Chicago Transit Authority

Track Maintenance Standards Manual

December 4, 2008

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Chicago Transit Authority
Construction and Maintenance Division

TRACK MAINTENANCE STANDARDS

Established February 1990
Revised February 16, 1999
Revised December 4, 2008

All Track roadmasters and Trackmen assigned to perform track inspections shall use this manual to define a minimum standard to which all tracks must be maintained for the safe operation of rapid transit trains. Only the manager of the Track Maintenance Department or his/her designee are permitted to authorize any variations from these standards.

Approved by

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1 Overview

This document establishes a standard for the periodic inspection and maintenance of Chicago Transit Authority Rail System trackage. This includes periodic visual, electrical, and mechanical inspections of components that affect safe and reliable operation. This standard also identifies the necessary qualifications for Chicago Transit Authority (CTA) employees or contractors that perform periodic inspection and maintenance tasks.

The design, maintenance, and inspection standards vary with industry development and improvement. This is a living document subject to revision as necessary.

1.1 Purpose

The purpose of this standard is to verify that tracks are capable of safely supporting train movements through periodic inspection and maintenance, thereby increasing reliability and reducing the risk of hazards, failures, and slow zones.

1.2 Scope

This standard applies to the Chicago Transit Authority Rapid Transit System.

1.3 References

This document shall be used in conjunction with the most recent version of the following publications:

49 CFR 213, Track Safety Standards, 2007.

AREMA Manual for Railway Engineering, Volume 1, Chapter 5.

The most recent version of this manual shall take precedence over any other document if a conflict between the two documents arises.

1.4 Acronyms

CTA Chicago Transit Authority
RTA Regional Transportation Authority of Northeastern Illinois
APTA American Public Transportation Association
AREMA American Railway Engineering and Maintenance-of-Way Association
FRA Federal Railroad Administration
FTA Federal Transit Administration
RTS Rail Transit System
P.C. Point of Curvature
P.T. Point of Tangency
S.T. Spiral to Tangent
T.S. Tangent to Spiral

1.4.1 Glossary of terms

Definitions of technical terms used in this document are provided in the separately available Track Maintenance Standards Glossary.

1.4.2 Combination of conditions

Requirements as prescribed in this part are described as single conditions at a given location. Each individual condition that exists in track may not require immediate action; however, a combination of multiple individual conditions may require a qualified person (as designated in Section 2) to evaluate the conditions for protection and take appropriate action as necessary. Train dynamics, track geometry and track design, location of the track, maximum speeds over the area and any other factors that could negatively influence the severity of the conditions found shall be taken into consideration when evaluating the proper action(s) to be taken, particularly in special work and curved locations.

1.4.3 Restoration and renewal of track

When any work is performed on the track to repair or correct conditions described herein, the work is to be under the supervision of a qualified person as designated by Section 2.

2 Qualified Persons

2.1 Designation of qualified persons

The Chicago Transit Authority shall designate individuals and parties who meet the stated requirements to be qualified to inspect track on the CTA rail system.

2.2 Work performed by others

All contract construction work completed by an outside contractor shall be inspected by a qualified person, as described herein, prior to placing the track in service. CTA shall provide the necessary training to ensure all qualified persons are up to date on Engineering Standards.

2.3 Minimum qualifications of qualified persons

A person designated by the CTA as a qualified person shall

a) have

1) at least two years of satisfactory related experience inspecting, constructing, or maintaining track and special work; or

2) a combination of experience in track maintenance and training from a qualified course in track inspection or from a college-level educational program related to track inspection; or

3) had progressive satisfactory supervisory experience on another transit or railroad system; and

b) demonstrate to the CTA that he or she

1) knows and understands the requirements of this standard;

2) can detect deviations from these requirements; and

3) can prescribe appropriate remedial action to correct or safely compensate for those deviations; and

c) has had no past safety violations.

All potential CTA qualified persons are required to attend the CTA track inspection training program. This program will cover the current CTA track inspection standards, procedures, equipment, and any other relevant material. After completing the course, potential qualified persons shall be required to take and pass an examination to become qualified.

All qualified persons shall be required to re-take and pass the examination yearly.

A list of qualified persons shall be maintained by the Track Maintenance Department.

3 Inspection

3.1 Track Inspection

a) Every effort shall be made to perform a walking inspection of all tracks. In the unusual event that inclement weather prevents a walking inspection the roadmaster may direct a qualified person to inspect the track from a revenue vehicle in a position in full view of the roadbed at a speed that allows detection of noncompliance with standards. Inspections shall be performed by a qualified person as prescribed by Section 2

b) Revenue tracks over 10 years of age shall be inspected twice every seven consecutive days.

c) Revenue tracks 10 years of age or newer shall be inspected once every seven consecutive days.

d) An interval of at least two but not more than seven consecutive days shall elapse between inspections.

e) Non-revenue (yard tracks) shall be inspected once every 30 consecutive days.

f) Each roadmaster in charge of inspection shall perform a complete general inspection of his/her territory once every 30 consecutive days.

g) At least once per calender year quality control inspections shall be performed in each inspection territory by qualified persons that do not report directly to the Manager of Track Maintenance, within 24 hours of a regular inspection, to determine the quality of the regular inspection.

h) The Chief Engineer shall perform a complete general inspection of the entire system at least once per calendar year.

Components of a section of track shall be inspected and their condition recorded on the provided hand-held data collector with all deviations or deficiencies input directly into the defect recording

software. Remedial action for defects shall be taken in accordance with the parameters set forth in this standard. All data collected shall be submitted daily for review and approval by the roadmaster in charge of inspection. All records shall be complete and retained on file for a minimum of one year after the date of remedial action and record closeout.

3.2 Ultrasonic rail inspection

Ultrasonic rail flaw detection shall be performed over all revenue track at least once per year. This inspection complements the periodic visual inspections of track. Defective rails shall be clearly marked on each side of the rail web and base. Inspection records shall show the nature of defects, location of flaw, and action taken, if any. Broken rails shall be reported as prescribed in Section 4. Records shall be maintained for a minimum of two years after inspection unless remedial action is taken. In that case, records shall be maintained for a minimum of one year after remedial action and record closeout.

3.3 Track strength inspection

The geometry of mainline standard gauge track shall be inspected and recorded at least once per year by an automated track inspection or measurement vehicle. This inspection complements the periodic visual inspections of track. Data collected in accordance with Section 6 - Track Geometry shall be maintained for three years. Defects detected that exceed tolerances shall be given to the track maintenance manager for corrective action as necessary. Defects shall be reported as prescribed in Section 4.

3.4 CWR inspection

Special inspections of CWR shall occur when the ambient temperature causes the rail temperature to significantly deviate from the neutral temperature of the rail. The neutral temperature for the Chicagoland area is between 80°F and 85°F. Special inspections of CWR shall be performed when the ambient temperature is 80°F less than or 40°F greater than the neutral temperature. Particular attention shall be given to weather periods where the

ambient temperature fluctuates 50°F or more in a short period of time.

3.5 Switch and crossing inspection

a) MAIN LINE switches shall be inspected for defects as part of the regular main line track inspection as described in Section 10.

b) YARD switches shall be inspected for defects as part of the regular yard track inspection as described in Section 10.

c) MAIN LINE and YARD track switches which are signaled or electrically controlled shall be inspected jointly by signal and track forces annually. Joint switch inspection forms shall be used and all information shall be completed for each switch inspected.

d) INSPECTION AFTER TRACK RELATED FAILURE. Switches that failed to operate properly due to a track cause or an undetermined cause shall be inspected by both signal and track qualified inspectors to determine the cause and ensure the repair is complete before being returned to service.

3.6 Special inspection

In the event of fire, flood, seismic activity, severe storm, or other occurrence that may have damaged the track and/or structure, a special inspection of the affected track and structure shall be made as soon as possible after the occurrence. Defects reported by the public or other employees shall be investigated as soon as possible. Appropriate corrective action shall be taken.

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4 Condition Reporting

4.1 Reporting of a condition's location

Proper reporting of the location of defects is a necessary part of the information flow to management and others involved with follow-up and repairs. When a defect is located it shall be recorded with a specific and repeatable position reference such as track number, line stationing, bent number, global positioning satellite (GPS) coordinates, or, if none of the above are available, distance from a signal number, emergency exit, etc.

4.2 Condition prioritization

Defects shall be categorized and quantified by the time sensitive nature of their condition as follows:

Red (1) : Conditions such that the qualified person(s) detecting the condition shall make every effort to correct the condition immediately, and shall also evaluate whether to allow operations to continue under supervision or to place the track out of service immediately. If operation is allowed to continue, the person(s) making the decision must not leave the scene until relieved or until the defect is repaired. When "walking" trains over such a condition, each train shall be stopped short of the defect and the person on the ground shall communicate the situation to the train operator. Movements shall be made at "Restricted Speed with Extreme Caution" — proceeding no faster than 6 mph, being prepared to stop at least two car lengths short of a visible object on the roadway, ready to make a fast stop, watching rails and switches for the route and looking for anything on the roadbed that is unsafe to pass.

Orange (2) : Conditions that require re-inspection by a qualified person within 24 hours of the time of the detection of the condition. The investigating person shall immediately determine whether a slow zone is necessary and what work is required, and shall base these decisions on findings and

other factors, such as the type of defect, the location, and permanent speed of the track in question. Every effort shall be made to correct these defects as soon as practical.

Yellow (3) : A yellow condition, left unrepaired, may affect the integrity of the track system. The inspector shall immediately determine whether a slow zone is necessary and what work is required, and shall base these decisions on findings and other factors, such as the type of defect, the location and permanent speed of the track in question. Every effort shall be made to correct these defects as soon as practical.

Blue (4) : Such designation alerts to a track condition that affects the ride comfort qualities of the track and that may degrade to a worse condition if left uncorrected. Work programs shall be established for the correction of these defects.

White (5) : Conditions that do not require any immediate action. These conditions may affect ride comfort qualities of the track, should they degrade to a worse condition. Uncorrected defects shall be recorded and the reports shall be used for scheduling future work.

4.3 Slow zones

A slow zone is a length of track where conditions require trains to operate at a reduced speed. When required, a slow zone shall be protected as follows:

Temporary slow zones

Locations that require repair and are scheduled for work within 48 hours. Standard flagging rules and procedures shall be utilized to slow trains. If necessary, the Signal Department shall adjust the cab signals accordingly.

Permanent slow zones

For locations that require a reduction in speed for more than 48 hours, the Signal Department shall adjust the cab signals accordingly.

Monitoring of slow zones

Any qualified person working on or inspecting track shall be responsible for reporting and/or replacing missing slow zone signs for locations known to require protection. Track inspectors shall be responsible for continually monitoring sign placement and cab signal speed, and closely monitoring the condition of slow zone locations.

4.4 Condition routing

When a track inspection has concluded, the data from the hand-held device shall be uploaded to the central defect database. During this process, each inspection is checked and approved by the roadmaster in charge of the inspection.

Track engineers shall perform regular queries of the central database to analyze new defects, audit inspections, develop work plans/schedules, and repair defects in a timely manner in order of importance.

The track engineers shall also route non-track related defects to the department in charge of repairing the defective item.

If a defect is critical and requires swift action (Orange or Red defects), then the person discovering the defect shall inform the roadmaster in charge of that track via telephone as soon as possible. The defect shall still be logged in the data collector.

4.5 Defects

The following defect descriptions are available in the software on the hand-held data collectors:

Element	Defect Description
Ballast	DIP IN TRACK
	FOULED BALLAST
	FROST HEAVE
	KINK IN TRACK
	OTHER BALLAST DEFECT
	WASH OUT
Drainage	OTHER TRACK DEFECTS (NOTE COMMENTS)
Fencing	DAMAGED FENCE
Footwalk	BAD WALK TIE
	DEFECTIVE FOOTWALK
	DEFECTIVE FOOTWALK SIGNS
Rail	DEFECTIVE 3RD RAIL ANCHOR
	DEFECTIVE 3RD RAIL INCLINE
	DEFECTIVE 3RD RAIL POT-HEAD
	DEFECTIVE 3RD RAIL TAP
	MISSING OR DEFECTIVE CHAIR
	BOLT HOLE CRACK
	BROKEN RAIL
	CRACKED RAIL
	CROSS LEVEL DEVIATION
	DEFECTIVE WELD
	DETAIL FRACTURE
	DIP IN RAIL
	ENGINE BURN FRACTURE
	EXCESSIVE GAGE WEAR
	EXCESSIVE HEAD WEAR
	HEAD SEPARATION

Table 4.1: Defect descriptions

Element	Defect Description
Rail	HORIZONTAL ALIGNMENT DEVIATION
	HORIZONTAL SPLIT HEAD
	KINK IN RAIL
	LOOSE RAIL
	MISSING LAG SCREW
	MISSING RAIL ANCHOR
	MISSING RAIL FASTENER
	OTHER DEFECT - RAIL (NOTED IN COMMENTS)
	PROFILE DEVIATION
	RAIL (WHEEL) BURN
	RAIL END MISMATCH
	SPLIT WEB
	STRAIGHT VERTICAL BREAK
	TRANSVERSE FISSURE
	VEGETATION GROWING OVER TRACK
	VERTICAL SPLIT HEAD
	WEB SEPARATION
	WORN RAIL
	BROKEN GUARD RAIL
	BROKEN SCREW SPIKES - GUARD
	CRACKED GUARD RAIL
	DEFECTIVE BRACE GUARD RAIL
	DEFECTIVE FISH PLATE
	DEFECTIVE GAGE- GUARD RAIL
	LOOSE BRACE BOLT- GUARD RAIL
	LOOSE FISH PLATE BOLT

Table 4.2: Defect descriptions

Element	Defect Description
Rail	LOOSE JOINT BOLTS - GUARD RAIL
	MISSING BRACE BOLT - GUARD RAIL
	MISSING JOINT BOLT - GUARD RAIL
	MOVING STEEL INSIDE GUARD
	OTHER DEFECT- GUARD RAIL
	WORN GUARD RAIL
	BAD ORDER INSULATED JOINT
	BROKEN ANGLE BAR
	BROKEN BOLT - JOINT
	BROKEN WASHER - JOINT
	EXCESSIVE JOINT OPENING
	LOOSE BOLT- JT
	MISSING ANGLE BAR
	MISSING BOLT - JOINT
	OTHER DEFECT- JOINT
	BROKEN BOLT FROG
	BROKEN HEEL BLOCK BOLT
	BROKEN/CRACKED SWITCH POINT
	CRACKED FROG
	LOOSE BOLT-SW
	LOOSE BRACE/WEDGE
	LOOSE JOINT FROG
	MISSING BOLT FROG
	MISSING BRACE WEDGE
	OTHER DEFECT - SPECIAL WORK (COMMENTS)

Table 4.3: Defect descriptions

Element	Defect Description
Safety	BROKEN OR MISSING MANHOLE COVER
	LOOSE PLANK ON FOOTWALK
	LOOSE RAILINGS
	LOOSE STAIRS
	MISSING WA LIGHT
	TREE OVER RIGHT-OF-WAY
	TRIP HAZARDS
Tie	BROKEN CLIP
	LOOSE CLIP
	LOOSE RAIL FASTENER
	MISSING CLIP
	BURNED TIE
	CONSECUTIVE FAILED TIES
	CRACKED PLASTIC TIE
	LOW TIE
	MISSING HOOK BOLT
	MISSING TIE
	MISSING TRACK MARKER
	NARROW GAGE
	OTHER DEFECT - TIE (COMMENTS)
	POUNDING JOINT
	PUMPING RAIL
	PUMPING TRACK
	SPLIT TIE
	WIDE GAGE

Table 4.4: Defect descriptions

Element	Defect Description
Tie	DEFECTIVE TIE PLATE
	MISSING TIE PLATE
	MISSING TIE SHIM
	SPLIT SHIM
	BROKEN SPIKE
	HIGH SPIKE
	LOOSE SCREW SPIKE
	MISSING SCREW SPIKE
	MISSING SPIKE
	WORN SPIKE
Timber Guard	BURNED TIMBER GUARD
	COMING UP
	CRACKED TIMBER GUARD
	HIGH LAG SCREW
	MISSING LAG
	OTHER TIMBER GUARD DEFECT

Table 4.5: Defect descriptions

5 Roadbed

The roadbed is an important component in the track system. A proper roadbed transfers the weight and dynamic load generated by the train to the ground or structure beneath the track and provides a solid and consistent base for the track. The roadbed is comprised of components that support the track.

5.1 Scope of section

This section prescribes minimum requirements for the roadbed and areas immediately adjacent to the track structure.

5.2 Vegetation

Vegetation found in ballast indicates poor drainage. Vegetation that is within or immediately adjacent to the roadbed shall be controlled so that it does not ----------

a) Become a fire hazard,

b) Obstruct visibility of signs and signals,

c) Interfere with employees performing normal trackside duties,

d) Prevent proper functioning of signal and communication lines,

e) Prevent employees from visually inspecting moving equipment from their normal duty stations, or

f) Strike or rub the sides or tops of trains.

5.3 Drainage

Drainage is an important component in the maintenance of track. Each drain, cross drain, or other water-carrying facility under or immediately adjacent to the CTA's track shall be kept free of

debris and obstructions to accommodate water flow. The senior track engineer shall know the location and condition of civil drainage facilities in his/her territory.

Evidence of drainage problems may include, but are not limited to, drains filled with mud and/or debris; water lines on walls, rails, or other vertical surface; standing water; and muddy ballast.

5.3.1 High water conditions

High water conditions in track shall restrict train operations as shown in Table 5.1.

Priority	Operating Speed	High Water Condition
Red	15 MPH or Less	Within the head of either running rail (No operation is permitted where water is above the running surface of either rail.)
Orange	25 MPH	Above the base of either running rail
Yellow	35 MPH	Up to the base of either rail

Table 5.1: High water conditions

5.4 Other defects along the right-of-way

Defects along the right-of-way such as broken fences, missing manhole covers, damaged footwalk, etc. shall not be reported using the hand held devices. Instead, these defects shall be reported to the roadmaster in charge. Table 5.2 lists some common defects and their priority.

5.5 Storage of materials and equipment along the right-of-way

Material and equipment stored along the right-of-way shall be placed where it will not interfere with the safe operation of trains. Placement shall be secure so that vibration from passing trains

Item	Condition/Priority		
	White	Blue	Red
Drain	Non-functional	—	—
Paper catcher	Missing, damaged, or ineffective	—	—
Handrail	—	—	Missing, damaged, or ineffective
Girder	Damaged	—	—
Ladder	—	—	Missing, broken, or improperly secured
Emergency Exit	—	—	Partially obstructed or blocked
Manhole	Damaged	Missing	—
Footwalk	—	Minor damage	Missing or damaged section
Fences	Damaged	Missing	—
"No Clearance" sign	Loose	Missing or not visible	—

Table 5.2: Miscellaneous appliances and devices

will not allow materials or equipment to move into the rail vehicles' clearance envelope. In addition, material and equipment stored shall be placed such that it will not interfere with the

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a) Possible evacuation of passengers and personnel in an emergency,

b) Possible actions of emergency personnel,

c) Rail vehicles,

d) Operation of train control systems,

e) Operation of switches and special track work,

f) Operation of movable bridges,

g) Traction power distribution systems, and

h) Running or guard rails.

In addition to the items shown above, extra precautions shall be taken with items such as rail, pipe, conduit, and inner-ducts to allow for thermal expansion and contraction. Proper housekeeping practices shall be maintained in all work areas at all times. This includes but is not limited to the removal of all material or equipment when work has been completed in the area.

5.5.1 Material placement

Material placement is dependent on the type of track as follows:

Ballasted Track

All materials shall be stored at a distance greater than seven feet and two inches (7'–2") from the centerline of the track and secured in a manner that will prevent any movement of the materials toward the track.

Subway

All materials shall be stored at a distance greater than seven feet and two inches (7'–2") from the centerline of the track. If the right-of-way does not permit a distance of seven feet and two inches (7'–2"), then the material shall be stored not less than five feet and seven inches (5'–7") from the field side of the

running rail and not greater than three feet and six inches (3'–6") in height. All materials shall be secured in a manner that will prevent any movement of the materials toward the track.

Elevated tracks

All materials shall be stored at a distance greater than seven feet and two inches (7'–2") from the centerline of the track. If the right-of-way does not permit a distance of seven feet and two inches (7'–2"), then the material shall be stored not less than five feet and seven inches (5'–7") from the field side of the running rail and not greater than three feet and six inches (3'–6") in height. All materials shall be secured in a manner that will prevent any movement of the materials toward the track.

5.5.2 Storage of small quantities

All small quantities of materials stored on elevated tracks shall be secured on the foot-walk by enclosing the area with four-inch high wood planks. The planking shall be used on wooden foot-walk and wedges shall be used on fiberglass foot-walk.

5.5.3 Limit quantities of materials

Materials stored on elevated track foot-walks shall not exceed 100 pounds per foot.

5.5.4 Removal requirements

All materials shall be removed from the work area no more than 14 days after the completion of the project. Rail stored as the result of an emergency shall be removed as soon as possible. Materials that are not removed or are stored improperly shall be entered as a defect with a priority of White, unless stored in an unsafe manner. If an unsafe storage condition is found, the roadmaster for that section shall be notified and shall advise on what actions shall be taken.

5.5.5 Storage of rail

Color codes

Stored rail shall be visibly painted within three feet of the ends of the rail as follows:

- Spare rail for revenue track — *bright yellow*
- Re-usable rail for use in yards — *white*
- Rail to be re-used for track construction projects — *blue*
- Scrap and defective rail — *red*

Scrap and defective rail

Scrap and defective rail shall be clearly and conspicuously marked or tagged for proper identification in the field. Any cracks or defects in the rail shall be clearly marked with RED paint along the whole length of the crack or defect.

5.5.6 Inspections

The roadmaster in charge of the track where the materials are stored shall perform an inspection of the site after every work period to ensure that the materials are safely stored and that the site is left in a safe condition.

6 Track geometry

Track geometry is an important part of the rail system. Track geometry defines the recommended speeds the trains may travel to provide a comfortable ride for passengers while minimizing the deterioration of rail cars and stress on the system.

Track gauge is a critical dimension of track geometry. If the gauge is out of tolerance and tight, the wheel-rail interaction could cause the train to climb out of the track and derail. On the other hand, wide gauge can lead to truck hunting that will prematurely wear the rail. Whether in tangent track or curved track, worn rail may prematurely wear the fasteners that will eventually lead to the plates' inability to hold gauge and allow the rail to spread and cause the train to derail.

Horizontal alignment describes how closely the track adheres to its designed geometry; or how straight the track is in tangent (straight) track or how close an actual curve is to its designed curvature.

Superelevation, found in curved sections of track, is where the cross-level is purposely not zero. Superelevation allows rail cars to go faster through curves and makes curves more comfortable for passengers as well as reduces rail wear.

6.1 Track gauge

6.1.1 Gauge

Track gauge is measured at right angles to the rail, 5/8 inch below the plane of the top of the rails. Standard track gauge for all tangent track, unguarded curves of radius 750 feet or greater, and guarded curves of radius 500 feet or greater is 56 1/2 inches. See Figure 6.1.

Refer to Table 6.1 for track gauge limits.

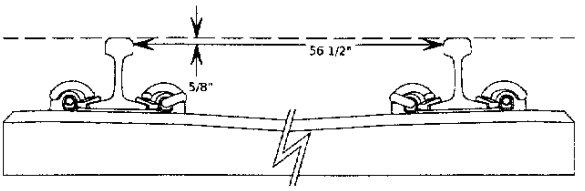

Figure 6.1: Gauge

6.1.2 Gauge limits

Track gauge under normal load conditions shall be maintained within the limits prescribed in Table 6.1.

Priority	Speed	Gauge shall be at least	But not more than
White	Normal	4' 8-1/2" (56-1/2")	4' 9" (57")
Blue	Normal	4' 8-1/2" (56-1/2")	4' 9-1/4" (57-1/4")
Yellow	35mph	4' 8-1/2" (56-1/2")	4' 9-1/2" (57-1/2")
Orange	25mph	4' 8-1/2" (56-1/2")	4' 9-3/4" (57-3/4")
Red	15mph	4' 8" (56")	4' 10" (58")
Red	STOP	loaded gauge greater than 4' 10" (58") or loaded gauge less than 4' 8" (56")	

Table 6.1: Track gauge limits

Some possible indications that a gauge problem may exist are as follows:

- Grease on the gauge face of the low rail on a guarded curve
- Loose rail joints
- One rail out of alignment
- Poor tie conditions
- Loose fasteners
- Evidence of lateral movement of plate on the tie
- Evidence of lateral movement of rail on tie plate
- High, missing, or worn spikes
- Gauge line wear on tangent track or head flow on tangent track

Priority	Speed	Gauge shall be at least	But not more than
White	Normal	4' 8-3/4" (56-3/4")	4' 9-1/4" (57-1/4")
Blue	Normal	4' 8-3/4" (56-3/4")	4' 9-1/2" (57-1/2")
Yellow	35mph	4' 8-3/4" (56-3/4")	4' 9-3/4" (57-3/4")
Orange	25mph	4' 8-3/4" (56-3/4")	4' 10" (58")
Red	15mph	4' 8-1/4" (56-1/4")	4' 10" (58")
Red	STOP	loaded gauge greater than 4' 10" (58") or loaded gauge less than 4' 8-1/4" (56-1/4")	

Table 6.2: Track gauge limits for curves where the radius $\leq 125'$

- Ice between rail and plate (frost heave)
- Worn curve rail
- Wheel flange marks in snow, dirt and mud, crossing timbers, etc.
- Observation of wheels on the rail on passing equipment
- Gapping switch point
- Skewed ties (tight gauge)

6.2 Horizontal alignment (line)

Horizontal alignment standards for curved and tangent track are based on the mid-ordinate (mid-chord offset) of a fixed chord length. Measurements shall be taken at points on the gauge side of the railhead. On tangent track, both rails shall be considered; the rail with the worst alignment shall be used for the application of these standards. On curves, the outside rail shall be used. The deviation from uniformity of the mid-offset from either a 62-ft. or 31-ft. chord shall conform to that shown in Table 6.3. See Figure 6.2

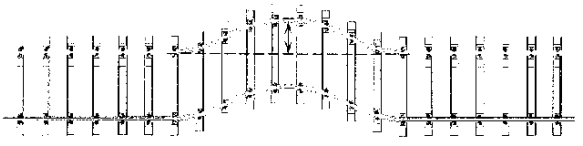

Figure 6.2: Horizontal alignment

Priority	Speed	Maximum Allowable Deviation			
		Tangent Track		Curved Track	
		31'	62'	31'	62'
White	Normal	1/2"	3/4"	1/2"	5/8"
Blue	Normal	1"	1-1/2"	1"	1-1/2"
Yellow	35	1-1/4"	1-3/4"	1-1/4"	1-3/4"
Orange	25	3"	3"	3"	3"
Red	15	3"	5"	3"	5"

Table 6.3: Allowable deviation from horizontal alignment for 31- and 62-foot chords

6.3 Track Surface

The CTA shall maintain the surface of its track within the limits prescribed in Table 6.4.

See Figures 6.3 and 6.4.

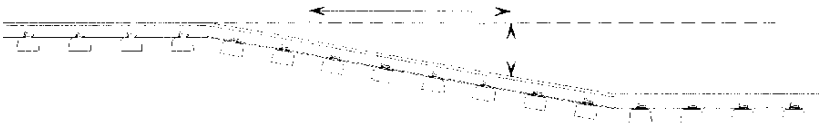

Figure 6.3: Runoff

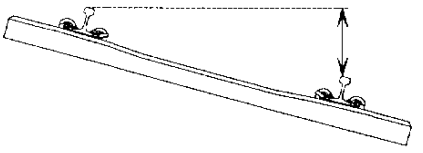

Figure 6.4: Crosslevel

6.4 Superelevation

Curved track shall be super-elevated in accordance with, and maintained within, the limits described in Tables 6.4 and 6.5.

Speed	Normal	Normal	35MPH	25MPH	15MPH
Runoff of 31' at the end of a raise may not be more than	1"	1-1/2"	2"	3"	3-1/2"
Deviation from uniform profile; 31-foot chord	1/4"	3/8"	1/2"	3/4"	1"
Deviation from desired elevation in spirals	3/4"	1"	1-1/2"	1-3/4"	2"
Deviation in cross-level in spirals between two points; 31-foot chord	3/4"	1"	1-1/4"	1-3/4"	2"
Deviation in constant cross-level between two points; 31-foot chord	1"	1-1/4"	1-1/2"	1-3/4"	2"
Deviation from constant cross-level	1"	1-1/4"	1-3/4"	2"	3"

Table 6.4: Track surface

6.5 Superelevation runoff

Superelevation runoff shall be at a uniform rate, as described in Table 6.5, within the limits of track surface deviation prescribed in Table 6.4. Typically, full superelevation shall be from start to finish of a circular curve with superelevation runoff extending the full length of the spirals and onto tangent track. If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be on adjacent tangent or curve. In the absence of a spiral, superelevation may be run up and off through tangent track. If the superelevation is run off within the curve, the minimum superelevation in the curve shall be used to calculate the maximum operating speed. If the superelevation is run off in adjacent tangent, the maximum cross-level on tangent track shall not exceed that shown in Table 6.4.

Type	Tie from +0										
	1	2	3	4	5	6	7	8	9	etc.	
Single	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	etc.		
Double	1/8	1/8	1/4	1/4	3/8	3/8	1/2	1/2	5/8	5/8	etc.
Triple	1/8	1/8	1/8	1/4	1/4	1/4	1/4	3/8	3/8	3/8	etc.

Table 6.5: Standard superelevation runoff in inches

6.6 Determination of superelevation

The method(s) used by the CTA to determine maximum operating speeds on curves shall be maintained on file in the Engineering Department.

6.7 Horizontal curve data

The CTA shall maintain horizontal curve data for every mainline curve on its system. The data shall include the location, overall length, limits, radius, degree of curve, superelevation, length of superelevation runoff, spiral length, spiral angle and maximum allowable operating speed. This data shall be readily accessible to all personnel designated as qualified herein.

7 Track Structure

Next to the roadbed, a sound track structure is fundamental to the railroad. The CTA currently has three major types of track structure. One consists of ties (crossties) and rail fasteners on an open-deck elevated structure. Another consists of ties and rail fasteners in ballast. The last consists of rail fastener assemblies bolted directly to a concrete roadbed structure. The ballast on CTA's ballasted tracks currently limestone. Crossties, or ties, may consist of either wood or composite (plastic). The CTA has four major types of rail fastener assembly. The first – which is the oldest and most simple – consists of a tie pad, a double-shoulder tie plate, two to four cut spikes, and rail anchors. The next consists of a tie pad, a rolled-steel tie plate, either two or four screw spikes or two lock spikes, and two e-clips. These plates may also have insulator bushings between the screw spikes and the plate. Another, used on the concrete roadbed in a system known as direct-fixation (DF) track, consists of a rubber-coated plate, two threaded inserts embedded into the concrete, two bolts, two serrated inserts under the bolt-heads, and two e-clips. The newest rail fastener assemblies consist of a tie pad, a tie plate, four screw spikes, a double-studded rail pad, two e-clips, and two inserts between the e-clips and the rail base.

7.1 Scope of section

This Section prescribes minimum requirements for ballast, crossties, and rail fasteners.

7.2 Ballast

Unless it is otherwise structurally supported, all tracks shall be supported by material that will _____

a) Transmit and distribute the load of the track and rolling equipment to the subgrade;

b) Restrain the track laterally, longitudinally, and vertically under dynamic loads imposed by rolling equipment and thermal stress exerted by the rails;

c) Provide adequate drainage for the track; or

d) Maintain proper track crosslevel, surface and alignment.

If track is raised, tamped, or otherwise disturbed in such a way that the ties are lifted in the roadbed, the track shall be inspected by a qualified person before a train is allowed to pass over that track. This inspection shall be made to ensure that the track has settled sufficiently to provide a safe railroad for the design speed.

Ballast must be distributed and promptly dressed so that ample clearance is provided for rolling equipment, switches are not fouled, and guard rail flangeways are unobstructed.

Conditions to recognize when looking for defects while inspecting ballast:

a) Churned (freshly disturbed) ballast.

b) Displaced ballast.

c) Gaps in the ballast at the end or sides of the ties.

d) Bunched up or piled ballast at the end or sides of the ties.

e) Insufficient ballast shoulder (typically less than 6 inches).

f) Vegetation growing in ballast.

7.3 Rail fastener requirements

7.3.1 General

a) Rail fasteners (crossties, direct fixation, and other rail fasteners) shall be made of a material to which rail can be securely fastened. Fasteners shall be capable of holding rails to their proper gauge and alignment, preventing excessive horizontal and vertical movement and transmitting wheel loads to the supporting structure or ballast.

b) Each segment of track shall have a sufficient number of rail fasteners that in combination provide effective support that will maintain gauge, surface, and alignment as prescribed herein.

c) The minimum number of non-defective rail fasteners for any 39-ft length of a single rail shall be as prescribed in Table 7.1.

d) The number of consecutive defective rail fasteners shall not be more than that prescribed in Table 7.2.

	Priority	Blue	Yellow	Orange	Red
	Speed (mph)	Normal	35	25	15/6
Tangent Track	Elevated	20	16	13	10
	All other	15	8	6	4
Unguarded Curves	Elevated	22	17	13	10
	All other	18	9	6	4
Guarded Curves	Elevated	22	18	14	12
	All other	21	10	6	4

Table 7.1: Minimum number of non-defective rail fasteners for any 39-foot length along a single rail

	Priority	Blue	Yellow	Orange	Red
	Speed (mph)	Normal	35	25	15/6
Tangent Track	Elevated	40"	64"	72"	76"
	All other	52"	78"	104"	108"
Unguarded Curves	Elevated	40"	50"	60"	72"
	All other	52"	70"	100"	104"
Guarded Curves	Elevated	40"	50"	60"	68"
	All other	52"	65"	90"	102"

Table 7.2: Maximum distance between non-defective rail fasteners

A rail fastener shall be considered defective if it is broken, bent, missing, or otherwise rendered ineffective. The following list provides examples of what a qualified person should look for when inspecting rail fasteners:

a) Tearing, lifting, or separating of direct fixation fasteners.

b) Missing rail anchors.

c) Rail anchors that are away from the edge of the tie.

d) Lifted, loose spikes or otherwise ineffective fasteners.

e) Resilient fasteners that are loose, missing, or broken along one side of the rail.

f) Skewed gauge rods.

g) Broken, loose, excessively worn, or missing insulator bushings, where applicable.

h) Does not hold gauge when 3000 or more pounds of test load is applied by a testing apparatus.

7.3.2 Timber crossties

Timber crossties shall be considered ineffective if any of the following conditions exist:

a) There are less than two spikes along each rail (one on the gauge side and one on the field side of each rail), except in cases of special tie plates designed otherwise,

b) The crosstie is broken or burned through,

c) The crosstie is spike-killed to the extent that it can no longer effectively hold spikes or gauge,

d) The crosstie is split or impaired to the extent the tie will allow the ballast to work through,

e) The crosstie is plate-cut more than 1 inch, or

f) The crosstie is deteriorated such that the tie plate or base of rail can move laterally more than 1/2 inch relative to the crosstie.

g) The crosstie is not spiked as required.

Conditions to recognize when inspecting ties that may indicate a track defect:

a) Skewed ties

b) Tie movement or bunching (uneven tie spacing)

c) Hanging or swinging ties, particularly at approaches to bridges or direct fixation track

d) Clusters of defective ties

7.3.3 Concrete ties

Concrete ties shall be considered ineffective if any of the following conditions exist:

a) The rail clip assembly is broken, missing, or impaired;

b) A rail clip bolt is stripped or broken;

c) The rail clip shoulder on the tie is damaged such that it provides no lateral support to the clips; or

d) The tie is cracked so that the opening is greater than or equal to 1/8 inch. (A crack opening greater than or equal to 1/16 inch shall be monitored with the anticipation of the opening growing to 1/8 inch constituting a failed concrete tie).

e) Particular attention shall be payed to cracks that run parallel to the running rail or extend to or from fasteners as this may cause corrosion to rebar or fasteners.

f) The tie angle between the blocks is cracked or is corroded through.

Concrete ties currently only exist at Foster Middle track, Edmunds Center track, and 98^{th} yard. These ties are of the two-block, Swedish Railway System type.

7.3.4 Direct fixation fasteners

Direct fixation fasteners (See Figure 7.1) shall be considered ineffective if any of the following conditions exist:

a) The rail clip is broken;

b) One or both anchor bolts are missing, broken, or so loose as to be rendered ineffective on one pad;

c) One or both anchor bolt inserts are stripped or otherwise unusable on one pad;

d) The pad is corroded, deteriorated, or broken such that the rail fasteners or anchor bolts no longer provide lateral or vertical support; or

e) The concrete supporting the fastener is deteriorated or impaired such that it does not provide proper support.

f) The concrete supporting the fasteners is cracked so that the opening is greater than or equal to 1/8 inch. (A crack opening greater than or equal to 1/16 inch shall be monitored with the anticipation of the opening growing to 1/8 inch).

g) Particular attention shall be given to cracks in the concrete that run parallel to the running rail or extend to or from fasteners as this may cause corrosion to re-bar or fasteners.

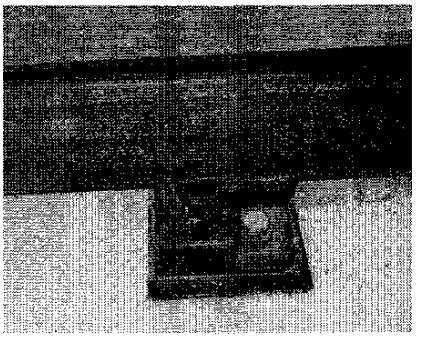

Figure 7.1: Typical direct fixation (DF) rail fastener

7.3.5 Composite (plastic) ties

Plastic crossties shall be considered ineffective if any of the following conditions exist:

a) The crosstie has any crack near a fastener parallel to the running rail,

b) The crosstie has visible voids or holes larger than two inches in diameter or a spongy core,

c) The crosstie has a crack perpendicular to the centerline of track,

d) The crosstie has a loss of cross-sectional area in the tie plate location,

e) There are less than two screw spikes along each rail (one on the gauge side and one on the field side of each rail), except in cases of special tie plates designed otherwise,

f) The crosstie is cracked through,

g) The crosstie is spike-killed to the extent that it can no longer effectively hold screw spikes or gauge,

h) The crosstie is plate-cut, or

i) The crosstie is deteriorated such that the tie plate or base of rail can move laterally more than 1/2 inch perpendicular to the centerline of track.

7.4 Clearances

a) The CTA has developed Right-of-Way Clearance Diagrams based upon the car and line equipment dynamic envelopes. Right-of-Way Clearance Envelopes cannot be violated without the prior approval of the Chief Engineer. Track clearances shall be maintained as required by the car and line equipment clearance diagrams. Any indication of equipment striking wayside objects requires prompt action. Any violation to personnel clearances shall be promptly communicated to the responsible manager, and marking of the affected area shall be performed as soon as possible. Clearances shall be checked after any work has been completed on or in the vicinity of the tracks.

b) Before commencing horizontal or vertical track alignment changes the responsible manager shall ensure that a physical inspection of the area to be surfaced is conducted prior to the beginning of the work. Special attention shall be given to reductions in overhead or lateral clearances caused by the installation of conduits, pipes, cables, light fixtures, or any other appurtenances. Clearance measurements shall be made before track is returned to service. Measurements of clearances before and after the work is completed shall be recorded and kept on file in the Engineering Department.

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8 Rail

Rail is classified by weight per length, which in the United States is pounds per yard. An example would be 115 RE rail, which is 115 pounds in weight per one yard of length. Other rail sections lighter than 115 pounds are present on the CTA system; however, the current design standard is AREMA 115 RE rail. All CTA standard sections are described in the AREMA Manual for Railway Engineering, Volume 1 - Track. The rail size, manufacturer, and date of manufacture can be found on the web of the rail, generally on the gauge side unless the rail has been transposed, or flipped. Rails can be joined by either joint bars or welding. Joint bars are generally classified by the number of holes in the bar, half of which are on each rail in the joint. On the CTA, 4-hole and 6-hole joint bars are used and, on ballasted track, welding is used to join rails. The rail itself has three parts – the base, the web, and the head. Defects that affect the ability of the rail to safely carry a train can occur in any part of the rail and can also occur in joint bars and welds. Defects can also be internal to the steel or external. Internal defects are not always visible but can be detected with ultrasonic testing. Some internal defects will cause a noticeable change in the shape of the rail, such as web separation, where the steel in the web is not fully bonded when the rail is rolled and it will split vertically down the middle causing a visible bulge in the web.

8.1 Scope of section

This Section prescribes the requirements for the maintenance of rail.

8.2 Defective rails

This Section prescribes the actions required when defective rails are discovered. Refer to the rail terminology in Figure 8.1 when identifying where in the rail a defect is located.

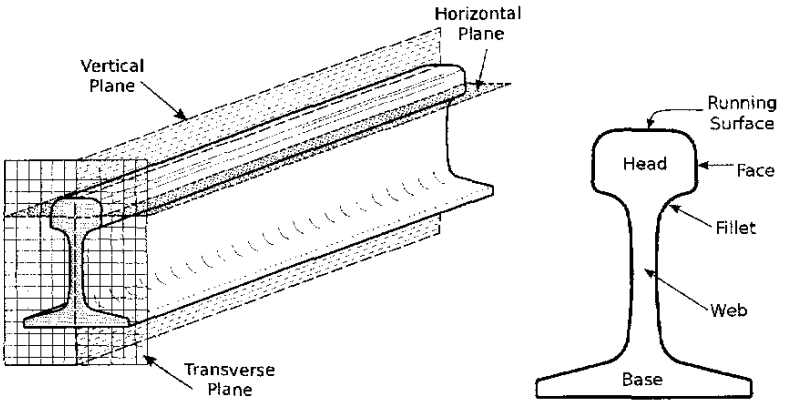

Figure 8.1: Rail terminology

8.2.1 Knowledge of defective rails

Upon notice that a rail in track contains any of the defects listed in Tables 8.1, 8.2, and 8.3, a qualified person shall immediately determine whether the track may continue in use until the rail is replaced or the appropriate remedial action described in Tables 8.1, 8.2, and 8.3 is taken.

8.2.2 Application of joint bars on defective rails

Where appropriate, when applying joint bars to mitigate rail defects action shall be taken as follows:

a) Bolts shall be applied to the defective rail through the outermost holes;

b) The minimum number of bolts that would be used for a rail joint at that same location as prescribed herein shall be used;

c) Care shall be taken not to drill bolt holes through the rail through the location of the defect;

d) At welds, if joint bars are used to protect rail defects, steps shall be taken to ensure that the joint bars properly fit the rail. Special rail joint bars, specifically designed for that rail section and for use at weld locations, shall be used. Field modified, torch cut, or strap protective bars shall not be used; and,

e) If a rail defect is found in the wing or heel rails of a frog,

the existence of two frog bolts on both sides of the defect may be considered the same as joint bars.

8.2.3 Defects within switch points and stock rails

If a switch point or stock rail is defective, then, at a minimum, the following action shall be taken, unless more restrictive action is required by Tables 8.1, 8.2, and 8.3:

a) Where remedial actions require the use of joint bars, and joint bars cannot be placed due to the physical configuration of the switch, remedial action B will govern, provided there are reinforcing bars on the both sides of the switch point and there are at least two bolts or rivets on each side of the defect; or,

b) A qualified person shall supervise each train movement over defective rail; or,

c) The operating speed over defect location is limited as determined by a qualified person.

8.3 Types of rail defects

There are many different types of rail defects that could occur. This section discusses the most probable defects, what should be done when they are found (Tables 8.1, 8.2, and 8.3), and how they are typically repaired.

8.3.1 Transverse defects

transverse defect : When ultrasonic testing locates a transverse defect (a defect in the transverse plane of the rail), the tester shall classify what type of defect has been located, such as a transverse fissure, compound fissure, detail fracture, etc.

transverse fissure : A progressive crosswise fracture starting inside the head from which it spreads outward as a smooth, light or dark, round or oval surface substantially at a right angle to the length of the rail. The distinguishing features of a transverse fissure from other types of fractures or defects are the crystalline center or nucleus and the nearly smooth surface of the development that surrounds it. See Figure 8.2.

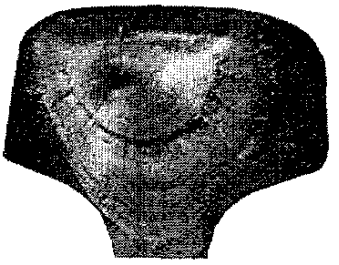

Figure 8.2: Transverse fissure

compound fissure : A progressive fracture originating in a horizontal split head which turns up or down in the head of the rail as a smooth, bright or dark surface, progressing until substantially at a right angle to the length of the rail. Compound fissures require examination of both faces of the fracture to locate the horizontal split head from which they originate. See Figure 8.3.

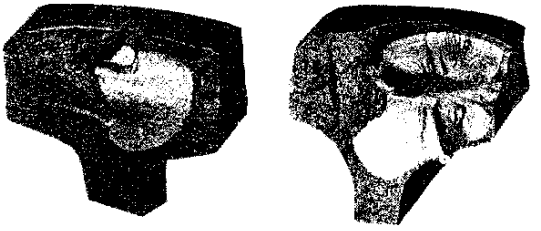

Figure 8.3: Compound fissure

detail fracture : A progressive fracture originating at or near the surface of the railhead. These fractures should not be confused with transverse fissures, compound fissures, or other defects, which have internal origins. Detail fractures usually have their origins in the following types of defects, and progress crosswise into the head of the rail — shelling, where a thin shell of metal becomes separated from the head, usually at the gauge corner, and head checks, usually at or close to the gauge corner where movement or flow of the surface metal is sufficient to start a hairline crack. See Figure 8.4.

engine burn fracture : A rail break resulting from the destruction of rail head metal caused by the train's powered wheels spinning in one spot.

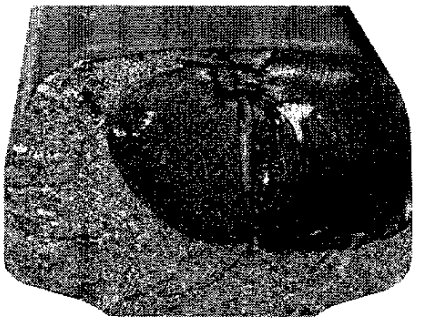

Figure 8.4: Detail fracture

defective weld : A field or plant weld containing any discontinuities or pockets, exceeding 5% of the rail head.

horizontal split head : A horizontal progressive defect originating inside of the rail head, usually 1/4" or more below the running surface and progressing horizontally in all directions, and generally accompanied by a flat spot on the running surface. The defect appears as a crack lengthwise along the rail when it reaches the side of the rail head. See Figure 8.5.

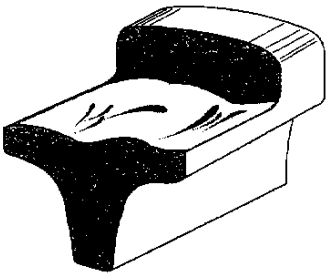

Figure 8.5: Horizontal split head

vertical split head : A split along or near the middle of the head of a rail and extending into or through it. A crack or rush streak may show under the head closest to the web, or pieces may be split off the side of the head.

split web : A longitudinal or diagonal transverse crack in the web of a rail. See Figure 8.6.

piped rail : One with a vertical split, usually in the web, due to failure of the sides of the shrinkage cavity in the ingot to unite in rolling. See Figure 8.7.

head and web separation : A progressive fracture, longitudinally separating the head

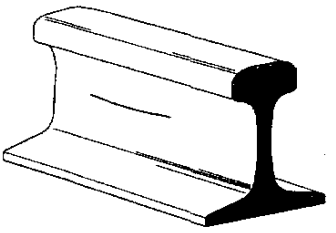

Figure 8.6: Split web

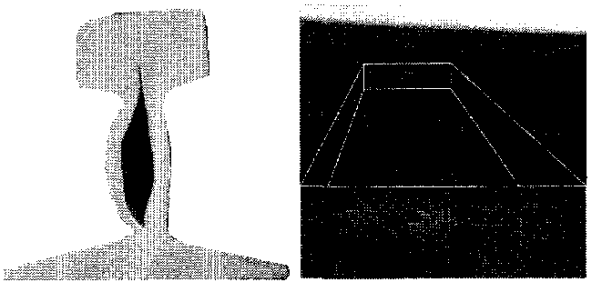

Figure 8.7: Piped rail

from the web of the rail at the head fillet area. See Figure 8.8.

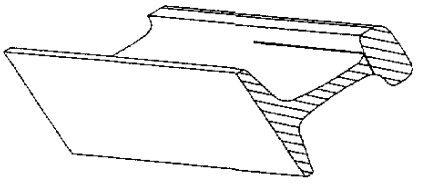

Figure 8.8: Head/web separation

bolt hole crack : A crack across the web, originating from a bolt hole, and progressing on a path either inclined upward toward the rail head or inclined downward toward the base. See Figure 8.9.

broken base : Any break in the base of the rail. See Figure 8.10.

flattened rail (head) : A short length of rail, not at a joint, which has flattened out across the width of the rail head to a measurable depth. Flattened rail occurrences have no repetitive regularity and thus do not include corrugations, and have no apparent localized cause such as a weld or engine burn. Their individual length is relatively short, as compared to a condition such as head flow on the low rail of curves. See Figure 8.11.

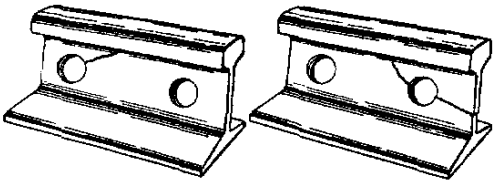

Figure 8.9: Bolt hole cracks

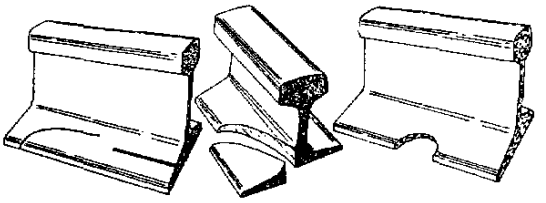

Figure 8.10: Broken or damaged bases

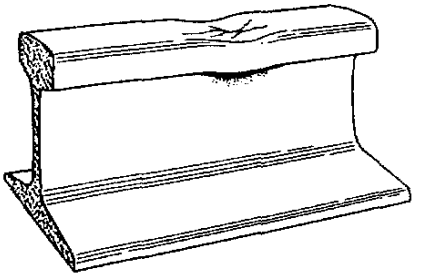

Figure 8.11: Flattened rail (head)

ordinary break : A partial or complete break in which there is no sign of fissure, and in which none of the other defects described in this manual are found. See Figure 8.12.

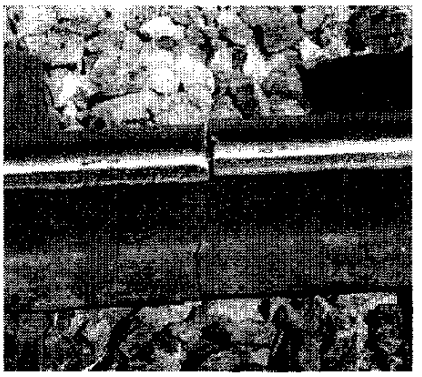

Figure 8.12: Ordinary break

corroded rail : Rail that has lost section due to corrosion, usually in the rail's base. See Figure 8.13.

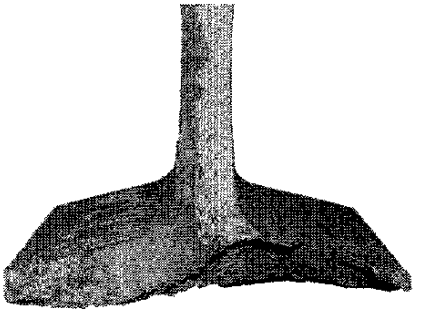

Figure 8.13: Corroded rail

rail corrugation : A wear condition on the railhead of alternate peaks and hollows, which may develop in service under certain conditions. See Figure 8.14.

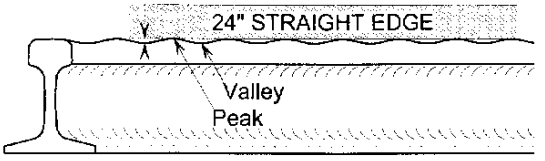

Figure 8.14: Rail corrugation

Defects shall be classified as in Tables 8.1, 8.2, and 8.3.

8.3.2 Torch cut rails

Rail may be torch cut as a part of destressing maintenance or during any other rail emergency. Once the rail has been torch cut, the rail shall be saw-cut no less than six inches from the closest part of the rail that was burned. Once torch cutting of rail has begun, the work shall proceed uninterrupted until complete.

8.3.3 Required action for defective rails

The CTA shall either replace the defective rail or, at a minimum, perform the action(s) shown in Tables 8.1, 8.2, and 8.3.

Type of transverse rail defect	Rail head cross-sectional area weakened by defect		Priority	Action
	Greater than	less than		
Transverse fissure	5%	33%	Yellow	B
	33%	100%	Orange	A2
	100%	—	Red	A
Compound fissure	5%	33 %	Yellow	B
	33%	100%	Orange	A2
	100%	—	Red	A
Detail fracture	5%	33%	Yellow	B
	33%	100%	Orange	A2
	100%	—	Red	A
Engine burn fracture	5%	33%	Yellow	B
	70%	100%	Orange	A2
	100%	—	Red	A
Defective weld	5%	25%	Yellow	C
	25%	80%	Orange	D
	80%	100%	Red	A2 or both E & H
	100%	—	Red	A or both E & H

Table 8.1: Rail defect remedial action

Type of longitudinal rail defect	Longer than	Shorter than	Priority	Action
Horizontal split head	1"	2"	Blue	H and F
	2"	4"	Yellow	I and G
	4"	—	Orange	B
	Break out in rail head		Red	A
Vertical split head	1"	2"	Blue	H and F
	2"	4"	Yellow	I and G
	4"	—	Orange	B
	Break out in rail head		Red	A
Split web	1"	2"	Blue	H and F
	2"	4"	Yellow	I and G
	4"	—	Orange	B
	Break out		Red	A
Piped Rail	1"	2"	Blue	H and F
	2"	4"	Yellow	I and G
	4"	—	Orange	B
	Break out		Red	A
Head/web separation	1"	2"	Blue	H and F
	2"	4"	Yellow	I and G
	4"	—	Orange	B
	Break out		Red	A
Bolt hole crack	1/2"	1"	Blue	H and F
	1"	1-1/2"	Yellow	H and G
	1-1/2"	—	Orange	B
	Break out		Red	A
Broken base	1"	6"	Orange	D
	6"	—	Red	A or both E & I

Table 8.2: Rail Defect Remedial Action (continued)

Other rail defects	Depth	Size	Priority	Action
Flattened rail (head)	Greater than or equal to 3/8"	Greater than or equal to 3/8"	Yellow	H
Ordinary break Damaged rail	N/A N/A	Any Any	Red Orange	A or E D
Corroded rail	Loss of metal at base of rail		Orange	K
Short wave rail corrugation	Over 1/8" deep		Yellow	Grind rail

Table 8.3: Rail Defect Remedial Action (continued)

Minimum Remedial Actions for Tables 8.1, 8.2, and 8.3:

A : A qualified person shall supervise each operation over defective rail at a speed not to exceed 15 MPH.

A2 : A qualified person shall make visual inspection. The qualified person may determine that operation may continue without continuous visual supervision at a maximum of 15 MPH for up to 24 hours. If the rail is not replaced within that 24-hour period, inspections by a qualified person shall continue, not more than 24 hours apart until the rail is replaced or a determination is made requiring a more restrictive action.

B : Apply joint bars within 20 days after it is determined to continue the track in use and limit operating speed over defective rail to a maximum of 25 MPH until joint bars are applied; thereafter, limit speed to 55 MPH. When a search for internal rail defects is conducted and defects are discovered in tracks with operating speed over 55 MPH, the operating speed shall be limited to 55 MPH, for a period not to exceed four days. If the defective rail has not been removed from the track or a permanent repair made within four days of the discovery, the maximum operating speed shall be limited to 25 MPH until joint bars are applied; thereafter, limit speed to 55 MPH.

C : Apply joint bars within 10 days after it is determined to continue the track in use by qualified person. In tracks

with operating speed over 55 MPH, limit operating speed over the defective rail to 25 MPH or less as authorized by a qualified person, until joint bars are applied; thereafter, limit speed to 55 MPH.

D : Apply joint bars to defect within 10 days if determined to continue the track in use with a maximum operation speed of 25 MPH or less as authorized by a by qualified person. After joint bars are applied, limit speed to 55 MPH or less as authorized by a by qualified person.

E : Apply joint bars.

F : Qualified person to re-inspect rail within three months after it is determined to continue the track in use.

G : Qualified person to re-inspect rail within one month days after it is determined to continue the track in use.

H : Limit operating speed over defective rail to no more that 55 MPH or less as determined by qualified person.

I : Limit operating speed over defective rail to no more that 25 MPH or less as determined by qualified person.

J : Limit operating speed over defective rail as determined by qualified person.

K : Base corroded rails shall be inspected and verified by track supervision. The track supervision shall perform an inspection of the base corroded rails at least once a week. If any priority track geometry defects are found at the base corroded rail location, the rail shall be replaced as soon as possible.

8.4 Rail wear

The CTA has established rail wear limits based on rail section and wheel flange dimension as shown in Table 8.4.

8.4.1 Measuring rail wear

Rail gauge face wear and head width shall be measured at the gauge line as defined herein. Vertical wear shall be measured along the centerline of the rail web. See Figure 8.15.

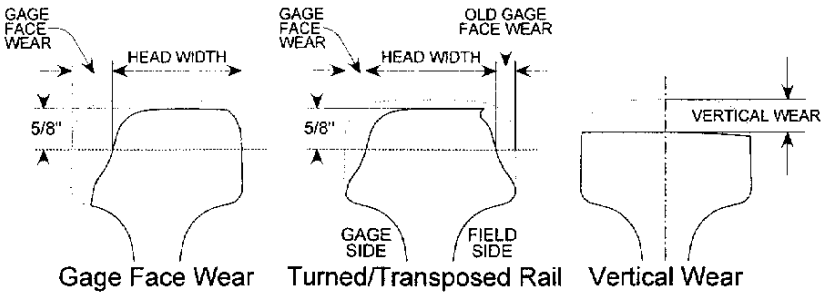

Figure 8.15: Rail wear (Gauge side on the left)

Rail Wear	Monitor	Change
Running Rail Vertical Wear	$\geq 1/2$"	$\geq 5/8$"
Running Rail Side Wear	$\geq 1/2$"	$\geq 5/8$"
Running Rail Vertical Wear	$\geq 1/2$"	$\geq 5/8$"

Table 8.4: Rail Wear Limits for 115 RE rail sections

8.5 Rail joints and rail ends

Rail joints, joint bars applied to rail defects, and joint bars on restraining rails shall be maintained as described herein.

8.5.1 Rail joints

a) Each rail joint, insulated joint (IJ), and compromise joint shall be of a structurally sound design and dimensions for the rail which it is applied. See Figure 8.16.

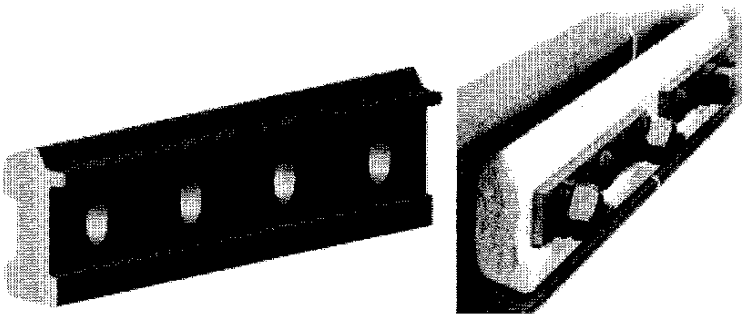

Figure 8.16: Rail joint bar (Left), Insulated joint (IJ)(Right)

b) If a joint bar is cracked, broken, or because of wear allows longitudinal or vertical movement of either rail when all

bolts are tight and the rail is replaced, it shall be replaced as necessary.

c) If a joint bar is cracked or broken between the middle two bolt holes it shall be replaced.

d) In the case of conventional jointed track, each rail shall be bolted with at least two bolts at each joint.

e) In the case of continuous welded rail track, each rail shall be bolted with a minimum of two bolts in each rail at each joint.

f) Each joint bar shall be held in position by four (4) track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations. When no-slip, joint-to-rail contact exists by design, the requirements of this paragraph do not apply.

g) No rail shall have a bolt hole that is torch cut or burned.

h) No joint bar shall be reconfigured by torch cutting.

Conditions to recognize when inspecting track that may indicate a defective joint:

a) Pull-aparts.

b) Track Bolts that are bent, broken, or worn.

c) Heavily worn fishing surfaces.

d) Frozen joints (rail end gaps at rail joints that are open when the rail is hot and closed when the rail is cold).

8.5.2 Rail ends

Rail ends shall be maintained as described herein.

Rail end mismatch

Gauge face mismatch shall be measured at the gauge line as described herein. Tread mismatch shall be measured along the centerline of the rail web. See Figure 8.17. Rail end mismatch shall not exceed that shown in Table 8.5.

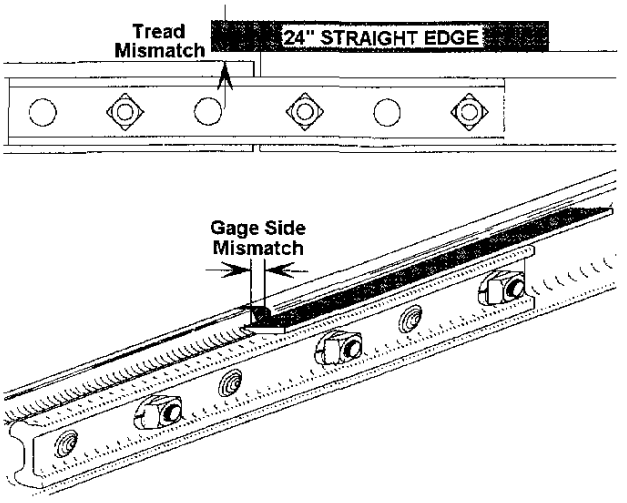

Figure 8.17: Mismatch

Priority	Speed	Tread Mismatch	Gauge Face Mismatch
Blue	35	1/8"	1/8"
Yellow	25	3/16"	3/16"
Orange	15	1/4"	3/16"
Red	6	1/4"	1/4"

Table 8.5: Rail end mismatch

Rail end batter

Rail end batter, weld batter and peaked weld shall not exceed that shown in Table 8.6. See Figure 8.18 for examples of rail end batter.

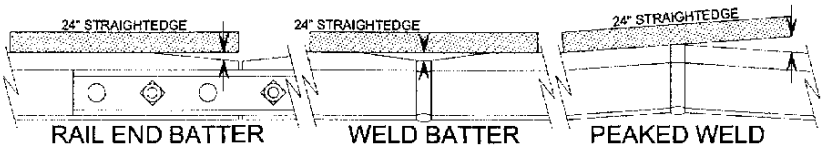

Figure 8.18: Rail batter

Priority	Speed	Tread Mismatch
White	Normal	1/16"
Blue	35	1/8"
Yellow	25	3/16"
Orange	15	1/4"
Red	6	1/2"

Table 8.6: Rail batter

8.6 Continuous welded rail (CWR)

8.6.1 Procedures

The CTA has formed written procedures that address the installation, adjustment, maintenance, and inspection of CWR, and a training program for the application of those procedures. Maintenance staff are required to be familiar with procedures pertaining to CWR and to successfully complete the training program. The following is a brief discussion of CWR.

a) Procedures for the installation of CWR include:

1) Designation of a desired rail installation temperature range for the geographic area in which the CWR is located. CWR shall be laid when the rail temperature is within the temperature range specified by the following equations:

$$Minimum\ D.R.T. = \frac{2H_t + L_t}{3} + 10 \qquad (8.1)$$

$$Maximum\ D.R.T. = \left(\frac{2H_t + L_t}{3} + 25\right) \pm 5 \qquad (8.2)$$

Where

$D.R.T.$ is the Desired Rail Temperature
H_t is the Highest Rail Temperature
L_t is the Lowest Rail Temperature

For Chicago, the D.R.T. range is 80 to 85 degrees Fahrenheit.

2) When performing any work on CWR that will disturb the track, the rails shall be stabilized.

b) Continuous welded rail shall be fastened using elastic fasteners such as e-clips. Care shall be taken to ensure that proper longitudinal restraint is developed to prevent rail movement regardless of the fastening system that is used.

c) The CTA has procedures that address maintaining a desired rail installation temperature range when cutting CWR including rail repairs, in-track welding, and in conjunction with adjustments made in areas of tight track, track buckles, or pull-aparts. Rail repair practices shall take into consideration existing rail temperature so that:

1) When rail is removed, the length installed shall be determined by taking into consideration the existing rail temperature and the desired rail installation temperature range; and

2) Under no circumstances should rail be added when the rail temperature is below that designated in Equation 8.1 herein without provisions for later adjustment.

d) The CTA also has procedures that address the monitoring of CWR in curved track for inward shifts of alignment toward the center of the curve as a result of disturbed track or from thermal stress.

e) The CTA has procedures that control train speed on CWR track when

1) Maintenance work, track rehabilitation, track construction, or any other event occurs which disturbs the roadbed or ballast section and reduces the lateral or longitudinal resistance of the track; and

2) In formulating the procedures under this paragraph, the CTA has:

i) Determined the speed required, and the duration and subsequent removal of any speed restriction based on the restoration of the ballast, along with sufficient ballast re-consolidation to stabilize the track to a level that can accommodate expected train-induced forces. Ballast re-consolidation can be achieved through either the passage of train tonnage or mechanical stabilization procedures, or both; and

ii) Taken into consideration the type of fasteners used.

f) The CTA also has procedures that prescribe when physical track inspections are to be performed to detect buckling prone conditions in CWR track and has identified the following:

1) Locations where tight or curved track geometry or special trackwork exist,

2) Locations where track work has disturbed the ballast section, or shoulders are not adequate and

3) In formulating the procedures under this paragraph, the CTA has:

i) Specified the timing of the inspection; and

ii) Specified the appropriate remedial actions to be taken when buckling prone conditions are found.

g) The CTA shall have in effect a comprehensive training program for the application of these written CWR procedures, with provisions for periodic re-training, for those individuals designated as qualified herein.

h) The CTA shall also prescribe record-keeping requirements necessary to provide an adequate history of track constructed with CWR. At a minimum, these records shall include:

1) Rail temperature, location, and date of CWR installations or adjustments. This record shall be maintained as long as the rail is in service.

2) A record of any CWR installation or maintenance work that does not conform to the written procedures. Such a record shall include the location of the rail and be maintained until the CWR is brought into conformance with such procedures.

3) The CTA maintains Track Books with the above information.

8.6.2 Inspection of CWR

When inspecting CWR, the following areas are to be addressed:

a) Adequacy of the ballast section at curved track, sags, culverts, ballasted deck bridges, and locations where vehicles may have been driven along the right of way or where footpaths may cross tracks.

b) Loose, bent, or broken bolts. Anchor position shall be checked and anchors repositioned against the ties if necessary.

c) Evidence of rail moving through fastenings/anchors.

d) Evidence of track moving downhill or with the direction of traffic by noting if anchored ties are moving toward non-anchored ties.

e) Short flat spots in curve alignment or line kinks in tangent track, and determine if ties are floating in the ballast section by digging out one tie end at a time. It is imperative that all ties in welded rail track be properly tamped.

f) Evidence of the base of rail not seated uniformly on the tie plates. Overstressed rail will have a tendency to lift and tilt on the tie plates.

8.6.3 Maintaining and working on CWR track

Before performing trackwork that has the potential to disturb CWR track, a qualified person shall determine if the rail needs to be de-stressed or other appropriate actions taken to maintain the stability of the track.

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9 Restraining (guard) rails on *regular track*

9.1 Scope of section

This section describes the requirements for maintenance of restraining rails in other than special trackwork. Where bolt-on type guards or guarding restraining rails on regular track are used this sub-part shall apply. Within special trackwork the requirements of Section 10 shall apply.

9.2 Restraining rail guard face gauge

The CTA uses restraining rail when a curve has a radius less than or equal to 400 feet (R≤400'). A record of these locations is on file. Where double guarding restraining rails are used the guard face gauge shall be maintained within the limits shown in Table 9.1.

Priority	Speed	Double Guarding Restraining Rails Guard Face Gauge
White	Normal	+1/4"
Yellow	25	+3/8"
Red	6	+1/2"

Table 9.1: Double guarding restraining rails guard face gauge

9.3 Restraining rail maintenance standards

The CTA has developed maintenance requirements regarding the maintenance, application, and use of restraining rails used for guarding purposes. A summary of the requirements is below:

a) Speeds shall be reduced for locations where guard rail has been removed based on the geometry at that location.

b) Upon discovery of a broken guard rail, either a slow zone or emergency repair shall be implemented as required, based upon the location and severity of the break.

c) Restraining rail fasteners shall be inspected during the routine track inspection. Defective fasteners shall be reported and either a slow zone or replacement plan shall be implemented as necessary.

d) Flares on restraining rails shall be 3-feet long, 2-inches in, and 2-inches down.

e) The flangeway width tolerance shall be -0 and + the value of the gauge face wear on the high side of the curve.

f) In no case shall the minimum flange-way width on restraining rails be allowed to be less than 1 7/8 inches.

10 Special trackwork

10.1 Scope of section

In turnouts and track crossings, fastenings shall be intact and maintained so as to keep the components securely in place. Each switch, frog, and guardrail area shall be kept free of obstructions that may interfere with the passage of wheels. Switches shall be periodically subjected to a joint switch inspection with the Signal Department. This inspection shall include observing the operation of the switch by moving the switch through a complete normal to reverse to normal cycle. Regular switch inspections shall include observing the switch while trains are passing over the switch.

10.1.1 Longitudinal rail movement

Tracks shall be equipped with rail anchoring through and on each side of track crossings and turnouts to restrain rail movement affecting the position of switch points and frogs.

10.1.2 Minimum flange-way

Flange-way at turnouts and track crossings shall be at least 1 1/2." Refer to Section 1.3 for exceptions.

10.2 Switches

a) Each stock rail must be securely seated in the switch plates, but care must be used to avoid canting the rail by over tightening the rail braces.

b) Each switch point shall fit and face up closely and accurately against its stock rail with the switch stand or switch machine in either of its closed positions, to allow wheels to pass the switch points without striking them. In switches with planed points (AREMA design with undercut stock rail) the point must be completely under the stock rail between the actual point of switch and the #2 track rod when

the point is in the closed position; the first 6 inches of the point should not be visible when looked at from above, and must not be higher, under any circumstances, than the top of the stock rail. Any signs of unusual wear on the first 6 inches of the point must be carefully investigated to determine and promptly eliminate the cause. Lateral and vertical movement of a stock rail in the switch plates, or of a switch plate on a tie must not adversely affect the fit of the switch point against the stock rail. Immediate protection and prompt corrective action are necessary when a switch point is found to stand open against its stock rail.

c) Any lip formation on the gauge side of the stock rail along its undercut area must be promptly corrected to ensure that the switch point fits tightly against the stock rail.

d) Each switch must be maintained so that the outer edge of the wheel tread (especially in worn wheels with false flange conditions) cannot contact the gauge side of the stock rail.

e) The heel of each switch point must be secure, and the bolts in each heel must be kept tight.

f) Each switch stand and connecting rod must be securely fastened and operable without excessive lost motion.

g) Each hand throw lever must be maintained so that it cannot be operated while the lock is in the keeper.

h) Each switch position indicator must be clearly visible at all times.

i) Switch points must be replaced when the raised portion of the switch point is worn down to the top of the stock rail (in general, the raised portion of the switch point starts after the second track rod and ends past the heel of the switch; the maximum rise of the switch point over the top of the stock rail in this area is inch). In addition, if the tip of the switch point, with the point set against its stock rail, is higher than the top of the stock rail, then both the point and the stock rail must be replaced.

10.2.1 Special design switches

Special design switches, which by design exceed maximum allowable gauge limits, are permitted where operating speeds do not

exceed 15 MPH.

10.2.2 Switch Inspection Check List

a) That a turnout is in proper surface and gauge.

b) That the ballast is 3 inches below the top surface of the ties. (If switch is in concrete it should show no signs of cracking).

c) Ties should show no signs of shifting in the ballast.

d) Rails must be properly secured to ties.

e) Switch points must have full bearing on slide plates.

f) Stock rails must show no signs of creeping.

g) Any loose or missing parts must be located and remedied.

h) Make sure switch rods are holding points firmly.

i) Make sure all joints are bolted and that there is no vertical or lateral movements.

j) Switch points must fit snugly against rails.

k) Make sure all switch fastenings are secured with cotter pins.

l) Switch points must fit snugly against stock rails.

m) Vertical bolts, housetop bolts, switch rod bolts must be secured tightly with cotter pins.

n) Throw of switch should be 3 3/4 at 1st rod (contingent on the type of switch).

o) Housetop Side Wear limits are 3/8 inch.

p) Housetop clearance under portion to top plane of switch points must be 3/16 inch. Any overflow must be corrected.

q) At heel of switch points check that bolts are not skewed. This can cause tight heel.

r) Check that the switch clips are clear of the side of the ties.

s) Check to ensure that the curved and straight leads are box anchored. Running rails from the heel of the frog, tangent and turnout must also be box anchored. This will prevent longitudinal movement of switch points.

t) Check for chipped switch points.

u) Switch point reinforcements should be secure.

v) Missing bolts should be replaced.

w) Proper housekeeping - remove papers from switch area.

10.3 Frogs general

10.3.1 Flange-way depth

Flange-way depth is measured from a plane across the wheel-bearing area of a frog. Flange-way depths shall be maintained as follows:

a) Where operating speeds do not exceed 15 MPH the Flange-way depth shall not be less than 1 3/8 inches;

b) Where operating speeds exceed 15 MPH the Flange-way depth shall not be less than 1 1/2 inches; and,

c) Where frogs are designed as flange-bearing, the flange-way depth may be less than the minimum shown herein; however, the operating speed may not exceed an appropriate restrictive speed not greater than 15 miles per hour.

10.3.2 Damaged frogs

a) If a frog point is chipped, broken, or worn more than five-eighths inch down and 6 inches back, operating speed over the frog shall not exceed 10 MPH.

b) If the tread portion of a frog casting is worn down more than three-eighths inch below the original contour, operating speed over that frog shall not exceed 10 MPH.

10.3.3 Spring rail frogs

Spring rail frogs shall be maintained as follows:

a) The outer edge of a wheel tread shall not contact the gauge side of a spring wing rail.

b) The toe area of each wing rail shall be solidly tamped and fully and tightly bolted.

c) Each frog with a bolt hole defect or head-web separation shall be replaced.

d) Each spring shall have compression sufficient to hold the wing rail against the point rail.

e) The clearance between the hold-down housing and the horn shall not exceed 1/4 inch.

10.3.4 Self-guarded frogs

The raised guard on a self-guarded frog shall not be worn more than three-eighths of an inch.

10.4 Guard rail gauges in frogs

The guard check and guard face gauges in frogs shall be within the limits prescribed in Table 10.1.

Priority	Speed	Guard check gauge shall not be tighter than	Guard face gauge shall not be greater than
White	Normal	−1/8"	+1/4"
Blue	35	−1/4"	+3/8"
Orange	15	−3/8"	+3/8"
Red	6	−1/2"	+1/2"

Table 10.1: Guard check and guard face gauges in frogs

10.5 Working on special work

Any trackwork in the vicinity of an electrically controlled switch that may change switch point adjustment must not start unless the signal department is notified. Any switch placed out of service for trackwork must not be returned to service unless proper point pressure and adjustment are provided. When working under traffic, switches shall be blocked, clamped or spiked to prevent switch point gapping.