ENGINEERING SPECIFICATIONS FOR INDUSTRIAL TRACKS

OFFICE OF CHIEF ENGINEER STRUCTURES, DESIGN, AND CONSTRUCTION

Revised November 15, 2015

Summary of Revisions to this Edition

This document supersedes all previous versions of CN's Engineering Specifications for Industrial Track Standards. Please discontinue using any previous versions of CN's Engineering Specifications for Industrial Tracks.

Table of Contents

1. Applicability

This document is for design purposes and is not to be taken as authority to construct industry trackage without an industry track agreement and review and written acceptance from CN's Regional Design and Construction Office for the proposed track design.

This document is prepared for industries, design firms, contractors, and local authorities ("INDUSTRY" or "CUSTOMER") who intend to construct a rail line to an existing facility or a new site including rail access to industrial lands and rail-truck transload facilities.

These specifications represent the minimum standards for design and construction of new industrial tracks. CN's Regional Design and Construction Office may require additional standards be met based upon individual project requirements.

Tracks meeting one or more of the conditions listed below have additional design and construction criteria over and above those presented in this document. Contact CN for the additional standards that must be met for:

- Tracks that will exceed 1/2 mile in length, or
- Tracks planned for speeds in excess of 10 mph, or
- Tracks that will handle cars greater than 70 feet in length, or
- Tracks that will handle hazardous materials or unit trains.

Any variance from the standards provided in these specifications, by the Customer must be submitted in writing to CN's Senior Manager, Design and Construction. The submittal must state the variance from standard being requested and reference the page of the submitted plans where the variance can be found. All variances are subject to review and written acceptance from the office of CN's Regional Chief Engineer. Depending upon the variance being requested, CN may have additional requirements and restrictions that must be met.

The most current version of this document is available at www.cn.ca

2. Industry Track Project Overview

The development of a project requiring rail service provided by CN is divided into five steps:

1. Initial customer/industry contact with CN Business Development/Real Estate
2. Development of detailed design
3. Submission of detailed design plans and specifications to CN
4. Permitting and construction
5. Project inspection and as-built drawings

Step 1 - Initial Contact with CN Business Development/Real Estate

The first step is to contact CN's Business Development/Real Estate group to discuss your needs for rail service. This group provides assistance with site selection, preliminary track schematics, rail serviceability options, and shipping rates. The Business Development/Real Estate Group will also consult with CN's Design and Construction, Engineering and Transportation departments to optimize the track plan and to help develop a customer service plan.

It is recommended the industry employ a consulting firm or contractor to prepare a conceptual design and operating plan based upon the information contained herein and provided by CN. The Industry's conceptual plan and operating plan must be submitted to, and accepted by CN before proceeding with the detailed design stage.

Step 2 - Development of Detailed Design

Once the conceptual design has been reviewed and accepted by CN, the Industry can proceed with detailed design for the project.

If required during the detailed design step, any work on CN property, including but not limited to, surveys, soils investigations, site walks, etc. will require authorization, via a signed Right of Entry Agreement from CN's Design and Construction Office.

Additionally, all work performed on CN property or within 30 feet of any CN track in operation (unless deemed not required by CN) must have a cable and utility locate completed, and be protected by a CN flagman.

All costs associated with Right of Entry fees, cable/utility locates, and CN flagmen are the Industry's responsibility (see Section 7.0, Safety and Right of Entry).

Step 3 - Submission of Detailed Design Plans and Specifications to CN

The detailed design submission will be reviewed by CN for acceptance. The design must include a drainage plan, track plan/profile, and typical sections (grading and track). The Industry will be responsible for CN's costs to review the plans and specifications.

The proposed grading and track design plans will be evaluated against CN's standards, as outlined in this document. The design will also undergo a final review with CN Transportation to verify serviceability. Reviews at this stage ensure the design and operating plan meets requirements specific to CN. Prior to submission to CN, the plans and specifications must be approved, signed and stamped by a Professional Engineer licensed in the applicable State or Province of the project. CN will advise the Industry in writing of acceptance of the design or of any revisions that may be required once the review is complete.

Drawing submissions to CN may be in hard copy format or electronic format (in AutoCAD and PDF). All drawings to be supplied in CN's drawing template as provided in Appendix A. The CN drawing template can be provided electronically to the Industry upon request.

If the submission contains any variances to CN standards, they must be summarized in a cover letter with the plans identifying each variance requested and supporting information why the CN standard cannot be met.

Drawings to be in imperial units of measure and to scale (minimum scale of 1"=200' OR 1:2000). Drawings must be a minimum of 11" x 17" in size. The submitted drawing to comply with the standard format listed below and presented in Appendix A (A26 through A30) of this document:

- Title Page for Construction Drawings
- Typical Plan View for Construction Drawings
- Typical Profile View for Construction Drawings
- Typical Cross Sections for Construction Drawings

The information contained in the drawings must include the following:

- Mileage and subdivision of the mainline connection
- Legal land description of the proposed development
- Width of the CN Right-of-Way
- Plan, profile and typical cross-sections
- Proposed top of rail grades
- Rail size
- Turnout type and locations
- Stationing in 100 foot increments
- Actual mainline stationing of point of switch (PS) locations
- If not connected to the mainline, identify spur name and nearest mainline subdivision and mileage
- Stationing for PS, clearance point, right-of-way line, and derail to be shown, with PS = 1 + 00
- Derail type
- Curve data including stationing for PC/PT points, spirals (if any), and degree of curve (chord definition). Horizontal curve data is to be summarized in a tabular format on the drawing.

- Vertical curve data, including length of vertical curve
- Track center dimensions
- Ditch line elevations, direction of flow, culvert dimensions and type
- Wetlands delineation (including impacts)
- Easements
- Location of utilities
- Location and details of fencing and gates
- Proposed car spots, maximum car lengths and proposed maximum gross weight
- Track lengths and car capacity summarized in a tabular format
- Clearance envelopes superimposed on cross-section

A proposed schedule for completing the work to also be included with any submission for a proposed development.

The Industry must certify that track related materials and equipment to be installed meet CN specifications.

A detailed list of all track material, including ballast specifications, must be submitted for CN Design & Construction review and acceptance.

Step 4 – Permitting and Construction

Once the detailed design has been accepted by CN Design & Construction; the Industry has executed an industrial track agreement with CN; utility locates are completed; and all applicable permits are in place (permitting is the responsibility of the Industry), construction activities can commence.

CN forces may perform all work on CN property connecting to the mainline or along a CN owned siding track/spur track adjacent to the CN main. CN will prepare an estimate of cost for the work that will be chargeable to the Industry. This work includes, but is not limited to, installation of mainline turnouts, track construction, surfacing, derail installation, rail welding, signals modifications/upgrades, etc. The Industry will be responsible for performing all other work including earthwork, drainage, fencing, modification of utilities, etc. It is the Industry's (and the contractor hired by the Industry) responsibility, to ensure construction is in accordance with the project design specifications. All work performed by the Industry within the CN Right-of-Way (earthwork, drainage, culvert installation, etc) will require authorization via a signed Right of Entry Agreement (see Section 7, Safety and Right of Entry).

Step 5 - Completion

Once construction is complete and the rail facility is ready to be placed into service, CN will conduct a final inspection prior to placing the track in service. This inspection by CN will occur once the design consultant has certified the track has been constructed in accordance with the accepted design plans and specifications, and is safe for rail traffic. The CN final inspection is typically done by the local Track Supervisor and will be arranged through CN's Design and

Construction Office. CN will also require an electronic copy (in AutoCad with appropriate coordinates indicated) of the As-Constructed/Agreement and drawing(s) for industry track agreement purposes and will retain a copy of the industry track agreement(s) for CN's records.

3. Grading Design and Construction Earthwork

The Industry is to retain the services of a Professional Engineer to prepare construction plans and specifications. The plans and specifications must provide adequate details to facilitate project completion and must include the following information:

- Drainage plan
- Storm water pollution prevention plan (including erosion control measures)
- Construction limits
- Grading requirements
- Soil conditions (soil boring information)
- Import material/fill requirements
- Sub-ballast material specifications
- Quality control and material testing requirements

3.1 Drainage Design Plan

- The subgrade to be designed and constructed to ensure there is adequate drainage away from the track structure.

- The subgrade/sub-ballast/ballast structure must be designed to ensure adequate structural capacity based upon the anticipated rail car loading (e.g. 286,000 lb cars).

- The drainage system must be capable of handling the maximum expected flow of water and may not compromise the existing drainage system of the Railway. Post-development flow rates of surface water on to CN property must not be increased. Design to be based upon 100-year rainfall event.

- Compaction specifications require compacting the full width of the subgrade and subballast to density not less than 95% maximum dry density in accordance with Standard Proctor Density Compaction Test (ASTM D698).

- Roadbed to conform to Appendix A, A1, Typical Cross Section Detail including:

    a. The top of the subgrade to be shaped with a minimum 40:1 slope for drainage, typically each way from the centerline of the track.

    b. Embankments must have side slopes not steeper than 2H: 1V.

    c. Minimum depth of sub-ballast structure must be 12" and must extend at least 4 feet beyond the edge of ballast, unless otherwise approved by CN Design &

Construction. Maintained top width to be a minimum of 24 feet.

d. Minimum depth of ballast structure must be 9” under industrial track and must provide a minimum 6” shoulder for jointed rail or 12" shoulder for continuous welded rail. Minimum ballast depth of mainline track class 2 or higher is 12”. Particular attention must be paid to turnout locations to ensure all minimum requirements are met.

e. At turnouts, with the exception of the mainline turnout, the width of sub-ballast on the diverging side of turnouts to be increased to create a walkway for train service employees. The sub-ballast width to taper from the minimum of 12’-0” up to 20’ from the centerline of the tangent side of the turnout at the end of the stock rail ahead of the point of switch, until it reaches a point that is 12’-0” from the centerline of the diverging track. The 12’-0” minimum width is to be maintained away from the point of switch until either 4’ past the location of a derail or 50’ past the clearance point if no derail is installed, and then is to be tapered (if needed) to a minimum width of 12’-0” from centerline of the track. The Industry and their consultant must review local requirements for walkways to determine if more stringent local requirements must be met. Walkways are only to be constructed within the limits of industrial tracks and are not to be built along main track switches.

f. Adequate site drainage is to be maintained throughout construction.

g. Drainage must be given particular attention at the following locations: Switches, frogs, diamond crossings, grade crossings, and other places with limited vertical and side clearance. No culvert to be situated within 45 feet from any switch or diamond. Buildings, parking lots and roadways will not drain onto the track.

h. Culverts to be corrugated steel pipes, structural plate corrugated steel pipes, or seamless steel pipes to the latest CN R7A-80.2 (see Appendix A, A13) and ASTM specifications. Culverts must be sufficient to support applicable Railway loading.

3.2 Construction Earthwork

- The Industry and its Contractor will be responsible for construction of an adequate subgrade that conforms to the submitted drawings. Prior to commencement of earthwork activities all required permits must be in place including but not limited to stormwater construction permits, wetland permits, and other applicable, regulatory permits. Any and all permits required for grading on CN right-of-way will be acquired and funded by the Industry. CN Design & Construction to be provided copies of all permit applications and final permits.
- The Industry and its Contractor are responsible for the identification and protection of overhead and underground utilities at the site, including the portion of CN right-of-way affected by the construction. Utility locate services will not be able to identify CN utilities, CN must be contacted to perform locates as well.
- The Industry’s contractor is responsible for the proper installation of required erosion control measures prior to starting eathwork activities.

- The Industry's contractor to clear all vegetation and brush (except for trees and shrubs which are to be preserved, as indicated on the drawings), rocks, expansive soils, and other similar objectionable materials from the project site, including the portion of CN right-of-way affected by the construction. The contractor is responsible for the safe and appropriate disposal of materials removed. No disposal or burning of clearing and grubbing materials on CN property is permitted.

3.2.1 Embankment Construction

Embankments to be constructed and compacted to the lines and grades set forth in the submitted drawings. If the quantity of materials required for construction of embankments is in excess of the quantity of material removed from excavations, additional material may be obtained by widening cuts in the grading area pending review and acceptance by CN Design & Construction. Cuts to be widened in such a manner as to:

- Provide slope stability.
- Provide adequate drainage for the cut slope and roadbed.
- Provide adequate protection against erosion.
- Comply with permit requirements and construction limits.
- Prevent future right of way drainage or snow drifting problems in the future.

3.2.2 Moisture and Density Control

Unless otherwise shown on the drawings, embankments and those portions of cut sections designated to be constructed with moisture and density control. The moisture content of the soil at the time of compaction to be at the optimum moisture content plus or minus four (4) percentage points of the optimum moisture content as determined by ASTM specification D 698.

3.2.3 Post Construction Erosion Control

A seed and fertilizer mixture, in compliance with local, state, provincial, and federal specifications to be applied so as to provide adequate erosion control and slope protection. Creeping grasses must not be used. Additional erosion control methods, such as the use of Jute fabric, geo-textiles, silt fence, or as per applicable permit to be applied to ensure the long-term integrity of slopes and embankments, as required.

3.3. Sub-Ballast Placement

- Sub-ballast material may be placed once the finished subgrade is inspected and accepted by the contractor's quality assurance inspector.

- Sub-ballast to be placed, using methods that do not lead to segregation or degradation of material.

- Place material to full width of section in uniform layers not exceeding 12" thickness and compact to specified density.

- Compact full width to density not less than 95% maximum dry density in accordance with Standard Proctor Density Compaction Test (ASTM D698).

- Representative samples of the sub-ballast material must be taken for laboratory tests to approve its quality and nature prior to and during its use.

- Finished sub-ballast surface must be within ½" of design elevations but not uniformly high or low.

4. Track Design and Construction Standards

When designing track to serve an industrial facility or lead track, the following elements must be considered and identified:

- Direction of inbound and outbound traffic;
- Car lengths and car floor heights (if applicable);
- Loading method and capacity;
- Frequency of service; and
- Commodity transported.

Track design and construction must comply with CN's engineering track standards and other applicable regulatory requirements.

4.1 Track Design General

- Industrial spurs or lead tracks longer than a ½ mile in length must provide for a run-around track. If a spur track or lead track is less than a ½ mile but does not have all switches facing the same direction, a run-around track may also be required. Storage tracks may be required to be provided by the industry within their facility.

- The maximum gradient on industrial spur tracks must not be greater than 2% and is to be limited to 1% on lead tracks. For loop tracks, the maximum grade will be 0.5%. Grades on tracks at locations used for spotting rail cars is to be 0%, but in no case exceed 0.2%. Curve compensation is calculated by adding 0.04% per degree of curvature to the proposed grade.
- All tracks to be designed for standard gauge of 56-1/2".
- Industrial track to be constructed with the following maximum tie spacing (see Appendix A, A7, Design Criteria and Material Table for further details):
    - Wood Ties - 20" tie spacing on leads and 22" in body tracks

- Concrete Ties – 24”
- Steel Ties – 24”

- Minimum track centers to be as follows:
  - Unless physically restricted, 25' track centers are to be used to provide safe working space for employees between main and industrial spurs or lead tracks. Any exception to this requires a safety mitigation plan to be approved by CN.
  - Between industrial or yard tracks: 14 ft.
  - Greater track centers may be required to accommodate loading of specific commodities. For example, a minimum of 25’ track centers is required at log/pole loading facilities.
  - Track centers for loading and unloading flammable products and tank storage must comply with Federal, State/Provincial, and local agency requirements including but not limited to Flammable Liquids Storage GO 0-32 and AAR Circular No. OT-55 (Appendix A, A6).

- The horizontal clearance envelope as well as the minimum distance between track centers to be increased to account for curvature as follows:
  - 1” per degree of curvature of track for horizontal clearance
  - 2” per degree of curvature of track for distance between parallel tracks

- Clearance envelopes will comply with the CN clearance requirements (See Appendix A, A3 through A5) and must be identified on the plans submitted to CN.

- Restricted Clearance Proposals
  - The appropriate governing regulatory agency to be informed of any permanent restricted clearances. Any proposal for permanent restricted clearances to be reviewed by CN Design & Construction in order to:
    a. Ensure that there is business justification for the proposed restriction and that it cannot be economically or conveniently eliminated.
    b. Ensure that the proposal is reviewed in the engineering context of structure adequacy and safety.
    c. Ensure that CN Transportation is satisfied that locomotives, railcars, and employees can safely operate past the proposed restriction.
  - Requests for review and acceptance of restricted clearances must be submitted to CN Design & Construction along with an application fee and must include the following information:
    a. Location of the facility and restricted clearance, including mile post and subdivision;

b. Location of standard restricted clearance signs;

c. Reason(s) for restricted clearance;

d. Method of operations over the track concerned (locomotive, car progressioner or gravity);

e. Need for locomotives to pass the point of restricted clearance;

f. Operations to be conducted over the track concerned;

g. Confirmation that the restricted clearance is unavoidable;

h. Nature of the restricted clearance (permanent or temporary);

i. An electronic PDF copy of the drawing showing the relative position of the track and the obstruction, with cross sections at each point of restricted clearance that drawing will indicate the following:

- Vertical clearance from the top of rail;
- Horizontal clearance from the centerline of track;
- Location of the "Restricted Clearance" sign. See applicable CN sign standard based project location.

- For new construction the minimum railway clearance (see Appendix A, A3, A4, A5) requirements are as follows:

  - Vertical:
    - 23'-0" to nearest obstruction (Does not apply to doors into warehouses) clear headway above the top of the highest rail) except:
    - 27'-0" to overhead wire lines (clear headway above the top of the highest rail) or greater depending upon the voltage (see Appendix A, A31, Wire Crossing and Encroachment Specifications).
  - Horizontal:
    - 8' 6" from the centerline of track to the nearest obstruction, unless otherwise provided in these specifications. In curves, the minimum distance between track centers to be increased to account for curvature as follows:
      i. 1" per degree of curvature of track for horizontal clearance
      ii. 2" per degree of curvature of track for distance between parallel tracks

Government regulations may require more stringent requirements be met in addition to CN's requirements. The Industry is responsible for determining what additional requirements must be met.

4.2 Curve Design

- Maximum curvature on industrial tracks to be 9° (or equivalent curve compensation per AREMA 3.7) unless a variance is submitted and accepted by the CN Senior Manager Design & Construction. See the Design and Material Table of Appendix A, A7, for specific details. Variance beyond this maximum curvature will require additional engineering measures.
- The chord definition of curvature is to be used. Degree of curve is defined as the angle at the center of a circular arc subtended by a 100' chord. Degree of curve is related to radius as follows:

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

  Where Dc = Degree of Curve and R = Radius
- Tracks to be designed to avoid coupling cars in curves.
- If coupling in a curve cannot be avoided, the maximum curvature to meet requirements of the Design and Material Table and not exceed 9° apply (this applies to coupling in curves for cars under 70 feet in length, additional guidelines apply to other scenarios). This will help prevent bypassing couplers.
- The minimum tangent distance between reverse curves to be no less than 70 feet.
- The rate of change for vertical curves is not to be more than 1.2% per station in sags and 1.5% per station in summits for industrial tracks. The rate of change for vertical curves is not to be more than 0.60% per station in sags and 1.0% per station in summits for lead tracks. Between vertical curves, 100 feet of tangent is to be maintained. See Appendix A, A8, "Vertical Curves for Industrial Tracks".
- No portion of a turnout is to be located in horizontal or vertical curves, spirals or within track with superelevation.
- The point of switch is not to be located within 100 feet of a horizontal curve.
- The point of switch of any turnout or switch point derail is not to be located within twenty-five (25) feet of a vertical curve. See Appendix A, A7, Design and Material Table, for minimum distances to bridges, curves, and road crossings.

4.3 Turnout Design

- Mainline turnouts will be supplied by CN, at the Industry cost, per current CN Engineering Track Standard plans, and will be a minimum of a No. 12. Snow clearing devices are required where snow and ice present operational challenges. If a power turnout requires a snow clearing device, the power derail will also be equipped with a snow clearing device. A cost estimate will be provided for mainline turnouts and will include price and installation costs of snow clearing devices, any related power or signal costs, and all overheads. Note: A minimum lead time of four (4) months will be required for delivery of turnouts and snow clearing devices.

- All turnouts within industrial facilities must be per the Design and Material Table, Appendix A, A7. Turnout rail weight must be 115RE or greater, unless approved by CN Design & Construction. Second hand turnouts must be of acceptable quality with rail that is free of physical defects and has less than 20% of allowable head wear.
- No portion of the mainline turnout to be installed closer than 100 feet to any bridge or public road crossing without an approved variance.
- Industrial turnouts must be in accordance with current CN Engineering Track Standard Plans. CN Senior Manager Design and Construction may accept alternate turnout designs upon review.
- All turnouts must have new No.1 hardwood switch ties. Switch ties must be borate treated in high decay zones and warmer climates.
- All turnouts must be equipped with adjustable rail braces.
- Switch stands will be of ergonomic design (36 E or 36 EH) and can be new or second hand and must be complete with connecting rods, targets, a lock (or keeper), and reflective tips as required. Second hand switch stands must not be: damaged, previously run through, or previously involved in a derailment.
- Frogs in other than main track turnouts will be either self-guarded solid manganese (SGSM) or rail bound manganese (RBM).
- Turnout components should not be painted.

4.4 Derails Design

- Derails must be installed on all industrial track connections at main and controlled sidings.
- Hinge and sliding type derails may be used where the speed of the equipment to be derailed will not exceed 15 mph.
- A derail with a wheel crowder must be installed where any of the following conditions apply:
    - Derailing speed could exceed 9 mph; or
    - The derail is installed on the inside of a curve.
- Double Switch point derails as per Appendix A, A14, Double Switch Point Derail Drawing, must be used when;
    - Speed of the equipment to be derailed could exceed 15 mph.
    - Where a locomotive, car mover, or cable progressioner is used by a customer to move and spot cars within the facility.
- Where switch point derails are used, adequate rail anchorage must be provided to prevent

rail creep.

- Derail signs, per the applicable standard, will be supplied by CN at the Industry's cost.
- CN's Regional Chief Engineer or designee will approve the derail selection for each installation.
- The following table is to be used in conjunction with available track length and grade information to determine derail requirements:

Distance (Feet) in which a Free-Rolling Car will achieve the Following Speed

Gradient (%)	**8 mph**	**9 mph**	**12 mph**	**15 mph**
0.30	1000	1280	2350	3800
0.50	485	615	1125	1805
0.75	310	395	700	1090
1.00	225	285	555	785
1.50	155	190	330	510
2.00	115	140	245	380

- Derails must be installed so equipment will derail away from the track being protected and to be at least 20' beyond the 13' 6" clearance (fouling) point. Derails must be a sufficient distance behind any insulated joints to ensure that equipment derails before fouling the track circuit.
- Hinge and sliding derails will be painted yellow, and any track equipped with a derail must have the switch stand lever painted yellow.
- Proper signage to be erected at derail locations.
- Exact locations of derail installation will be coordinated with CN Design & Construction.

4.5 Cable Progressioners/Car Movers

- Must comply with clearance specifications.
- Must have adequate lighting to ensure permanently mounted snatch blocks are visible at all times and that cables will not impede normal working activity.
- Must be painted a conspicuous color.
- Lockout controls must be installed on car progressioner panel to prevent operation during switching or track maintenance.
- Alarm system (i.e. bell, buzzer, etc.) to be integrated with start control so that a five second warning is given to personnel in the vicinity that car progressioner will be operating.
- Standard warning sign to read "Caution: Car Puller Cables on Ground".

4.6 Under Track Pits

- Unloading pits to be designed and constructed in accordance with the provisions of the CN Unloading Pit Standard JL3-5 (See Appendix A, A15); AREMA Manual, Specifications, Chapter 15, Part 8, Section 8.4.
- Drawings must be stamped and approved by a Professional Engineer. Separate unloading pit plans must be submitted for review and acceptance by CN Design & Construction.
- Unsupported running rail:
  - No joints in running rails are permitted over the pit.
  - The top of the concrete pit walls to be true and level to provide full bearing for the running rails.
- Structural supporting beams:
  - Running rails to be attached to the supporting beams at 2' centers.
  - Welding of rails to beams is not permitted.
  - Beams to be provided with masonry plates.
  - Two anchor bolts for each masonry plate (bearing plate) to be provided.
- The cover for the unloading pit is to be installed flush with the top of the ties or constructed to provide minimum slopes of 4:1 from top of the ties to top of the opening and must not protrude above the rail. Both the cover and slope sections to be metal and removable for ready inspection of rail and supports.
- Capacity of the foundation to support the unloading pit to be a component of the overall design. The foundation report must be provided with the application and drawings.

4.7 Track Construction

Track must be constructed to meet current CN Engineering Track Standards and applicable regulatory/industry standards and guidelines. These standards include but are not limited to FRA, Transport Canada, AREMA, and CN critical tasks (CT's).

4.7.1 Timber Track Tie Installation

- Line the end of the track ties true on one side of the entire length of the track. All ties are to be installed at right angles to the rail with heart side down.
- Treated ties must not be handled with any tool having sharp points that will penetrate beyond the depth of the treatment, or cause damage to the ties.
- When ties are re-spiked, the spike holes must be plugged with approved chemical expanding foam plugging compound.

4.7.2 Rail Installation

- Rail must be handled carefully at all times. Rail must be unloaded by use of a crane, skids, tongs or threader and must not be dropped. Rail must not be struck with a steel hammer or similar tool.
- Lay second hand rail in the same position it occupied before removal from the previous track so that the gauge side remains the gauge side.
- Rail having cuts or holes made with an oxy-acetylene torch or an electric arc must not be used unless the cuts and/or holes have been removed with a saw cut. The saw cut must be made no less than four inches from the torch cut.
- Rail ends must be cut vertical and perpendicular to the length of the rail. All saw cuts to be made with an abrasive blade. Rail saws must be supported with guide arms to ensure straight cuts.
- Use rail drills only for drilling rail. Rail index bars must be utilized for accurately locating bolt holes.
- Where new rail adjoins second hand rail the maximum mismatch to not exceed 1/8". Where required, mismatch to be reduced through welding, grinding or replacement of the rail.
- All installations to be designed using the same sized rail section throughout.
- Use compromise rails, compromise welds or compromise joints to transition between rails of different sections.
- Avoid placing rail joints at road crossings.
- Joints to be staggered by at least 7 to 12 feet on opposite rails to avoid square joints. Joints must not be evenly staggered.
- Expansion gaps between rail ends when lying bolted rail or track panels, must be provided. Fiber, hardwood or metal shims may be used to obtain the proper expansion space by bringing rail ends squarely together against the expansion shims. Expansion shims must not be removed until the rail is properly spiked, the bolts tightened, and rail anchors applied. Expansion gaps must conform to the following:

Expansion Gap Inches	33 ft. Rail Temp. Degree F.	39 ft. Rail Temp. Degree F.
5/16	Below 10	Below 6
¼	10 to 14	6 to 25
3/16	15 to 34	26 to 45
1/8	35 to 59	46 to 65
1/16	60 to 85	65 to 85
0	Above 85	Above 85

- Place joint bars and tighten bolts before spiking the rail.

- Tighten bolts in the rail joints in the following sequence:
  - The two bolts at the center of the bar,
  - The second bolt from the end of each rail,
  - The third bolt from the end of each rail.

- Tighten bolts to the following torque:

Size of Bolt	Torque (ft-lb)
1"	490
⅞"	375

- If Continuous Welded Rail (CWR) is used, ensure that it is destressed before placing the track into service and that Preferred Rail Laying Temperature as provided in the table below is achieved:

Location*	PRLT
Eastern Region and Western Region (Canada)	90°F
US Region - North of Superior, WI	100°F.
US Region – South of Superior, WI	105°F.

**Check with local CN Design & Construction Office for the appropriate PRLT based on project location.*

- Anchor rails per Appendix A, A11, Anchor Pattern for Continuous Welded & Jointed Track. For CWR, anchoring must be completed once rail has been properly destressed.

- Gauge of track after laying rail must be uniform and within 1/8” of design.

4.7.3 Turnout Installation

- Minimum 14" tie plates are to be used in all turnout construction.
- Spiking in turnouts must fill all spike holes in the plate, up to a maximum of 6 spikes per plate.
- The turnout stock rail must be bent horizontally, as shown on the standard plan. Only standard carbon and 3HB rail, in 115 lb section or smaller, may be field bent with an approved bender. For safety reasons, under no circumstances are head hardened rails or rails greater than 115 lb to be bent in the field.

- Fully anchor the length of the turnout as per CN standards.
- Ensure the switch point fits snugly against the stock rail for the entire length of the planed portion.
- Bolt switches, frogs and guard rails fully. Provide proper washers and cotter pins for bolts as required. Lock tight nuts are recommended.
- Switch stands must be securely bolted or lagged to the head block ties.
- Switch stands must be equipped with a lock or keeper.
- All switches must be equipped with the appropriate reflectorized target. Target assemblies will be properly adjusted to display green when the switch is lined for the normal route and yellow (siding/industrial) or red (main line) when lined for the diverging route.
- Switch targets will bear 3" black numbers on the yellow target representing the track number.
- Install switch rod bolts and connecting rod bolts, except the bolt under the switch stand, with the nut on the upper side to permit ready inspection of the cotter pin.
- Install the connecting rod bolt under the switch stand with the head on the upper side. Install cotter pins on all connecting and switch rod bolts.
- Position the handle to be on the frog side of switch stand when the switch is lined in the normal position.
- Ergonomically designed switch stands are to be used on all turnouts.
- Lubricate switch stands, switch plates, connecting rod bolts and spring frogs properly after assembly.
- Ensure the distance between the gauge side of a frog and the bearing side of the guard rail is at most 4'.
- Tamp turnout ties firmly throughout the entire length.
- Upon completion of final track surfacing and regulating, the cribs of ties under the switch point will be cleared of ballast to mid-tie and all rods free to move as intended.
- Once installed, line new turnouts for through movement and clamp or spike the switch point. Switch points to remain clamped or spiked until inspected by a CN Track Supervisor or a designee.

4.7.4 Track Surfacing and Lining

Distribute Ballast

- Damage caused to CN tracks or equipment during ballast unloading, surfacing, and lining must be reported immediately to the CN project manager.
- The Contractor is cautioned that damage caused by their equipment to CN property during the distribution of ballast and surfacing will be repaired by the Industry's at their expense.

- Care must be taken to protect signal appliances during ballasting and track surfacing operations.

Lifting

- Single track raises will be limited to a maximum of 4 inches.
- Raise all tracks and turnouts with the ballast to provide a minimum depth of 9" from the bottom of the tie to top of sub-ballast or to a depth indicated on approved design.
- Tamping machines or other mechanical tamping equipment will be used to tamp ballast.
- Tamp both sides of ties from a point 16" inside each rail to the end of the ties.
- Tamp inside and outside of the rail simultaneously.
- Do not tamp at the center of the ties between the inside limits stated above.
- On turnouts, tamp ties for 16 inches either side of all rails.
- Manually tamp the areas under the frog, guard rails, and heel castings, using bars or mechanical hand tampers.

Lining

- Line all track and turnouts to conform to the approved drawings.
- Verify that final curve alignment fits designed curvature.

Dressing

- Dress the ballast to conform to the ballast sections as shown on attached standard drawing Appendix A, A1, Typical Cross Section Detail.

Surfacing

- Bring track to a uniform gradient with corresponding cross-level to suit the alignment.

Tolerances

- Alignment: The maximum out-of-alignment measured from mid-ordinate of a 62' chord may not be more than 1/8".
- Surface: The deviation from uniform profile on either rail at the mid-ordinate of a 62' chord may not be more than 3/16".
- Cross-level: The deviation in cross-level from design may not exceed 3/16".

4.7.5 Road Crossings

- All new crossings to conform to all applicable regulations.
- Crossing sightlines are to comply with all regulatory requirements.

- All crossings to be located clear of turnouts, switches, and other track appliances.
- Rail joints to be kept clear of crossings and where practicable must not be located closer than 25' from the edge of the crossing.
- Insulated rail joints at crossings, if required, to be installed per current CN Engineering Track Standards. No fiber insulated joints are allowed.
- Crossing surface to be as follows:
    - Only fully planked timber, asphalt, concrete or solid rubber planking will be accepted. Gravel or filled crossing surfaces are not permitted.
    - Planks to be full depth of the crossing to match the height of rail. Planks must not protrude above the top of the rail.
    - Crossing surface planks may be shimmed to the correct height with shims covering the full contact area between the tie and the plank.
    - Provide a flangeway space of not more than 3" or less than 2” deep, and not less that 2 ½" or more than 3" wide.
    - Fasten timber planks with ½" x 12" crossing spikes or lag screws, with one fastening in every other tie and at each end. Countersink planks for recessing of the washer and the lag bolt head.
    - Trim the ends of the planks parallel to the road centerline. Bevel edges to prevent dragging equipment from catching on planks.
- Drainage of the track at all crossings must be properly maintained at all times. Each quadrant of the crossing will have swales to direct runoff away from the track and crossing.

5. Materials Standards

This section details CN’s material requirements for industry track projects.

5.1 Rail

- Continuous Welded Rail (CWR) may be specified and will be laid and anchored under separate specifications per current CN Engineering Track Standards.
- For tracks handling dangerous commodities, rail must be control cooled and approved by CN.
- New rail must be a minimum of 115 lb RE or greater. No Open Hearth (OH) rail is allowed.
- Secondhand (PW) rail must be a minimum of 100 lb ARA-A or heavier for installations in Canada and 112 lb RE or heavier for installations in the United States.
- Rail quality may include minor imperfections in line and/or surface, or minor physical defects

that will not interfere with the safe use of the rail in yard tracks, industrial tracks and light density spurs.

- PW rail may be used in customer industrial locations, provided it meets the following standards:

  Rail lengths of 27 feet or greater are acceptable, but rail less than 39 feet may not make up more than 25% of the total rails. Rails 78 foot or longer must be used through road crossing with joints no closer than 25' from each end of the crossing surface.

- Rail to be free of internal defects confirmed by UTT Testing prior to installation.
- PW rail to be installed must be within the following limits of wear:

Section	136RE	132RE	115RE	112RE U.S. Only	100 ARA-A Canada Only
Max Loss of Vertical Height	5/8"(16mm)	9/16"(14mm)	1/2" (13mm)	3/8"(10mm)	5/16"(8mm)
Max Gauge Face Wear	3/8"(10mm)	3/8" (10mm)	3/8" (10mm)	3/8"(10mm)	3/8"(10mm)
End Batter	5/32"(4mm)	5/32"(4mm)	5/32"(4mm)	5/32"(4mm)	5/32"(4mm)
Maximum Combined Wear	3/4"(28mm)	15/16/'(24mm)	7/8"(21mm)	3/4"(17mm)	11/16"(14mm)

5.2 Welding

- Welding kits must be compatible with the type of rail being welded. For any weld involving a chrome alloy rail, only a chrome welding procedure to be used.
- Thermite or field flash butt welds to be located as close as possible to the center of tie cribs. The weld must not be closer than 4" to the edge of the tie and in no case may a field weld be situated over a tie plate.
- Thermite Welds will not be made:
  - Within 6 feet of another thermite weld
  - Within 3 feet of a plant weld
- Welding gaps for thermite welds to be minimum 1", maximum 1 1/8" inches except where approved wide gap welds are used.
- All rail ends must be saw cut. The cut must be square and perpendicular to the rail axis, with a variation not exceeding 1/8" and all burrs must be removed.

MAXIMUM ALLOWABLE RAIL HEIGHT DIFFERENCE

		WEIGHT OF RAIL		
		100 lb. and smaller	112 / 115 lb.	132 / 136 / 141 lb.
TYPE OF WELD	Standard Thermite	0.125" (3 mm)	0.30" (8 mm)*	0.30" (8 mm)*
	Step Down Thermite Kit 136NEW to			0.375" (10 mm)
	Flash Butt Welder	0.20" (5 mm)		

* If Vertical Rail Base Offset exceeds 1/8" (3 mm) a sloped base plate must be used

5.3 Joint Bars

- All rail joint bars must be of proper design and dimension for the rail on which it is to be applied.
- "Skirted" or "Toed" bars are not permitted.
- Second hand joint bars in good condition may be used except insulated or compromise joints which must be new in all cases.
- All joints to be fully bolted with rail drilling that conforms to proper dimension and design for the rail section.

5.4 Sub-ballast

- Sub-ballast gradation to be sufficient to prevent penetration of the sub-ballast into the subgrade and to conform to CN requirements.

5.5 Ballast (Crushed Gravel)

- Ballast to conform to the following gradation and the specifications of Appendix A, A16, CN Granular Specification, or be subject to the review and acceptance of CN Senior Manager Design & Construction (type and size may be modified slightly to meet local conditions) Heavy use leads or trackage may require crushed rock ballast as determined by CN Design & Construction.

Nominal Size	1-3/4" (45.3 mm)	1-1/4" (32 mm)	1" (25.4 mm)	¾" (19 mm)	½" (12.7 mm)	No. 4 (4.76 mm)	No. 200 (74 micron)
% Passing by Weight	100	–70-95	–50-80	10-40	0-15	0 - 1	0-1

- Industry must provide a sieve analysis of the ballast.
    - Provide a sample for testing by a recognized materials testing consultant.
    - Pay for material testing.
- Ballast to have a minimum count of particles with one or more fractured faces of 70% on each sieve size.
- Material in sample finer than No.4 (4.76 micron) sieve will not be considered in determining the percentage of fractured faces.
- Grading of crushed gravel ballast to be determined by ASTM C316, latest edition.
- Amount of material finer than No. 200 (74 micron) to be determined by ASTM C117, latest edition.
- The percent of wear due to abrasion to be less than 30% for the ballast per ASTM C 131 "A" grading.

5.6 Rail Anchors

- Rail anchors are to be new or manufacturer certified refurbished rail anchors of appropriate size.
- Rail anchor application to match the pattern as shown in Appendix A, A11, Anchor Pattern for Continuous Weld and Jointed Track.

5.7 Tie Plates

- Recommended tie plate usage found in Appendix A, A21, Turnout Return Curves and Spiking Pattern for Industrial Track drawing.
- Tie plates to be a minimum of 11" for 5 ½" base rail on tangents, and a minimum of 14" for 6" base rail and in curves. For locations with curves 9 degrees or greater, 16" cast plates to be installed on every other tie. All 16" cast plates to be a CN approved premium plate.
- Tie plates to be double shouldered with 1 in 40 cant.
- Tie plates may be second hand provided the plates are not broken, damaged or have worn spike holes.
- All ties are to be fully plated.

5.8 Ties

- All ties are to be treated in accordance with the latest edition of AREMA Manual Chapter 30.

- Timber Track Ties:
    - Track ties are to be new and a minimum of No.2 hardwood ties. No. 1 hardwood ties are required on curves over 6 degrees, and on all lead and loop tracks.
    - Track ties are to be a minimum 8'-6" in length and have minimum cross section dimensions of 6" x 8". The corners may be beveled to provide a minimum 7-1/2" flat surface on the top and bottom.
- The use of concrete or steel ties may be considered pending review and acceptance by CN Senior Manager Design & Construction.
- Switch ties to be new No. 1 hardwood ties, minimum 7"x9" in size, with length as required per the appropriate CN Engineering Track Standard plan. Refer to Appendix A, A7, Design Material Table for spacing and type.
- Borate treated switch ties and track ties are recommended for high decay zones (warmer climates or wet swampy conditions).

5.9 Hardware

- All hardware (bolts, nuts, spring washers, etc.) to be new.
- Track bolts to be of appropriate size, complete with nuts and conform to latest edition of AREMA Manual, Chapter 4.
- Spring washers to be of appropriate size and conform to the latest edition of the AREMA Manual, Chapter 4.

5.10 Track and Screw Spikes

- Spiking on industrial spurs and lead tracks is to be done per Appendix A, A11, Turnout Return Curves & Spiking Patterns for Industrial Tracks.
- Screw spikes to be 6" x 7/8" diameter with rectangular head.

5.11 Bumping Posts/Earthen Bumpers

- Stub end tracks require the installation of a bumping post or earthen bumper.
- Design of bumping posts/earthen bumpers to take into account protection of any infrastructure beyond the end of track.
- Install bumping posts or earthen bumpers 10 feet from the end of track, with 10 ties in front of and all ties behind it fully anchored.
- No car is to be spotted within 30 feet of the bumping post or earthen bumper.
- Bumping posts to be Hayes Type WG or HD (or equivalent) for the designated rail section.
- Due to the potential damage to rail car undercarriages, wheel stops are not acceptable for new track construction.

- An earthen bumper or bumping post is the preferred end of track protection. A typical earthen bumper and bumping post is provided in Appendix A, A2, Earthen Bumper/Bump Post Detail.

5.12 Derails

- Design tracks to leave a minimum of 50 feet from the derail to the last car that could be spotted in the track.
- Install derails in accordance with the appropriate standard plans, as follows:
    - Hayes EB (Hinged Type Derail)
    - Hayes HB (Sliding Type Derail)
    - Switch Point Derail per drawing "Double Switch Point Derail" attached (see Appendix A, A14).
- The correct size of derail to be used on various rail sections is as follows:
    - Size 6: 100 ARA-A to 115 lb (worn)
    - Size 7: 115 lb (new) and larger
- A plywood or steel shim of the correct thickness with holes punched or drilled for all fasteners may be necessary under the derail to ensure the block lies flat on the top of the rail.

5.13 Bonding and Track Grounding

- At any location where flammable commodities may be loaded or off-loaded, bonding wires and track grounding are to be provided per CN SCP 1301 and 1302 (see Appendix A, A17 and A18) and/or Railway Prevention of Electric Sparks regulations (CTC 1982-8 for Canada).

5.14 Lighting

Lighting for switching facilities requires adequate lighting per industry recommendations and specifications. Adequate lighting must be provided for train crews working at night. Work areas near switches, gates, and buildings must be illuminated to prevent walking and tripping hazards. Lighting levels must be sufficient to allow operating crews riding rail cars the ability to see without relying on use of a flashlight.

6. Regulatory Requirements

Regulatory requirements pertaining to the design and construction of railway tracks are established at the National, State/Provincial, and local level. They pertain to a variety of issues

such as the handling of hazardous materials, pipe and wire crossings, regulatory clearances, minimum construction and maintenance requirements, and road crossings. Prior to commencing development of a project, the CN Business Development/Real Estate department must be contacted to obtain current and local information pertaining to regulatory requirements and submissions.

6.1 Utility Crossings

Utility crossings including pipe, wire, and culverts must be submitted for review and acceptance to CN. Detailed instructions and requirements for utility crossings are available through the CN Design & Construction contact. Information is also available on the CN website:

http://www.cn.ca/en/delivering-responsibly/safety/erailsafe/utility-installations

Submissions to CN for permission to cross the Railway with any type of pipe or wire must conform to the relevant standard. The application must be submitted to the appropriate CN contact for review and acceptance. The steps for obtaining review and acceptance for an application are as follows:

a. Application - submit for review an electronic PDF copy of an acceptable plan to CN with the application fee.
b. Agreement - once the plans are approved an agreement will be sent outlining the agreement, costs, special conditions, and Industry's responsibilities.
c. Installation - installation of pipes or wires may begin once the permission is received by CN and two (2) weeks notice is given to arrange flagging protection and signals locating as required.
d. Additional information regarding the requirements for an application for a pipe or wire crossing may be obtained from CN Design & Construction.

6.2 Flammable Liquids Bulk Storage Regulations

For bulk storage on CN property, the industry is required to compile all relevant information needed for submission to regulatory agencies by CN. Any other regulatory review and approval for bulk storage off of CN property will be the responsibility of the respective industry.

7. Safety and Right of Entry

- Authorized personnel working within the CN right of way must adhere to "Safety Guidelines for Contractors and Non-CN Personnel" and must be in the possession of a "Right of Entry Permit" issued by an Officer of the Railway that is only valid for the time period outlined in the document. To obtain a copy of the permit, contact CN Design & Construction. Insurance required by the "right of entry permit" must be approved prior to working on CN property.

- Flagging will be required for all work performed by contractors within 30 feet of any CN tracks in operation or where CN representative deems it necessary.
- Flagging costs will be the responsibility of the industry.

7.1 Certification and Training

Contractors working on or near CN property must present proof that all personnel have completed the required training. All contractor personnel must also complete safety and security training per CN Police and Risk Management requirements.

On-Track Worker Safety:

- E-Railsafe (www.erailsafe.com) – **in USA**
- Contractor Orientation (www.contractororientation.com) or E-Railsafe (erailsafe.com) – **in Canada**
- CN Welder Training (for Welders only)

Non-CN contractors working on CN property must complete the training requirements located at www.contractororientation.com.

8. Post Construction Requirements and Submissions

- Once construction is complete, the local CN Track Supervisor must inspect the track before the facility is placed into service. The inspection can be arranged directly with the Track Supervisor or by contacting CN Design & Construction.
- CN also requires that an agreement/as–constructed drawing be submitted to complete their records and to form the basis for an agreement for service. The preparation of this drawing is the responsibility of Industries' Engineering Consultant or Rail Contractor. The drawing may be submitted in the same manner as the design drawing, but must include the following additional information:
    - Track that is owned by the Industry is to be colored green.
    - Track that is owned by CN is to be colored red.
    - Complete formal name of Industry to be registered on the agreement.

- The electronic file (AutoCAD and PDF format) of the agreement/as-constructed drawing are to be submitted to the Business Development/Real Estate Manager as soon as possible after construction, prior to track being placed into service.

Appendix A – Tables and Figures

1. Typical Cross Section Detail
2. Earthen Bumper Detail
3. Typical Horizontal and Vertical Clearances - US
4. Typical Horizontal and Vertical Clearances - Canada
5. Typical Platform and Signal Clearances
6. AAR Circular No. OT-55-M
7. Design Criteria and Material Table
8. Vertical Curves for Industrial Track
9. Design Clearances for Highway and Pedestrian Overpass
10. KIU-10_2 and KIU-10_3 Design Clearances for Highway and Pedestrain Overpass - Canada
11. Anchor Pattern for CWR and Jointed Rail
12. Turnout Geometry
13. R7A-80.2_1 and R7A-80.2_2 CSP and SPCSP Culverts – Canada and US
14. Double Switch Point Derail
15. CN Unloading Pit Standard JL3-5
16. CN Granular Spec 12-20
17. SCP 1301 – Prevention of Electric Sparks at Flammable Liquid and Gas Transfer Facilities
18. SCP 1302 – Isolation and Grounding of Railway Tracks Servicing Electrical Supply Stations
19. Road Crossing Details
20. G4A – Sightline Crossing Requirements
21. Turnout Return Curves and Spiking Pattern for Industrial Track
22. Typical Grading at Mainline Turnout Locations
23. Switch Stand 36E and 36EH
24. Walkways for Industrial Tracks
25. CN Walkway Detail Term & Yards - Canada
26. Title Page for Construction Drawings
27. Typical Plan View for Review/Construction Drawings
28. Typical Plan View for Exhibit Drawings
29. Typical Cross Sections for Construction Drawings
30. Typical Profile Drawing
31. Wire Crossing and Encroachment Specifications

Appendix B – Terms and Definitions

Unit Train – Generally, a train specially made up at point of origin for transporting a single commodity to one destination in a single type of car and at special rates. The cars making up these trains are not used on any other trains, and are generally 50 cars or more in length.

Loop Track – Any track that makes a complete loop.

Hazardous Material - A substance or material that is dangerous to health, safety, and/or the environment. Hazardous materials are subject to Department of Transportation safety requirements. Examples are explosives, poisons, flammable liquids, corrosive substances, and oxidizing or radioactive materials. Cars are placarded.

Industrial Grade Tie – Timber tie meeting vendor specification for Industrial Grade.

Lead Track – An industrial track serving one or more industries from which additional tracks branch from.

Industry or Customer – The applicant for an industry track (includes industries, customers, and their design consultants and contractors).