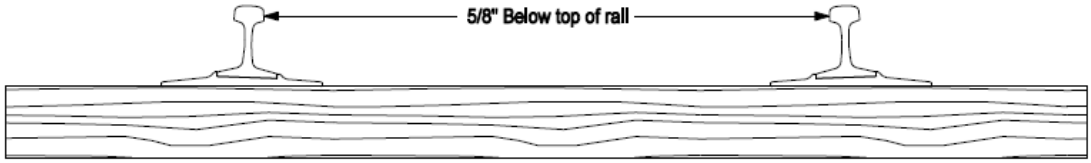

Figure 2.2.4-A

2. Record measurements at 15-1/2-foot intervals on the same rail for the full length of tangent and curved segments.
3. Use a 31-foot, 62-foot or 124-foot chord (Class 6 track) length to obtain track alignment measurements as shown in Figure 2B.

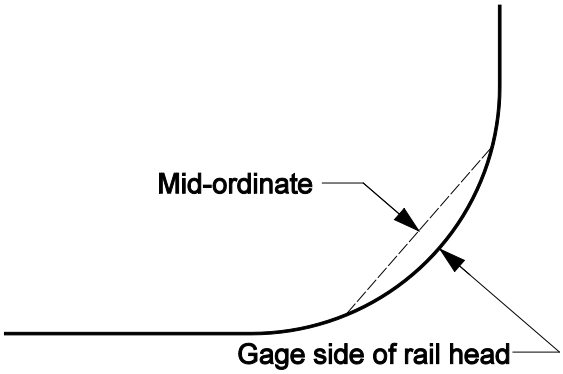

Figure 2.2.4-B

NOTE: The distance between the mid-ordinate or center of a 31-foot, 62-foot or 124-foot chord and the gauge side of the rail head determines track alignment.

- When using a 31-foot chord, multiply readings by four.
- When using a 62-foot chord, note that the measurement in inches equals the degree of curvature, as shown in the examples in Table 2.2.4-A.

Examples of Converting Measurements to Degrees of Curvature		
Measurement	**31-foot Chord**	**62-foot Chord**
1 inch	4 degrees	1 degree
1-1/4 inches	5 degrees	1 degree – 15 minutes
1-1/2 inches	6 degrees	1 degree – 30 minutes
1-3/4 inches	7 degrees	1 degree – 45 minutes
2 inches	8 degrees	2 degrees

Table 2.2.4-A

4. Using Shims
    - To measure alignment on tangent track, you may need to place 1-inch or greater shims at the gauge side of the rail where the ends of the 62-foot chord would normally contact the rail head.

> **NOTE: Shims offset the 62-foot chord to take the measurement at the mid-ordinate without contacting the rail head along the chord.**

- Subtract the shim thickness from the mid-ordinate measurement to determine the exact reading.

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2.2.6 Line Ordinates in Turnouts and Crossovers

The designated line rail for referencing alignment through the turnout side of switches is the turnout side closure rail. The closure rail connects the switch point to the frog and continues from the heel of the frog through the last long switch tie.

Follow these requirements when establishing alignment in turnouts and crossovers:

1. To establish alignment through turnout side of switches through the last long switch tie, use line ordinates provided in the Engineering Track Standards book, Sections 5000–5099, Turnouts.

NOTE: Line ordinates denote the specific spread distance between gauge lines of curved closure rails and adjacent rails on the straight side of turnouts. The spread distance establishes the proper alignment for the turnout side of switches.

2. Establish alignment for the turnout side of switches not having published ordinates as follows:
   a. Align the straight side of the turnout to the desired alignment.
   b. Stretch a string between the heel of the switch and the toe of the frog along the gauge line.
   c. Measure the overall distance and divide into four equal parts.
   d. Offset the center ordinate at a right angle to the string 6 inches and spike in place.
   e. Offset each quarter ordinate at a right angle to the string 4-1/2 inches and spike in place as shown in Figure 2.2.6-A.

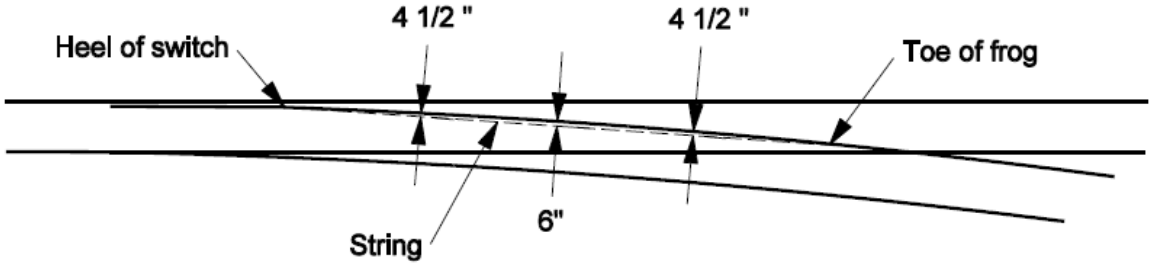


Figure 2.2.6-A

A. Line Ordinates Behind Frog

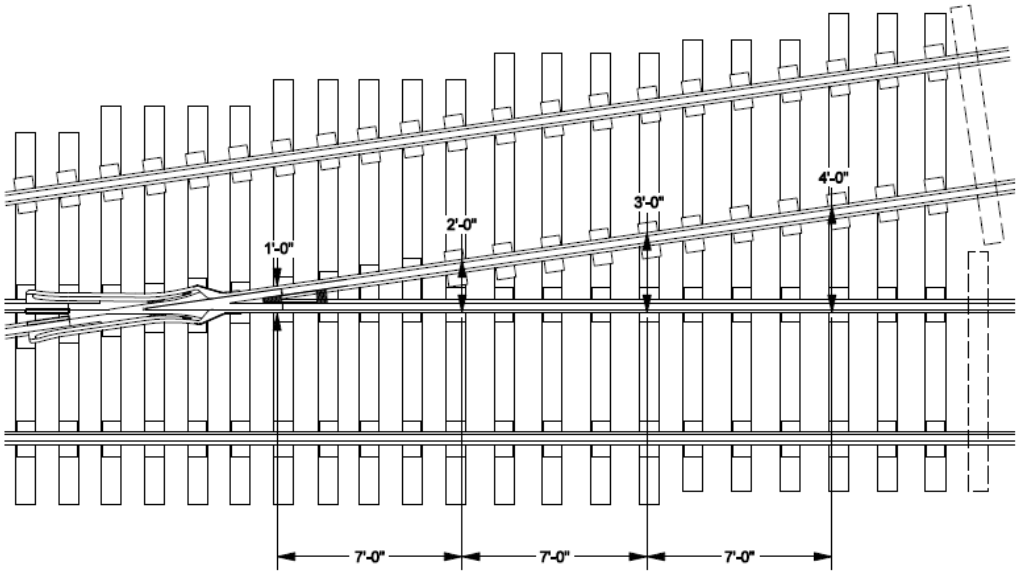
Line ordinates behind the frog spread apart over a given distance at a rate determined by the frog size. See Table 2.2.6-A.

If frog size is…	The spread increases 1 foot every…
7	7 feet
8	8 feet
8.5	8.5 feet
9	9 feet
10	10 feet
11	11 feet
14	14 feet
15	15 feet
20	20 feet
24	24 feet
30	30 feet

Table 2.2.6-A

When determining line ordinates for behind the frog:

1. Locate the point where the frog's heel spread measures 1 foot between the gauge lines.
2. From this point measure away from it down the straight side of the turnout. Measure the number of feet that equals the frog size.
3. At this point, spread the gauge lines and spike them 2 feet apart.
4. Continue this process until you establish all ordinates and spike through the last switch tie as shown in Figure 2.2.6-B.



No. 7 Turnout Example

Figure 2.2.6-B

2.2.7 Six Axle Restrictions – Maximum Curve Degree

The Maximum Curve Degree for operating Six Axle Locomotives is 16 Degrees (there are a few ML/INDL curves that are currently over 16 degrees that are grandfathered in). This rule applies to **ALL** track types. Any curve, turnout or turnback curve over 16 degrees will be restricted to Four Axle Locomotive use. Exemption: #7 turnouts are allowed to be utilized with six axle locomotives.

2.3 Track Gauge

Track gauge is the distance between the two running rails of the track structure. Properly maintained track gauge provides for a smooth ride, reduces rail wear, retains alignment and surface, and ensures that wheels do not fall between rails.

For instructions on restoring track gauge to standard, refer to the WPD on Restoring Track to Standard.

2.3.1 Designated Gauge Rail

The rail opposite the designated line rail of track or turnouts is the designated gauge rail.

2.3.2 Standard Gauge

Standard track gauge is 56-1/2 inches.

2.3.3 Measuring Gauge

Follow these requirements when measuring gauge:

1. Measure gauge between the heads of the rail at right angles to each other. Measure at a point 5/8 inch below the top of the rail head as shown in Figure 2.3.3-A.

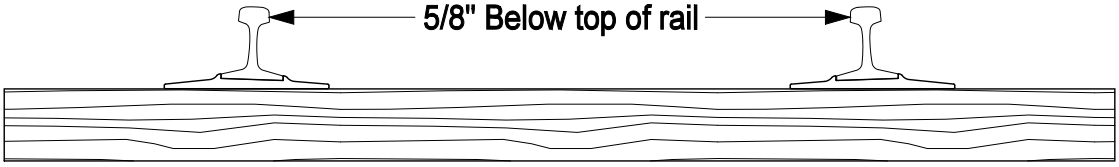


Figure 2.3.3-A

2. Use an approved track gauge every fourth tie when adjusting or checking gauge, spiking ties, relaying rail, or constructing new track to conform to standard gauge as shown in Figure 2.3.3-B.
   - Measure the track gauge with a tape measure to verify its accuracy before use.
   - Do not force the track gauge between rails.

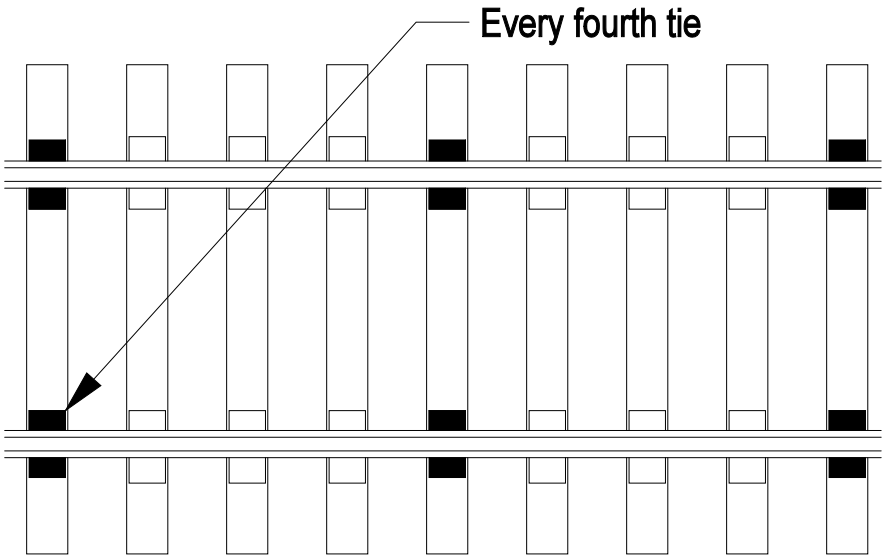


Figure 2.3.3-B

Before replacing or transposing rail back into tie plates without re-gauging, take inside base-to-base measurements to ensure that installing full-balled rail will not create narrow gauge. Take these measurements as shown in Figure 2.3.4-A and Table 2.3.4-A in section 2.3.4.

[redacted]

[redacted]

[redacted]

[redacted]

2.4 Clearances

Maintain adequate spacing between tracks to enable trains to safely pass or meet rolling stock on adjacent tracks. Maintain sufficient horizontal and vertical clearance to enable trains to clear wayside structures and facilities.

Reference Standard Drawing No. 0038 for Standard Minimum Operating Clearances.

2.4.1 Measuring Track Centers

Follow these requirements when measuring track center:

1. Measure track centers between the centerline of two adjacent tracks. Measure from the gauge line of a rail of one track to the same rail of an adjacent track as shown in Figure 2.4.1-A.

Figure 2.4.1-A

2. Check track centers at the beginning of surfacing operations and every 660 feet or less behind automatic tamping machines where adjacent tracks are present. Check track centers every 330 feet or less through spirals and the full body of curves.
3. Contact Clearance Department at 402-544-2090 with any questions about track centers or when track centers are changed.
4. When new tracks are constructed, report the new track centers to the Clearance Dept. with measurements every 528’.

2.4.2 Minimum Track Centers

Follow these requirements for track center length:

1. Maintain at least 13 feet between the centerline of main tracks and other adjacent track(s) on tangent track.
    - Track centers less than 12' 6" on tangent track and 13' in curves are a Geometry Car Critical exception in Class 1-6. These exceptions must be field verified and remediated immediately and updated in the TMP within 48hrs. If exception is found in multiple track territory, all tracks effected must be protected per Table 2.4.2-A.
    - Protect tight track centers with the following restrictions:

	10 MPH	25 MPH
Degree of curve	Track Centers less than	Track Centers less than
0	12' 0"	12- 6"
1	12' 1-3/8"	12' 7-3/8"
2	12' 2-3/4"	12' 8-3/4"
3	12' 4-1/8"	12' 10-1/8"
4	12' 6"	12' 11-1/2"
5	12' 6-7/8"	13' 0-7/8"
6	12' 8-1/4"	13' 2-1/4"
7	12' 9-5/8"	13' 3-5/8"
8	12' 11"	13' 5"
9	13' 0-3/8"	13' 6-3/8"
10	13' 1-3/4"	13' 7-3/4"
11	13' 3-1/8"	13' 9-1/8"
12	13' 4-1/2"	13' 10-1/2"
13	13' 5-7/8"	13' 11-3/4"
14	13' 7-1/4"	14' 1-1/4"
15	13' 8-5/8"	14' 2-5/8"
16	13' 10"	14' 4"

Table 2.4.2-A

2. Maintain at least 12 feet 6 inches between the centerline of other than main tracks.
3. Maintain track centers in curves of parallel tracks to allow for car tilt and overhang due to curvature. Maintain track centers through the entire length of the curve and for 80 feet beyond the curve.
4. Use Table 2.4.2-B to determine the minimum track centers required for sufficient clearance in curved track for meeting and passing dimensional loads up to 12 feet wide.

MINIMUM TRACK CENTERS ON CURVES TO PROVIDE SUFFICIENT CLEARANCE ON ADJACENT TRACKS FOR MEETING AND PASSING DIMENSIONAL LOADS UP TO 12' WIDE						
Where curve elevations are	and curvature is 1 degree	and curvature is 2 degrees	and curvature is 3 degrees	and curvature is 4 degrees	and curvature is 5 degrees	and curvature is 6 degrees
1/4"	13' 4-1/8"	13' 7-1/8"	13' 10-1/8"	14' 1-1/8"	14' 4-1/8"	14' 7-1/8"
1/2"	13' 5-1/4"	13' 8-1/4"	13' 11-1/4"	14' 2-1/4"	14' 5-1/4"	14' 8-1/4"
3/4"	13' 6-3/8"	13' 9-3/8"	14' 0-3/8"	14' 3-3/8"	14' 6-3/8"	14' 9-3/8"
1"	13' 7-1/2"	13' 10-1/2"	14' 1-1/2"	14' 4-1/2"	14' 7-1/2"	14' 10-1/2"
1 1/4"	13' 8-5/8"	13' 11-5/8"	14' 2-5/8"	14' 5-5/8"	14' 8-5/8"	14' 11-5/8"
1 1/2"	13' 9-3/4"	14' 0-3/4"	14' 3-3/4"	14' 6-3/4"	14' 9-3/4"	15' 0-3/4"
1 3/4"	13' 10-7/8"	14' 1-7/8"	14' 4-7/8"	14' 7-7/8"	14' 10-7/8"	15' 1-7/8"
2"	14' 0"	14' 3"	14' 6"	14' 9"	15' 0"	15' 3"
2 1/4"	14' 1-1/8"	14' 4-1/8"	14' 7-1/8"	14' 10-1/8"	15' 1-1/8"	15' 4-1/8"
2 1/2"	14' 2-1/4"	14' 5-1/4"	14' 8-1/4"	14' 11-1/4"	15' 2-1/4"	15' 5-1/4"
2 3/4"	14' 3-3/8"	14' 6-3/8"	14' 9-3/8"	15' 0-3/8"	15' 3-3/8"	15' 6-3/8"
3"	14' 4-1/2"	14' 7-1/2"	14' 10-1/2"	15' 1-1/2"	15' 4-1/2"	15' 7-1/2"
3 1/4"	14' 5-5/8"	14' 8-5/8"	14' 11-5/8"	15' 2-5/8"	15' 5-5/8"	15' 8-5/8"
3 1/2"	14' 6-3/4"	14' 9-3/4"	15' 0-3/4"	15' 3-3/4"	15' 6-3/4"	15' 9-3/4"
3 3/4"	14' 7-7/8"	14' 10-7/8"	15' 1-7/8"	15' 4-7/8"	15' 7-7/8"	15' 10-7/8"
4"	14' 9"	15' 0"	15' 3"	15' 6"	15' 9"	16' 0"
4 1/4"	14' 10-1/8"	15' 1-1/8"	15' 4-1/8"	15' 7-1/8"	15' 10-1/8"	16' 1-1/8"
4 1/2"	14' 11-1/4"	15' 2-1/4"	15' 5-1/4"	15' 8-1/4"	15' 11-1/4"	16' 2-1/4"
4 3/4"	15' 0-3/8"	15' 3-3/8"	15' 6-3/8"	15' 9-3/8"	16' 0-3/8"	16' 3-3/8"
5"	15' 1-1/2"	15' 4-1/2"	15' 7-1/2"	15' 10-1/2"	16' 1-1/2"	16' 4-1/2"
5 1/4"	15' 2-5/8"	15' 5-5/8"	15' 8-5/8"	15' 11-5/8"	16' 2-5/8"	16' 5-5/8"
5 1/2"	15' 3-3/4"	15' 6-3/4"	15' 9-3/4"	16' 0-3/4"	16' 3-3/4"	16' 6-3/4"

Continuation of previous table:

MINIMUM TRACK CENTERS ON CURVES TO PROVIDE SUFFICIENT CLEARANCE ON ADJACENT TRACKS FOR MEETING AND PASSING DIMENSIONAL LOADS UP TO 12' WIDE						
Where curve elevations are	**and curvature is 7 degrees**	**and curvature is 8 degrees**	**and curvature is 9 degrees**	**and curvature is 10 degrees**	**and curvature is 11 degrees**	**and curvature is 12 degrees**
1/4"	14' 10-1/8"	15'1-1/8"	15' 4-1/8"	15' 7-1/8"	15' 10-1/8"	16' 1-1/8"
1/2"	14' 11-1/4"	15' 2-1/4"	15' 5-1/4"	15' 8-1/4"	15' 11-1/4"	16' 2-1/4"
3/4"	15' 0-3/8"	15' 3-3/8"	15' 6-3/8"	15' 9-3/8"	16' 0-3/8"	16' 3-3/8"
1"	15' 1-1/2"	15' 4-1/2"	15' 7-1/2"	15' 10-1/2"	16' 1-1/2"	16' 4-1/2"
1 1/4"	15' 2-5/8"	15' 5-5/8"	15' 8-5/8"	15' 11-5/8"	16' 2-5/8"	16' 5-5/8"
1 1/2"	15' 3-3/4"	15' 6-3/4"	15' 9-3/4"	16' 0-3/4"	16' 3-3/4"	16' 6-3/4"
1 3/4"	15' 4-7/8"	15' 7-7/8"	15' 10-7/8"	16' 1-7/8"	16' 4-7/8"	16' 7-7/8"
2"	15' 6"	15' 9"	16' 0"	16' 3"	16' 6"	16' 9"
2 1/4"	15' 7-1/8"	15' 10-1/8"	16' 1-1/8"	16' 4-1/8"	16' 7-1/8"	16' 10-1/8"
2 1/2"	15' 8-1/4"	15' 11-1/4"	16' 2-1/4"	16' 5-1/4"	16' 8-1/4"	16' 11-1/4"
2 3/4"	15' 9-3/8"	16' 0-3/8"	16' 3-3/8"	16' 6-3/8"	16' 9-3/8"	17' 0-3/8"
3"	15' 10-1/2"	16' 1-1/2"	16' 4-1/2"	16' 7-1/2"	16' 10-1/2"	17' 1-1/2"
3 1/4"	15' 11-5/8"	16' 2-5/8"	16' 5-5/8"	16' 8-5/8"	16' 11-5/8"	17' 2-5/8"
3 1/2"	16' 0-3/4"	16' 3-3/4"	16' 6-3/4"	16' 9-3/4"	17' 0-3/4"	17' 3-3/4"
3 3/4"	16' 1-7/8"	16' 4-7/8"	16' 7-7/8"	16' 10-7/8"	17' 1-7/8"	17' 4-7/8"
4"	16' 3"	16' 6"	16' 9"	17' 0"	17'3"	17' 6"
4 1/4"	16' 4-1/8"	16' 7-1/8"	16' 10-1/8"	17' 1-1/8"	17' 4-1/8"	17' 7-1/8"
4 1/2"	16' 5-1/4"	16' 8-1/4"	16' 11-1/4"	17' 2-1/4"	17' 5-1/4"	17' 8-1/4"
4 3/4"	16' 6-3/8"	16' 9-3/8"	17' 0-3/8"	17' 3-3/8"	17' 6-3/8"	17' 9-3/8"
5"	16' 7-1/2"	16' 10-1/2"	17' 1-1/2"	17' 4-1/2"	17' 7-1/2"	17' 10-1/2"
5 1/4"	16' 8-5/8"	16' 11-5/8"	17' 2-5/8"	17' 5-5/8"	17' 8-5/8"	17' 11-5/8"
5 1/2"	16' 9-3/4"	17' 0-3/4"	17' 3-3/4"	17' 6-3/4"	17' 9-3/4"	18' 0-3/4"

Table 2.4.2-B

2.4.3 Track Centers in Crossover Switches

Follow these track center requirements at crossover switches:

1. Align existing or newly constructed tracks to parallel track centers for at least 660 feet in advance of the crossover being installed.
2. When long switch ties extend under both tracks of a crossover:
   - Spike the ties to the same track center measurement as the track they connect. An example is shown in Figure 2.4.3-A.
   - Align the tracks approaching the crossover switch to the same track center measurement as the last long switch tie on each end of the crossover, as shown in Figure 2.4.3-A.

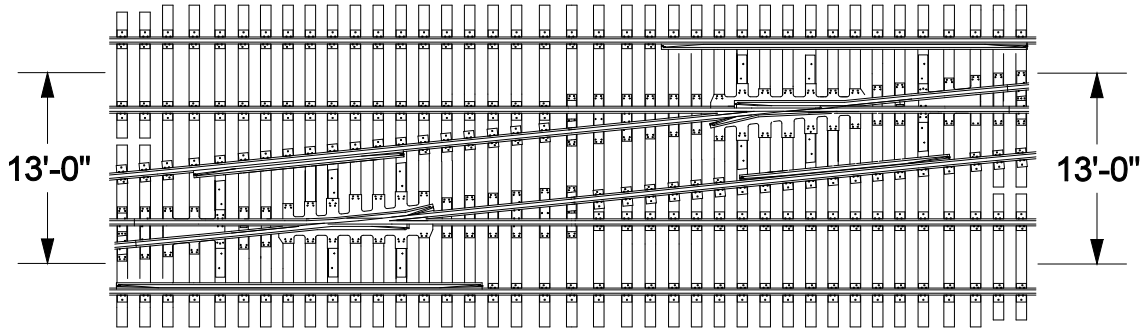


Figure 2.4.3-A

2.4.4 Minimum Clearances

Maintain horizontal and vertical clearances according to Standard Drawing No. 0038 and follow these requirements:

1. Maintain appliances not shown on this drawing to a minimum clearance of 9 feet from the centerline of the track and at least 23'4" feet above the top of the rail.
2. Place top-of-rail markers at all structures with 23 feet or less of overhead clearance. Place markers according to Standard Drawing Nos. 0540 and 0541.
3. Where overhead and lateral obstructions are present, such as overpasses, tunnels, bridges, rock cuts, slide fences, platforms etc., minimize track raises and never raise the track above the top of rail markers or alter alignment from stakes.
4. Where markers indicate clearances are close, perform spot surfacing manually.
5. Before raising track above the top-of-rail marker, or aligning track that may create clearance problems, or to report a track shift contact the Clearance Dept. at 402-544-2090.
6. If no top of rail marker is present contact Clearance Dept. prior to raising track.
7. Before the temporary installation of falsework, such as construction scaffolding, that will reduce clearances, the Clearance Dept. must be notified at 402-544-2090. The Clearance Dept. must then protect temporary clearance reduction by recording the falsework modification in the computerized clearance system. Contact the Clearance Dept. when the temporary falsework clearance restriction has been removed.

NOTE: For Clearance information please reference the Clearance Maps and Structures Site (MyUP- >Maps>Clearance Maps and Structures.)

Clearance recommendations:

These standards will apply to all oversized loads except for double stack containers and apply to clearance car operations.

Clearance Condition	Remediation
Protect overhead and side clearances	
6" or greater clearance	Unrestricted
Less than 6" to 4" clearance	Maximum 25 MPH
Less than 4" to 2 ½" clearance	Maximum 10 MPH
Less than 2 ½" clearance	Clearance Team will determine remedial action
Protect overhead clearances for double stack containers	
4" or greater clearance	Unrestricted
Less than 4" to 2 ½" clearance	Maximum 25 MPH
Less than 2 ½" clearance	Clearance Team will determine remedial action

Table 2.4.4-A

Process Summary:

1. If found by Clearance Car the Chief of the Car will immediately notify MTM/DTM, by email and phone, to issue order. A TMP exception will be written.

   An automated notification will go to the CE/GD of the Region providing location, restriction and Form A impact.
2. If found by the EC Car the EC Car will stop and verify. If verified the MTM/DTM will immediately issue restriction. A TMP exception will be written.

   An automated notification will go to the CE/GD of the Region providing location, restriction and Form A impact.

Clearance Questions Contact Clearance Department 402-544-0725

2.4.5 Allowable Superelevation in Adjacent Tracks

To ensure adequate clearance between tracks, maintain adjacent tracks in curves to the limits shown in Table 2.4.5-A.

MAXIMUM SUPERELEVATION ALLOWABLE IN ADJACENT OUTSIDE TRACK TO PROVIDE SUFFICIENT CLEARANCE					
Where super-elevation of inside curved track is	**And track centers are 13' 0"**	**And track centers are 13' 6"**	**And track centers are 14' 0"**	**And track centers are 14' 6"**	**And track centers are 15' 0"**
1/4"	1/4"	1-1/2"	3"	4-1/2"	5-1/2"
1/2"	1/2"	1-3/4"	3-1/4"	4-3/4"	5-1/2"
3/4"	3/4"	2"	3-1/2"	5"	5-1/2"
1"	1"	2-1/4"	3-3/4"	5-1/4"	5-1/2"
1-1/4"	1-1/4"	2-1/2"	4"	5-1/2"	5-1/2"
1-1/2"	1-1/2"	2-3/4"	4-1/4"	5-1/2"	5-1/2"
1-3/4"	1-3/4"	3"	4-1/2"	5-1/2"	5-1/2"
2"	2"	3-1/4"	4-3/4"	5-1/2"	5-1/2"
2-1/4"	2-1/4"	3-1/2"	5"	5-1/2"	5-1/2"
2-1/2"	2-1/2"	3-3/4"	5-1/4"	5-1/2"	5-1/2"
2-3/4"	2-3/4"	4"	5-1/2"	5-1/2"	5-1/2"
3"	3"	4-1/4"	5-1/2"	5-1/2"	5-1/2"
3-1/4"	3-1/4"	4-1/2"	5-1/2"	5-1/2"	5-1/2"
3-1/2"	3-1/2"	4-3/4"	5-1/2"	5-1/2"	5-1/2"
3-3/4"	3-3/4"	5"	5-1/2"	5-1/2"	5-1/2"
4"	4"	5-1/4"	5-1/2"	5-1/2"	5-1/2"
4-1/4"	4-1/4"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
4-1/2"	4-1/2"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
4-3/4"	4-3/4"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
5"	5"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
5-1/4"	5-1/4"	5-1/2"	5-1/2"	5-1/2"	5-1/2"
5-1/2"	5-1/2"	5-1/2"	5-1/2"	5-1/2"	5-1/2"

Table 2.4.5-A

2.5 Grade

Track grade provides a uniform plane that allows trains to negotiate uphill and downhill terrain. Grade is preserved when uniform track raises occur during normal surface and lining operations.

2.5.1 Designated Grade Rail

The inner or low rail of curves is the designated reference rail for maintaining grade.

NOTE: The designated grade rail for referencing grade is the same rail as the designated line rail in tangent track.

2.5.2 Grade Stakes

Grade stakes will be provided for relocated or newly constructed tracks to help establish the proper grade.

When necessary, grade stakes will be provided to re-establish or modify existing grade.

2.5.3 Multiple Track Grade Crossings

Establish and maintain grade crossings to a uniform plane across all tracks as follows:

1. Where practicable, establish and maintain the difference between the top-of-rail elevation of adjacent tracks to within 1 inch of each other:

   - Through grade crossings where track centers are within 20 feet of each other as shown in Figure 2.5.3-A.

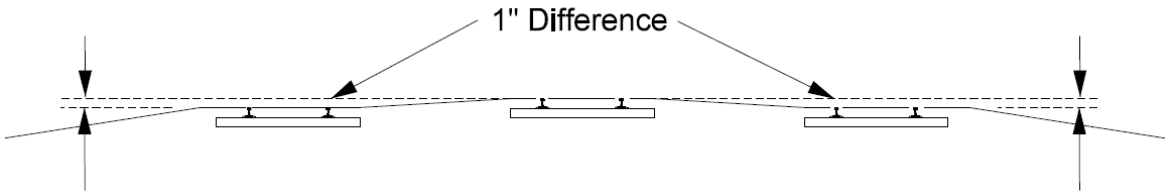


Figure 2.5.3-A

   - Through grade crossings that exist in curved track that contains superelevation as shown in Figure 2.5.3-B.

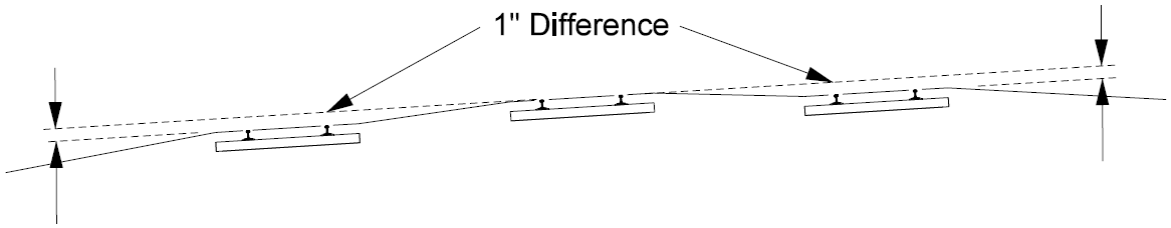


Figure 2.5.3-B

2. Stretch a string line across the tops of the rails of all existing tracks to verify the top-of-rail relationship through grade crossings. Use the highest track as a reference to determine that the lower tracks conform.

2.5.4 Turnouts and Crossovers

The top-of-rail elevation of tracks approaching crossover switches should be as level as practicable with each other for at least 660 feet in advance of main line crossovers.

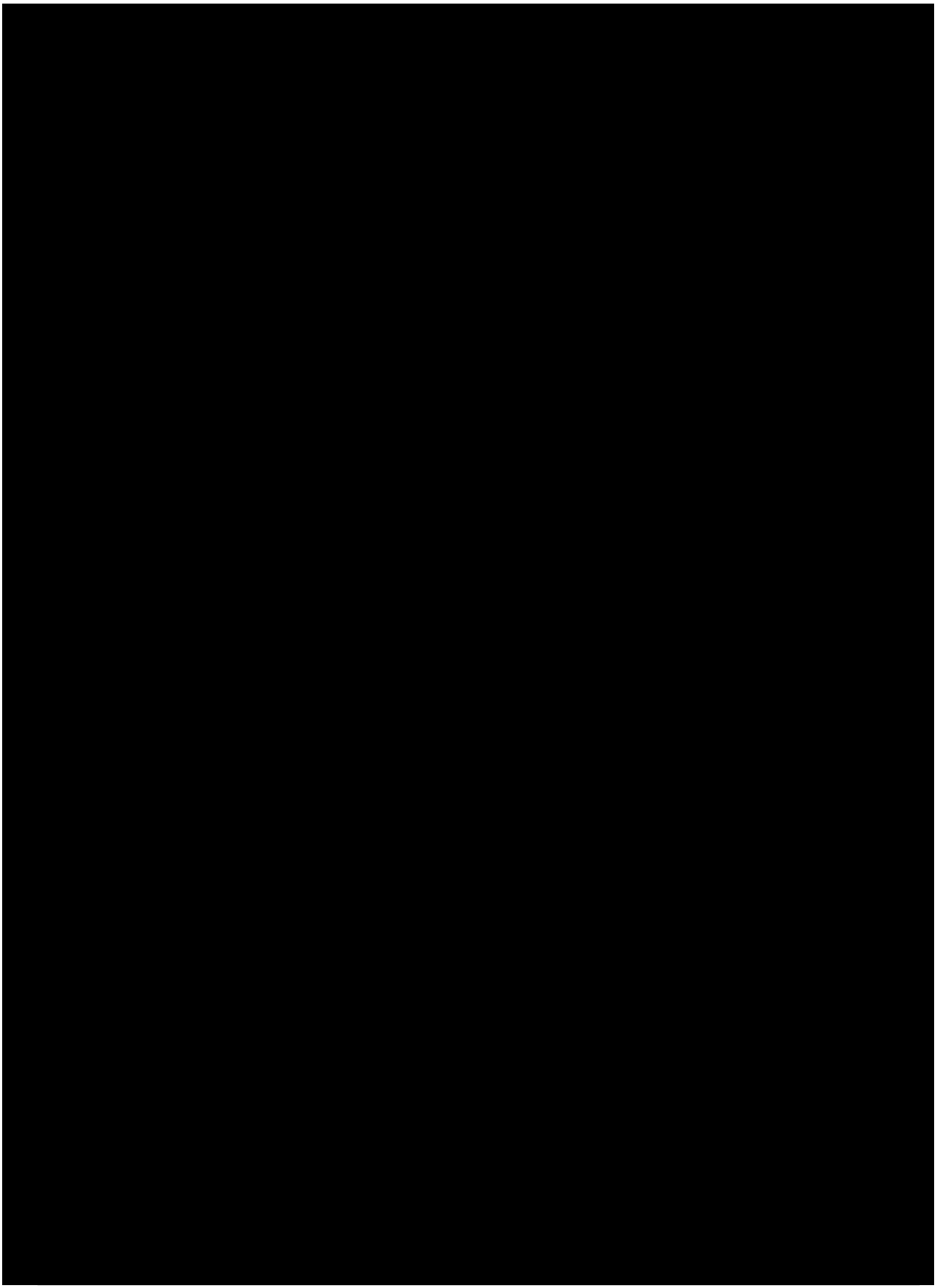
The top-of-rail elevation of main and diverging tracks must be level with each other through the turnout, and, where possible, for 250 feet beyond the signal or fouling point, whichever distance is greater.

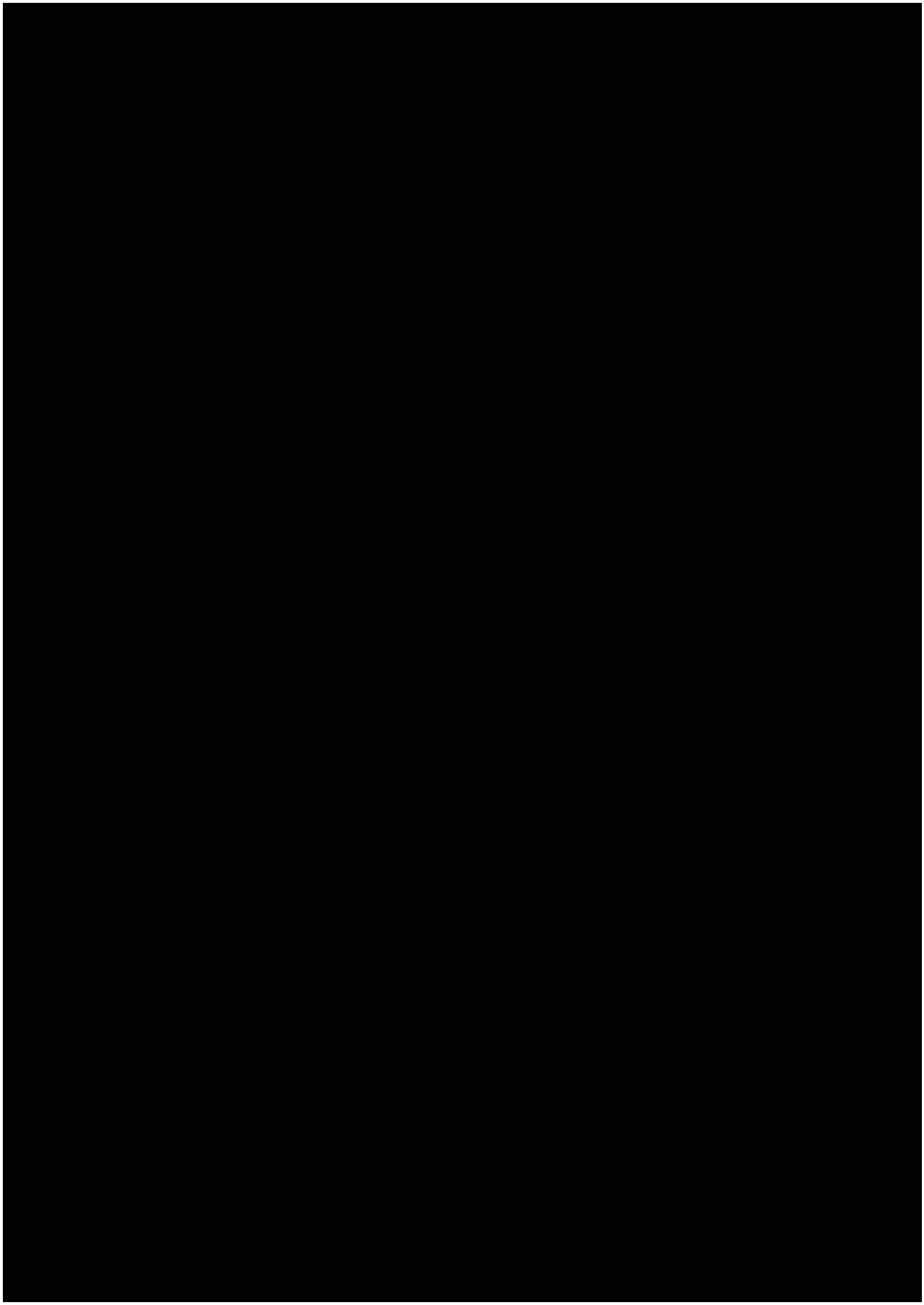
2.5.5 Vertical Curves

Vertical curves connect the intersection of different grades. Curves that connect two uphill grades are summit curves, and curves that connect two downhill grades are sag curves.

Design vertical curves according to Standard Drawing No. 0016.

[redacted]





2.6.5 Track Surface Limits

1. Track Surface Limits - Do not allow track surface to deviate from uniform profile and crosslevel more than the following thresholds for the applicable class of track. Measure deviations as prescribed by each category.
   - If maximum crosslevel in a curve is 6" or more and there is a difference in crosslevel between any 2 points less than 62 feet apart of more than 1-1/2" the track is not good for any class of track.
   - To control harmonics on Class 2 through 5 in jointed track with staggered joints, the cross-level difference shall not exceed 1-1/4" in all of six consecutive pairs of joints, as created by 7 low joints. Track with joints staggered less than 10 feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints for measurement.

Table 2.6.5-A shows Critical Limits

Track Surface	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
The maximum crosslevel on the outside rail of a curve may not be more than…	6"	6"	6"	6"	6"	6"
The runoff in any 31 feet of rail at the end of a raise may not be more than…	3-1/2"	3"	2"	1-1/2"	1"	N/A
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot cord may not be more than...	N/A	N/A	N/A	N/A	N/A	1"
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot cord may not be more than...	3"	2-3/4"	2-1/4"	2"	1-1/4"	1"
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot cord may not be more than...	N/A	N/A	N/A	N/A	N/A	1-3/4"
The deviation from zero crosslevel at any point on tangent may not be more than…	3"	2"	1-3/4"	1-1/4"	1"	1"
The difference in crosslevel between any 2 points less than 62 feet apart may not be more than…	3"	2-1/4"	2"	1-3/4"	1-1/2"	1-1/2"
The variation of crosslevel on the spiral per 31 feet may not be more than:	2"	1 3/4"	1 1/4"	1"	3/4"	5/8"
The difference in crosslevel between any 2 points in a curve less than 10 feet apart (Short Warp) may not be more than…	N/A	N/A	N/A	N/A	N/A	1-1/4"

Table 2.6.5-A

2. **Multiple Track Surface Deviation – Class 6 track only.**
   - Do not allow track surface to deviate from uniformity more than the threshold for **three or more non-overlapping deviations** occurring within a distance equal to five times the specified cord length.

Table 2.6.5-B shows Critical Limits for Class 6.

Track Surface	Track Class
	6
The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot cord may not be more than...	**3/4"**
The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot cord may not be more than...	**3/4"**
The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot cord may not be more than...	**1-1/4"**

Table 2.6.5-B

2.6.6 Spirals

Spirals designed into curves gradually transition alignment and superelevation from tangents into curves, from curves into tangents, and between curves of varying degrees. Follow these requirements:

1. Curves of 10 minutes (00° 10' 00") or greater require spirals.
2. The maximum rate of change in superelevation must not exceed 1 inch per 44 feet of distance. Limit this rate of change to curves with a maximum speed of less than 50 MPH.
3. Use Table 2.6.6-A to determine the distance requirements for each 1-inch change of superelevation.

Distance Between Each Inch Change of Superelevation		
Maximum Speed (1)	**Desired Distance for New and Existing High Speed Tracks (2)**	**Minimum Distance for Canyon and Heavy Grade Territory (3)**
20 MPH	44 feet	44 feet
25 MPH	44 feet	44 feet
30 MPH	44 feet	44 feet
35 MPH	44 feet	44 feet
40 MPH	47 feet	44 feet
45 MPH	53 feet	44 feet
50 MPH	59 feet	49 feet
55 MPH	65 feet	54 feet
60 MPH	70 feet	59 feet
65 MPH	76 feet	64 feet
70 MPH	82 feet	69 feet
75 MPH	88 feet	73 feet
80 MPH	94 feet	78 feet
85 MPH	100 feet	83 feet
90 MPH	106 feet	88 feet
95 MPH	112 feet	93 feet
100 MPH	118 feet	98 feet
105 MPH	124 feet	103 feet
110 MPH	130 feet	108 feet

Table 2.6.6-A

4. If the length of the spiral permits, run superelevation off at a uniform rate over the entire length of the spiral, with full superelevation through the body of the curve and no superelevation on tangent track.
5. If no spirals exist, or spirals are too short to meet the required rate of runoff, a maximum of 1 inch of superelevation may be run onto tangent track.
6. When the tangent between two curves is too short to provide the minimum length of runoff for the authorized superelevation:
    - Divide the tangent into two parts in proportion to the degree of curvature of the adjoining curves.
    - If possible, place the longer segment adjacent to the curve of greater degree.
7. Maintain at least 100 feet of level track between reverse curves, regardless of whether tangent track exists or not, to ensure that cars can right themselves between curves.
8. Ensure that compound curves have full superelevation for the higher-degree curve carried through the entire higher-degree portion of the curve and reduced superelevation on the lower-degree portion of the curve within the prescribed runoff rates.

2.6.7 Superelevation

The outer or high rail of curves is the designated reference rail for installing and maintaining superelevation. Maintain superelevation as provided on curve markers and/or designated on the high rail of curves.

- The EFMS curve database that can be accessed through the Engineering Website may be used to determine approved elevations and degree of curvature when there are no field markings on the rail. If the accuracy of the EFMS curve database is in doubt, the Manager of Track Maintenance should contact a Manager Geometry at 402-544-1037. Changes to the database cannot be made without AVP Maintenance Approval.

NOTE: Designated superelevation may not be less than 3/4 inch or greater than 5 inches in any curve.

Install approved superelevation in main tracks when track renewals involve surfacing and lining.

Unless approved by the AVP Maintenance the designated superelevation is 1 inch unbalanced. The AVP Maintenance must approve all changes to designated superelevation.

All speeds are rounded up to the nearest 1/4 inch.

Use Table 2.6.7-A to design new superelevation.

Note: 4" Unbalance shown in green is for passenger operations only.

Class 1-5

Superelevation (Inches)														
Curve		Unbalanced Condition	Curve Speeds (Miles Per Hour)												
Deg	Min		10	15	20	25	30	35	40	45	50	55	60	65	70
0	30	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
1	0	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25	1.75	2.00	2.50
		2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.50
		3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
1	30	1	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25	1.75	2.25	3.00	3.50	4.25
		2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25	2.00	2.50	3.25
		3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.50	2.25
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25
2	0	1	0.75	0.75	0.75	0.75	0.75	0.75	1.25	2.00	2.50	3.25	4.25	5.00	
		2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.50	2.25	3.25	4.00	5.00
		3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25	2.25	3.00	4.00
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25	2.00	3.00
2	30	1	0.75	0.75	0.75	0.75	0.75	1.25	2.00	2.75	3.50	4.50			
		2	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.75	2.50	3.50	4.50		
		3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.50	2.50	3.50	4.50	
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.50	2.50	3.50	4.75
3	0	1	0.75	0.75	0.75	0.75	1.00	1.75	2.50	3.50	4.25				
		2	0.75	0.75	0.75	0.75	0.75	0.75	1.50	2.50	3.25	4.50			
		3	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.50	2.25	3.50	4.75		
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.25	2.50	3.75	5.00	
3	30	1	0.75	0.75	0.75	0.75	1.25	2.25	3.00	4.00					
		2	0.75	0.75	0.75	0.75	0.75	1.25	2.00	3.00	4.25				
		3	0.75	0.75	0.75	0.75	0.75	0.75	1.00	2.00	3.25	4.50			
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	2.25	3.50	5.00		
4	0	1	0.75	0.75	0.75	0.75	1.75	2.50	3.50	4.75					
		2	0.75	0.75	0.75	0.75	0.75	1.50	2.50	3.75	5.00				
		3	0.75	0.75	0.75	0.75	0.75	0.75	1.50	2.75	4.00				
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.75	3.00	4.50			
4	30	1	0.75	0.75	0.75	1.00	2.00	3.00	4.25						
		2	0.75	0.75	0.75	0.75	1.00	2.00	3.25	4.50					
		3	0.75	0.75	0.75	0.75	0.75	1.00	2.25	3.50	5.00				
		4	0.75	0.75	0.75	0.75	0.75	0.75	1.25	2.50	4.00				
5	0	1	0.75	0.75	0.75	1.25	2.25	3.50	4.75						
		2	0.75	0.75	0.75	0.75	1.25	2.50	3.75						
		3	0.75	0.75	0.75	0.75	0.75	1.50	2.75	4.25					
		4	0.75	0.75	0.75	0.75	0.75	0.75	1.75	3.25	4.75				
5	30	1	0.75	0.75	0.75	1.50	2.50	3.75							
		2	0.75	0.75	0.75	0.75	1.50	2.75	4.25						
		3	0.75	0.75	0.75	0.75	0.75	1.75	3.25	5.00					
		4	0.75	0.75	0.75	0.75	0.75	0.75	2.25	4.00					

Superelevation (Inches)														
Curve		Unbalanced Condition	Curve Speeds (Miles Per Hour)												
Deg	Min		10	15	20	25	30	35	40	45	50	55	60	65	70
6	0	1	0.75	0.75	0.75	1.75	3.00	4.25							
		2	0.75	0.75	0.75	0.75	2.00	3.25	4.75						
		3	0.75	0.75	0.75	0.75	1.00	2.25	3.75						
		4	0.75	0.75	0.75	0.75	0.75	1.25	2.75	4.75					
6	30	1	0.75	0.75	1.00	2.00	3.25	4.75							
		2	0.75	0.75	0.75	1.00	2.25	3.75							
		3	0.75	0.75	0.75	0.75	1.25	2.75	4.50						
		4	0.75	0.75	0.75	0.75	0.75	1.75	3.50						
7	0	1	0.75	0.75	1.00	2.25	3.50								
		2	0.75	0.75	0.75	1.25	2.50	4.25							
		3	0.75	0.75	0.75	0.75	1.50	3.25	5.00						
		4	0.75	0.75	0.75	0.75	0.75	2.25	4.00						
7	30	1	0.75	0.75	1.25	2.50	3.75								
		2	0.75	0.75	0.75	1.50	2.75	4.50							
		3	0.75	0.75	0.75	0.75	1.75	3.50							
		4	0.75	0.75	0.75	0.75	0.75	2.50	4.50						
8	0	1	0.75	0.75	1.25	2.50	4.25								
		2	0.75	0.75	0.75	1.50	3.25	5.00							
		3	0.75	0.75	0.75	0.75	2.25	4.00							
		4	0.75	0.75	0.75	0.75	1.25	3.00	5.00						
8	30	1	0.75	0.75	1.50	2.75	4.50								
		2	0.75	0.75	0.75	1.75	3.50								
		3	0.75	0.75	0.75	0.75	2.50	4.50							
		4	0.75	0.75	0.75	0.75	1.50	3.50							
9	0	1	0.75	0.75	1.75	3.00	4.75								
		2	0.75	0.75	0.75	2.00	3.75								
		3	0.75	0.75	0.75	1.00	2.75	4.75							
		4	0.75	0.75	0.75	0.75	1.75	3.75							
9	30	1	0.75	0.75	1.75	3.25	5.00								
		2	0.75	0.75	0.75	2.25	4.00								
		3	0.75	0.75	0.75	1.25	3.00								
		4	0.75	0.75	0.75	0.75	2.00	4.25							
10	0	1	0.75	0.75	2.00	3.50									
		2	0.75	0.75	1.00	2.50	4.50								
		3	0.75	0.75	0.75	1.50	3.50								
		4	0.75	0.75	0.75	0.75	2.50	4.75							
10	30	1	0.75	0.75	2.00	3.75									
		2	0.75	0.75	1.00	2.75	4.75								
		3	0.75	0.75	0.75	1.75	3.75								
		4	0.75	0.75	0.75	0.75	2.75								
11	0	1	0.75	0.75	2.25	4.00									
		2	0.75	0.75	1.25	3.00	5.00								
		3	0.75	0.75	0.75	2.00	4.00								
		4	0.75	0.75	0.75	1.00	3.00								
11	30	1	0.75	1.00	2.25	4.25									
		2	0.75	0.75	1.25	3.25									
		3	0.75	0.75	0.75	2.25	4.25								
		4	0.75	0.75	0.75	1.25	3.25								

Superelevation (Inches)														
Curve		Unbalanced Condition	Curve Speeds (Miles Per Hour)												
Deg	Min		10	15	20	25	30	35	40	45	50	55	60	65	70
12	0	1	0.75	1.00	2.50	4.25									
		2	0.75	0.75	1.50	3.25									
		3	0.75	0.75	0.75	2.25	4.75								
		4	0.75	0.75	0.75	1.25	3.75								
12	30	1	0.75	1.00	2.50	4.50									
		2	0.75	0.75	1.50	3.50									
		3	0.75	0.75	0.75	2.50	5.00								
		4	0.75	0.75	0.75	1.50	4.00								
13	0	1	0.75	1.25	2.75	4.75									
		2	0.75	0.75	1.75	3.75									
		3	0.75	0.75	0.75	2.75									
		4	0.75	0.75	0.75	1.75	4.25								
13	30	1	0.75	1.25	3.00	5.00									
		2	0.75	0.75	2.00	4.00									
		3	0.75	0.75	1.00	3.00									
		4	0.75	0.75	0.75	2.00	4.75								
14	0	1	0.75	1.25	3.00										
		2	0.75	0.75	2.00	4.25									
		3	0.75	0.75	1.00	3.25									
		4	0.75	0.75	0.75	2.25	5.00								
14	30	1	0.75	1.50	3.25										
		2	0.75	0.75	2.25	4.50									
		3	0.75	0.75	1.25	3.50									
		4	0.75	0.75	0.75	2.50									
15	0	1	0.75	1.50	3.25										
		2	0.75	0.75	2.25	4.75									
		3	0.75	0.75	1.25	3.75									
		4	0.75	0.75	0.75	2.75									
15	30	1	0.75	1.50	3.50										
		2	0.75	0.75	2.50	5.00									
		3	0.75	0.75	1.50	4.00									
		4	0.75	0.75	0.75	3.00									
16	0	1	0.75	1.75	3.50										
		2	0.75	0.75	2.50	5.00									
		3	0.75	0.75	1.50	4.00									
		4	0.75	0.75	0.75	3.00									
16	30	1	0.75	1.75	3.75										
		2	0.75	0.75	2.75										
		3	0.75	0.75	1.75	4.25									
		4	0.75	0.75	0.75	3.25									

Note: 4.5” Unbalance shown in green is only to be used on the Springfield and Joliet High Speed Line.

Class 6

Superelevation (Inches)									
Curve		Unbalance Condition							
Deg	Min		75	80	85	90	95	100	105	110
0	30	1	1.00	1.25	1.75	2.00	2.25	2.50	3.00	3.25
		2	0.75	0.75	0.75	1.00	1.25	1.50	2.00	2.25
		3	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.25
		4	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		4.5	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
1	0	1	3.00	3.50	4.25	4.75				
		2	2.00	2.50	3.25	3.75	4.50	5.00		
		3	1.00	1.50	2.25	2.75	3.50	4.00	4.75	
		4	0.75	0.75	1.25	1.75	2.50	3.00	3.75	4.50
		4.5	0.75	0.75	0.75	1.25	2.00	2.50	3.25	4.00
1	30	1	5.00							
		2	4.00	4.75						
		3	3.00	3.75	4.75					
		4	2.00	2.75	3.75	4.75				
		4.5	1.50	2.25	3.25	4.25	5.00			
2	0	1								
		2								
		3	5.00							
		4	4.00	5.00						
		4.5	3.50	4.50						

Table 2.6.7-A

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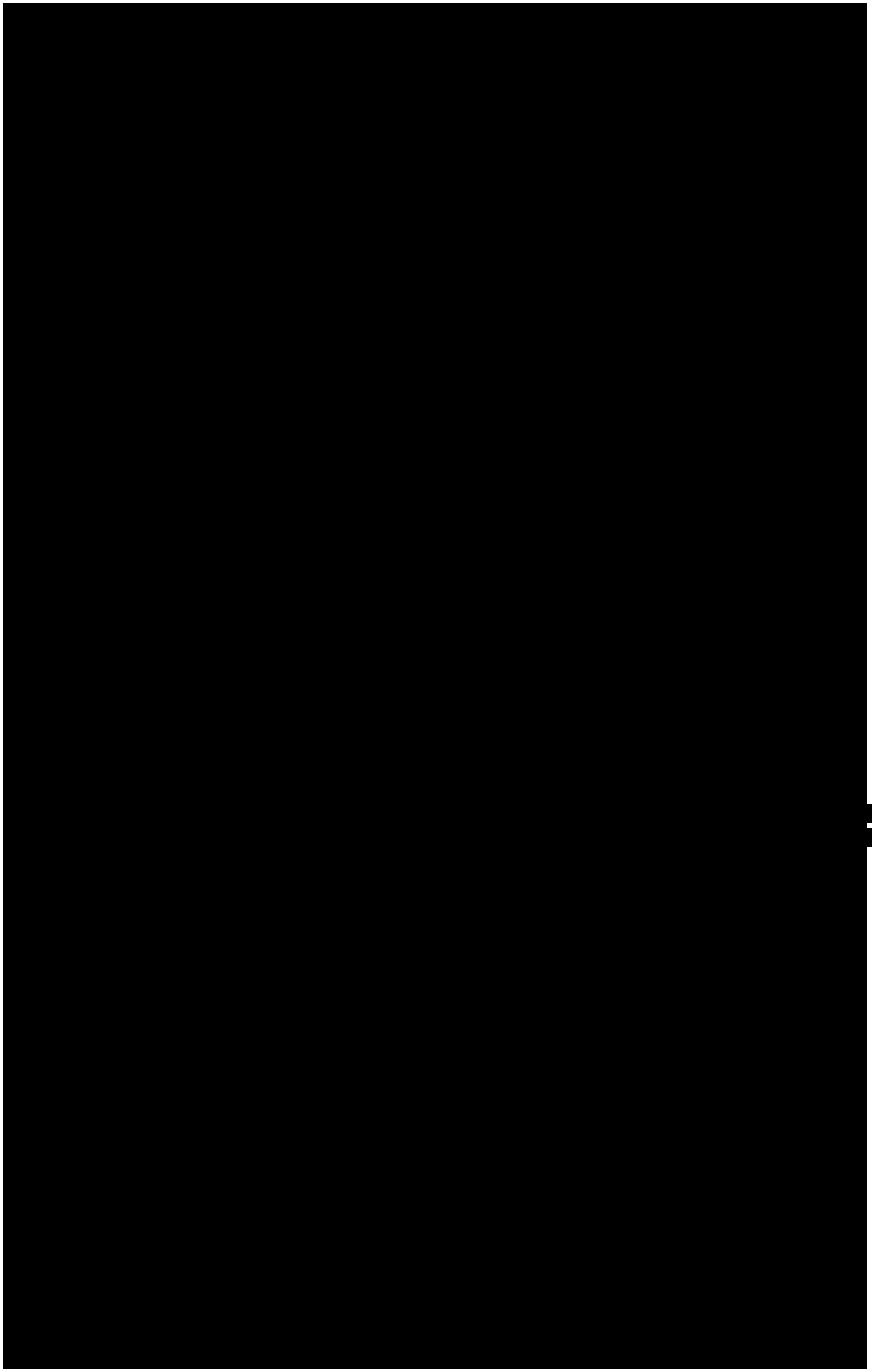

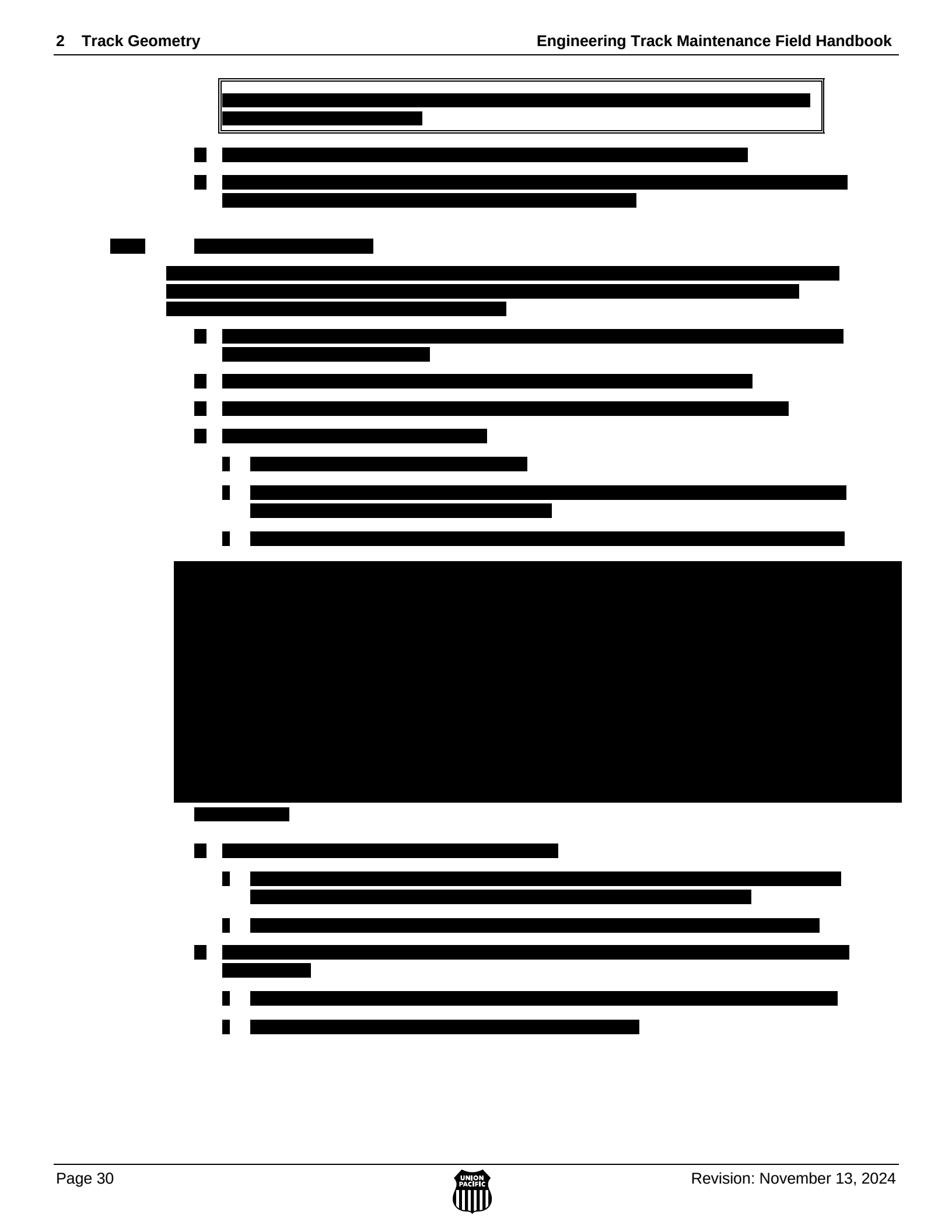

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2.9 Surveying and Marking Curves

Curve surveying is utilized to ensure curves are properly lined and surfaced. Surveying and marking of curves is a method in which the curve is surveyed, calculated, and marked to guide maintenance or construction gangs to either set the curve back to its original design or if due to current conditions that cannot be achieved, a new design. During surfacing operations, when curve tamping solutions vary by the following thresholds from the curve database or survey marks, then notify supervisor immediately for further instructions unless otherwise notified that changes are correct.

1. Spiral Length change of 50% or more
2. Curve Length change of 500 feet or more
3. Curve degree change of 0.5° or more
4. Change in curve geometry from simple to compound or reduction in compounds

Curve Surveys are recommended to be prioritized by the following:

1. Ahead of Capital Program Undercutter projects.
2. Ahead of Capital Program Track, Surface, and Line projects
3. Ahead of Capital Program Tie Replacement projects.

3 TIES AND FASTENINGS

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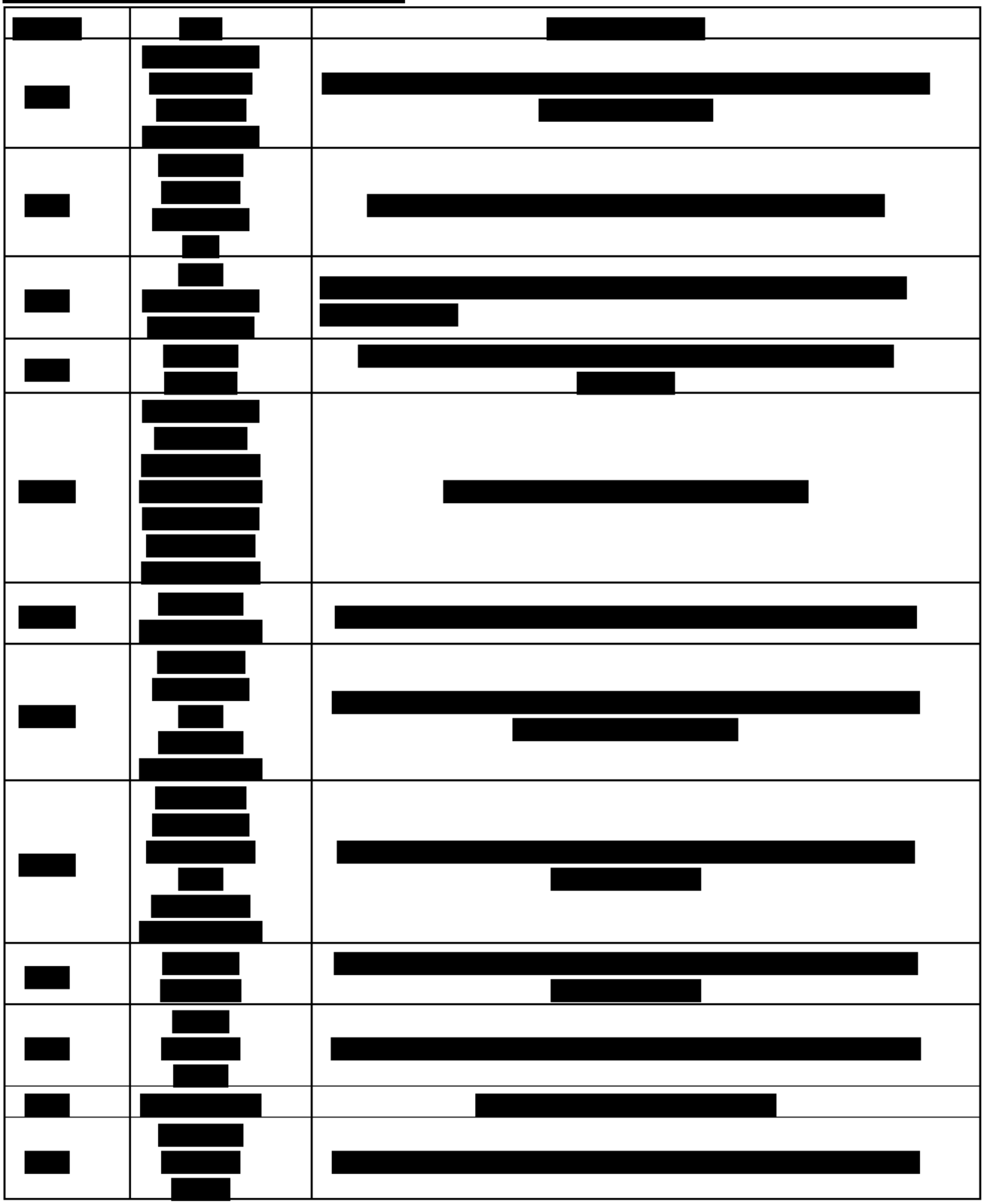


3.1 Ties

A tie is a support to which rails are fastened and held to gauge. Ties are designed to distribute wheel loads to the roadbed and to interlock with ballast to prevent lateral, longitudinal and vertical movement of the track structure.

3.1.1 Types and Applications

Determine the tie requirements for various track applications according to subsections A. Wood Ties, B. Concrete Ties, C. Steel Ties, D. Composite ties and E. Borate Treated Wood Ties.

Tie Tier Map

A. Wood Ties

Follow these requirements when using wood ties:

1. Install wood ties of the designated length and size as determined by annual traffic density on the main track. Use Table 3.1.1-A to determine tie length and size.

Wood Tie Types and Applications			
Track Type	**ML Traffic Density**	**Tie Size**	**Tie Length**
Main	Greater than 10 MGT	7” x 9”	8’6”
Main	Less than 10 MGT	7" x 9"	8 feet or 8' 6"
Sidings	50 MGT or more	7" x 9"	8’6”
Sidings	Less than 50 MGT	7" x 9"	8 feet or 8' 6"
Industry and Yards	All locations	6" x 8" or 7" x 9"	8 feet or 8' 6"

Table 3.1.1-A

DO NOT INTERMIX WOOD TIES WITH CONCRETE TIES TO MAKE PERMANENT REPAIRS.

2. Union Pacific utilizes Hardwood, Softwood and Borate wood ties dependent on track type and decay zone. For assistance with determining which type of wood tie to utilize, review the Tie Type Designation Map under the Capital Projects Portal → Project Identification → Wood Tie Usage Map.
3. Wood Tie Installation in Road Crossings:
    a. Install 10 foot wood ties and concrete crossing panels for 10 foot ties if the daily traffic count exceeds 500 vehicles/day.
    b. Install 8’-6” foot wood ties and wood prefab crossing panels if the daily traffic count is less than 500 vehicles/day.
    c. For daily traffic count use: http://home.www.uprr.com/emp/engineering/apps/efms/afi_reports/facility_reports.cfm > Road Crossings
4. Reconditioned and industrial grade ties may be utilized on Industrial Leads and Yard Tracks. Capital wood tie projects may utilize reconditioned and industrial grade ties if intermixed with new wood ties but not to exceed 50% reconditioned and industrial grade ties. Reconditioned tie availability may be limited. Reach out to the Sr. Analyst – Tie Planning and the material group for availability.

B. Concrete Ties

Concrete Ties should only be utilized in concrete tie locations approved by the VP of Engineering. Refer to the tie applications map. The fastening system is integrated into the concrete tie, see the Work Procedure Document on fastening systems (WPD 3.01) for additional details.

Follow these requirements when installing ties in concrete tie track:

1. Clean and drain the ballast section. Proper track drainage is critical to concrete tie performance.
2. Concrete ties can be installed out of face in curves with high gauge restraint requirements located in wood tie territory.
3. Ensure that the ballast section has a minimum depth of 12 inches below the bottom of the tie and a minimum shoulder width of 12 inches.
4. Where guard rails are required on concrete ties, utilize the ties shown in Standard Drawing Nos. 0202 and 0206 with the platework shown in Standard Drawing No. 4004. Use only coach screws and washers shown in Standard Drawing No. 0409. For Vossloh installations, utilize item numbers 503-1956 on the ends and 503-1955, Vossloh applications do not require platework.
5. Concrete Tie Installation in Road Crossings:
    a. Install 10 foot concrete ties and concrete crossing panels for 10 foot ties if the daily traffic count exceeds 200 vehicles/day.
    b. Install 8-6 foot concrete ties and concrete crossing panels for 8-6 foot ties if the daily traffic count is less than 200 vehicles/day.
    c. Use Item Number 540-1930 for crossing pads that will be installed on the UP11 and UP15 (Rail.One) tie. Refer to Standard Drawing No. 0209 for tie details.
6. When handling concrete ties, ensure ties are carefully handled by mechanized equipment to avoid chipping and breaking of concrete. Do not allow ties to drop more than 2 feet when unloading to the ground; do not allow ties to drop on other ties.

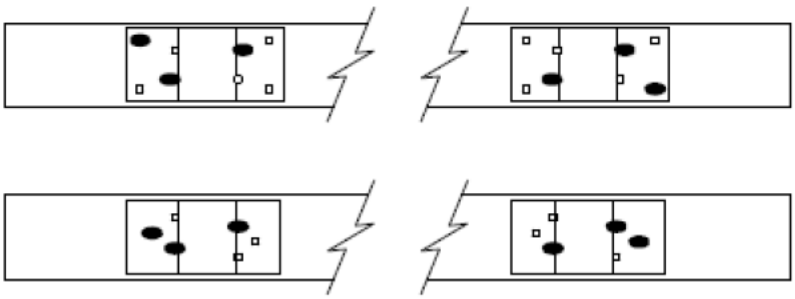
C. Steel Ties

Steel Ties are recommended for specialty applications only, such as areas with specialized clearance requirements. Examples of these locations are mechanical facilities, platform locations or areas where corrosive materials may be present (i.e. locomotive facilities). Steel Tie Turnouts can be utilized in wood applications. Follow the requirements in WPD on Steel Tie Installation and Maintenance when using steel ties.

D. Composite Ties

Composite Ties are ties manufactured out of materials other than concrete or wood. Polymer fiber reinforced is the most common type utilized. They have specialized installation and maintenance requirements versus a wood tie. Refer to WPD on Composite Tie Installation and Maintenance.

Composite ties have different spiking requirements than standard wood ties. In addition, they generally require a pre-drill for lag screw and cut spike applications. On tangent track and curves up to 1 degree, use 1 gauge spikes and 2 field spikes. The goal is to keep spikes from being side by side.



On all curves of 1 degree or greater, use 2 gauge and 2 field spikes.

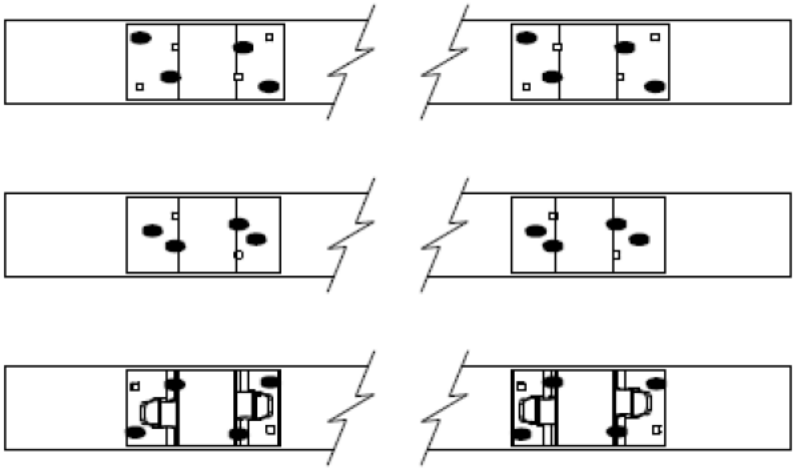


Figure 3.1.1-A

E. Borate Treated Wood Ties

Borate acts as a preservative enhancer for creosote treated wood ties. Borate treated wood ties are not distinguishable from a standard wood tie by the naked eye and should be handled exactly like standard wood ties including installation, inspection and maintenance. Both standard crossties and switch ties are available with borate treatment.

Use the following requirements when using Borate treated wood ties:

1. Borate treated wood ties are to be used in areas where wood tie life is shortened due to environmental conditions.
    - High decay areas (See map located at: MyUP>Reference> Bulletin Board>Maps>Tie Usage Map)

3.1.2 Installation and Spacing

Follow these requirements when installing and spacing ties. Unless otherwise noted, these requirements apply for all tie types. Note : There are specific instructions for program installation of wood ties in section 3.1.10:

1. Do not replace more than three consecutive cross or switch ties at one time.
2. Do not replace more than two consecutive cross or switch ties at one time if the rail temperature is at, above, or forecasted to be above, the "Rail Temperature Required for Speed Restriction Behind Track Work" for the Subdivision.
3. Do not replace more than 50 percent of the cross or switch ties in any rail length at one time (39'6" is a standard rail length) unless Steps 1 and 2 are followed and:
    a. All ties installed in the first pass have been:
        - Fully spiked, anchored or clipped depending on tie type and requirements for location.
        - Refer to section 2.3.3 Measuring Gauge for base gauge.
        - Installed with enough ballast to maintain proper surface and alignment.
    b. Make an additional pass to install ties if required.
4. Tie replacement requirements 1 - 3 do not apply when installing ties in:
    - Road crossings.
    - Station platforms.
    - Confined track areas.
    - Sledding, plowing, or undercutting operations.
5. Install ties at a right angle to the track's running rails (except No. 20 and No. 30 concrete switch ties per Standard Drawing Nos. 5054 and 5057).

6. Mark the inner rail of curves with appropriate tie spacing prior to removal. Maintaining proper tie spacing in curves can be difficult without markings present.
7. Where tracks come together behind turnouts:
   - Do not interlace ties.
   - Maintain at least 3 inches between the ends of ties.
8. On wood tie applications install ties with "sap side" kerf marks (1/8" grooves cut into the top of the tie) facing UP. This places the tie's hardest surface down on the ballast as shown in Figure 3.1.2-A. Different composite ties may have a designated "top" surface, consult the WPD on Composite Tie installation for more information.

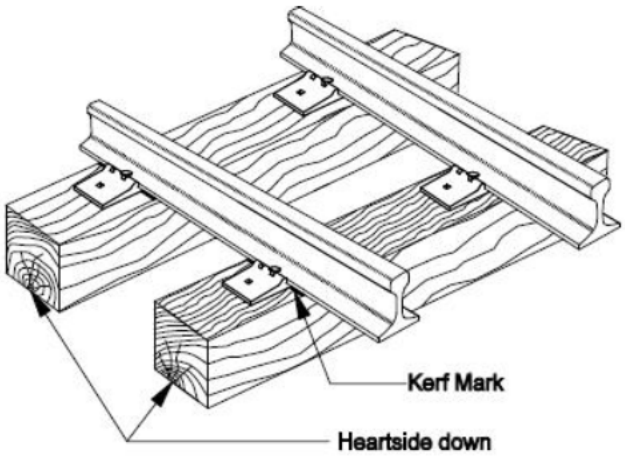


Figure 3.1.2-A

9. On wood and composite applications, it is important that the same distance of the tie extend away from the rail seat on each side of the track. Failure to do so can result in tie length staggering which may result in surface issues. Align the kerf mark in ties with the rail base of the designated line rail. Install non-marked wood ties with the tie ends extending from the outside rail base of the line rail as shown in Table 3.1.2-A.

Distance from Outside Rail Base to End of Wood Tie on Line Rail		
Tie Application	**Tie Length**	**Outside Line Rail Base to End of Tie Distance**
Cross Tie	8 feet	15 inches
Cross Tie	8 feet 6 inches	18 inches
Cross Tie	9 feet	21 inches
Cross Tie	10 feet	27 inches
Switch Tie	10 to 17 feet	*27 inches
Switch Tie	18 feet	*21 to 27 inches
Switch Tie in Crossover	23 to 27 feet	*21 to 27 inches with ties centered under the 2 tracks

Table 3.1.2-A

***NOTE: See Section 3.1.3 Switch Ties for additional information.**

10. Prior to wood ties being re-spiked, plug the spike holes utilizing plugging compound or wooden plugs.
11. When composite ties are re-spiked, re-spike into existing hole without plugging compound or plugs. If changing the spiking pattern, re-drill pilot holes for new spike pattern.

12. When trains must operate through tie renewal areas during continued installation, adhere to the minimum required number of ties left unspiked or unfastened outlined in Table 3.1.2-B.

Track Type	Maximum Number of Consecutive Ties Left Unspiked or Unfastened	Maximum Allowable Train Speed (MPH)
Tangent	3	25
Curve	2	25

Table 3.1.2-B

13. Maintain a minimum number of ties at the designated spacing in each 39 feet of track as determined by the tie and track type. Use Table 3.1.2-C to determine the quantities.

Tie Quantities Per 39 Feet of Track and Required Spacing		
Tie Type	**Main Track**	**Sidings and Yards**
7" x 8'6" Wood/ Composite	24 ties @ 19-1/2 inches	20 ties @ 24 inches
6" x 8" Wood	Do not use	22 ties @ 21-1/4 inches
Concrete	20 ties @ 24 inches	20 ties @ 24 inches
7 1/2" x 8'6" Steel	Do not use	20 ties @ 24 inches

Table 3.1.2-C

NOTE: When converting an existing wood tie curve to concrete ties, the tie spacing may be reduced to 19-1/2 inches to allow for easier installation and increased gauge restraint.

14. Install and space ties under rail joints with the centerline of the tie measuring between 9 and 18 inches from the rail end. Ensure that tie spacing will allow for field welding of joints to avoid re-spacing ties.

3.1.3 Switch Ties

The standards that apply to cross ties also apply to switch ties. Follow these general switch tie requirements:

1. Maintain a standard set of switch ties in every turnout according to the applicable Standard Drawing.
   - Do not install cross ties in turnouts in place of switch ties to make a permanent repair.
   - Do not cut switch ties to make shorter lengths. Exception – If switch is being straight railed.
2. When ordering replacement concrete or steel ties, specify the turnout size, hand, individual tie number, tie generation, HST present, tie spacing and frog type.

NOTE: Unlike wood ties in wood tie turnouts, each concrete or steel switch tie in a turnout is unique. The ties are individually numbered for identification. Concrete turnout ties span multiple generations and tie spacings. To avoid errors in ordering and for assistance with ordering contact Sr. Manager Tie Assessment.

A. Installing Switch Ties at Turnouts

Follow these requirements when installing switch ties:

1. Install 10-foot switch ties ahead of the switch points in main track and siding switches according to Standard Drawing No. 0270.
2. Install 10-foot switch ties under the full length of the switch points. You may use 9-foot ties in yard track switches where the track configuration does not give enough clearance between tie ends of adjacent track.
3. Ensure that wood switch ties extend 27 inches from the outside base of the designated line rail on the

straight side of a switch.

4. Change switch tie lengths to the next longer tie where the amount of tie that extends from the outer rail base on the turnout side becomes less than 21 inches while maintaining the prescribed 27-inch distance on the straight side of the switch.
5. Reduce the amount of tie that extends from the base of the designated line rail on the straight side of a switch to 21 inches on the last few 18-foot switch ties. See Figure 3.1.3-A.
    - Do this where the amount of 18-foot tie that extends on the turnout side becomes less than 21 inches while maintaining the 27 inches on the straight side.
    - Install the remaining 18-foot ties in this manner to where at least 45 inches exist between the outside rail bases of the turnout and straight side rails.

NOTE: For new installations refer to latest turnout Standard Drawing Nos. 5000 to 5099.

NOTE: For all program and maintenance tie installation, install ties according to the existing layout. Exception – Crossover applications may be updated to the recommended tie layout, see section 3.1.3.B.

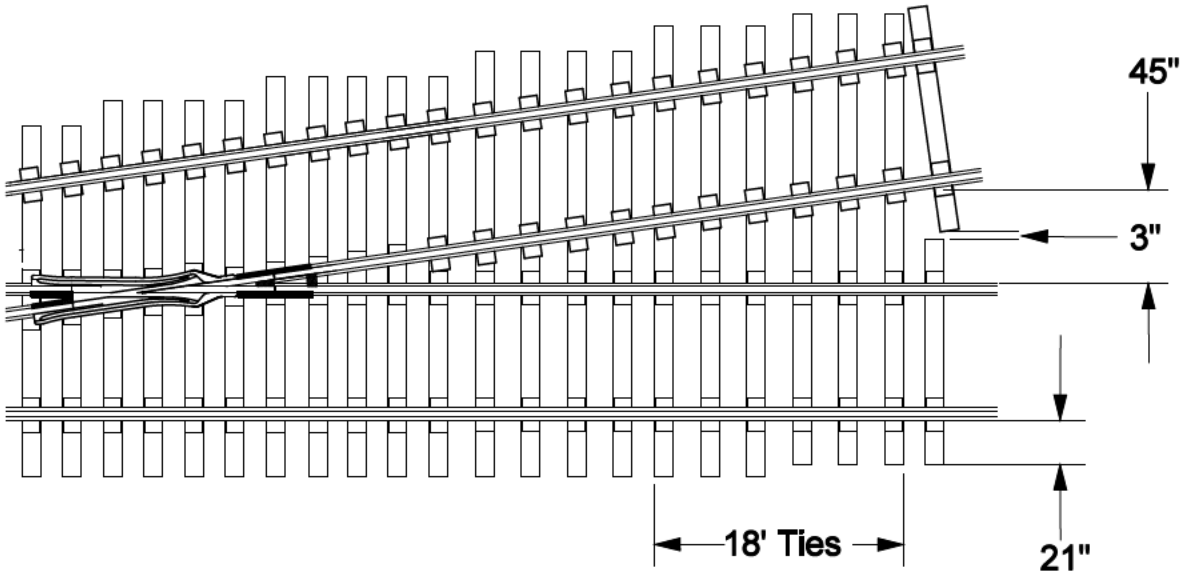


Figure 3.1.3-A

B. Installing Switch Ties in Crossover Switches

Follow these requirements when installing switch ties in crossover switches:

1. In 2004 UP modified its crossover switch tie layout. The previous layouts had all long ties 23' and larger under the entire crossover. The revised layout shown in Figure 3.1.3-B utilizes staggered long and short ties where every third tie is a long tie (23' to 27').
2. During program switch tie replacement, upgrading to the new staggered layout is advised. This may require that tie lengths be changed over several replacement cycles in order to fully upgrade to the new standard layout.
3. Measure track centers in wood tie track to determine the length of staggered long switch ties required in crossover switches where ties extend under both tracks. See Table 3.1.3-A.

Long Switch Tie Lengths for Crossover Switches	
Existing Track Center	**Long Switch Tie Length**
13 feet to 13 feet 11 inches	23 feet
14 feet to 14 feet 11 inches	24 feet
15 feet to 15 feet 11 inches	25 feet
16 feet to 16 feet 11 inches	26 feet
17 feet to 17 feet 11 inches	27 feet
18 feet or greater	Not required

Table 3.1.3-A

NOTE: In crossover switches, staggered long switch ties extending under both tracks replace shorter length switch ties used in standard turnouts where track centers are less than 18 feet. Old switch tie pattern consisted of all long ties - when replacing ties, update to current design.

4. At crossover switches where the track centers do not measure in even feet, center the long switch ties under both tracks, with 21 to 27 inches extending from the outer rail base of the designated line rails.
5. The ideal pattern is to have two short ties to one long tie, as shown in Figure 3.1.3-B. Previous crossover switches had all longer ties (23' to 27') under the switch. There are certain track centers that will require a change in the pattern in the center of the crossover (where the two turnouts meet). One rule to remember here is that at no time shall two long ties be placed next to each other.

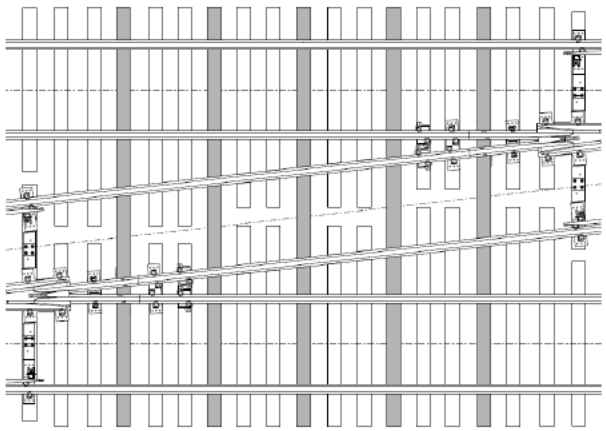


Figure 3.1.3-B

6. On original standard crossovers, i.e. crossovers that utilize all long ties, use Table 3.1.3-B below to determine the shorter length switch ties replaced by long switch ties in crossover switches. This does not apply to the new staggered standard.

Switch Ties Replaced by Long Switch Ties in Crossover Switches	
Existing Track Center	**Long Switch Ties Replace These Shorter Length Ties**
13 feet to 13 feet 11 inches	14 feet and longer
14 feet to 14 feet 11 inches	15 feet and longer
15 feet to 15 feet 11 inches	16 feet and longer
16 feet to 16 feet 11 inches	17 feet and longer
17 feet to 17 feet 11 inches	18 feet and longer
18 feet or greater	Not applicable

Table 3.1.3-B

3.1.4 Head Block and Switch Machine Ties

Union Pacific has utilized standard switch ties, dap-cut switch ties and

Follow these requirements to install head block and switch machine ties:

1. In hand-operated switches, determine the length of wood switch ties to use as head block ties by determining the length of the connecting rod. See Table 3.1.4-A. In hand operated switch applications standard section switch ties are to be utilized.

NOTE: When using Table 3.1.4-A, round the actual length of the connecting rod to the nearest foot.

Head Block Tie Length for Hand-Operated Switches	
Connecting Rod Length	**Head Block Tie Length**
3 feet	13 feet
4 feet	14 feet
5 feet	15 feet
6 feet	16 feet
7 feet	17 feet

Table 3.1.4-A

2. In most power operated applications the switch machines ties are dapped or tapered. Install dapped/tapered switch machine ties in power-operated switches where there are dapped gauge plates.
   - Make sure helper rod assemblies on switches mount to specific length switch ties to provide adequate clearance for automatic tamping machines to surface through the switch point area.
   - Use Table 3.1.4-B to determine the proper combination of switch tie lengths.

Dapped/Tapered Switch Machine Tie Lengths			
Turnout Size	**Helper Rod Design**	**Switch Machine Tie Length**	**Supporting Switch Tie Length**
7 to 15	Not applicable	14 feet 6 inches	Not applicable
20	Single	14 feet 6 inches	11 feet
20 and Larger	Double	15 feet 6 inches	12 feet

Table 3.1.4-B

3. Switches size 20 and greater often utilize helper rods to assist with throwing the switch as shown in Figure 3.1.4-A. Use the standard drawing for the turnout and consult with the signal group to assist with the installation location for helper rod supporting switch ties.

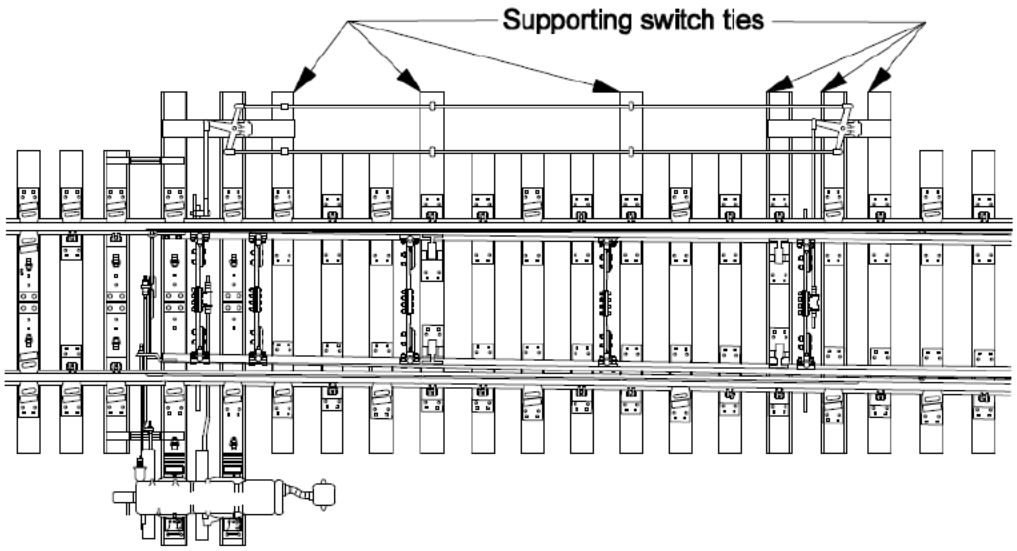


Figure 3.1.4-A

3.1.5 Transition Zones

Follow the requirements in Standard Drawing 0270 for transition zones:

1. Install wood ties of specific lengths with elastic fasteners to transition to wood turnouts and standard concrete ties to transition from wood ties to concrete turnouts as shown in Table 3.1.5-A.

Elastically Fastened Wood Tie and Standard Concrete Tie Requirements for Turnout Transitions		
When transitioning from...	**And maximum train speed is...**	**Then install...**
Wood or Concrete Ties to Wood Tie Turnouts	More than 40 MPH on Mainline Side	Forty 10-foot ties ahead of the switch points and Twenty-four 8'-6"-foot ties behind the last long switch tie on the mainline side
Wood or Concrete Ties to Wood Tie Turnouts	More than 40 MPH on Mainline Side and More than 35 MPH on Turnout Side Track	Forty 10-foot ties ahead of the switch points and Twenty-four 8'-6" ties behind the last long switch tie on both mainline and turnout sides
Wood Ties to Concrete Tie Turnouts	More than 40 MPH on Mainline Side and More than 35 MPH on Turnout Side Track	Forty standard concrete ties ahead of the switch points and Twenty standard concrete ties behind the last long switch tie on both mainline and turnout sides

Table 3.1.5-A

2. Install transition zone ties on the approaches of open deck bridges as show in Table 3.1.5-B.

Open Deck Bridge	
Wood Ties	10 ea 10' Ties
Concrete Ties	10 ea Ties with varied spacing between 17" and 24" per Standard Drawing 0270.

Table 3.1.5-B

3. In areas where transitioning from wood ties to concrete ties a small section of elastic fasteners should be utilized on the wood tie track to help smooth the transition. Install wood ties of specific lengths with elastic fasteners to provide transition from wood tie track to concrete ties in Table 3.1.5-C.

Elastically Fastened Wood Tie Requirements for Concrete Tie Transitions			
When transitioning from...	**And maximum train speed is...**	**Then install this quantity of 8'-6" wood ties with Elastic Fasteners ...**	**And install this quantity of 10-foot wood ties with Elastic Fasteners...**
Concrete to Wood or Composite Ties	Less than 30 MPH	10	None
Concrete to Wood or Composite Ties	30 to 50 MPH	10	10
Concrete to Wood or Composite Ties	More than 50 MPH	10	20

Table 3.1.5-C

NOTE: Install the 10-foot ties next to the concrete ties per table in the transition zone.

NOTE: It is not recommended that composite ties be utilized in the transition zone.

4. When transitioning from concrete to wood tie track, do not install transition zones in curves or through road crossings. Instead, extend the concrete beyond these conditions.
5. Concrete tie track to concrete tie turnouts do not include/require transition ties. The transition ties are included in the concrete switch tie set.

3.1.6 Tie Drilling – Wood and Composite Ties

Drill pilot holes as follows:

1. Drill the proper diameter pilot holes into wood ties before installing screw type fasteners. Use drill bit sizes according to the wood type in Table 3.1.6-A.

Drill Bit Size Required by Tie Type				
Fastener Size and Type	**Softwood**	**Hardwood**	**Composite**	**Azobe**
15/16- x 6 1/2-inch Coach Screw	11/16 inch	3/4 inch	3/4 inch	13/16 inch
3/4-inch Dome Head Road Crossing Screw	1/2 inch	9/16 inch	3/4 inch	11/16 inch
5/8-inch Torx Head Road Crossing Screw	*Not required	*Not required	1/2 inch	9/16 inch
Standard cut spike	Not required	Not required	3/8 inch	Not required

Table 3.1.6-A

***NOTE: Torx head screw spikes are self-tapping.**

2. Drill ties 1/4 inch below the lowest point where the screw fastener will penetrate the tie. Ensure that pilot holes do not extend through the bottom of the ties.

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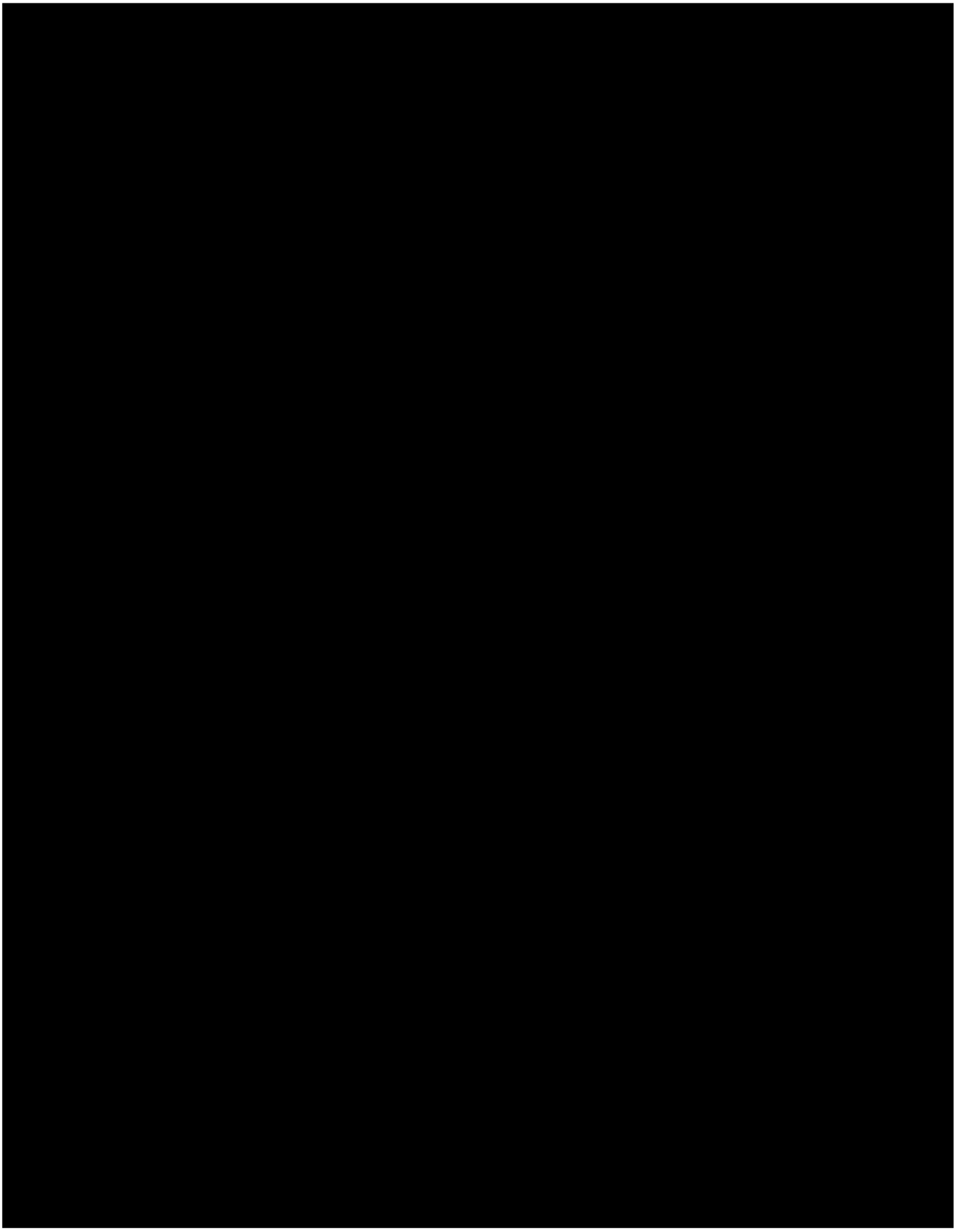

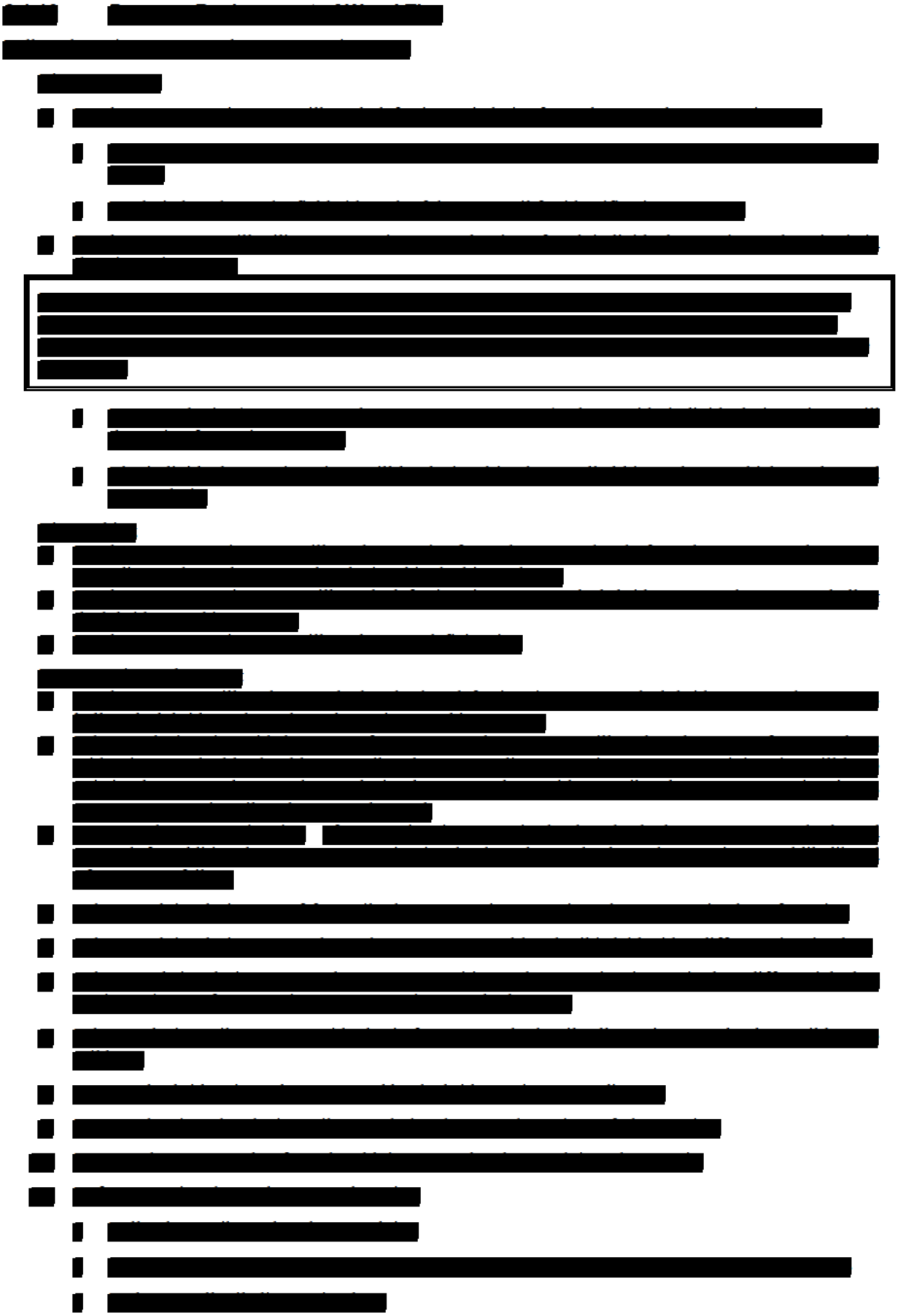

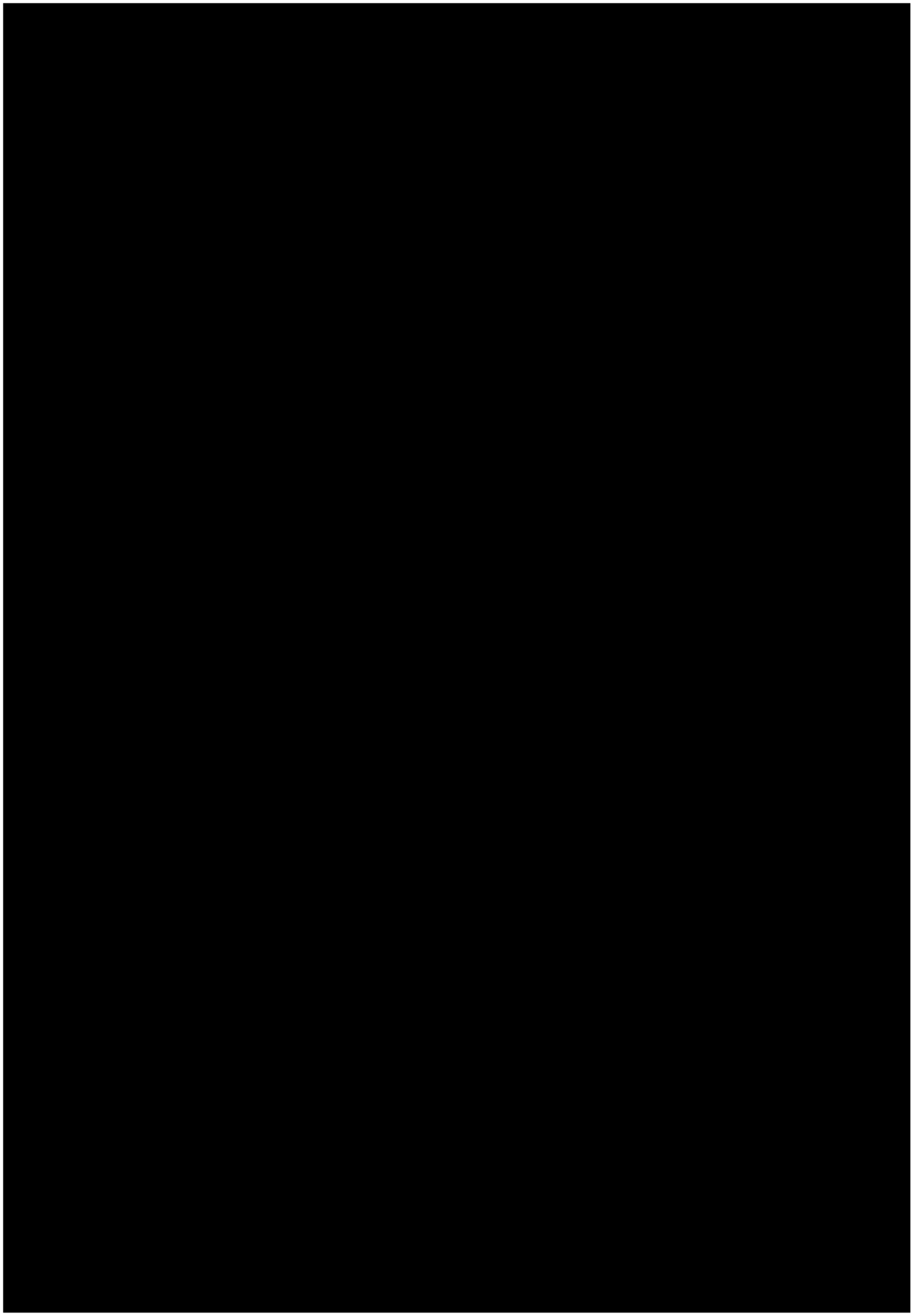

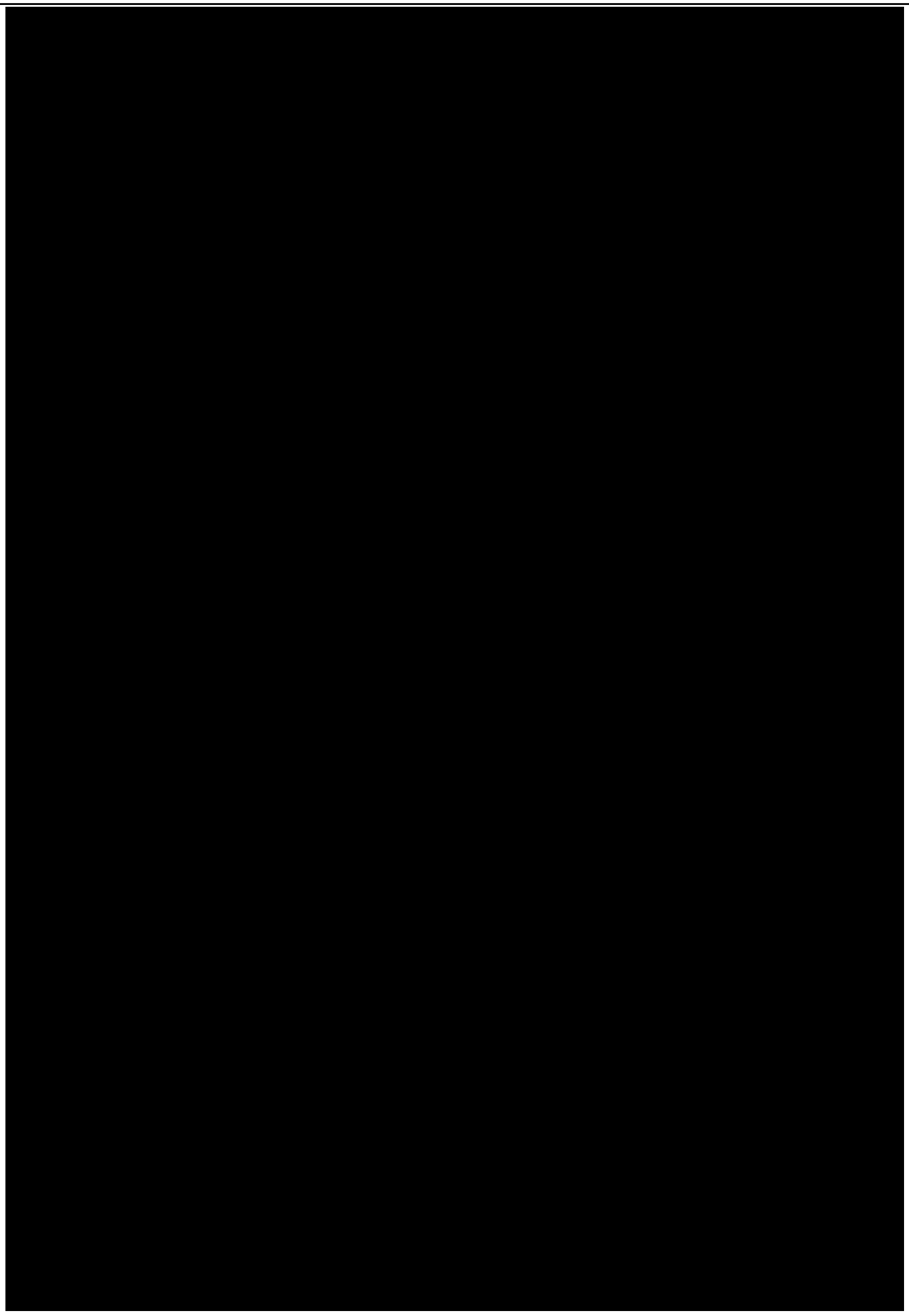

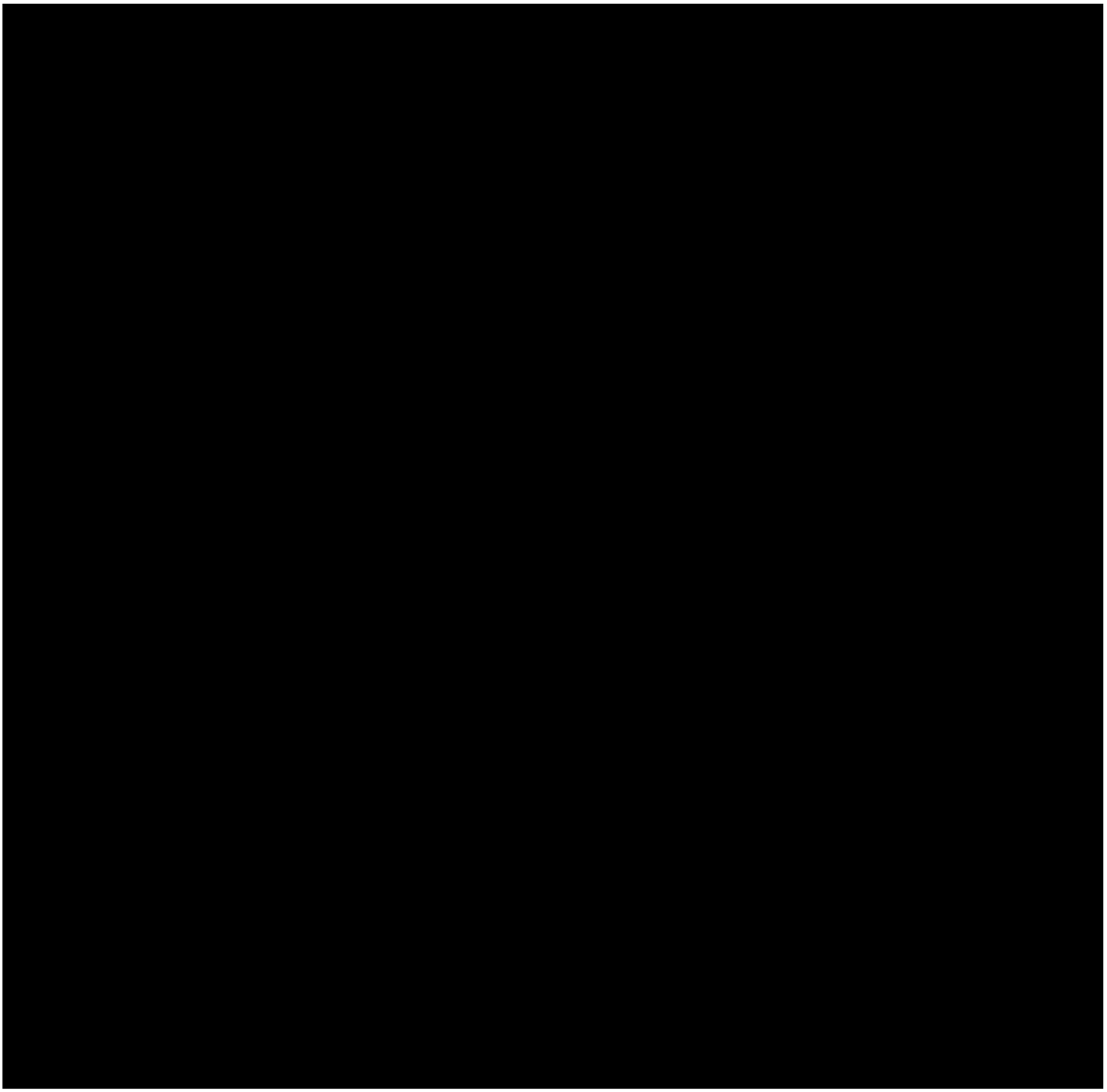

3.1.15 Concrete Tie Rating

Concrete tie rating is very different from rating wood ties. Refer to the WPD on Tie Rating for guidelines.

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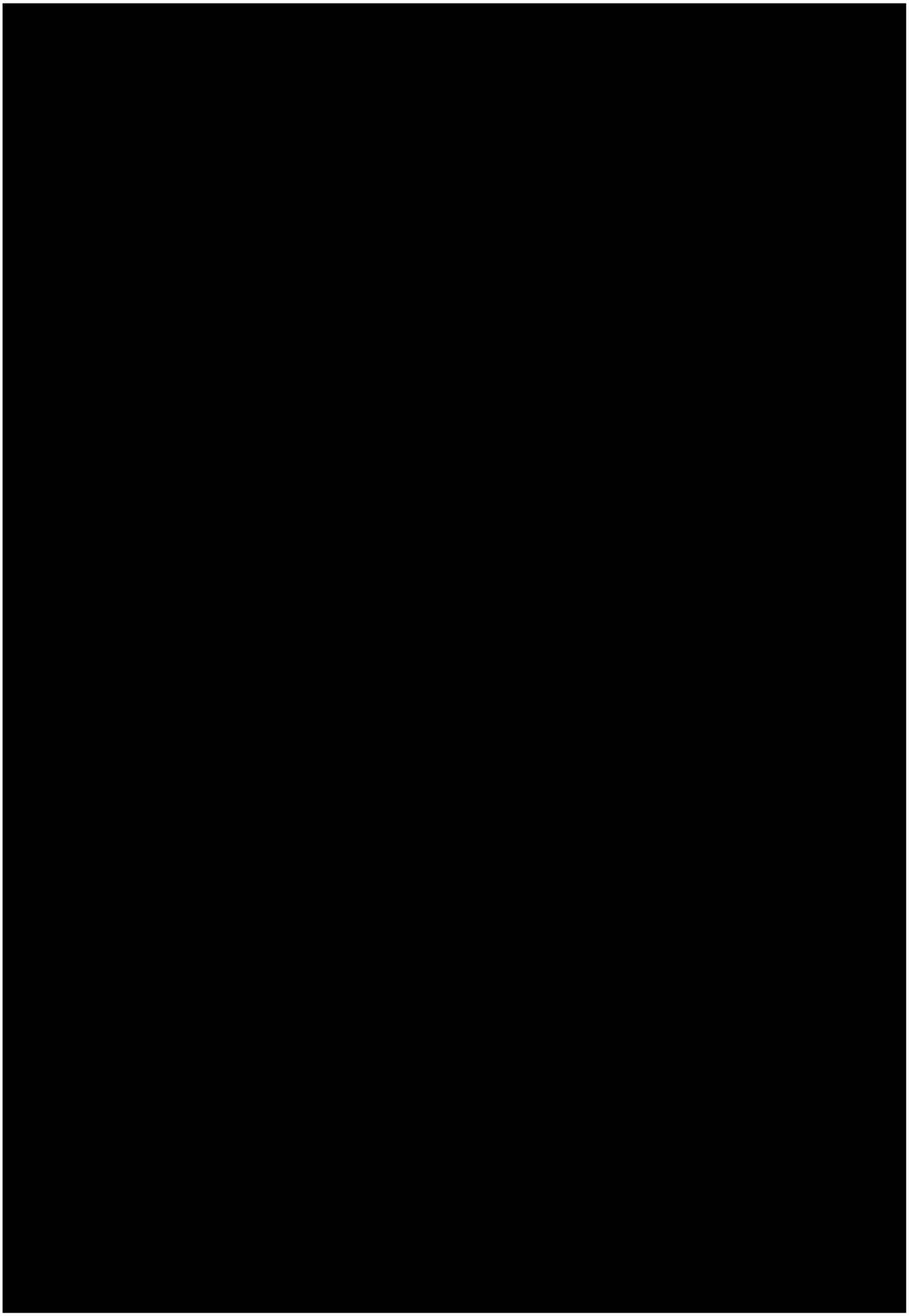

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3.3 Elastic Fasteners

Elastic Fasteners are any fastener that acts as a "spring" to hold the base of the rail down with much higher force than standard cut spikes. They are often referred to as spring clips because of this. Due to higher loading they often reduce the requirement for anchors over standard cut spikes. All concrete tie fastening systems are elastic fasteners. Wood tie elastic fasteners include e-clips and Safelok I clips. Table 3.3.8-A shows the most common spring clip types. Refer to the WPD on Fastening Systems for more information.

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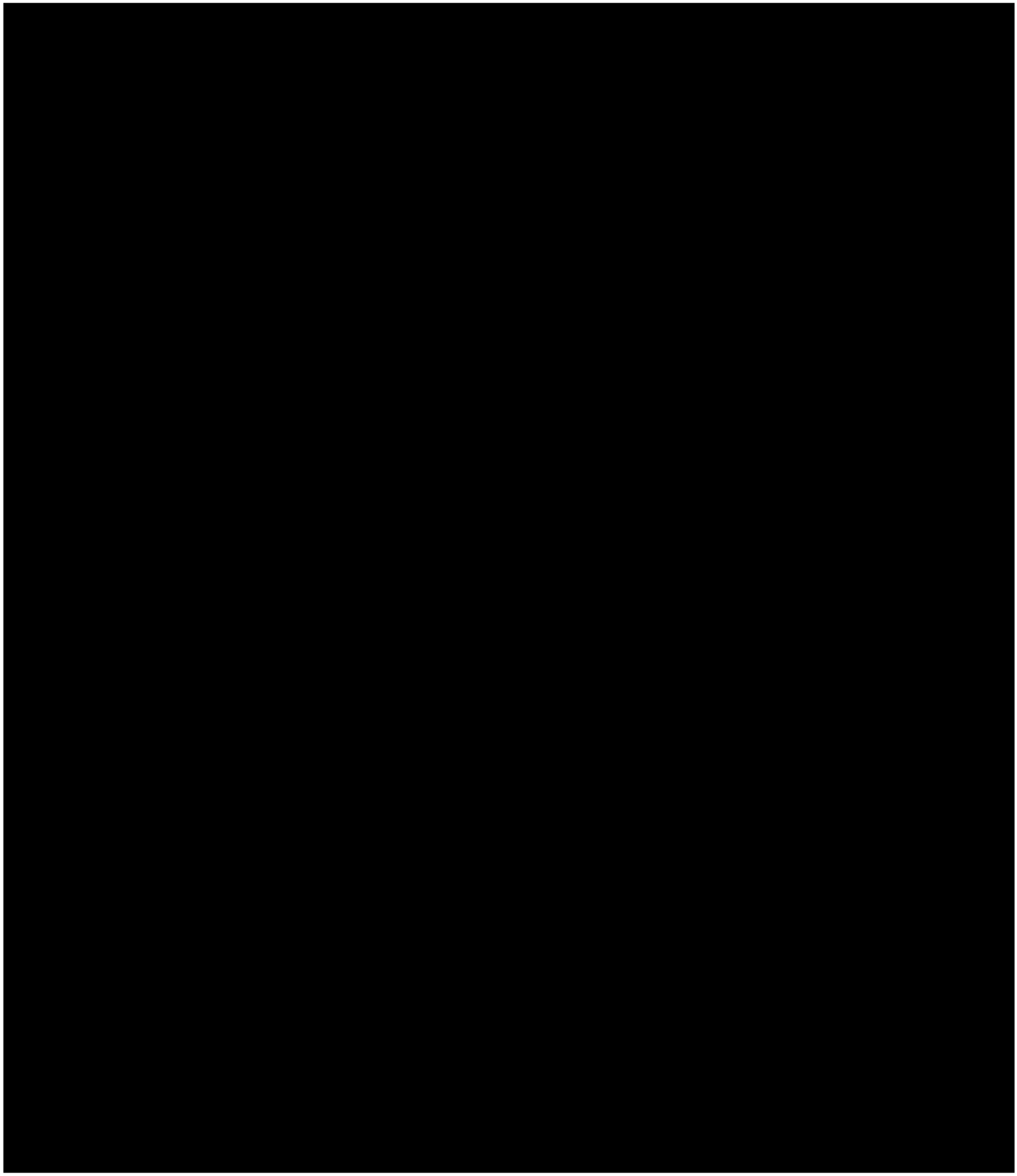
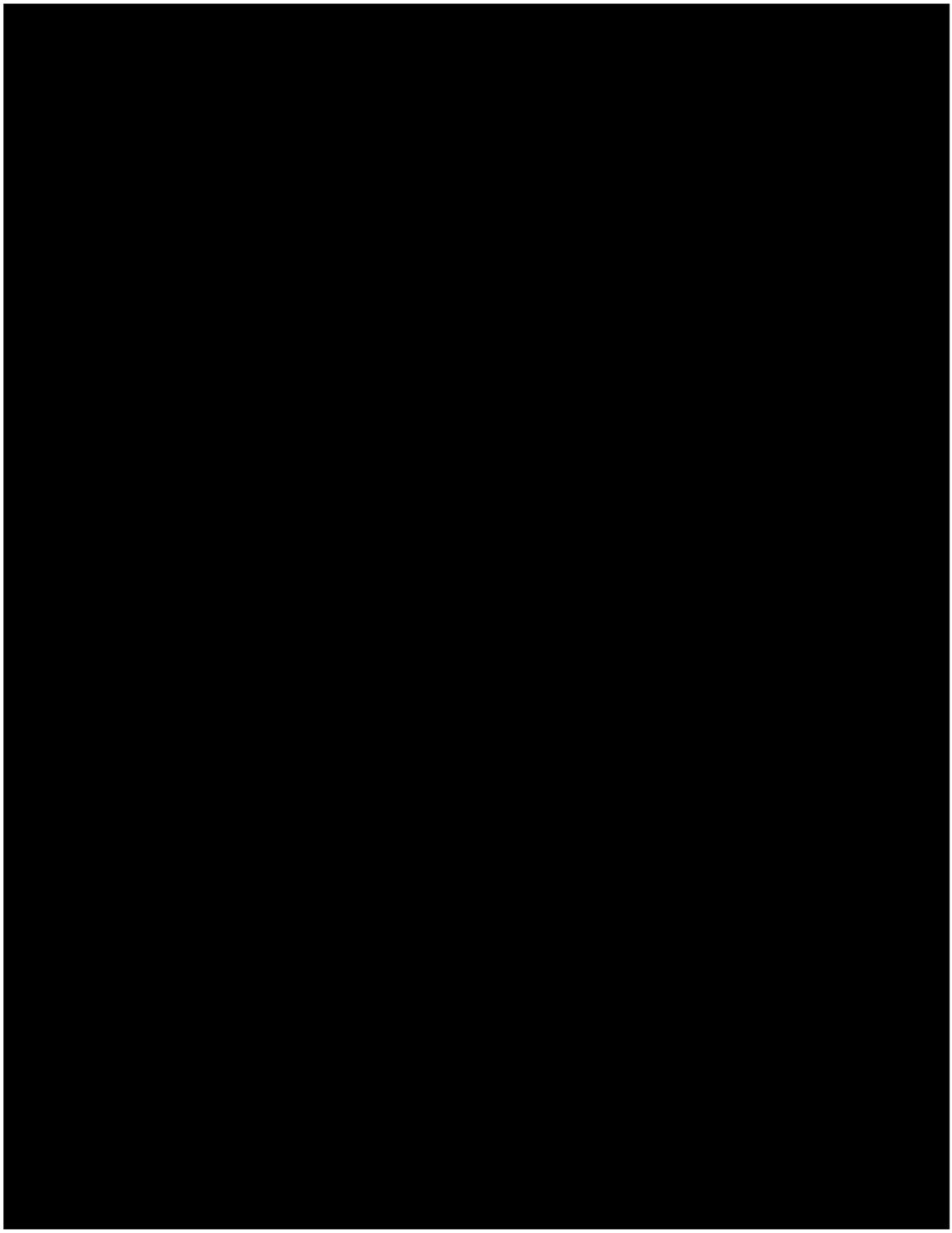
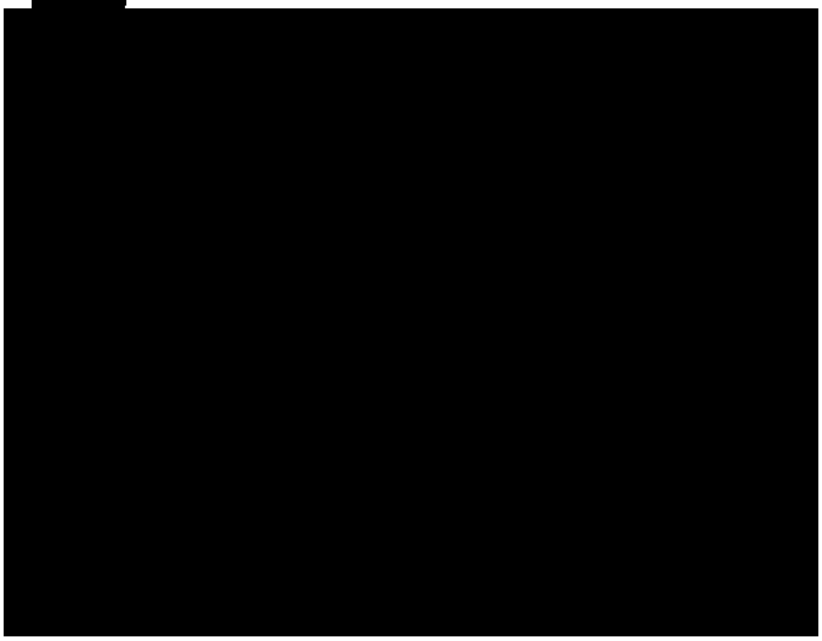
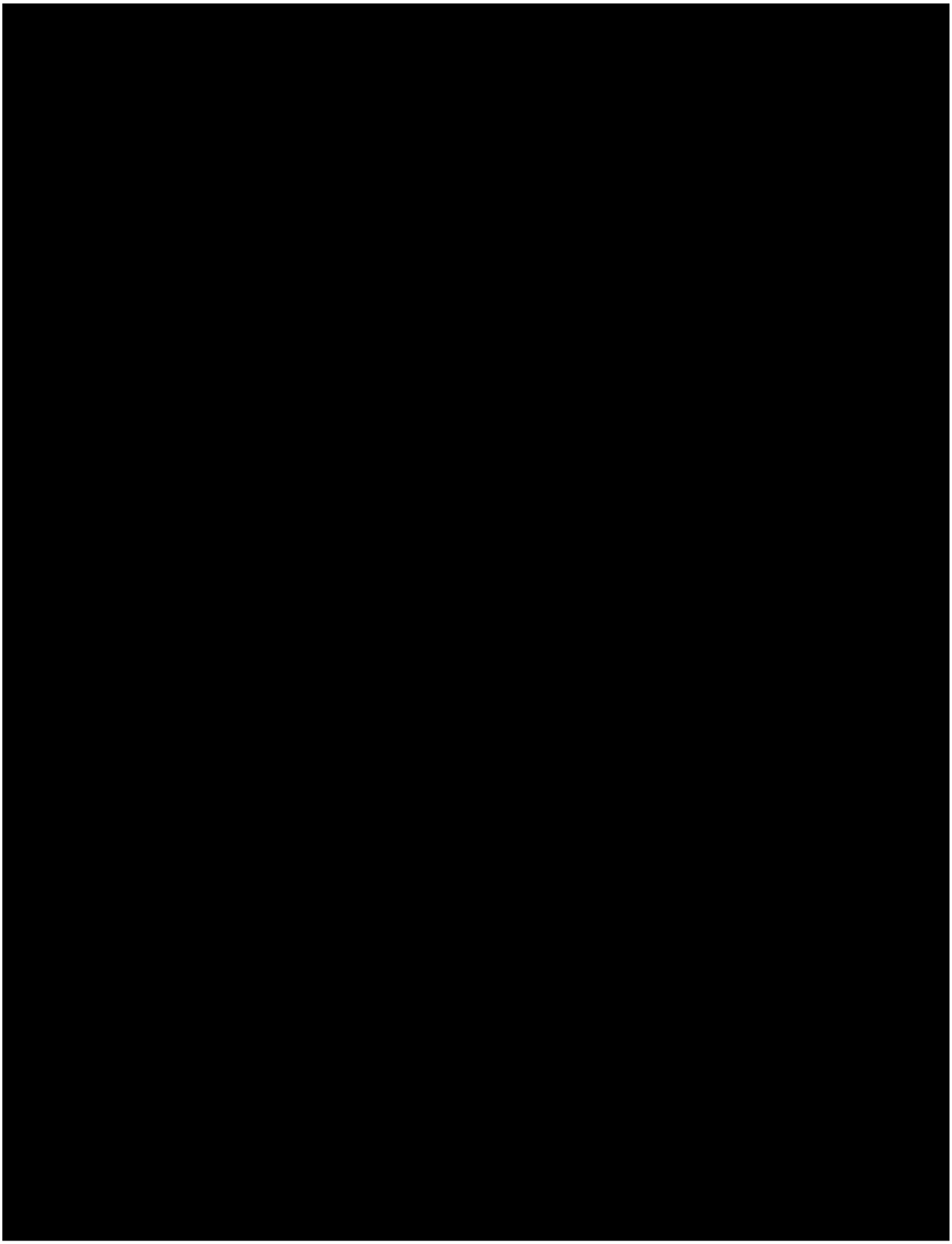








3.3.6 Insulated Joint Fastenings

Install insulated joint bar insulators between special spring insulated joint clips and the rail base of bonded insulated joints on concrete, steel, or wood ties that use the Safelok system. See Standard Drawing No. 0410 or 0414 depending on clip type. For an insulated joint e-clip see Standard Drawing No. 0437.

NOTE: Joints in concrete tie track directly across from one another cannot be insulated.

3.3.7 Weld-On Shoulders

Safelok weld-on shoulders are insulated or non-insulated and differ by height. The insulated shoulder is approximately 5/16 inch higher than the non-insulated as shown in Table 3.3.7-A.

Weld-On Shoulder Types and Dimensions	
Shoulder Type	**Approximate Height**
Non-Insulated	1-1/8 inch
Insulated	1-7/16 inch

Table 3.3.7-A

Safelok weld-on shoulder applications include:

- Special plate work fastened to concrete, wood or steel ties in turnouts.
- Plate work directly applied to steel turnout ties at the frog base.

A. Installing Non-Insulated Weld-on Shoulders

Install non-insulated weld-on shoulders:

- To plate work where spring clips fasten the rail base.
- Directly to steel turnout ties to fasten the rail base of other than self-guarded frogs.

B. Installing Insulated Weld-on Shoulders

Install insulated weld-on shoulders:

- To plate work under insulated or standard joints.
- To frog plates where spring clips fasten to the thicker base of self-guarded frogs in wood turnouts.
- Directly to steel turnout ties to fasten to the thicker rail base of self-guarded frogs.

C. Replacing Weld-on Shoulders

Replace weld-on shoulders damaged from derailments or other causes when they do not effectively hold the rail clip in place.

Replace damaged weld-on shoulders with similar shoulders.

D. Welding Weld-on Shoulders

Weld weld-on shoulders to special plate work or steel turnout ties with a 3/8-inch fillet weld using an E7018 welding rod.

E. Installing Weld-on Shoulders in Various Applications

Follow these requirements:

1. When installing non-insulated weld-on shoulders in the following applications, maintain a 1/16-inch gap between the rail base and the front face of the shoulder. See Figure 3.3.7-A.
   - Plate work under standard joints that uses cast joint spacers and spring joint clips.
   - Plate work where spring clips fasten to the rail base or the base of frogs.
   - Steel turnout ties where spring clips fasten to the rail base of frogs.

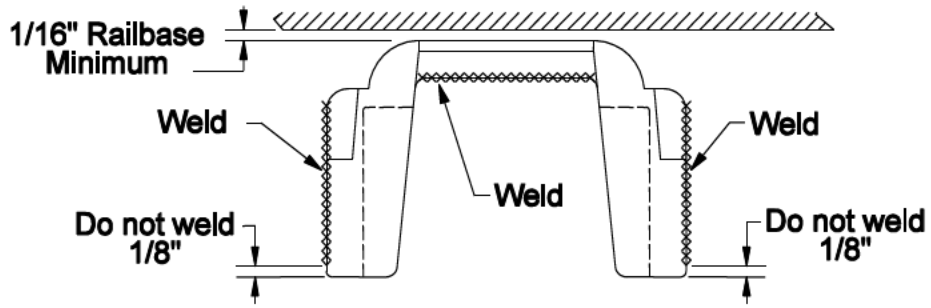


Figure 3.3.7-A

2. When installing insulated weld-on shoulders in the following applications, maintain a 5/16-inch gap between the rail base and the front face of the shoulder to allow for the installation of insulators or cast spacers (see Figure 3.3.7-B).
   - Plate work under insulated joints that uses insulated joint insulators, cast pins, and insulated joint spring clips.
   - Plate work fastened to steel turnout ties in a signalized or circuited application that uses plastic insulators.
   - Base plates of guard rails that use cast spacers.

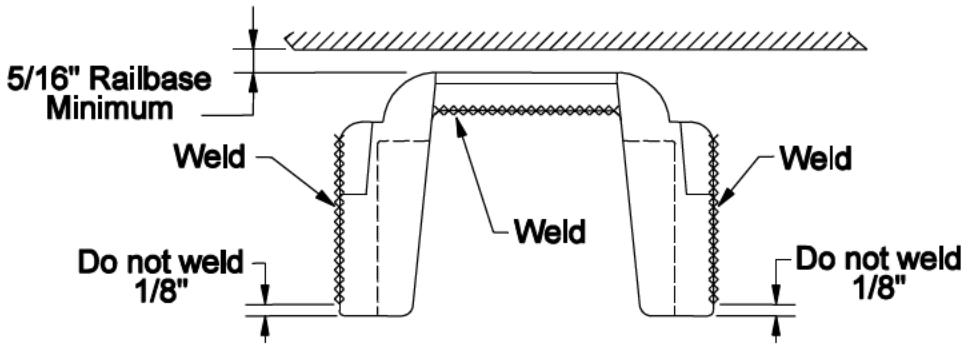


Figure 3.3.7-B

3.3.8 Hook-In Shoulders

Steel cross and switch ties use hook-in shoulders to apply spring clips. The hook-in shoulder must match the steel tie thickness.

1. Identify the proper hook-in shoulder from Table 3.3.8-A.

Hook-In Shoulder Types and Steel Tie Dimensions		
Shoulder Type	**Steel Tie Type**	**Tie Thickness**
12 millimeter	Existing Tunnel or Mainline Ties	12 millimeter
10 millimeter	Yard Track Tie	10 millimeter
10 millimeter	Turnout Tie	10 millimeter

Table 3.3.8-A

2. Replace hook-in shoulders damaged from derailments or other causes when they do not effectively hold the rail clip in place.

3.4 Tie Plates

[redacted]

3.4.2 Tie Plate Requirements

Follow these requirements when installing tie plates:

1. Apply tie plates to all wood and composite ties.
2. Do not intermix plates of different sizes and cant along the same rail.

NOTE: Cut spike plates and lag screw plates can be intermixed if they have the same rail seat cant. This would be done for the purposes of replacing the lag screw fastening system with cut spikes for maintenance or program work. When replacing lag screw plates with cut spike plates on consecutive ties as a permanent repair, rail anchors must be used. Victor plates with spikes are elastic fasteners and do not require anchors.

3. Install tie plates so that:
   - Plates have full even bearing on the ties.
   - Field-side plate shoulder is square against the field-side base of the rail.
   - Plate is centered on the tie.
   - Proper cant is provided to the rail when the wide side of the plate is on the field side. See Figure 3.4.2-A.
   - Do not reuse broken, bent, worn, or corroded tie plates.

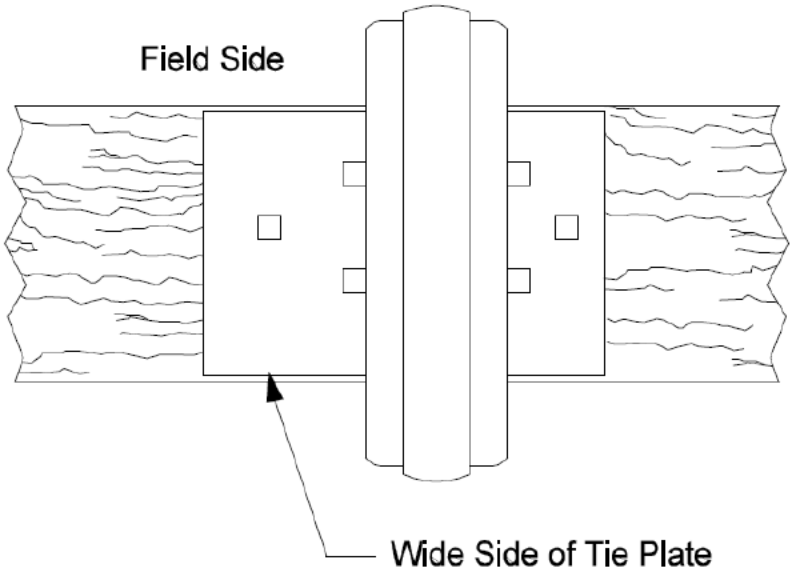


Figure 3.4.2-A

See Table 3.4.2-A for types of tie plates.

Size and Type	Road	Cant
DBL Single shoulder 5-1/2" and 6" base rail	SP	1:40
DBL shoulder 8" x 14" for 6" base rail	UP/SP/ CNW	1:40
DBL shoulder 5-1/2" base rail	UP/ MP/CNW	1:40
DBL shoulder 8-1/2" x 16" for 6" base rail	UP	1:30
Cast Plate for Safelok fastening 16" prior to year 2003	UP	1:30
Cast Plate for Safelok fastening 18"	UP	1:40
Cast Plate for Safelok fastening 16" after year 2003	UP	1:40
DBL shoulder 7-3/4" x 16" for 6" base rail	UP	1:40
Rolled e-clip plate 7-3/4" x 16" for 6" base rail	UP/CNW/SP	1:40

Table 3.4.2-A

3.4.3 Curve Blocks

Install tie plates with curve blocks in main track curves of 3 degrees or higher. See Figure 3.4.4-B for tie plate requirements.

Install tie plates with curve blocks on every fourth tie as shown in Figure 3.4.3-A.

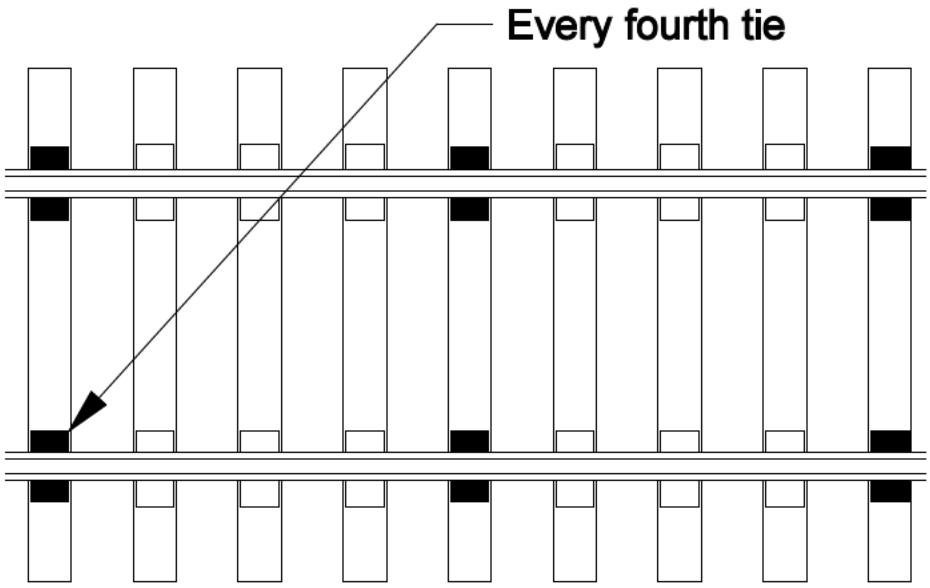


Figure 3.4.3-A

3.4.4 Elastic Fastener Plates

Elastic fastener plates are used in specific locations to assist in holding gauge, and areas of special track work. Victor plates are the standard elastic fastener plates for high degree curves. (Figure 3.4.4-A) Note: For compound curves, use greatest degree curvature to determine plate type.

Note: For compound curves, use the greatest degree of curvature to determine plate type.

1. Curves less than 3 degrees will use 16" double shoulder cut spike plates
2. Curves 3 degrees and greater will utilize curve block plates on both high and low sides on subdivisions with less than 20 MGT.
3. Subdivisions with 20 MGT or more will utilize 16" Victor plates with cut spikes on curves 3 degrees and greater.
4. Non-Mainline Tracks will default to < 20 MGT. Exceptions due to operating conditions should be reviewed with Director Rail Management 402-544-5079.
5. Open deck bridges on Critical, Premium and Major routes will utilize E-Clip Cast Plates as shown in Standard Drawing 0466.

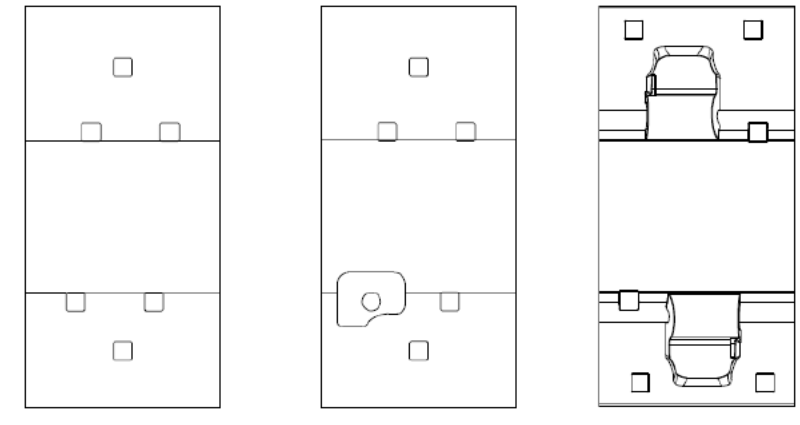
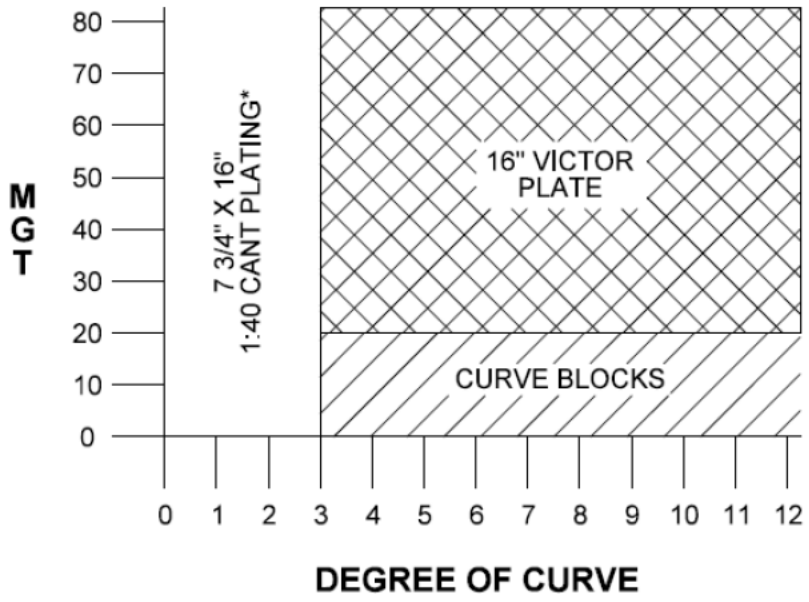


Figure 3.4.4-A



EXISTING TIE PLATES MAY BE RE-USED IF WEAR DOES NOT EXCEED 1/8" AND IS NOT A CAST PLATE.

AREAS WHERE GRADE EXCEEDS 2% AVERAGE WILL UTILIZE ELASTIC FASTENERS ON CURVES > 6 DEGREES.

SECONDHAND PLATES MAY BE UTILIZED ON RAIL OR TIE RELAY PROJECTS IF WEAR DOES NOT EXCEED 1/8". PLATES CAN BE SHIPPED IN BULK FROM SECONDHAND SORTING FACILITY.

Figure 3.4.4-B

3.5 Spikes and Screws

3.5.1 Spikes (Cut Spikes)

Spikes fasten rail, tie plates, switch stands and other devices to wood and composite ties. Follow these requirements:

1. Spike each tie with a minimum of two rail spikes per plate.
2. Before driving spikes, properly align ties and center tie plates.
3. Maintain uniform standard track gauge within permissible limits when spiking.
4. Drive spikes vertically with the face in contact with the base edge of the rail.
5. Drive spikes just until they contact the rail. Over driving spikes may damage the base of the rail.

3.5.2 Joint Spikes

Follow these requirements when spiking joints:

1. When spiking insulated joints, turn spike heads away from the rail.
2. Do not drive spikes into the slots or holes of skirted joint bars. Do not drive rail spikes within 2 inches of the end of skirted joint bars.
3. When driving rail spikes within 2 inches of the ends of non-skirted joint bars, leave the spikes up approximately 2 inches to allow the joint bar to bypass the spike head if rail movement occurs.

3.5.3 Spike Pattern

Standard spiking patterns are required during tie renewal, rail relay and new construction.

During rail and tie renewals, additional spikes may be required to bring track into compliance with the standard pattern. Track ties not being replaced also may require additional spiking.

Use Table 3.5.3-A, Table 3.5.3-B, Table 3.5.3-C, and Figure 3.5.3-A to determine proper spiking patterns.

Note: Locations with permanent speed restrictions must have spike patterns based on a subs predominant class of track. For example, if a mile long section of track is permanently slow ordered to Class 3, but the sub's predominant class of track is Class 5 then the mile long section requires Class 5 spike patterns.

Main Track and CTC Sidings Less Than 40 MPH	
Application	**Pattern**
Tangents and curves less than 1° 30'	1
Curves at least 1° 30' but less than 4°	3
Curves at least 4° but less than 8°	4
Victor Plates on curves at least 3° but less than 8°	4
Curves 8° or more and Turnouts	5
Victor Plates on curves 8° or more	5

Table 3.5.3-A

Main Track and CTC Sidings 40 MPH or More	
Application	**Pattern**
Tangents and curves less than 30'	2
Curves at least 30' but less than 1° 30"	3
Curves at least 1° 30' but less than 4°	4
Curves 4° or more and Turnouts	5
Victor Plates	5

Table 3.5.3-B

Yard and Industry Tracks	
Application	**Pattern**
Tangents and curves less than 4°	1
Curves at least 4° but less than 8°	3
Curves 8° or more	4
Turnouts	5

Table 3.5.3-C

**For Composite tie spiking patterns refer to Figure 3.1.1-A

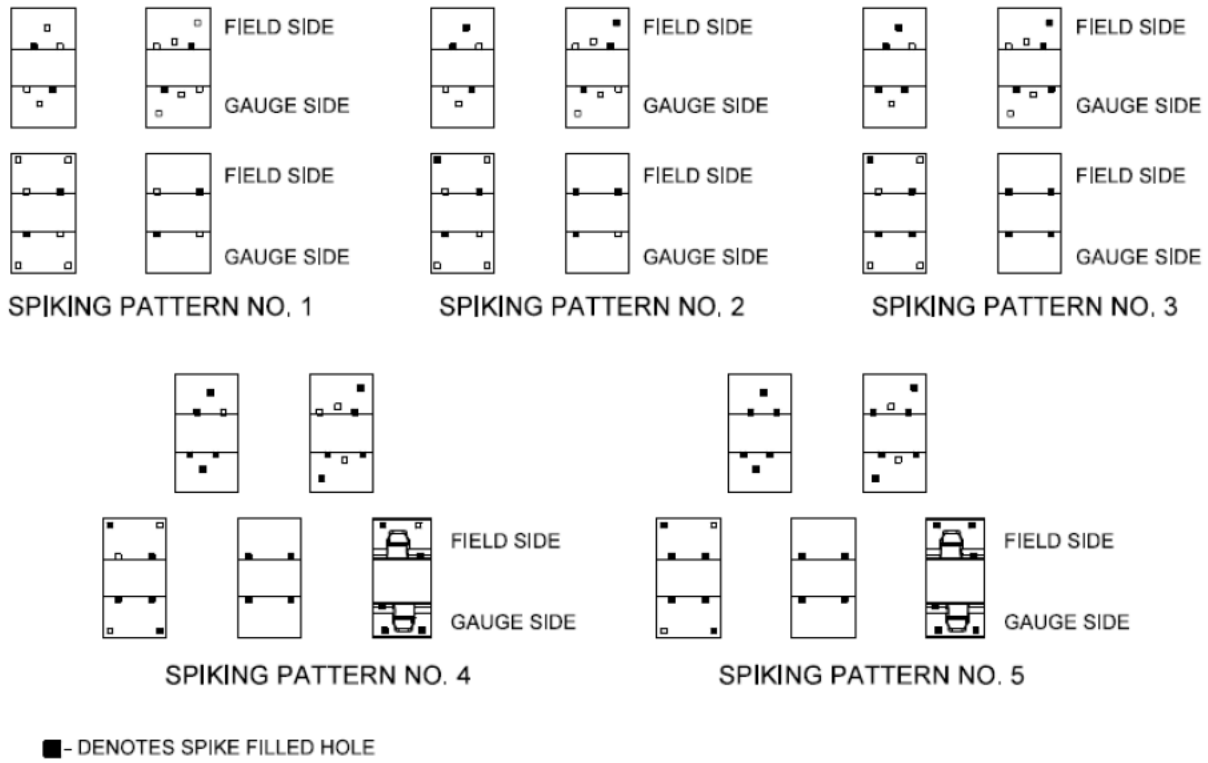


Figure 3.5.3-A

Where only one outer rail spike is required, and tie plates with offset spike holes are used, drive the outer rail spikes in the spike hole punched nearest to the center of the tie plate. See Figure 3.5.3-B.

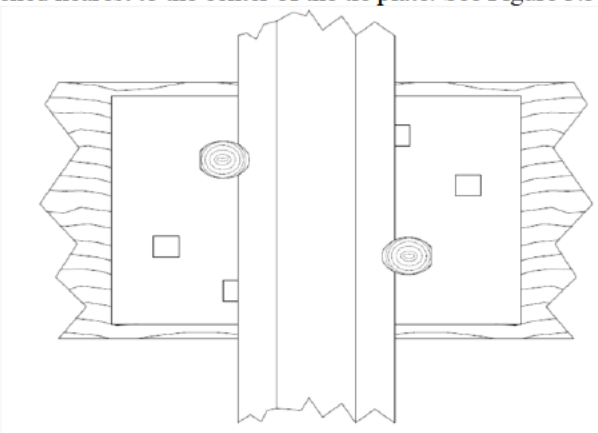


Figure 3.5.3-B

A. Spiking Turnouts

When spiking turnouts, use spike pattern number 5 in Figure 3.5.3-A on:

- All switch ties.
- 24 ties ahead of switch points.
- 24 ties behind the last long switch tie on the mainline side of the switch.
- Diverging side of the turnout from the last long switch tie through the reverse curve and for 24 ties onto tangent track.

- Fully spike all switch, frog, and guard rail plates in wood turnouts. Refer to Chapter 5 for more details.

B. Spiking Road Crossings

When the design of the road crossing material will not allow for installation of the standard spike pattern, spike ties directly under the crossing material as shown in Figure 3.5.3-C to ensure that the crossing panel will set flat on the ties.

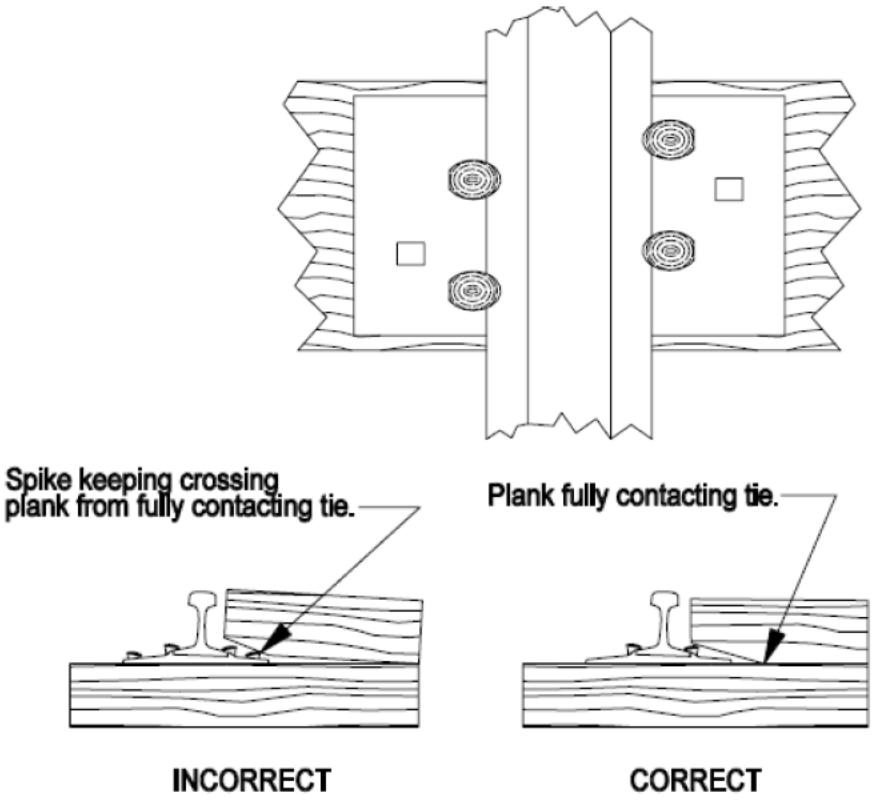


Figure 3.5.3-C

3.5.4 Lag Screw Application

Lag screws are utilized in open deck bridges, road crossings, turnouts and crossovers. Historically lag screws were installed in curves and may still require maintenance, however when replaced the new plate and fastener must follow the requirements in section 3.4.4.

Follow these requirements:

1. Do not re-use lag screws when performing maintenance such as tie replacement, gauging etc. When re-installing a lag screw a new lag should be utilized.
2. Ensure screws are inserted to a depth, where the bottom of the head of the lag screw is touching the top of the plate and securely fastens the plate to the tie.
3. Do not over tighten the lag screws.
4. Do not drive lag screws into the tie.
5. Use the proper size drill bit for the type of tie when drilling holes for lag screws as referred to in Table 3.5.4-A.
6. Drill holes to a depth of 6 inches.
7. Do not drill through the bottom of the tie.
8. Do not place track spikes in round screw holes.
9. See Work Procedure Document on utilizing hardwood dowels to plug lag screw holes when repair/gauging is required.

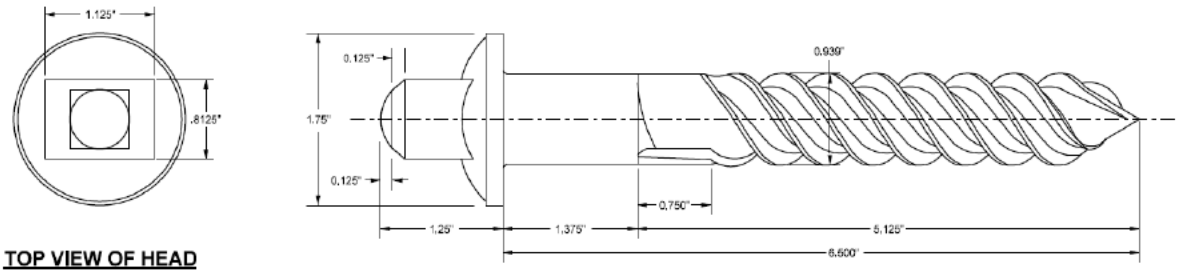
Hole diameters for 15/16-inch X 6 1/2-inch lag screws are as follows:	
Douglas Fir or other softwood	11/16 inches
Oak , hardwood or composite	3/4 inches
Azobe or other exotic hardwoods	13/16 inches

Table 3.5.4-A

3.5.5 Evergrip Lag Screw

Evergrip lag screws in Figure 3.5.5-A are used in specific applications in crossings, turnouts and crossovers to secure frogs, gauge plates, guardrails and elastic fastener plates to ties. Historically they have been used in curves similar to standard lag screws and should be handled in the same manner as laid out in section 3.5.4. Evergrip lag screws should be inspected and treated just as a standard lag screw. Evergrip lag screws require fewer revolutions to fully tighten and have a higher holding power than the standard lag screw. See Standard Drawing No. 0418.

Follow the requirements in Section 3.5.4 Lag Screw Applications.



TOP VIEW OF HEAD

Figure 3.5.5-A

4 RAIL AND JOINTS

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4.18 Rail Handling 51

4.1 General

CWR - Continuously Welded Rail is any section of rail that is joint free for 400' or greater. Once rail becomes classified as CWR it remains CWR.

Jointed Rail - Rail that is broken into individual sticks of rail (generally 39'-6" segments) and bolted together. Note - Installing joints in CWR sections does not constitute jointed rail.

4.2 Rail Relays and Wear Limits

Out-of-face rail and curve relay programs are based on accumulated gross tonnage, defect rates, and rail head wear.

4.2.1 Classification and Use of Secondhand Rail

The specification and inspection parameters below detail the guidelines for the secondhand rail standards. These standards will be used to grade secondhand rail for recovery for re-use, or purchase from outside sources. The instructions outlined below are designed to provide consistent evaluation of secondhand rail throughout the system so that each rail is properly marked for its identity and use. Refer to Figure 4.2.1-A and Table 4.2.1-A.

NOTE: DO NOT TRANSPOSE RAIL. TRANSPOSED RAIL IS SECONDHAND RAIL THAT HAS HAD TRAFFIC RUN ON ONE SIDE INITIATING THE WEAR PROCESS AND THEN IS FLIPPED SO THE OTHER SIDE IS RUN ON.

Class 1-Principal use is for main line replacement rails, rail relays on lines carrying between 5 and 20 MGT per year and other areas requiring long term serviceable secondhand rail.

Class 2-Principal use is for secondary main line or siding replacement rails, rail relays of lines carrying less than 5 MGT per year, yard or industry tracks and other areas of low track speeds or demands on serviceable secondhand rail.

Class 3-Principal use is for yard or industry tracks and other areas of temporary service or low demands on quantity of secondhand rail.

A. Acceptable Lengths

The minimum acceptable length for secondhand rail classified at the weld plant is 25 feet. Minimum length for a plug rail is 15 feet.

B. Wear Measurement References

Vertical head measurement will be taken from the center of the rail's head (+/- 3/8") to its base plane (excluding base pitting). See Section 4.3.4 Curve Rail Wear Limits. Determine gauge face wear loss by measuring the width of the railhead at a point 5/8" below the top surface of the railhead.

[redacted]

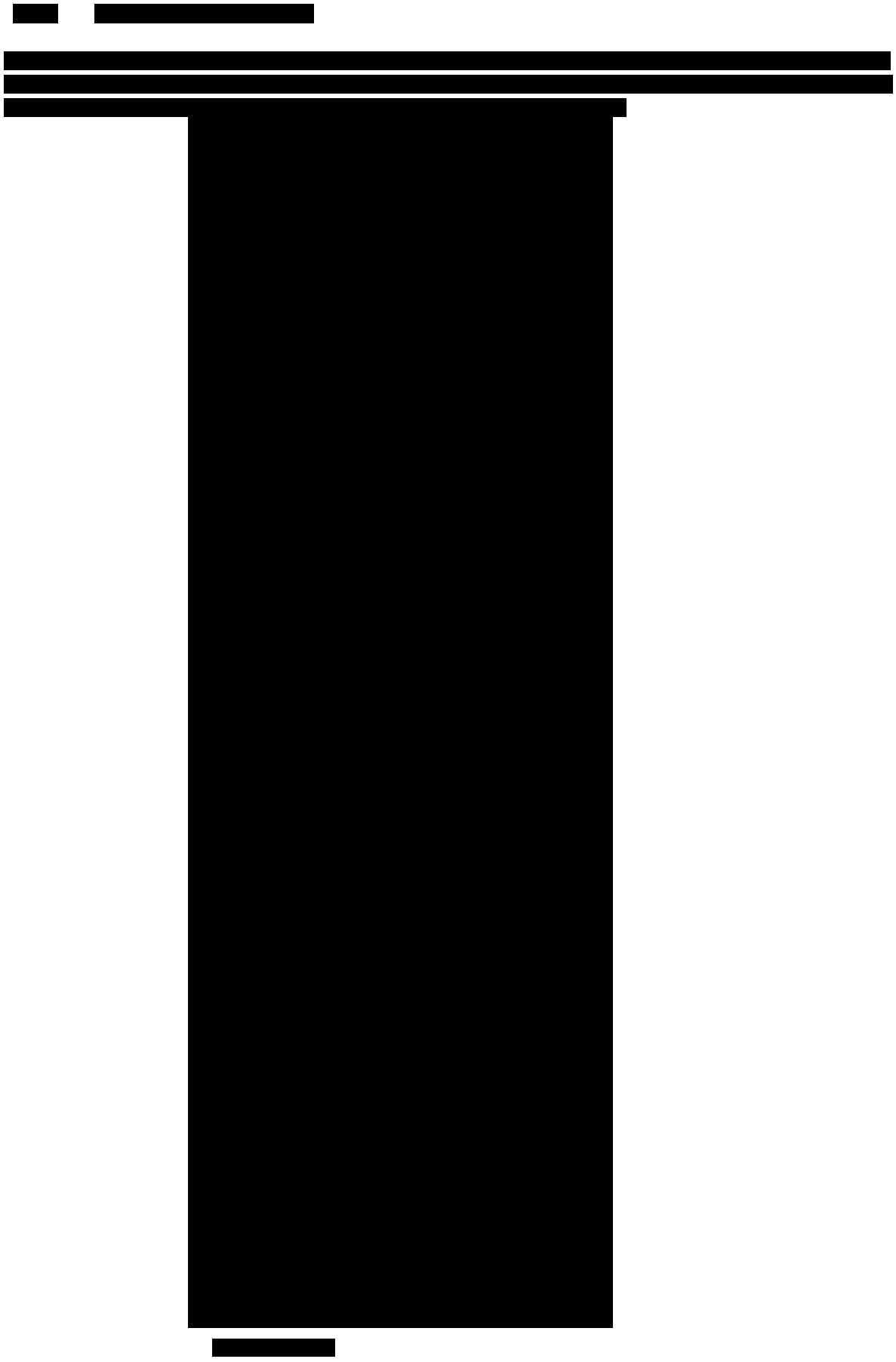
4.2.2 Out-of-Face Rail Relays

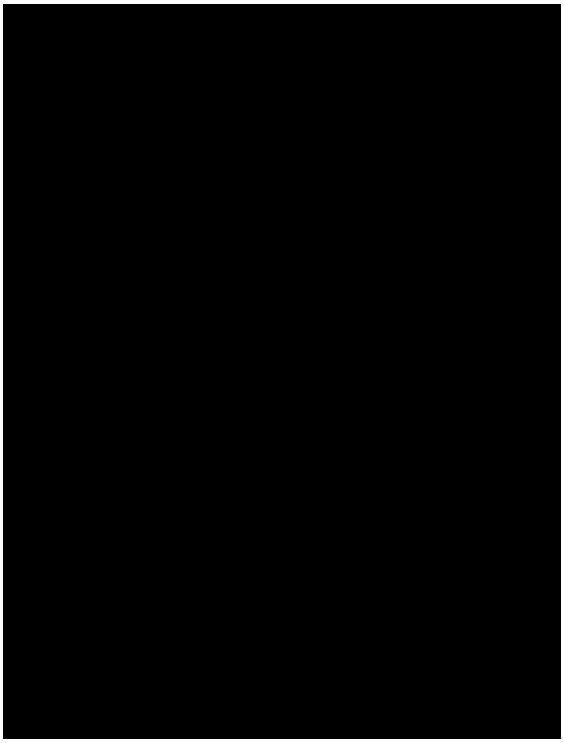
For a list of guidelines of approved rail sections for out-of-face rail relay programs, refer to the Union Pacific Standard Rail Sections map. See Maps in the Engineering Bulletin Board on the Engineering Website.

Follow these requirements:

1. When second-hand rail is unavailable, a different rail size or kind may be substituted.
2. Under no circumstances will rail, with a roll date older than 1975, be installed in any main line application.
3. During concrete tie renewals (TRT), replace existing rail when:
    - The rail section is not 133 lb., 136 lb. or 141 lb. head hardened.
    - Vertical head loss is 3/8 inch or more.
    - Rail defect rate meets or exceeds replacement logic.

[redacted]





4.3 Inner Guard Rails

Refer to Engineering Standard Drawing Nos. 4000 to 4004 to determine which structures require inner guard rails. Refer to Engineering Standard Drawing Nos. 4005 to 4008 to determine turnout guard rail use. These drawings also show construction details.

Follow these guidelines for keeping inner guard rails fully plated, bolted and spiked:

1. On tangent track, spike the inner guard rail with two spikes per plate on each rail on the tangent portion, and four spikes per plate on each rail on the curved portion.
2. On curved track, spike the entire inner guard rail with four rail spikes per plate on each rail.
3. Do not install joints in the curved portion of the inner guard rail except where an insulated joint is required in signalized territory.
4. The rules with regards to Torch Cut Rail and Torch Cut Bolt Holes do not apply to inner guard rails. Inner guard rails may be torch cut to fit and can utilize torch cut bolt holes.

[redacted]

[redacted]

4.6 Compromise Joint Bars

Compromise joint bars align the tread and gauge lines of adjoining rails of different sizes.

NOTE: Compromise joint bars are marked with the weight of the rail on each side. Utilizing bars that are not correct for the rail section can result in an increased chance of premature failure.

4.6.1 Step (“Non-Handed”) Joint Bars

Step or “non-handed” joint bars align the tread area of rails with the same rail base size. Apply step joint bars when the difference in the width of rails does not exceed 1/8 inch at gauge lines.

1. Bars are identified as A and B. Together they make up a joint set that fit either side of the rail.
2. Depending on which rail the joint bars are to be applied, the individual bars will be placed on either the gauge side or field side of the rail. See Figure 4.6.1-A.

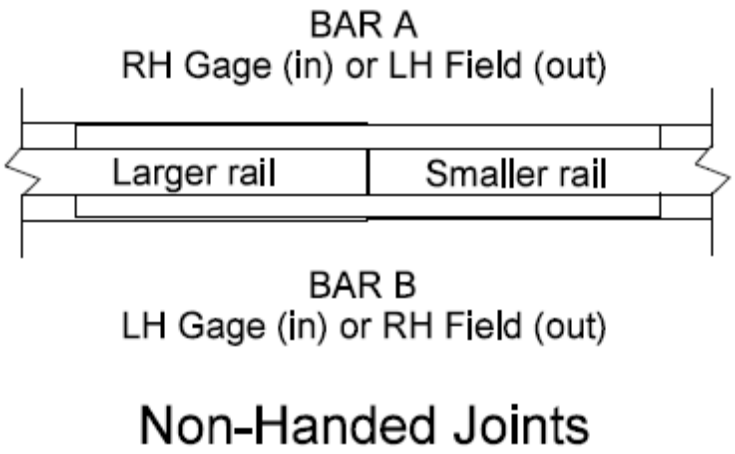


Figure 4.6.1-A

4.6.2 Compromise/Transition Rails

Compromise and Transition Rails are manufactured rails that are used to connect rails of different wear and or different rail sections. These rails should be utilized in favor of compromise joint bars or compromise thermite field weld kits whenever possible. In new track installations such as turnouts, road crossings, bridges, etc. it is highly recommended that compromise/transition rails be utilized whenever possible.

Compromise Rails – Transition from one rail section to another, generally when different rail base widths are present, using a forged section providing rail on both ends that matches the existing or newly installed track rail (ex. 136# rail to 115# rail).

Transition Rails – Transition from one wear or rail section to another using a solid piece of machined rail. These rails are highly effective when installing new rail, turnouts etc. in areas with worn or different rail sections (ex. 136# worn rail to 136# new rail).

NOTE:
In compromise rails, if a defect is found within 30 inches in either direction of the forged area, the entire rail must be replaced.

Both compromise and transition rails may be handed and will be marked LH or RH on the joint. The proper hand can be determined using the same instructions in section 4.6.1 Step ("Non-Handed") Joint Bars. Universal joints can be installed with either side used for the gauge face. Different joint types are shown in Table 4.6.2-A.

Use of transition rails is recommended over the use of compromise transition bars or mismatch rail welds. Special attention needs to be paid to wear limits when using a rail wear weld kit. If wear limits are outside of those recommended by the weld kit limit the speed to 25MPH until replaced by the proper transition/comp rail.

Available Compromise/Transition Rails						
Rail Section	Vertical Wear	Rail Section	Vertical Wear	Hand	Total Length	Item Number
115	NEW	90	3/8"	LH	25'	552-2219
115	NEW	90	3/8"	RH	25'	552-2220
133	NEW	115	1/8"	LH	20'	552-3820
133	NEW	115	1/8"	RH	20'	552-3821
136	1/4"	115	NEW	LH	24'	552-4385
136	1/4"	115	NEW	RH	24'	552-4386
136	NEW	115	NEW	LH	24'	552-4387
136	NEW	115	NEW	RH	24'	552-4388
136	NEW	115	3/16"	LH	24'	552-4389
136	NEW	115	3/16"	RH	24'	552-4390
136	7/8"	115	3/8"	UNIVERSAL	37' 6"	552-4407
136	NEW	133	7/8"	UNIVERSAL	37' 6"	552-4393
136	NEW	136	7/8"	UNIVERSAL	40'	552-4395
141	NEW	115	NEW	LH	24'	552-4402
141	NEW	115	NEW	RH	24'	552-4403
141	NEW	133	7/8"	UNIVERSAL	37' 6"	552-4400
141	NEW	132	11/16”	UNIVERSAL	40'	552-4405

Table 4.6.2-A

4.7 Rail Joints

The rail joint consists of the rail area and Other Track Material (OTM) within the entire length of the joint bars.

NOTE: If rail has been torch cut, remove with rail saw, 2 or more inches of rail before installing rail to make a joint.

4.7.1 Permanent Joints

Permanent joints are joints that are not intended to have the rail ends welded together.

Permanent joints include:

- **Insulated joints.**
- **Joints in bolted rail territory.**
- **Joints in CWR that will remain in track**
  - **Examples are: Joints in non-extended turnouts and crossing frogs**

Permanent joints must be:

- **Fully drilled.**
- **Fully bolted.**
- **Bolt holes and rail ends to be beveled and slotted per Standard Drawing No. 0721. To de-burr and bevel holes drilled in the field, use abrasive stone item number 411-3867.**
- **Fully box anchored per Section 4.15 Rail Anchors in CWR territory.**

4.7.2 Joint Placement and Support

Joints must be properly supported by the correct tie arrangement. Reference Section 3.1.9 Joint Tie Support for minimum requirements.

To enable joint removal in CWR with thermite field welds, do the following:

1. Except in an emergency to pass trains over a broken rail, joints must not be located within:
   - **30 inches from an existing plant or in-track weld or 15' from an existing rail joint or field weld on subdivisions listed in table 4.10.1-1 or as specified by the AVP Maintenance.**

   NOTE: The only exception to this 15' weld rule is in special track work around or near turnouts and rail crossings (diamonds) where because of geometry layout or component spacing, the 15' is not obtainable.

   - **30 inches from an existing rail joint or weld of any type on subdivisions not listed in table 4.10.1-1**

   NOTE: In order to prevent weld clusters or a multitude of field welds installed closely together, no more than two field welds are allowed in the same length of rail (plant weld to plant weld), rule doesn't apply to long rail, 320' and 480' lengths.

   NOTE: When installing replacement rail, effort must be made to eliminate thermite welds.
2. Center joints between ties to enable field welds to be made without moving or adzing tie. Field welds must not be located directly over a tie. Refer to Section 4.11 Field Welding (Thermite).

4.7.3 Rail Joint Stagger and Rail Joints Near Bridge Approaches

Follow these requirements for staggering rail joints:

1. The standard stagger between consecutive rail joints on opposite rails is 12 feet, plus or minus 2 feet.
2. Staggered rail joints are preferred but not required on industry leads and yard tracks where the speed does not exceed 25 MPH and the curvature is less than 4 degrees.
3. Bridge approach guidelines
   - Installation of new track panels through the bridge on the mainline must have rail joints and welds no closer than 5' from the abutment off the bridge, and thermite welds no closer than 25' from the abutment off the bridge. Reference Standard Drawing No. 6007.
   - If rail joints and/or welds are present within this area, a 25 MPH slow order will be applied.
4. When trying to figure the stagger of rail around a curve use this rule of thumb:
   - For every 80 feet of rail laid, the low rail will become 1 1/2 inches longer for every one degree of curvature.

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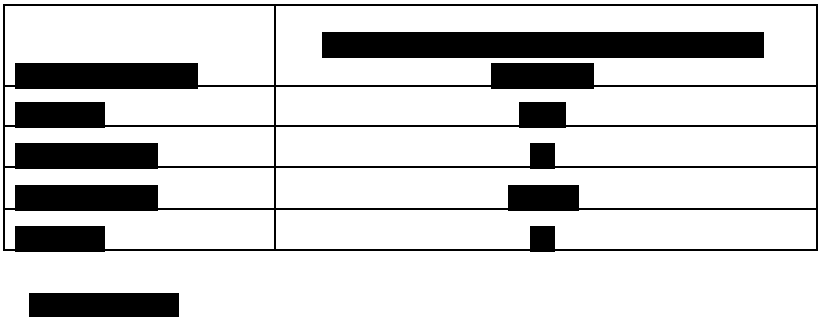

4.8 Insulated Joints

Insulated joint bars perform the same function as standard joint bars. In addition, they isolate the rail ends from each other to allow the signal track circuit to work properly. Figure 4.8-A shows a typical cut section.

Requirements for inspection and remedial actions for defective insulated joints are located in Section 7.11.6 Insulated Joint Bar Inspections.

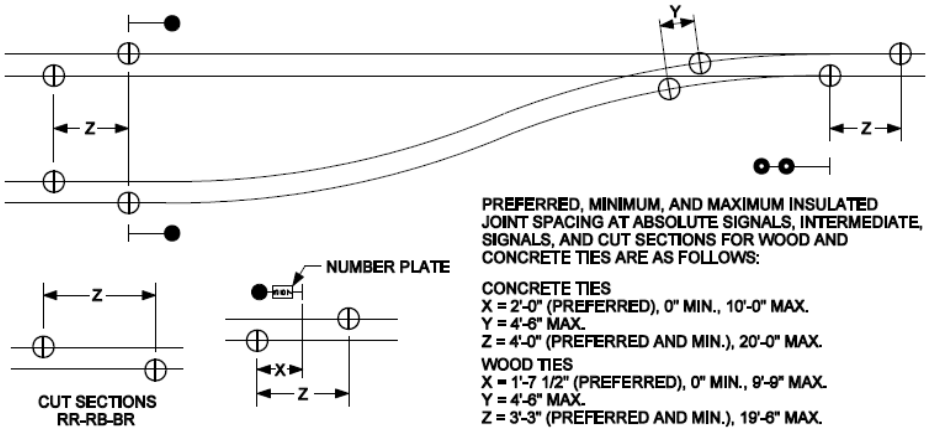

Figure 4.8-A

1. Verify the proper placement of insulated joints with a signal representative before moving their location or installing a new location.
2. The track and signal departments are jointly responsible for installing and maintaining insulated joints.
3. Remove from track as soon as practical. Maintain joint inspection frequency and IJ condition assessment frequency until removed.
4. On wood ties do not place the middle of an insulated joint on top of a tie plate.

4.8.1 Types and Applications

Insulated joint rail plugs are constructed from head hardened rail. See Table 4.8.1-A.

Insulated Joint Applications			
Type	Rail Type	Application	Track Speed
Kevlar Insulated Bonded Joint	CWR	< 30 MGT Applications	Any
Center-Liner Insulated Bonded Joint	CWR	> 30 MGT Applications	Any
Long Angle Profiled (LAP)	CWR	Additional LAP joints are not to be installed past 2014, instructions are provided for maintenance only.	Any
Poly-Coated	Jointed	Special applications where standard bonded joint rails cannot be installed.	Over 10 MPH, recommended to not exceed 25 MPH
Fiberglass	Jointed	Yard and Industry applications only	10 MPH or Less

Table 4.8.1-A

NOTE: Long Angle Projection (LAP) Insulated Joints are used For Maintenance Only, no additional LAP joints will be installed in track.

Figure 4.8.1-A

4.8.2 Poly-Coated and Fiberglass Insulated Joints

A. Poly-Coated Insulated Joints

1. Poly-coated insulated joints may be installed in any jointed rail application.
2. Do not install in CWR territories except as a temporary or emergency repair. Reduce track speed to 25 MPH until removed from track.
3. Poly-coated insulated joints may be installed in the turnout side of yard and industry switches in CWR territory.

B. Fiberglass Insulated Joints

1. Install fiberglass insulated joints in jointed rail applications where physical clearances will not allow the installation of poly-coated insulated joints.
2. Do not install in CWR territories under any condition.
3. Do not install in any track where maximum speed exceeds 10 MPH.

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abutment off the bridge.

4.12 Weld Tolerance Specifications

To improve overall track geometry and reduce Evaluation Car exceptions, Thermite, Mobile In-Track and Plant weld maximum geometry tolerances below must be followed. Use the following table when auditing weld geometry.

These are cold (ambient temperature), finish ground specifications.

Auditing welds instructions can be accessed using the WPD Auditing Welds.

Use Table 4.12-A to determine weld tolerance specifications for Class 1 through Class 6 Tracks.

Weld Type	Vertical Offset (1)	Combined Vertical Offset and Vertical Crown (2)	Horizontal Offset (3)	Combined Horizontal Offset and Horizontal Kink (4)	Base Horizontal Offset (5)	Base Vertical Offset (6)
Thermite	0.020”	0.040”	0.030”	0.040”	0.060”	0.250”
In-Track (Class 1-5)	0.025”	0.060”	0.030”	0.040”	0.060” New 0.100” SH	0.125”
In-Track (Class 6)	0.020”	0.030”	0.030”	0.040”	0.060”	0.125”
Plant - (New and Classified 1 Rail)	0.025”	0.060”	0.030”	0.040”	0.060”	0.060”
Plant – (Classified 2 & 3 Rail)	0.050”	0.080”	0.050”	0.065”	0.100”	0.125”

Table 4.12-A

1. Vertical Offset measured adjacent to weld and tapered.
2. Combined Vertical Offset and Vertical Crown not to exceed maximum stated limit as measured 18" from center of weld.
3. Horizontal offset measured adjacent to weld on gauge side of rail head.
    a. Plant weld measurement checked on either side of rail head. (Check both sides for uniformity).
4. Combined Horizontal Offset and Horizontal Kink not to exceed maximum stated limit as measured 18" from center of weld.
5. Base Horizontal Offset measured adjacent to weld not to exceed maximum stated limit.
6. Base Vertical Offset measure adjacent to weld not to exceed maximum limit (any offset on top of rail must be tapered to reduce impact forces).
    a. Measurement not to exceed 0.250” on thermite welds of same base width.
    b. Measurement not to exceed 0.125” on in-track welds and Plant welds Classified 2 and 3 SH rail.
    c. Measurement not to exceed 0.060” on new Plant welds and Classified 1 SH rail.

4.13 Vertical Rail Stiffness Equipment (VERSE)

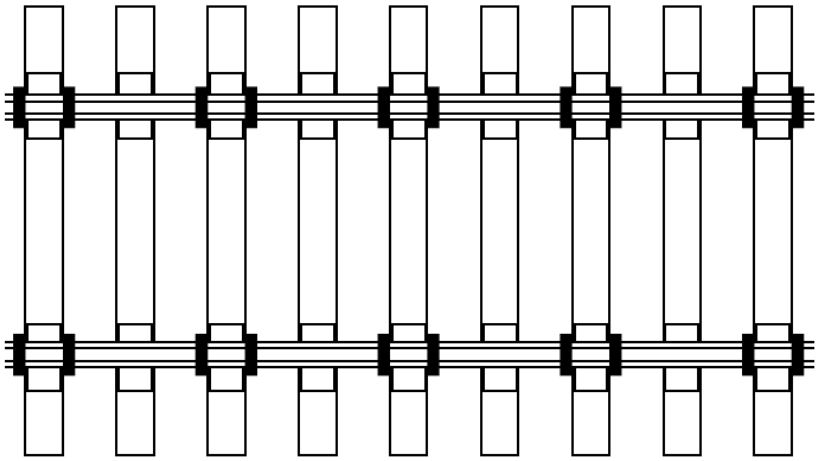
Vertical Rail Stiffness Equipment (VERSE) is a system developed for measuring the RNT of continuous welded rails (CWR). The system is based on the principle that the vertical force required to lift a rail varies with the axial force contained within the rail due to stressing. VERSE fulfils the need for a simple non-destructive RNT measurement technique.

VERSE measurements will be in accordance with the Work Procedure Document for VERSE Testing and reporting the test results can be completed by accessing the VERSE web page in the TMP.

4.14.3 Standard Box Pattern

Follow these requirements:

1. On all tracks, apply rail anchors out-of-face along each rail, directly across from each other on the same tie, according to Rail Anchor Pattern No. 1 shown in Figure 4.14.3-A.



ANCHOR PATTERN NO. 1

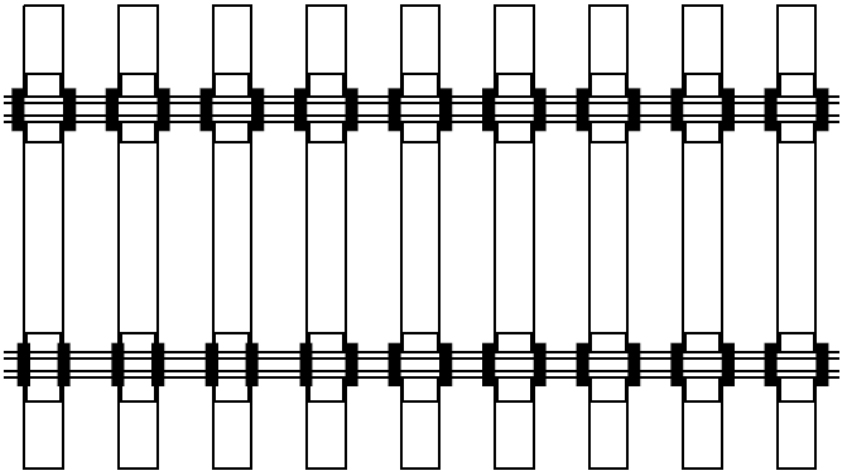
Figure 4.14.3-A

2. Establish the standard rail anchor pattern shown above on both rails throughout relay limits and for 5 rail lengths on either side of the work limits during single or double side rail relays.
3. Additional rail anchors may be required to provide additional longitudinal rail restraint.

4.14.4 Solid Box Pattern

Follow these requirements:

1. Solid box anchor every tie as shown in Figure 4.14.4-A for Rail Anchor Pattern No. 2 at specific locations to provide additional restraint against rail movement.



ANCHOR PATTERN NO. 2

Figure 4.14.4-A

2. Use Table 4.15.7-A to determine where box anchoring of every tie is required in wood, composite and concrete tie track. For composite ties, follow the same standards as for wood ties. Also reference Standard Drawing No. 0420.

Location	Rail Type	Requirement
Turnouts (Concrete and Wood Ties)	CWR	All switch ties and 120 ties in all directions
Turnouts (Wood Ties Only)	Jointed	All switch ties and 48 ties in all directions
Crossing Frogs (Concrete and Wood Ties)	CWR or Jointed	120 ties in all directions
Hot Box / Dragging Equipment Detectors (Wood Ties Only)	CWR or Jointed	120 ties in each direction
All Permanent and Insulated Joints (Wood Ties Only)	CWR	120 ties in each direction
Expansion Joints (Concrete and Wood Ties)	CWR or Jointed	120 ties in each direction
Lines with traffic of 95 MGT or more annually (Wood Ties Only)	CWR	Every tie
Open-Deck Bridges (Concrete and Wood Ties)	CWR	All bridge ties and 120 ties in each direction EXCEPTION: See Standard Drawing 0421 for steel spans.
Ballast Deck Bridges and Passenger Platforms (Wood Ties Only)	CWR	Anchor with same pattern as rail leading into the facility
Road Crossings (Wood Ties Only)	CWR or Jointed	Every tie through the crossing limits

Table 4.14.4-A

4.14.5 Bridge Pattern

Follow these bridge anchoring requirements:

1. Ballast deck bridges should be anchored according to Standard Drawing No. 0421.
   - **Anchor ballast deck bridges with the same pattern as the rail leading onto the bridge.**
2. Open deck bridges should be anchored according to Standard Drawing No. 0421.
   - **Solid box anchor every bridge tie across open-deck bridges and 120 ties each side of bridge headwalls.**

     Exception: For steel spans more than 125 feet long:

     – Box anchor all bridge ties in at least one-third of the total number of panels of the bridge at the fixed end of the span.

4.14.6 Turnout Pattern

Follow these turnout anchoring requirements:

1. Box anchor all switch ties to the extent that the anchors will not interfere with the proper operation of the turnout. Refer to Standard Drawing No. 0420.
2. Anchor the switch point and stock rail at the heel block as follows:
   a. Locate the heel blocks on the mainline and turnout sides, refer to Figure 4.14.6-A.
   b. Anchor the switch point and stock rail on the mainline side as follows:
      i. Begin by installing two anchors next to one tie and two additional anchors next to the other tie in a crib.

         NOTE: Solid anchoring of a single crib will require 6-8 anchors.

      ii. Continue to apply anchors to fill in area between the first four anchors installed.

CAUTION: Ensure anchors are tight against the edge of ties with no gaps. If a gap is too small to be filled with an anchor ensure that gap is in the middle of the anchors.

c. Repeat step b for the switch point and stock rail on the turnout side.

d. In turnouts that utilize a Movable Point Frog the same pattern in the heel block area can be utilized to limit rail movement in the frog. Fully anchor the MPF as shown in Figure 4.14.6-B. Care must be taken to not place anchors where they may interfere with point movement. Locations shown may be adjusted, however both point and wing rails must have minimum of one crib on each side fully box anchored.

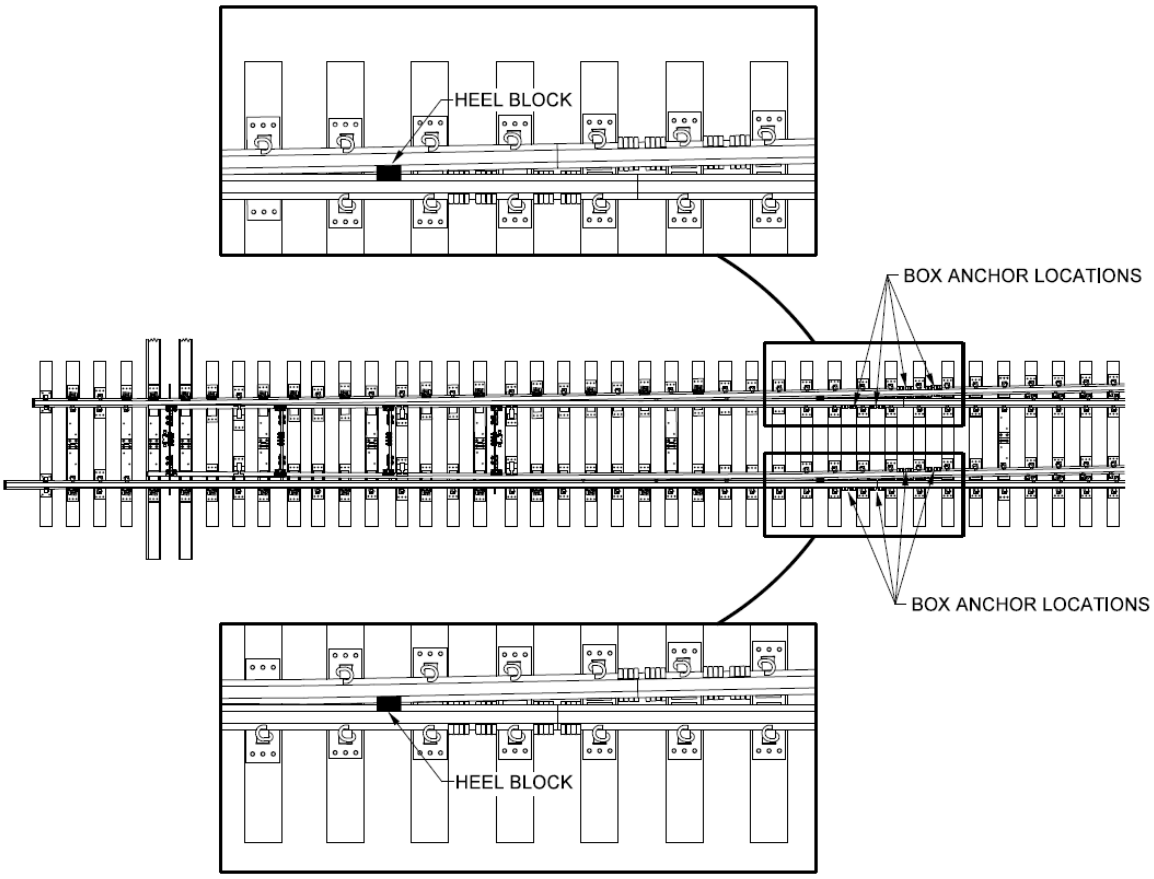


Figure 4.14.6-A

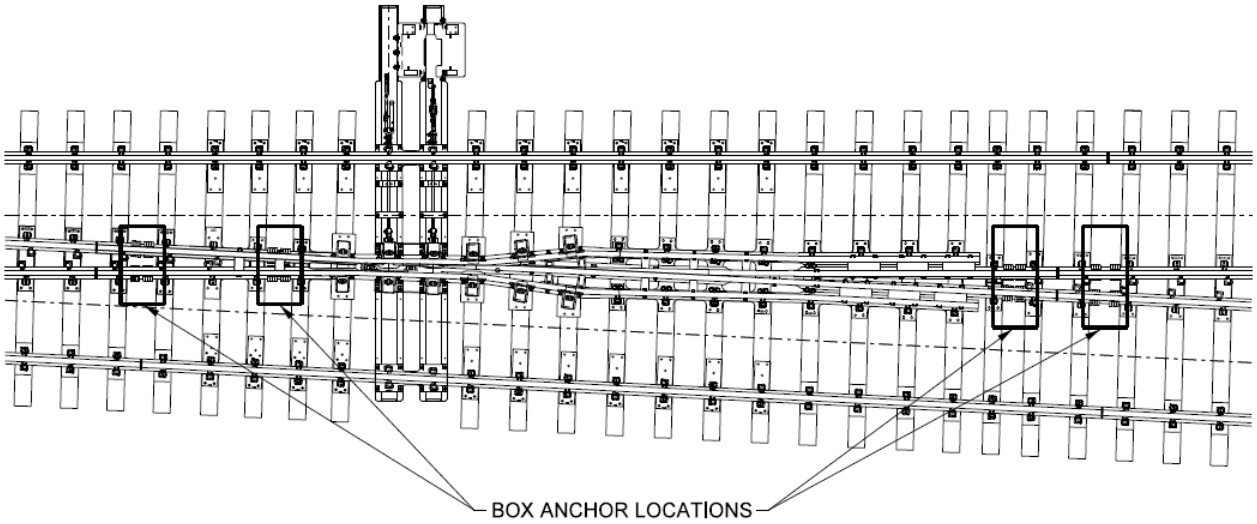


Figure 4.14.6-B

4.14.7 Transition Pattern

Transition anchor pattern at locations where CWR connects to jointed rail as shown in Figure 4.14.7-A.

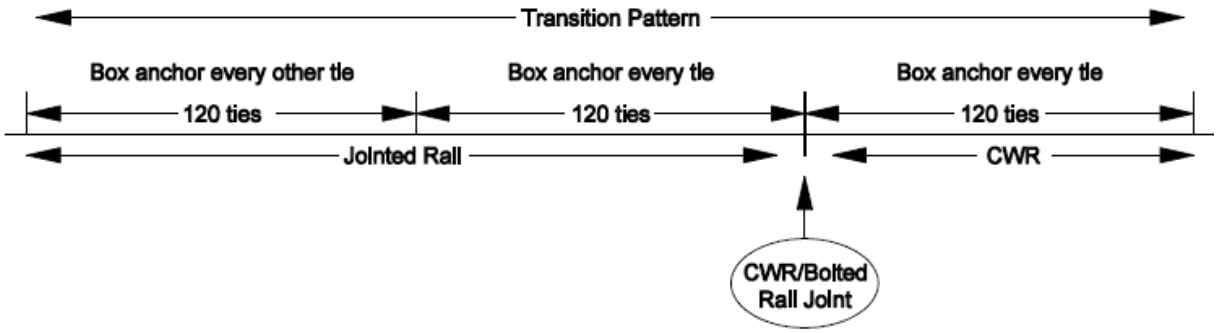


Figure 4.14.7-A

When transitioning from CWR to jointed rail:

1. Solid box anchor the CWR for 120 ties before the jointed rail.
2. Solid box anchor the first 120 ties in the jointed rail next to the CWR.
3. Box anchor every other tie in the next 120 ties in the jointed rail next to the 120 solid box anchored ties.

4.14.8 Crossing Frogs

Follow these crossing frog anchoring requirements:

1. Add solid crib anchors in two cribs between ties 10-12 in all directions from crossing frog, where expansion joints are not present, to reduce longitudinal forces from the crossing frog. Refer to Standard Drawing No. 0270.
2. Box anchor every tie 120 ties away from the crossing frog in all directions on concrete and wood ties. Refer to Standard Drawing 0420.

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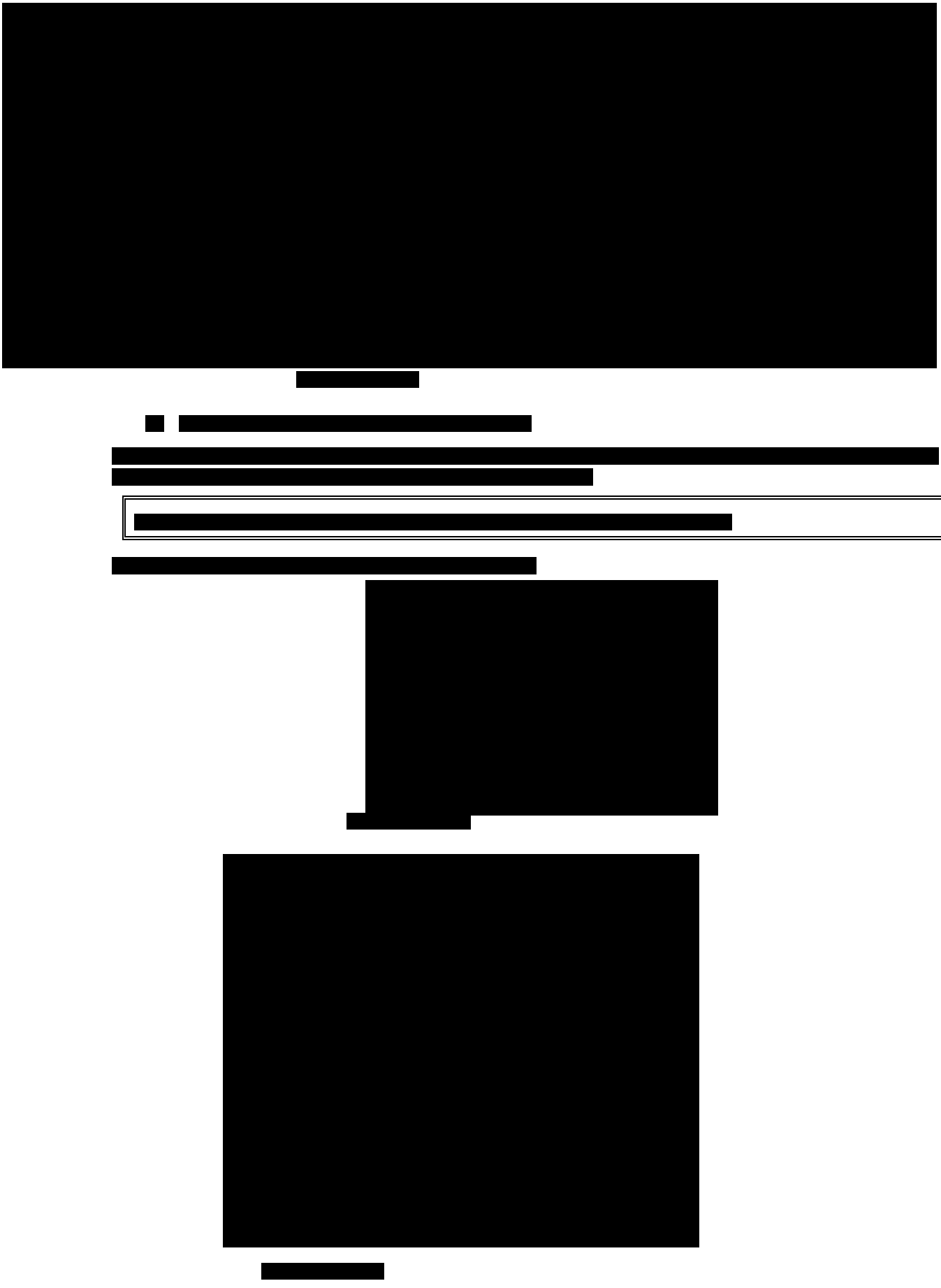

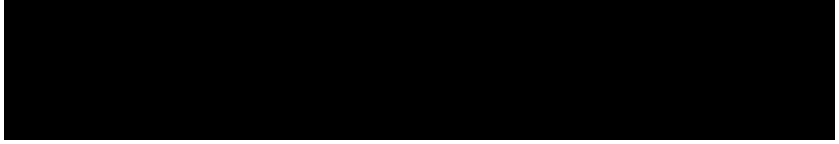

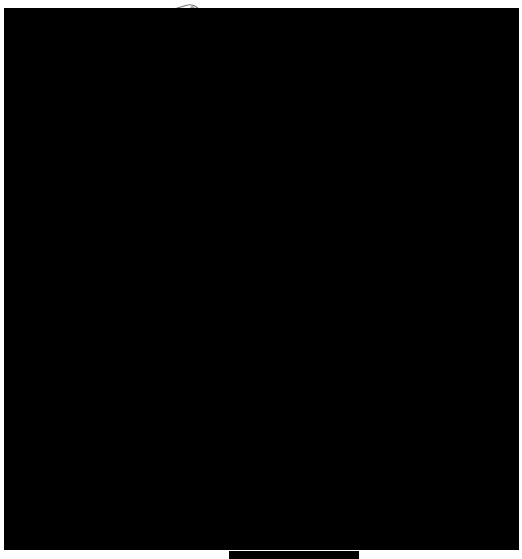

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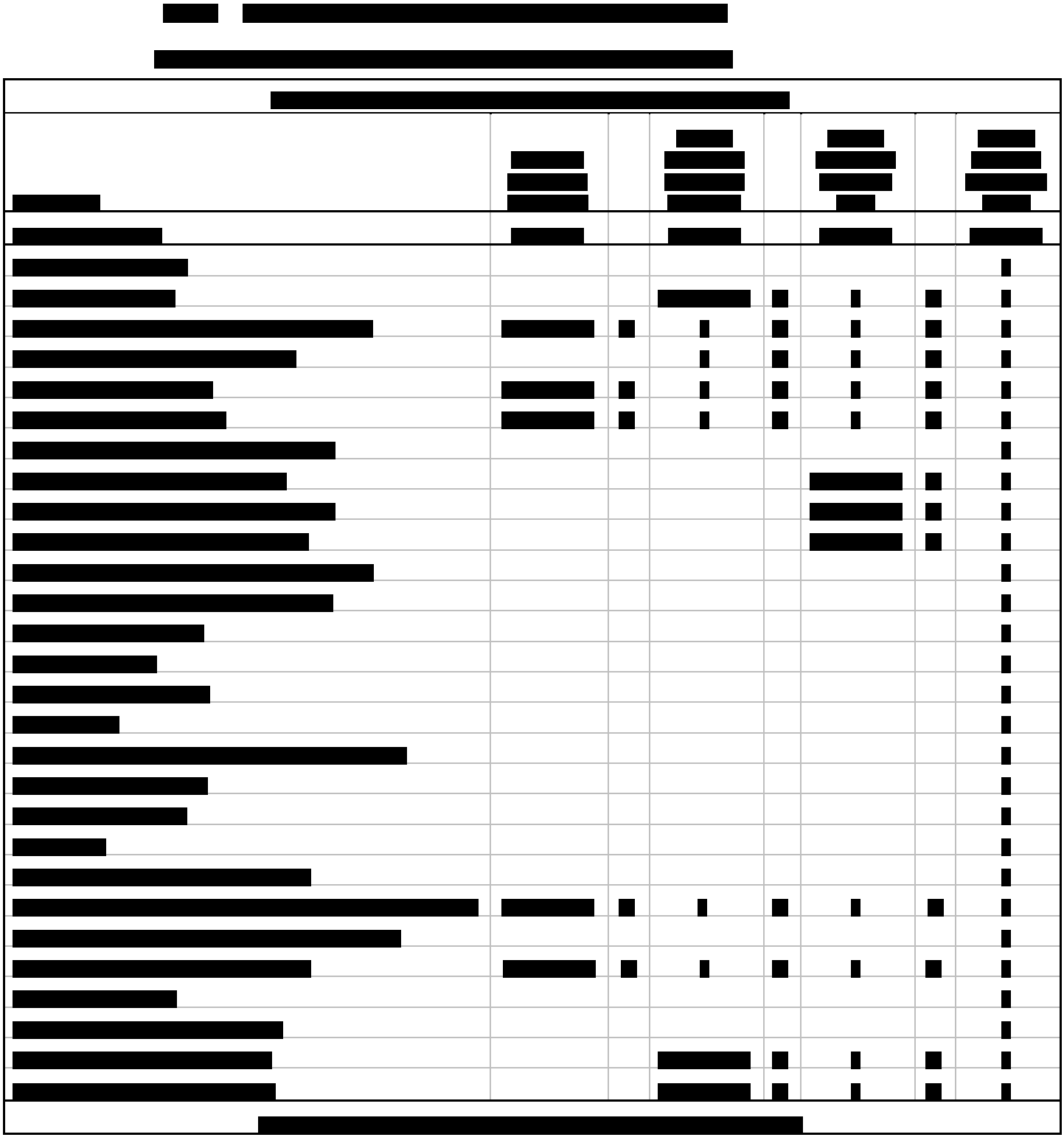

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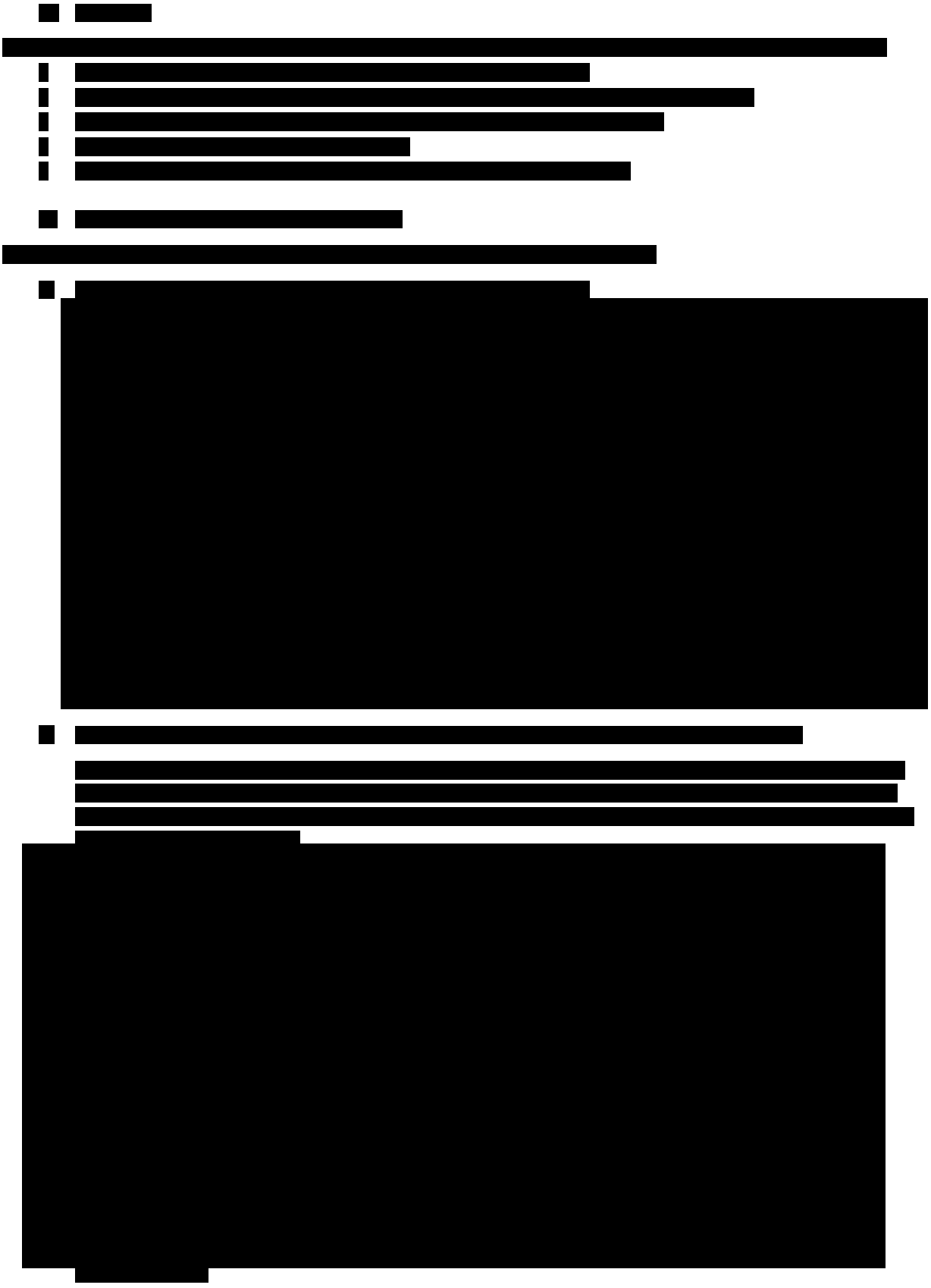

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- Gauge widening

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4.18 Rail Handling

When lifting rail:

1. Center mark rail before lifting to balance the load.
2. Use approved rail tongs or grapple buckets when handling rail 60 feet or less.
3. Use a spreader bar when handling rail more than 60 feet.

5 TURNOUTS

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5.1 Turnout Identification

5.1.1 General

The following are general guidelines for turnout identification:

1. Identify turnouts by their frog number. Refer to Standard Drawing No. 0080 for recommended turnout applications.
2. Determine if a turnout is a left- or right-hand turnout by determining the direction of the diverging track. To do this, stand in the track ahead of the switch and face the frog.
   - If the diverging track is on the left, it is a left-hand turnout. See Figure 5.1.1-A.

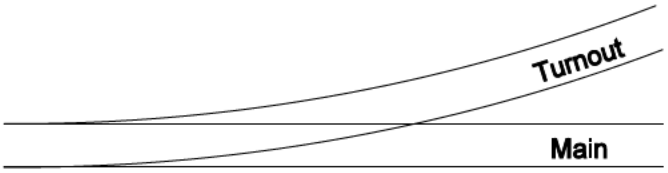

Figure 5.1.1-A

   - If the diverging track is on the right, it is a right-hand turnout. See Figure 5.1.1-B.

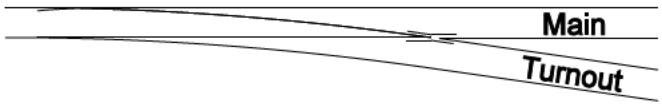

Figure 5.1.1-B

- If both tracks diverge an equal amount, it is an equilateral turnout. See Figure 5.1.1-C.

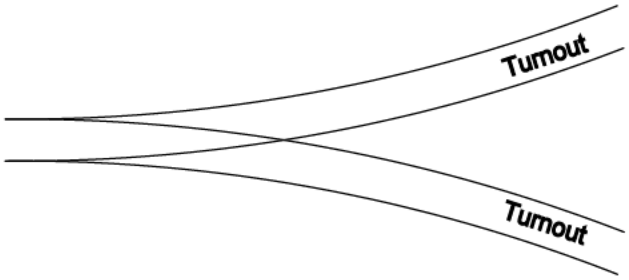

Figure 5.1.1-C

3. Some general turnout terms are identified in Figure 5.1.1-D.

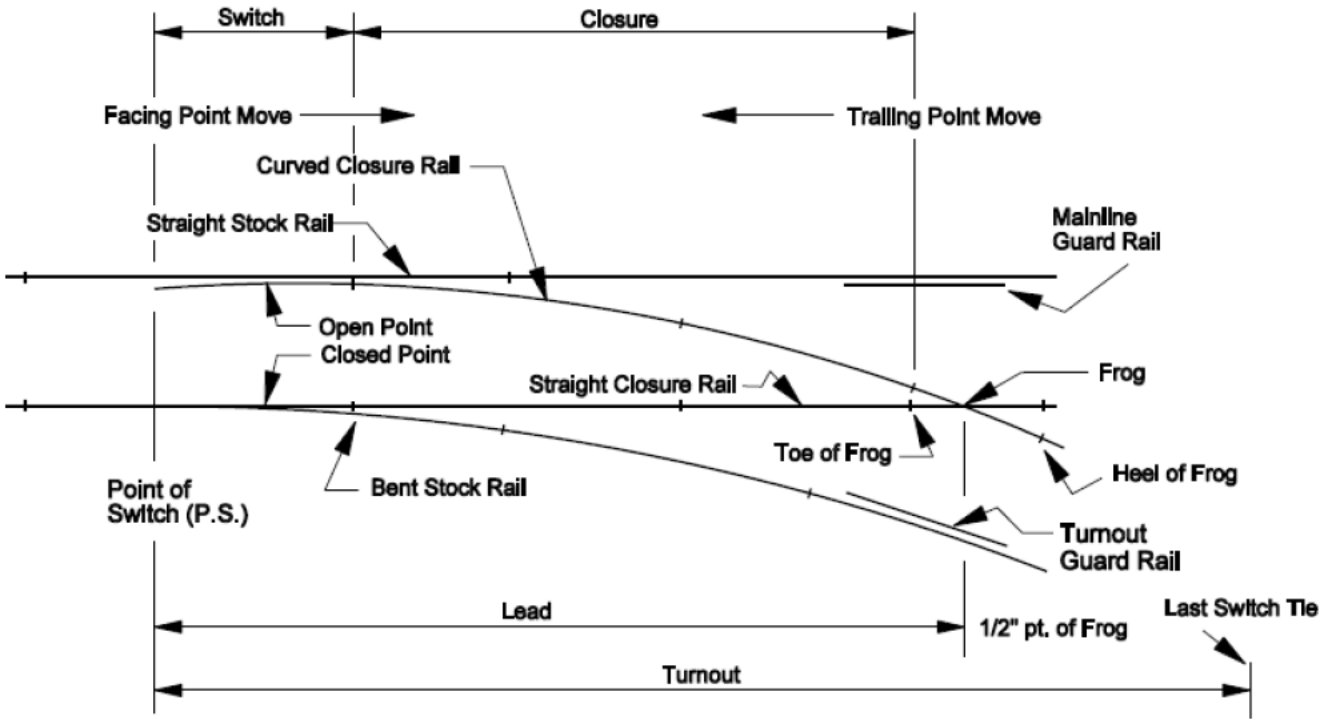

Figure 5.1.1-D

4. UP primarily utilizes AREMA standard geometry for its turnout layouts. The common turnout sizes are now #9, #11, #15, #20/24, however, multiple other sizes have been utilized over the years. There are specialty applications where alternative geometry such as Clothoidal or Spiral layouts are utilized. The following are the common turnout types:
   - Wood
   - Concrete
   - Steel
   - Specialty – such as custom geometry
   - Lap Switches – Switch within a switch, primarily used in hump yards to save space

5.1.2 Turnout Construction

Follow these requirements for constructing turnouts:

1. Construct turnouts as prescribed in the UPRR Track Standards.
2. Construct turnouts using head hardened rail. Intermediate strength head hardened rail may be used where authorized by UPRR standards.
3. Do not use rails of different sizes in the same turnout except in case of emergency where transition rails are utilized.
4. Spike turnouts according to Standard Drawing No. 0417.
5. Box anchor all switch ties to the extent that the anchors will not interfere with the proper operation of the turnout. Refer to Standard Drawing No. 0420 and Section 4.17 Rail Anchors for further information.

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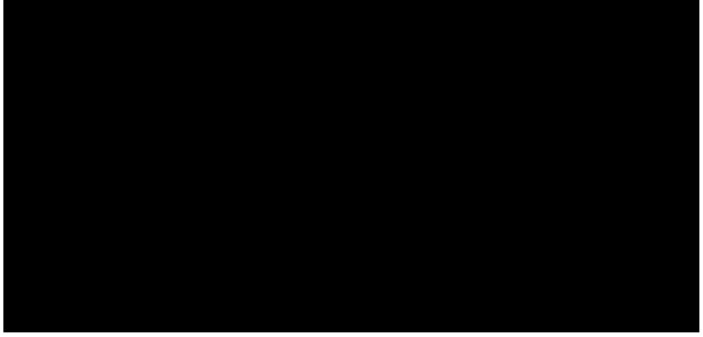

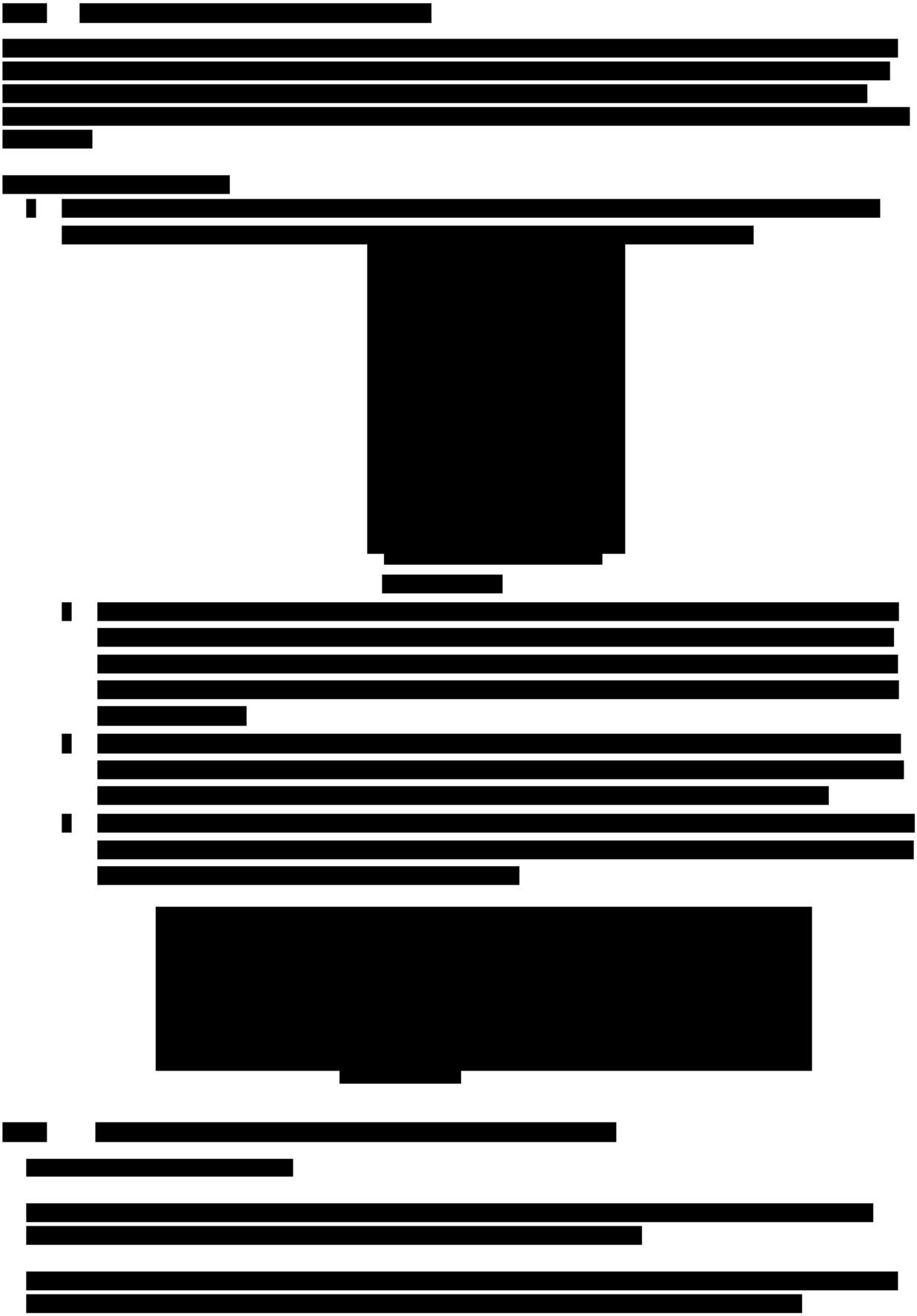

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5.5 Frogs

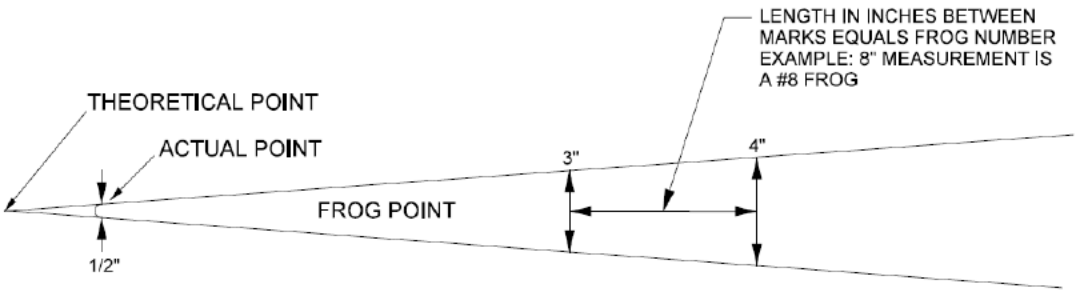
Frogs allow wheels to pass over one rail and onto another.

1. Frogs are designated by frog number according to their angle. Use frogs with turnouts of the same number. Refer to Standard Drawing No. 0080 for frog applications.
2. Frogs are furnished in extended lengths to provide clearance for field welding in track and replacement in the field without having to add additional rail. This type of frog may need to be cropped before installation in the field to take advantage of its versatility. Refer to the appropriate turnout Standard Drawing for cropping locations.
3. Tighten per 5.5.6.

5.5.1 Identification of Frogs by Number

The rail weight and frog size are stamped on a tag attached to the heel of the frog or cast into the top of the filler block. If these markings are not clearly visible. Use the following guidelines to determine the frog number:

1. With a tape measure, mark a 3-inch width across the top of the frog.
2. Mark a 4-inch width across the top of the frog.
3. Measure between marks. The number of inches measured equals the frog number. See Figure 5.5.1-A.



FIELD IDENTIFICATION OF FROG NUMBERS

Figure 5.5.1-A

5.5.2 Frog Types

Subsections A through F describe typical frog types.

A. Railbound Manganese Frog (RBM)

The RBM frog has a cast manganese body insert for the point section of the frog. See Figure 5.5.2-A. Refer to Standard Drawing No. 3021. RBM frogs can either be Heavy or Standard Point, see section 5.5.4 for additional details.

NOTE: In mid-2000's UPRR and the BNSF converted to conformal top RBM frogs. Conformal top frogs feature a 1:20 slope on the wing portion of the castings where as a standard RBM is flat. For help identifying conformal top frogs see Standard Drawing No. 3044 and Section 5.5.4 Frog Wear Conformal Frogs (Heavy Point RBM's).

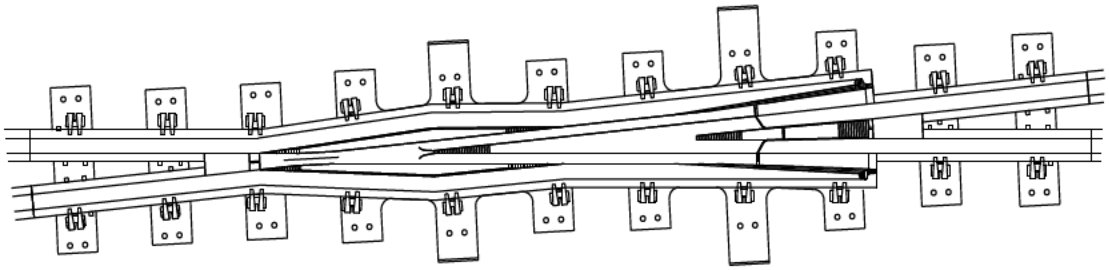


Figure 5.5.2-A

B. Rigid Bolted Frog (All Rail)

The rigid bolted frog is similar in design to the RBM frog, except the point section is constructed from rail instead of manganese. Install a frog with the short point on the turnout side if it is available. See Figure 5.5.2-B.

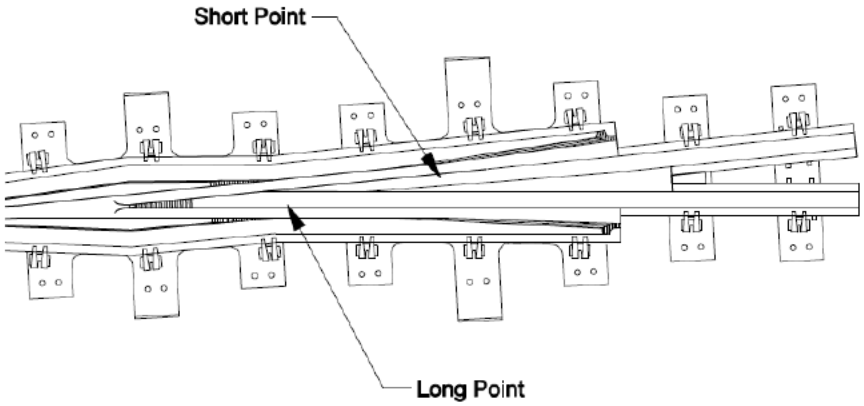


Figure 5.5.2-B

C. Spring Frog

The spring frog has a movable wing rail that is normally held closed against the body of the frog except when pushed open by a diverging movement. See Figure 5.5.2-C. Refer to Standard Drawing No. 3020. Use this frog in main track applications where the diverging traffic is less than 40 percent of the main track traffic.

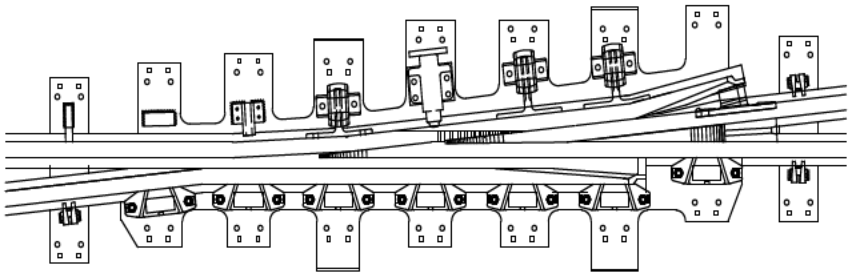


Figure 5.5.2-C

D. Solid Manganese Self-Guarded Frog (SMSG)

The SMSG frog has a body cast in one piece from manganese steel. A raised guard cast into the body protects the frog point from passing wheels, making the installation of a guard rail on the opposite rail unnecessary. See Figure 5.5.2-D. Refer to Standard Drawing No. 3021.

Use this frog in yard and industry applications where the track speed does not exceed 20 mph.

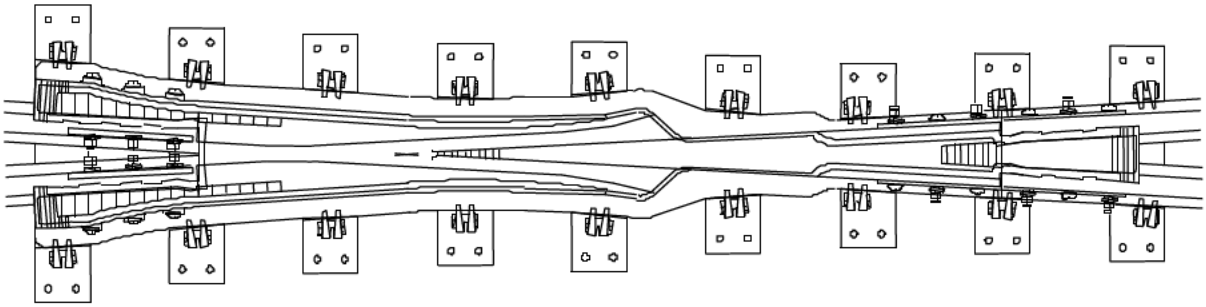


Figure 5.5.2-D

Follow these special guidelines for SMSG frogs:

1. If building the frog point under traffic, build the guarding face before the frog point.
2. Install guard rails as an option in cases where additional guarding may be required, such as curved switches.

E. Movable Point Frog (MPF)

The MPF is equipped with a point that is movable in the same manner as the switch points. See Figure 5.5.2-E. Refer to Standard Drawing No. 3022. This frog is used in heavy tonnage on #20 and larger, high-speed main track where the traffic on the straight and diverging side of the turnout is comparable.

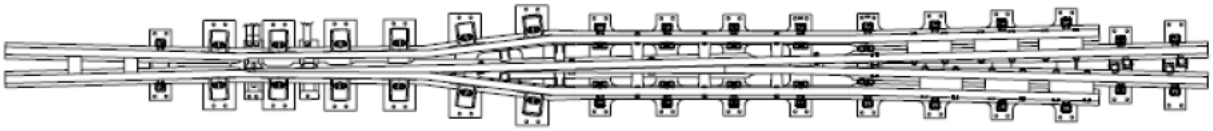


Figure 5.5.2-E

F. Jump Frog

The jump frog features a continuous mainline rail and a flange bearing run on the turnout side. This frog can be utilized in situations where traffic through the diverging route is minimal such as maintenance of way tracks or small industry tracks. Speed is limited on the turnout run to 10 MPH.

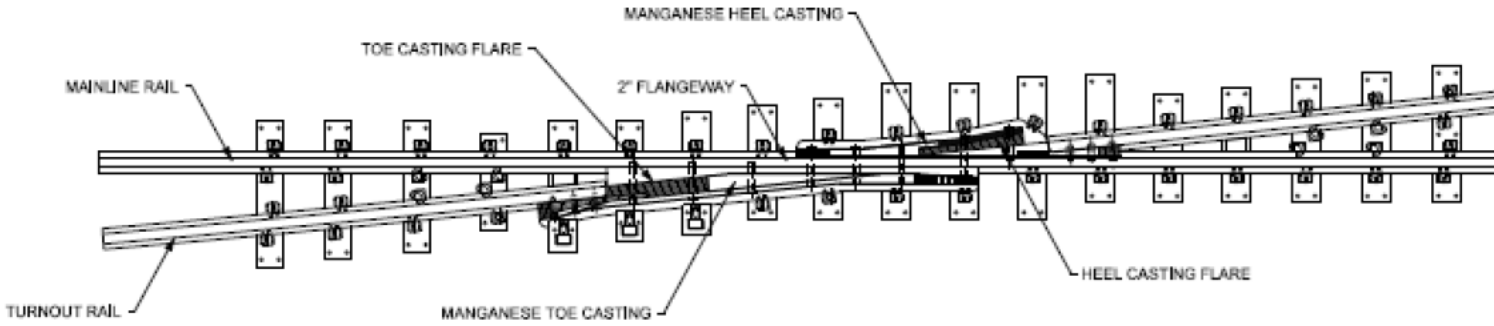
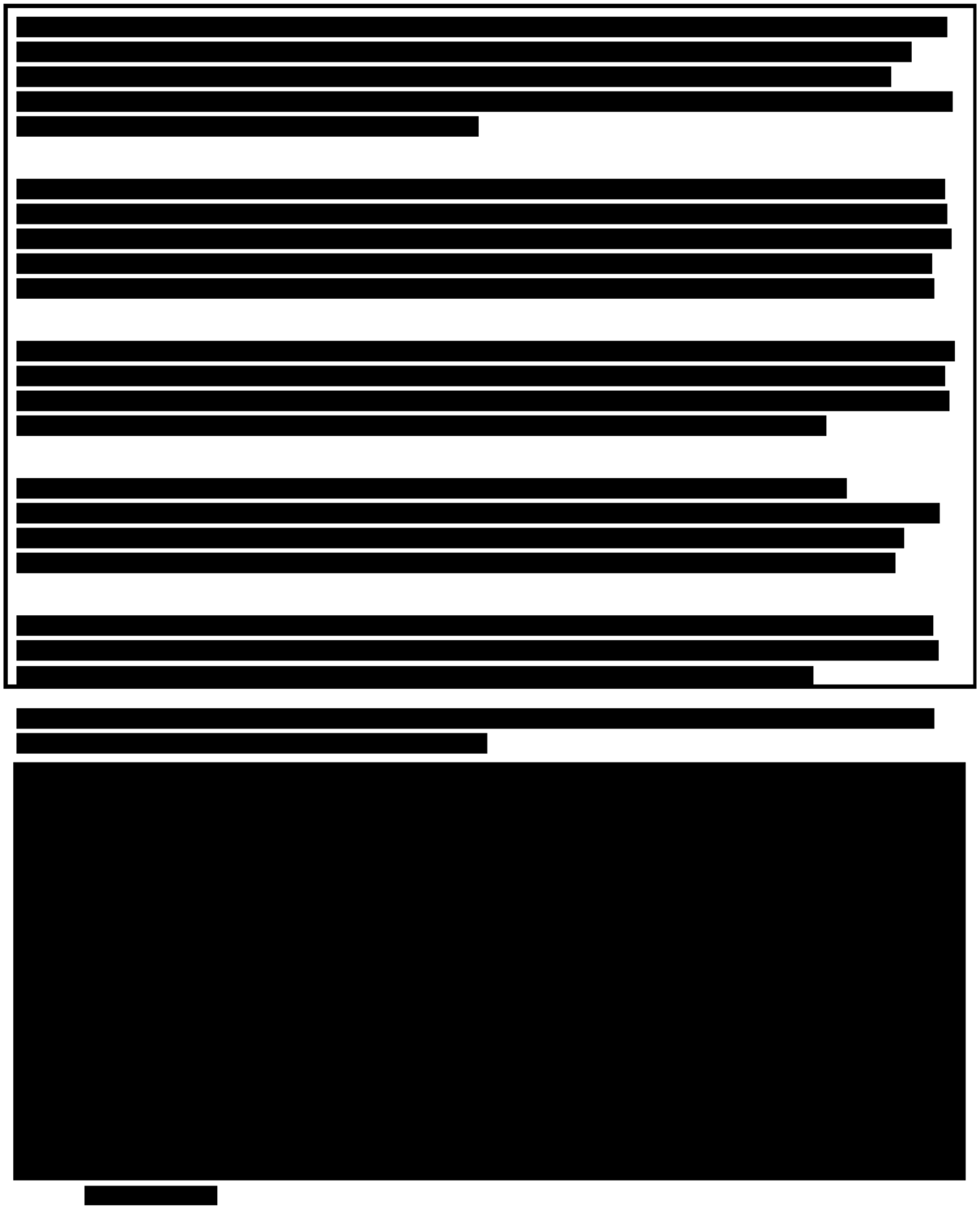
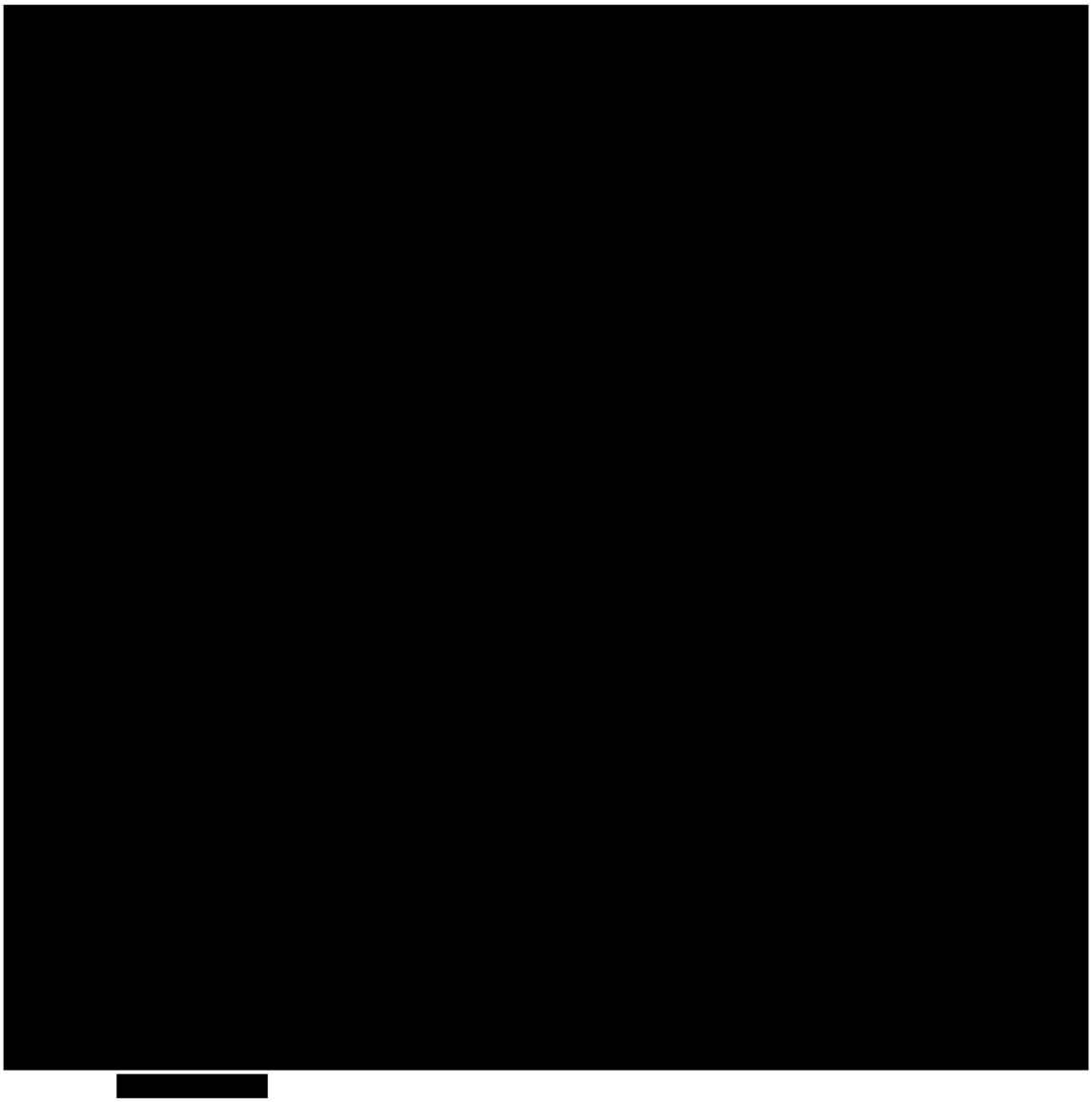


Figure 5.5.2-F





5.5.5 Frog Guard Rail Size and Length

Follow these requirements for guard rail size and length:

1. Use guard rails that are the proper size. Position them correctly in relation to the frog. Refer to the appropriate turnout Standard Drawing for details on guard rail placement. Refer to Standard Drawing Nos. 4005 to 4009 for more information on guard rail specifications and settings.
2. Use guard rail lengths for turnouts as shown in Table 5.5.5-A.

Frog Size	Main Track Guard Rail Length (Feet)	Turnout Guard Rail Length (Feet)
No. 7 and No. 9	13 feet*	13 feet**
No. 10 and No. 14	19'6" feet (min.)	15 feet
No. 11 and No. 15	19'6" feet	19'6" feet**
No. 20 and No. 24	26 feet	26 feet

Table 5.5.5-A

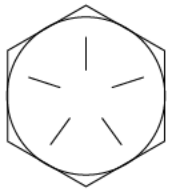
*** If the track speed is greater than 40 mph, use at minimum a 19'6"-foot guard rail length.**

**** For 5 ½" base rail, alternate guard rail size may be necessary**

Do not build up guard rails by welding in the field.

5.5.6 Frog / Diamond Bolts

Replace frog bolts that are missing, bent, cracked or worn more than 1/8 inch in diameter, or that cannot be tightened to compress the washer. Use only frog bolts made from Grade 8 material. Grade 8 bolts can be identified by 5 tick marks on the bolt head. See Figure 5.5.6-A. Use proper length bolts that do not allow the threaded portion of the bolt to extend more than 1 inch past the nut.



Grade 8 Bolt Marking

Figure 5.5.6-A

Frog Bolt Sizes and Torque

Determine the frog bolt and washer diameter and torque from Table 5.5.6-A.

Rail Size	Bolt and Washer Diameter	Torque (lb.)
85 lb. or less	1-1/8"	1,500
90 to 100 lb.	1-1/4"	1,750
110 lb. or more	1-3/8"	2,200

Table 5.5.6-A

Installing frog bolts with a proper torque wrench is ideal, however in many cases this cannot be accomplished due to availability. When Torque wrench is not available apply a never seize lubricant such as WD-40 or PB Blaster to the bolt threads and nut threads before tightening. Tighten until refusal.

Utilize One Heavy Hex Lock Nut and One Hardened Steel Flat Washer with each Frog Bolt.

Proper Torque is CRITICAL on crossing diamonds, especially new installations. Contact Chris Roop at 402-501-3887 for assistance and instructions on how to order and operate torque wrenches.

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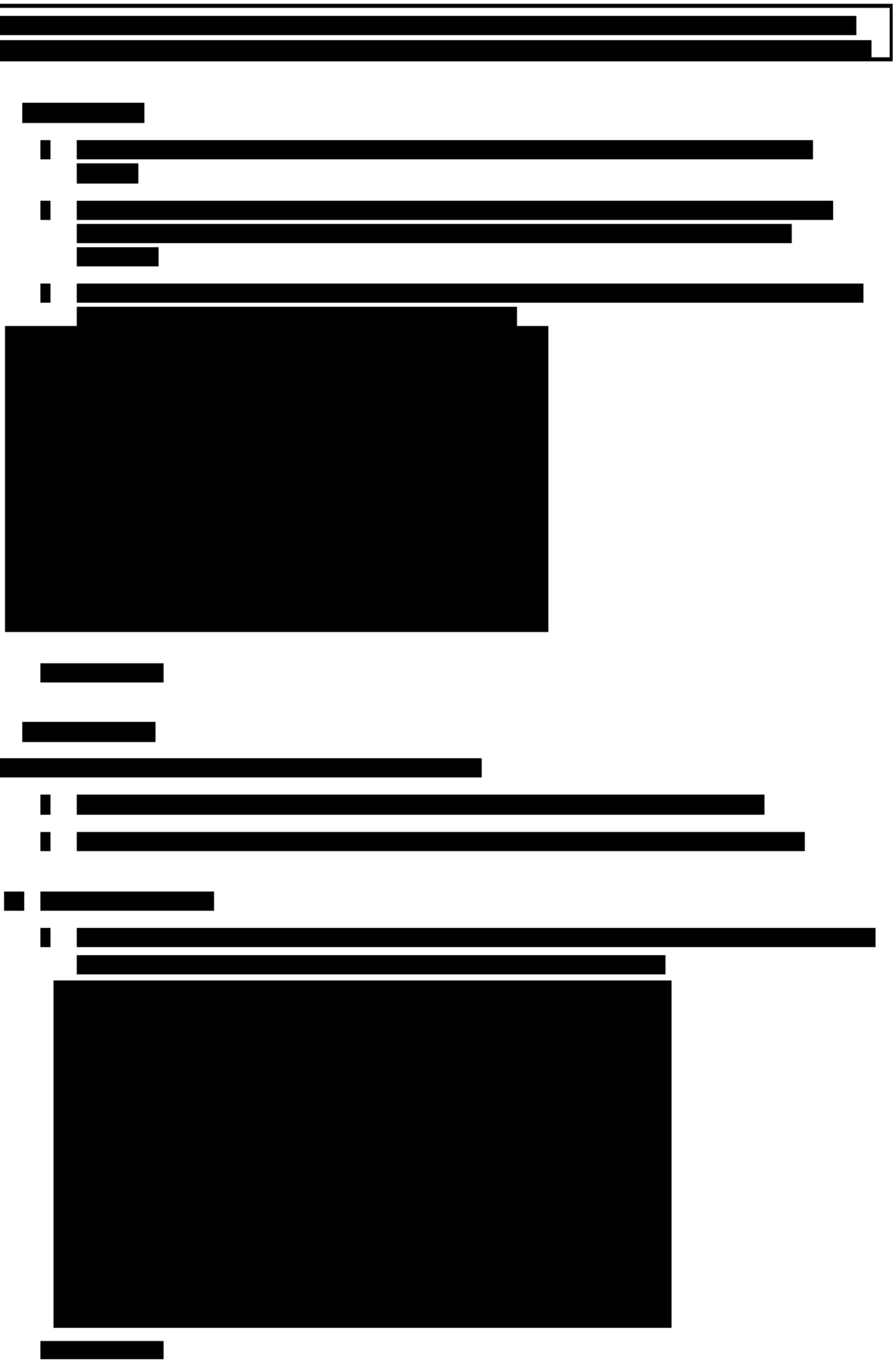

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5.7 Derails – Permanent & Portable

5.7.1 Permanent Derail Requirements

Inspect and evaluate the territory for correct placement of required permanent derails. Refer to Standard Drawing Nos. 2000 to 2022 for details and instructions on placement. Refer to the WPD on Derail Installation for installation instructions.

- All mainiline and siding routes require protection by permanent derails on all connecting industrial or auxiliary tracks.
- Ensure derails are installed on solid ties and secure with lag screws whenever possible.
- Whenever possible avoid installing in a curve. If no other option is available install permanent derail on the outside rail of curves (high side). When necessary to derail towards the inside rail install a type 2 or 3 derail.

Permanent derails installed on Siding or CNRT track types may not be removed unless approved by the Vice President Engineering.

Leave derails lined and locked in the derailing position except when movement over is expected and authorized.

5.7.2 Use of Portable Derails

Portable derails are to be used only for temporary applications where permanent derails cannot be installed. Portable derails must be applied per the procedure below and UPRR Standard Drawing No. 2003.

Portable derails must be stored inside a locked tool box or storage box on vehicles or inside of a locked storage facility. If no lockable tool box is available on a vehicle for storing portable derails, they must be chained using a grade eight chain and lock or otherwise secured and locked to the vehicle.

When UPRR standards require a permanent derail and one does not exist where cars are being stored, a portable derail may be used. Portable derail(s) will be placed 25 feet from the first and last car in the siding. Portable derail(s) must be secured and locked with a padlock to prevent removal. Portable derail(s) may only be installed for a maximum of 30 days. After 30 days the proper derail must be installed or the cars removed from the track or track removed from service.

Any portable derails that are struck by equipment must be discarded and replaced.

5.7.3 Placement of Derails on Controlled Tracks for Long Term Storage

Prior to placing derails in a controlled track, contact the Manager of Signal Maintenance to review the requirements.

- Signal dept. will follow yellow book instructions 1.1.13.
- Track personnel will place derail(s) 25 feet from the first and last car in the track. Derail(s) must be secured and locked with a padlock to prevent removal.

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5.9 Clearance Point

1. Ensure the clearance point on auxiliary and yard lead tracks are clearly marked with cone. See Figure 5.9-A. See Standard Drawing No. 0026 for more details.

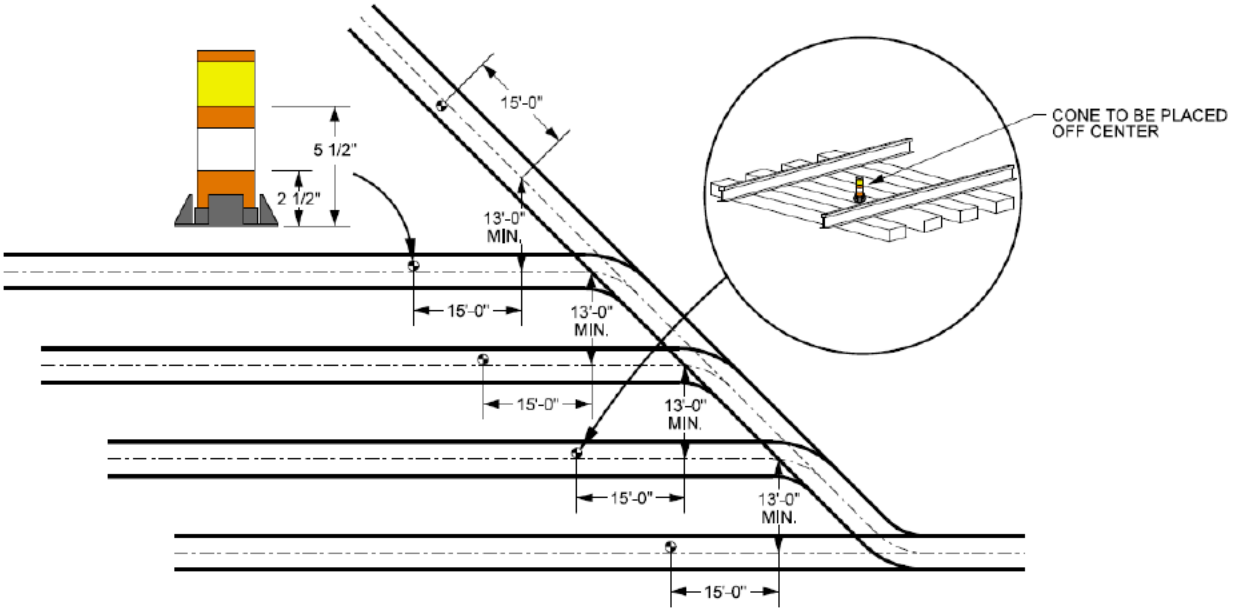

Figure 5.9-A

6 RIGHT OF WAY AND OTHER FACILITIES

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6.1 Area of No Obstruction 2

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4

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6.1 Area of No Obstruction

The Area of No Obstruction refers to the area around the track where Engineering Personnel need to avoid placing material, equipment etc. as it may be struck by a passing train or equipment during normal movement. When unloading material such as ballast, rail or OTM it should not be left in this area during normal train operations. Care should also be taken to secure material that may move to avoid it being able to enter this area unmonitored. When material is left in this area movement over it should be done at restricted speed and monitored. This Area of No Obstruction applies specifically to material, equipment left in place and does not supersede the standard minimum operating clearances or on track safety requirements.

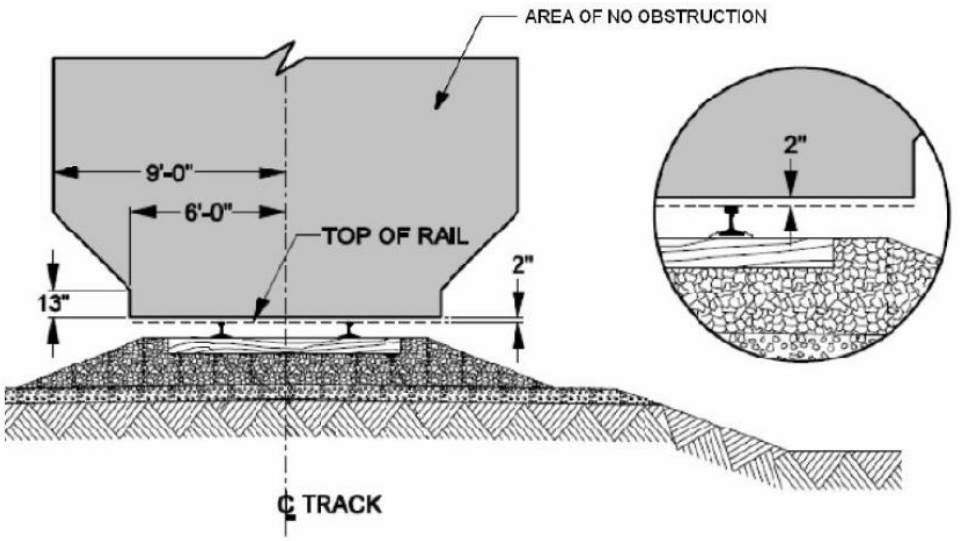

Figure 6.1-A

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6.3 Roadway Signs

Roadway signs are an important means to provide information to employees and others. They are a vital part of the safety of the railroad, providing instructions and visual reminders of warnings. They also serve as reference markers for structures and locations. As such, their use and maintenance should not be overlooked.

6.3.1 General

Employees must place and maintain roadway signs where required. Keep roadway signs erect, plumb, and legible. Replace all defaced signs as soon as practicable. Any deviation from the standards must have Vice President Engineering approval.

NOTE: Refer to Engineering Track Standard Drawing Nos. 0501 through 0599 for proper size and placement of all approved railroad signs. When sign is installed, write date on back of sign in MM/YY format. This is for warranty purposes.

6.3.2 Whistle Signs

Whistle signs are used to inform an engineer that the train is approaching a road crossing. Federal law requires the engineer to sound a whistle cadence at identified crossings unless designated as a Quiet Zone. Place per Standard Drawing No. 0543 or Standard Drawing No. 0544 for Quiet Zone Crossings. These locations are designated in the DOT Crossing Inventory.

6.3.3 Standard Highway Crossing Signs (Crossbucks)

Standard highway crossing signs (crossbucks) must be placed on the right side of each approach of all public road crossings without signalized protection.

The initial installation of yield or stop signs at these crossings is negotiated by the Engineering Department's Industry and Public Projects Group. Union Pacific maintains / replaces these signs after they are installed.

Follow these requirements for installation and inspection:

- Place per Standard Drawing No. 0519
- Follow inspection requirements for crossing signs as detailed in M/W Rule 53.1.1 Road Crossing Condition.
- Follow these requirements for replacement of existing signs:
- To determine the current sign type and standard for existing yield or stop sign installations for any particular at-grade crossing location(s), utilize the UPRR website: MyUP> Public Projects> Facility Reporting> DOT Road Crossing Reports> Summary List of DOT's.
- Contact your local Industry and Public Projects representative if you have questions regarding installations at crossings that may be exceptions to standards. If local law enforcement or municipalities contact UPRR maintenance forces to request a change to the type of sign installed, contact your local Industry and Public Projects representative for further handling.

6.3.4 Clearance Warning Signs

Follow these requirements for mounting clearance warning signs:

- Use close or impaired clearance signs at locations with horizontal or vertical clearances that are less than standard.
- Mount close clearance signs at each end of the restricted track's entrance so they are clearly visible from the direction of approach.
- Mount close clearance signs on posts or structures.
- See Standard Drawing No. 0507 for general placement details. Specific requirements for state or local ordinances may also be required on the sign face.

6.3.5 End of Track Sign

The End of Track Sign was developed to eliminate the risk of a red board being placed on a stub track adjacent to the mainline.

Signs to be installed per Standard Drawing No. 0513 at all end of track applications.

[redacted]

6.4 Roadways

Follow these requirements for maintaining right of way

6.4.1 Grade Crossings

Follow these requirements for maintaining right of way access at road crossings.

A. General

To provide for safe train operation and safe condition of the highway travel crossing, give special attention to road crossing maintenance. Follow these general requirements:

1. Do not construct, install, widen, relocate, or remove any road crossing without IPP and PTC Change Management approval. Reference OI1, PTC Change Management Rules and IPP contact map.
2. Construct all crossings according to UPRR Standard Drawing Nos. 0301-0331 and Standard Drawing Nos. 0090 and 0095.
3. Use concrete crossing panels on crossings constructed on concrete tie track.
4. Use concrete panels for public crossings when available.
5. Use prefabricated timber panels or second hand concrete for private crossings outside concrete tie track.
6. Where a road crosses more than one track, where practical, top of rail elevation of all tracks should be in compliance with 2.5.3.
7. Maintain crossings to a smooth, even grade with no abrupt changes in slope or surface. For approach asphalt roadway paving and installation, refer to Standard Drawing 0304.
8. Before performing any work on a public road crossing that might require a road or lane closure or detour, contact the proper local, county, or state officials to discuss scope of work, obtain permission, and any required permits.
9. When constructing or maintaining road crossings, remove all rail joints within the crossing limits. Keep rail joints at least 15 feet from the edge of the crossing.
10. Follow these requirements for maintaining flangeways:

Maintain the flangeway opening along the gauge side of the running rail at no less than 3 inches.

Keep flangeways free of debris, gravel, ice, or other objects.

B. Crossing Warning Devices (Passive/Active)

Employees must immediately repair or replace all damaged or illegible signs. Report all damaged signalized crossing warning devices to the Signal Department hotline 1-800-848-8715.

Follow these requirements for maintaining crossing warning devices:

- Properly maintain crossbucks and whistle posts at all times. Refer to Standard Drawing 0519.
- Keep the view clear in both directions for vehicles approaching the track. See Section 6.2.
- Work on or about highway crossings with the least possible inconvenience to highway traffic. Take care to protect all employees and the traveling public.
- Refer to M/W Rule 53.0 Road Crossings and Signs for additional requirements.

C. Crossing Drainage

- Control the amount of water entering road crossings. Follow these requirements for controlling crossing drainage:
- Make sure the surface of the highway slopes away from the track where possible.

- Maintain approved culverts and ditches to allow water to flow without adversely affecting the track structure or roadway.

Refer to the Work Procedure Document on Road Crossing Drainage for detailed information.

6.4.2 Right of Way Roads

Follow these requirements for controlling access to right of way roads:

1. Keep the gates controlling entrances to roads closed and locked, when not in use, to prevent unauthorized access.
2. Where access to right of way roads is not controlled, post "No Trespassing" signs according to UPRR Standard Drawing No. 0528.

[redacted]

6.6 Bridges

Refer to Engineering Standard Drawing Nos. 4001 to 4004 to determine which structures require inside guard rails. These drawings also show construction details.

6.6.1 Bridge Identification

The following illustrations Figure 6.6.1-A, Figure 6.6.1-B, and Figure 6.6.1-C show some basic bridge terminology.

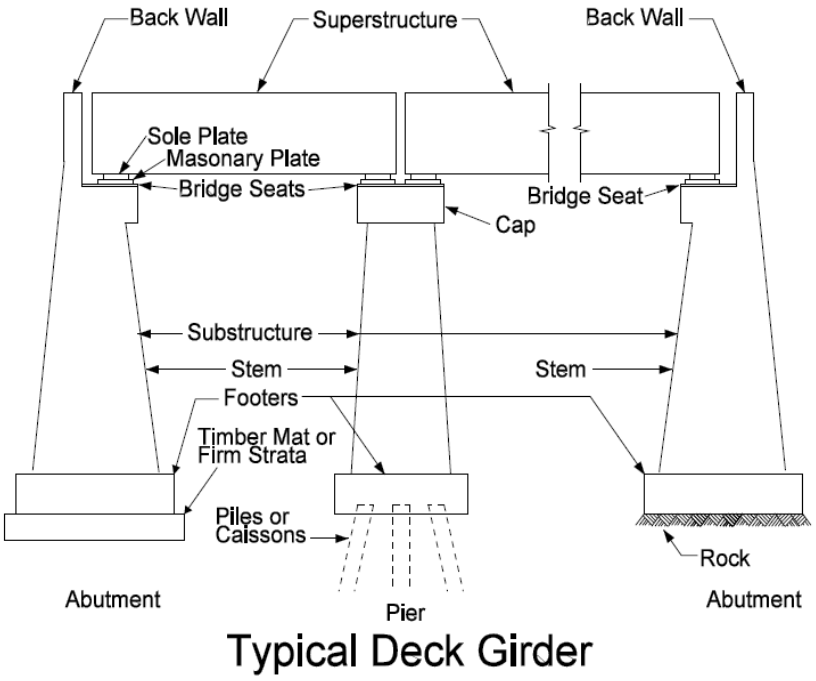


Figure 6.6.1-A

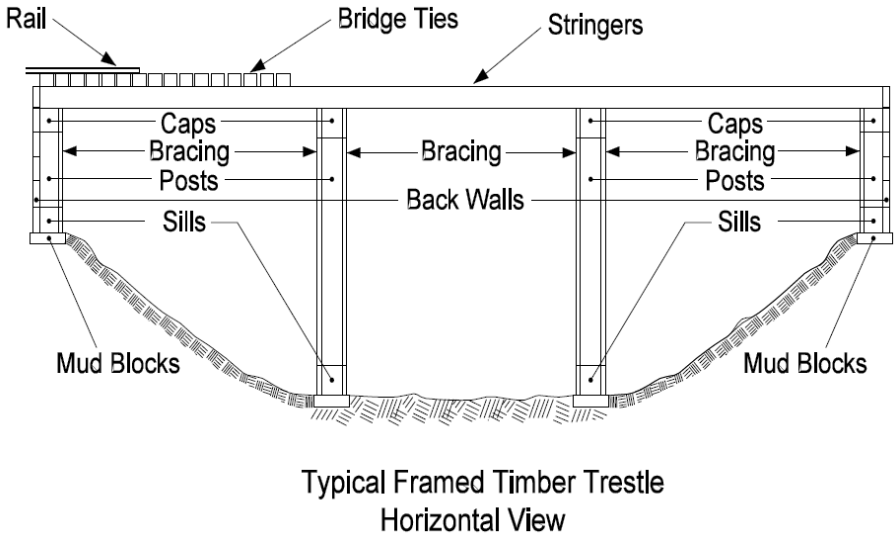
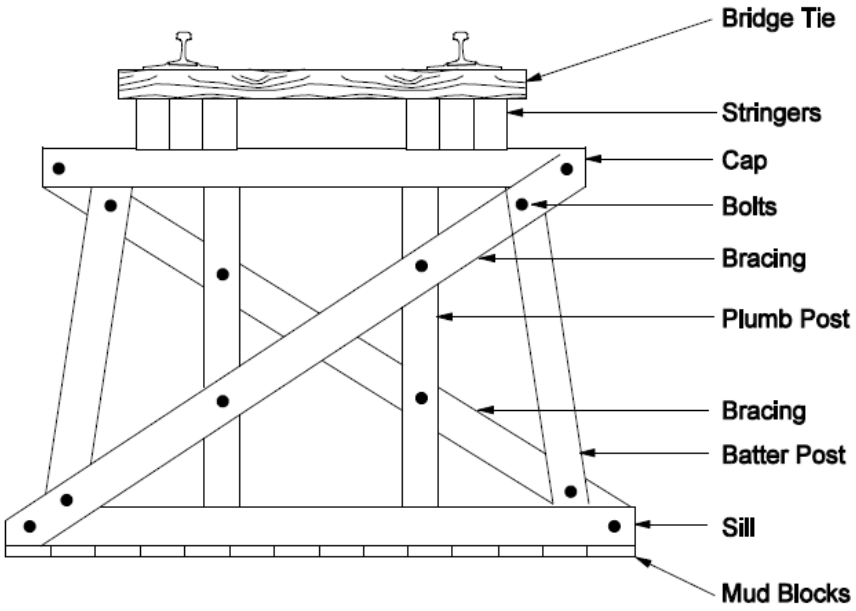


Figure 6.6.1-B



Timber Frame Trestle Cross-Section

Figure 6.6.1-C

6.7 Fiber Optics

Follow these requirements:

- Know if the area you are working in contains fiber optic cable.
- Take necessary measures to avoid damaging cable. Protect it from damage by outside parties.

Signs posted along the right of way indicate the presence of fiber optic cable but not the precise location. The absence of a sign does not necessarily imply that no cable is present, nor does it relieve an employee of the responsibility of checking to see if cable is present.

If you are unsure about the presence of cable, call 1-800-336-9193 before digging. If cable is present, do not dig in the area until the cable location has been marked or it has been determined that the work will not endanger the cable.

Call Union Pacific's *Call Before You Dig* hotline (800-336-9193) to determine if there are any fiber optic cables or other utilities in the work area. Call SOC in a terminal to contact water services and electricians.

Each State has a one-call hotline that must also be contacted at least 48 hours before performing any work. Call the North American One Call Referral System (888-258-0808) to obtain the appropriate state one-call number. Call the state one-call center, who will notify all utility owners within the work area.

***Do not* begin excavation or construction along the railroad's right-of-way until all utilities in the work area have been located and protected by their owners.**

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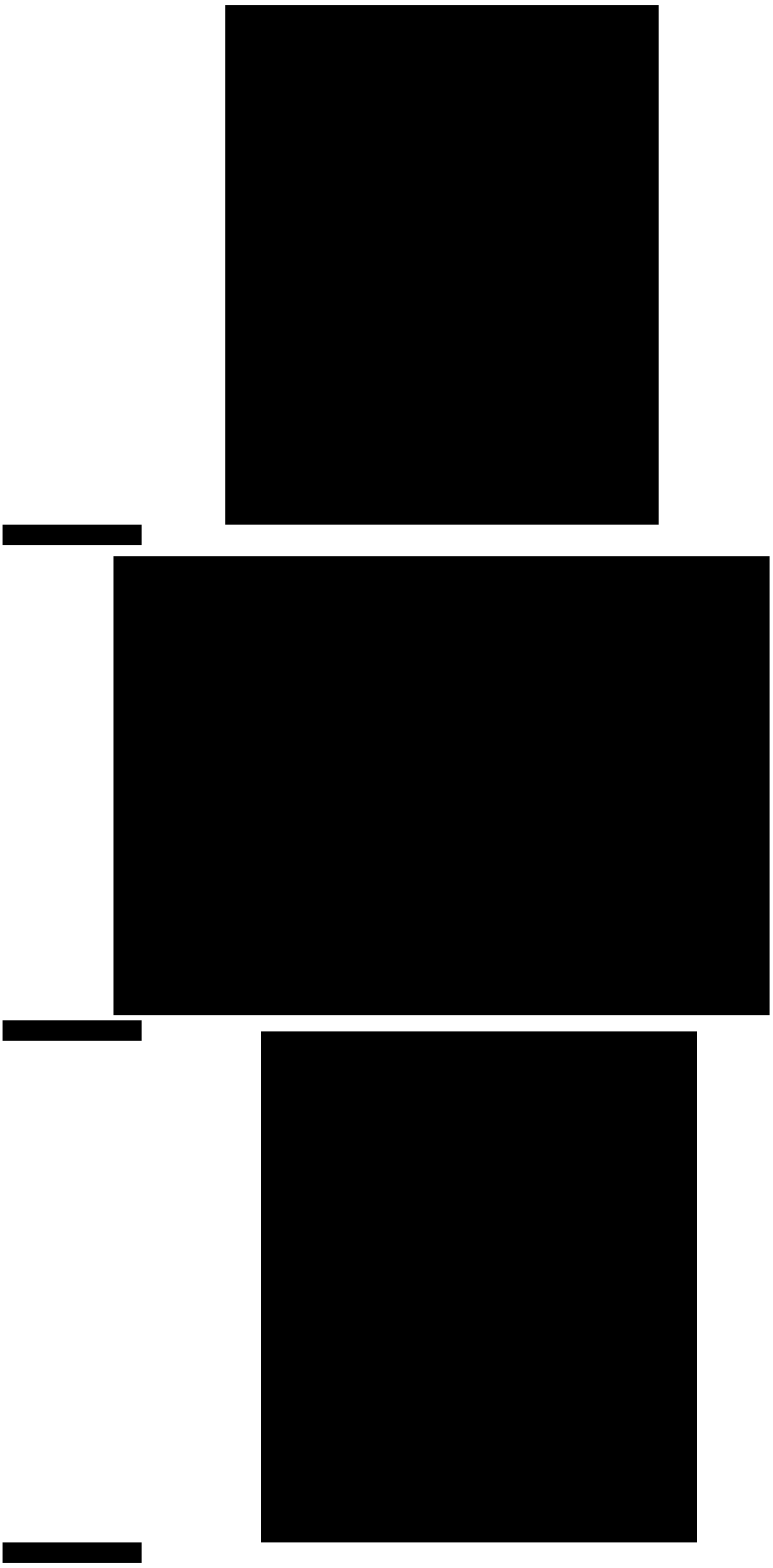

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6.8 PTC – Critical Asset Change Management

Reference the Work Procedure Document for PTC Change Management for more details.

	9 PTC CRITICAL FEATURES
1	**Track Center Line**
	Data collected that is the track centerline represented by the Latitude/Longitude/Elevation
2	**Signal**
	An asset used to display a color aspect for train movement
3	**Switch Point**
	A location on the track where movement can be made from one track to another track
4	**PTC Clearance Point**
	A designated location from an asset with a minimum of 13 foot track centers to keep equipment from fouling
5	**Mile Post**
	Markers used to establish the location using whole mile values
6	**Road Crossing**
	The Leading and Trailing edges of the crossing that intersects the railroad at grade
7	**Permanent Speed Restriction Sign**
	Entry and Exit points of the Speed Restriction
8	**Station Signs**
	Location of station signs in Track Warrant Control (TWC) territory
9	**Method of Operation Signs**
	Signs designating a change in the operation control of a territory (ie. Begin CTC, Begin ABS, Yard Limits, etc.)

GLOSSARY

This section includes definitions of terms relating to track work, switches, frogs, guard rails, crossings, and turnouts.

Abutment

A substructure composed of stone, concrete, brick, or timber supporting the end of a span.

Adjustable Separator

A metal block or two or more parts acting as a filler between the running rail and the guard rail and designed to provide varying widths of flangeway.

Alignment

The horizontal location of a railroad as described by curves and tangents.

Alloy Steel

Steel to which has been added silicon, manganese, nickel, or other elements to give greater strength, or impart other desirable properties for a particular use.

Angle Bar

One of two bars used to join two rail ends together to form continuous track.

Auxiliary Track

Any track not otherwise specified that directly connects to any main track, siding or industrial lead where cars or locomotives are left standing.

Ballast

Material selected for placement on the roadbed for the purpose of holding the track in line and at surface.

Ballast Section

A vertical cross section of the track from the subballast up, including ballast.

Bolted Rail Crossing

A crossing in which all the running surfaces are of rolled rail, the parts being held together with bolts.

Bolted Rigid Frog

A frog built essentially of rolled rails, with fillers between the rails, and held together with bolts.

Buckled Track

A major irregularity in track alignment caused by excessive compression in the rails. See also Thermal Misalignment.

Cant

The tilt or inclination on a surface.

Center Frogs

The two frogs at the opposite ends of the short diagonal of a crossing.

Classification Track

One of the tracks in a classification yard, or a track used for classification purposes.

Classification Yard

A rail yard consisting of a number of usually parallel tracks, used for making up trains.

Clearance Point

The location behind a turnout where track centers reach 13 foot. Exception: Yard tracks that have designed track centers of 12 foot 6 inches.

Closure Rails

The rails located between the parts of any special trackwork layout, as the rails between the switch and the frog in a turnout (sometimes called the lead rails or connecting rails); also the rails connecting the frogs of a crossing or adjacent crossings.

Company Material

Material transported by a particular railroad such as rail, cross ties, ballast, fuel oil, etc., used in connection with its operations.

Compound Curve

A continuous curve composed of two or more different curves put together with no tangent in between them, curving in the same direction.

Compromise Joint (Trackwork)

A rail joint between rails of different height and section, or rails of the same section but of different joint drillings.

Compromise Rail

A relatively short section of rail where one end is forged to a different section of rail.

Conformal Frog

A frog with a 1:20 sloped running surface designed to better fit the profile of wheels.

Connecting Rod

The rod that connects the switch stand and switch rod.

Connecting Track

A track defined as such in EFMS and the Track Inspection System, usually a track or a wye that connects two subdivisions or railroads.

Continuous Welded Rail (CWR)

Rail length that is 400 feet or longer.

Controlled Siding

A siding within CTC or Interlocking limits where a signal indication authorizes the siding's use.

Creosote

A tar distillate produced by high-temperature carbonization of bituminous coal and used in wood treatment.

Crib

The lateral space between two railroad ties.

Cross Level

The distance one rail is above or below another. This should not be confused with superelevation on curves.

Cross Tie

The transverse member of the track structure to which the rails are spiked or otherwise fastened to provide proper gauge and to cushion, distribute, and transmit the stresses of traffic through the ballast to the roadbed.

Crossing (Rail)

A structure, used where one track crosses another at grade, consisting of four connected frogs.

Crossing Plates

Plates interposed between a crossing and the ties or other timber to protect the ties and to better support the crossing by distributing the loads over larger areas.

Crossover

A combination of two switches that connect two adjacent tracks.

Crossover, Double

Two crossovers that intersect between the connected tracks.

Crossover, Universal

Two crossovers in opposite directions.

Curve, Compound

A continuous change in direction of alignment by means of two or more contiguous simple curves of different degrees having a common tangent at their junction points.

Curve, Degree of

The angle subtended at the center of a simple curve by 100 ft. chord.

Curve, Reverse

Two contiguous simple curves in opposite directions, with a common tangent at their junction point.

Curve, Simple

A continuous change in direction of alignment by means of an arc of a single radius.

Curve, Vertical

A transition in the track to connect two intersecting grade lines.

Curved Closure Rail

The rail between the switch point and frog on the diverging side of a turnout.

Curved Lead

The distance between the actual point of the switch and the half-inch point of the frog, measured on the outside gauge line of the turnout.

Departure Track

One of the tracks in a departure yard on which outgoing cars are placed.

Departure Yard

A rail yard where trains are assembled and made ready for departure.

Derail

A safety device, attached to one rail of a siding or storage track that will cause a car to be derailed in the event it rolls free towards a main track where it could cause a major accident.

Derailment

Anytime the wheels of a car or engine come off the head of the rail.

Drift Pin

A special railroad tool of round steel tapered for insertion to align holes by striking the large end.

Drill Track

A track connecting with the ladder track, over which locomotives and cars move back and forth in switching.

Dutchman

Short piece of rail that can be used to reduce the gap between rails ends. Used to make emergency or temporary movement of trains over a wide joint gap. Must be used within the limits of joint bars.

Easer Rail (or Easer)

A rail placed with its head along the outside and close up to the head of the running rail and sloped at the ends to provide a bearing for the overhanging portion of hollowed-out treads of worn wheels.

Elevation (of Curves) Superelevation

The vertical distance that the outer rail is above the inner rail.

End Frogs

The two frogs at the opposite ends of the long diagonal of a crossing.

Expansion Shim

Spacer inserted between ends of abutting rails while track is being laid to provide allowance for expansion of steel when temperature changes.

Facing Point Switch

A track switch, the points of which face traffic approaching in the direction for which the track is signaled.

Fastenings

Joint bars, bolts, clips, lag screws and spikes.

Fastenings, Auxiliary

Locknuts, spring washers, tie plates, rail braces, cotter pins and anti-creeping devices.

Federal Railroad Administration (FRA)

An agency of the U.S. Department of Transportation with jurisdiction over matters of railroad safety.

Fiber Optics

Light transmission through very fine flexible glass rods.

Field Side

The side of a rail opposite the gauge side.

Field Weld

A weld joining two rails together after rails are installed in track.

Filler Block (Trackwork)

A steel block molded and designed to keep uniform the angle spread between lead and turnout rails and frogs, etc.

Flange Lubricator

A device by which either grease or oil can be applied to the flanges of a locomotive driving wheel for the purpose of preventing flange wear and cutting. Rail lubricators, mounted along the rail in high curvature territory are also used to apply lubricant to passing flanges to reduce both wheel and rail wear.

Flangeway

The open way through a track structure that provides a passageway for wheel flanges.

Flangeway Depth

The depth of the wheel flange passageway.

Flangeway Width

The distance between the gauge line and the guard line of a track structure, which provides a passageway for wheel flanges.

Flare

A tapered widening of the flangeway at the end of the guard line of a track structure, as at the end of a guard rail or at the end of a frog or a crossing wing rail.

Flare Opening

The distance between the gauge line and the guard line of a track structure at the wider end of the flare.

Flat Yard

A yard where car switching is dependent on locomotive power with little assistance from gravity.

Foot Guard

A filler for the space between converging rails to prevent human feet from becoming accidentally wedged between the rails.

Fouling Point

The location behind turnouts that measures 50 feet beyond the clearance point.

Frog

A track structure used at the intersection of two running rails to provide support for wheels and passageways for their flanges, thus permitting wheels on either rail to cross the other.

Frog Angle

The angle formed by the intersecting gauge lines of a frog.

Frog Heel

The end of a frog furthest from the switch, or opposite the point end.

Frog Number

The ratio of the spread to the length of the frog.

Frog Plates

Any specially designed plate used between the toe and heel of a frog.

Frog Point

The part of a frog lying between the gauge lines extending from their intersection toward the heel end.

(a) Theoretical Point

The point of intersection of the gauge lines of a frog.

(b) Half-Inch Point

A point located at a distance from the theoretical point towards the heel equal in inches to one-half the frog number, and at which the spread between the gauge lines is one-half inch. It is the origin from which measurements are made.

(c) Actual Point

The physical location of the point of frog. This is called the 5/8” point.

Frog, Throat

The point at which the converging wings of a frog are closest together.

Frog, Toe

The end of a frog nearest the switch.

Fusee

A warning device consisting of a cardboard tube filled with a combustible mixture of chemicals that burns brightly when ignited and remains burning for varying lengths of time. Fusees are ignited and dropped on the right-of-way to indicate to a following train the presence of stopped or slow-moving equipment ahead.

Gauge (Track)

See Standard Gauge.

Gauge Line

A line 5/8 in. below the top of the center line of head of running rail along the side nearer the center of the track.

Gauge Plate

A metal plate, extending from rail to rail, used to maintain gauge of track.

Gauge Rod

A device for holding track to correct gauge, generally consisting of 1-1/4-in. rod with a forged jaw on one end and a malleable jaw on the other end, adjustable through a lock nut.

Gauntlet Track

A section of railroad track (as over a bridge or in a narrow pass) where two lines of track overlap so that one rail of each track is within the rails of the other. In such cases no switch is needed. The crossing of the two inner rails is made by ordinary frogs.

Geotextile

A material designed to permit the passage of water through it, but not particles of soil or dirt carried by the water. Used under ballast to function as a subballast. Also used to wrap corrugated or loose jointed pipe and to line drainage trenches or French drains. Also called “filter fabric” or “engineering fabric.”

Grade (Degree Of)

As used in connection with railway line, the rise or fall in a track expressed as a ratio to 100 feet of horizontal track.

Grade Crossing

An intersection of a highway with a railroad at the same level.

Guard Check Gauge

The distance between guard line and gauge line, measured across the track at right angles to the gauge lines.

Guard Face Gauge

The distance between guard lines, measured across the track at right angles to the gauge lines.

Guard Line

A line along the side of the flangeway that is nearer the center of the track and at the same elevation as the gauge line.

Guard Rail

A rail or other structure laid parallel with the running rails of a track to prevent wheels from being derailed; or to hold wheels in correct alignment to prevent their flanges from striking the points of turnout or crossing frogs or the points of switches. A rail or other structure laid parallel with the running rails of a track to keep derailed wheels adjacent to running rails.

Guard Rail (Frog)

A rail or other device to guide the wheel flange so that it is kept clear of the point of the frog.

Guard Rail (Switch)

A rail or other track structure laid parallel with the running rail ahead of a split switch and forming a flangeway with the running rail, to hold the wheels of rolling stock in correct alignment when approaching the switch.

Guard Rail Brace

A metal shape designed to fit the contour of the side of the guard rail and extend over the tie, with provision for fastening thereto, to restrain the moving or tilting of the guard rail away from the running rail.

Guard Rail Brace, Adjustable

A guard rail brace, which may be adjustable laterally with respect to the rail, to vary the distance between the guard rail and the running rail.

Guard Rail Clamp

A device consisting of a yoke and fastenings designed to engauge the running rail and the guard rail and hold them in correct relation to each other.

Guard Rail, One-Piece

A guard rail consisting of a single complete unit, either fabricated or cast, designed so that no auxiliary parts or fastenings other than spikes are required for its installation.

Head Rod

A rod connecting the points of a switch or movable point frog, by means of which the relative location of the points is maintained and to which the operating rod is attached.

Head Separation

The point on a switch rail where the head of the rail attains its full width.

Head Block Ties

The ties to which a switch stand is attached.

Heel (of Frog)

The end of the frog farthest from the switch.

Heel Block

A steel block, through which bolt holes are drilled, that is placed between the heel of a switch point and its stock rail.

Heel Length

The distance between the heel end and the half-inch point of a frog, measured along the gauge line.

Heel Spread

The distance, at the heel, between the gauge line of a switch rail and the gauge line of its stock rail. (This has been standardized at 6-1/4 in. for AREMA style switches.)

House Track

A track diverging from the main track or siding used to set out cars or store equipment.

Hump

The hill over which cars are pushed for classification in a hump yard.

Industrial Track

A switching track serving industries, such as mines, mills, smelters, and factories.

Insulated Rail Joint

A joint in which electrical insulation is provided between adjoining rails.

Insulated Switch

A switch in which the fixtures, principally the gauge plates and the switch rods, connecting or reaching from one rail to the opposite rail, are provided with insulation so that the electric track circuit will not be shunted.

Insulation

A device or material that prevents the flow of electric current in a track circuit from passing from one rail to the other or through switches and other track structures.

Joint Bar

A steel bar commonly used in pairs for joining rail ends in railroad track.

Joint Gap

The distance between the ends of rails joined by joint bars.

Joint Rail Drilling

The spacing of holes in the ends of rails or other track structures to receive the bolts for fastening joint bars.

Joint, Permanent

A rail joint that will remain in track.

Joint, Rail

The area of fastenings and rail where rail ends meet.

Joint, Supported

A rail joint that sits directly on top of a tie.

Joint, Suspended

A rail joint that sits between two consecutive ties.

Knuckle Rail

A bent rail, or equivalent structure, forming the obtuse point against which the movable center points, of a movable point crossing or slip switch, rest when set for traffic.

Lag Curve

Any curve with 3 consecutive lag plates on either rail.

Lead (Actual)

The length between the actual point of the switch and the half-inch point of the frog measured on the line of the main track.

Lead (Theoretical)

The distance from the theoretical point of switch to the theoretical point of the frog, measured on the line of the main track.

Lead Track

An extended track connecting to a series of yard tracks.

Line

The condition of the track with regard to uniformity in direction over short distances on tangents, or uniformity of curvature over short distances on curves.

Lock Nut

A special type of nut with a feature that prevents the nut from turning off the bolt once it is secured. Lock nuts are not reusable since removing them generally destroys the locking feature.

Lock Rod

A rod, attached to the front rod or lug of a switch, movable point frog, or derail, through which a locking plunger may extend when the switch points or derail are in the normal or reverse position.

Lock Washer

A washer designed to prevent undesired loosening of a nut after it has been tightened.

Main Track (Line)

A track extending through yards and between stations that must not be occupied without authority or protection. (General Code)

Manganese Steel

Steel containing a high percent of manganese; an alloy of steel to increase hardness and wear resistance.

Manganese Steel Insert Crossing

A crossing in which a manganese steel casting is inserted at each of the four intersections, being fitted into rolled rails and forming the points and wings of the crossing frogs.

Manganese Tipped Switch

A split switch in which the head of one or both of the switch rails is cut away in the point portion and manganese steel insert is fastened to the rail to form the point.

Monday Maul

Sledge hammer.

Movable Center Point

One of the movable tapered rails of a movable point crossing or slip switch.

Movable Point Frog

A frog equipped with points that are movable in the same manner as the points on a switch.

Movable Point Crossing

A crossing of small angle in which each of the two center frogs consists essentially of a knuckle rail and two opposed movable center points with the necessary fixtures.

Passing Track

A track to the main track for meeting or passing trains. Today this is called a siding.

Planing, Bottom

The cut planed at an angle on the bottom of the base of the switch rail from the point and towards the heel to allow the switch rail to rest on the top of the base of the stock rail when the switch rail is closed.

Planing, Chamfer Cut

The vertical beveling of the gauge side of the switch point to produce a sharp edge that prevents wheel flanges from striking the point.

Planing, Side

The cuts made on the sides of the head of the switch rail to form the taper.

Planing, Top

The cut made on the top of the head of the switch rail from the point and to approximately the head separation.

Point of Switch (Actual)

The end of the switch rail farther from the frog; the point where the spread between the gauge lines of the stock rail and the switch rail is sufficient for a switch point.

Point of Switch (Theoretical) of Vertex

The point where the gauge line of the switch rail, if extended, would intersect the gauge line of the stock rail.

Point Rail, Switch Rail, or Switch Point

The tapered rail of a split switch.

Pull-Apart

A condition that exists at a rail joint when all the bolts in one rail end are missing and the two rail ends have gapped.

Rail

In track, a rolled steel shape, commonly a T-section, designed to be laid end to end in two parallel lines on cross ties or other suitable supports to form a track for railway rolling stock.

Rail Anchor

A device attached to the base of a rail bearing against a cross tie to prevent the rail from moving longitudinally under traffic.

Rail Bond

A short metal cable attached to adjacent rails at the joints to ensure proper electrical continuity across the joint.

Rail Brace

A bracing device used at switches, movable point frogs, etc., in combination with switch, tie, or gauge plates for holding the rail from lateral roll.

Rail Brace (Switch)

A metal shape designed to fit the contour of the side of the stock rail and extend over the switch plate, with provision for fastening through the plate to the tie, to restrain the lateral roll of the stock rail.

Rail Brace, Adjustable (Switch)

A rail brace that may be adjusted laterally with respect to the stock rail, to compensate for variations in the dimensions of the rail and to permit adjusting for wear.

Rail Creep

Longitudinal sliding of rails in track under traffic or because of temperature changes.

Rail Joint

A fastening designed to unite the abutting ends of contiguous rails.

Rail Lubricator (Flange)

A device designed to apply grease to the gauge side of the rail head at the beginning of a curve, to minimize wear of the rail and wheel flange or to eliminate noise.

Rail Lubricator (Top of Rail)

A device designed to apply lubrication to the top of the rail head to minimize wear of the rail and reduce lateral forces, or to eliminate noise.

Railbound Manganese Steel Frog

A frog consisting essentially of a manganese steel body casting fitted into and between rolled rails and held together with bolts.

Reinforcing Rail

A bent rail placed with its head along the outside or close up to the head of a knuckle rail to strengthen it and to act as an easer rail; or a piece of rail similarly applied to a movable center point.

Relay Rails

Rails taken up from tracks where formerly used, suitable for relaying in other tracks.

Retarder

A braking device, usually power operated, built into a railway track to reduce the speed of cars by means of brake-shoes which, when set in braking position, press against the sides of the lower portions of the wheels.

Reverse Elevation

In curved track, when the outer rail is lower than the inner rail.

Right of Way

The strip of land on which a railroad track is built.

Rip Track

A car repair facility with one or more tracks.

Roadbed

The foundation upon which the ballast, ties and rails of a railroad are laid.

Running Rail

a.) The rail or surface on which the tread of the wheel bears.

b.) Longitudinal movement of rail caused by an insufficient fastening system.

Running Track

A track reserved for movement through a yard.

Scale Track

A track leading to and from, and passing over a track scale.

Screw Spike

A cylindrical threaded spike, designed to be turned with a special wrench into holes bored in ties, to secure rails or to act as a tie plate holder.

Section Limits

A division of railroad into specific territories for maintenance purposes. Sections are usually inspected and maintained by an assigned group of men.

Self-Guarded Frog (Flange Frog)

A frog provided with guides or flanges, above its running surface, which contact the tread rims of wheels for the purpose of safely guiding their flanges through the frog.

Shaved Anchor

A rail anchor with a lip that remains lower than the top of the base of the rail when it is locked in so that the switch point will not contact it when thrown.

Side Track

An auxiliary track to the main track.

Siding

A track connected to the main track and used for meeting or passing trains. Locations of sidings are shown in the timetable. (General Code)

Slide Fence

A fence interconnected to the signal system placed at the bottom of a cut to warn trains of rock slides by the use of signal indication.

Slip Switch, Double

A combination of a rail crossing and two turnouts interconnected into one assembly.

Slip Switch, Single

A combination of a rail crossing and one turnout interconnected into one assembly.

Snow Fence

A barrier placed along the right of way to prevent blowing snow from drifting onto the track.

Solid Manganese Steel Frog

A frog consisting entirely of a single manganese steel casting.

Special Trackwork

Any trackwork consisting of more than two rails and ties. Examples are turnouts, switches and crossing frogs.

Specification

A set of instructions that provide the requirements of a material to be manufactured or constructed.

Spike

A long steel square nail with a cutting edge used to fasten track components in place.

Spiked Switch

A switch whose points are held in fixed position by a spike to prevent the switch from being thrown or to prevent trains from using track that has been taken out of service.

Spiral

The gradual and uniform increase and decrease of curvature between the tangent and the full curve.

Split Switch

A track structure consisting of two movable point rails and necessary fixtures used to divert rolling stock from one track to another.

Split Switch with Graduated Risers

A split switch in which the switch points are gradually elevated by means of graduated riser plates until they reach the required height above the stock rail.

Split Switch with Uniform Risers

A split switch in which the switch points have a uniform elevation on riser plates for the entire length of the switch, the point rail rise being run off back of the switch points in the closure rails.

Spring Rail Frog

A frog with a movable wing rail that is held against the point rail by springs, thus making an unbroken running surface for wheels using one track, whereas the flanges of wheels on the other track force the movable wing rail away from the point rail to provide a passageway.

Spring Rail Frog, Right-Hand and Left-Hand

Standing at the toe end of a spring rail frog and looking toward its point, a right-hand frog has the movable wing rail located on the right-hand side, and a left-hand frog has the movable wing rail located on the left-hand side.

Spring Switch

A switch with a spring mechanism that returns the switch points to the original position after they are trailed through.

Spring Washer

A component designed to apply compressive force to prevent reverse movement of a nut.

Spur

A single-ended track diverging from a main or other track.

Standard Gauge

The standard distance between rails of North American railroads: 4 ft. 8-1/2 in. measured between the inside faces of the rail heads 5/8 in. below the top of the rail.

Stock Rail

The rail against which the point of a switch or derail fits.

Stock Rail Bend

The bend placed in the stock rail at or near the switch point to match the switch rail angle.

Storage Track

A track on which cars are placed when awaiting disposition or when not in service.

Straight Closure Rail

The rail between the switch point and frog on the straight side of a turnout.

String Lining

a.) A method to determine the alignment of a curve by measuring offset from a string line to the gauge side of the high rail.

b.) When a train pulls it's consist off the low side of a curve.

Stripped Joint

See Pull-Apart.

Subballast

Any material spread on the finished subgrade of the roadbed below the ballast to provide better drainage, prevent upheaval by frost, and better distribute the load over the roadbed.

Subgrade

The finished surface of the roadbed below the ballast and track.

Sun Kink

See *Thermal Misalignment*.

Switch

A track structure with movable rails to divert rolling stock from one track to another.

Switch Angle

The angle included between the gauge lines of the switch rail at its point and the stock rail.

Switch Circuit Controller

A device connected at the point to switch, derail, or moveable point frog which will electrically indicate an open switch condition when the switch point is open 1/4" or more.

Switch Heater

A device that will heat the area around a switch to melt snow and ice.

Switch Heel

The designated location on the switch point where the heel block is located.

Switch Machine

A machine used to throw track switches. Switch machines can be powered operated or used manually.

Switch Plate

Any specially designed tie plate for use in the switch area of a turnout.

Switch Point

A machined rail with a sharp end mated against a stock rail used to divert rolling stock from one track to another.

Switch Point Derail

A device consisting of at least one switch point for the intended purpose of derailing rolling stock.

Switch Point Protector

A device that diverts a rolling wheel away from the switch point.

Switch Rail Brace

A brace placed against a running rail to dissipate lateral force thus preventing rail turnover.

Switch Rod

A rod connecting the two points of a switch which maintains the proper distance between the points.

Switch Stand

A device for the manual operation of a switch.

Switch Tie

Ties made of various lengths used in a switch, turnout or special trackwork.

Tangent

A section of track that connects two curves.

Thermal Misalignment

An irregularity in track alignment caused by excessive compressive forces in the rail.

Thermite Weld

A weld, made by pouring molten materials into the gap between rail ends, that fuses the rail ends together.

Throat of Frog

The location ahead of the point at which the wing rails of a frog are closest together.

Throw of Switch

The distance between the back of the open switch point and gauge line of the stock rail measured along the center line of the No. 1 switch rod. (This distance is standardized at 4-3/4 in.)

Tie Pad

A dampening device located between the rail and the tie.

Tie Plate

A steel plate between a rail and a tie.

Tie Plug

A wood or composite material used to fill holes in ties from which spikes have been removed.

Toe (of Frog)

End of a frog nearest the switch.

Toe Length

The distance between the toe end of the frog and the half-inch point of the frog, measured along the gauge line.

Track

An assembly of rails, ties, ballast and fastenings over which cars, locomotives, and trains are moved.

Track Bolt

A bolt with a button head and oval, or elliptical neck, and a threaded nut designed to fasten rails and joint bars.

Track Crossing (slang; Diamond)

A track component consisting of four connected frogs that permits one track to cross another at grade.

Track Shims

Flat wood boards of length and width similar to tie plates. They are placed between the ties and the tie plates when the ballast is frozen to correct surface irregularities.

Transition Rail (Trackwork)

A manufactured rail using the same rail section that is machined to compensate for various amounts of rail head loss.

Tread

a.) The top surface of the rail that contacts the wheel.

b.) The portion of the wheel that contacts the top of the rail.

Turnback Curve

The curve(s) directly behind the diverging side of a turnout.

Turnout

A section of trackwork that allows rolling stock to be diverted from one track to another.

Turnout, Panel

A pre-assembled turnout complete or in sections.

Turnout Plates

Any specially designed tie plate used between the heel of the switch point and toe of the frog.

Turnout Number (Size)

The number corresponding to the size of the frog used in the turnout.

Washout

An erosion of the permanent roadbed by storm or flood.

Wheel Flange

The portion of the wheel that protrudes down from the wheel tread to guide rolling stock along the track.

Wide Gauge

Any gauge wider than standard gauge caused by track deterioration or improper installation.

Wye

A track arrangement shaped like the letter Y but with a connecting segment between the two upper legs to enable the turning of equipment.

Yard

A system of tracks, other than main tracks and sidings, used for making up trains, storing cars, and other purposes.