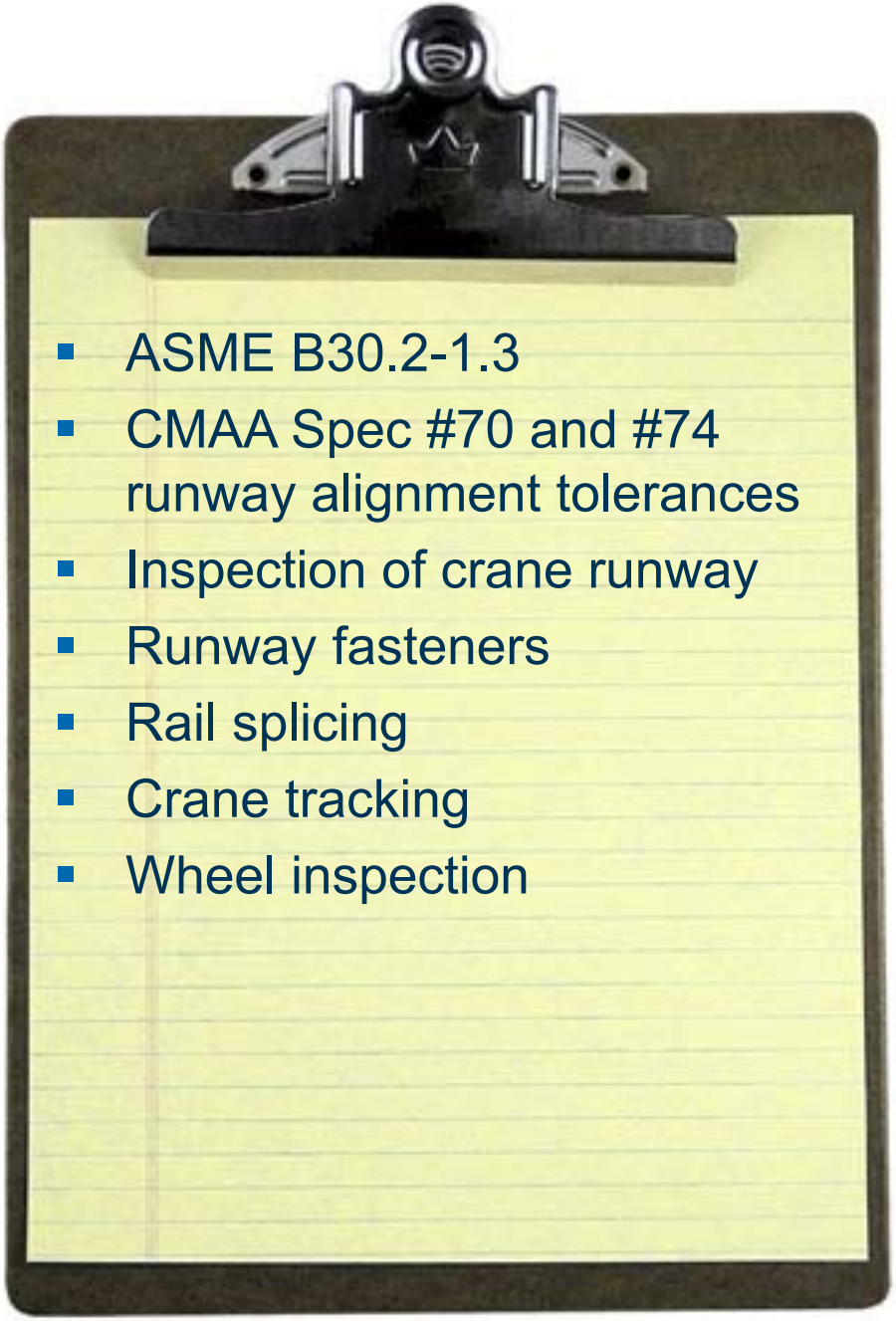
Section 5
Runways And Wheels
Top running cranes
Monorails & Under running cranes

Topics to be Covered



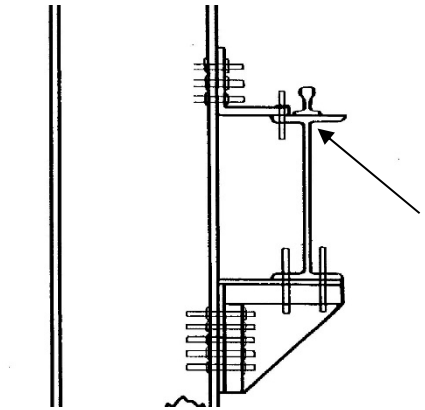
- ASME B30.2-1.3
- CMAA Spec #70 and #74 runway alignment tolerances
- Inspection of crane runway
- Runway fasteners
- Rail splicing
- Crane tracking
- Wheel inspection

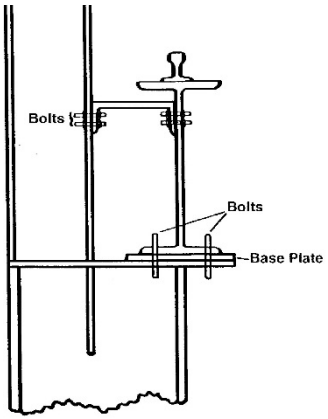
Training Objective

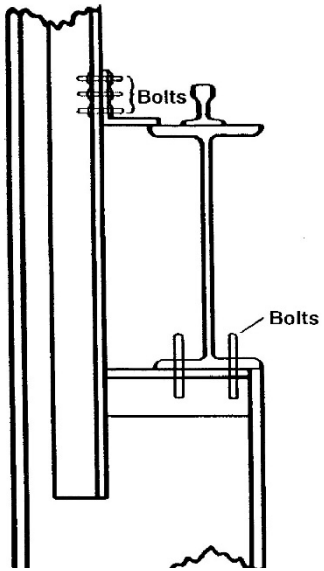
At the completion of this section, students should have a working knowledge of:

- inspection procedures associated with both under running and top running crane runways and crane wheels.

Runway Support







Inspect:

- Tiebacks
- Bolts
- Welds
- Rail to girder off set

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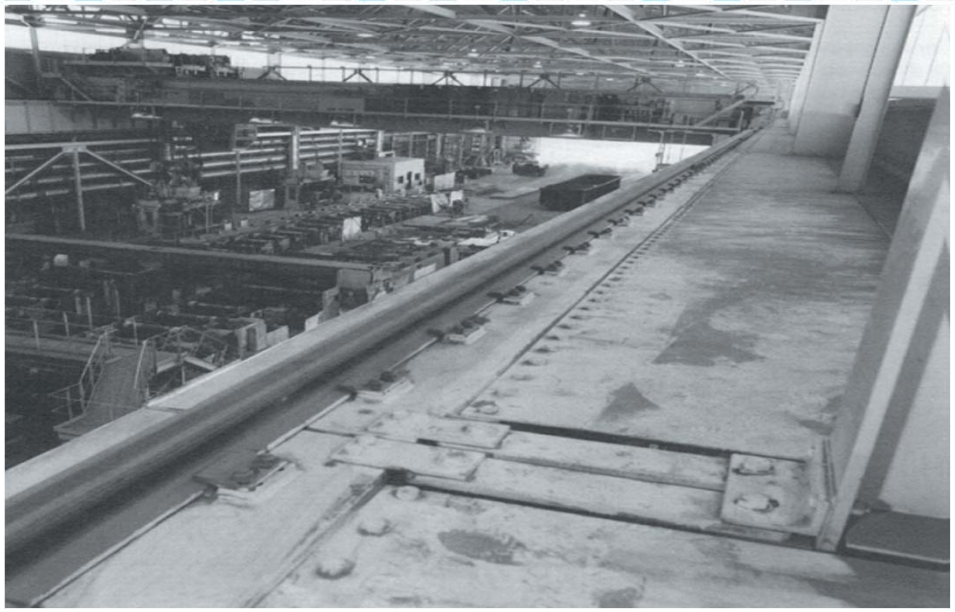
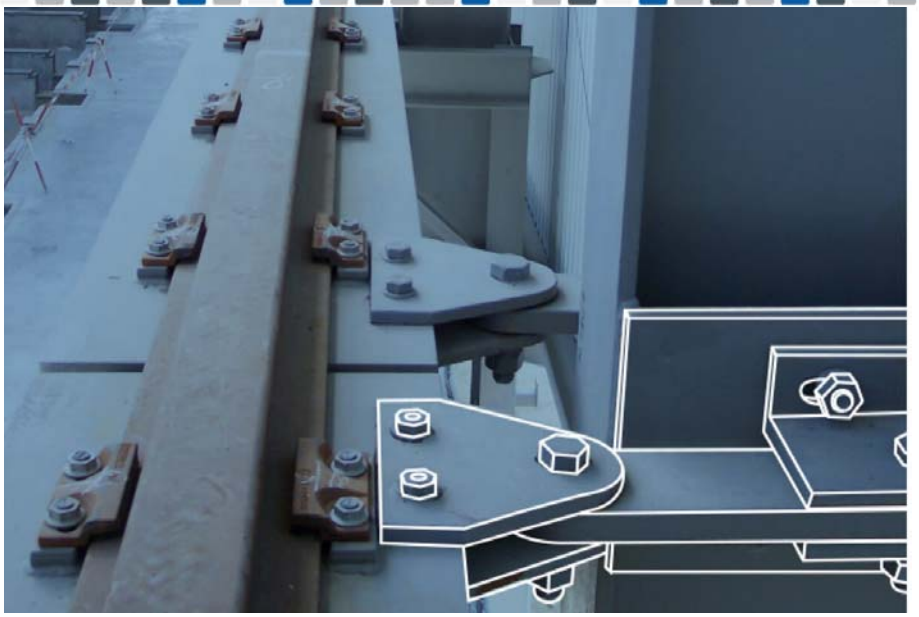
Tie Backs





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Tie Backs

Tie backs are used to restrain the lateral forces that are imposed on a crane runway system.

Essentially they keep the runway & rail from being pulled toward the center of the bridge.

They are usually anchored to a structural member & the runway beam. They help to maintain the runway span to be consistent the length of the runway, parallel.

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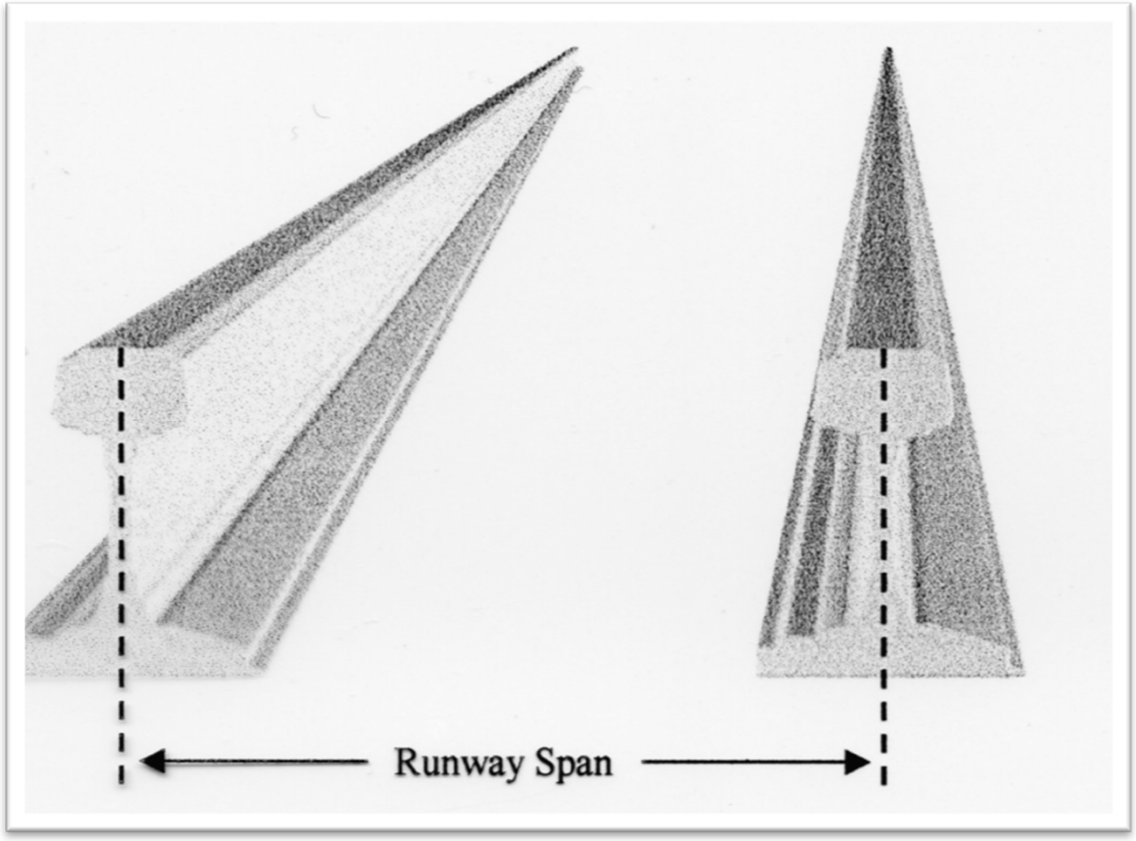
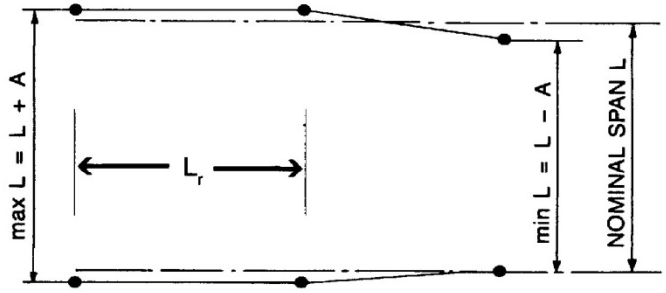
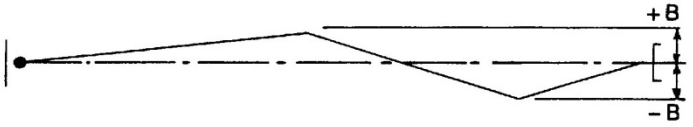
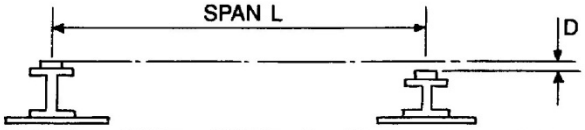
Crane Runways



CMAA SPEC. 70 & 74

ITEM	FIGURE	OVERALL TOLERANCE	MAXIMUM RATE OF CHANGE
CRANE SPAN (L)		L≤50′ A = 3⁄16″ L>50′≤100′ A = 1⁄4″ L>100′ A = 3⁄8″	1⁄4″ IN 20′-0″
STRAIGHTNESS (B)		B = 3⁄8″	1⁄4″ IN 20′-0″
ELEVATION (C)		C = 3⁄8″	1⁄4″ IN 20′-0″
RAIL-TO-RAIL ELEVATION (D)		L≤50′ D = ± 3⁄16″ L>50′≤100′ D = ± 1⁄4″ L>100′ D = ± 3⁄8″	1⁄4″ IN 20′-0″

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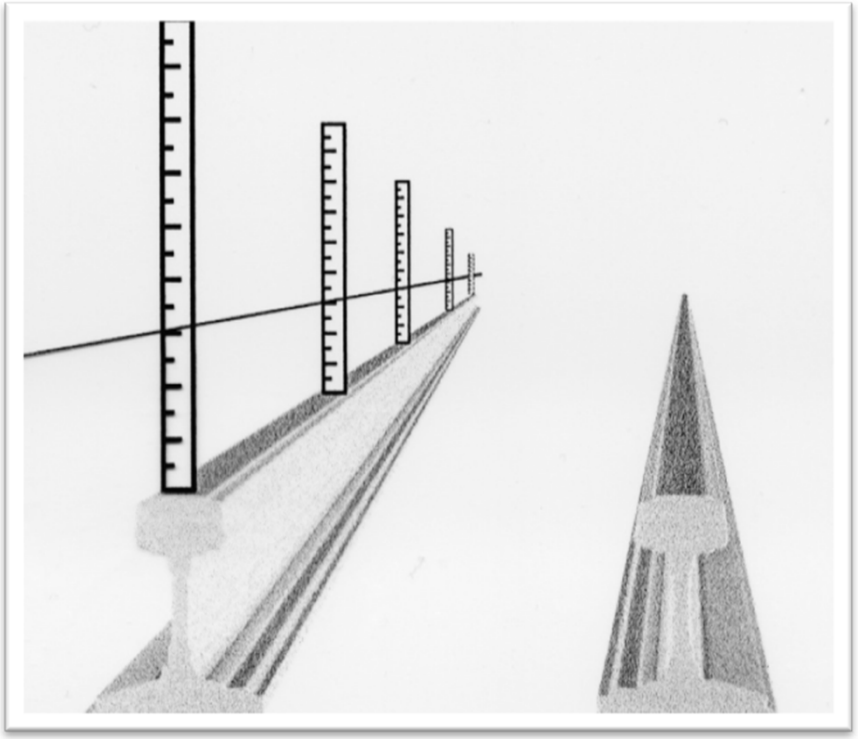
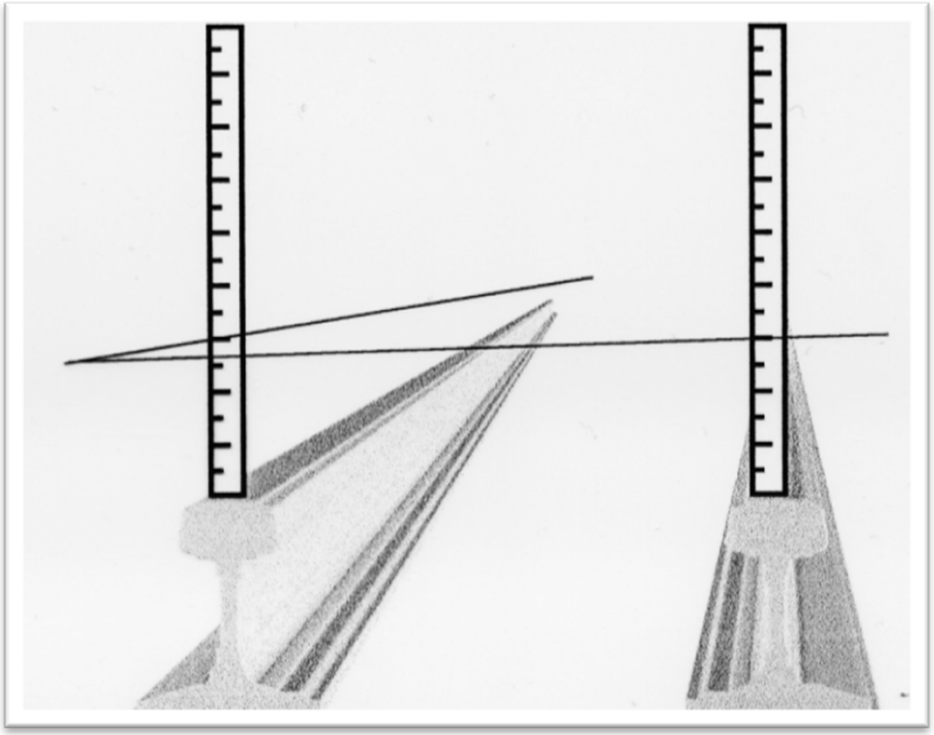
Runway Elevation



SINGLE RAIL ELEVATION



RAIL-TO-RAIL ELEVATION

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Rail Orientation

Runway Elevation

SINGLE RAIL ELEVATION:

- Take measurements at approximately 10’ intervals
- Ensure single rail elevation is within CMAA Specifications
- Rail should be level within ± 3/8 “

RAIL-TO-RAIL ELEVATION:

- It is only necessary to take this measurement once
- Take this measurement at approximately 10’ intervals
- Rail to rail elevation specifications depend on the span of the runway

Rail to rail elevation problems are one of the leading causes of poor crane tracking.

NOTE REF:
CMAA #70 Crane Runway Rail Tolerances (Table 1.4.2-1) Rev. 2015

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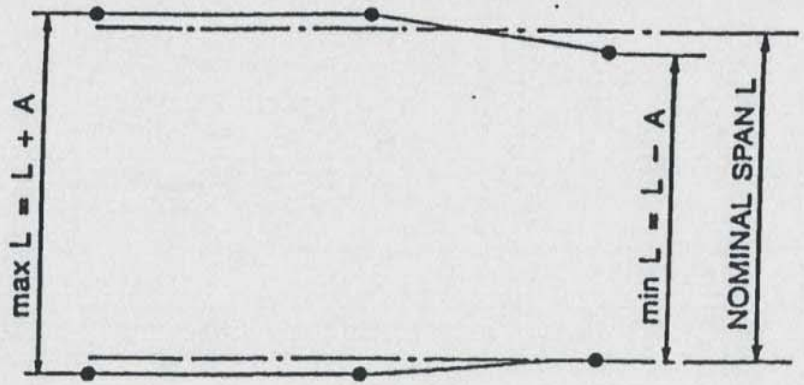
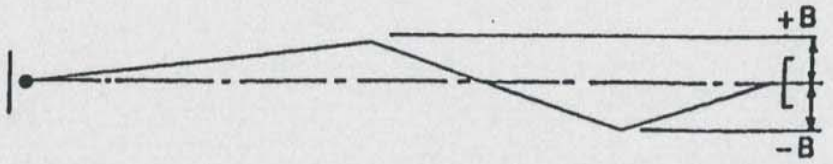
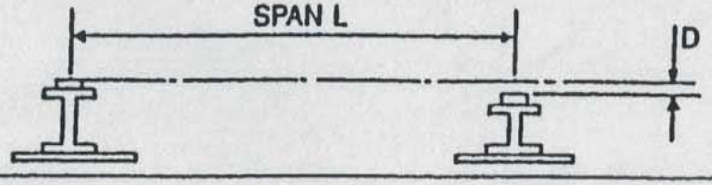
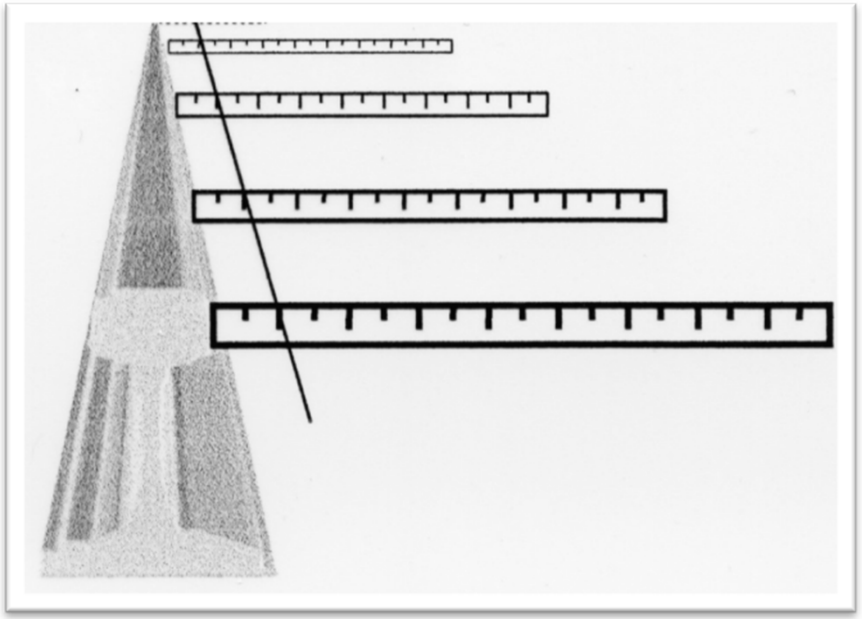
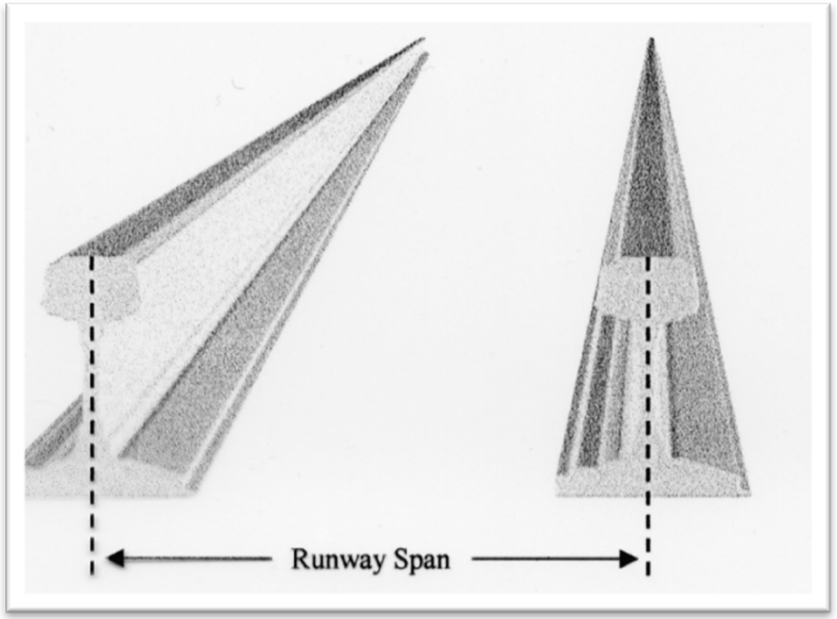
CMAA #70 Crane Runway Rail Tolerances (Table 1.4.2-1) Rev. 2015

ITEM	FIGURE	OVERALL TOLERANCE	MAXIMUM RATE OF CHANGE
SPAN		L<50′ ± A = 3/16″ L>50′<100′A = 1/4″ ± L>100′ ± A = 3/8″	1/4″ IN 20′-0″
STRAIGHTNESS		± B = 3/8″	1/4″ IN 20′-0″
ELEVATION		C = 3/8″	1/4″ IN 20′-0″
RAIL-TO-RAIL ELEVATION		L<50′ D = ± 3/16″ L>50′<100′D = ± 1/4″ L>100′ D = ± 3/8″	1/4″ IN 20′-0″

Runway Alignment & Span



STRAIGHTNESS



SPAN USING LEFT RAIL AS REFERENCE

Runway Alignment & Span

SINGLE RAIL STRAIGHTNESS:

- Take measurements at approximately 10’ intervals
- This alignment must be done after rail elevation
- Ensure single rail straightness is within ±3/8” CMAA Specifications
- A rail with excessive deviation or that exceeds maximum rate of change, will cause the crane to “rack” as it travels the runway.

RAIL SPAN

- Span should be taken with a precision measuring instrument, such as various EDM devices now available.
- Span should be taken using the reference rail as the bench mark
- Reference rail is the rail installed on the power side of the bay
- Rail span is the single most important measurement and alignment on a runway system. Ensure it is within acceptable CMAA tolerance.

Rail span issues are the number #1 cause of tracking problems in overhead cranes.

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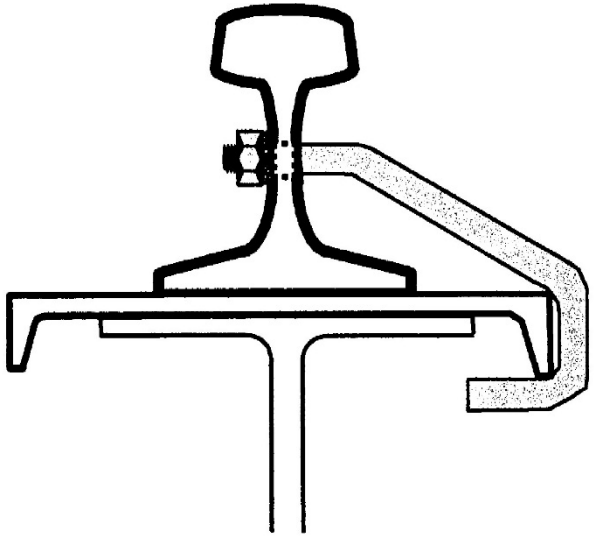
J Bolts – Hook Bolt



RAIL SECTION	BOLT DIAMETER	TYPICAL CHANNEL SIZE	AVERAGE WEIGHT	NORMAL SPACING
175-LB TO 100-LB	1"	15"	4.50 LBS	PAIRS – 24"
90-LB	7/8"	15"	3.50 LBS	"
90-LB	7/8"	12"	2.82 LBS	"
85-LB TO 70-LB	7/8"	15"	3.00 LBS	"
85-LB TO 70-LB	7/8"	12"	2.73 LBS	"
60-LB & 40-LB	¾"	12"	1.93 LBS	"
30-LB	5/8"	12"	1.27 LBS	"
25-LB TO 12-LB	½"	12"	.80 LBS	"
25-LB TO 12-LB	½"	10"	.71 LBS	"

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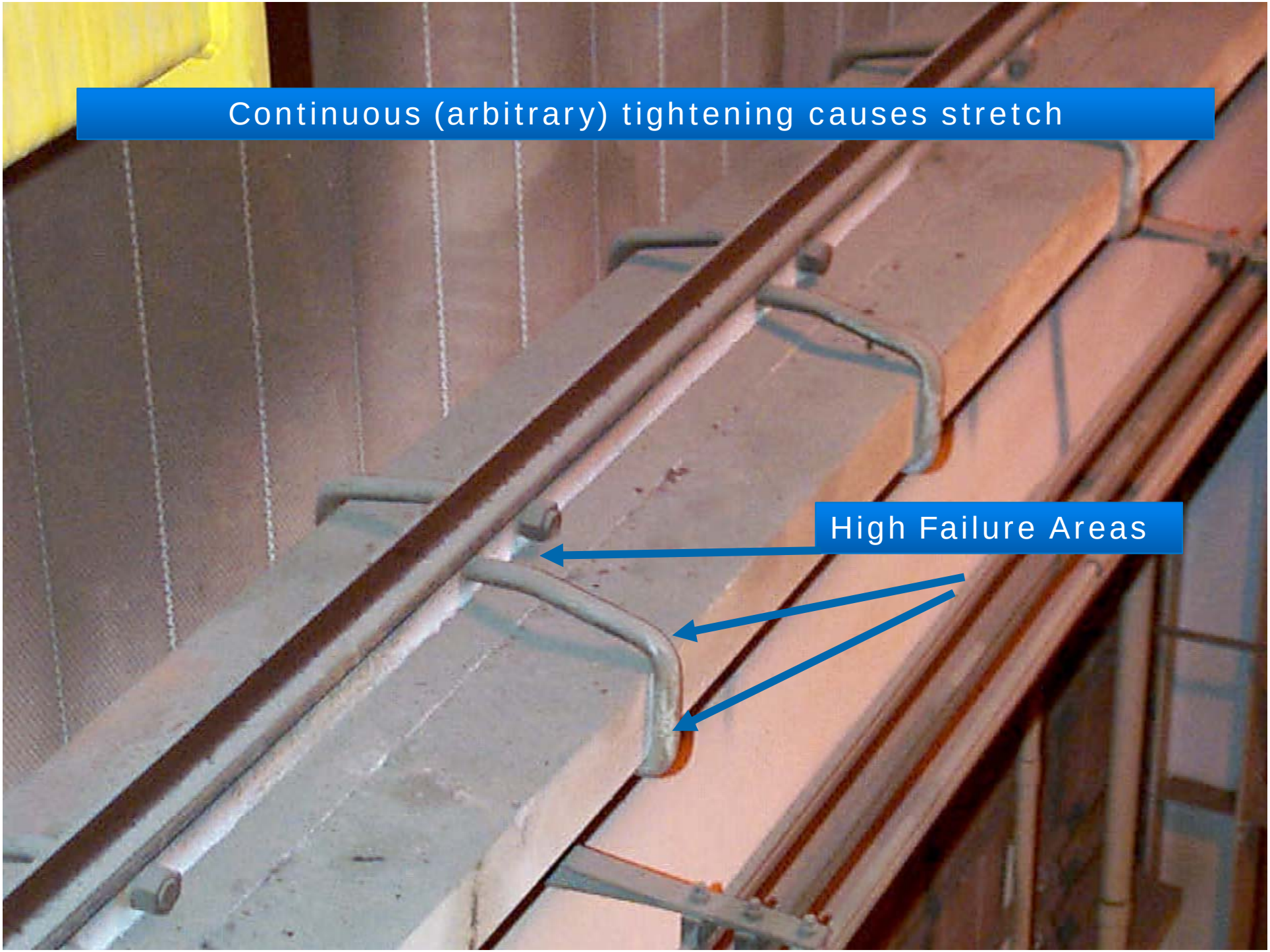
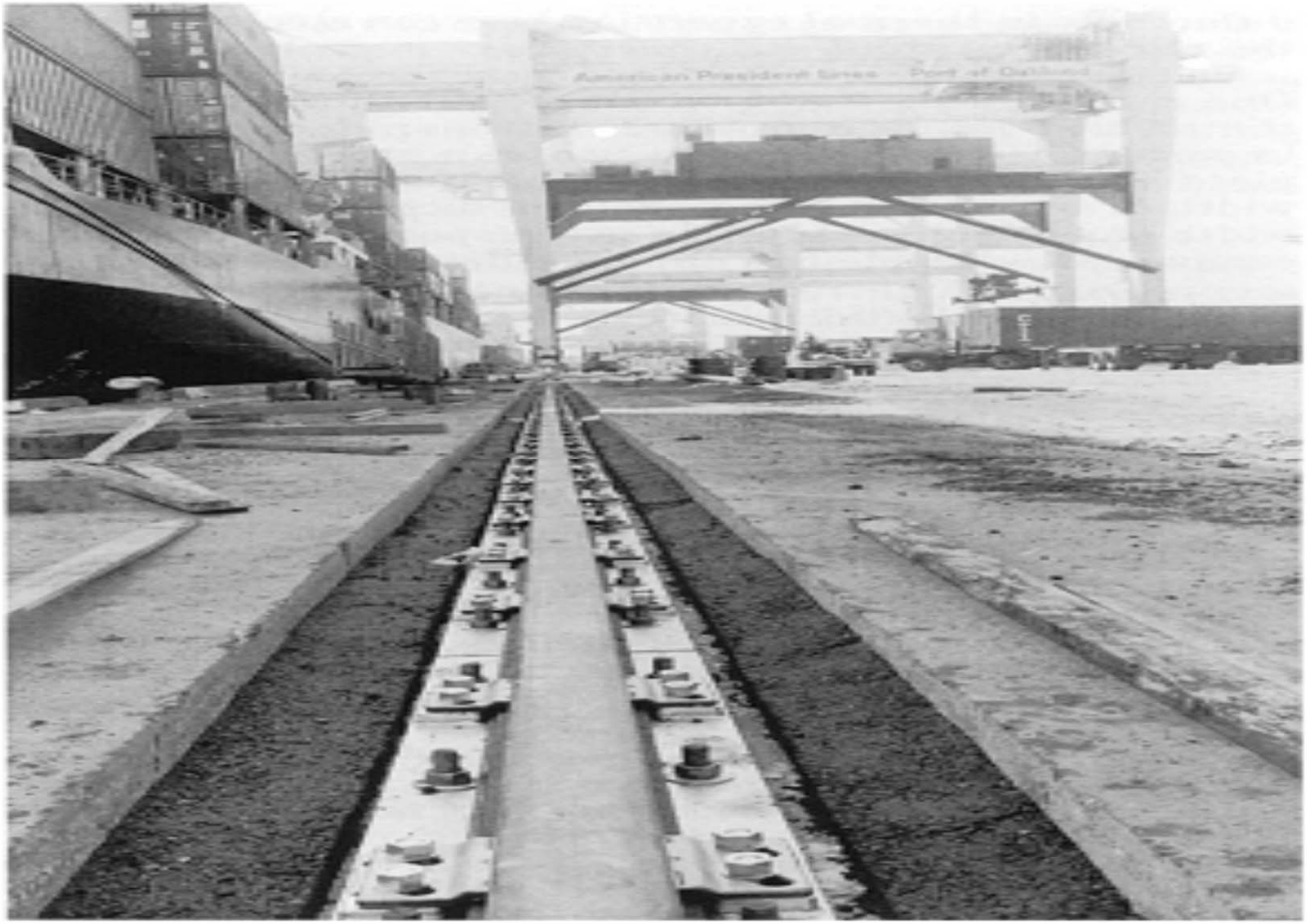

Continuous (arbitrary) tightening causes stretch
High Failure Areas

Gantry Mount

Gantry Runway



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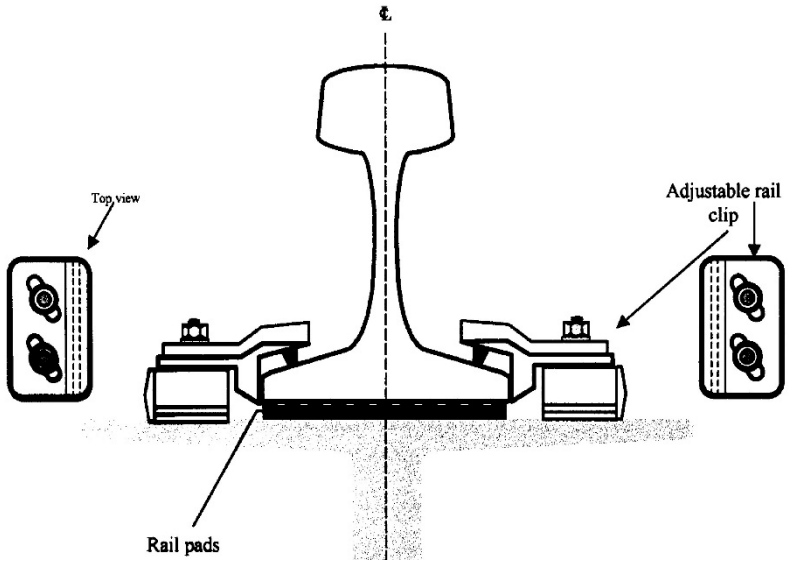
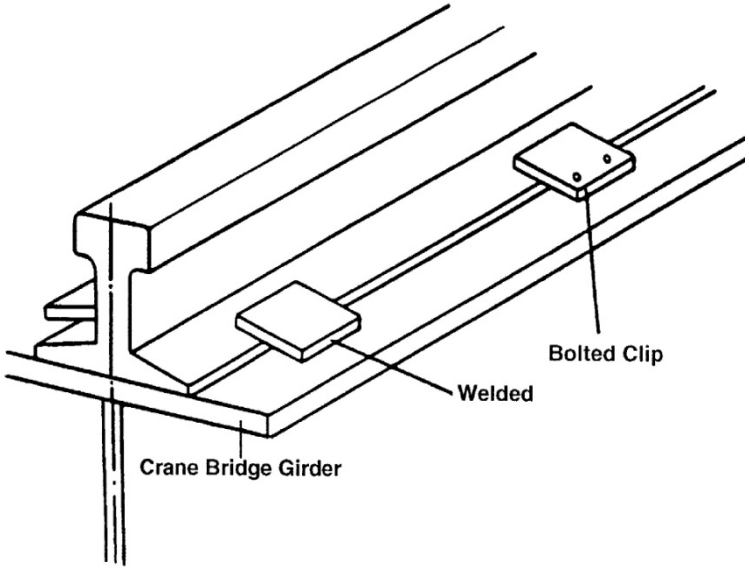
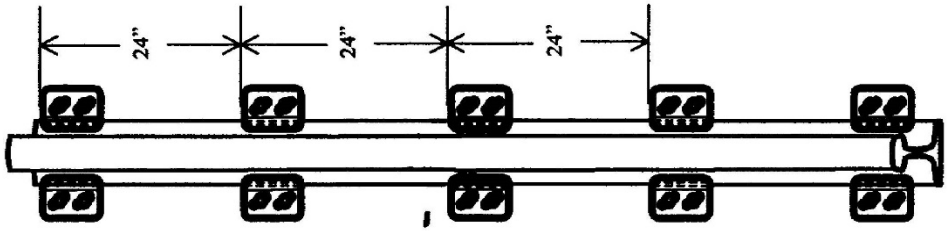
Bridge Rail for a Trolley

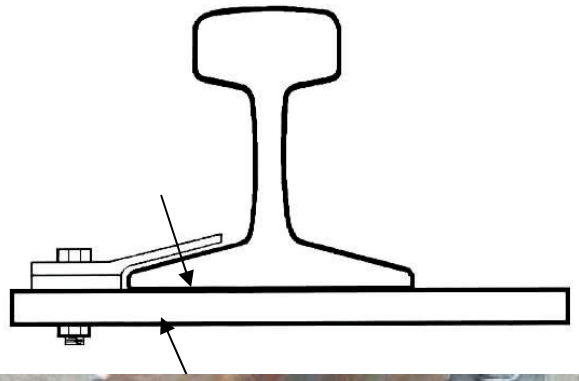
Rail Clips


℄
Top view
Adjustable rail clip
Rail pads

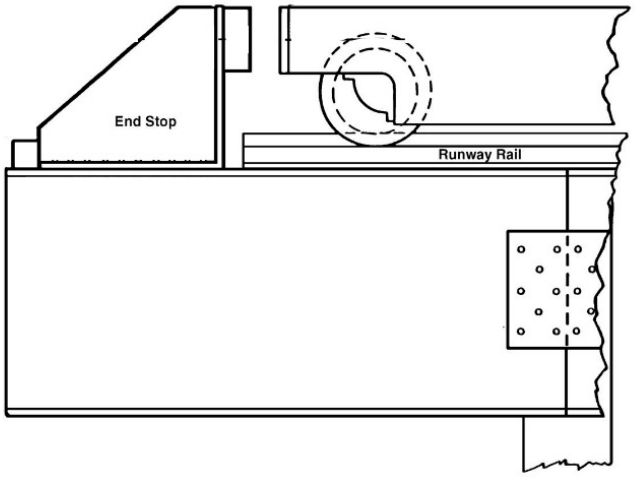

Bolted Clip
Welded
Crane Bridge Girder


24"
24"
24"

Rail Movement



- Crane rails should be allowed to float lengthwise but **never side to side**.



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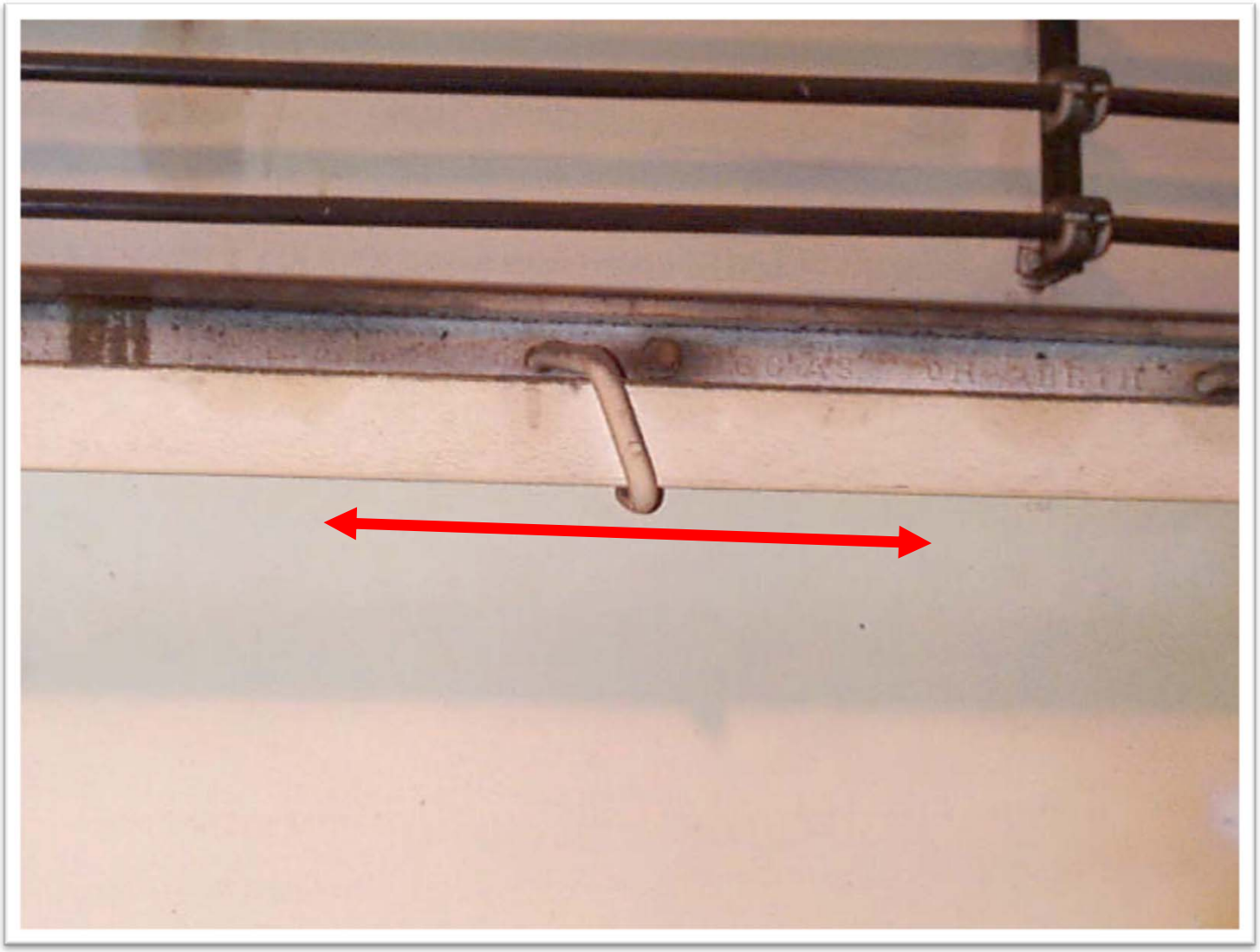
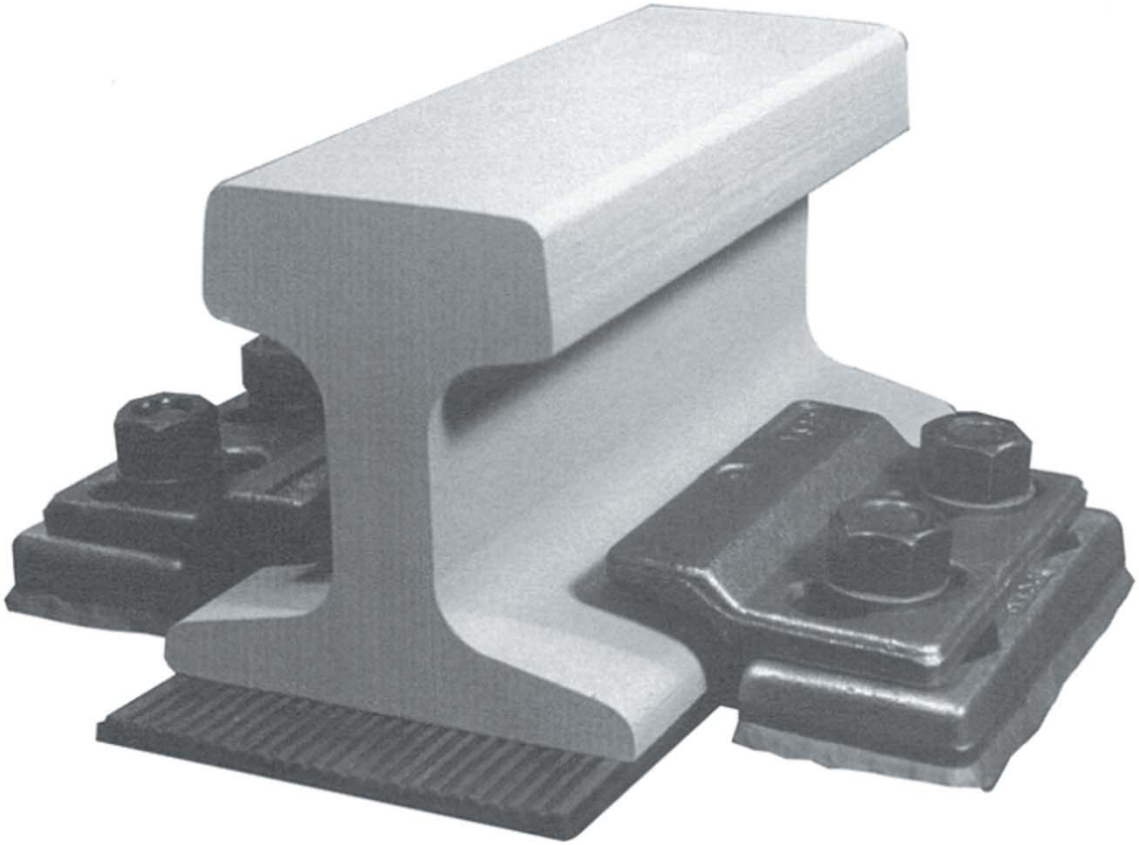
Rail Walk



Gantrex Weldable Clips



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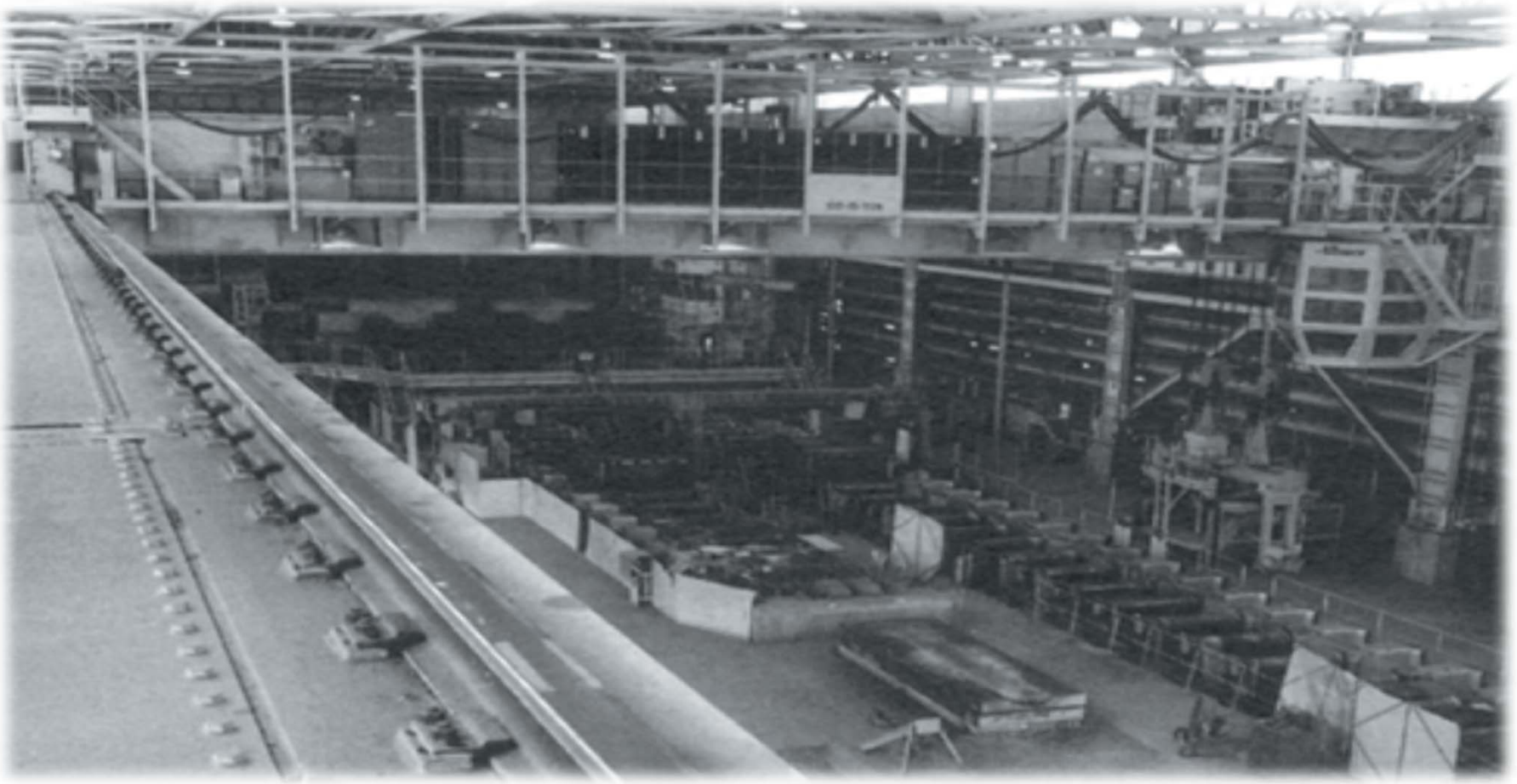
Overhead Crane Rail



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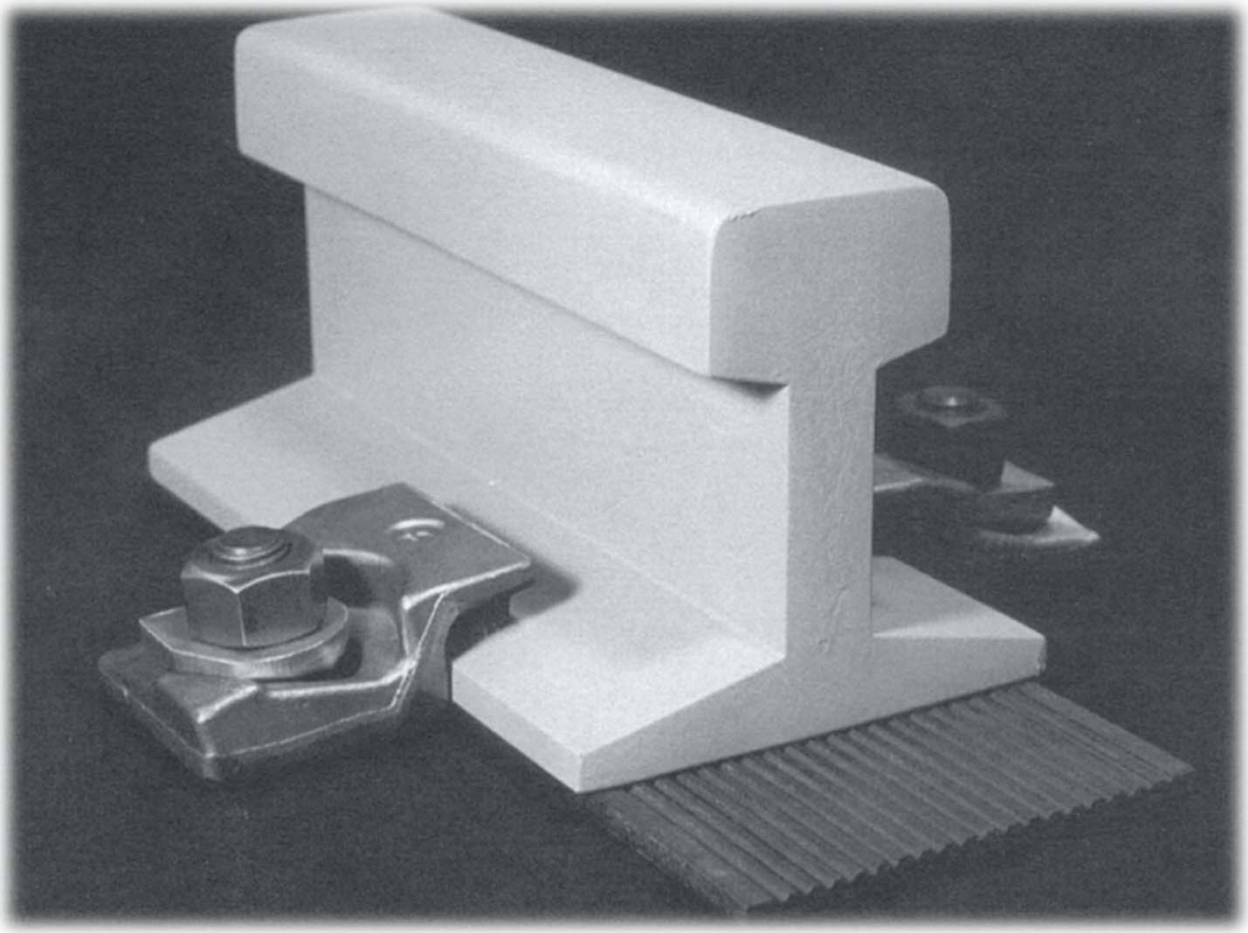
Gantrex Cam Lock



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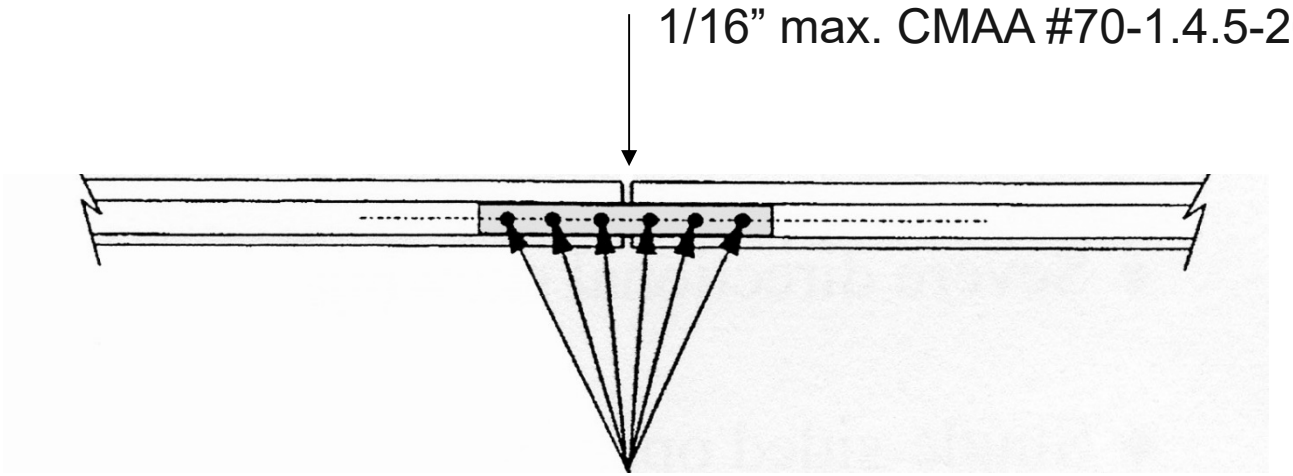
Rail Splices



INSPECT:

- Loose / Missing bolts
- Rail gap
- Rail alignment
- Welds if so joined

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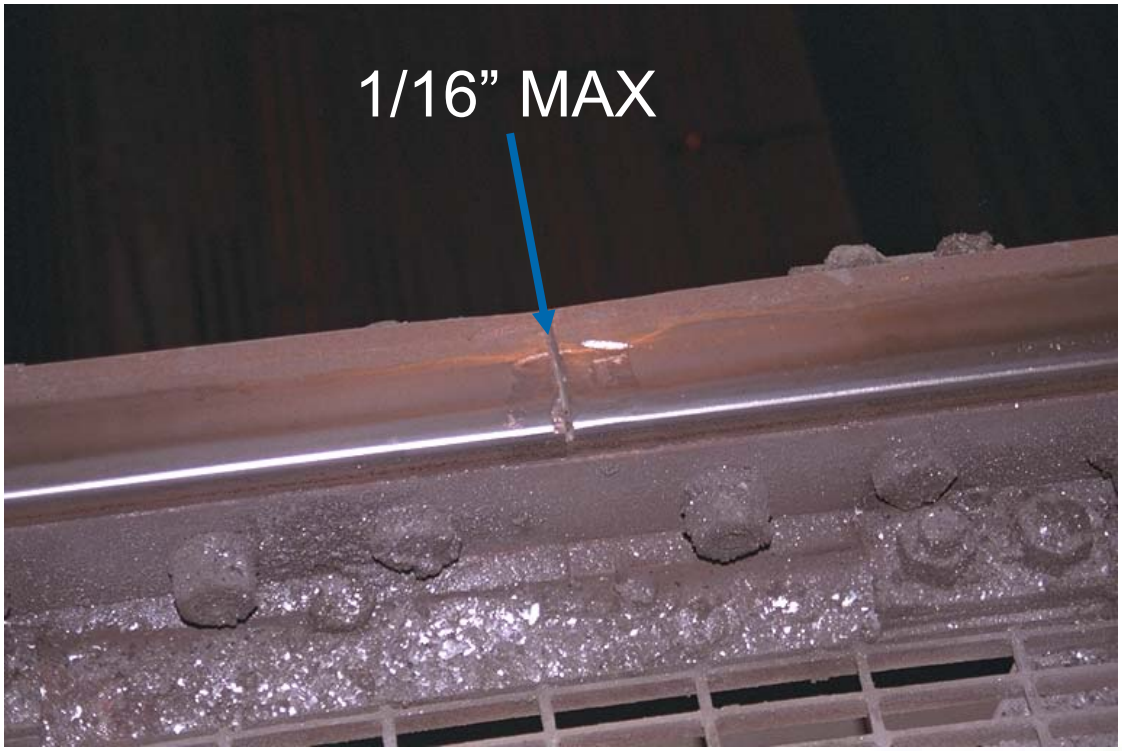
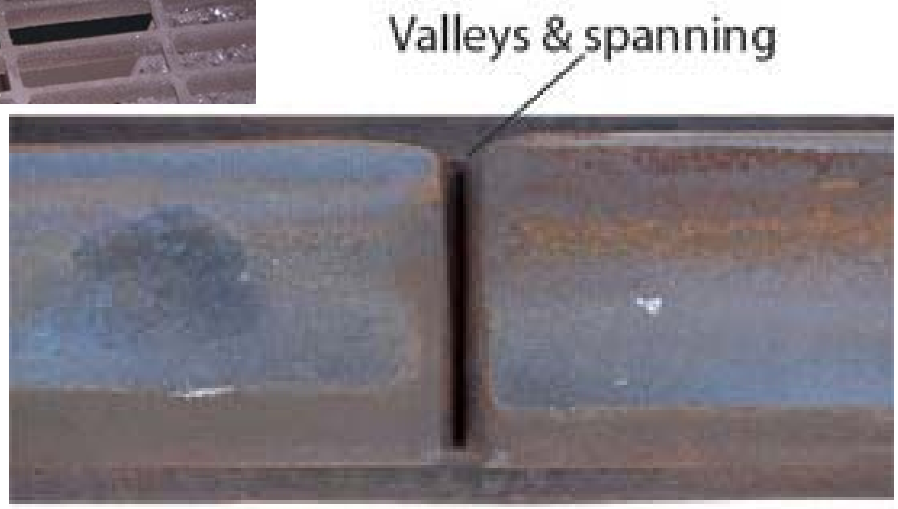
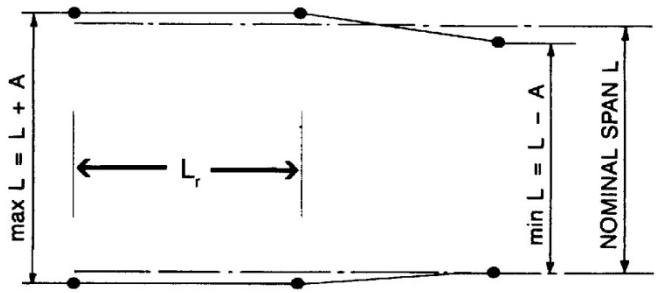
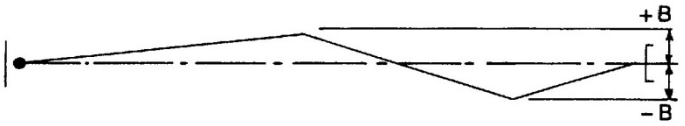
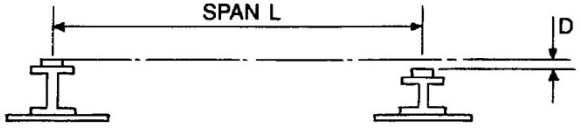
Rail Gaps






WEST VIRGINIA 80 LB
Trolley rail is often welded.
Check for cracks

Under Running Crane Runway

ITEM	FIGURE	OVERALL TOLERANCE	MAXIMUM RATE OF CHANGE
CRANE SPAN (L)		L≤50′ A = 3⁄16″ L>50′≤100′ A = 1⁄4″ L>100′ A = 3⁄8″	1⁄4″ IN 20′-0″
STRAIGHTNESS (B)		B = 3⁄8″	1⁄4″ IN 20′-0″
ELEVATION (C)		C = 3⁄8″	1⁄4″ IN 20′-0″
RAIL-TO-RAIL ELEVATION (D)		L≤50′ D = ± 3⁄16″ L>50′≤100′ D = ± 1⁄4″ L>100′ D = ± 3⁄8″	1⁄4″ IN 20′-0″

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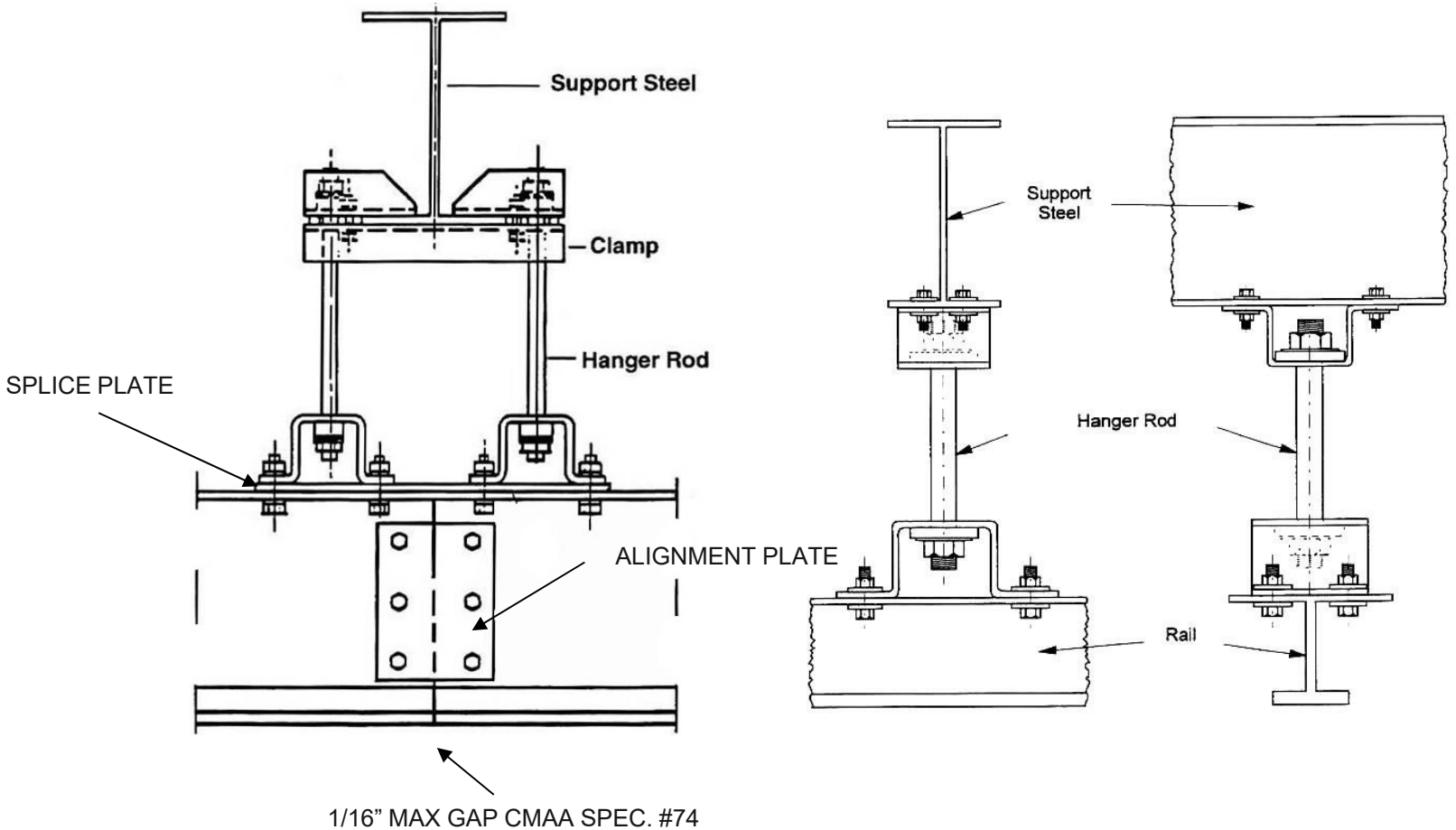
Under Running Crane And Monorail



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Yale

What ASME Standard pertains to Underhung Cranes?

- ASME B30.11/30.17

…which will refer to what standard for the hoist?

- ASME B30.16

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Under Running Crane

INSPECT:

- Support beam and track condition (bottom flange)
- Splice and alignment plates
  ASME B30.17/11-1.3.1(c)
- Hanger rods plumb
  ASME B30.17/11-1.3.2 (b)
- End stops for bridge and trolley / carrier
  ASME B30.17/11-1.3.1(g)
- Sway and thrust bracing
  ASME B30.17/11-1.3.2(d)
- Hanger rod nuts
  ASME B30.17/11-1.3.2(e)
- Drop limiting Lugs on bridge end trucks
  ASME B30.17/11-1.12(a)

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Monorail

INSPECT:

- Support beam and track condition (bottom flange)
- Splice and alignment plates
  ASME B30.17/11-1.3.1(c)
- Hanger rods plumb
  ASME B30.17/11-1.3.2 (b)
- Stops for trolley/carrier
  ASME B30.17/11-1.3.1(g)
- Sway and thrust bracing
  ASME B30.17/11-1.3.1(d)
- Hanger rod nuts
  ASME B30.17/11-1.3.2(e)
- Track opener stops
  ASME B30.17/11-1.4.2
- Interlocks
  ASME B30.17/11-1.4.3 (a) & (b)

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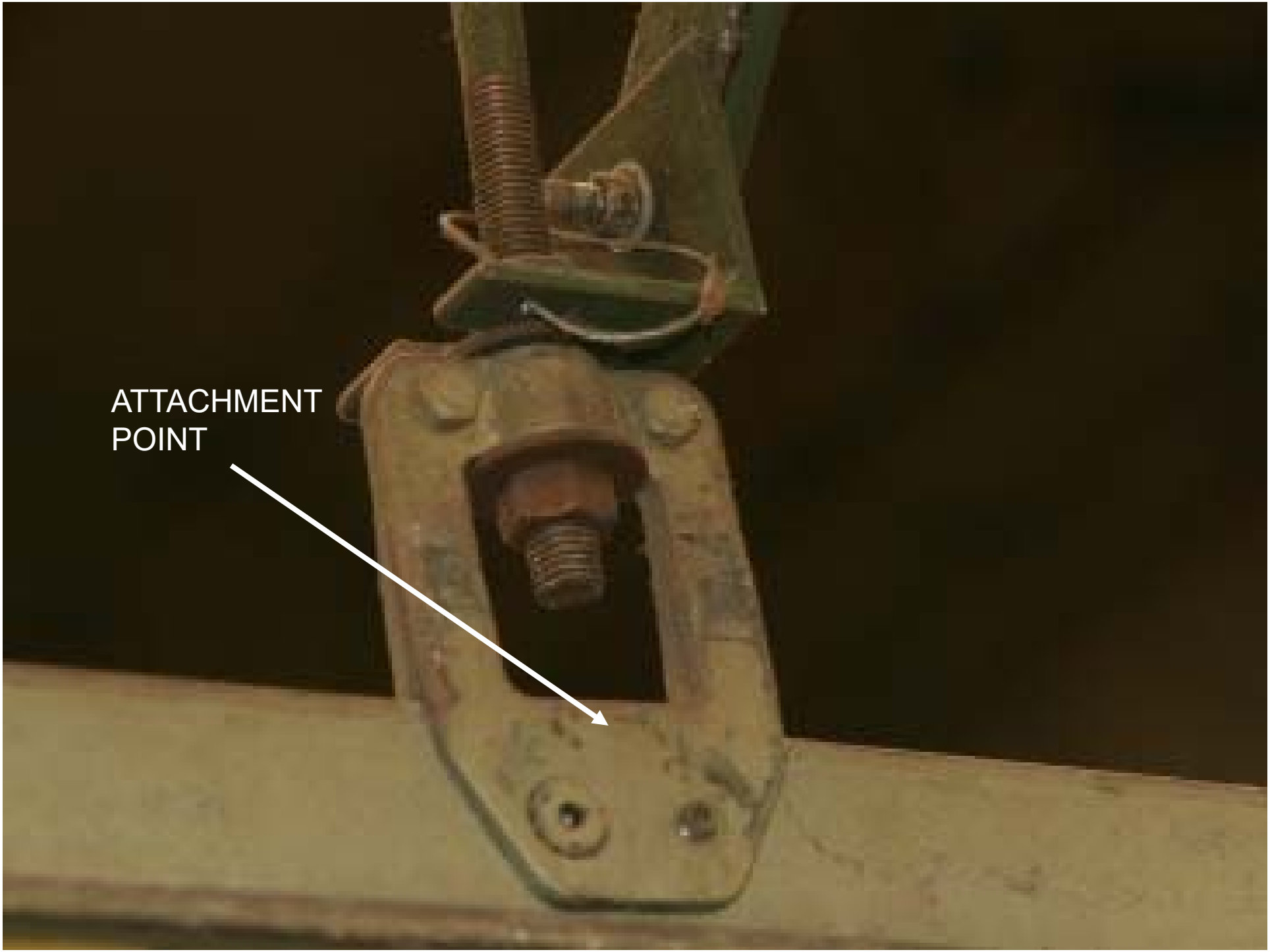
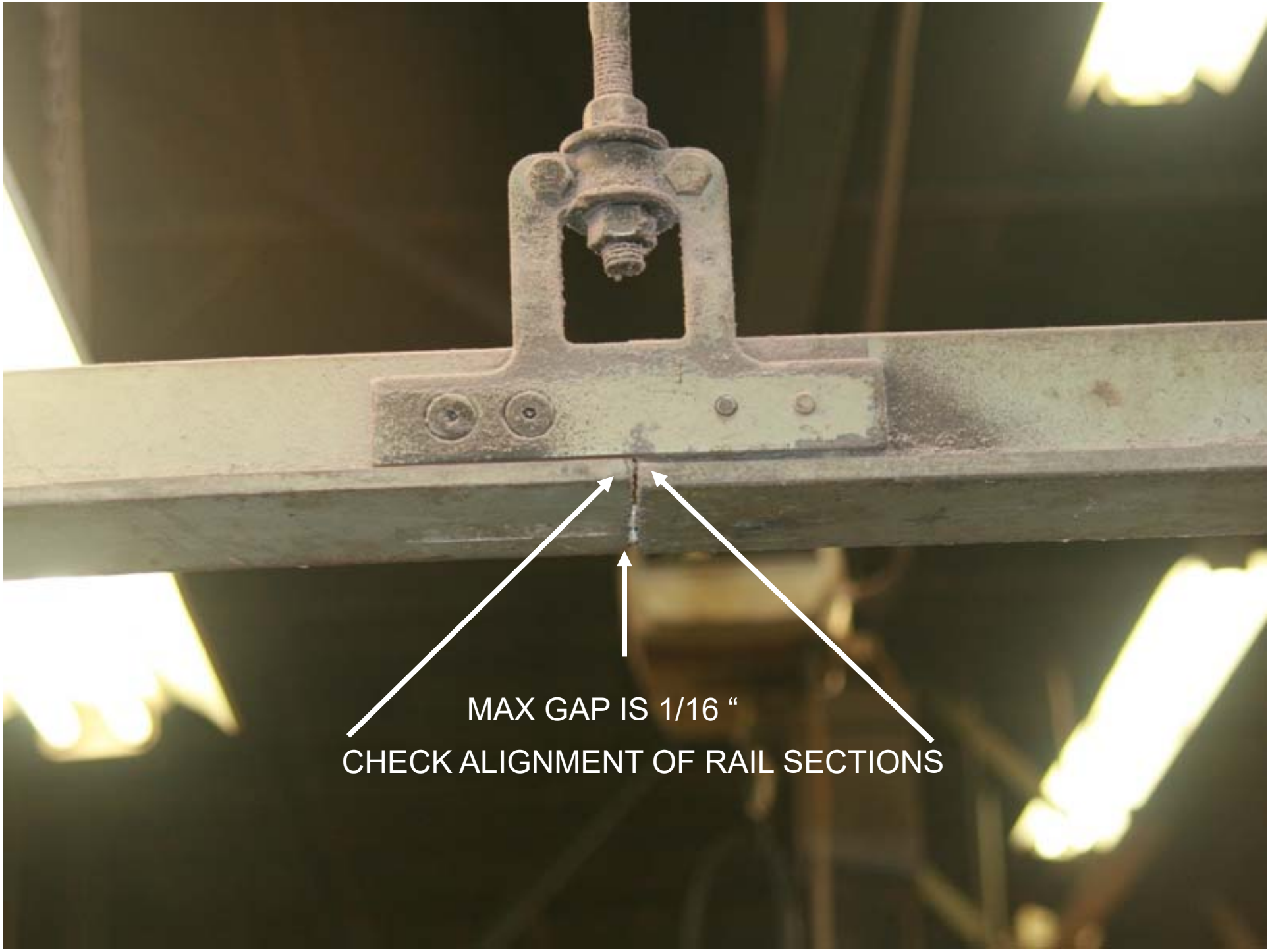

ATTACHMENT
POINT


CHECK THE NUTS
FOR SIGNS OF
BACKING OFF

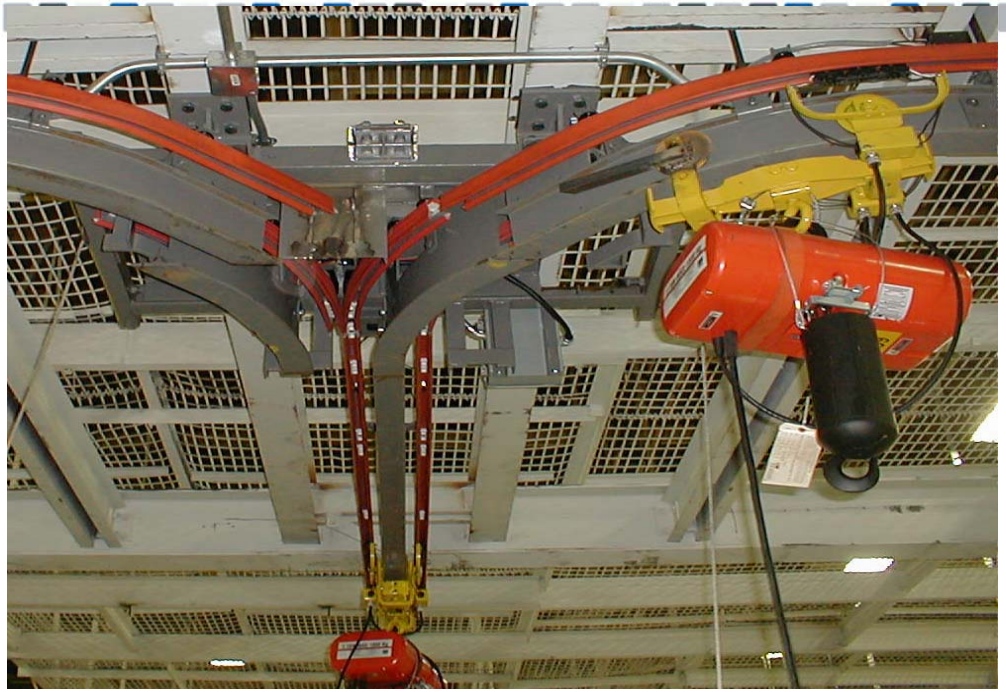

MAX GAP IS 1/16 “
CHECK ALIGNMENT OF RAIL SECTIONS

ASME B30.17/11-1.4.4 Track Switches

SECTION 10 – Track Switches ANSI MH 27.2 – 2003

10.1 Track switches shall be of the tongue, rotary, or sliding type. They shall maintain alignment of the incoming tracks and switch tracks, with a maximum gap of 1/16" (1.5 mm) between adjacent ends of the load-carrying flanges. Misalignment shall not exceed 1/16" (1.5 mm). Switches may be operated by mechanical-, electric-, pneumantic- or hydraulic-operated devices.

ASME B30.17/11-1.4.3 Interlocks



ANSI MH 27.2 – 2003 Section 9- Cranes, Transfer Crane & Interlocking Cranes

9.1.10.1 Interlock mechanisms shall limit load-carrying flange misalignment to a maximum of 1/8" (3 mm).

9.1.10.2 Stops or forks shall be an integral part of the interlock mechanisms. When girders and spur tracks or transfer sections are aligned and interlock mechanisms are engaged, stops or forks shall be in the open position and permit transfer of carrier from one to the other. When girders and spur tracks of transfer sections are not aligned and/or interlock mechanisms are disengaged, stops or forks shall be in the closed position and prevent carriers from rolling off the end of spur tracks, transfer sections, or crane girders.

9.1.10.3 Transfer and interlocking cranes, spur tracks, and fixed transfer sections shall have a maximum gap of 1/8" (3 mm) between adjacent ends of the load-carrying flange.

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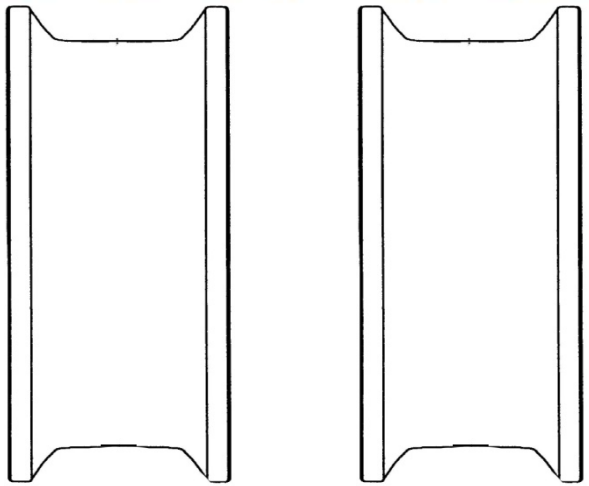
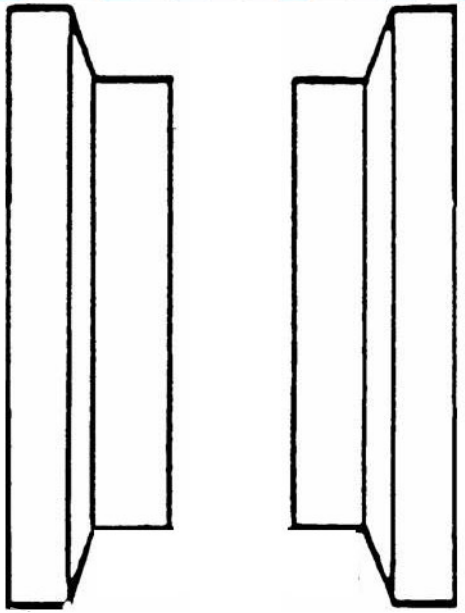
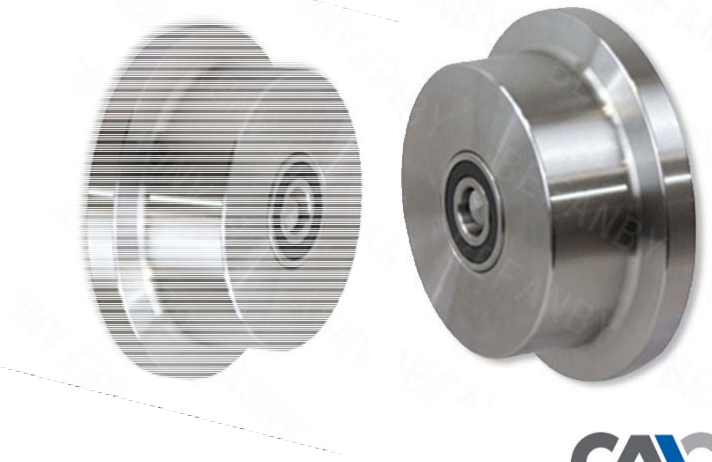
Wheels







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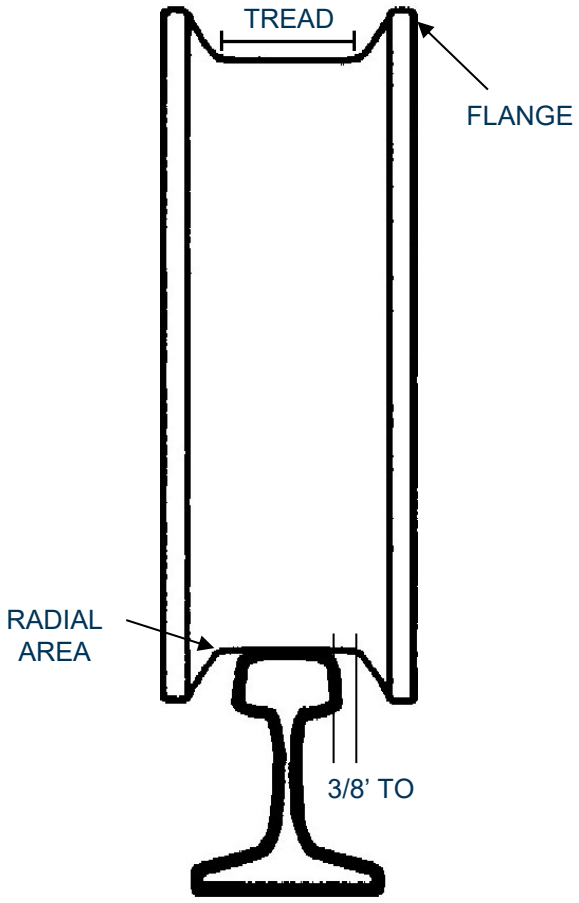
Straight Tread Top Running Wheels



INSPECT

- Tread wear pattern (polished tread and flange)
- Flat spots (caused by sliding)
- Flange thickness (replace at 50% wear)
- Pitting, spalling or case crushing
- Dark spots
- Fillet build up (radial area)
- Total wheel float (CMAA Spec. #70-4.13.4 requires 3/4" to 1" total float)
- Drive wheels must be matched within .001" per inch of diameter with a maximum difference of .010" (CMAA Spec. #70)
- Idler wheels within 3/"16" of same side drive wheel

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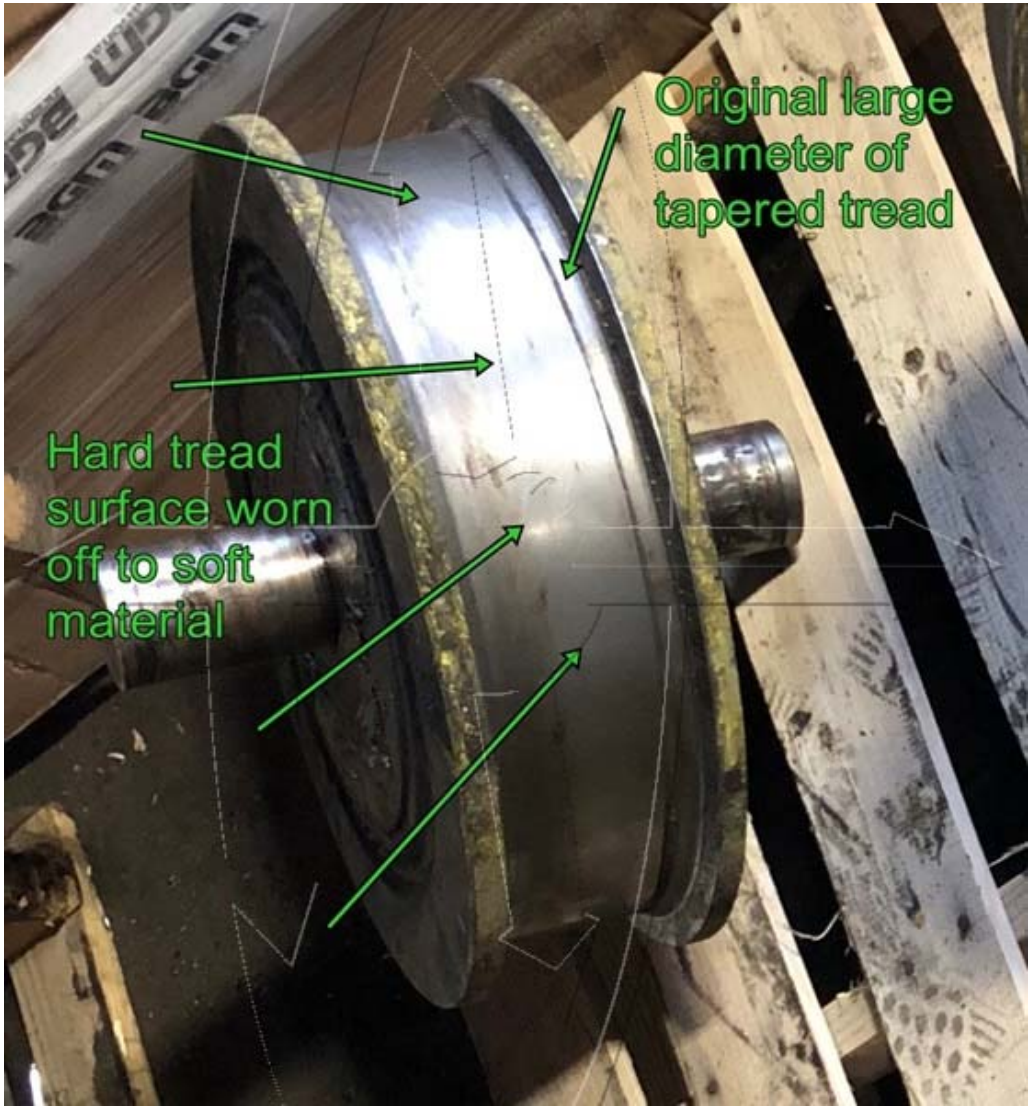
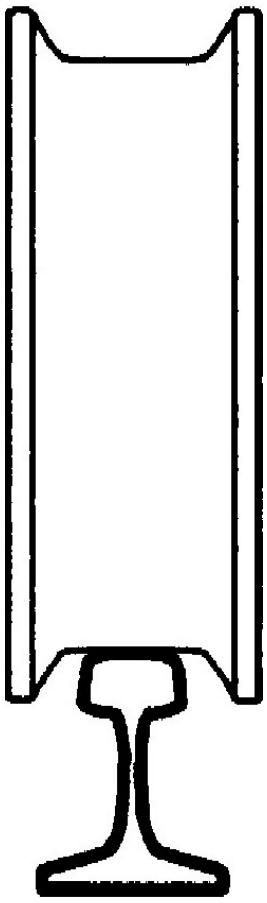

Original large diameter of tapered tread
Hard tread surface worn off to soft material

Top Running Crane Wheels



CMAA #70 - 4.13.2 Wheels
Wheels shall be rolled or forged from open hearth, basic oxygen or electric furnace steel, or cast of an acceptable carbon or alloy steel unless otherwise specified. Wheels shall be heat treated only if specified. Other suitable materials may be used. Due consideration shall be given to the brittleness & impact strength of the material used.

- Wheels are hardened across a wide range of hardness values – Generally from 20-25 R_C up to 60+ R_C .
- A soft wheel would be in the 20 R_C -25 R_C range, a moderately hardened wheel would be around 40 R_C and a very hard wheel would be above 50 R_C to 55 R_C.

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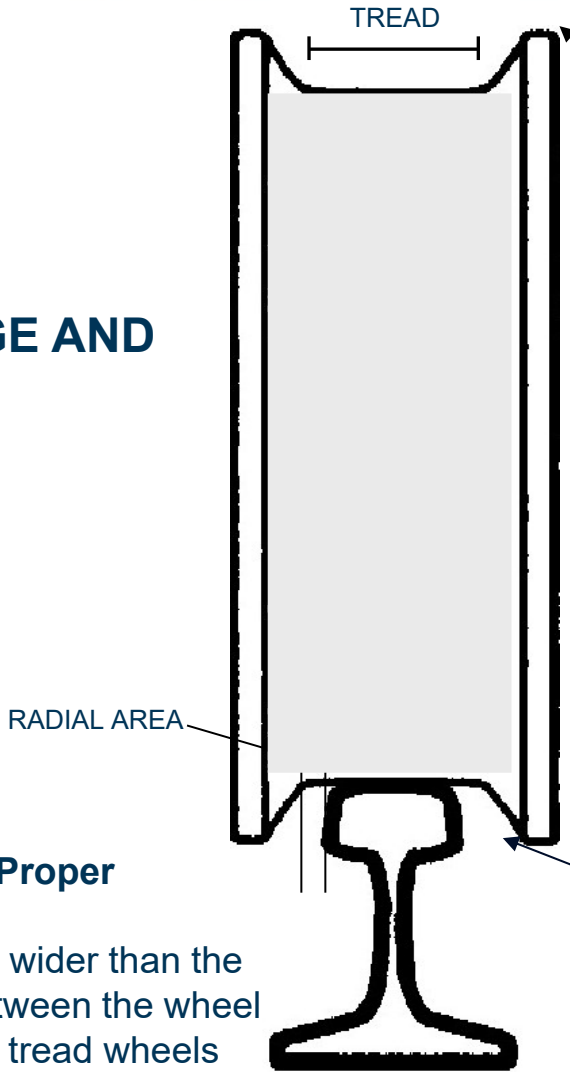
Wheels



Replace at 50% thickness

POLISHED FLANGE AND TREAD

Drive wheel must be matched within .001” per inch of diameter with a maximum difference of .010” CMAA Spec. #70 Wheels 4.13.1

3/8’ TO 1/2” CMAA #70-4.13.4 Proper Clearance for Bridge Wheels

A total of approximately ¾” to 1” wider than the rail head should be provided between the wheel flanges & the rail head. Tapered tread wheels may have a clearance over the rail head of 150% of the clearance provided for straight wheels as recommended by the manufacturer.

Skewing causes fillet build-up

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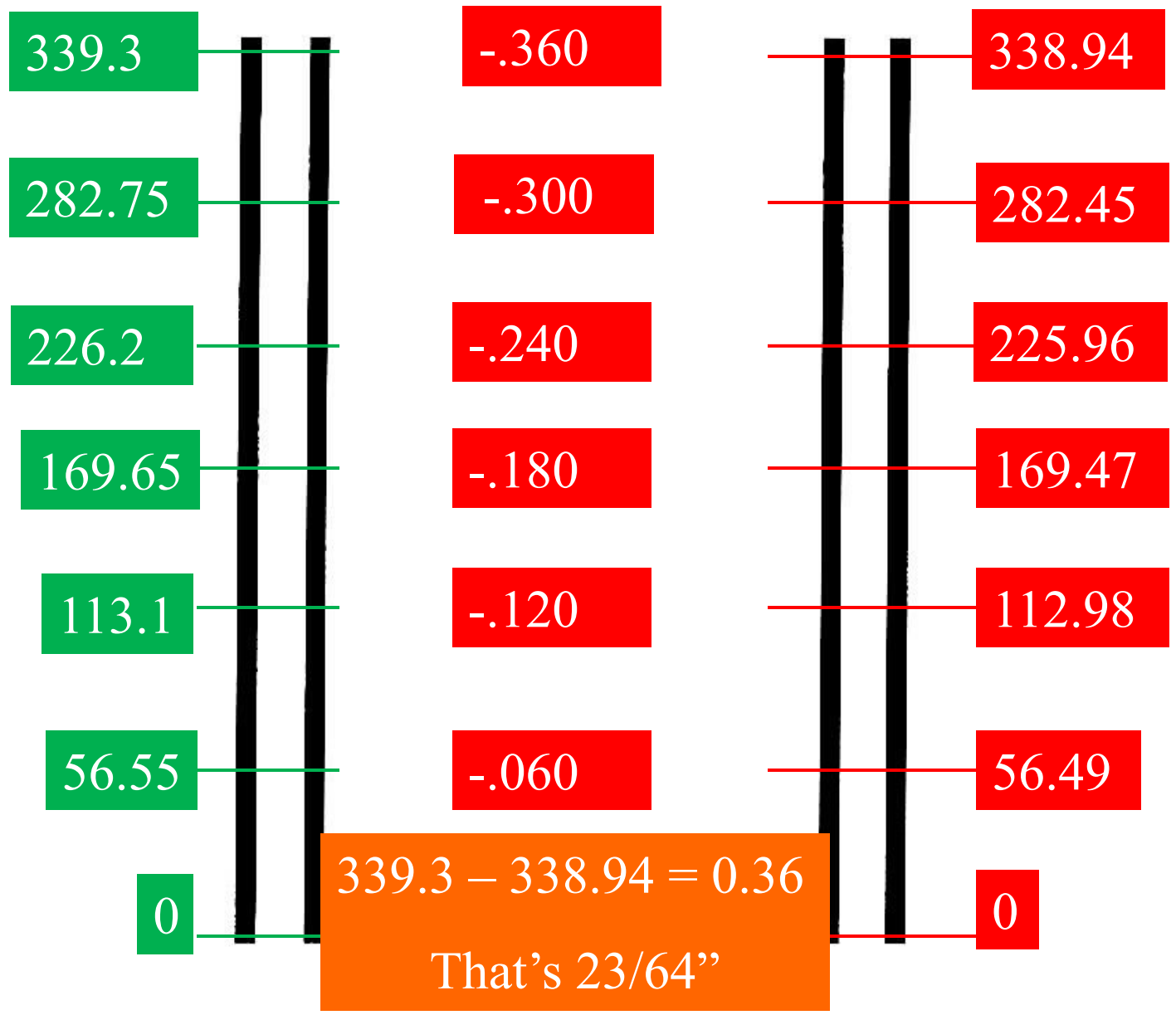
18 X π (3.14)
= 56.55 inches

Tracking over 28.275 ft.
6 revolutions of 18” wheel

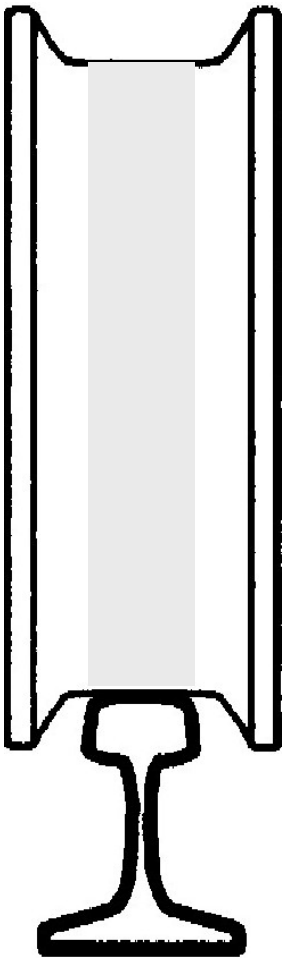
17.98 X π (3.14)
= 56.49 inches



339.3 – 338.94 = 0.36

That’s 23/64”

Top Running Wheel Wear



- A softer wheel takes on a dull tread wear appearance as it ages. This is a sign that the hardness is worn away.
- It is time to consider replacing the wheel.
- As the profile of the wheel tread changes accelerated rail wear will occur.

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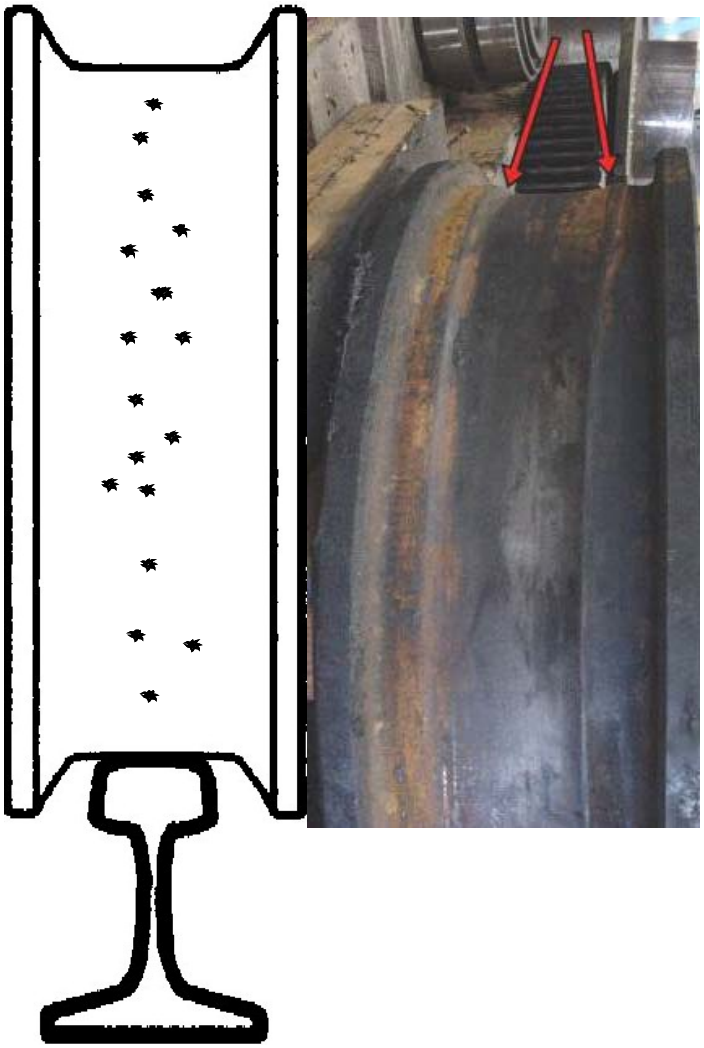
Top Running Wheel Wear



- A harder wheel will display signs of what appears to be pitting. This is actually *case crushing*.
- Typically, this indication will be concentrated toward the center of the wheel tread.
- The wheel is worn to the point where it is time to consider replacement

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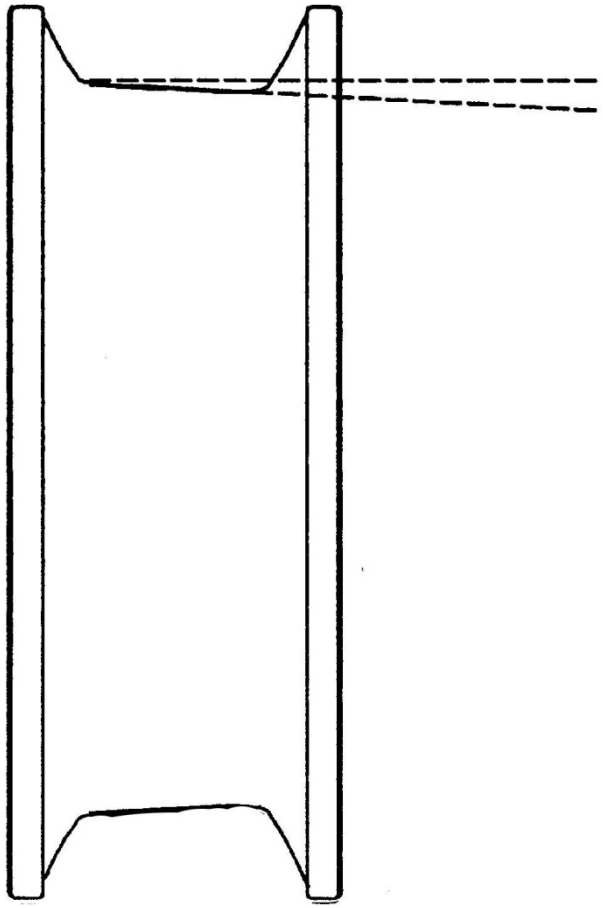
Tapered Wheels



2° - 4° OF TAPER

- Tapered wheels are used to diminish or eliminate undesirable tracking characteristics.
- These undesirable characteristics are almost always caused by the runway.

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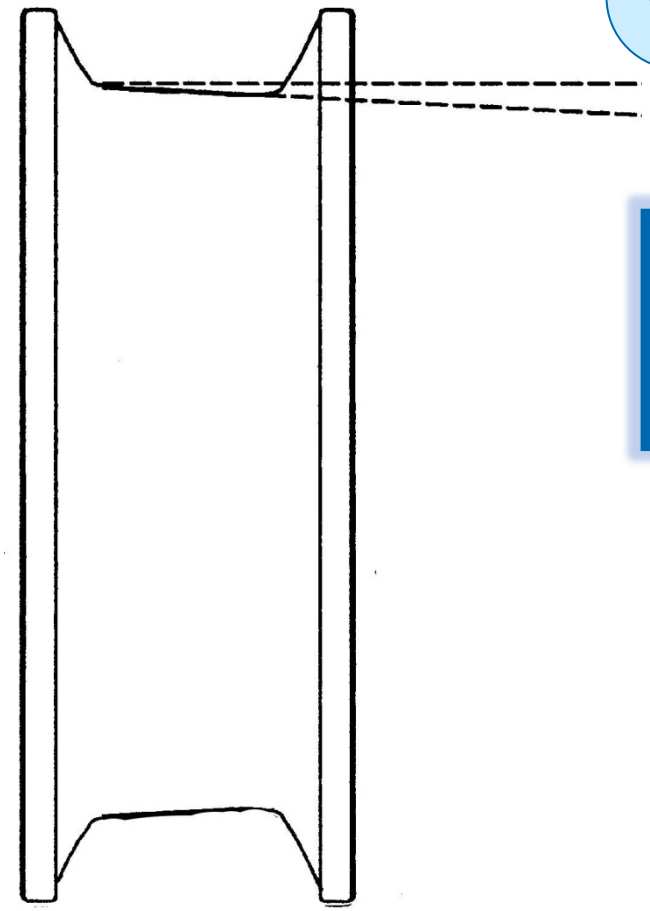
Tapered Wheels



Why put tapered wheels on the crane instead of fixing the runway?

ANSWER:
Wheels are much less expensive than a runway

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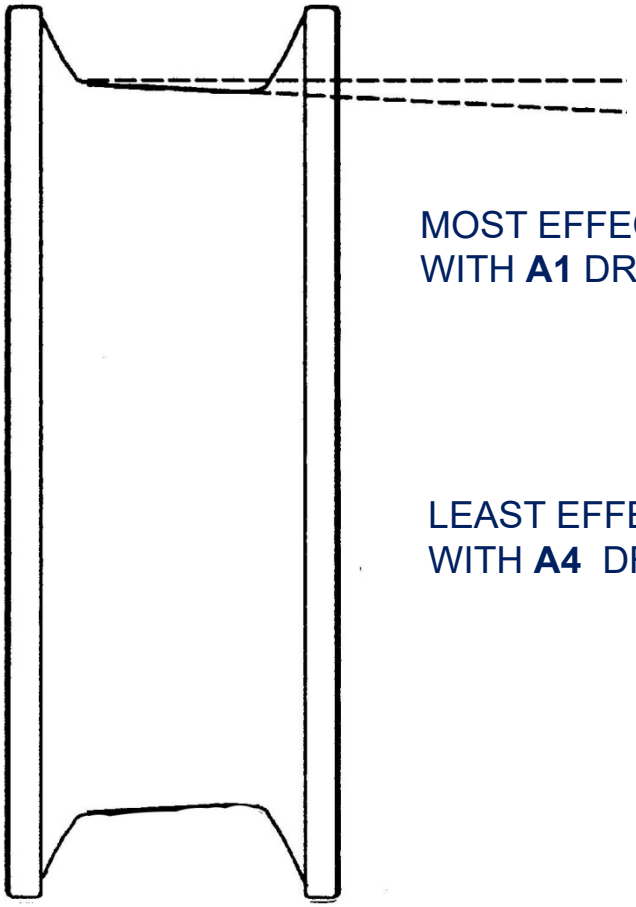
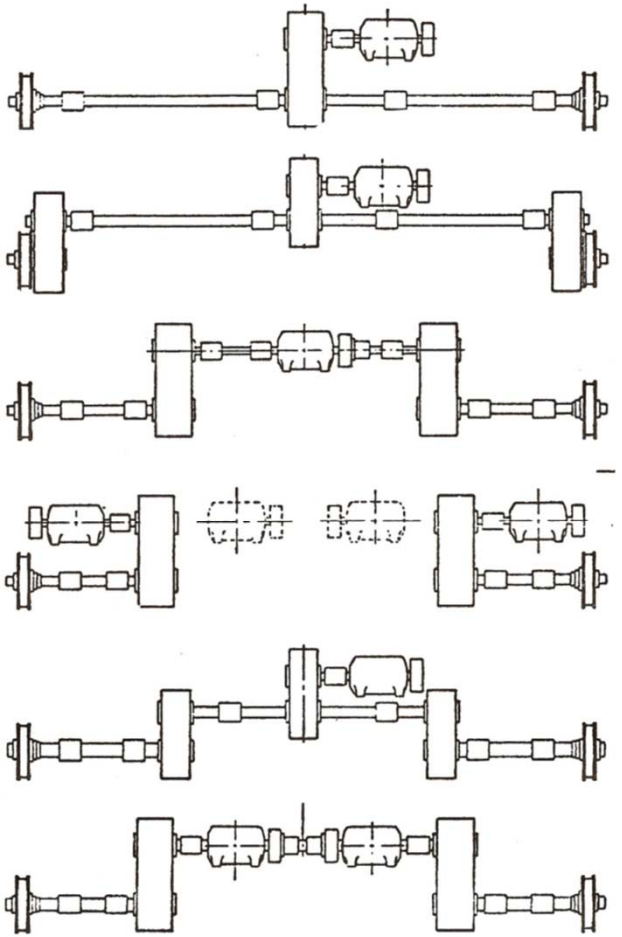
If the bridge travels only short distances, there is less benefit to tapered wheels.



2° - 4° OF TAPER

MOST EFFECTIVE
WITH **A1** DRIVE

LEAST EFFECTIVE
WITH **A4** DRIVE



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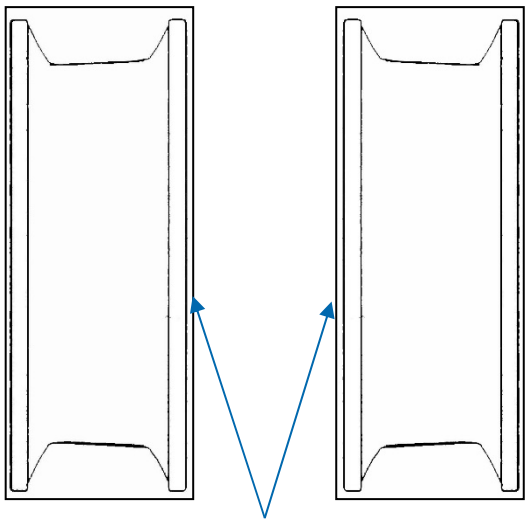
Tapered Wheel Orientation



LARGE DIAMETERS MUST GO INBOARD

INSPECT:

- Tread wear pattern
  (polished tread, not so much on the flange.)
- Flat spots (caused by sliding)
- Flange thickness
  (replace at manufactures recommendation)
- Pitting, spalling or case crushing
- Drive wheel must be matched within .001” per inch of diameter with a maximum difference of .010” (CMAA Spec. #70 – 4.13.1)

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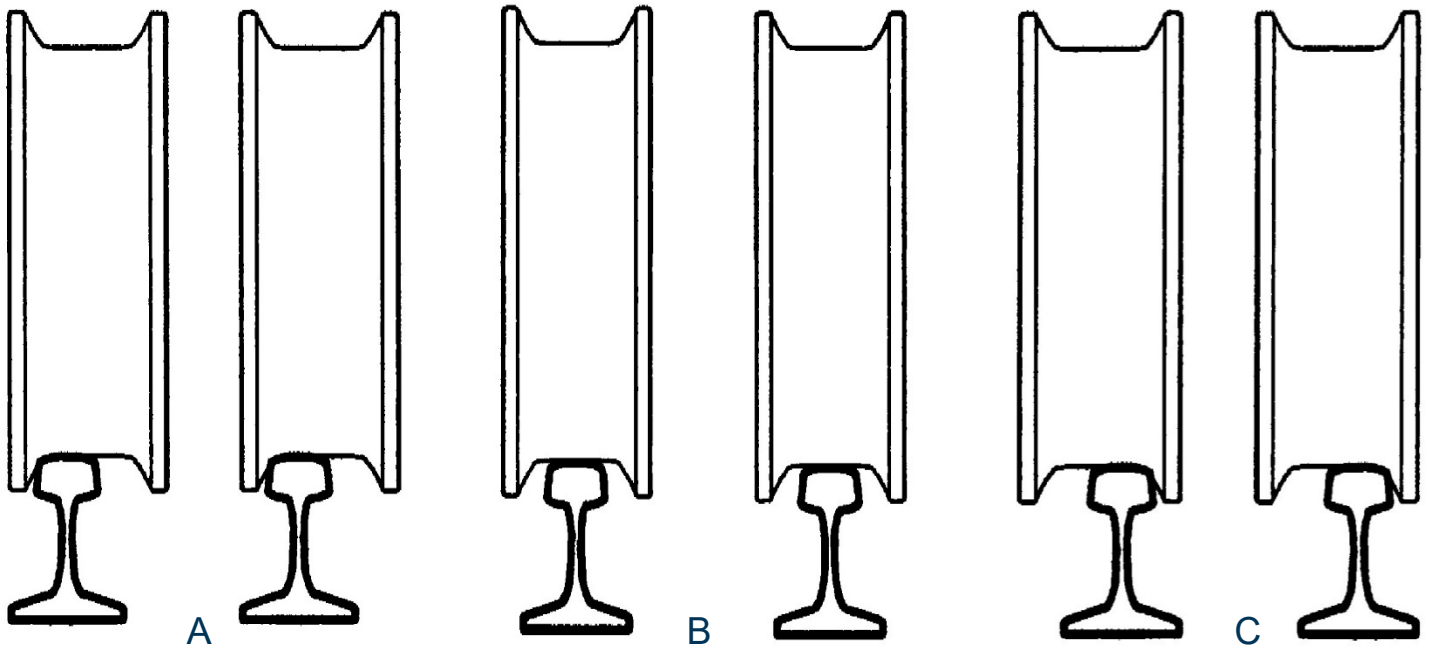
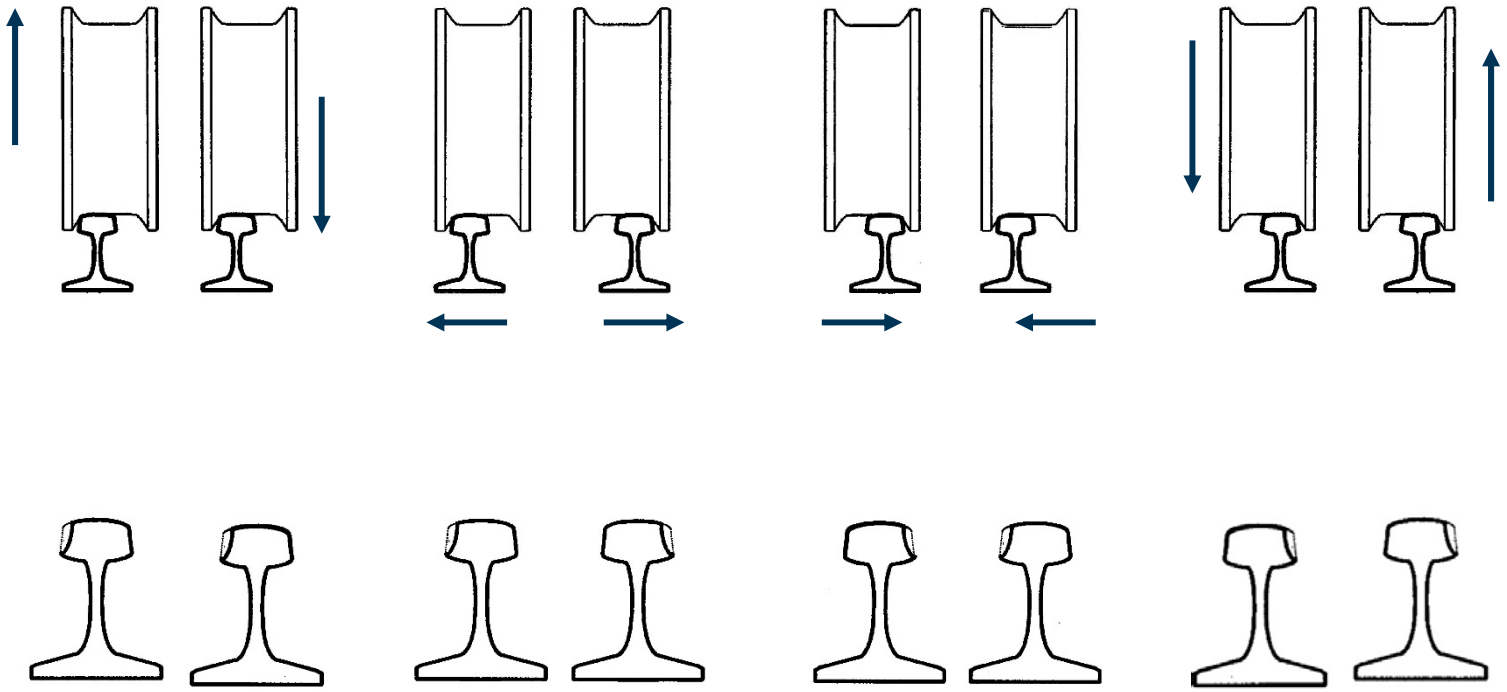
Wheel To Rail Relationship

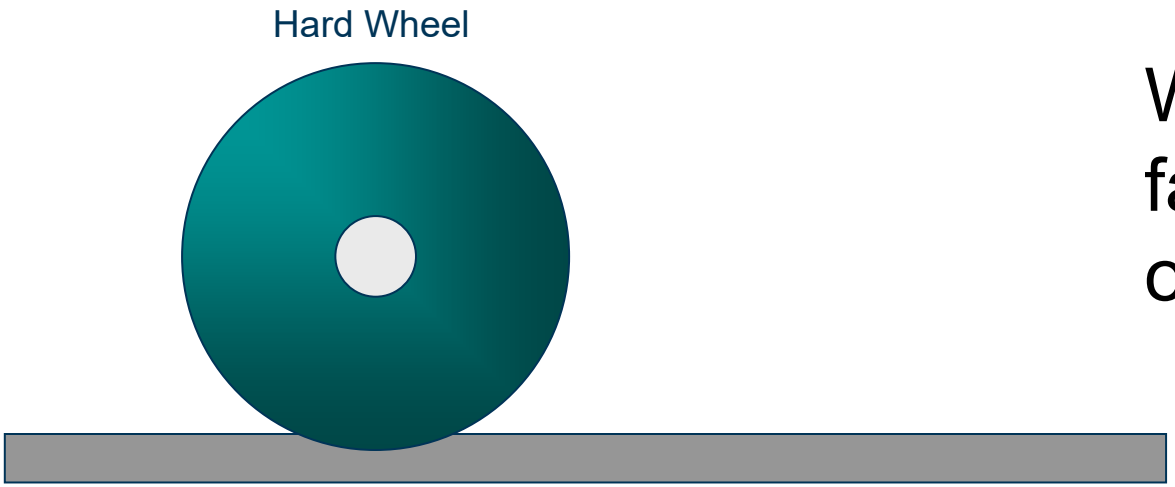


Wheel To Rail Relationship



"Pay me now or pay me later."

Wheel Wear



Which wears faster, the wheel or the rail?

THE WHEEL

WHY?

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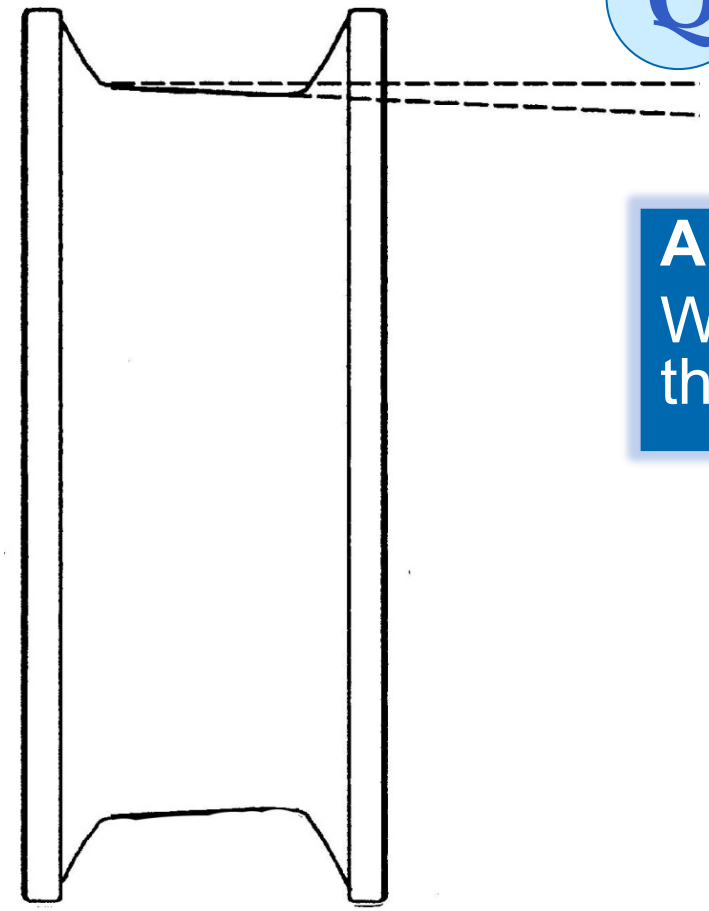
Tapered Wheels



Why put tapered wheels on the crane instead of fixing the runway?

ANSWER:
Wheels are much less expensive than a runway

Remember this?

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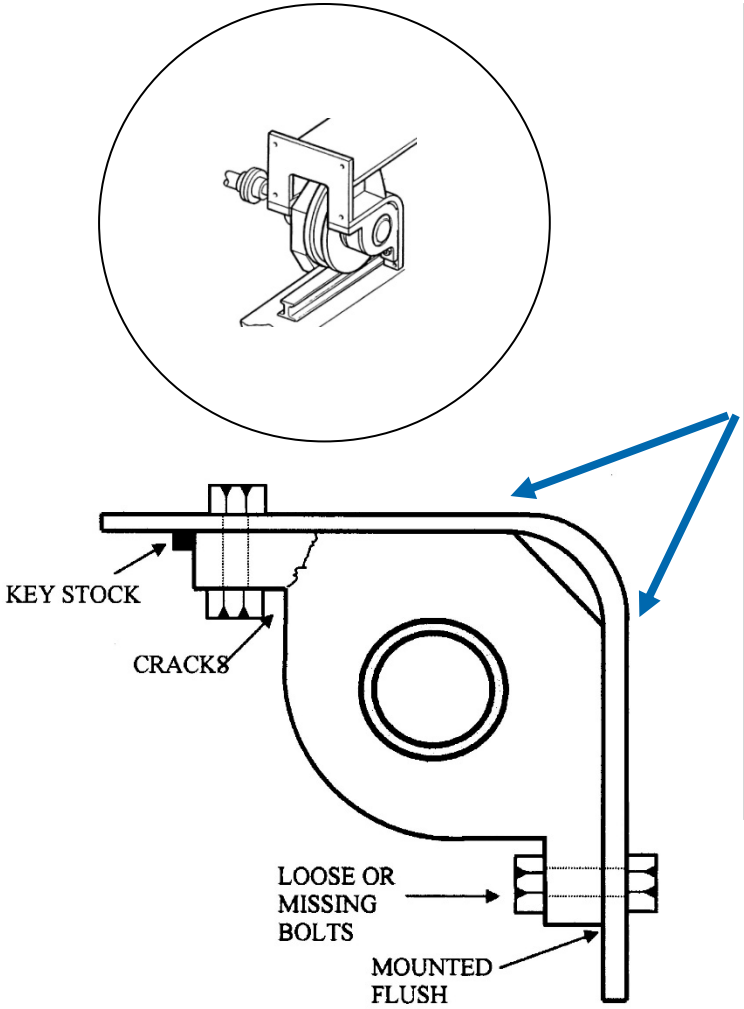
Wheel Bearing Housings



INSPECT:

- Ensure nuts and bolts are in place and securely fastened
- Bearing housing flush against end truck
- If key stock is used check for movement or cracked bead
- Check for cracks in housing
- The radius of end truck can cause a stress concentration point check carefully for signs of fatigue, scaling or cracking

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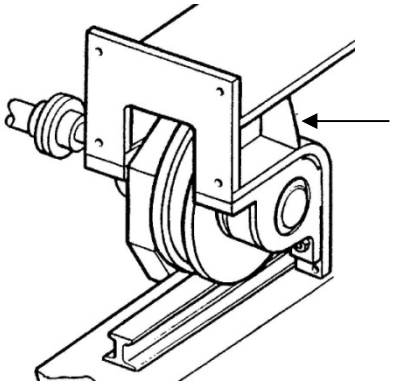
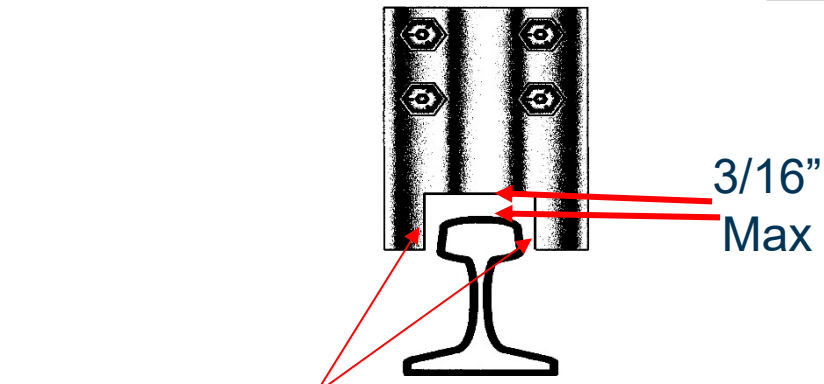
End Truck Structure



INSPECT:

- Bridge rail sweep properly and securely fastened
- Bent, twisted or cracked
- Proper clearance (OSHA 1910.179(e)(4)) (CMAA Spec #70) (ASME B30.2-1.9)(B30.17/11-1.10(c)(1)(2))



Wheel tread width + 1/8” Max
Spacing should be equal on both sides

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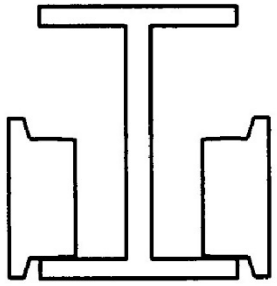
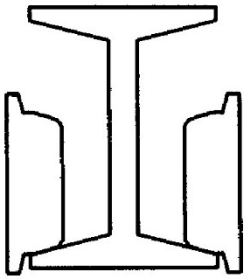
Underhung Wheels



STRAIGHT TREAD



CROWNED / TAPERED

INSPECT

- Wheel tread
- Proper wheel for rail type
- Wheel flange
- Wheel spacing
- Bearings, shafts, nuts and bolts
- Side plates
- Drop limiter / lugs if equipped

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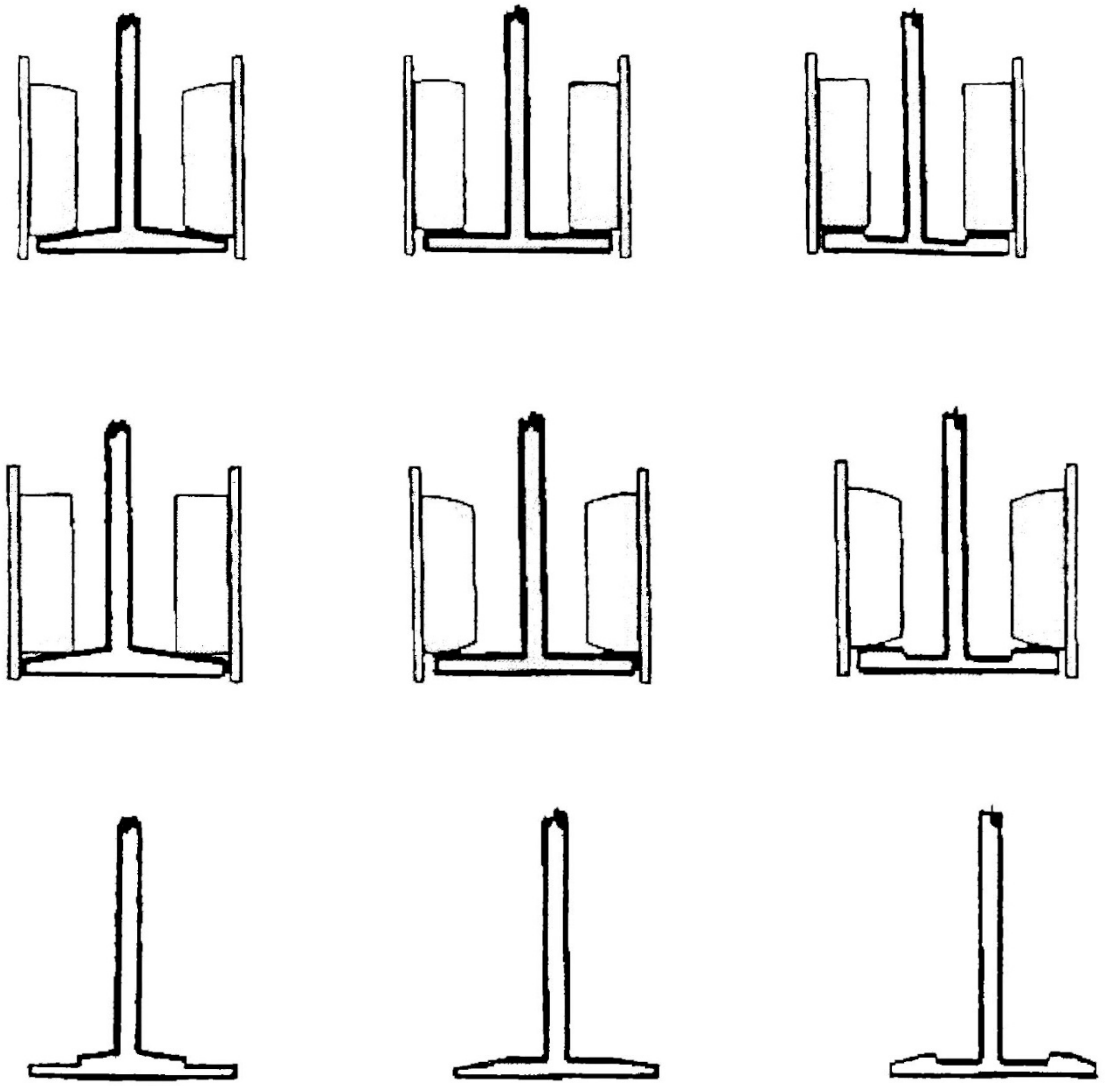
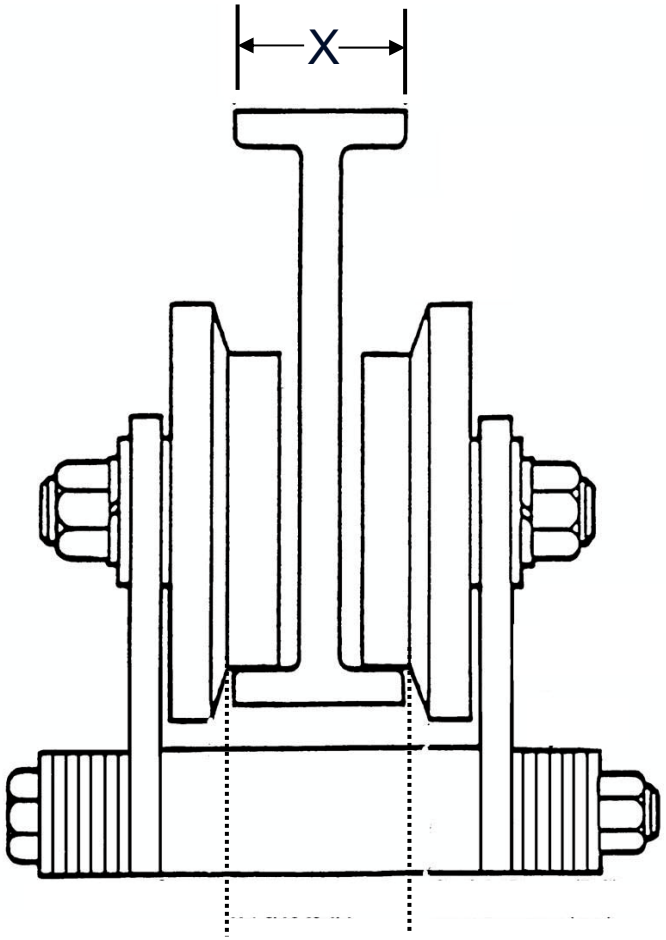
Proper Wheel Rail / Track Application



Wheel Spacing ASME B30.17-1.18(d)



X + 1/8” to ¼” TOTAL STRAIGHT TRACK
For curved track applications refer to manufacture recommendations

- Underhung cranes inherently skew. Wheel spacing being too great is the number one cause of binding, noise racking, etc.. REMEMBER.. Flange contact steers the crane.
- Excessive wheel spacing on monorails causes the same issues. However, they are far less apparent. Dropping a trolley or wedging it on the rail because of side pulling can result if wheels are spaced too far apart.

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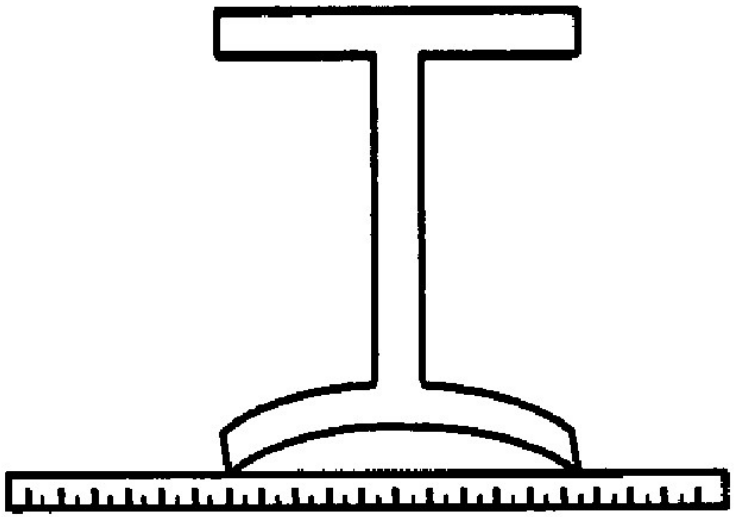
Underhung Rail Inspection



This condition is known as **peaning** and can be extremely dangerous. Consult an engineer or qualified person.

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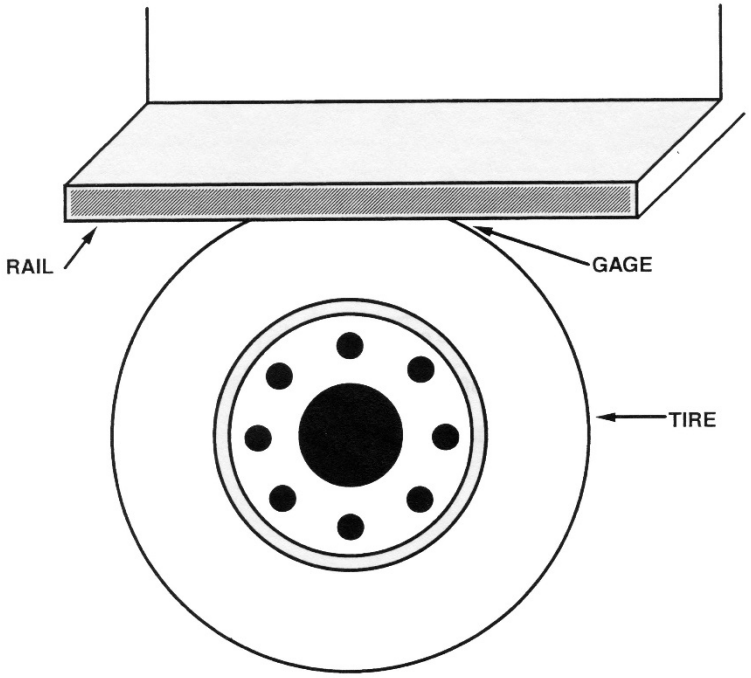
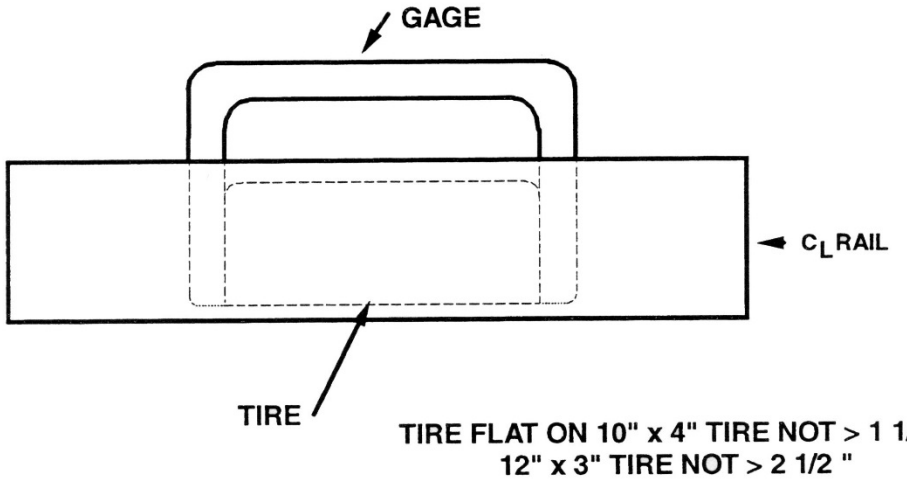
Wheel Inspections





TIRE FLAT ON 10" x 4" TIRE NOT > 1 1/4 "
12" x 3" TIRE NOT > 2 1/2 "

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Questions??

Thanks for your attention,
let's take a break!

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