Synopsis:

On Wednesday, May 29, 2013 at approximately 5:48 p.m., a ten-car southbound #1 train (interval 1726) was traveling in the tunnel south of the 125th Street station on track #BB1 when the train dipped suddenly and experienced an unrequested emergency brake application, followed by an abrupt series of jarring movements. The train operator went to the roadbed to investigate and discovered that all four wheels on the #1 truck of the head car (#2460) had derailed to the east side of the tracks. Further inspection of the roadbed revealed a broken section of rail located approximately 22 feet from the entrance to the portal at survey marker #BB1-71+48. It was estimated that the head car traveled for a distance of approximately 250 feet before stopping. There were no reported injuries to any of the 425 passengers or crew members on board the train as a result of the derailment. The total incident costs were estimated to be $52,912.99.

Investigation:

As the southbound 1726 interval #1 train entered the portal south of the 125th Street Station, a 28 inch section of the east running rail located at survey marker #BB1-71+48 fractured beneath the #1 wheel of the head car (#2460). A portion of the head and web of the rail had separated from its base and fell into the gauge of the track. This action promoted wheel climb as the head car traveled over the broken rail, resulting in the #1 wheel flange of the #1 truck running on top of the east running rail for approximately 18 feet before it dropped off to the field side (right) of the tracks at survey marker BB1-71+30. As a result of the #1 wheel dropping off to the east rail, the #2, #3 and #4 wheels also derailed to the east and began striking track components. The #1 shoe beam assembly on car #2460 struck the contact rail resulting in extensive damage car #2460 and to third rail components for a distance of approximately 250 feet. In addition car #2460 came in contact with six structural columns which sustained minor damage. The train came to a final rest at survey marker BB1 68+90.

The track in the area of the derailment was last rebuilt in 1991 and was estimated to have twenty years of useful life remaining as per the last condition survey conducted by the Maintenance of Way Track Engineering in 2010. Department of Track inspectors are tasked with inspection of main line track in their geographical area twice during a seven-day period and documenting defects affecting the condition of track components based upon the “Code for Track Inspector Reporting Form.” Following the track inspectors, a supervisor must inspect the main line track on average twice a month, which is referred to as a 14-day supervisory inspection. The last recent report by a track walker in the area was May 25, 2013 and the last supervisory inspection was May 21, 2013. A review of the records indicated that on June 21, 2012 a track inspector documented a priority 3 rail defect on both rails approximately 17 feet north of the future point of derailment. A priority 3 rail defect is used to identify track condition that may affect the ride comfort qualities of the track that can
potentially degrade to worse condition if left uncorrected. The NYCT Office of System Safety concluded that although a single point is referenced for this priory 3 defect, this record was actually intended to capture the multiple surface defects occurring in this location. The database that records this information does not allow the exact same type of defect to be entered if they are occurring within six feet of each other. This circumstance offers a possible explanation to as why no multiple defects in the area were listed. However, the track inspector should have defined the beginning and ending point of the defect area.

Evacuation:

The Rail Control Center (RCC) dispatched two trains to act as reach trains, so the approximate 425 passengers onboard the incident train could be safely walked back to the 125th Street Station. The two reach trains were lined up behind the disabled train on track #BB1 to act as a bridge back to the platform at the 125th Street Station. The two rescue trains coupled together forming one twenty-car train. The train was secured by applying numerous hand brakes throughout the consist. The evacuation began at approximately 6:59 p.m., and was reported complete without any incidents at 7:21 p.m.

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 by FTA standards should be administered as soon as practicable following an incident. The MAC lab technician completed administering the alcohol breath test to the train operator at 9:40 p.m., which did not meet the two hour FTA guide line for alcohol testing. The MAC lab technician completed administering the urinalysis drug test to the train operator at 10:00 p.m., which met the thirty-two hour FTA guide line for drug testing. The MAC lab technician completed administering the alcohol breath test to the conductor at 9:34 p.m., which did not meet the two hour FTA guide line for alcohol testing. The MAC lab technician completed administering the urinalysis drug test to the conductor at 9:44 p.m., which met the thirty-two hour FTA guide line for drug testing. The FTA alcohol testing was not promptly administered to the train operator and the conductor due to the length of the RTO and Police investigation. The results of the post incident drug and alcohol testing for the train operator and the conductor, at the time of testing, did not meet concentrations equal to or greater than the cutoff requirement for a positive drug or alcohol test.

Track Geometry Car:

A review of an earlier Track Geometry Car (TGC) run was used to help determine how long these rail surface defects had been present in the area of the derailment. An April 4, 2011 TGC #4 video showed that two minor surface defects were present in the incident area on that day. They were both located on the east rail and spaced approximately 15 inches apart. The most recent TGC run prior to the derailment on April 1, 2013 shows that the surface defects at this location had grown progressively more pronounced over time. One of these surface defects would eventually escalate to become the fractured rail at the point of derailment.

Sperry Rail Services Track Inspection Car:

The Sperry track inspection car uses ultrasonic rail flaw detection (sound waves introduced into the rail) to identify defects in the rail such as: internal separations of the steel within the rail section known as transverse defects; bolt hole cracks and web defects; and longitudinal defects such as vertical split heads, horizontal split heads, head and web separations, facilitating pre-emptive repairs
of the defective rails. Sperry, the developer of ultrasonic rail testing, has provided this service continuously for NYC Transit for over 50 years, using a self-propelled custom-built rail vehicle to meet NYCT tunnel clearances. It is owned, operated and maintained by Sperry Rail Services. This vehicle uses Sperry’s proprietary hardware and software to conduct the ultrasonic rail testing. The Sperry car inspects the rails of the mainline tracks on a periodic basis, typically six subway test runs per year.

The area south of the 125th Street Station on track #BB1 was previously inspected by Sperry Rail Services on March 19, 2013 and May 15, 2013. After reviewing the data collected during each of the runs of the Sperry Rail Car, Sperry Rail Services reported only a shallow running surface condition and indicated that there seemed to be no indication of a crack in the rail at this location, noted on either Sperry Car test run in March or May. New York City Transit MOW Track engineering is dependent upon SRS to perform this track analysis as they do not interpret the raw data collected by SRS, and did not have any reason to dispute the findings reported by Sperry Rail Services, and included them in the NYCT Office of System Safety Derailment, Final Report issued on September 11, 2013.

Lucius Pitkin Inc (LPI) Metallurgist Report:

Sections of the fractured rail involved in the derailment were submitted to Lucius Pitkin Inc (LPI) for evaluation and testing. A visual inspection revealed a network of chevron markings that point back to the crack origin location. The report states, “The fracture initiation was coincident with an area on the rail head exhibiting significant dislodgement of material and is attributed to severe shelling. The dark coloration of the shell surface suggests that its presence pre-dated the occurrence of the failure. Dimensional, compositional and hardness testing all conformed to NYCT specification”.

Preliminary results of the LPI laboratory examination suggest the failure of the rail occurred due to progressive cracking-fatigue, coincident with a pre-existing shell on the rail head. The examination revealed the presence of extensive shelling along the gauge side of the rail as well as a localized area of extensive head cracking identified approximately 15 inches from the shell on the head of the rail that was the origin of the rail failure.

Post Incident Analysis:

MOW Engineering performed an internal analysis of the rail break and determined that the transverse defect originated at the field corner of the head of the rail due to a crack growth at that location. The most probable cause of the defect was a depression on the rail head, which was visible on video recorded April 1, 2013 by the track geometry car. The depression on the head rail as well as the depression being formed a few inches north of the break seemed to have been formed by a combination of conditions due to water dripping on the head of the rail, which in turn caused wheel slip at the location, causing a rail surface condition (squats). Rail squats are a type of metal fatigue resulting from wheel impacts on the rail head which “bruise” the steel and over time lead to degradation of the track. This condition results in the development of a rail head depression that subsequently breaks the top layer of the steel rail head, leading to the pounding of the rail wheels that traverse over the rail at this location. The defect then slowly grew over time, which ultimately resulted in the breakout of the head web in a sudden event under the wheels of the derailed train.

Division of Infrastructure:

A review of the Division of Infrastructure database revealed there were several water leak defects that were reported during inspections of the incident area dating back to 1992. The NYCT Office of
System Safety reviewed the most recent water intrusion abatement activities that have been preformed in this area. An inspection performed in this area in June 2010 found water seepage had corroded the steel beams and columns, with the concrete roof showing signs of distress. In March 2011 the stone coping above the area was removed and fenced off with a plastic membrane and 3rd rail mats were used to minimize the water seepage. The work to correct this defect is presently under contract and is forecasted to be complete in March 2015.

Addendum to the Final Report

On November 14, 2013 the Office of System Safety (OSS) issued an Addendum to the 125th Street Derailment-Final Report dated September 11, 2013. At that time, OSS had not considered Sperry Rail Services (SRS) to be a contributing factor in the derailment. OSS has since learned that this position appears to be inaccurate and prepared an Addendum to the Final Report to address these new circumstances and now considers SRS to be a causal factor in the 125th Street derailment. During the course of the investigation, SRS management had informed Maintenance of Way (MOW) Track Engineering personnel that they had performed a review of data collected during the Sperry car runs conducted on March 19, 2013 and May 15, 2013, which had preceded the derailment. SRS management’s review concluded that although there was a shallow running surface condition on the rail in the derailment area, there seemed to be no indication of a crack in the rail at this location on either test run. MOW Track Engineering is dependent upon SRS to perform this analysis as they cannot interpret the raw data collected by SRS and did not dispute SRS’s findings at that time. Additionally, the New York City Transit (NYCT) contracted Lucius Pitkin Inc. (LPI) to perform an independent analysis of the section of rail involved in the derailment to ensure that as an agency, they were not solely relying on the SRS’s analysis of the rail break to form a conclusion as to the causal factors in this event. The initial draft report submitted by LPI did not indicate that SRS had contributed to the incident, therefore, based upon these circumstances, i.e. the LPI draft report not identifying SRS as a contributing factor, the SRS analysis of the previous Track Geometry Car runs concluding that no crack in the rail was present and MOW Track Engineering initially not disputing SRS’s finding, SRS was excluded as a contributing factor in this incident. However, upon LPI issuing its final report, the conclusion contained within the report states in part, “that the rail was inspected ultrasonically on March 19, 2013 and again on May 15, 2013, and the Non Destructive Evaluation (NDE) vendor confirmed that although there was a “shallow running surface” condition, there had not been any indications of cracking in the rail at the location during these inspection runs, which was not the case in this instance.” Upon receiving LPI’s final report and conclusion, MOW Track Engineering requested and reviewed the SRS’ B-Scans of the rail defect at the location where the breakage and subsequent derailment at 125th Street occurred. MOW Track Engineering’s findings were that their review indicated that Sperry’s B-scans showed UT signals (incipient ultrasonic 70 degree transducers, multiple indications) being detected at the specific point where LPI reported the fractures origin. These indications on the B-Scans should have triggered verification on both tests (March 19th and May 15th). The latest B-scan in May showed that the suspected potential critical condition was increasing in size because the UT signals were displayed clearer than in the March B-Scan. This should have been a clear warning that a potential critical condition was active and getting worse. Therefore, LPI conclusion is that SRS failed to properly identify and verify this defect, which should be considered one of the causal factors of the derailment.

The NYCT Maintenance of Way Track Engineering Automated Track Inspection group met with Sperry Rail Services (SRS) personnel to discuss the new findings in the LPI Metallurgist Report. The meeting concentrated on the potential lack of proficiency by SRS personnel in identifying
and reporting suspected defects. In addition to the defect identified as a casual factor in this derailment, the circumstances surrounding two other rail defects that led to serious breaks were also discussed. One rail break occurred on September 27, 2013 at West 4th Street on the 6th Avenue Line. In this incident, a bolt hole crack that was identified using three separate runs; went unreported to NYCT and escalated into a broken rail. In the second incident that occurred on July 8, 2013 at the High Street Station on the Eight Avenue Line, SRS personnel did not correctly identify the size of a defect and this condition also escalated into a broken rail.

As a result of the meeting between SRS and MOW Track Engineering, SRS has since agreed to make the following changes to their track car inspection process. They agree to report invalid tests or test exceptions to MOW Track Engineering on a daily basis. In the past practice, SRS had performed a quarterly audit of data, which was conducted by a second B-scan qualified person reviewing a portion of the data (typically 5% as per SRS company policy) with the intent of looking for any suspect indications that may have been missed during the primary analysis; however, in reaction to NYCT concerns, SRS has agreed to increase the number of field verification audits to 25% of the data collected for a 30 day period, which started in October 2013. After that period, SRS and NYCT will agree to extend, maintain, or increase the frequency based upon the findings of those audits.

SRS also agreed to increase the frequency of their verification audits from twice a year to quarterly. The verification audit requires a senior verifier to complete a four-page form, which covers Test Equipment, Safety, Test Process & Quality Assurance, along with other items. SRS is reviewing the current working hours/shift patterns to ensure that its staff has reduced exposure to excessive hours and have sufficient rest periods between shifts.

NYCT MOW Track Engineering determined that the above changes implemented by SRS to be acceptable and their Track Engineering’s Automated Rail Flaw Inspections Manager will now monitor SRS compliance with it. In addition, while MOW track Engineering’s staff does not have the ability to interpret SRS’s raw data, they do have the ability to review processed data in the form of B-scans at their discretion. MOW Track Engineering management will request this information following significant defects found by the track geometry car’s ultras sound system or following service rail breaks.

MOW Track Engineering met with Sperry Rail Services (SRS) technical managers and the SRS403 track inspection car Supervisors and asked them to provide the status of the revised agreement for test reporting, auditing, and review of SRS personnel working hours. MOW Track Engineering reviewed the following changes made by SRS and considers them to be effective.

- The reporting of invalid tests or test exceptions started with the first test run of 2014.
- The quarterly audit of data is already being performed in SRS personnel on an increased basis. Approximately 25% of the data collected during 30 testing days is being audited.
- SRS has already established new positions to deal with increased verification audits. Starting with the first test runs of 2014, a senior verifier position was created whose sole function is to audit all the verifications teams on a regular basis.
- SRS has started a rotation of personnel on board the SRS403 Car and the verification teams, to insure that none of its personnel works in excess of 12 hours per shift on a regular basis.
Further, SRS is providing extra refresher and certification courses to its technical personal in charge of reviewing data collected by SRS403 Car. The PTSB staff will adopt and monitor for compliance via the Corrective Action Plan process, these five internal recommendations agreed upon between NYCT Maintenance of Way Track Engineering Automated Track Inspection group and Sperry Rail Services personnel as Corrective Action Plan Item number 12111-5 in the conclusion.

Conclusion:

Submitted for the review of the Public Transportation Safety Board members is the NYCT Office of System Safety Derailment Report, S/O 125th Street Broadway-7th Ave Line, Track BB1, on May 29, 2013, Final Report issued by NYCT on September 11, 2013 and the Addendum-Final Report issued on November 14, 2013. Also included are the new revisions to the NYCT MW-1 Track Standards Manual.

Based upon the information presented in this report as a whole, the Public Transportation Safety Board staff concurs with its findings and the actions taken, and makes no additional comments or recommendations. The PTSB staff will adopt and monitor via the Corrective Action Plan process, the four internal recommendations issued by the NYCT Office of System Safety in their Final Report, September 11, 2013, namely:

12111-1. Revise the MW-1 to re-prioritize the combination of conditions where squat (similar to a wheel burn) coexists with a constant water condition, such as a location where water is dripping onto the rail. This combination of conditions should be classified as a Priority 2, require remedial action consisting of replacement of the rail in less than 90 days and diverting the water and/or grouting the leaks.

Response: 10/29/2013 - Attached is a copy of the revised MW-1 Track Standards, Section 108.7, Defective Rails and Rail Wear, (B), (H), (I), (J), and (K).

CAP Recommendation Status: CLOSED

12111-2. Require as part of the 14-day supervisory inspection that Division of Track supervision pay special attention to locations where wheel burns are prone to occur such as steep grades or changes in grades.

Response: 10/29/2013 - Attached is a copy of the “Division of Track Maintenance Gram” being distributed by subdivision heads requiring DT supervision, as part of the 14-day supervisory inspection, pay special attention to locations, where wheel burns are prone to occur such as steep grades or changes in grades.

CAP Recommendation Status: CLOSED

12111-3. Establish a rail replacement program for locations where wheel burns are prone to occur or as an alternative, consider, if possible, establishing a dedicated grinding/rail milling program to address these locations..

Response: 10/29/2013- Rail Replacement Program: The Broken Rail Initiative, a new project was recently established to address (6) broken rail critical corridors identified by Track Engineering and listed as follows: Queens Blvd. Line, 8th Avenue Line, 6th Avenue
Line, Broadway/7th Avenue Line, Lexington Avenue Line, and Astoria Line. Hotspots containing BC, Broken Rails, UT, Sperry and Wheel Burn/Rail Head Defects within these areas are identified and prioritized for remediation based on criticality, track access, material requirements and availability, as well as other resource needs.

The project manager will walk the Hotspots and develop a detailed scope of work and safe job plan for each location. The goal of the Broken Rail Initiative is to reduce the number BC rails that are 60+ days outstanding and 90+ days outstanding until the backlog is significantly reduced. The group will look to maximize CWR (continuous welded rail), resilient fasteners and friction pads (pandrol installations) where practicable.

Rail Grinding Program - On August 19, 2013, Loram Maintenance of Way Inc. was awarded the contract for LIRR, MNRR and NYCT rail grinding services. NYCT is allocated $2,058,040 of these contracted services estimated to be consumed in approximately 15 months. Particular attention is being given to the aforementioned corridors.

CAP Recommendation Status: CLOSED

12111-4. Use the Track Geometry Car (TGC) video inspection software to automatically detect the locations having a combination of wheel burns and water conditions.

Response: 10/29/2013 - The TGC video inspection software does not have those capabilities, but a purchase order was prepared to acquire such software enhancements from Plasser-American. The purchase order, specifications, and cost estimate was sent to the MOW Engineering Contracts Group for processing. The process of acquiring the software, testing it, learning how to use it, training inspectors in its and deploying work stations in the Track Maintenance subdivisions is estimated to take several months.

4/5/2014 - The software to automatically detect rail conditions using the TGC Rail View and Side Rail View video systems is being purchased through the Plasser American Maintenance Contract. It is expected that the software will be delivered, tested and ready to be deployed by June 2014. Once the software has been tested and debugged, the automatic recognition of rail defects may be possible. MOW will establish the monetary budget needed to support this new function, the formal request will be submitted by April 30, 2014.

9/5/2014 - The installation of software to automatically detect rail and fastener defects using the TGC Rail View and Side View video systems has been delayed because of technical and production problems. It is estimated that the installation and debugging of the software will take place between September and October of 2014. In addition, the installation of the Field Side Rail View cameras and lights on TGC is still with Procurement and may be delayed.

CAP Recommendation Status: OPEN
12111-5. Sperry Rail Services (SRS) and MOW Track Engineering Automated Track Inspection group agreed upon five SRS internal recommendations to address issues that came to light in this investigation regarding test reporting, auditing, and review of SRS personnel working hours.

a) The reporting of invalid tests or test exceptions started with the first test run of 2014.

b) The quarterly audit of data is already being performed in SRS personnel on an increased basis. Approximately 25% of the data collected during 30 testing days is being audited.

c) SRS has already established new positions to deal with increased verification audits. Starting with the first test runs of 2014, a senior verifier position was created whose sole function is to audit all the verifications teams on a regular basis.

d) SRS has started a rotation of personnel on board the SRS403 Car and the verification teams, to insure that none of its personnel works in excess of 12 hours per shift on a regular basis.

e) Further, SRS is providing extra refresher and certification courses to its technical personal in charge of reviewing data collected by SRS403 Car.

Response: The NYCT Department of Subways (DOS) response dated January 8, 2014 stated MOW Track Engineering has met with Sperry Rail Services (SRS) technical managers asked them to provide the status of the agreement for test reporting, auditing, and review of SRS personnel working hours. MOW Track Engineering reviewed the changes made by SRS and considers them to be effective.

CAP Recommendation Status: CLOSED

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<th>Date of Board Approval</th>
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<tr>
<td>Robert Maraldo</td>
<td>Robert Maraldo</td>
<td>November 20, 2014</td>
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Chief Investigator, PTSB
Attachments to this Rail Transit Agency Report:

1. NYCT Final Report of the Derailment which occurred on May 29, 2013, south of the 125th Street station on the Broadway-7th Avenue Line issued on September 11, 2013


3. Excerpts from the recently revised NYCT MW-1 Track Standard Manual regarding Base Corrosion Squats or Shells, revision 9/6/2013; Section 108.7, Defective Rails and Rail Wear, (B), (H), (I), (J), and (K).

4. The “Division of Track Maintenance Gram” distributed by subdivision heads requiring DT supervision, as part of the 14-day supervisory inspection, pay special attention to locations, where wheel burns are prone to occur such as steep grades or changes in grades.
Date  September 11, 2013

To     Joe Leader, Acting Senior Vice President, Department of Subways

From  Cheryl E. Kennedy, Vice President, Office of System Safety

Re     Final Report, Derailment, 125th Street, Broadway-7th Avenue Line

On May 29, 2013, the Office of System Safety investigated a derailment that occurred south of the 125th Street Station on the Broadway-7th Avenue Line.

Based on a review of the attached report, please provide a response to the recommendations within 30 days.

cc: C. Bianco
    J. Gaul
    S. Librera
    D. Knights
    K. Mooney
    M. Wetherell
    P. Lavin
    G. Rivera
    File
Office of System Safety
Derailment Report

S/O 125th Street
Broadway-7th Ave Line
Track BB1
May 29, 2013
Derailment

Track BB1,
S/O 125th Street
Broadway-7th Ave Line

May 29, 2013

FINAL REPORT

September 11, 2013
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SYNOPSIS

At approximately 17:48 hours on May 29, 2013, a ten car train designated as the 17:26 “1” 242/SFY (consist: S/M 2460-2459-2458-2457-2456-1830-1829-1828-1827-1826) was traversing Track BB1 south of 125th Street Station on the Broadway Line, when it experienced an emergency brake application, immediately followed by an abrupt series of jarring movements. Upon inspecting the Right of Way to determine the cause of the Brakes in Emergency (BIE), the Train Operator (T/O) observed all four wheels of the #1 truck of car 2460 had derailed to the east. Further inspection of the roadbed revealed a broken rail located approximately 22 feet inside the entrance to the portal at survey marker BB1 71+48. Upon being notified of the situation, the Rail Control Center (RCC) dispatched two rescue trains to the scene, which permitted the approximately 425 customers onboard the incident train to walk through the multiple trains and be safely evacuated onto the platform at the 125th Street Station. There were no injuries reported as a result of this incident. The total incident costs were estimated to be $52,912.99.

The Office of System Safety (OSS) has determined that the causal factor in this incident was a rail surface defect (“squat,” which is similar to a wheel burn) had escalated into a broken rail. A contributing factor in this incident was an overhead water leak that over a prolonged period of time had accelerated the progression of the “shelling” that was occurring on the surface of the rail head. This condition is evidenced by a portion of the material from the surface of the rail dislodging and falling away. The missing layer of surface material allowed significant additional vertical forces (pounding) to be introduced onto the head of rail as trains went through the area, which resulted in the fracturing of the rail and the subsequent derailment.

INVESTIGATION

Occurrence

At approximately 17:48 hours on May 29, 2013, a ten car train designated as the 17:26 “1” 242/SFY was traversing Track BB1 south of 125th Street Station on the Broadway Line. As the train entered the portal, a 28 inch section of the east running rail located at survey marker BB1-71+48 fractured beneath the lead car. A portion of the head and web of the rail separated from its base and fell into the gauge of the track. This action promoted wheel climb, which resulted in the #1 wheel of the #1 truck of Car 2460 flange running on top of the east running rail for approximately 18 feet before it dropped off to the field side of the track at survey marker BB1 71+30.

As a result of the #1 wheel dropping to the field side of the east rail, the #2, #3 and #4 wheels also derailed to the east and began striking various track components. The #1 shoe beam assembly on Car 2460 struck the contact rail resulting in extensive damage
to third rail components for a distance of approximately 250 feet. In addition, Car 2460 came into contact with six structural columns, which sustained minor damage during the event. Two tunnel lighting fixtures mounted on the same columns that were orientated to face Track BM were also damaged and hanging off the columns.

Car Equipment components on lead Car 2460 sustained significant damage. Specifically, the #1 shoe beam assembly had shattered and several pieces of wooden debris from it were found between Tracks BB1 and BBM. Car 2460 also sustained damage to the #1 truck and exterior car body damage where the “B” side of it came into contact with the six structural columns. The train came to final rest at survey marker BB1 68+90.

Upon being notified of the situation, the RCC dispatched two rescue trains to the scene, which permitted the approximately 425 customers onboard the incident train to walk through the multiple trains and be safely evacuated onto the platform at the 125th Street Station. There were no injuries reported as a result of this incident. The total incident costs were estimated to be $52,912.99

**Rapid Transit Operations**

**Train Operator Statement:**
The T/O aboard the 17:26 “1” 242/SFY interval stated that just after entering the portal south of 125th Street, he felt the train dip and then significantly bounce back up, which was immediately followed by an emergency brake application. As the train was coming to a stop, the T/O felt the train bounce up and down and rock from side to side. The T/O informed the RCC of the incident and upon going to the roadbed to investigate the cause of the BIE, he observed the first truck of Car 2460 derailed to the east. The T/O relayed this information to the RCC and waited for assistance.

**Human Factors**
T/O #1 was originally hired by New York City Transit on June 16, 1997 in the title of Conductor. He was promoted to the title of T/O on September 19, 1999. T/O #1 was critiqued on March 20, 2013 on all aspects of train operation by his assigned TSS. He received a rating of “satisfactory” in all areas including proper train control, judgment of speed, proper station stop and signal comprehension. A review of his disciplinary action history revealed various attendance violations and one operational infraction; a signal overrun for which he received a 5 day suspension.
T/O #1 worked the following hours on the day of the incident and the seven days prior to the incident:

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<th>Incd. Day</th>
<th>Day 1</th>
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<th>Day 7</th>
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</thead>
<tbody>
<tr>
<td>0:41</td>
<td>Sick</td>
<td>Hol. Off</td>
<td>Vac.</td>
<td>RDO</td>
<td>RDO</td>
<td>8:27</td>
<td>8:31</td>
</tr>
</tbody>
</table>

**Total: 17:39 hours**

**Fitness for Duty**
Occupational Health Services (OHS) personnel performed post incident testing on the T/O approximately four hours and four minutes after the incident occurred. The reason cited for the testing not being performed within two hours of the incident was attributed to the on scene incident investigation and the time consumed transporting the T/O to the Medical Assessment Center (MAC). OHS personnel administered alcohol testing at 21:52 hours. Drug testing occurred at 22:00 hours. The results of the post incident testing were negative.

**Train Operation**
A review of General Signal Arrangement Drawing MW 7BB-40-SL-O that depicts the geographic area where the derailment occurred reflects that there are no speed restrictions on train movement in this area. The typical operating speed through this area is approximately 30 MPH and although the Car Equipment involved in this incident is not equipped with data logging equipment, OSS did not find any evidence to suggest that the T/O was operating the train in a manner inconsistent with the typical operating speed through the area.

Rapid Transit Operations (RTO) was not a contributing factor in this incident.

**Division of Track**
The track in the area of the derailment is a Modified Type II design, which is a concreted type of track specially designed for use in subway locations. The track in the derailment area was last rebuilt in 1991 and is estimated to have twenty years of useful life remaining as per the last Condition Survey conducted by MOW Track Engineering during calendar year 2010.

DT personnel are required to regularly inspect track to identify conditions that deviate from the standards established in the MW-1 Track Standards Manual. DT Track Inspectors (T/I) are tasked with the inspection of main line tracks in their geographical area twice during a seven day period. T/I's are also responsible for documenting defects affecting the condition of track components based upon the “Codes for Track
Inspector Reporting Form,” e.g. deteriorating, mud condition, water condition, pumping, rotted, etc. A DT supervisor must inspect main line track on average, twice every month, which is referred to as the 14 day Supervisory inspection.

OSS reviewed the hourly and supervisory Track Inspection Forms for a period of one year prior to the derailment. DT personnel had performed the required Track Walker and Supervisory Inspections on a consistent basis leading up to the derailment. The most recent Track Walker inspection occurred on May 25, 2013 and the last Supervisory 14 day inspection occurred on May 21, 2013. The inspection records also indicate that on June 21, 2012, the Track Inspector documented a Priority 3 rail defect (head checked) on both rails at survey marker BB1 71+65. This location is approximately 17 feet north of the future Point of Derailment (POD). It should be noted that surface defects of this nature are typically denoted with an origination and ending point, therefore, OSS believes that although a single point is referenced, this record was actually intended to capture the multiple surface defects occurring at this location. In addition, the database does not allow the exact same type of defect to be entered into the system if they are occurring within six feet of each other. This circumstance offers a possible explanation as to why multiple defects in the same area were not listed; however, the T/I should have defined the beginning and end point of the defect area.

As stated, the rail surface defect in this area was classified as a Priority 3 rail defect. A Priority 3 designation is used to identify track condition that may affect the ride comfort qualities of the track that can potentially degrade to a worse condition if left uncorrected. Therefore, Priority 3 defects require that work programs should be established for the correction of these conditions on mainline revenue tracks.

Track Geometry Car 4
Video from the Track Geometry Car 4 (TGC 4) car was used to estimate how long the rail surface defect had been present in the future derailment area. Video from the April 4, 2011 run reflects that two minor surface defects were present. They were both located on the east rail and spaced approximately fifteen inches apart. The most recent TGC 4 run was performed in the incident area on April 1, 2013 and did not identify any significant track defects at this location; however, the video shows the two surface defects had grown progressively more pronounced (see Appendix-Photographs). One of these rail surface defects would eventually escalate to become the fractured rail at the POD.
Sperry Rail Services
The area south of the 125th Street Station on Track BB1 was previously inspected by Sperry Rail Service (SRS) on March 19, 2013 and May 15, 2013 and no defects were reported. Upon further review of the data collected during these runs, SRS reported that although there was a shallow running surface condition, there seemed to be no indication of a crack in the rail at this location on either test run.

Metallurgist Report
Sections of the fractured rail involved in the derailment were submitted to Lucius Pitkin Inc. (LPI) for an evaluation and testing. LPI’s report indicates that a visual examination of the piece of rail revealed a network of chevron markings that point back to the crack origin location. The report states, “The fracture initiation was coincident with an area on the rail head exhibiting significant dislodgement of material and is attributable to severe sheeling. The dark coloration of the shell surface suggests that its presence pre-dated the occurrence of the failure. Dimensional, compositional, and hardness testing all conformed to New York City Transit specification.” Please note that two pictures contained in “Appendix – Photographs” section of this report reflect the condition of the head of the rail after the rail surface material had dislodged.

In addition, the LPI report further states, “Preliminary results of the laboratory examination suggest the failure of the rail occurred due to progressive cracking-fatigue, coincident with a pre-existing shell on the rail head. The examination revealed the presence of extensive sheeling along the gauge side of the rail as well as a localized area of extensive head cracking was identified approximately 15 inches from the shell on the head of the rail that was the origin of the rail failure. With respect to the severe spall associated with the shell at the initiation site, examination of an image of the rail taken on April 1, 2013 indicates an apparent depression on the rail head but no evidence of significant dislodgement of material.”

MOW Track Engineering Analysis
MOW Track Engineering performed an internal analysis of the rail break, which states in part, “The transverse defect originated at the field corner of the head of the rail due to a crack growth at that location. The most probable cause of the defect was a depression on the rail head, visible on the Rail View video recorded by the TGC 4 on its latest test run of the track on April 1, 2013, as well as on previous runs since 2011. The depression on the rail head, and another one being formed a few inches north of the actual one at the location of the break, seems to have been caused by a combination of the action of the water dripping on the head of the rail, which in turn caused wheel slip at that location, therefore initiating a rail surface condition (squat). This condition, similar to a wheel burn, resulted in the development of the rail head depression, subsequent breakout of the top layer of the rail head leading to pounding of the wheels
at this location and initiating the transverse defect growth, which ultimately resulted in the breakout of the head, web and base in a sudden event under the wheels of the derailed train."

Post Incident Activities
During post incident discussions, OSS was informed that MOW Track Engineering and DT management had reviewed the current work programs established to correct rail surface defects on mainline revenue tracks and determined that in this instance, the deterioration of the pre-existing rail surface defect (squat) at this location was accelerated by the presence of water from the over head leak that was being infused into the microscopic surface cracks on the head of rail by the wheels of each passing train. Therefore, in locations where water intrusion is present along with rail surface defects, additional actions that will be detailed in the recommendation section of this report, should be taken to reduce the likelihood of the reoccurrence of this type of an event.

DT personnel have since identified 155 locations in the system in which water is dripping on a rail surface defect. The DT intends to establish a goal of correcting these types of defects within 90 days of being identified; however, with their current level of resources they are committed to correcting any of these types of locations identified going forward and are prioritizing repairing the existing population based upon their level of severity until they are all addressed.

The DT was the causal factor in this derailment.

Division of Infrastructure
The Division of Infrastructure (DI) personnel conducted a post incident inspection of the incident site and due to four consecutive support columns being damaged, they installed temporary shoring to support the columns that been struck by the derailed train to ensure the area is safe.

A review of the DI defect database revealed there were several leak defects that were reported during inspections of the incident area dating back to 1992. OSS reviewed the most recent water intrusion abatement activities that had been performed in this area. The derailment area was of particular concern due to an inspection performed in June of 2010 that found that water seepage had corroded the steel beams and columns, and the concrete roof showed signs of distress. In March of 2011, the stone coping above the area was removed, fenced off and a plastic membrane and 3rd rail mats were placed on top of the membrane to minimize seepage. The structure in the vicinity of the derailment is presently under contract (Contract C-44508) for rehabilitation and the six damaged columns from this event will be added for repair/replacement under the
contract as part of the rehabilitation and a new waterproofing membrane will be installed. The contract was awarded in March of 2013 and substantial completion is forecast for March of 2015.

In addition, as part of post incident activities, the NYC Department of Environmental Protection was requested to inspect water services and water mains in the area for leaks to assist in determining the source of the over head leak in this area. The inspection results came back as negative.

The DI was a contributory factor in this derailment.

**Division of Car Equipment**
The cars involved in this incident are of the R-62A car class. They were built in 1987 by the Bombardier Corporation, are 51 feet, ½ inches long overall and each weigh 76,000 lbs.

**Car Case Histories**
The R-62A class cars are maintained according to the Scheduled Maintenance (SM) calendar. A review of the car case histories for all cars involved in this incident for the time period May 29, 2012 through May 29, 2013, indicated that they completed periodic SM 1,2,3,4 Type Inspections at the 240th Street Maintenance Facility. The review reflected that there were no braking, propulsion or truck system defects that contributed to this derailment.

**Cars 2460 involved in the Derailment:**
A review of the car case history for car 2460 revealed no car equipment defects that would have contributed to this incident. On May 31, 2013, Car Equipment Engineering and Technical Support (CEE&TS) recorded wheel, axle, and flange measurements on the No. 1 and No. 2 trucks of car 2460 utilizing Finger Gauge No. 336, Back-To-Back Gauge No. 391, and Flange Gauge No. 230. All measurements were found to be within NYCT standards.

<table>
<thead>
<tr>
<th>Car 2460</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. 391 Back-to Back Gauge</strong></td>
<td><strong>No. 336 AAR Finger Gauge</strong></td>
</tr>
<tr>
<td>No. 1 Axle: 53 1/4”</td>
<td>No. 1 Wheel: 40 X 0”</td>
</tr>
<tr>
<td>No. 2 Axle: 53 1/4”</td>
<td>No. 2 Wheel: 40 X 0”</td>
</tr>
<tr>
<td>No. 3 Axle: 53 5/16”</td>
<td>No. 3 Wheel: 40 X 0”</td>
</tr>
<tr>
<td>No. 4 Axle: 53 5/16”</td>
<td>No. 4 Wheel: 40 X 0”</td>
</tr>
</tbody>
</table>

DCE was not a contributing factor in the derailment.
Division of Signals
Maintenance of Way (MOW) Signals Operations Engineering (SOE) conducted a post incident investigation of the signal system in the vicinity of the derailment. All signal equipment was found to be operating as designed.

The Division of Signals was not a contributing factor in this incident.

Injuries
There were no reported injuries as a result of this derailment.

Weather
The incident occurred in the subway; therefore, weather was not a contributing factor in this incident.

Damages Costs:
DT Damage
Various track appurtenances were replaced in order to restore Track BB1 to a state of good repair.

DT Labor Costs: $13,091.26
DT Material Costs: $1,712.80
Total DT Costs: $14,804.06

DI Damage
Various infrastructure appurtenances were replaced in order to restore Track BB1 to a state of good repair.

DI Labor Costs: $17,554.63
DI Material Costs: $2,274.00
Total DI Costs: $19,828.63

DCE Damage:
Various components were replaced in order to bring the cars to a state of good repair:

DCE Labor Costs: $14,545.30
DCE Material Costs: $3,735.00
Total DCE Costs: $18,280.30

Total Incident Costs: $52,912.99
Rules and Regulations

DT personnel regularly inspect track to identify conditions that deviate from the standards established in the MW-1 Track Standards Manual. These deviations are categorized based upon their severity, reported to the appropriate Subdivision, and acted upon as prescribed below:

NYCT MW-1 Track Standards (2010): Section 104.3 Conditions and Course of Action

(A) Priority 1: Conditions requiring immediate action. The qualified person detecting the condition shall make every effort to correct it immediately and must also evaluate whether to allow operation to continue under supervision or to place the track out of service immediately.

(B) Priority 2: Conditions that require inspection by a supervisor-or Deputy Superintendent of Track of the Staten Island Railway – within 24 hours of the time of detection of the condition. The investigating person shall immediately determine whether a slow speed may be necessary and what work is required, and shall base these decisions on findings and other factors, such as type of condition, its location and the permanent speed of the track where the condition was found. Every effort shall be made to correct these conditions as soon as practicable.

(C) Priority 3: Such designation alerts to a track condition that may affect the ride comfort qualities of the track and that could potentially degrade to a worse condition if left uncorrected. Work programs should be established for the correction of these conditions on mainline revenue tracks.

NYCT MW-1 Track Standard (2010): Section 201.2 Drainage

(G) WITHIN TUNNELS AND SUBWAY structures, defects in the roof or walls that allow water to fall on the track or to drain to the track shall be reported to the Division of Infrastructure immediately, and, until repairs are made, a drainage or collection system should be installed to allow the water to drain toward a sewer or sump for removal. Water must not be allowed to accumulate and remain in the track structure.
ANALYSIS

From the physical evidence gathered at the scene of the accident, a review of LPI, SRS and TGC inspection reports, DT inspection records, and the results of employee interviews, the following sequence of events is considered to have been most probable:

- At approximately 17:48 hours on May 29, 2013, a ten car train designated as the 17:26 “1” 242/SFY was traversing Track BB1 south of the 125th Street Station on the Broadway Line. As the train entered the portal, a 28 inch section of the east running rail located at survey marker BB1-71+48 fractured beneath the lead car. The head and web of the rail separated from its base and fell into the gauge of the track. This action promoted wheel climb, which resulted in the #1 wheel of the #1 truck of car #2460 flange running on top of the east running rail for approximately 18 feet before it dropped off to the field side of the track at survey marker BB1 71+30.

- As a result of the #1 wheel dropping to the field side of the east rail, the #2, #3 and #4 wheels also derailed to the east and began striking various track components. The #1 shoe beam assembly on Car 2460 struck the contact rail resulting in extensive damage to third rail components for a distance of approximately 250 feet. In addition, Car 2460 came into contact with six structural columns, which sustained minor damage during the event. Two tunnel lighting fixtures mounted on the same columns that were orientated to face track BM were also dislodged and hanging away from the columns.

- Car Equipment components on lead Car 2460 sustained significant damage. Specifically, the #1 shoe beam assembly had dislodged and several pieces of wooden debris from it were found between tracks BB1 and BBM. Car 2460 also sustained damage to the #1 truck and exterior car body damage where the “B” side of Car 2460 came into contact with the six structural columns. The train came to final rest at survey marker BB1 68+90.

- Upon being notified of the situation, the RCC dispatched two rescue trains to the scene, which permitted the approximately 425 customers onboard the incident train to walk through the multiple trains and be safely evacuated onto the platform at the 125th Street Station. There were no injuries reported as a result of this incident. The total incident costs were estimated to be $52,912.99
Post incident investigation of this incident identified the broken rail as the causal factor of this incident. The rail break was the result of a pre-existing rail surface defect (squat) at survey marker BB1 71+48.

A review of the video images captured during the April 1, 2013 TGC run reflects that a depression on the rail head where the future break would occur, as well as another depression formed approximately fifteen inches north of it. These defects were most probably caused by a combination of water dripping on the head of the rail, which in turn caused wheel slippage at the location resulting in a rail surface condition (squat) similar to a wheel burn type defect.

These minor rail surface defects were negatively influenced by overhead water dripping onto the head of the rail for a prolonged period of time, which resulted in water constantly being infused into the microscopic cracks in head of the rail by train wheels traversing the area. This action in turn, accelerated the sheathing that was occurring at this location.

The accelerated sheathing is evidenced by a portion of the material on the head of the rail dislodging and falling away. Once the surface material dislodged, significant additional vertical forces (pounding) was introduced onto the head of rail as trains went through the area, which eventually resulted in the rapid fracturing of the rail at this location and the subsequent derailment.

A review of the most recent data from the automated inspections (SRS and TGC 4) performed did not reveal any defects in the immediate area of the derailment site.

OSS also reviewed the hourly and supervisory DT Inspection Forms for a period of one year leading up to the derailment. DT personnel had performed the required Track Walker and Supervisory Inspections on a consistent basis leading up to the derailment. The most recent Track Walker inspection occurred on May 25, 2013 and the last Supervisory 14 day inspection occurred on May 21, 2013.

DT inspection records also indicate that on June 21, 2012, the Track Inspector documented a Priority 3 rail defect (head checked) on both rails at survey marker BB1 71+65. In addition, a review of TGC videos from previous runs reflects that the rail surface defects had been present on April 4, 2011 and had grown progressively more pronounced over time as most recently evidenced in the April 1, 2013 TGC 4 run; however, the track defects in this area were still correctly classified as a Priority 3 defect by the DT personnel performing inspections in the area.
• OSS believes the rail surface material had dislodged some time after the last Track Walker inspection had occurred on May 25, 2013 or within four days prior to the derailment. OSS further contends that it was not until the surface material dislodged, that the classification of this defect would have increased to a Priority 2 designation as defined by current MW1 Track Standards.

• Additionally, OSS believes it is most probable that the surface material dislodgement occurred in close proximity to the time of the derailment. The actual rail fracture is believed to have been a rapid failure once the rail break commenced as a result of the absence of a layer of surface material resulting in significant vertical forces (pounding) to be transmitted upon the head of the rail by the train wheels traversing the area.

• Track defects designated as Priority 3 do not typically pose a threat to safety as this designation is used to identify track condition that may affect the ride comfort qualities of the track and that could potentially degrade to a worse condition if left uncorrected; however, according to the MW-1 Track Standards Manual these defects also require that work programs should be established for the correction of these conditions on mainline revenue tracks.

• As such, MOW Track Engineering and DT management reviewed the current work programs established to correct rail surface defects on mainline revenue tracks. It was determined that in this instance the deterioration of the pre-existing rail surface defect (squat) at this location was accelerated by the presence of water intrusion from the over head leak. Therefore, based on this finding, in locations where water intrusion is present along with rail surface defects, additional actions which will be detailed in the recommendation section of this report, should be taken to reduce the likelihood of the reoccurrence of this type of an event.

• There were several leak defects that were reported during infrastructure inspections in the area dating back to 1992. OSS reviewed the most recent water intrusion abatement activities that had been performed in the area. The derailment area was of particular concern due to an inspection performed in June of 2010 that found that water seepage had corroded the steel beams and columns and the concrete roof showed signs of distress. In March of 2011, the stone coping above the area was removed and fenced off and a plastic membrane and 3rd rail mats were placed on top of the membrane to minimize seepage.
Although these minor leaks may not present an imminent safety hazard, their presence over a prolonged period of time accelerates the deterioration of Right of Way components, which will reduce the projected life cycle of equipment as well as adding additional state of good repair costs.

CONCLUSION

OSS has determined that the causal factor in this incident was a rail surface defect (squat) that had escalated into a broken rail. A contributing factor in this incident was an overhead water leak that over a prolonged period of time had accelerated the progression of the “shelling” that was occurring on the surface of the rail head. This condition is evidenced by a portion of the material from the surface of the rail dislodging and falling away. The missing layer of surface material allowed significant additional vertical forces (pounding) to be introduced onto the head of rail as trains went through the area, which resulted in the fracturing of the rail and the subsequent derailment.

ACTIONS TAKEN

1. The structure in the vicinity of the derailment, where the water intrusion is occurring, is presently under contract (Contract C-44508) for rehabilitation. The contract was awarded in March of 2013 and will include as part of the rehabilitation, repair of the damaged columns and a new waterproofing membrane. Substantial completion is forecast for March of 2015.

2. DT personnel have since identified 155 locations in the system in which water is dripping on a surface rail defect. The DT intends to establish a goal of correcting these types of defects within 90 days of being identified; however, with their current level of resources they are committed to correcting any of the locations identified going forward and are prioritizing repairing the existing population based upon the level of severity until they are all addressed.

RECOMMENDATIONS

OSS recommends the Department of Subways (DOS):

1. Revise the MW-1 to re-prioritize the combination of conditions where squat (similar to a wheel burn) coexists with a constant water condition, such as a location where water is dripping onto the rail. This combination of conditions should be classified as a Priority 2, require remedial action consisting of
replacement of the rail in less than 90 days and diverting the water and/or grouting the leaks.

2. Require as part of the 14 day supervisory inspection that DT supervision pay special attention to locations where wheel burns are prone to occur such as steep grades or changes in grades.

3. Establish a rail replacement program for locations where wheel burns are prone to occur or as an alternative, consider, if possible, establishing a dedicated grinding/rail milling program to address these locations.

4. Use the TGC 4 video inspection software to automatically detect the locations having a combination of wheel burns and water conditions.

Note: OSS has previously made a recommendation regarding water intrusion abatement. This recommendation is contained within the OSS Final Report regarding an obstruction incident that occurred at 96th Street on November 30, 2011. The recommendation focuses on the level of resources dedicated to water intrusion abatement and is presently being tracked to conclusion.

**SUBMITTAL**

**Prepared by**
This report was prepared by William Casey, Superintendent, Rapid Transit Investigations, OSS.

Signature: [Signature] Date: 9/11/13

**Reviewed by**
This report was reviewed by John Szurlej, Manager, Rapid Transit Investigations, OSS.

Signature: [Signature] Date: 9/11/13

**Submitted by**
This report is submitted by Patrick Lavin, Senior Director, OSS.

Signature: [Signature] Date: 9/11/13
Appendix - Photographs

Future location of the start of the break recorded during the TGC run on 04/01/2013.

Figure 4 from the LPI Report: Section of rail identified by chevron-markings as the suspect failure initiation location.

Figure 9 from the LPI Report: Close up of rail inspection image as compared to photographs of the fractured rail showing the area of shelled material loss.
(B) RAIL SURFACE DEFECTS REQUIRE CLOSE MONITORING and may require replacement if so determined by a qualified person. Surface defects are: shelly spots or “squats”, head checks, wheel burn (but not fracture), mill defect, flaking, spalling, corrugation, and corrosion. See paragraphs (H) to (K) below for base corroded rail requirements, and paragraph 207.5 (D) in Part 2 of this Manual, for wheel burn requirements. At locations where a combination of a “Priority 2” track geometry defect and a rail surface defect or a non-critical rail flaw defect does exist, immediate inspection and action is required; see section 104.3 “Course of Action”, paragraph (F) for more details.

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**TABLE 108.7A  RAIL DEFECTS (continued)**

<table>
<thead>
<tr>
<th>Condition</th>
<th>UNRESTRICTED SPEED</th>
<th>SLOW SPEED 1-10 mph</th>
<th>SUPERVISE OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTION</td>
<td>Priority 3</td>
<td>Priority 2</td>
<td>Priority 1</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>D FECT ECT</td>
<td>HORIZONTAL SPLIT HEAD (1)</td>
<td>&lt; 2&quot;</td>
<td>&lt; 4&quot;</td>
</tr>
<tr>
<td></td>
<td>VERTICAL SPLIT HEAD (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPLIT WEB (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PIPE</td>
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</tr>
<tr>
<td></td>
<td>HEAD-WEB SEPARATION (1)</td>
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</tr>
<tr>
<td></td>
<td>BOLT HOLE CRACK (1)</td>
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<tr>
<td></td>
<td>BROKEN BASE</td>
<td>&lt; 6&quot;</td>
<td>≥ 6&quot;</td>
</tr>
<tr>
<td>L ENGFTH</td>
<td>ORDINARY BREAK (1)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>DAMAGED RAIL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P экономическ</td>
<td>WHEEL BURN/ SQUAT/SHELL</td>
<td>Small</td>
<td>Medium (2)</td>
</tr>
<tr>
<td></td>
<td>BASE CORROSION</td>
<td>Slight</td>
<td>Medium</td>
</tr>
</tbody>
</table>

(< : less than; > : greater than; ≤ : less than or equal to; ≥ : greater than or equal to)

**NOTE:** (1): If so determined by a qualified Inspector

**A:** APPLY JOINT BARS IF NOT REPLACED IN 15 DAYS, IF FOUND SAFE FOR OPERATION

**B:** INSPECT IN 30 DAYS OR AS REQUIRED

**C:** LIMIT SPEED TO 10 MPH IF DETERMINED BY QUALIFIED PERSON. REPLACE DAMAGED RAIL WITHIN 90 DAYS OF ITS DETECTION

**D:** LIMIT SPEED TO 10 MPH

**E:** SUPERVISE OPERATION; REPLACE BASE CORRODED RAIL WITHIN 48-HRS. (SEE PARAGRAPH 108.7 (I) BELOW)

**F:** APPLY JOINT BARS, CARRYOVER BARS AND/OR NON-CONDUCTIVE PLATES IMMEDIATELY

**L = LARGE (41-100%); M = MEDIUM (21-40%); S = SMALL (0-20%)**

**(1): ALSO APPLIES TO WORKING GUARD RAILS**

**(2): APPLIES TO WHEEL BURNS/SQUATS/SHELLS LESS THAN 3” LONG AND/OR LESS THAN 1/8” DEEP, IN LOCATIONS WHERE A WATER CONDITION, SUCH AS DRIPPING ON TOP OF THE RAIL, DOES EXIST**
(3): SEVERELY BASE CORRODED RAILS WITH ANY CRACK(S) OF ANY SIZE SHALL BE REPLACED IMMEDIATELY

...  
...

(H) RAIL CORROSION CONSISTS OF THE DETERIORATION AND DISINTEGRATION of the rail steel starting at its surface, due to chemical reactions, oxidation and electrolysis effects in the presence of water containing salts or other impurities. It is therefore paramount to divert any water away from the track elements (rails, fasteners and ties) so that they are not affected by electrolysis and corrosion; in addition, rail corrosion could lead to rail breaks and signal system failures. Levels of rail corrosion shall be classified as follows:

- **SLIGHT** (minimal): rusting of the steel rail surfaces, perhaps with some minor flaking of surfaces; surface pitting is small (pin-head size or smaller typically) and/or sporadic; loss of any section of the rail at the web or base is minimal (less than \(\frac{1}{16}''\)); no visible cracks are present at the deteriorated surfaces.

- **MEDIUM:** heavy rusting and flaking of rail surfaces; surface pitting is medium-sized (approximately \(\frac{1}{8}''\) in diameter on average) and more prevalent; loss of any section of the rail at the web or base is small (less than \(\frac{3}{4}''\)); small cracks, if present, on the deteriorated surfaces are less than \(\frac{1}{8}''\) in length.

- **SEVERE** (significant): surface pitting is large-sized (more than \(\frac{1}{8}''\) on average) and extensive; rail base or web have loss of section equal to or larger than \(\frac{3}{4}''\), either on a uniform basis or concentrated at point or points on the base; cracks in the deteriorated surfaces, if present, are \(\frac{1}{8}''\) or larger in length.

The above corrosion levels shall be treated in accordance with the actions shown in Table 108.7A above, except otherwise as specified in the following paragraphs.

(I) **BASE CORRODED RAILS MUST BE INSPECTED AND VERIFIED** by a Track Supervisor – or the Deputy Superintendent of Track (or his qualified designee) of the Staten Island Railway. The base corroded rails shall be marked with highly visible paint in the web of the rail only, so that they can be easily monitored. The Track Supervisor shall inspect all base corroded rails in the section as part of the twice a month supervisory inspection (as per section 102.2 (D) of this Manual), and a written record of each inspection must be forwarded to the Assistant Chief Track Officer. The Track Inspector of the section shall monitor and report the condition of the base corroded rails found during each and every inspection performed in the Section.

(J) **REPLACEMENT OF BASE CORRODED RAILS SHALL BE SCHEDULED AS FOLLOWS:**

1. In general, severely based corroded rails shall be replaced within no more than 48-hrs. of their detection, or immediately if there are any cracks of any size at the location where the corrosion is most severe. If the severely base corroded rail can not be replaced within 48 hrs., either joint bars, carryover bars and/or non-conductive plates shall be installed at the location of the most severe corrosion, or the rail shall be cut and joint bars installed if there are any cracks at that location.

2. Base corroded rails of medium severity shall be replaced within 90 days of their detection. If they can not be replaced within 90 days, then either joint bars, carryover bars and/or non-
Conductive plates supporting the base of the corroded rail section shall be installed in each case to the rail at the location where the base corrosion is found to be significant.

3. Base corroded rails of slight severity shall be monitored by the Track Inspector and the Track Supervisor of the section where they are found, and their condition must be periodically reported as per paragraph (I) above.

4. If there are any Priority 2 visual or track geometry defects present at locations where rails of medium or severe base corrosion do exist, then immediate action shall be taken, consisting of placement of a slow speed order, immediate replacement of the corroded rail and correction of the Priority 2 defect.

(K) REPLACEMENT OF BASE CORRODED RAILS SHALL BE PRIORITIZED AS follows:

1) any rails with severe base and/or web corrosion, especially at fastener locations;
2) any rails with medium corrosion and any cracks of any size in the corroded areas;
3) base corroded rail of medium severity at locations with any Priority 2 defects;
4) base corroded rails of medium severity in under river tubes;
5) base corroded rails of medium severity in all tracks in high traffic volume areas, such as:
   - Lexington Ave. Line (IRT), from 125th St. to Atlantic Ave.;
   - Queens Blvd. Line (IND), S/O 5th Avenue to 71st – Continental Aves.
   - 6th Avenue Line (IND), Broadway-Lafayette to 59th St. & 8th Ave.
   - 8th Avenue Line (IND), 168th St. to Hoyt-Schermerhorn St.
   - Broadway-7th Ave. Line (IRT), 96th St. to Chambers St.
   - Broadway and Brighton Lines (BMT), 57th St. & 7th Ave. to Prospect Park.
Supervisors are required to pay special attention to steep grades, grade changes, and other locations, specially where water dripping is present, for wheel burns and rail squats during their 14 Day Supervisory Track Inspection.

**Rail squats** are a type of rolling contact metal fatigue, similar in appearance to wheel burns, which result from wheel impacts or slippage on the railhead which ‘bruise’ the steel, and create a rail pounding condition over time, leading to severe degradation of the rail.

Often the squat will grow under the surface as a hidden damage zone evidenced by a small wheel burn on the railhead. Squats will further deteriorate the rail steel through the effects of water and weather. If left unmanaged, squats can lead to rail damage, transverse defects, and even rail fracture.

Rail squats are a form of cold work rolling contact fatigue. Thus a rail squat is literally a depression of the surface of rail; sometimes a dark spot on a rail is indicative of Rail Squats. This spot arises from plastic flow of the surface of the rail, which becomes possible because a subsurface crack frees the layer of steel above it to flow. Water appears to be essential to growth of squats as the presence of water in a crack creates conditions of wheel slippage which is a known factor in worsening the growth of squats.

Another danger with Squats is that they may impede ultrasonic testing and may prevent genuine TD indications from being detected.

Small wheel burn and minor rail surface defects, such as light corrugation and rail shelling, can be influenced by overhead water dripping or splashing onto the rail head for prolonged periods of time, creating microscopic crack layers from train wheel slippage which can lead to a Transverse Defect and rail failure. Resolving Key preventative factors in eliminating rail squat causation and worsening is early detection which allows early correction.

<table>
<thead>
<tr>
<th>TABLE 108.7A RAIL DEFECTS (continued)</th>
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<tbody>
<tr>
<td><strong>SPEED</strong></td>
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<tr>
<td>UNRESTRICTED SPEED</td>
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<tr>
<td>SLOW SPEED 1-16 mph (1)</td>
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<tr>
<td><strong>SUPERVISE</strong></td>
</tr>
<tr>
<td>OPERATION</td>
</tr>
<tr>
<td><strong>ACTION</strong></td>
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<tr>
<td>Priority 3</td>
</tr>
<tr>
<td>Priority 2</td>
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<tr>
<td>Priority 1</td>
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<tr>
<td><strong>DEFECT LENGTH</strong></td>
</tr>
<tr>
<td>HEAD-WEBS (1)</td>
</tr>
<tr>
<td>PIPE</td>
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<tr>
<td>BOLT-HOLE CRACK (1)</td>
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<tr>
<td>BROKEN BASE (1)</td>
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<tr>
<td>ORDINARY BREAK (1)</td>
</tr>
<tr>
<td>DAMAGED RAIL</td>
</tr>
<tr>
<td>WHEEL BURN/ SQUAT/SHELL</td>
</tr>
<tr>
<td>BASE CORROSION</td>
</tr>
<tr>
<td><strong>CONDITION</strong></td>
</tr>
<tr>
<td><strong>A</strong></td>
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<td><strong>C</strong></td>
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<td><strong>F</strong></td>
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<td>&lt; 2&quot;</td>
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<tr>
<td>&lt; 3&quot;</td>
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<tr>
<td>&lt; 1-1/2&quot;</td>
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<tr>
<td>&lt; 6&quot;</td>
</tr>
<tr>
<td>YES</td>
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<tr>
<td>SMALL (2)</td>
</tr>
<tr>
<td>SLIGHT (2)</td>
</tr>
<tr>
<td><strong>NOTE</strong>: (1): If so determined by a qualified inspector</td>
</tr>
<tr>
<td><strong>NOTE</strong>: (2): Slight, Medium, Severe</td>
</tr>
</tbody>
</table>

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A: APPLY JOINT BARS IF NOT REPLACED IN 15 DAYS, IF FOUND SAFE FOR OPERATION
B: INSPECT IN 30 DAYS OR AS REQUIRED
C: LIMIT SPEED TO 10 MPH IF DETERMINED BY QUALIFIED PERSON. REPLACE DAMAGED RAIL WITHIN 90 DAYS OF ITS DETECTION
D: LIMIT SPEED TO 10 MPH
E: SUPERVISE OPERATION; REPLACE BASE CORRODED RAIL WITHIN 48-HRS. (SEE PARAGRAPH 108.7 (I) BELOW)
F: APPLY JOINT BARS, CARRYOVER BARS AND/OR NON-CONDUCTIVE PLATES IMMEDIATELY
L = LARGE (41-100%); M = MEDIUM (21-40%); S = SMALL (0-20%)
(1): ALSO APPLIES TO WORKING GUARD RAILS
(2): APPLIES TO WHEEL BURNS/SQUATS/SHELLS LESS THAN 3" LONG AND/OR LESS THAN 1/8" DEEP, IN LOCATIONS WHERE A WATER CONDITION, SUCH AS DRIPPING ON TOP OF THE RAIL, DOES EXIST
(3): SEVERELY BASE CORRODED RAILS WITH ANY CRACK(S) OF ANY SIZE SHALL BE REPLACED IMMEDIATELY

THINK SAFETY, OWNERSHIP and RESPONSIBILITY. 

David A. Knights
Chief Officer, Track