On Monday, October 19, 2009, at approximately 9:18 a.m., a southbound #2 train was traveling at 7.5 MPH on a curved section of track K-2 approaching Park Place Station on the “3” Line in Manhattan when an un-requested emergency brake application occurred. The train operator reported to the Control Center that he felt the train “bucking” just prior to the brakes applying. The train came to a stop with the head car adjacent to the Park Place Station platform.

After securing the train, the train operator and a train service supervisor dispatched by the Control Center, inspected under the train looking for the cause of the emergency brake application. Their inspection discovered that both trailing wheels on the lead truck on the second car (#6944) had derailed to the field side of track K-2. Further investigation found a broken rail at survey marker K2-173+55 which initiated wheel climb resulting in the derailment. The Control Center instructed the conductor to key open the front set of doors and discharge the passengers to the platform. There were no reported injuries as a result of this accident. Repairs were estimated at approximately $50,000.00.

The Investigation

The derailment occurred when running rail fractured; allowing the R-2 wheel of the lead truck of car #6944 to climb onto and traverse the head of the running rail for 17 feet before dropping off. Subsequently, the L-2 wheel was pulled off the head of the west rail; dropping between the rails where it continued forward striking and damaging track and signal components. The train traveled approximately 270 feet before stopping at survey marker 176+25.

Metallurgical Consultant

New York City Transit sent a section of the broken rail to a metallurgical consultant for analysis. The consultant concluded that in all probability, the initiation of the crack was due to fatigue; caused by high cyclic bending forces exerted by trains traversing the tight radius curve at an inordinately slow speed. The consultant study further stated that when a train is traveling around a curve at a low speed, the cant of the roadbed causes high lateral forces resulting in the weight of the cars being exerted on only a small portion of the rail base. The lateral forces pushing against the rigid track structure increases rail head wear which causes head checks and can cause canting of the rail. In this accident, excessive stresses caused a crack in the base of the rail which propagated through the web, then branched out through the head of the rail.
metallurgical consultant’s final conclusion was that the rail fracture was the result of the NYCT’s practice of operating trains over tight radius curves at inordinately slow speeds.

Maintenance of Way - Signal Operations Engineering

On October 19, 2009, Signal Operations Engineering personnel performed operational testing on the timing circuits in the derailment area. Trains traversing the area were unable to negotiate the track at the posted speed of 15 MPH due to the grade time signals not clearing as they should. Grade time signals are designed to permit train operators to operate the train through a series of track circuits or timing sections at a predetermined speed. Each signal circuit has a time release feature and the amount of time that a train must consume is based on the speed permitted in the area.

Signal Operations Engineering personnel measured the lengths of the track circuits and found them not in accordance with the time/distance listed on the timing charts. The field measurements were shorter than the times recorded on the charts. This required trains to operate through the area at slower speeds than they should. Under the direction of the Signal Operations Engineering group, maintenance personnel recalibrated several grade timers to allow train service to traverse the area at designed speeds.

Division of Track

The track in the area of the derailment was NYCT MW-1 Standards, Modified Type II design. The NYCT Office of System Safety reviewed the track inspection forms for a period of one year prior to the derailment and found track inspection documentation noting over 70 minor repairs including replacing broken and missing clips, replacing plate fasteners and associated hardware; tightening loose bolts and replacing broken joint bars. Based on the frequency and numbers of reported defects, it is apparent that the associated track hardware is less resilient and unable to stand the lateral forces being exerted on them by train movement.

Track Inspection

The Track Geometry Car (TGC), which is used to inspect for various defects involving track gauge, flange wear, cross level, surface and alignment of the track under load was last over track K-2 north of Park Place Station on August 7, 2009. That inspection detected a small portion of track south of the point of derailment to have a tight gauge of 56 3/16 inches. Track engineering personnel reviewing the data printout did not identify this condition as a red defect which they should have. Although this condition existed, it did not play a part in this derailment. Furthermore, it was determined that future geometry car printouts should include a visual indication of proper gauge to help identify problems involving track gauge. Also, an ultrasonic rail car inspection for internal rail defects was performed on September 21, 2009 and no internal defects were detected.

Post Incident Drug and Alcohol Testing

The train operator and the conductor were taken to the NYCT Medical Assessment Center for post incident drug and alcohol testing which was not administered within the required FTA time limit of two hours due to the length of the Rapid Transit Operation’s investigation. The results were negative. The train was sent to the East 180th Street Maintenance Facility for post accident inspections where no major defects were noted.

Corrective Actions

During the course of the investigation several anomalies came to light that required New York City Transit to issue corrective actions, including to:
1. Track Engineering – for failing to identify a tight gauge defect (red flag) in the area of the derailment. Track Engineering personnel were re instructed regarding interpreting data obtained on tight curves during automated track inspections. Track Engineering personnel also performed a review of all recent Track Geometry Car inspection printouts. The re-review identified two additional tight gauge defects that were undetected and since repaired. Track Engineering personnel were asked to double check all of the TGC printouts in which staff identified red defects to insure they are correctly identified.

2. Maintenance of Way, MW-1 Track Standards Manual - Section 104.3 - Conditions and Course of Action (E) was amended to require a supervisor or superintendent to investigate and evaluate the condition of the track in the areas where a combination of non critical rail surface defects or base corroded rail are present as soon as either type has been detected. Also, Section 102.2 - Walking Track Inspection (B) was amended to require a Superintendent to make a general inspection of all guarded curves with a radius of less then 50 feet on all mainline tracks and main yard tracks every three months. The revision also requires a written inspection report be prepared indicating the curved sections and switches inspected along with any findings.

Scheduled Maintenance System Program Proposal

Track Engineering’s analysis of the latest mainline track condition survey shows that there are around 190 guarded curve locations of Type II and IIM track throughout the subway. These locations symptomatically exhibit worn rails resting on broken or deteriorated fasteners that no longer hold the rails properly. These conditions exists even though the tie blocks and ballast still are in good to fair condition as these curve locations were reconstructed over the past 10-15 years.

Track Engineering developed a scheduled maintenance system (SMS) program for these identified guarded curves. The SMS program builds on a 2004 study of broken rails and other rail conditions on the NYCT performed by the National Research Council of Canada. That study showed that dynamic forces and stresses rise significantly in areas where a higher track modulus (a measure of the tracks resiliency) and tight curvature exist. The study further concluded that stresses in the rail that lead to fatigue and failure are reduced by using resilient fasteners that lower the track modulus. Track Engineering concurred that the combination of sharp curvature on a rigid track type such as type II and IIM track guarded curves with non-resilient fasteners creates excessive stresses on the main track components that are more prone to failure. The lack of track resiliency coupled with the excessive lateral and longitudinal forces exerted by the train wheels in sharp guarded curves where the interaction between the wheel flanges and the rails is constant and repetitive results in the excessive levels of wear and fatigue of those elements under significant loads; therefore resulting in their premature failure. The SMS program is projected to encompass all sharp guarded curve locations per year at a cost of 1.05 million per curve. The Program is expected to reduce the likelihood of catastrophic failures in guarded curves.

Conclusion

The PTSB staff finds that the most probable cause of this derailment was the development of a metal fatigue crack at the base of the running rail brought on by high track stresses incurred when trains slowed down around the curve entering Park Place Station. The fatigue crack was caused by forces brought about by trains traversing the tight radius curve at inordinately slow speeds (less than 8 mph) resulting in high lateral forces against the rail head. In this accident, these conditions placed undue stress on the rail causing a crack in the base of the east rail that rapidly propagated upward, causing full separation of the rail. Contributing to this accident was the improper grade timer signal settings which prohibited train service from operating through the area at the intended design speed.
Based on the information contained in this report, the Public Transportation Safety Board staff makes no additional recommendations. The PTSB staff will adopt and monitor via the corrective action plan process, the three internal recommendations issued by the NYCT Office of System Safety, namely:

1. NYCT evaluate the implementation of the SMS project proposed by the Department of Track and the Track Engineering and provide PTSB staff with the results of their evaluation.

2. NYCT provide to PTSB staff a copy of the revised Maintenance of Way Department’s MW-1 Track Standard Manual.

3. NYCT provide PTSB staff with verification that the Track Geometry Car printouts have been modified to display the correct gauge limits in guarded curves to help identify problems involving track gauge.

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<tr>
<td>Robert Maraldo</td>
<td>Jerry Shook</td>
<td>May 20, 2010</td>
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