



American Railway Engineering and  
Maintenance-of-Way Association

## CHAPTER 18

# LIGHT DENSITY AND SHORT LINE RAILWAYS<sup>1</sup>

### TABLE OF CONTENTS

| Part/Section | Description                                                 | Page          |
|--------------|-------------------------------------------------------------|---------------|
| <b>1</b>     | <b>General Engineering</b> .....                            | <b>18-1-1</b> |
| 1.1          | Engineering Records .....                                   | 18-1-2        |
| 1.2          | Budgeting (To Be Developed) .....                           | 18-1-7        |
| 1.3          | Contracting and Contract Management (To Be Developed) ..... | 18-1-7        |
| <b>2</b>     | <b>Track</b> .....                                          | <b>18-2-1</b> |
| 2.1          | Track Components and Design .....                           | 18-2-2        |
| 2.2          | Track Inspection and Maintenance .....                      | 18-2-4        |
| 2.3          | Track and Roadway Rehabilitation .....                      | 18-2-10       |
| <b>3</b>     | <b>Bridges</b> .....                                        | <b>18-3-1</b> |
| 3.1          | Bridge Management Program .....                             | 18-3-2        |
| 3.2          | Construction Fundamentals .....                             | 18-3-5        |
| 3.3          | Inspection .....                                            | 18-3-9        |
| 3.4          | Bridge Inspection Checklist (To Be Developed) .....         | 18-3-14       |
| <b>4</b>     | <b>Communication and Signals (To Be Developed)</b> .....    | <b>18-4-1</b> |

<sup>1</sup> The material in this and other chapters in the AREMA *Manual for Railway Engineering* is published as recommended practice to railroads and others concerned with the engineering, design and construction of railroad fixed properties (except signals and communications), and allied services and facilities. For the purpose of this Manual, RECOMMENDED PRACTICE is defined as a material, device, design, plan, specification, principle or practice recommended to the railways for use as required, either exactly as presented or with such modifications as may be necessary or desirable to meet the needs of individual railways, but in either event, with a view to promoting efficiency and economy in the location, construction, operation or maintenance of railways. It is not intended to imply that other practices may not be equally acceptable.

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## SCOPE

The material in this chapter is supplementary guidance for railroad lines categorized as light density or short lines. While these categories have no exact limits, for engineering purposes they are generally defined as follows:

### LIGHT DENSITY

A railroad line carrying less than 5 million gross tons of traffic per year. (Note: 1 million gross tons approximately equals the passage of 7,600 loaded 100-ton cars, or an average of 21 of these cars each day of the year.)

### SHORT LINE

A railroad not large enough to economically justify the use of large scale production maintenance techniques or to have fully staffed engineering and maintenance-of-way departments. Maintenance-of-way staff is sized for routine maintenance activities and may not perform this work full time. Engineering and design work, and perhaps much of the track and structure maintenance, are typically done by contract.

## INTRODUCTION

The Chapters of the AREMA Manual are divided into numbered Parts, each comprised of related documents (specifications, recommended practices, plans, etc.). Individual Parts are divided into Sections by centered headings set in capital letters and identified by a Section number. These Sections are subdivided into Articles designated by numbered side headings.

**Page Numbers** – In the page numbering of the Manual (18-2-1, for example) the first numeral designates the Chapter number, the second denotes the Part number in the Chapter, and the third numeral designates the page number in the Part. Thus, 18-2-1 means Chapter 18, Part 2, page 1.

In the Glossary and References, the Part number is replaced by either a “G” for Glossary or “R” for References.

**Document Dates** – The bold type date (Document Date) at the beginning of each document (Part) applies to the document as a whole and designates the year in which revisions were last made somewhere in the document, unless an attached footnote indicates that the document was adopted, reapproved, or rewritten in that year.

**Article Dates** – Each Article shows the date (in parenthesis) of the last time that Article was modified.

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**Proceedings Footnote** – The Proceedings footnote on the first page of each document gives references to all Association action with respect to the document.

**Annual Updates** – New manuals, as well as revision sets, will be printed and issued yearly.





American Railway Engineering and  
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## Part 1

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### General Engineering

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— 2000 —

#### TABLE OF CONTENTS

| Section/Article                                                  | Description                                                  | Page          |
|------------------------------------------------------------------|--------------------------------------------------------------|---------------|
| <b>1.1 Engineering Records</b>                                   |                                                              | <b>18-1-2</b> |
| 1.1.1                                                            | Introduction (2000)                                          | 18-1-2        |
| 1.1.2                                                            | Valuation Maps (2000)                                        | 18-1-2        |
| 1.1.3                                                            | Contracts, Easements, and Agreements (2000)                  | 18-1-2        |
| 1.1.4                                                            | Original Right-of-Way Grant Instruments (Deeds, etc.) (2000) | 18-1-3        |
| 1.1.5                                                            | Operation and Maintenance Records (2000)                     | 18-1-3        |
| 1.1.6                                                            | Bridge , Culvert, and Tunnel Records (2000)                  | 18-1-5        |
| 1.1.7                                                            | Signals and Communications Plans and Records (2000)          | 18-1-6        |
| 1.1.8                                                            | Building and Utility Plans and Records (2000)                | 18-1-6        |
| 1.1.9                                                            | Environmental Information and Records (2000)                 | 18-1-6        |
| 1.1.10                                                           | Material Inventory Records (2000)                            | 18-1-7        |
| <b>1.2 Budgeting (To Be Developed)</b>                           |                                                              | <b>18-1-7</b> |
| <b>1.3 Contracting and Contract Management (To Be Developed)</b> |                                                              | <b>18-1-7</b> |

## SECTION 1.1 ENGINEERING RECORDS

### 1.1.1 INTRODUCTION (2000)

- a. The following sections describe engineering records which are considered essential for the proper management of a short line or light density railroad property. These records are valuable for legal as well as engineering purposes. They also greatly aid maintenance planning and budgeting and decisions for future construction and roadway improvements.
- b. Whenever a railroad line is purchased or sold, these records should be included with the property transfer, and purchasers should ensure that these documents are obtained, checked, and updated as needed. If the acquisition is a lease, rather than a purchase, then good reproducible copies should be obtained as well as several sets of reproductions. When available, computerized versions should also be acquired.
- c. As many of these documents define legal obligations and restrictions, they should be reviewed before planning or conducting construction, excavation, or drainage work. A thorough review and understanding will also minimize misunderstandings with other parties. Compliance with various agreements may also affect annual maintenance plans and budgets.

### 1.1.2 VALUATION MAPS (2000)

- a. These include:
  - (1) Right-of-Way maps with index maps and sheets.
  - (2) Station maps with index maps and sheets.
  - (3) Track and structure maps with index maps and sheets.
- b. Valuation mapping includes the predominate 1" = 400' right-of-way maps, special maps at 1" = 100' or 200' for stations, index maps and sheets showing only schedules of property, etc.
- c. Track maps should show the length and degree of curves.

### 1.1.3 CONTRACTS, EASEMENTS, AND AGREEMENTS (2000)

- a. These include:
  - (1) Contracts for industry tracks railroad land.
  - (2) Easements for construction and maintenance of public highway crossings.
  - (3) Easements for construction and maintenance of private road crossings.





- (4) Agreements for utilities to cross over or under the railroad, or run parallel to it on the right-of-way (above or below ground level).
- (5) Agreements for joint facilities operation and maintenance.
- (6) Side track agreements.
- (7) Track leases.
- (8) Agreements for moveable bridges over navigable waterways and for wharves and docks.
- (9) Permits issued by the U. S. Army Corps of Engineers.
- b. Industry track contracts and land usage contracts (easements) specify the responsibilities of both parties regarding maintenance, cost sharing, and property restoration when the contract ends or if it is terminated.
- c. Agreements for the road crossings, both public and private, will assist the new owner on liability questions, maintenance responsibility and access rights.
- d. Agreements for utilities include power lines, telephone lines, sanitary and storm sewers, irrigation canals, pipelines and cable (fiber optic, telephone and television). These agreements will be needed to avoid disruptions or liabilities through unaware excavations, for collection of periodic rents, and for other maintenance purposes.
- e. Joint facility agreements will assist in defining the responsibilities for the operation and maintenance of the facility, such as interlocking, crossing diamonds, interchange tracks, trackage rights, towers, joint stations, etc.
- f. Documents relating to navigable waterways concern drawbridges and permits for docks and wharves involving the Coast Guard, the Army Corps of Engineers, or similar agencies (including state or municipal agencies).

#### 1.1.4 ORIGINAL RIGHT-OF-WAY GRANT INSTRUMENTS (DEEDS, ETC.) (2000)

- a. These are mainly right-of-way deeds.
- b. Although legal challenges to the continuity of an operating railroad's right-of-way are rare, possession of a complete set of original right-of-way deeds (or good copies from the county recorders) is essential. In addition to defining ownership, these documents may also establish restrictions such as a duty to construct and maintain right-of-way fences, or reversion clauses which affect the longer-term value of the right-of-way land. Occasionally a lender may require title insurance regarding a borrowing short line's properties, and the need for good information on the origin and quality of the railroad's right, title and interest in its land is important.

#### 1.1.5 OPERATION AND MAINTENANCE RECORDS (2000)

- a. These records will assist in planning future maintenance activities. They include:

- (1) Track charts.
  - (2) Track and turnout inspection records.
  - (3) Maintenance standards and special instructions.
  - (4) Operating rules, timetables, and special instructions.
  - (5) Clearance records.
  - (6) Rail replacement records.
  - (7) Tie replacement records.
  - (8) Ballast and surfacing records.
  - (9) Curve records.
  - (10) Grade crossings records.
- b. Track charts are indispensable for maintenance planning, conducting track inspections, and most activities and communications regarding track maintenance. A good track chart includes: track profile (with gradients marked); curve location and degree; milepost locations and track stationing (surveyor's stationing); locations of bridges, structures, utility crossings, culverts, overhead bridges, and any structure or feature which may restrict clearances; length of sidings; and for yards, track layout and numbering (or names).
- c. Track and turnout inspection records are essential for knowing the conditions on the railroad and are a basis for determining annual maintenance and rehabilitation needs. In addition to regular visual inspections, they should also include records of inspections for internal rail defects (ultrasonic inspections). Thorough track, turnout, and internal rail inspection records are also required by the Federal Railroad Administration.
- d. Maintenance standards and instructions define the level to which each section of track is to be maintained. These documents are further covered in Part 2 below. (It is important to note that Federal Railroad Administration track standards are not, and should not be used as, maintenance standards. They are intended to be only minimum safety standards for operating purposes).
- e. In addition to train operations, operating rules, timetables, and special instructions govern the operation of maintenance machines on the track, and knowledge of their contents is important for the safety of track maintenance personnel while on or near the track. They also indicate areas with slow orders and other operating restrictions including load and clearance limits.
- f. Clearance records should show all locations where horizontal or vertical clearances are in any way restricted, the structure or feature which limits the clearance, and the what the limiting measurement is. (All states specify minimum required clearances through or past various structures. See Chapter 28 for more information on clearances).
- g. Rail replacement records should show where and when rail was replaced due to in-service failures (i. e. rails broken in-service), or internal defects, or from general wear. They should also show where rail has been transposed in curves. Rail grinding records should show when and where grinding was done and indicate the grinding pattern and grinding depth. The accumulated tonnage which has passed over the rail should also be indicated.





- h. Tie replacement records should show the number of ties replaced in each section or mile of track during tie replacement programs.
- i. Ballast and surfacing records should indicate where and when surfacing has been done; the amount the track was raised; and the type, amount, and source of ballast used.
- j. Curve records should detail the engineering information on each curve such as degree, length, amount of superelevation, and length of spiral at each end.
- k. Grade crossings records should show for each crossing the AAR/DOT (Association of American Railroads / Department of Transportation) inventory number, the name of the road crossing the track, and the type of crossing protection there (signs, lights, gates, etc.). (See [Article 1.1.7](#) regarding crossing warning devices).

### 1.1.6 BRIDGE , CULVERT, AND TUNNEL RECORDS (2000)

- a. These include:
  - (1) General and detailed drawings for each structure.
  - (2) Inspection reports.
  - (3) Repair records.
  - (4) Ratings and load limits.
  - (5) Bridge standard plans.
  - (6) Pile-driving records.
  - (7) Drainage studies and surveys.
  - (8) Tunnel plans.
  - (9) Clearance diagrams and records.
- b. Bridge inspection records are critical for ensuring operating safety and for planning and prioritizing maintenance and repairs; they may also indicate the needed to revise allowable loads permitted on the structures. Records of past repairs may be included with inspection reports and may indicate the need to update bridge drawings. Plans for the steel structures are especially needed for repair and rating purposes. Pile driving records show the depth to which the piles were driven, etc.
- c. Drainage studies and surveys indicate nearby water flow characteristics and capacities under bridges and through culverts.
- d. Tunnel plans are used for any maintenance repairs and clearance work which may be necessary at a future date.
- e. Clearance diagrams and records for bridges and tunnels are needed for routing any high or wide loads (as well as heavy loads) over the railroad.

### 1.1.7 SIGNALS AND COMMUNICATIONS PLANS AND RECORDS (2000)

- a. These include:
  - (1) Signal standard plans.
  - (2) Individual signal plans.
  - (3) Signal inspection records.
  - (4) Interlocking plans records.
  - (5) Road crossing warning device plans and inspection records.
  - (6) Communications system plans.
- b. Signal, communication system, and interlocking plans show construction and wiring of signals and signal systems, including manufacturers models and other information needed when ordering replacement parts. The plans also indicate how the signals are intended to function, thus aiding in diagnosing problems and making repairs. These plans will also help in determining the most cost effective methods to use when upgrades or modifications are needed. Working on a system without these plans could adversely impact train operations or create safety hazards.
- c. Signal inspections and records, including those for active warning devices (flashing lights, gates) at road crossings, are required by the Federal Railroad Administration. These must show the dates the devices were checked for proper operation and what tests were performed.

### 1.1.8 BUILDING AND UTILITY PLANS AND RECORDS (2000)

- a. These include:
  - (1) Building plans and construction and repair records.
  - (2) Utility plans and construction and repair records.
- b. The original architectural plans for significant buildings will be used for repair and improvement work. Utility plans (water and gas lines, sanitary and storm drains, communication and electrical conduits, etc.) will be necessary for locating the lines in case of emergency repair work or normal maintenance.

### 1.1.9 ENVIRONMENTAL INFORMATION AND RECORDS (2000)

- a. These include:
  - (1) Phase 1 reports.
  - (2) Existing environmental situations
  - (3) Regulatory (State, Federal EPA) permits.
- b. The current environmental conditions should be documented; this is often done through a "Phase 1" environmental survey of the property prepared by a qualified contractor. Any reports detailing known environmental situations on the property should be documented if the property is to be sold or leased; the buyer or lessee should seek competent technical legal advice and obtain whatever records are



suggested by the experts. All regulatory permits need to be kept where conveniently accessible, as they need to be produced when required for various construction or rehabilitation activities, and even to verify permission for certain routine operations.



#### 1.1.10 MATERIAL INVENTORY RECORDS (2000)

- a. Material inventory records should show the track, bridge, signal, and building materials on hand to accomplish needed maintenance and repairs, including material type, size, and location. Material on hand is part of the engineering assets of the railroad and may represent significant dollar value. Inventory records will assist in maintenance and rehabilitation budgeting and planning by indicating what does or does not need to be purchased. Certain projects may be prioritized by the amount of material already on hand to accomplish the work.



### SECTION 1.2 BUDGETING (TO BE DEVELOPED)



### SECTION 1.3 CONTRACTING AND CONTRACT MANAGEMENT (TO BE DEVELOPED)



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## Part 2

## Track

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— 2005 —

### TABLE OF CONTENTS

| Section/Article                             | Description                                                       | Page           |
|---------------------------------------------|-------------------------------------------------------------------|----------------|
| <b>2.1 Track Components and Design</b>      |                                                                   | <b>18-2-2</b>  |
| 2.1.1                                       | Subgrade (To Be Developed)                                        | 18-2-2         |
| 2.1.2                                       | Drainage (To Be Developed)                                        | 18-2-2         |
| 2.1.3                                       | Ballast and Sub-ballast (2003)                                    | 18-2-2         |
| 2.1.4                                       | Crossties and Switch Ties (To Be Developed)                       | 18-2-4         |
| 2.1.5                                       | Rail (To Be Developed)                                            | 18-2-4         |
| 2.1.6                                       | Fastenings and OTM (To Be Developed)                              | 18-2-4         |
| 2.1.7                                       | Turnouts and Rail Crossings (To Be Developed)                     | 18-2-4         |
| 2.1.8                                       | Highway Grade Crossings (To Be Developed)                         | 18-2-4         |
| <b>2.2 Track Inspection and Maintenance</b> |                                                                   | <b>18-2-4</b>  |
| 2.2.1                                       | Inspection Overview (2000)                                        | 18-2-4         |
| 2.2.2                                       | Preparation for an Inspection (2000)                              | 18-2-4         |
| 2.2.3                                       | Inspection Procedures (2000)                                      | 18-2-6         |
| 2.2.4                                       | Inspection Check List (2000)                                      | 18-2-6         |
| <b>2.3 Track and Roadway Rehabilitation</b> |                                                                   | <b>18-2-10</b> |
| 2.3.1                                       | Definition (2000)                                                 | 18-2-10        |
| 2.3.2                                       | Determining Rehabilitation Needs (2000)                           | 18-2-10        |
| 2.3.3                                       | The Rehabilitation Plan (2000)                                    | 18-2-12        |
| 2.3.4                                       | Guidance On Rehabilitation of Track and Roadway Components (2005) | 18-2-13        |
| 2.3.5                                       | Final Plans and Work Preparation (2000)                           | 18-2-22        |
| 2.3.6                                       | Construction and On-site Inspection (2000)                        | 18-2-23        |

### LIST OF TABLES

| Table  | Description                                                                                   | Page   |
|--------|-----------------------------------------------------------------------------------------------|--------|
| 18-1-1 | Ballast/Sub-Ballast Gradation Chart for Coarse Aggregate Suppliers in the United States . . . | 18-2-3 |

See Plan 1001 in AREMA's *Portfolio of Trackwork Plans* "Rail Sections -- In Use Since About 1980."

## SECTION 2.1 TRACK COMPONENTS AND DESIGN

### 2.1.1 SUBGRADE (TO BE DEVELOPED)

### 2.1.2 DRAINAGE (TO BE DEVELOPED)

### 2.1.3 BALLAST AND SUB-BALLAST (2003)

The following table should be used as a guide when AREMA ballast gradations are not available. For quality recommendations of ballast refer to [Chapter 1, Section 2.4](#).



Table 18-1-1. Ballast/Sub-Ballast Gradation Chart for Coarse Aggregate Suppliers in the United States

|                    |                    |             |                                    |    |      | Sieve Size                                     |        |        |        |        |       |       |      |                                |     |            |      |
|--------------------|--------------------|-------------|------------------------------------|----|------|------------------------------------------------|--------|--------|--------|--------|-------|-------|------|--------------------------------|-----|------------|------|
|                    |                    |             |                                    |    |      | Size of Opening                                |        |        |        |        |       |       |      | Number of Openings/<br>sq. in. |     |            |      |
|                    |                    |             |                                    |    |      | 3"                                             | 2 1/2" | 2"     | 1 1/2" | 1"     | 3/4"  | 1/2"  | 3/8" | #4                             | #8  | #30        | #200 |
| Use                | Standard           | Gradation # | Nominal Size<br>Square<br>Openings |    |      | Percent Passing Through Sieve Size (min.-max.) |        |        |        |        |       |       |      |                                |     |            |      |
| Mainline           | AREMA              | 24          | 2 1/2"                             | to | 3/4" | 100                                            | 90-100 |        | 25-60  |        | 0-10  | 0-5   |      |                                |     |            |      |
| Mainline           | AASHTO             | 24          | 2 1/2"                             | to | 3/4" | 100                                            | 90-100 |        | 25-60  |        | 0-10  | 0-5   |      |                                |     |            |      |
| Mainline           | AREMA              | 25          | 2 1/2"                             | to | 3/8" | 100                                            | 80-100 | 60-85  | 50-70  | 25-50  |       | 5-20  | 0-10 | 0-3                            |     |            |      |
| Mainline           | AREMA              | 3           | 2"                                 | to | 1"   |                                                | 100    | 95-100 | 35-70  | 0-15   |       | 0-5   |      |                                |     |            |      |
| Mainline           | AASHTO<br>and ASTM | 3           | 2"                                 | to | 1"   |                                                | 100    | 90-100 | 35-70  | 0-15   |       | 0-5   |      |                                |     |            |      |
| Mainline           | AREMA              | 4A          | 2"                                 | to | 3/4" |                                                | 100    | 90-100 | 60-90  | 10-35  | 0-10  |       | 0-3  |                                |     |            |      |
| Mainline           | AREMA              | 4           | 1 1/2"                             | to | 3/4" |                                                |        | 100    | 90-100 | 20-55  | 0-15  |       | 0-5  |                                |     |            |      |
| Mainline           | AASHTO<br>and ASTM | 4           | 1 1/2"                             | to | 3/4" |                                                |        | 100    | 90-100 | 20-55  | 0-15  |       | 0-5  |                                |     |            |      |
| Yard/Side<br>Track | AASHTO<br>and ASTM | 5           | 1"                                 | to | 1/2" |                                                |        |        | 100    | 90-100 | 20-55 | 0-10  | 0-5  |                                |     |            |      |
| Yard/Side<br>Track | AREMA              | 5           | 1"                                 | to | 3/8" |                                                |        |        | 100    | 90-100 | 40-75 | 15-35 | 0-15 | 0-5                            |     |            |      |
| Yard/Side<br>Track | AASHTO<br>and ASTM | 56          | 1"                                 | to | 3/8" |                                                |        |        | 100    | 90-100 | 40-75 | 15-35 | 0-15 | 0-5                            |     |            |      |
| Yard/Side<br>Track | AREMA              | 57          | 1"                                 | to | #4   |                                                |        |        | 100    | 95-100 |       | 25-60 |      | 0-10                           | 0-5 |            |      |
| Yard/Side<br>Track | AASHTO<br>and ASTM | 57          | 1"                                 | to | #4   |                                                |        |        | 100    | 95-100 |       | 25-60 |      | 0-10                           | 0-5 |            |      |
|                    |                    |             |                                    |    |      |                                                |        |        |        |        |       |       |      |                                |     |            |      |
| Sub-Ballast        | Generic            | DGA/ABC     | 1"                                 | to | #200 |                                                |        |        | 100    | 90-100 |       | 60-90 |      | 30-60                          |     | 10-40 4-13 |      |

AREMA - American Railway Engineering and Maintenance of Way Association

AASHTO - American Association of State Highway and Transportation Officials

ASTM - American Society for Testing and Materials

DGA - Dense Graded Aggregate

ABC - Aggregate Base Course

#### 2.1.4 CROSSTIES AND SWITCH TIES (TO BE DEVELOPED)

#### 2.1.5 RAIL (TO BE DEVELOPED)

#### 2.1.6 FASTENINGS AND OTM (TO BE DEVELOPED)

#### 2.1.7 TURNOUTS AND RAIL CROSSINGS (TO BE DEVELOPED)

#### 2.1.8 HIGHWAY GRADE CROSSINGS (TO BE DEVELOPED)



### SECTION 2.2 TRACK INSPECTION AND MAINTENANCE

#### 2.2.1 INSPECTION OVERVIEW (2000)

- a. The main purpose of a track inspection is to ensure that the track is safe for the passage of trains. Next in importance is to determine any aspects of the track and roadway which do not meet the designated maintenance standard for that line.
- b. The check list below is intended to provide a guide and refresher to the track inspector on defects to look for, observations which may indicate a potential or actual problem, and important measurements to check. Specific limits for the measurements have mostly been omitted as these usually depend on the maintenance standards for each line.
- c. To aid in obtaining a thorough and accurate inspection record, it is recommended that the inspector stop at each significant point, such as a milepost or switch, and review the check list along with notes and items observed since the previous stopping point. Any items omitted from the inspection report or detailed notes should be added at this time, before inspecting the next segment.
- d. Once the inspection is complete, the inspector should review all notes and group any deficiencies found into the following three categories:
  - (1) Defects needing immediate action to ensure safe train operation.
  - (2) Deficiencies or defects which should be corrected soon to bring the track back into compliance with the designated maintenance standard.
  - (3) Items or areas which should be closely or more frequently watched to ensure that unacceptable conditions do not occur.

#### 2.2.2 PREPARATION FOR AN INSPECTION (2000)

- a. Before conducting an inspection the following documents and information should be obtained, reviewed, and kept accessible while out on the track:
  - (1) Operating rules.
  - (2) Current timetable.
  - (3) General instructions.



- (4) Track car rules.
- (5) First aid rules.
- (6) Maintenance of way rules.
- (7) Safety rules.
- (8) Motor vehicle rules.
- (9) Standard practice circulars.
- (10) Railroad company maintenance standards.
- (11) FRA (Federal Railroad Administration) track safety standards.
- (12) Copy of the previous track inspection report.
- (13) Blank inspection forms.

b. If using a vehicle when conducting an inspection the following tools and materials should be on hand:

- (1) 25-foot or 50-foot measuring tape.
- (2) 18-inch straightedge.
- (3) 62-foot string.
- (4) 6-foot folding rule.
- (5) A box of (yellow) lumber crayons.
- (6) Trouble light.
- (7) Red flag.
- (8) Goggles and hard hat.
- (9) Track gage and level.
- (10) Spike maul and track wrench.
- (11) Shovel, ballast fork, and pick.
- (12) Claw bar, jack bar (lining bar), and a small track jack.
- (13) Drift pins.
- (14) Several spikes, bolts, joint bars, anchors.
- (15) Bundle of tie plugs.
- (16) Switch broom.

### 2.2.3 INSPECTION PROCEDURES (2000)

- a. Inspections should be done by walking the track or traveling in a vehicle on the track at a speed which is slow enough to visually detect defects.
- b. Over the year, it is best to alternate the direction in which a track section is inspected and to inspect it at different times in the day. Varying the direction and time will often help an inspector pick up defects which were not as obvious during the last inspection.
- c. When track is normally inspected from a vehicle, the inspector should make it a point to walk at least some portions of the track on a rotating basis, so that over a year's time, every piece of track will have been walked a few times. Also, if practical, the inspector should ride in an engine over the track during each season so that the track can be checked under a full load. At known or suspected trouble spots, the track should be observed from the ground while the engine (and train) passes.
- d. When time permits, the inspector should perform minor repairs that can be safely and easily done during the inspection trip.

### 2.2.4 INSPECTION CHECK LIST (2000)

- a. Rail Defects:
  - (1) Abnormal appearance or unusual marks.
  - (2) Rust streaks or discolorations.
  - (3) Deep chips or gouges.
  - (4) Excessive surface corrugations.
  - (5) Excessive vertical or horizontal head wear, especially in curves.
  - (6) Ordinary breaks.
  - (7) Breakouts in joint area.
  - (8) Vertical or horizontal split head.
  - (9) Vertical/horizontal mismatched ends.
  - (10) Damaged rails.
- b. Rail Fastening Defects:
  - (1) Cracked, broken, or loose joint bars.
  - (2) Loose or missing bolts.
  - (3) Broken or missing lock washers.
  - (4) High, missing, or loose spikes.
  - (5) Condition of insulated joints.





- (6) Missing or broken tie plates.
- (7) Improperly positioned tie plates, particularly at joints.
- (8) Defective, missing, or improperly applied rail anchors.

c. Turnout and Crossing Defects:

- (1) Unlocked or improperly aligned switches.
- (2) Insecure switch stand and worn latches.
- (3) Switch rods worn or out of adjustment.
- (4) Stockrails improperly seated/worn braces.
- (5) Switch/slide plates not clean and lubricated.
- (6) Gapping, worn/chipped, poorly fitting switch points.
- (7) Missing bolts and cotter pins.
- (8) Loose joints in heel and frog area.
- (9) Worn or chipped frog point and surface.
- (10) Outer edge of wheel contacting gauge side of spring frog wing rail.
- (11) Spring frog horn clearance less than 1/4 inch.
- (12) Proper gage in turnout - particularly in curved closure rails.
- (13) Proper guard check gage and guard face gage in frog.

d. Roadway and General Surface Defects:

- (1) Pumping, loose, or hanging joints.
- (2) Frost heaves.
- (3) Sink holes.
- (4) Washouts.
- (5) Frozen or tight joints.
- (6) Tight or creeping rail.
- (7) Ice or sand build-up between tie plate and rail base.
- (8) Curve and spiral alignment, elevation, and run-off beyond allowable tolerances.
- (9) Track geometry measurements beyond allowable tolerances (gage, surface, cross level, alignment, warp or twist).

e. Rail Lubricator Defects:

- (1) Lubricator not properly adjusted or not operating.
- (2) Reservoir not filled and puddled.
- (3) Hoses not in good condition.
- (4) Track area contaminated (too much being pumped out).

f. Tie Defects:

- (1) Broken.
- (2) Damaged.
- (3) Split through.
- (4) Rotted or deteriorated.
- (5) Plate cut more than 2 inches.
- (6) Spike killed.
- (7) Skewed.
- (8) Not properly supporting joints.
- (9) Insufficient non-defective ties to support rail.

g. Ballast Defects:

- (1) Not clean and free draining (fouled).
- (2) Not properly supporting the track.
- (3) Not restraining track laterally (shoulders not full).
- (4) Not restraining track longitudinally (cribs not full).

h. Culvert Defects:

- (1) Not structurally sound (loss of ballast over culvert).
- (2) Not free of debris, drift, and silt.
- (3) Not fully open for passage of water (ends not clean).

i. Ditch and Drainage Channel Defects:

- (1) Not free draining.
- (2) Not free of debris, drift, and silt.
- (3) Washed out areas or scour present.

