U.S. Department
of Transportation

**Federal Railroad
Administration**

Memorandum

Date: FEB 1995

Reply to Attn. of: T-95-02

Subject: Inspection of Movable Point Frogs and Tangential Geometry Turnouts

From: Director, Office of Safety Enforcement

To: All Regional Administrators, Deputy Regional Administrators, Track Specialists, Signal and Train Control Specialists, Track Inspectors, Signal and Train Control Inspectors

Background: The following discussion is intended primarily for the guidance of Track and Signal and Train Control Inspectors who, respectively, have the responsibility to inspect those components of main track turnouts that fall within each scope of discipline.

For many years, turnouts (e.g. Number 15 or Number 20) with conventional split switches and rail bound austenitic manganese steel (AMS) frogs have been successfully used on both freight and passenger railroads. Most railroad turnout designs are based on those found in the American Railway Engineering Association (AREA), Portfolio of Trackwork Plans. In recent years, in an effort to reduce maintenance costs on high tonnage lines and to increase turnout speeds, railroads have begun to evaluate advanced turnouts.

Movable (alternative manufacturer's spelling is "moveable") point frogs originated in Europe and have been installed in both conventional and tangential geometry turnouts in this country. Passenger railroads appear to be moving toward the tangential design to attain higher speeds through main track crossovers. Amtrak's Number 32.7 high speed turnout, for example, was tested in 1993 at 100 miles per hour.

Although tangential turnouts and movable point frogs are not widespread throughout the industry and, therefore are less frequently inspected by FRA field personnel than conventional turnouts, these installations are becoming increasingly more common. Several frogs are in the Powder River Basin area of Wyoming and the Northeast Corridor and are being evaluated in other parts of the country.

The purpose of this bulletin is familiarize inspectors with these advanced turnouts, point out potential safety considerations, and standardize FRA's reporting procedures. The safety issues described in this bulletin derive from a joint headquarters and regional staff inspection of several movable frogs and tangential geometry turnouts.

Discussion of Movable Point Frogs: Most of the movable point frogs are manufactured outside this country, primarily in Austria, England, and Japan. Frogs are predominately manufactured by Nortrak, Voest-Alpine, Yamato, Henry Boot, and Balfour Beatty. Amtrak's 32.7 frogs were manufactured in England by Balfour Beatty and Bethlehem Steel assembled the components of the tangential turnouts for Amtrak.

The photograph in Figure 1 shows a typical installation of a movable point frog. In this case, the frog is a Nortrak swing nose frog on a Number 20 tangential geometry turnout. Most installations of the swing nose frog have one or two power switch machines connected to the movable point. Some 32.7 frogs, for example, have two switch machines to move the point while Number 20 frogs on a freight line in Wyoming are powered by one switch machine. Note the absence of a guard rail on the running rail opposite the frog in Figure 1.

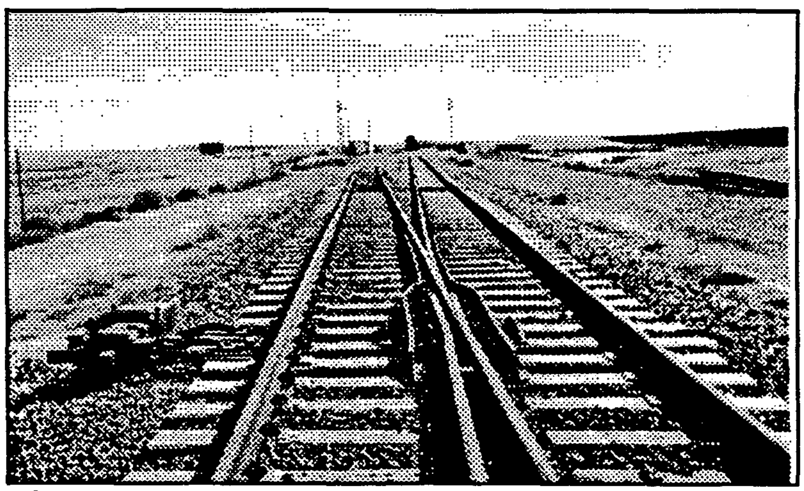

Figure 1 Number 20 Nortrak Swing Nose Frog

The movable point frog has a continuous running surface through the frog which provides the inherent advantage of reducing the impact forces normally associated with conventional frogs when wheels traverse the gap at the frog point.

The point which most manufactures and railroads call a "vee" pivots from side to side from one "wing rail" to the other. The short rails in the gage of the track shown in Figure 1 currently have no function but once served as part of a "clamp lock" system. This system has been removed and the "locking" is now contained within the power switch machine. The vee rails and the wing rails are customarily made from conventional hardened rail.

Some movable frogs are fastened to concrete or timber switch ties with screw-type fasteners while others are fastened with Pandrol or other types of clip-type fasteners. The frogs have various bracing schemes that are analogous to the adjustable bracing that provides support to stock rails on split switches.

Figure 2 is a photograph of a Voest Alpine Number 20 frog which is a forerunner of the Nortrak. The arrow points out the particular configuration on this frog that supports the wing rails.

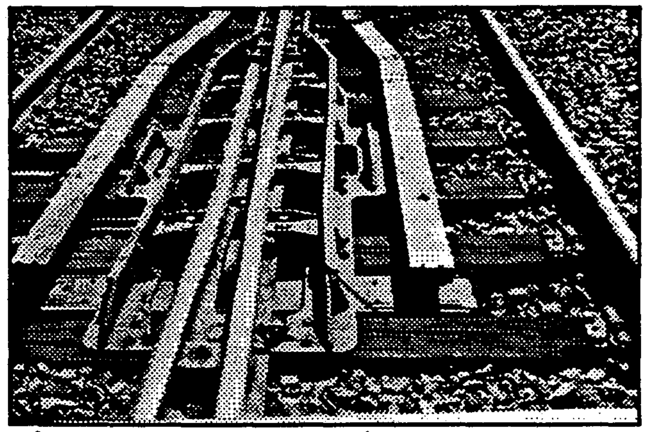
Figure 2 Voest Alpine Number 20

The photograph in Figure 3 shows a Yamato swing nose frog which exhibits a problem common to all the designs, especially in heavy tonnage areas: broken bolts or screws. In this particular case, the bolts sheared below the plate in the concrete ties. Repair consists of backing out the screw-type fastener and reinstalling a new fastener. In some cases, machine bolts which provide the connections on the wing rail support mechanism break or become loose. Repair can consist of drilling out the bolt, retapping the hole and reinstalling another bolt.

An important consideration of movable point frogs in general is that the fit of the vee point rails against the swing rails is critical. This is analogous to the fit of a switch point against a stock rail. If the frog point did not properly fit against the wing rail, wheels could "split" the point and take the wrong direction. The designs observed by FRA so far have an arrangement where the vee fits into an undercut part of the frog or is protected by a bend or "pocket". As is the case with switch points, the frogs are designed so that flanges do not contact the vee in the first several inches of the point. Inspectors may use a string or straight edge along the gage side

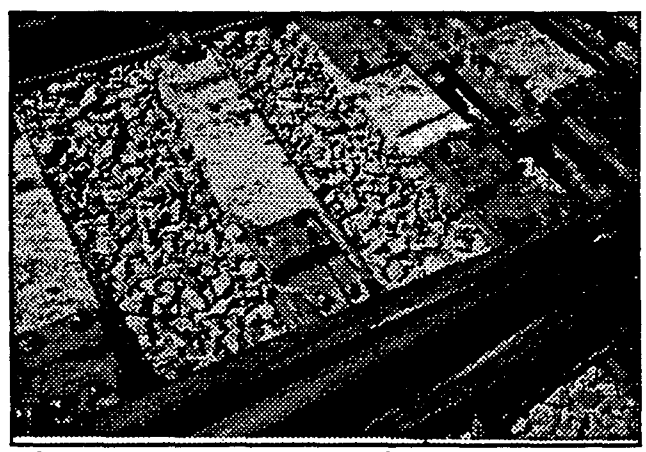
Figure 3 Yamato Series C

of the wing rail to check the fit. Evidence where the point of the vee has been struck or marked by wheel flanges is a serious safety condition.

A few earlier movable point frogs have holes in the base of the wing rails which rest on nubs on the frog plate. It is not clear whether this practice was designed to keep the frog together during shipping or the manufacture believed that this would improve resistance to longitudinal movement of the wings. In any case, cracks have been reported in the wing rails or frog plates near the holes or nubs.

Railroad maintenance forces are learning more about the movable frogs as they remain in track. For example, although not a serious safety problem, Amtrak recently moved blocks and readjusted bracing on a number 32.7 installation to improve the fit of the vee against the wing. The railroad also advised that future frog installations of this type will have the switch machine moved a crib or two ahead to also improve the design.

Discussion of Tangential Geometry Turnouts: The purpose of the tangential geometry turnout is that it provides for a smoother transition to the diverging route. The sketch in Figure 4 compares a conventional number 20 turnout with a tangential geometry turnout. One railroad is exploring the possibility of using a modified tangential which is also depicted in the sketch.

The chief characteristic of the tangential design is that the point of switch is at or near the tangent point to a simple curve extending through the turnout side.

Amtrak's number 32.7 turnout has a tangent point about 8 feet ahead of the switch point. The switch points on Amtrak's design are about 130 feet long.

Some designs use standard adjustable rail bracing while

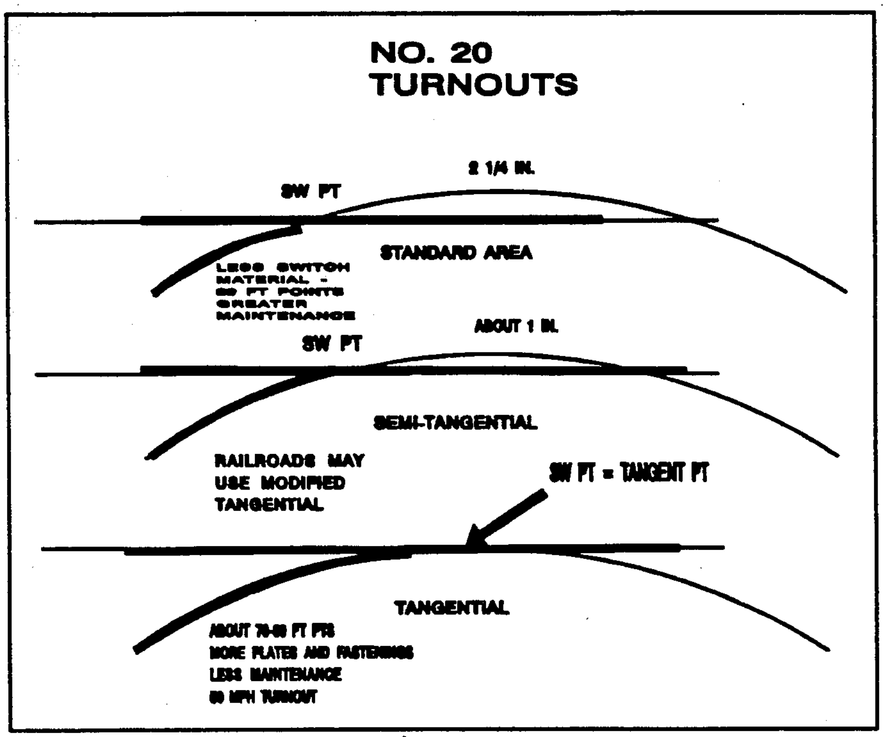

Figure 4 The tangential concept

others are supported entirely by spring clips inside and outside each stock rail.

Asymmetrical switch point rails are used on some turnouts. The two sections are flash butt welded or forged together. This asymmetrical characteristic has been observed, as well, on some movable frog wing rails. The sketch in Figure 5 illustrates an asymmetrical switch point on Amtrak's Northeast Corridor.

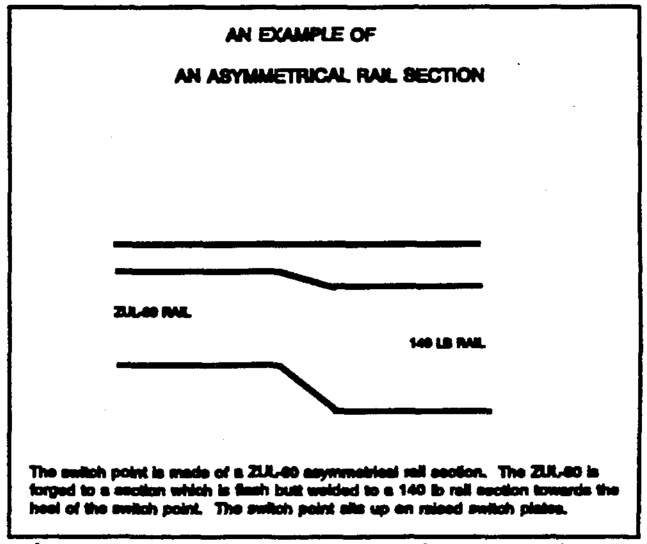

Figure 5 An Asymmetrical Rail

During an inspection of several movable frogs on a freight railroad, FRA observed a frog wing rail that had broken under traffic near an area where two asymmetrical rail sections were forged together.

Conclusions:

1. Tangential geometry switches must be inspected in the same manner as conventional switches. Switch inspections are described in the Track Enforcement Manual. During these inspections, FRA personnel must be cognizant of the unique characteristics of advanced designs such as the use of clip fasteners in lieu of conventional bracing and the presence of asymmetrical switch point rails.

2. Bolting or fastener designs which fasten the movable point frog to concrete or timber switch ties are considered fasteners in the same manner as cut spikes, Pandrol clips, and lag screws function on conventional frogs. Fastenings are discussed under Section 213.127 of the Track Enforcement Manual. Bolts that connect movable frog components together are considered frog bolts and must be addressed by using defect code 133.12, loose or missing frog bolts.

3. Of paramount importance is a proper fit of the vee point rails against the wing rails on movable frogs. Inspectors must use judgement to determine if the point fits the wing rail properly to allow wheels to pass the frog point. Movements of the wing rail must not adversely affect the fit of the frog point to the wing rail. When an inspector encounters a condition on a movable frog which should be addressed on the inspection report and no existing defect code is available for that condition, defect code 137.99

will be acceptable with a full description of the condition in the appropriate column of the inspection report.

4. Unlike rail bound austenitic manganese frogs, the running surface of most, if not all, movable frogs is made of hardened rail. Inspectors must be aware that this rail may contain defects that require remedial action under Section 213.113. Asymmetrical rails found in some switch points and frogs must be closely examined during inspections as this appears to be a potential weak spot where a crack or break could occur.

5. When performing inspections, FRA inspectors should discuss any concerns about an advanced turnout with appropriate railroad personnel. Inspectors should consult with the Regional Track Specialist to resolve any questions about the safety of these installations.