

APPENDIX B

FIELD IDENTIFICATION OF RAIL DEFECTS

B-1. Rail defects may be observed in track.

This appendix presents definitions relating to rail and brief descriptions of the common rail defects observed in track. Figure B-1 presents common rail nomenclature, and figure B-2 shows the relative positions of planes through the rail.

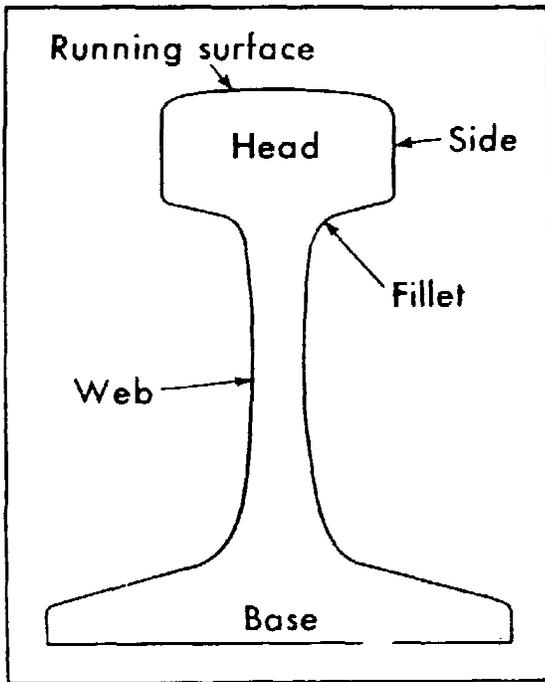


Figure B-1. Rail nomenclature.

B-2. Not all rail defects are critical.

A critical defect is a rail defect that will effect the safety of train operations. Noncritical defects are defects that occur in the rail but do not effect the structural integrity of the rail or the safety of the trains operating over the defect. Noncritical de-

fects are identified in the defect descriptions presented in this appendix. Table 7-1 of these standards presents a listing of rail defects, operating restrictions, and remedial actions.

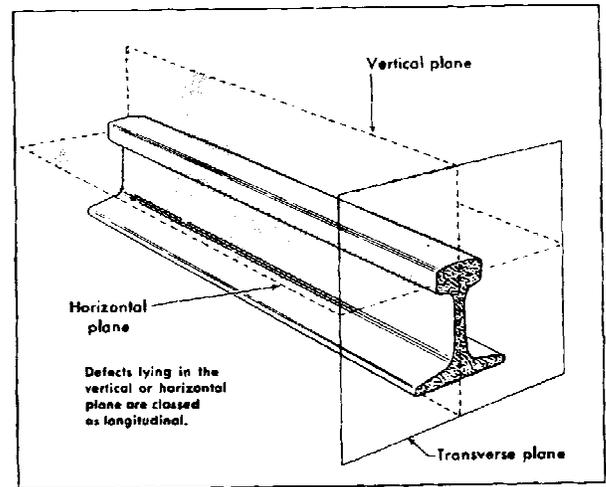


Figure B-2. Relative positions of planes through a rail.

B-3. Field identification of rail defects.

These descriptions are presented in alphabetical order to assist in identifying defective rails in track. Refer to TM 5-627/AFM 91-33 for additional information.

a. Bolt hole crack.

(1) *Description.* A progressive fracture originating at a bolt hole.

(2) *Appearance in track.* Bolt hole cracks are not visible until a bolt or a joint bar has been removed unless the defect has progressed beyond the bar. They may be recognized by a hairline crack extending from the bolt hole (fig B-3).

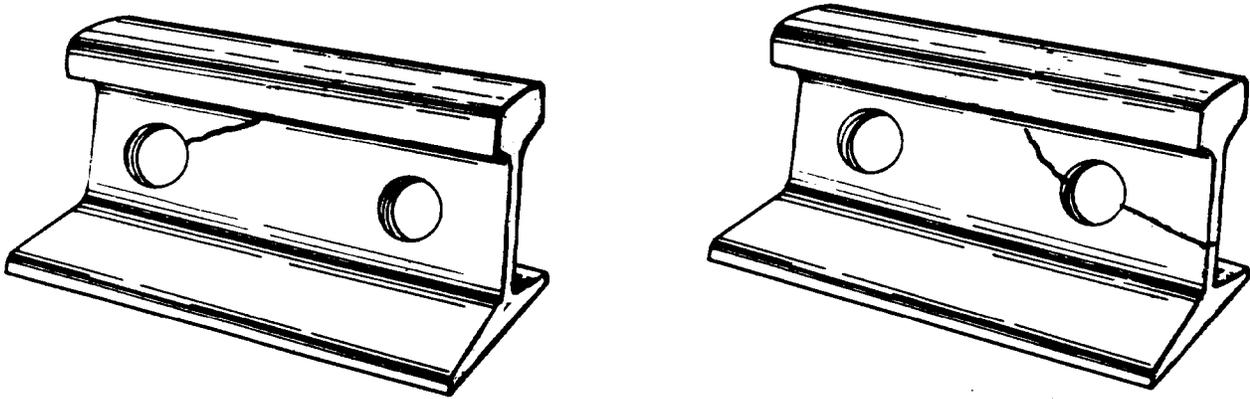


Figure B-3. General appearance of bolt hole cracks.

b. Broken base.

(1) Description. Any break in the base of the rail.

(2) Appearance in track. Generally appears as a half-moon crack break in the rail base. Figure B-4 illustrates three different appearances of broken bases.

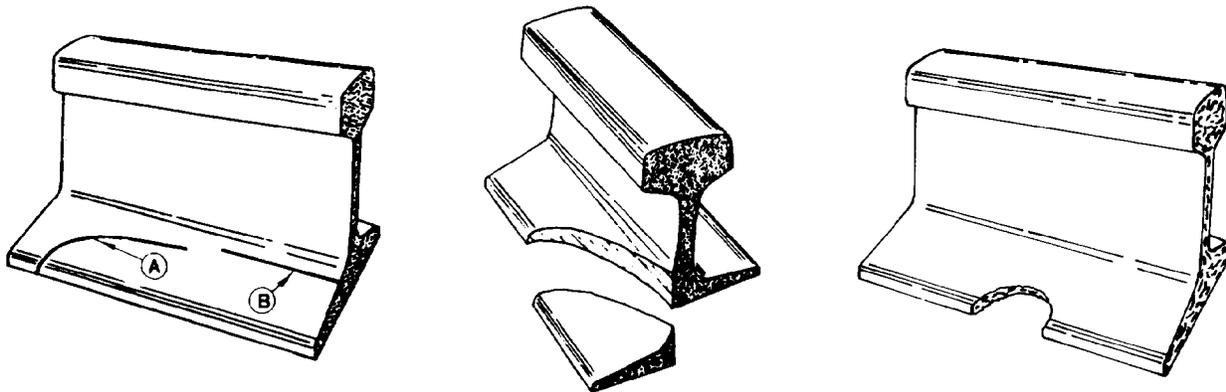


Figure B-4. General appearance of broken base.

c. *Complete break (broken rail).*

(1) *Description.* A complete transverse separation of the head, web, and base of the rail.

(2) *Appearance in track.* May appear as a hairline crack running completely around the rail, usually accompanied by bleeding or a separation of the rail at the break with one or both of the broken ends battered down (see fig B-5).

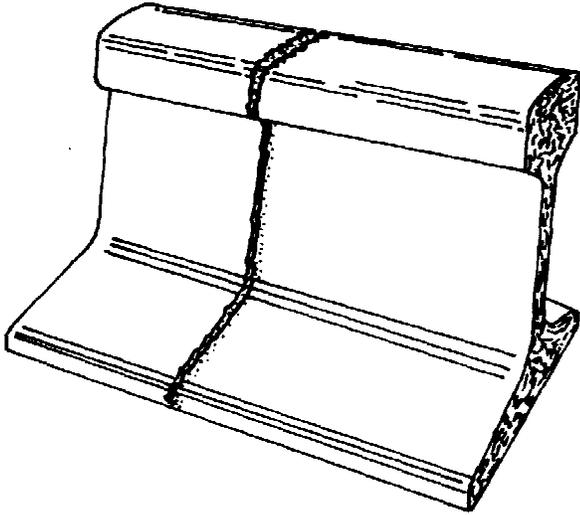


Figure B-5. General appearance of broken rail.

d. *Compound fissure.* See "transverse defects."

e. *Corrosion.*

(1) *Description.* The decaying or corroding of the metal in the web or base of the rail.

(2) *Appearance in track.* Pits or cavities in the upper base or the web of the rail. In advanced stages, a significant loss of material is evident.

f. *Corrugation.*

(1) *Description.* A repeated wavelike pattern on the running surface of the rail. Corrugations develop over a long period of time. A number of factors contribute to the development of corrugations with the actual cause dependent on the track and operating conditions. Corrugations are not a critical defect.

(2) *Appearance in track.* Small, hard, bright, short-pitch ridges along the running surface

of the rail varying anywhere from 2 to 18 inches apart and usually less than $\frac{1}{16}$ (0.0625) inch deep. Although the individual waves (ridges) are usually only a short distance apart, the corrugations may extend over a considerable distance (see fig B-6).

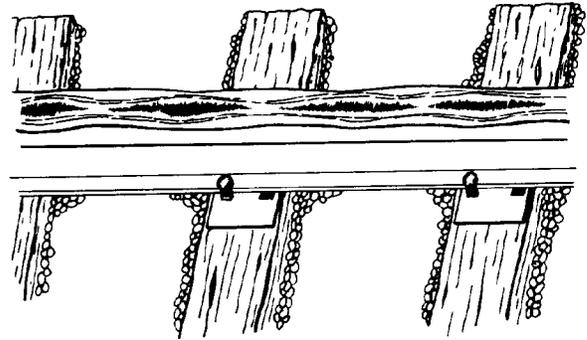


Figure B-6. General appearance of corrugation.

g. *Crushed head.*

(1) *Description.* The flattening of several inches of the rail head, usually accompanied by a crushing down of the metal but with no signs of cracking in the fillet under the head.

(2) *Appearance in track.* Generally appears as:

(a) Flattening and widening of the head for several inches with the entire head sagging.

(b) Small cracks in a depression on the running surface.

(c) In advanced stages, a bleeding crack may be present at the fillet under the head (fig B-7).

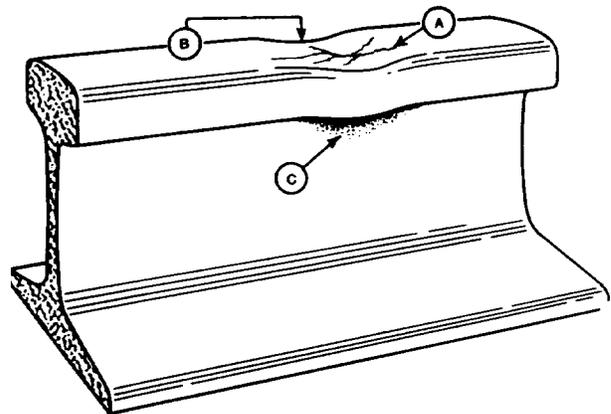


Figure B-7. General appearance of crushed head.

h. Defective weld.

(1) *Description.* A progressive transverse separation within an area where two rails have been joined by welding or a rupture at a weld where improper fusion has occurred.

(2) *Appearance in track.* No outward sign is visible until the separation reaches the rail surface. A defective weld may then be recognized by a vertical bleeding crack at the welded portion of the rail joint where the separation has reached the surface.

i. Detail fracture. See “transverse defects.”

j. End batter.

(1) *Description.* Damage caused by wheels striking the rail ends.

(2) *Appearance in track.* Appears as damage to or a depression in the top surface of the rail head at the ends of the rail (fig B-8).

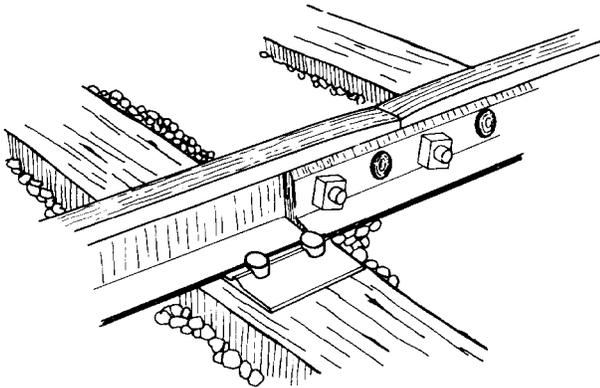


Figure B-8. Rail end batter.

k. Engine burns (burned rail).

(1) *Description.* Rail that has been scarred on the running surface by the friction of slipping locomotive wheels. An engine burn is not a critical defect; however, an engine burn may lead to an engine burn fracture.

(2) *Appearance in track.* Round or oval rough spots or holes on the tread of the running surface. Often the source of engine burn fractures. Engine burns may be deep (fig B-9).

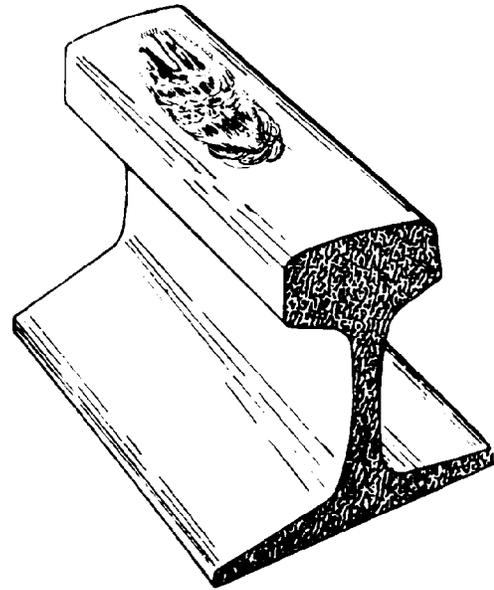


Figure B-9. Typical appearance of an engine burn.

l. Engine burn fracture.

(1) *Description.* A progressive fracture in the rail head starting from a point where engine wheels have slipped and burned the rail.

(2) *Appearance in track.* No sign of transverse separation is visible until the defect reaches the rail surface (cracks out). An engine burn fracture may then be recognized by one or more of the following characteristics.

(a) A hairline crack on the side of the head in the immediate vicinity of an engine burn and at right angles to the running surface. The crack may be visible on either the field or gage side of the head.

(b) Transverse thermal cracks extending from the burn to the gage corner and down the side of the head for at least $\frac{1}{8}$ (0.125) inch.

(c) A cracked out horizontal separation on the field side of the rail head under the burned area often accompanied by one or more thermal cracks extending transversely to the gage corner (fig B-10).

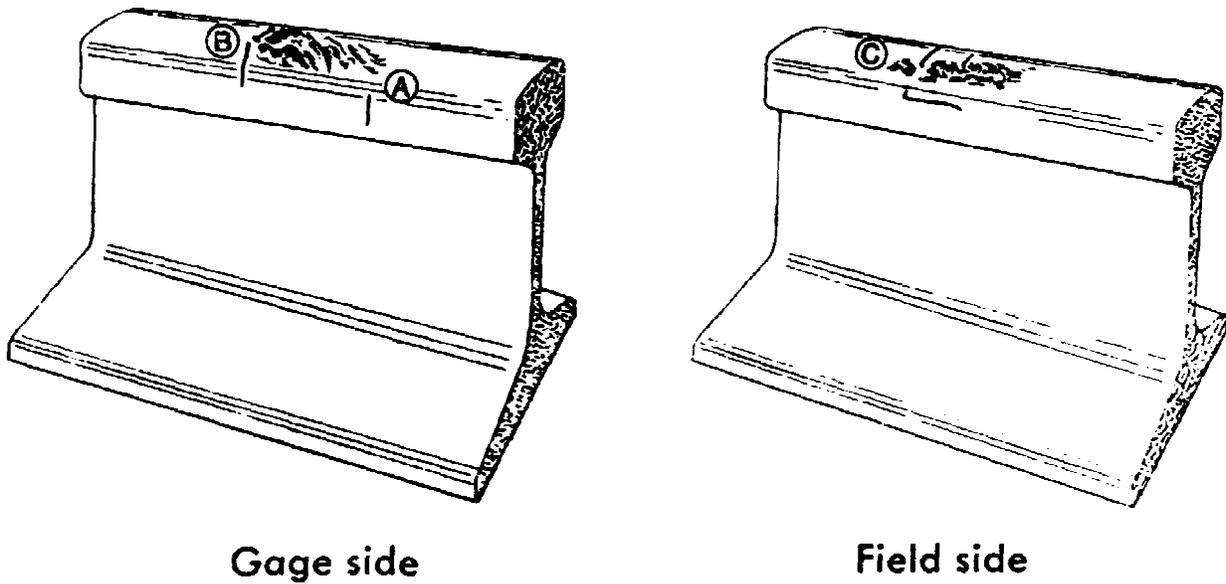


Figure B-10. General appearance of an engine burn fracture.

m. Flaking.

(1) *Description.* A progressive horizontal separation on the running surface near the gage corner often accompanied by scaling or chipping. Flaking should not be confused with shelling as flaking occurs only on the running surface near the gage corner and is not as deep as shelling. Flaking is not a critical defect.

(2) *Appearance in track.* Can be recognized by one or more of the following characteristics:

(a) Shallow depressions with irregular edges occurring on the running surface near the gage corner. Generally flaking will occur within $\frac{1}{4}$ (0.25) inch of the corner of the rail.

(b) Horizontal hairline cracks along the running surface near the gage corner of the rail head, resembling small slivers (fig B-11).

n. Flowed rail.

(1) *Description.* A rolling out of the tread metal beyond the field corner with no breaking down of the underside of the head. Flow is not a critical defect.

(2) *Appearance in track.*

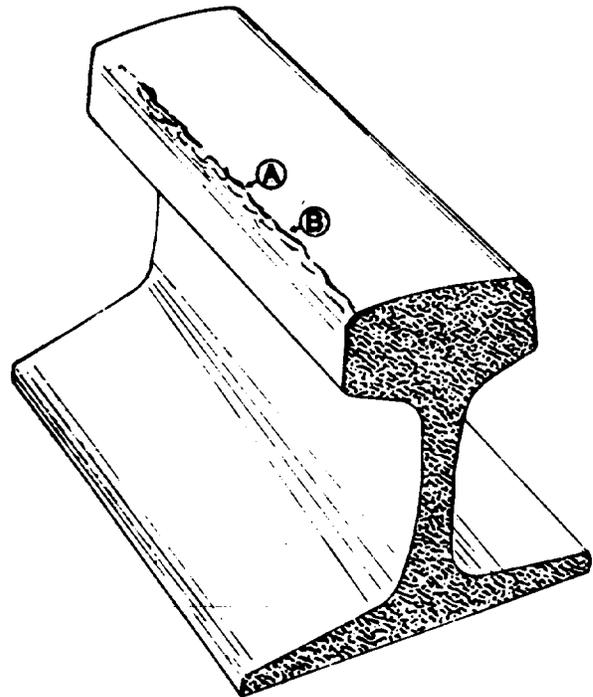


Figure B-11. General appearance of flaking.

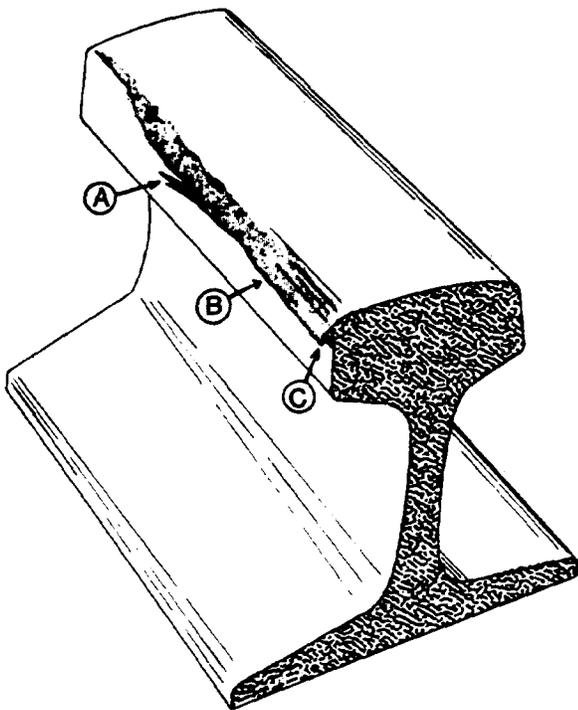


Figure B-12. General appearance of flow.

(a) Surface metal on the head flowed toward the field side giving a creased appearance on the running surface near the field corner.

(b) A protruding lip extending along the length of the rail.

(c) In the advanced stage, flow becomes bladelike, jagged, or nonuniform and may hang down or separate from the rail head (fig B-12).

o. Head/web separation.

(1) *Description.* A progressive fracture separating the head and web of the rail.

(2) *Appearance in track.* Can be recognized by one or more of the following characteristics.

(a) In earlier stages, wavy lines appearing along the fillet under the head.

(b) As the condition develops, a small crack will appear along the fillet on either side progressing longitudinally with slight irregular turns upward and downward.

(c) In advanced stages, bleeding cracks will extend downward from the longitudinal separation through the web and may extend through the base (fig B-13).

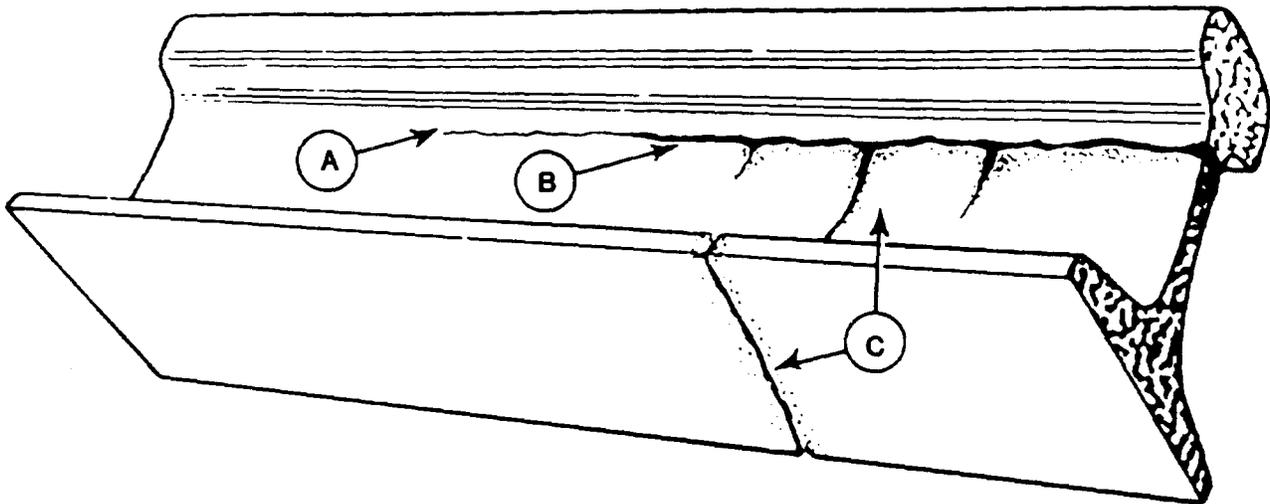


Figure B-13. General appearance of head/web separation.

p. Horizontal split head.

(1) *Description.* A progressive longitudinal fracture in the rail head parallel to the running surface.

(2) *Appearance in track.*

(a) Before cracking out, a moderate size horizontal split head will appear as a flat spot on the running surface often accompanied by a slight widening or dropping of the rail head. The flat spot will be visible as a dark spot on the bright running surface.

(b) After cracking out, the horizontal split head will appear as a hairline crack in either side or both sides of the rail head usually $\frac{1}{4}$ (0.25) inch or more below the top of the rail head (fig B-14).

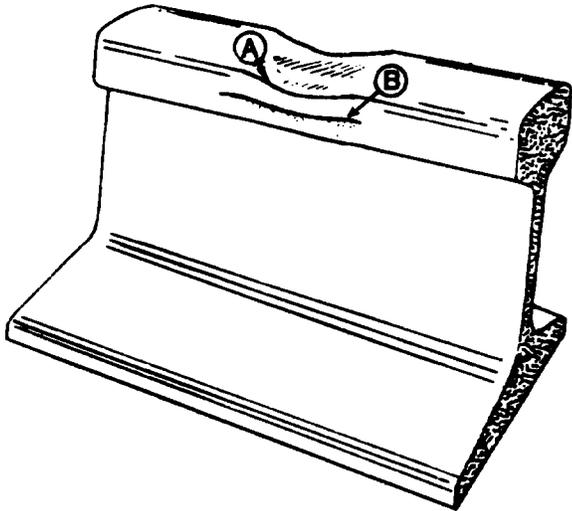


Figure B-14. General appearance of horizontal split head.

q. Mill defects.

(1) *Description.* Deformations, cavities, seams, or foreign material found in the head, web, or base of the rail. Mill defects are not critical defects.

(2) *Appearance in track.* Any deformation in the rail, broken out area, or inclusion (fig B-15).

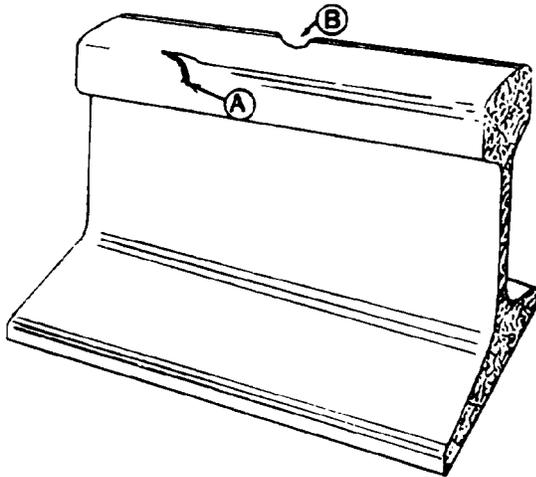


Figure B-15. General appearance of mill defects.

r. Piped rail.

(1) *Description.* A progressive longitudinal fracture in the web of the rail with a vertical separation or seam, forming a cavity in the advanced states of development.

(2) *Appearance in track.*

(a) A bulging of the web on either or both sides. Shallow cracks due to distortion may be found in the bulging surface.

(b) A slight sinking of the rail head may exist above the pipe (figs B-16 and B-17).

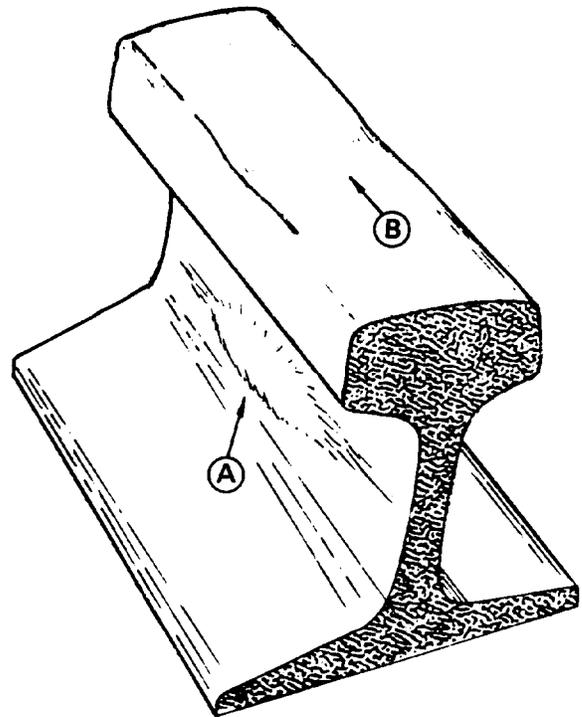


Figure B-16. General appearance of piped rail.

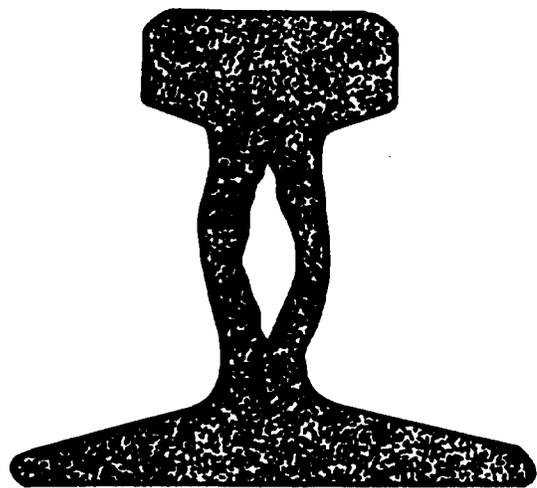


Figure B-17. Cross-sectional view of piped rail.

s. Rail wear.

(1) *Description.* The loss of material from the running surface and side of the rail head due to the passage of wheels over the rail.

(2) *Appearance in track.* Rail wear appears as a rounding of the running surface of the rail head, particularly on the gage side (fig B-18).

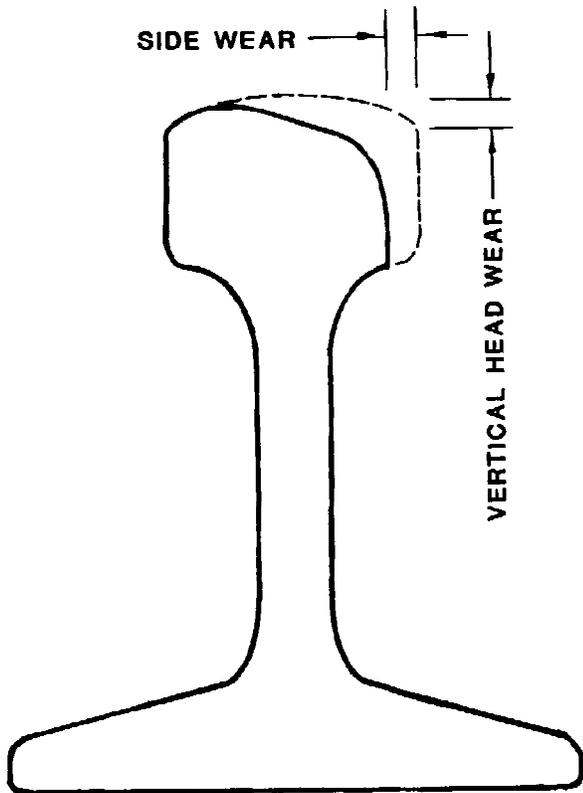


Figure B-18. General appearance of vertical head and side wear.

t. *Shelling.*

(1) *Description.* A progressive horizontal separation which may crack out at any level on the gage side but generally at the gage corner. It extends longitudinally not as a true horizontal or vertical crack, but at an angle related to the amount of rail wear. Shelling is not a critical defect.

(2) *Appearance in track.* Appears as one or more of the following:

(a) Dark spots irregularly spaced on the gage side of the running surface.

(b) Longitudinal separation at one or several levels in the upper gage corner with discoloration from bleeding.

(c) If the rail has been turned, the shelly spots will appear on the field side with an irregular overhanging lip of metal similar to flowed rail (fig B-19).

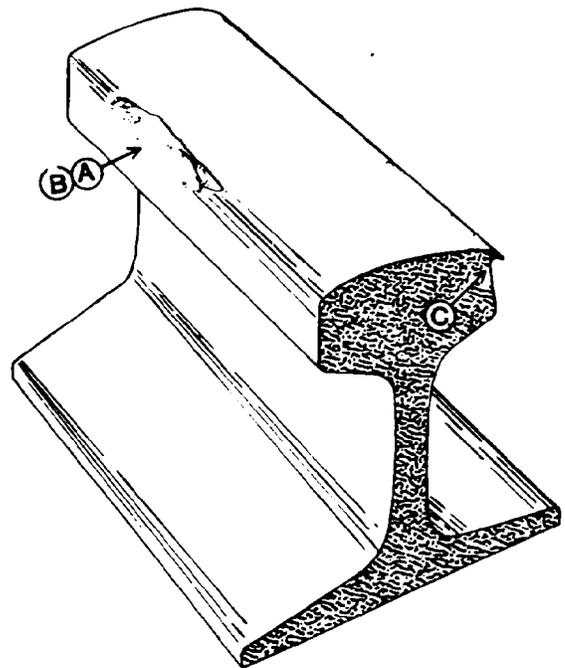


Figure B-19. General appearance of shelling.

u. *Slivers.*

(1) *Description.* A sliver is the separation of a thin, tapered mass of metal from the surface of the head, web, or base of a rail. Slivers are not critical defects.

(2) *Appearance in track.* Thin slivers on the surface of the rail head and parallel to the rail length similar to wood slivers (fig B-20).

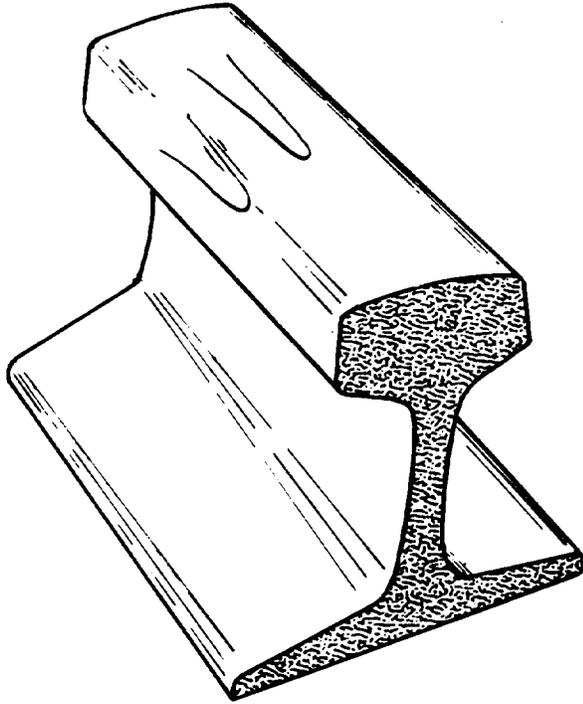


Figure B-20. General appearance of slivers.

v. *Split web.*

(1) *Description.* A progressive fracture through the web in a longitudinal or transverse direction, or both.

(2) *Appearance in track.* Horizontal and/or vertical bleeding cracks in the web (fig B-21).

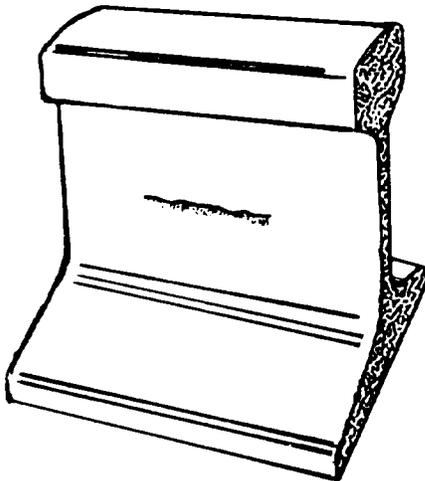


Figure B-21 General appearance of split web.

w. *Surface bent rail.*

(1) *Description.* The permanent downward bending of the rail ends due to long-term passage of traffic over track with loose or poorly supported

joints. Surface bent rail is not a critical defect and cannot be corrected without replacing the rail.

(2) *Appearance in track.* A downward bending of the rail head near the rail ends giving the appearance of low joints. When track with surface bent rail is surfaced (raised and tamped), the rail ends soon return to a lower elevation. In the more serious cases the vertical curve in the rail head is still visible after surfacing.

x. *Surface damage.*

(1) *Description.* Any damage to the surfaces of the rail, both the running surface and the external surfaces, caused by deep engine burns (running surface) or by striking the rail. Surface damage is not normally a critical defect but may lead to detail fractures or engine burn fractures.

(2) *Appearance in track.* Deep engine burns, dents, nicks, cuts, or other abnormalities on the surface of the rail.

y. *Torch cut rail.*

(1) *Description.* Any rail that is cut or otherwise modified (including bolt holes) using an acetylene torch or other open flame.

(2) *Appearance in track.* Irregular or rough rail ends and/or bolt holes (fig B-22).

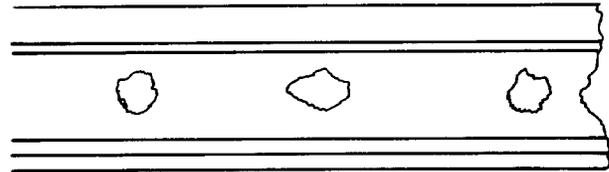


Figure B-22. General appearance of torch cut rail.

z. *Transverse defects.* (Compound fissure, transverse fissure, and detail fracture)

(1) *Description.* Any progressive fracture occurring in the rail head having a transverse separation, however slight. The exact type of transverse defect cannot be determined until after the rail is broken for examination.

(2) *Appearance in track.* Not visible until the defect reaches an outer surface. A transverse defect may be recognized by one or more of the following characteristics:

(a) A hairline crack on the side of the head at right angles to the running surface, at the fillet under the head, and occasionally on the running surface.

(b) Bleeding at the crack.

(c) A hairline crack at the gage corner of the rail head. On turned rail, this condition may occur at the field corner. Numerous small gage cracks or head checks are often present but should not cause suspicion unless a single crack extends

much farther down the side and/or across the running surface.

(d) A horizontal hairline crack in the side of the rail head turning upward or downward at one or both ends usually accompanied by bleeding. Under such conditions a flat spot will generally be present on the running surface.

(e) A hairline crack extending downward at right angles from a horizontal crack caused by shelling of the upper gage corner of the rail head (fig B-23).

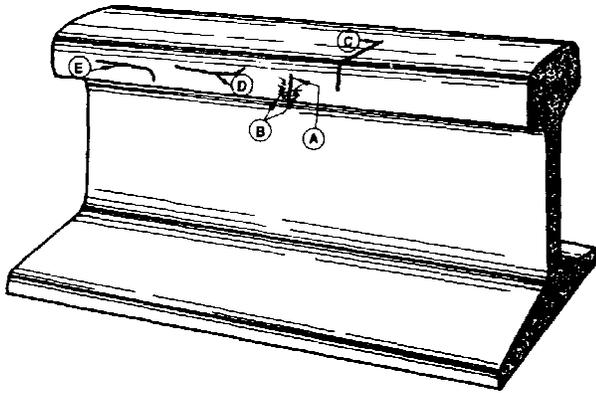


Figure B-23. General appearance of transverse defects.

aa. Vertical split head.

(1) Description. A progressive longitudinal fracture in the head of the rail perpendicular to the running surface.

(2) Appearance in track. Can be recognized by one or more of the following:

(a) A dark streak on the running surface.

(b) Widening of the head for the length of the split. The cracked side of the head may show signs of sagging.

(c) Sagging of the head causing a rust streak to appear on the fillet under the head.

(d) A hairline crack near the middle of the rail head.

(e) In advanced stages, a bleeding crack is apparent on the rail surface and in the fillet under the head (fig B-24).

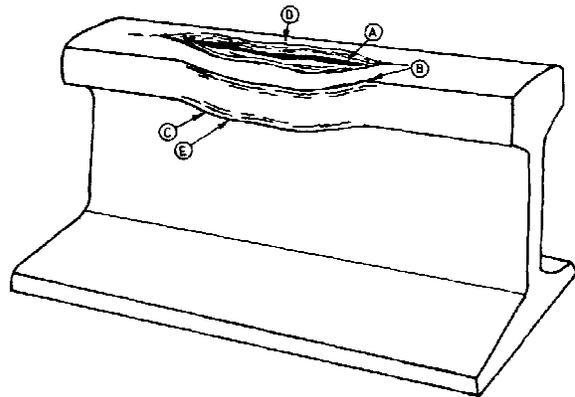


Figure B-24. General appearance of vertical split head.