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W-0304 Derailment – Near Ronald Reagan Washington National Airport Station – September 29, 2023

Document Purpose

This WMSC written report on WMATA Metrorail's safety event investigation and review of Metrorail's findings in accordance with the WMSC Program Standard, in conjunction with the attached Metrorail investigation report that has undergone WMSC staff review, feedback, and Metrorail revision, describes the investigation activities, identifies factors causing or contributing to the accident, and sets forth ongoing, additional, or upcoming corrective actions and further oversight work (such as inspections and audits) as necessary or appropriate. The WMSC's ongoing oversight during the investigative process, including safety event reporting and verification, investigative activities at the derailment scene and other parts of the WMATA Rail System, participation in investigative interviews, data review, consistent communication with the Metrorail investigations team, and feedback on Metrorail's reports leads to further improvements prior to consideration of the reports by WMSC Commissioners for adoption. The WMSC's safety event investigation oversight assures the sufficiency and thoroughness of Metrorail's investigations. The WMSC Commissioners are considering these documents (the WMSC review and Metrorail's investigation report) as a unified item for adoption at the Washington Metrorail Safety Commission meeting on August 6, 2024.

WMSC staff recommend adoption of this investigation.

Summary of WMSC Response to Scene & Follow-up activities:

A cross-functional WMSC team responded to the derailment location immediately upon receiving preliminary information (via Metrorail's ROCC Alerts and monitoring of radio communications) that the derailment occurred. Due to the timely WMSC monitoring and safety oversight of Metrorail data and operations, and the WMSC's timely response to that information, the WMSC was on scene at the incident command post within an hour of the derailment occurring. Other members of the WMSC team off-site gathered and monitored Metrorail data including train movement logs, information on the railcars in each train consist, and radio communications, and coordinated with various Metrorail personnel who were also responding to the event. When the WMSC team arrived, some Metrorail personnel had entered the roadway and walked to the derailment location without the required coordination with incident command to ensure safe and effective response and recovery. As Metrorail later validated, the executives were on the roadway without coordination with incident command, which as a serious safety risk. The WMSC followed safety procedures and coordinated with Metrorail personnel in charge of the scene at the incident command post. This effective coordination by the WMSC included work with the Metro Transit Police Department, Office of Emergency Preparedness, Railcar Maintenance, the Metropolitan Washington Airports Authority, and other personnel. Metrorail did not consistently maintain awareness and communicate to its personnel who the incident commander was or where the command post was, and had not provided the personnel with the necessary skills to implement Metrorail's incident management framework. Metrorail later identified that its incident management framework training should be reviewed. At multiple points, responding personnel were unsure who the incident commander was or where the command post was, and a Metro Transit Police Department officer gave personnel permission to access the roadway even though that officer was not the incident commander or otherwise authorized to give such permission. Metrorail also did not fully account for and brief all personnel arriving on scene, and, at the direction of senior leadership, a Metrorail employee trained to manage the incident was replaced by a Rail Transportation Superintendent who Metrorail's plans and records

show was not trained to oversee response to an incident of this type and scale. The WMSC participated at the station in an initial interview of the train operator of the train that derailed, inspected the derailment location and the area leading up to it, inspected the brake disc lodged under the derailed train and identified that it came from a different series of railcars, inspected the train, and observed the download and playback of forward-facing video from the derailed train. The WMSC team coordinated on site with Metrorail's investigations team to ensure that Metrorail identified and inspected the trains that preceded the derailed train, and that Metrorail properly maintained the integrity of relevant evidence. This included ensuring that Metrorail documented the conditions of the other train that the investigation identified as likely to be, and later confirmed as, the source of the 2000/3000 Series railcar brake disc on the roadway. Once the conditions were documented, the train was moved to a rail yard. The WMSC observed Metrorail's subsequent inspection of the train in the Alexandria Rail Yard service and inspection shop the following day, and, as the WMSC team typically does for each safety event investigation, participated in subsequent investigative interviews, identified relevant data, and reviewed and analyzed that data. The WMSC ensured that Metrorail conducted and provided sufficient metallurgical analysis of the damaged and dislodged bolts. The results of this analysis are now included in the investigation report.

The derailment caused significant damage to the track infrastructure on the bridge where the train derailed, as well as the damage to the derailed train and the train that the brake disc fell from. After Metrorail conducted work to re-rail the train and move it to a rail yard, the WMSC monitored Metrorail's work to replace and repair track infrastructure. These repairs included fastener studs, e-clips, concrete grout pads, and the emergency guard rail that is designed to reduce the risk of a train that derails falling from the bridge. No damage was identified on the underside of the bridge deck.

Metrorail provided updates on the track repair work. Metrorail also began inspecting brake disc bolts on other 2000 Series and 3000 Series railcars (the brake disc assemblies on the 6000 Series and 7000 Series railcars are designed differently and therefore were not determined to pose an elevated risk). The WMSC observed some of this work in railcar shops in the days after the derailment. Due to WMSC feedback related to ongoing inspections and data reviews, Metrorail developed improved procedures for these checks and associated maintenance work over the following months. The WMSC continues to review Metrorail data on these brake disc and bolt torque checks and replacement processes, including as it relates to repeat problems identified on the same railcar and wheel location. Follow-up WMSC inspections of these activities have identified and led to Metrorail addressing items such as ensuring that personnel observed are relying on the current version of the inspection procedure rather than an outdated version.

This derailment occurred as the WMSC was beginning its Revenue Vehicle (Railcar) Audit. The final report for this audit was issued on May 21, 2023. The findings of this audit included that Metrorail is not carrying out railcar maintenance and inspection tasks as specified by its procedures, and is not identifying and mitigating hazards related to railcars and railcar personnel. Metrorail is now in the process of developing and implementing corrective action plans to address the findings from this audit.

Cause and Contributing Factors:

The causes and contributing factors include:

- Metrorail's insufficient maintenance practices and maintenance oversight to detect the loosening and potential failure of the brake disc attachment during routine maintenance checks.

- Inadequate inspection procedures for railcar brake systems.
- Inadequate installation procedures for railcar brake systems.
- The investigation also identified Metrorail's failure to institute speed restrictions required by its procedures.

Corrective actions:

As a result of this investigation, after-action review, and associated WMSC follow-up, Metrorail developed the following corrective actions:

Railcar-related:

- Metrorail developed a process for and conducted a fleetwide check of the tightness of brake disc bolts on 2000 and 3000 Series railcars and any 2000 and 3000 Series railcar trucks available in railcar maintenance facilities (Service Bulletin 649, completed October 5, 2023).
- Metrorail developed a torque tightness check process and added this process to its periodic inspection process. This has subsequently been updated to provide this as a new task in the procedure.
- Metrorail developed a brake disc installation process to include cross-torquing of bolts.
- Metrorail reviewed 2012 investigation reports into dislodged brake discs identified by the WMSC, and associated engineering reports.
- Metrorail reviewed the design of the brake assembly including the disc, spacer and bolts.

Response-related:

- Metrorail increased the planned frequency of announcements of the location of the Incident Command Post over the radio during emergency response.
- Metrorail added the Incident Command Post location and identifying information for the Incident Commander to email alerts sent by the control center to Metrorail personnel during emergencies and other service disruptions.
- Metrorail assigned Metro Transit Police Department personnel to communicate from the MICC with Metrorail's Incident Commander.
- Metrorail is developing visual markers for the Incident Command Post and key incident management positions
- Metrorail is revising incident management framework processes and training, and plans to address training for executives, and to address training gaps for others related to basic functions and skills.
- Metrorail met with the Metropolitan Washington Airports Authority to develop action plans for any future similar event along airport property that can build upon the coordination during this event.
- The Metro Transit Police Department issued a memorandum to staff highlighting the importance of maintaining personnel accountability on scene and of other incident management responsibilities.

Related Open CAPs

- Metrorail leadership did not follow the incident command and scene control processes during this event. Metrorail is in the process of implementing CAP C-0162 addressing the finding that Metrorail does not consistently follow the incident command system structure, had procedures that did not comply with National

Incident Management System requirements, and did not have sufficient training requirements to prepare personnel to respond do and manage emergencies.

- Metrorail is in the process of implementing corrective action plans to address the WMSC's Railcar Audit issued in May 2023. These include:
  - CAP C-0270 addresses the finding that Metrorail is not carrying out railcar maintenance and inspection tasks as specified by its procedures (Scheduled completion January 2026).
  - CAP C-0273 addresses the finding that Metrorail is not identifying and mitigating hazards related to railcars and railcar personnel (Scheduled completion October 2025).

Safety event summary:

Brake disc bolts and a brake disc fell from southbound Yellow Line Train 308 soon after it departed Ronald Reagan National Airport Station at 10:43 a.m. on September 29, 2023. The brake disc and bolts fell from railcar 3069. The brake disc struck the following car, railcar 3068, the last car of the six-car train, damaging one of railcar 3068's four collector shoe assemblies that collects power from the third rail (two on each side of each railcar). The damaged collector shoe assembly was later found near Potomac Yard Station. Later inspection identified that the right front primary power cable on railcar 3068 was flashed, the #1 collector shoe assembly was broken off, the #3 collector show was missing, and all collector shoe fuses were blown. The loss of this brake disc and the associated damage was not identified when it occurred. There were no notable indications to the Train Operator of Train 308, who therefore would not have known that this damage occurred.

As evidenced by markings on the concrete bridge surface, the dislodged brake disc bounced down the roadway behind the train. Forward-facing video from the following train shows the brake disc ended up leaning against the inside of the left running rail in a curve approximately ¼ mile from Reagan National Airport Station. That following train, Train 406, departed the station at 10:45 a.m.

Train 406, travelling at more than 35 mph, struck the brake disc and derailed by the left front wheel climbing on the brake disc and falling outside the left rail. The right wheel fell inside the right rail. In an interview, the day of the event and a subsequent interview later, the Train Operator stated that they did not see the brake disc as they were looking farther ahead on the tracks, and only felt the train derail. Video shows the brake disc was visible to the Train Operator only briefly prior to the derailment. Only the lead railcar of the train, 7246, derailed and was damaged.

Prior to the derailment, on September 26, 2023, Metrorail had recorded, via ENSCO's track geometry vehicle, a wide gauge up to 57.4" in this area (Metrorail sets its normal track gauge – the distance between the two running rails -- as 57.25"). Metrorail's manuals list this as a yellow severity rating that requires a medium speed restriction. Metrorail had not implemented this required speed restriction. The wide gauge did not contribute to this derailment.

The Train Operator properly reported the derailment to the Rail Traffic Controller, who informed the control center's Assistant Operations Manager on duty and instructed the Train Operator to conduct a ground walkaround to verify the derailment and to identify any additional safety issues. The Assistant Operations Manager properly contacted the Metropolitan Washington Airports Authority (MWAA) to request a police and fire response. The Arlington County Fire Department also responded. Metrorail dispatched Metro Transit Police Department personnel and the Emergency Response Team assigned to address track problems. Automatic Train Control Maintenance personnel, a Rail Supervisor, and Railcar Maintenance personnel also responded, among others.

The Rail Traffic Controller informed the operator of Train 407, the train following the derailed train, that Train 407 would be used as a rescue train. Riders on that train were offloaded at the Reagan National Airport Station platform. After a Rail Supervisor and Car Maintenance Road Mechanic walked to the derailed train to ensure the tracks were safe for the rescue train's movement, the rescue train was pulled forward by a Rail Supervisor to the rear of the derailed train, and the 43 riders from the derailed train were walked through the bulkhead (end) door onto the rescue train, which was then moved back to the station for riders to disembark onto the station platform.

Third rail power was de-energized on Track 2 in the area of the derailed train at approximately 11:37 a.m. Incident Command subsequently requested at 12:02 p.m. that third rail power be de-energized on Track 2 at the station as well.

At the location of the derailment and where the train stopped after derailing, the two mainline tracks are on separate bridges. Therefore, Metrorail directed a train operator to use an out-of-service train on the opposite track, Track 1, to check the safety of operation on that track. The operator reported it was safe for train movement on Track 1. Metrorail began single-tracking using that track (the normal inbound track) at 12:41 p.m.

As the WMSC team prepared to walk back to the platform from inspecting the derailed train, Metrorail requested third rail power energization to expedite video download from the derailed train. The WMSC therefore remained on the train to comply with safety procedures. The video was downloaded and reviewed, showing the brake disc present on the rail as the train approached.

As noted above, the WMSC and Metrorail personnel had already identified that the brake disc was not from a 7000 Series railcar. The derailed train was a 7000 Series train. The WMSC reviewed Metrorail data, and Metrorail reviewed this data, to identify the trains that had been operating ahead of the derailed train. Due to the service disruption caused by the derailment, the train that had been just ahead of the derailed train had been held at the end of the line and had not returned to service. Prior to the train re-entering service, the WMSC ensured that Metrorail kept the train out of service, that Metrorail documented the conditions of that train prior to any further movement to a rail yard for additional inspection, and that Metrorail verified that such movement to the rail yard would be safe.

Metrorail also assigned track inspectors to check conditions between Ronald Reagan Washington National Airport Station and Huntington Station on Track 2, the track that the damaged train had travelled on after the loss of the brake disc. The inspectors identified elements of the damaged railcars 3068 and 3069 near Potomac Yard Station (collector shoe assembly) and Braddock Road Station (collector shoe obstructing switch point).

Metrorail re-railed the derailed train at 12:11 a.m. September 30, 2023. The train was safely moved to the Alexandria Rail Yard.

To repair the track damage, Metrorail drilled 494 core holes, replaced 247 fasteners, and re-gauged the track in the area. Metrorail ran a Track Geometry Vehicle to measure the area and conduct ultrasonic testing of the running rails, and conducted stray current testing.

This repair work took several days. Metrorail reported on October 3, 2023 at 4:16 a.m. that the repairs were complete. Metrorail returned the track to passenger use that day.

Metrorail conducted a productive after-action review of the emergency response to this event on October 27, 2023. This review identified corrective actions noted above that are designed to improve response and reduce risk in the

future. The timely rider evacuation to the station platform was one of the strengths Metrorail identified in the response. Like the WMSC, Metrorail identified safety gaps related to identifying the incident commander and incident command post, personnel at multiple levels of the organization not following incident command requirements creating a serious safety risk, the assignment of personnel without the necessary skills to carry out incident command tasks, and the use of a separate radio channel without procedures to govern such use.

Brake Disc Process at Time of Event

At the time of this derailment, Metrorail processes included visual checks of wheelset assemblies, but did not include any regular checks of the torque of the bolts holding the brake discs in place.

On the day of this event, the train that later operated as Train 308 underwent a daily inspection at the New Carrollton Rail Yard. The daily inspection requirements include a car maintenance mechanic conducting an on-board systems test and a visual check of exterior elements while the train is in the rail yard.

Metallurgical testing of the failed bolts that were recovered demonstrated material degradation and signs of fatigue, indicating potential quality issues or inadequate stress tolerance. The test report demonstrated that the bolts were insufficiently torqued or improperly tightened. Subsequent review of Metrorail's maintenance practices and data demonstrated discrepancies in bolt installation protocols and maintenance procedures.

The metallurgical testing found that the cap screws failed by fatigue at the interface between the engaged and non-engaged threads, the highest stressed area. The cracks initiated at a thread root then propagated under cyclic loading. The fracture indicated reverse or rotational bending, indicating insufficient initial clamping load, allowing the screw to loosen in service. Metrorail had identified a similar failure mode of these cap screws in 2012. Metrorail records indicate in 2012 and 2013 Metrorail conducted brake disc crack inspections of 2000 and 3000 Series railcars, and in 2015 Metrorail did a one-time ALP brake disc cap screw inspection on the brake disc bolts of the 2000 and 3000 Series railcars.

Other Brake Disc Failures Identified in New Checks

Following the derailment, Metrorail developed and conducted new interim checks of brake discs on each 2000 and 3000 Series railcar and on all other available 2000 and 3000 Series railcar trucks. These initial checks identified 87 of the 352 active 2000 and 3000 Series railcars had at least one brake disc with one or more broken or loose bolts. Each brake disc has 8 bolts connected in pairs by safety wires. At the scene of the derailment, the WMSC found some of the bolts from the fallen brake disc still connected by safety wire. Safety wires are designed to prevent bolts from loosening due to vibration by preventing further movement.

The 87 railcars found in the immediate checks with improperly secured brake discs demonstrated a systemic issue across the 2000 Series and 3000 Series railcar fleet of bolts not torqued to the required specifications.

As identified in Metrorail's investigation report, factors contributing to this critical lapse in maintenance procedures include a lack of standardized procedures, inadequate training, insufficient supervisory oversight mechanisms, documentation deficiencies, and inadequate communication channels.

Metrorail subsequently developed a procedure to check the torque of these bolts in periodic inspection processes. Metrorail updated the associated work instructions and tasks over the course of several months to reflect areas for

improvement identified by the WMSC or Metrorail personnel. This includes incorporation of direction on torquing processes for installation of bolts, and references to the appropriate updated procedures when additional steps are required. For example, when the WMSC identified that the new periodic inspection checks had identified additional bolts that were not properly torqued including instances where the brake disc at the same location on a wheelset that Metrorail has previously replaced have been found to again have loose or broken bolts, the WMSC communicated this to Metrorail. After WMSC follow-up on this item, Metrorail informed the WMSC it would implement a standardized cross-torquing process into its procedures, which Metrorail subsequently also incorporated into training for active personnel.

The WMSC incorporated observations of Metrorail's brake disc work into our regular inspections.

Washington Metropolitan Area Transit Authority
Department of Safety (SAFE)
Office of Safety Investigations (OSI)

FINAL REPORT OF INVESTIGATION A&I E23685

Date of Event:	September 29, 2023
Type of Event:	A-5: Derailment
Incident Time:	10:46 Hours
Location:	Ronald Reagan Washington National Airport Station, track 2 CM C2 379+00
Time and How received by SAFE:	10:47 Hours – SAFE/MAC
WMSC Notification Time:	12:43 Hours
Responding Safety Officers:	WMATA: Office of Emergency Preparedness (OEP) Office of Safety Investigations (OSI) Office of Safety Oversight (OSO) Washington Metrorail Safety Commission (WMSC) Other: N/A
Rail Vehicle:	Train ID 308 L2024/25-2046/47-3069/68T Train ID 406 L7246/47x7193/92x7510/11x7565/64T
Injuries:	None
Damage:	Rail Car 7246 – Wheel damage Rail Car 3069 –Brake Disc #4 detached Rail Car 3068 – Collector shoe assembly Track – Multiple fasteners, concrete, emergency guard rail
Emergency Responders:	Metro Transit Police Department (MTPD) Emergency Response Team (ERT) Metropolitan Washington Airport Authority Fire & Police Department (MWAA) Arlington County Fire Department (ACFD)
SMS I/A Incident Number:	20230929#111771MX

Ronald Reagan Washington National Airport Station – Derailment

September 29, 2023

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Abbreviations and Acronyms

ACFD	Arlington County Fire Department
AIMS	Advanced Information Management System
AOM	Assistant Operations Manager
ARS	Audio Recording System
ATCM	Office of Automatic Train Control Maintenance
CCTV	Closed-Circuit Television
CENV	Vehicle Program Services
CM	Chain Marker
CMNT	Office of Car Maintenance
CMOR	Office of the Chief Mechanical Officer
CSS	Crime Scene Search
ERT	Emergency Response Team
IIT	Incident Investigation Team
MOR	Metrorail Operating Rulebook
MTPD	Metro Transit Police Department
MWAA	Metropolitan Washington Airport Authority
NOAA	National Oceanic and Atmospheric Administration
OAP	Operations Administrative Policy
OEP	Office of Emergency Preparedness
RTC	Rail Traffic Controller
RTRA	Office of Rail Transportation
ROCC	Rail Operations Control Center
SAFE	Department of Safety
SMS	Safety Measurement System
SPOTS	System Performance On-Time Summary
TRST	Office of Track and Structures
WMATA	Washington Metropolitan Area Transit Authority
WMSC	Washington Metrorail Safety Commission

Executive Summary

**Note that all times listed are approximate and may contain minor variations due to differences between systems of record. **

On Friday, September 29, 2023, at 10:43 hours, Train ID 308, a mixed consist of 2000 and 3000 series railcars (L2024/25-2046/47-3069/68T), departed Ronald Reagan Washington National Airport Station (National Airport Station) on track 2 towards Huntington Station. After leaving the station, the brake disc on rail car 3069 dislodged from the train and struck the trailing car, 3068. The brake disc came to rest lying against the left running rail, within the gauge, near chain marker (CM) C2 379+00.

At 10:45 hours, Train ID 406 (L7246/47x7193/92x7510/11x7565/64T), the next train to depart National Airport Station, struck the brake disc, which was lying against the left running rail within the gauge on the non-third-rail side. At 10:46 hours, the Train Operator of Train ID 406 contacted the Rail Operations Control Center (ROCC) and reported a derailment outside of National Airport Station, near CM C2 384+00. The derailment occurred on the aerial structure, approximately 1500 ft beyond the platform. The Radio Rail Traffic Controller (RTC) instructed the Train Operator to perform a ground walkaround to assess the derailment damage.

At 10:46 hours, the Button RTC notified the Assistant Operations Manager (AOM) of the event. The AOM contacted the Incident Emergency Center for the National Airport and requested a response from the Metropolitan Washington Airport Authority (MWAA) Fire & Police Department. The ROCC Metro Transit Police Department (MTPD) Liaison reported the event to the MTPD Dispatcher, and multiple units advised that they were responding to National Airport Station. The Emergency Response Team (ERT) was dispatched to the scene.

At 10:48 hours, the Radio RTC informed Train ID 407 that they would be the rescue train and to offload customers at the National Airport Station.

At 10:56 hours, the Radio RTC granted permission to the responding Office of Rail Transportation (RTRA) Rail Supervisor and Office of Car Maintenance (CMNT) Road Mechanic to enter the roadway to walk to the derailed train to ensure the tracks were safe to send the rescue train. At 11:02 hours, the Rail Supervisor informed the Radio RTC that it was safe to send the rescue train.

At 11:03 hours, personnel from the Office of Automatic Train Control Maintenance (ATCM) and ERT reported on the scene at the National Airport Station. At 11:07 hours, the Arlington County Fire Department (ACFD) arrived at the National Airport Station.

At 11:27 hours, Train ID 407, the rescue train, was within two feet of the derailed train when the Radio RTC instructed to use close-in procedures and not couple to the derailed train to rescue the customers. At 11:30 hours, the customers were transferred from the derailed train to the rescue train. At 11:33 hours, the Rail Supervisor advised the Radio RTC that all customers were on board the rescue train.

At 11:45 hours, MTPD transferred Incident Command to the Office of Emergency Preparedness (OEP). At 12:02 hours, third rail power was requested to be de-energized from the platform to the

derailment scene. At 12:21 hours, Train ID 301 was used as a test train to perform a track inspection on track 1. At 12:38 hours, the Train ID 301 reported a good track inspection. At 12:41 hours, single-tracking operations began on track 1.

At 13:28 hours, Incident Command requested that third rail power be energized to allow the investigation team, led by MTPD's Crime Scene Search (CSS) unit, to perform a download of Train ID 406. At 14:02 hours, Incident Command advised that the data download was complete and requested that third rail power be de-energized.

At 14:40 hours, the WMSC provided an event scene release. At 14:48 hours, the incident scene transitioned to a recovery effort. At 15:05 hours, OEP facilitated a Hot Wash with all involved parties.

CMOR personnel recognized that there was a legacy brake disc wedged under the propulsion inverter of car 7247 and determined that all the brake discs on Train ID 406 were attached to the derailed vehicle. At 16:30 hours, CMNT personnel reported that brake disc #4 was missing from rail car 3069.

Rerailing was completed at 00:11 hours on September 30, 2023, and the train was transported under its own power to Alexandria Rail Yard. TRST drilled 494 core holes, replaced 247 fixations and re-gauged the area. The Track Geometry Vehicle (TGV) measured the area and performed ultrasonic testing. They also conducted stray current testing in the area.

In adherence to Standard Operating Procedure 102-01-02, which outlines the protocol for Removing an Employee from Service for involvement in an operational safety event, the Radio RTC dispatched a Rail Supervisor to relieve the Train Operator from duty for post-incident testing.

In accordance with the Office of the Chief Mechanical Officer (CMOR) Incident Investigation Team (IIT) Operations Administrative Policy (OAP) 102.06, ROCC promptly initiated the removal of Train ID 308 and Train ID 406 from revenue service for post-incident investigative measures. This action adhered to the Rail Vehicle Event Investigation Policy, ensuring a comprehensive examination of the incident.

The probable cause of the Derailment event at National Airport Station on Friday, September 29, 2023, a hardware failure occurred on rail car 3069, specifically with the brake system. The #4 brake disc detached from the hub assembly, resulting in it dislodging from the train and coming to rest within the gauge of the left running rail due to fatigued bolts

Contributing Factors were Maintenance Oversight where there was a failure to detect the loosening or potential failure of the brake disc attachment during routine maintenance checks. This failure in maintenance contributed to the detachment of the brake disc.

The Inspection Procedures had gaps and inadequacies in the inspection procedures related to the brake system, as the detached brake disc wasn't identified prior to the incident.

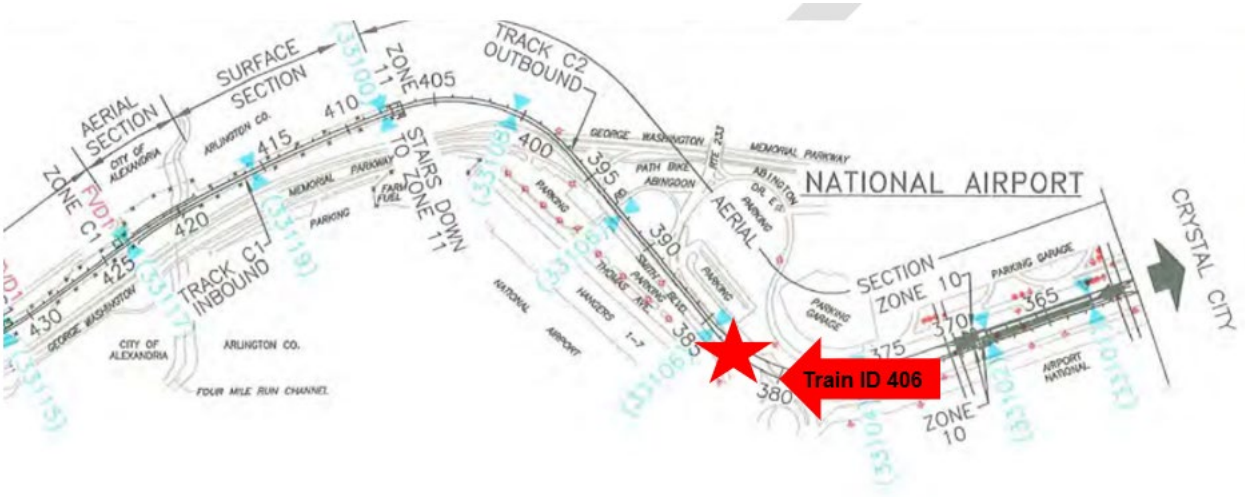
The Response Protocol while the response to the incident seemed well-coordinated, there could be areas of improvement in communication protocols or response procedures to ensure quicker identification and resolution of such incidents.

Additional Observations were damage to the lead car 7246 and associated components like the collector shoe assembly and primary power cable indicate the severity of the impact caused by the dislodged brake disc.

Incident Site

CM C2 379+00
Track 2, direct fixation tracks, split aerial structure, curved section of track

Field Sketch/Schematics



The above depiction is not to scale.

Purpose and Scope

The purpose of this accident investigation and candid self-evaluation is to collect and analyze available facts, determine the probable cause(s) of the incident, identify contributing factors, and make recommendations to prevent a recurrence.

Investigative Methods

The investigative methodologies included the following:

- Physical Site Assessment

- Formal Interviews – SAFE interviewed two individuals as part of this investigation. Interview included persons present at, during, and after the incident, those directly involved in the response process, and representatives from the Washington Metrorail Safety Commission (WMSC). SAFE interviewed the following individuals:
  - Train Operator (Train ID 308)
  - Train Operator (Train ID 406)

- Informal Interviews – Collected through conversations with individuals during the investigation to provide background and supporting information. Written statements were reviewed from personnel present during the event.

- MTPD Officer #1
- MTPD Officer #2

- Documentation Review – Collection of relevant work history information and process documentation contained in WMATA systems of record. These records include:
  - Train Operator's Written Statements
  - Train Operator's Training Records
  - Train Operator's Certifications
  - Train Operator's 30-day work history review
  - Metrorail Operating Rulebook (MOR)
  - National Oceanic and Atmospheric Administration (NOAA)
  - Rail Operations Control Center (ROCC) Incident Report
  - Maximo Data

- System Data Recording Review – Collection of information contained in Metro Data Recording Systems. This data includes:
  - Audio Recording System (ARS) playback [Radio and Landline Communications]
  - The Office of Car Engineering Vehicle (CENV) Analysis
  - Closed-circuit television (CCTV)
  - Advanced Information Management System (AIMS)
  - System Performance On-Time Summary (SPOTS)

Investigation

On Friday, September 29, 2023, at 10:43 hours, Train ID 308[1] (2024/25-2046/47-3069/68) departed National Airport Station on track 2 towards Huntington Station. After leaving the station, the #4 brake disc on car 3069 dislodged from the truck assembly near CM C2 379+00. The brake disc struck a collector shoe and collector shoe assembly on car 3068 as it fell and came to rest within the gauge of the left running rail. Train ID 308 experienced no faults observed by the Train Operator and continued towards Huntington Station.

Image 1 – Forward-facing camera view from Train ID 406 of brake disc #4 from Train ID 308 before the derailment.

[1] On the day of the event, Train ID 308 (2024/25-2046/47-3069/68) was Daily Inspected at New Carrollton Yard and began operation in revenue service at 05:08 hours at Huntington Station. The consist was utilized on the Yellow Line under the same train identification number until the consist was secured in the tail track at Huntington Station at 11:08 hours.

At 10:45 hours, Train ID 406[2] (7246/47-7193/92-7510/11-7565/64) departed the National Airport Station after Train ID 308 and struck the brake disc. At 10:46 hours, the Train Operator of Train ID 406 contacted ROCC and reported that the lead car 7246 had derailed outside of National Airport Station, near CM C2 379+00.

Image 2 – Train ID 406, lead car 7246 derailed.

The Radio RTC instructed the Train Operator to make announcements to the customers and perform a ground walkaround. After completing the ground walkaround, the Train Operator returned to the train and led 43 customers to the trailing rail car to stand by for a rescue train.

The Radio RTC began instructing the trains approaching the National Airport Station to hold.

At 10:46 hours, the Button RTC notified the AOM of the event. The AOM contacted MWAA. The ROCC MTPD Liaison reported the event to the MTPD Dispatcher, and multiple units advised that they were responding to the National Airport Station. The Emergency Response Team (ERT) was dispatched to the scene.

At 10:48 hours, the Radio RTC instructed Train ID 407, located at Crystal City Station, to continue to National Airport Station and offload the train in preparation to recover Train ID 406.

At 10:49 hours, a CMNT Road Mechanic and RTRA Rail Supervisor #1 reported they were at the National Airport Station.

[2] On the day of the event, Train ID 406 (7246/47-7193/92-7510/11-7565/64) was Daily Inspected at Dulles Yard and began operation in revenue service at 06:34 hours at Franconia–Springfield Station. The consist was utilized on the Blue Line under various train identification numbers.

At 10:54 hours, Train ID 308 arrived at Huntington Station and was placed out of service to reduce the number of trains that were operating due to the derailment event. There were no reported mechanical issues at the time.

At 10:56 hours, the Radio RTC instructed and granted foul time for the Road Mechanic and Rail Supervisor to enter the roadway and perform a track inspection by walking to Train ID 406. MTPD arrived and established the Incident Command Post at the National Airport Station platform. At 11:02 hours, the Rail Supervisor informed the Radio RTC that it was safe to send the rescue train.

MWAA emergency responders reported their arrival on the scene and established a Unified Command Post at National Airport Avenue between garages 1 and 2. At 11:03 hours, Rail Supervisor #2, ATCM personnel, and ERT personnel arrived at the National Airport Station. At 11:07 hours, the ACFD arrived.

At 11:08 hours, Train ID 308 was moved to the tail track at Huntington Station to allow space for trains arriving at Huntington Station. There were no reported mechanical issues before the train was moved to the tail track.

At 11:14 hours, MTPD advised that the Command Post was relocated to the platform at the National Airport Station.

At 11:27 hours, the Radio RTC instructed Rail Supervisor #2 to operate Train ID 407 and use close-in procedures to approach Train ID 406. Rail Supervisor #2 removed the Train Operator and took over the train operations. At 11:30 hours, the customers transferred from Train ID 406 onto Train ID 407. At 11:37 hours, Train ID 407 returned to National Airport Station and offloaded the rescued customers, and third rail power was de-energized between CM C2 370+00 and 400+00. At 11:39 hours, MWAA departed the Unified Command Post.

At 11:45 hours, OEP arrived, and MTPD reported that the Command was turned over to OEP. OEP relocated the Command Post to the mezzanine area of the National Airport Station. At 11:55 hours, OEP notified the Mission Assurance Coordinator (MAC) that they assumed Command from MTPD.

At 12:02 hours, Incident Command requested that third rail power be de-energized at National Airport Station on track 2. At 12:21 hours, Train ID 301 was used as a test train to perform a track inspection on track 1. At 12:38 hours, the Train ID 301 reported a good track inspection.

After performing a track inspection on track 1 at 12:39 hours, Incident Command granted permission for single tracking operations at the National Airport Station. At 12:41 hours, single-tracking operations began on track 1.

At 13:28 hours, Incident Command requested that third rail power be energized to allow the investigation team to perform a download of Train ID 406's video and VMDS data. At 14:02 hours, Incident Command advised that the data download was complete and requested that third rail power be de-energized.

At 14:40 hours, the WMSC provided the event scene release. At 14:48 hours, the incident scene transitioned to a recovery effort. At 15:05 hours, OEP conducted a Hot Wash with all involved parties. At 15:35 hours, the Office of Track and Structures (TRST) took over control of the scene

and performed a track inspection[3] between National Airport Station and Huntington Station on track 2.

While on the scene, CMNT personnel confirmed that all the brake discs on Train ID 406 were accounted for, and the brake disc that caused the derailment was identified as a brake disc that was attached to a legacy train consist; then recommended inspecting the train that was ahead of Train ID 406. ROCC determined that Train ID 308 departed the National Airport Station ahead of Train ID 406. At 16:09 hours, CMNT personnel were dispatched to Huntington Station to inspect Train ID 308. At 16:30 hours, CMNT personnel reported that brake disc #4 was missing from rail car 3069. Additionally, on rail car 3068, the front right primary power cable was flashed, the #1 collector shoe assembly was broken off, the #3 collector shoe was missing, and all collector shoe fuses were blown.

At 16:42 hours, Train ID 308 was dispatched to Alexandria Yard for post-incident inspection.

At 16:40 hours, ERT turned the event scene over to RTRA. At 18:07 hours, the TRST performed track maintenance between National Airport and Potomac Yard Station.

On Saturday, September 30, 2023, at 00:11 hours, Train ID 406 was re-railed, and further inspection of the train and track was conducted. At 02:24 hours, TRST confirmed that third rail power could be restored on track 2. At 03:24 hours, Train ID 406 was dispatched to Alexandria Yard for post-incident inspection. After Train ID 406 departed, the third rail power was de-energized for continuing track inspections and repairs. TRST drilled 494 core holes, replaced 247 fixations and re-gauged the area. The TGV measured the area and performed ultrasonic testing. They also conducted stray current testing in the area.

On Tuesday, October 3, 2023, at 04:16 hours, all repairs were completed, and third rail power was re-energized on track 2. The TRST conducted a riding track inspection and advised that track 2 was ready to return to service.

After the event, CMOR instructed personnel to conduct a fleetwide Tightness Check of all ALP bolts installed on the 2K/3K fleet. The fleet-wide inspection was completed on October 5, 2023, in accordance with SBB 649 Rev1. During the fleetwide Tightness Check of all ALP (Air Line Pipe) bolts installed on the 2K/3K fleet following the derailment incident, a certain number of bolts were found to have failed. The number of failed bolts was not explicitly mentioned in the provided data. However, the inspection revealed that multiple bolts across the fleet had experienced failure. Failed bolts were collected and sent to the engineering group for further analysis.

A post-event inspection was performed of the derailed train on September 30, 2023. Damage was isolated to the lead car 7246.

Results of initial round of metallurgical testing showed the analysis of failed bolts revealed material degradation and signs of fatigue, indicating potential quality issues or inadequate stress tolerance.

[3] During the track inspection, TRST identified broken collector shoe assembly and parts at the Potomac Yard Station Interlocking. Additionally, a switch obstruction was discovered near the heel block at the Braddock Road Station Interlocking. The obstruction was specifically identified as the #4 brake disc from rail car 3069. The brake disc detached from the hub assembly, due to a hardware failure, and fell off the train. After detaching, the brake disc came to rest within the gauge of the left running rail, creating a significant obstruction on the track.

The stress analysis evaluation of bolted connections identified instances of insufficient torque or improper tightening procedures, leading to compromised integrity. The engineering evaluations assessment of maintenance practices and historical data highlighted discrepancies in bolt installation protocols and maintenance procedures.

First Round of the PI Cycle drove the following findings. There were Corrective actions implemented, CMNT revised maintenance procedures and updated torque specifications and standardized bolt installation techniques were introduced to ensure consistent and proper fastening. CMNT Enhanced Training Programs including comprehensive training sessions were conducted for maintenance personnel to reinforce proper bolt installation procedures and emphasize the importance of torque accuracy. Instituted Quality Control Measures for stringent inspection protocols and quality assurance checks were implemented to verify the integrity of bolted connections during maintenance activities.

The outcomes and observations lead to CMNT improved bolt integrity. Subsequent inspections revealed a reduction in the incidence of bolt failures and loosening, indicating the efficacy of the revised maintenance procedures and enhanced training initiatives. Enhanced safety protocols and strengthened quality control measures and standardized maintenance practices contributed to a safer operating environment and reduced the risk of structural failures or equipment malfunctions.

Positive feedback from personnel and maintenance staff noted increased confidence in their ability to perform bolt installations accurately, citing the benefits of the updated training programs and clearer procedural guidelines.

Extent of Non-Torqued Brake Discs the investigation revealed a systemic issue regarding the torquing of brake discs across the railcar fleet. Specifically, it was found that a significant number of brake discs, including the one involved in the derailment incident, were not torqued to the prescribed specifications. This discrepancy indicates a critical lapse in maintenance procedures and raises concerns regarding the integrity and safety of the rolling stock.

Analysis identified several factors contributing to the non-torquing of brake discs. These factors include inadequate training of maintenance personnel, insufficient oversight mechanisms, and a lack of standardized procedures for torque application. Additionally, deficiencies in the documentation process and inadequate communication channels further exacerbated the issue, leading to inconsistencies in maintenance practices across different locations.

Compliance with Safety Protocols the investigation highlighted a lapse in adherence to safety protocols regarding the failure to enforce the mandated speed restriction as outlined in TRST manuals. It was found that the required speed restriction, mandated by TRST manuals in designated areas prone to maintenance or operational issues, had not been fully implemented before the derailment event.

Massachusetts Material Research conducted a Failure Analysis of ALP Brake Disc Cap Screws and Other Components: Based on their analysis Car 3069 All eight cap screws from the failed brake disc for Car 3068 failed by fatigue. The failure location for all of them is at the interface between the engaged and non-engaged threads. This area is the highest stressed location in the assembly. The cracks always initiated at a thread root and then propagated by fatigue under cyclic loading.

The overall fracture morphology is that of a reverse bending and/or rotational bending condition. This fracture morphology is typical of fasteners which had insufficient initial clamping load to remain in position, allowing the screw to loosen during subsequent service. Loosening increases the amplitude of cyclic service loading, eventually initiating and propagating fatigue cracks in all other screws. Both the reverse and rotational bending types of fatigue is indicative of insufficient tightening of the Cap Screws during assembly.

All of the tested Cap Screws met the required and expected material properties for ASTM A574 Cap Screws and Drawing 4M-2041-3 submitted. We do not believe that any material deficiencies were present which would have contributed to the failure of the screws. No anomalies were noted in the analyzed lock washers and spacer rings, both used and new, which could have contributed any way to the subject failure. Limited analyses were performed on the wheel and brake disc; again, no significant anomalies were detected, which would anyway contribute to the failure. The similar cap screws analyzed in February 2020 for WAMTA by Massachusetts Material Research displayed the same failure mode of the cap screws. These cap screws also met the drawing and specification requirements.

Chronological Event Timeline

A review of ARS playback, i.e., phone and radio communications, revealed the following timeline:

Time	Description
September 29, 2023	
10:43:43 hours	Train ID 308: Departed National Airport Station. [SPOTS]
10:45:38 hours	Train ID 406: Departed National Airport Station. [SPOTS]
10:45:57 hours	Train ID 406: Attempted to contact ROCC. Radio RTC: Making an announcement. Train ID 406: Contacted ROCC and reported that the lead car was derailed. Radio RTC: Requested the location of a Rail Supervisor. [Radio Ops 3]
10:46:42 hours	Button RTC: Notified the AOM. [Phone Ops 3]
10:47:05 hours	Radio RTC: Instructed Train ID 403 and Train ID 305 to hold. Train ID 403: Acknowledged and repeated. Train ID 305: Acknowledged and repeated. [Radio Ops 3]
10:47:41 hours	Radio RTC: Instructed the Train Operator to make announcements and perform a ground walkaround. Train ID 406: Reported looking from the window and that the lead car was slumped down, no damage on the left or right side of the train, the emergency brake was applied. [Radio Ops 3]
10:48:15 hours	Radio RTC: Instructed Train ID 407 to hold at Crystal City Station. Train ID 407: Acknowledged and repeated. [Radio Ops 3]
10:48:42 hours	Radio RTC: Advised Train ID 407 that they would be the rescue train, continue to National Airport Station, and offload the train. Train ID 407: Acknowledged and repeated. [Radio Ops 3]
10:48:42 – 12:41:00 hours	Train service between National Airport Station and Potomac Yard Station was suspended. [Radio Ops 3]
10:48:45 hours	ROCC MTPD Liaison: Reported Train 406 derailed near National Airport Station on track 2. [Radio MTPD 1X]

Drafted By: SAFE 711 – 10/25/2023
Reviewed By: SAFE 71 – 10/27/2023
Approved By: SAFE 707 – 12/28/2023

Time	Description
10:49:10 hours	MAC: Notified OEP personnel of the event and instructed them to respond to National Airport Station. [Radio SAFE MAC]
10:49:12 hours	Train ID 406: Advised that the train was keyed down and ready to perform a ground walkaround. Radio RTC: Acknowledged and instructed to perform a ground walkaround. [Radio Ops 3]
10:49:25 hours	CMNT Road Mechanic: Reported on location at National Airport Station. Radio RTC: Instructed to board the train on track 2. [Radio Ops 3]
10:49:40 hours	Rail Supervisor #1: Reported located at National Airport Station. Radio RTC: Instructed to board the train on track 2. [Radio Ops 3]
10:49:53 hours	Train ID 406: Reported that the lead car was derailed. Radio RTC: Acknowledged. Request a CM location. Train ID 406: Advised able to see the CM on track 1 at 383+00. Radio RTC: Acknowledged. Instructed to board the train, escort the customers to the trailing car, and provide a head count. [Radio Ops 3]
10:51:11 hours	ROIC Controller: Notified the Incident Emergency Center for National Airport and requested a response from the Metropolitan Washington Airport Authority Fire & Police Department. [Phone ROIC Lead]
10:51:55 hours	Train ID 406: Reported back aboard the train. Radio RTC: Acknowledged. Inquired if trains were able to move on track 1. Train ID 406: Confirmed that trains could move on track 1. [Radio Ops 3]
10:53:42 hours	MTPD Officer #1: Reported located at National Airport Station. [Radio MTPD 1X]
10:54:37 hours	Train ID 308 arrived at Huntington Station. [SPOTS]
10:56:51 hours	Radio RTC: Granted foul time to the Road Mechanic and Rail Supervisor to enter the roadway, walk, and perform a track inspection. [Radio Ops 3]
10:56:53 hours	MTPD Officer #1: Established the Incident Command Post at the National Airport Station Platform. [Radio MTPD 1X]
10:58:23 hours	MTPD Dispatcher: Instructed to move transmissions to MTPD 2X. [Radio MTPD 1X]
10:58:24 hours	MWAA Fire & Police Dispatcher: Notified of the derailment and dispatched rescue units. [Radio Open MHZ]
10:58:48 hours	Incident Commander: Requested MWAA Fire Department to respond. ROCC MTPD Liaison: Advised that the Fire Department was en route. Incident Commander: Acknowledged. [Radio MTPD 2X]
10:58:09 hours	Train ID 406: Reported located at the rear of the train with 50 customers. [Radio Ops 3]
11:02:00 hours	Rail Supervisor #1: Advised that sending the rescue train on track 2 was safe. Radio RTC: Acknowledged. [Radio Ops 3]
11:02:30 hours	MWAA Fire and Rescue Department reported on the scene. The command is located on National Airport Avenue between garages 1 and 2. [Open MHZ]
11:03:00 hours	Rail Supervisor #2, ATC, and ERT reported being at the National Airport Station. [Radio Ops 3]

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Time	Description
11:04:00 hours	Radio RTC: Inquired if the customers required medical assistance. Train Operator: Responded, no medical assistance was requested. [Radio Ops 3]
11:07:00 hours	MTPD Officer #1 Reported that the Arlington County Fire Department was on the scene. [Radio MTPD 2X]
11:10:20 hours	MTPD Officer #1: Reported MWAA was on the scene. [Radio MTPD 2X]
11:13:00 hours	Radio RTC: Instructed Rail Supervisor #2 to board Train ID 407 with MTPD, MWAA, and ERT and use close-in procedures to approach Train ID 406. Rail Supervisor #2: Acknowledged and repeated. [Radio Ops 3]
11:14:00 hours	Rail Supervisor #1: Reported that the lead car was derailed and damage to the inside of the running rail. Radio RTC: Acknowledged. [Radio Ops 3]
11:14:32 hours	MTPD Officer #2: Reported the Unified Command Post on the platform. [Radio MTPD 2X]
11:16:00 hours	Radio RTC: Granted permission to ATC to enter the roadway and clamp switch 7 in the normal position. [Radio Ops 3]
11:23:00 hours	Radio RTC: Granted a permissive block to Train ID 407 to close in on Train ID 406. [Radio Ops 3]
11:30:00 hours	Rail Supervisor #1 Reported that the customers began boarding the rescue train. [Radio Ops 3]
11:34:00 hours	Rail Supervisor #1: Reported the customers aboard the rescue train. [Radio Ops 3]
11:37:00 hours	Train ID 407 returned to National Airport Station, and the customers offloaded the train. [CCTV]
11:37:30 hours	Third rail power was de-energized [AIMS]
11:39:55 hours	MWAA: Advised departing the Unified Command Post. [Open MHZ]
11:45:47 hours	MTPD Officer #2: Reported the Command Post was turned over to OEP. Advised that the command post moved the mezzanine entrance of the National Airport Station. [Radio MTPD 2X]
11:55:39 hours	MAC: Advised OEP will assume command. The Command Post was located at the mezzanine level (south side), and the staging area was on the platform level. [Radio MTPD 2X]
12:00:24 hours	MAC: Advised that all National Airport incident communications switch to Radio Ops 6. [Radio MTPD 2X]
12:02:51 hours	Incident Commander: Contacted the MAC to request third rail power be de-energized from the platform to the incident train on track 2. [Ops. 6]
12:21:00 hours	Radio RTC: Instructed Train ID 301 to conduct a track inspection between National Airport Station and Potomac Yard Station on track 1. [Radio Ops 3]
12:38:00 hours	Train ID 301 (701): Reported a good track inspection. [Radio Ops 3]
12:41:00 hours	Single tracking began between National Airport Station and Potomac Yard Station on track 1. [Radio Ops 3]
13:17:00 hours	The bus bridge was terminated. [Radio Ops 6]
13:45:00 hours	MAC: Informed Incident Command that third rail power was restored. [Radio Ops 6]

Drafted By: SAFE 711 – 10/25/2023
Reviewed By: SAFE 71 – 10/27/2023
Approved By: SAFE 707 – 12/28/2023

Time	Description
14:02:00 hours	Incident Command: Reported data downloads were completed, and third rail power was requested to be de-energized between the National Airport and the derailment site. [Radio Ops 6]
14:40:00 hours	WMSC granted an event scene release.
15:05:00 hours	Incident Command was terminated, and a Hot Wash was conducted.
15:35:00 hours	OEP turned the scene over to TRST/ERT.
16:09:00 hours	CMNT personnel were dispatched to Huntington Station to inspect Train ID 308. [Radio Ops 3]
16:30:00 hours	CMNT personnel reported that a brake disc had detached from rail car 3069 [Radio Ops 3]
16:40:00 hours	ERT turned the scene over to RTRA.
16:42:47 hours	Train ID 308 was dispatched to Alexandria Yard. [SPOTS]
September 30, 2023	
00:11:00 hours	Train ID 406 was re-railed, and further inspection of the train and track was conducted. [MAC Phone]
02:24:00 hours	Third rail power was restored on track 2. [AIMS]
03:24:00 hours	Train ID 406 was dispatched to Alexandria Yard for post-incident inspection. [Radio Ops 3]
03:30:00 hours	Third rail power was de-energized for continuing track inspections and repairs. [AIMS]
October 3, 2023	
04:16:00 hours	All repairs were completed, and the third rail power was energized on track 2.

Note: Times above may vary from other systems' timelines based on clock settings.

Advanced Information Management System (AIMS)

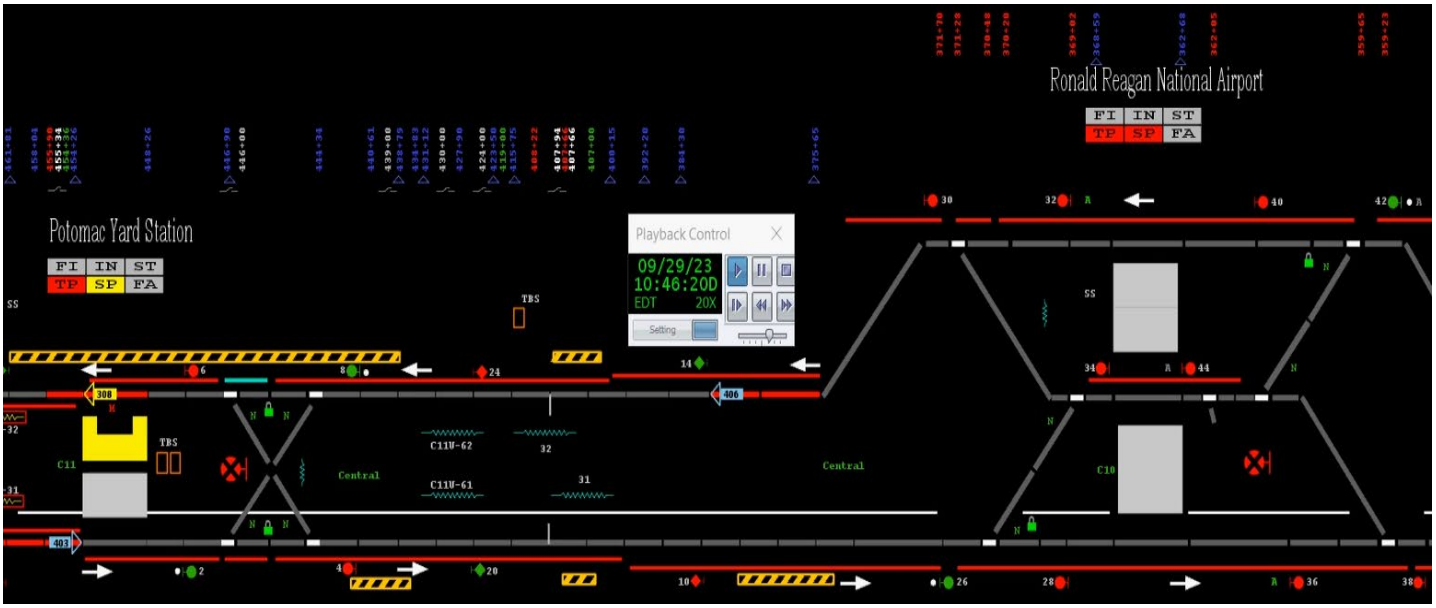


Figure 1 - AIMS Playback of Train ID 406 located at CM C2 384+00 at 10:46 hours.

Office of Car Engineering Vehicles (CENV)
Adopted from CMOR IIT report with minor formatting and grammatical edits:

Timeline of events ID 406 09/29/2023—DERAILMENT BETWEEN C10-2 to C11-2

ER EMM Review local time:

1) At 10:45:16, Train ID 406 was heading to the Potomac Yard station, regulated speed 40MPH, MC in P5.
2) At 10:45:40, Actual Vehicle Speed was approximately 38.44MPH, picked up F1 Marker, 1024.32 feet after leaving National—MC in coast—then B1-B3 @10:45:41
3) At 10:45:42.06, Actual Vehicle Speed was 35.48MPH, Master Controller Position in Emergency (1108 ft after leaving National)—and ID 406 experienced slide.
4) At 10:45:42.820, the Vehicle speed (29.9MPH) EM TL went low, and the brake pipe dumped.
5) At 10:45:43.580, Vehicle speed (20.67MPH) EM TL remained low as brakes were released to correct the slide.
6) At 10:45:46.830: Vehicle speed (8.638MPH) brake reapplied.
7) At 10:45:47.09, Vehicle speed (7.343MPH) brakes were rereleased to correct slide.
8) At 10:45:52.560, Vehicle speed (2.283MPH) brakes were reapplied, and the slide was finally corrected.
9) At 10:45:53.320, MC Dead Man Handle was de-energized—Vehicle speed (0.37MPH)
10) At 10:45:54.08, Train ID 406 stopped 12 seconds after the emergency brake request—and 1230 feet after leaving the National Airport.

The VMDS and equipment logs have been reviewed as well—and nothing wrong was found in the train function that could have contributed to this derailment other than the brake disc seen in the video below at 10:46:08, which coincides with the time in step 3) where EM brake application was requested from ID 406.

According to the video, ID 406 stopped at 10:46:20—26 seconds ahead of local time in step 10).”

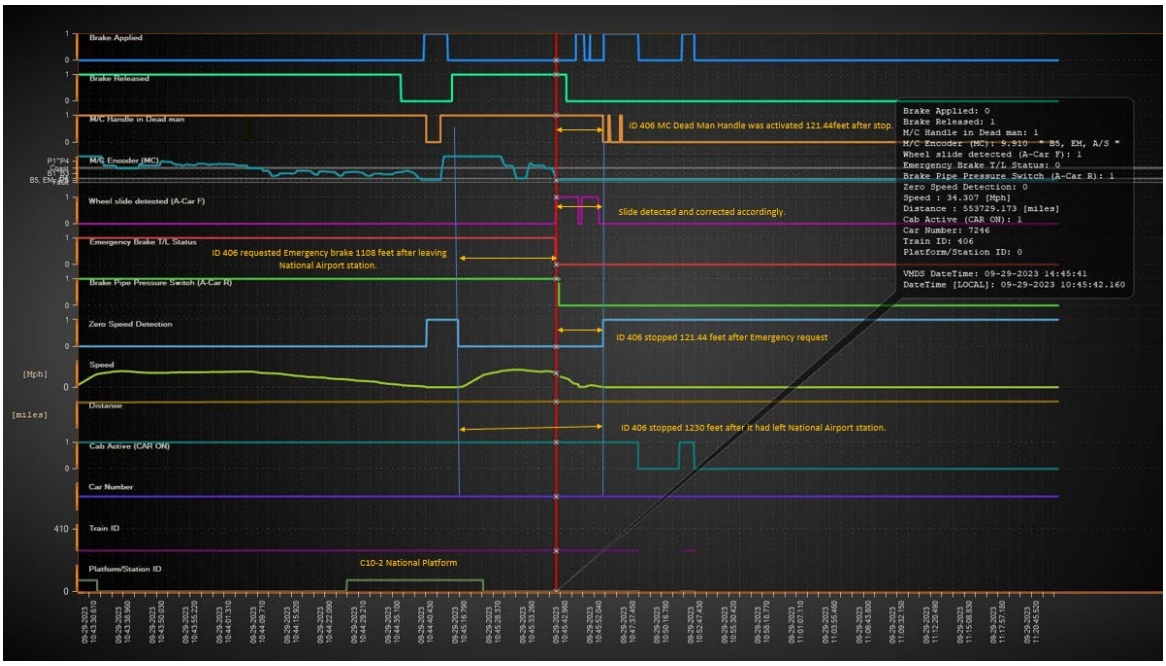


Figure 2 - Event Recorder data visualization.

The VMDS Time listed within the Event Recorder is approximately 4 hours faster than Local time and 26 seconds behind the video.

As part of the SBB 649 Rev1 fleetwide inspection, the following tests will be ordered for the bolts recovered from the 3069 brake disc, the "failed" bolts retrieved from the fleet inspection, as well as the exemplar bolts:

1) Mechanical Properties
2) Chemical Properties
3) Evaluation of coating type and thickness
4) Evaluation of fracture surface morphology with determination of fracture mechanism
5) Metallographic cross-section and evaluation of threads
6) Hydrogen embrittlement (exemplar bolts only)
7) Perform wedge test per ASTM A574
8) Spring washer chemical/mechanical analysis (exemplar washers)

The following analysis will be conducted on the Brake Disc, Spacer Ring, and Wheel #4 from car 3069:

Wheel:
1) Measure wheel hub thread depth and diameters for signs of deformation.
2) Inspect the wheel hub thread for deformation.
3) Conduct a hardness test of the wheel hub.
4) Measure the tensile strength of the wheel hub portion of the wheel.
5) Conduct analysis of chemical properties.

Spacer Ring:
1) Conduct geometric/dimensional analysis of the front/rear of bolt holes and width.
2) Evaluate surfaces under washer contact areas and evaluate wear.

3) Chemical/Mechanical property analysis.

Brake Disc:
1) Visual inspection of mating surfaces and mounting holes.
2) Measure the hold diameter (circumferential and radial) on the inboard side of the disc.

7246									
B2B					JOURNAL BEARING				
	1	2	3	4		1	2	3	4
09/10/2022	53.298	53.294	53.317	53.291		0	0	0	0
9/20/2022	53.312	53.305	53.318	53.298	9/20/2022	0	0	0	0
9/28/2022	53.31	53.3	53.324	53.298	9/28/2022	0	0	0	0
10/4/2022	53.313	53.298	53.321	53.296	10/4/2022	0	0	0	0
10/11/2022	53.308	53.3	53.325	53.294	10/11/2022	0	0	0	0
10/20/2022	53.302	53.304	53.313	53.298	10/20/2022	0	0	0	0
10/29/2022	53.305	53.302	53.32	53.294	10/29/2022	0	0	0	0
11/1/2022	53.292	53.296	53.314	53.291	11/1/2022	0	0	0	0
11/6/2022	53.303	53.294	53.319	53.293	11/6/2022	0	0	0	0
11/11/2022	53.312	53.305	53.315	53.294	11/11/2022	0	0	0	0
11/16/2022	53.292	53.278	53.312	53.276	11/16/2022	0	0	0	0
11/21/2022	53.303	53.298	53.311	53.289	11/21/2022	0	0	0	0
11/26/2022	53.297	53.292	53.313	53.293	11/26/2022	0	0	0	0
12/1/2022	53.318	53.307	53.328	53.307	12/1/2022	0	0	0	0
12/6/2022	53.305	53.292	53.32	53.292	12/6/2022	0	0	0	0
12/11/2022	53.294	53.293	53.312	53.283	12/11/2022	0	0	0	0
12/16/2022	53.299	53.293	53.313	53.288	12/16/2022	0	0	0	0
12/21/2022	53.304	53.301	53.319	53.295	12/21/2022	0	0	0	0
12/26/2022	53.293	53.288	53.312	53.287	12/26/2022	0	0	0	0
12/31/2022	53.313	53.305	53.327	53.306	12/31/2022	0	0	0	0
1/5/2023	53.308	53.299	53.324	53.297	1/5/2023	0	0	0	0
1/10/2023	53.302	53.297	53.32	53.295	1/10/2023	0	0	0	0
1/15/2023	53.289	53.293	53.31	53.288	1/15/2023	0	0	0	0
1/20/2023	53.296	53.295	53.319	53.291	1/20/2023	0	0	0	0
1/25/2023	53.306	53.314	53.322	53.304	1/25/2023	0	0	0	0
1/30/2023	53.317	53.312	53.333	53.304	1/30/2023	0	0	0	0
2/7/2023	53.313	53.314	53.326	53.313	2/7/2023	0	0	0	0
2/15/2023	53.302	53.295	53.319	53.291	2/15/2023	0	0	0	0
2/23/2023	53.304	53.297	53.323	53.296	2/23/2023	0	0	0	0
3/3/2023	53.311	53.307	53.329	53.297	3/3/2023	0	0	0	0
3/10/2023	53.305	53.296	53.322	53.303	3/10/2023	0	0	0	0
3/18/2023	53.301	53.303	53.319	53.297	3/18/2023	0	0	0	0
3/26/2023	53.302	53.293	53.318	53.291	3/26/2023	0	0	0	0
4/3/2023	53.313	53.308	53.324	53.297	4/3/2023	0	0	0	0
4/11/2023	53.296	53.297	53.316	53.291	4/11/2023	0	0	0	0
4/19/2023	53.303	53.297	53.314	53.293	4/19/2023	0	0	0	0
5/5/2023	53.298	53.291	53.316	53.294	5/5/2023	0	0	0	0
5/21/2023	53.304	53.3	53.32	53.3	5/21/2023	0	0	0	0
6/6/2023	53.275	53.285	53.302	53.281	6/6/2023	0	0	0	0
7/6/2023	53.279	53.27	53.296	53.273	7/6/2023	0	0	0	0
8/3/2023	53.301	53.291	53.318	53.284	8/3/2023	0	0	0	0
8/22/2023	53.312	53.3	53.327	53.294	8/22/2023	0	0	0	0
9/1/2023	53.283	53.277	53.31	53.279	9/1/2023	0	0	0	0

Figure 3 - Back-to-Back measurement history for railcar 7246

Office of Systems Maintenance, Office of Radio Communications (COMR)

The Office of Radio Communications conducted comprehensive radio checks (TX/RX) between National Airport and King Street Stations on tracks one and two. No trouble was found.

Track and Structures (TRST)

The last completed track inspections were on the dates below.

September 06, 2023
September 08, 2023
September 15, 2023
September 20, 2023
September 22, 2023
September 27, 2023
September 29, 2023, the walk was not completed, but the derailment area was inspected.

On September 28, 2023, Track personnel tightened fasteners from C2 381+00-371+00 on the left rail (1000 ft), and tracks were deemed revenue ready.

Also on the night of September 28, 2023, a Track Maintenance Crew conducted a vertical rail stressing equipment (VERSE) test from C2 382+00-384+00, and tracks were deemed revenue-ready.

TRST – Post Derailment Gauge Check

CM	GAUGE Requirements
377+60	56 11/16"
377+80	56 3/4"
378+45	56 7/8"
378+80	56 7/8"
379+30	57"
379+50	56 7/8"
380+20	57"
380+70	56 3/4"
381+30	57 1/16"
381+40	57 5/16"
381+50	57 3/8"
381+70	57 1/4"
382+10	57"
382+70	57"

*Note: These gauges fluctuate within the derailment segment and are not 100% valid because of the damage to the studs, clips, and all other hardware that hold the rails down. Per the TRST 1000-Track Inspection & Safety Standards manual, gauge measurements between 55 7/8” and 57 ¼” are considered a “Green” level and are permitted for Normal track speeds.

Interview and Written Statement Findings
As part of the investigation launched into the event, SAFE interviewed two people. The interviews identified the following key findings associated with this event. Findings detailed below include reported information from involved personnel and may conflict with other data sources contained in the report.

RTRA

Train Operator (Train ID 308)

- Train ID 308 Operator was traveling on track 2 en route to the Huntington Station.
- Train Operator indicated that the day was normal, and trains were running at regular schedule.
- The Train Operator heard the radio transmission regarding the derailment of Train ID 406 and realized that said train was traveling behind Train ID 308.
- Train ID 308 Operator became nervous and concerned about the event.
- Train ID 308 arrived at Huntington Station, and the consist was removed from service.

Train Operator (Train ID 406)

- Train ID 406 was traveling on track 2, approached the National Airport, and served the station.
- This was their last trip en route to Franconia Springfield.
- Train ID 406 departed the National Airport Station, and once they approached a curve, the train derailed.
- Emergency stopping procedures were initiated.
- Train ID 406 came to a complete stop.
- Train Operator notified the ROCC of the situation.
- Train Operator inspected the consist and reported their observations.
- The Train Operator announced to the passengers and walked customers to the end cars.
- Conducted a count of the passengers and waited for a rescue train to arrive.

Weather

On September 29, 2023, at the time of the incident, NOAA recorded the temperature as 69.8°F, with clear skies, winds of nine mph, and 73.15% humidity. The weather did not contribute to this incident (Weather source: NOAA) – Location: Arlington, VA.

Related Rules and Procedures

SOP # 9 Train Derailment – Mainline And Yard
Incident Management Framework

Human Factors

Fatigue

Signs and Symptoms of Fatigue

Conditions were evaluated at the time of the incident to distinguish whether evidence of fatigue was present. Train ID 308 and 406 Operators reported feeling fully alert during the incident. Train

ID 308 and 406 reported experiencing no symptoms of fatigue in the time leading up to the incident.

Fatigue Risk

RTRA

Train Operator (Train ID 308)

The incident data was evaluated for fatigue risk factors for Train ID 308. Risk factors for fatigue were not present. Since fatigue evidence and risk factors were absent, the biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied.

Train Operator (Train ID 406)

The incident data was evaluated for fatigue risk factors for Train ID 406. Risk factors for fatigue were not present. Since fatigue evidence and risk factors were absent, the biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied.

Post-Incident Toxicology Testing

WMATA's Drug and Alcohol Program determined that the Train Operator of Train ID 406 complied with the Drug and Alcohol Policy and Testing Program 7.7.3/6.

Training and Work History

Train Operator (Train ID 406)

- Train Operator was hired by WMATA in November 2004.
- Train Operator certified as a Train Operator in September 2007.
- Train Operator's most recent certification was in October 2022. They received a Quality Level 1 ranking (highest).
- Train Operator has two safety violations within the last three years. Both occurred in 2021:
    - SOP 40 violation
    - Failure to perform safety stops.

Train Operator (Train ID 308)

- This Train Operator was assigned to the Alexandria Division.
- The Train Operator certified as a Train Operator in November 2014.
- The Train Operator's most recent recertification was in September 2023.

Findings

- 43 Customers were aboard Train ID 406 at the time of the derailment; no injuries were reported.
- Train ID 308 departed National Airport Station approximately three minutes before the derailment. Car 3069, the fifth car in the six-car consist, was found missing the #4 brake disc.
- Car 3068's right rear collector shoe was missing, and the front right collector shoe assembly was damaged by the #4 brake disc Car 3069.
- The broken collector shoe assembly was found in the Potomac Yard Station Interlocking.

Drafted By: SAFE 711 – 10/25/2023
Reviewed By: SAFE 71 – 10/27/2023
Approved By: SAFE 707 – 12/28/2023

- The brake disc came to rest against the left running rail and emergency guard rail on the opposite side of the third rail near CM C2 379+00.
- Two wheelsets on the lead car, 7246, derailed because of the collision with the brake disc.

Immediate Mitigation to Prevent Recurrence

- Train service was suspended at the National Airport Station.
- TRST conducted interlocking and track inspections between National Airport Station and Huntington Station.
- CMNT conducted a fleetwide Tightness Check of all ALP bolts installed on the 2K/3K fleet and all 2K/3K trucks, which was completed on October 5, 2023, in accordance with SBB 649.
- Several departments participated in under-car inspections, and SAFE provided oversight.
- Reviewed SBB, MSI, and PI manuals related to brake disc maintenance. Note that PI manuals have been updated to perform Torque Tightness check (similar to SBB-649)
- Reviewed 2012 investigation reports and CMOR / LTK reports.
- CENV will review the design of the brake assembly – disc, spacer, bolts.
- Reviewing industry standards.
- Components from the incident (4 bolts, spacer, disc) and failed bolts will be sent to labs for testing. Exemplar bolts/washer as well.
- Chemical/mechanical property analysis (tensile strength, hardness, elongation, brittleness) of the brake component to be conducted.

Probable Cause Statement

The probable cause of the Derailment event at National Airport Station on Friday, September 29, 2023, a hardware failure occurred on rail car 3069, specifically with the brake system. The #4 brake disc detached from the hub assembly, resulting in it dislodging from the train and coming to rest within the gauge of the left running rail.

Contributing Factors were Maintenance Oversight where there was a failure to detect the loosening or potential failure of the brake disc attachment during routine maintenance checks. This failure in maintenance contributed to the detachment of the brake disc.

The Inspection Procedures had gaps and inadequacies in the inspection procedures related to the brake system, as the detached brake disc wasn't identified prior to the incident.

The Response Protocol while the response to the incident seemed well-coordinated, there could be areas of improvement in communication protocols or response procedures to ensure quicker identification and resolution of such incidents.

Additional Observations were damage to the lead car 7246 and associated components like the collector shoe assembly and primary power cable indicate the severity of the impact caused by the dislodged brake disc.

A Fleetwide Inspection following the incident, there was a fleetwide inspection of ALP bolts installed on the 2K/3K fleet, indicating a proactive approach to identifying potential issues across the fleet.

Recommended Corrective Actions

Corrective Action Code	Description	Responsible Party	Estimated Completion Date
111771_SAFE CAPS_CMNT _001	CMNT is to conduct a fleetwide Tightness Check of all ALP bolts installed on the 2K/3K fleet and all 2K/3K trucks.	CMNT	Completed
111771_SAFE CAPS_CMNT _002	Update PI manuals to include procedures for performing Torque Tightness checks	CMNT	Completed
111771_SAFE CAPS_CENV _001	CENV to review the design of the brake assembly – disc, spacer, bolts.	CENV	Completed
111771_SAFE CAPS_TRST_ 001	TRST is to perform repairs to 494 holes (drilled), replace 247 direct fixation, and re-gauge the area.	TRST	Completed
111771_SAFE CAPS_SAFE_ 001	SAFE to provide oversight while CMNT conducts a fleetwide Tightness Check of all ALP bolts installed on the 2K/3K fleet and all 2K/3K trucks.	SAFE	Completed

Appendices

Appendix A – Interview Summaries

The below narratives summarize the incident and represent the statements made by the involved individual. As such, times and details may present a conflict with the data contained in systems of record.

RTRA

Train Operator (Train ID 308)

The Train Operator is a WMATA employee with 22 years of service and 13 total years of experience as a Train Operator. The Train Operator holds a Roadway Worker Protection (RWP) Level 2 certification that expires in November 2023.

On the day of the event, Train ID 308 Operator was traveling on track 2 en route to the Huntington Station. Train Operator indicated that the day was normal, and trains were running on a regular schedule. The Train Operator stated that at 10:45 hours, they heard the radio transmission regarding the derailment of Train ID 408 and realized that said train was traveling behind Train ID 308. Train ID 308 Operator then stated they became nervous and concerned about the event. Once Train ID 308 arrived at Huntington Station, the consist was removed from service. Later that morning, the Train Operator learned more details about the event.

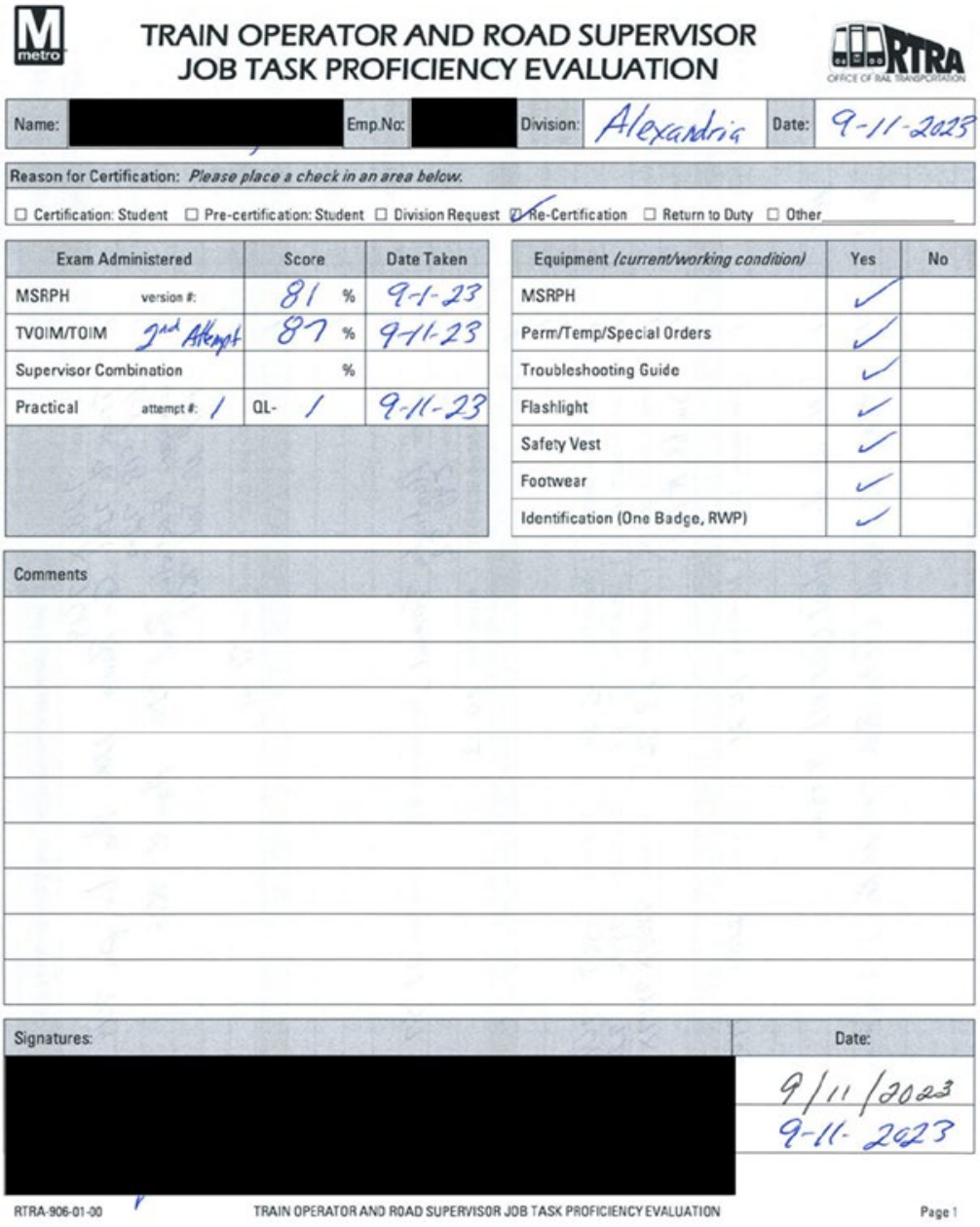
Train Operator (Train ID 406)

The Train Operator is a WMATA employee with 19 years of service and 8 total years of experience as a Train Operator. The Train Operator holds a Roadway Worker Protection (RWP) Level 2 certification that expires in January 2024.

On the day of the event, Train ID 406 was traveling on track 2, approached the National Airport, and served the station. Train Operator indicated it was their last trip en route to Franconia Springfield. Train ID 406 departed the National Airport Station, and once they approached a curve, the train derailed. Train Operator immediately initiated emergency stopping procedures. Train ID 406 stopped, and the Train Operator notified the ROCC of the situation. The ROCC instructed the Train Operator to inspect the consist and report their observations. The Train Operator also indicated that they made announcements to the passengers advising them of the emergency, walked customers to the end cars of the consist, conducted a count of the passengers, and waited for a rescue train to arrive.

Appendix B – Certifications

Train Operator (Train ID 308)



TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION

Name: [redacted] Emp.No: [redacted] Division: Alexandria Date: 9-11-2023

Reason for Certification: *Please place a check in an area below.*

☐ Certification: Student ☐ Pre-certification: Student ☐ Division Request ☑ Re-Certification ☐ Return to Duty ☐ Other

Exam Administered		Score	Date Taken
MSRPH	version #:	81 %	9-1-23
TVOIM/TOIM	2nd Attempt	87 %	9-11-23
Supervisor Combination		%	
Practical	attempt #: 1	QL- 1	9-11-23

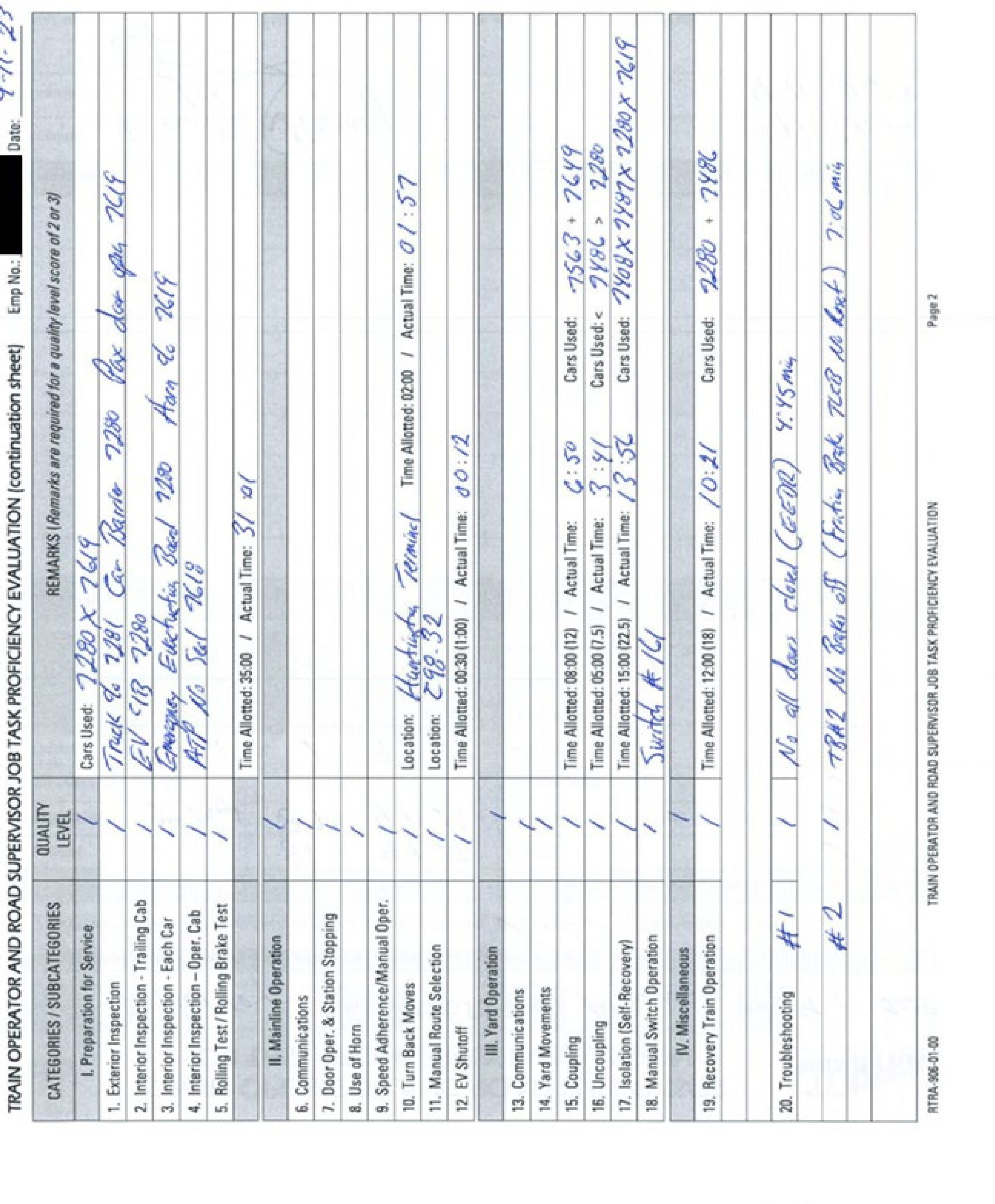
Equipment *(current/working condition)*	Yes	No
MSRPH	✓	
Perm/Temp/Special Orders	✓	
Troubleshooting Guide	✓	
Flashlight	✓	
Safety Vest	✓	
Footwear	✓	
Identification (One Badge, RWP)	✓	

Comments

Signatures:	Date:
[redacted]	9/11/2023 9-11-2023

RTRA-906-01-00 TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION Page 1

Figure 4 - Train Operator and Road Supervisor Job Task Proficiency Evaluation – Page 1 of 1

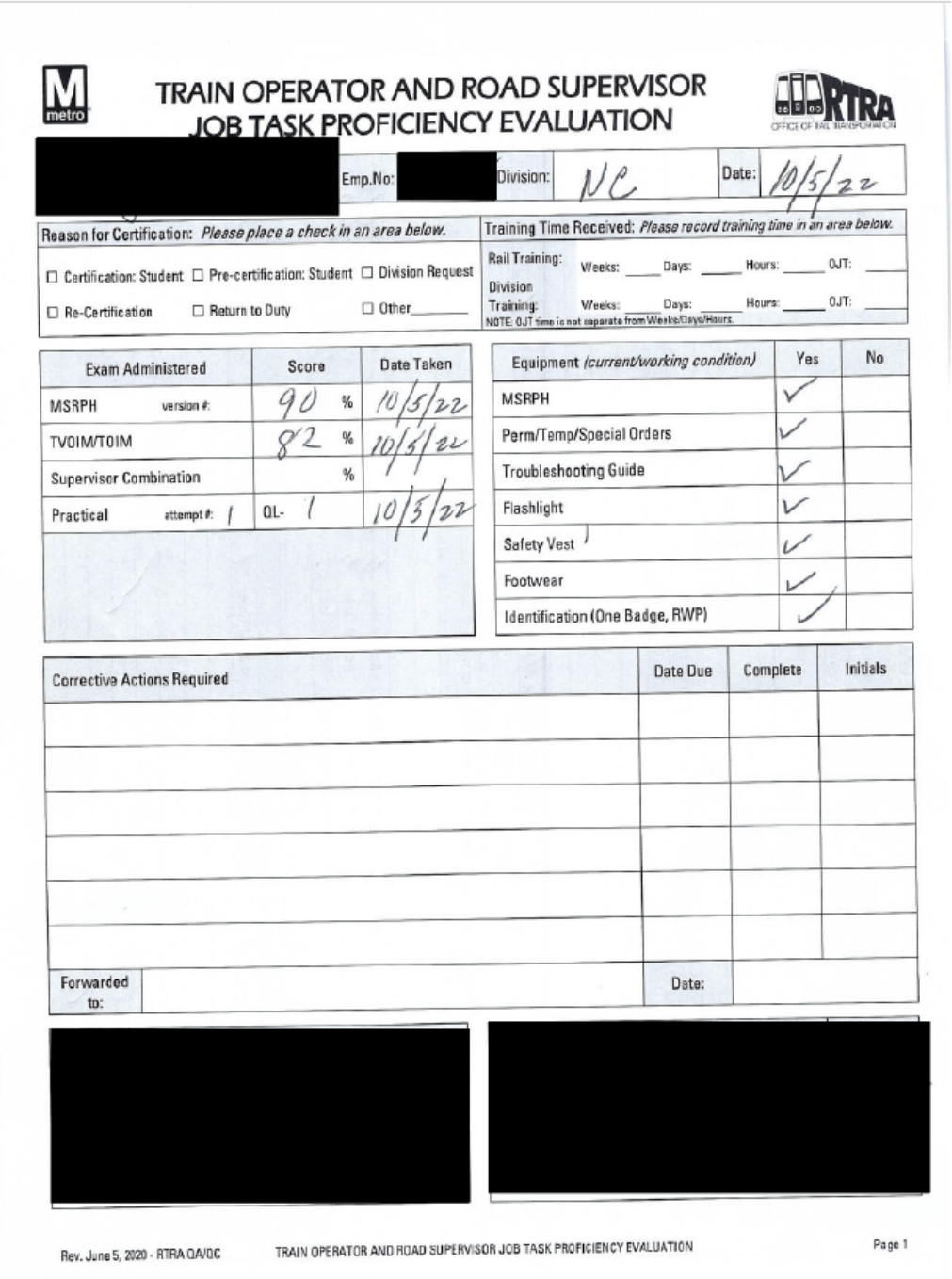


TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION (continuation sheet) Emp No.: [redacted] Date: 9-11-23

CATEGORIES / SUBCATEGORIES	QUALITY LEVEL	REMARKS (*Remarks are required for a quality level score of 2 or 3*)
I. Preparation for Service	/	Cars Used: 7280 X 7619
1. Exterior Inspection	/	Truck to 7281 Car Barrier 7280 Pax door open 7619
2. Interior Inspection - Trailing Cab	/	EV CB 7280
3. Interior Inspection - Each Car	/	Emergency Evacuation Board 7280 Horn to 7619
4. Interior Inspection – Oper. Cab	/	ATP No Seal 7618
5. Rolling Test / Rolling Brake Test	/	
		Time Allotted: 35:00 / Actual Time: 31 01
II. Mainline Operation	/	
6. Communications	/	
7. Door Oper. & Station Stopping	/	
8. Use of Horn	/	
9. Speed Adherence/Manual Oper.	/	
10. Turn Back Moves	/	Location: Huntington Terminal Time Allotted: 02:00 / Actual Time: 01:57
11. Manual Route Selection	/	Location: C98-32
12. EV Shutoff	/	Time Allotted: 00:30 (1:00) / Actual Time: 00:12
III. Yard Operation	/	
13. Communications	/	
14. Yard Movements	/	
15. Coupling	/	Time Allotted: 08:00 (12) / Actual Time: 6:50 Cars Used: 7563 + 7649
16. Uncoupling	/	Time Allotted: 05:00 (7.5) / Actual Time: 3:41 Cars Used: < 7486 > 7280
17. Isolation (Self-Recovery)	/	Time Allotted: 15:00 (22.5) / Actual Time: 13:56 Cars Used: 7408 X 7487 X 7280 X 7619
18. Manual Switch Operation	/	Switch #161
IV. Miscellaneous	/	
19. Recovery Train Operation	/	Time Allotted: 12:00 (18) / Actual Time: 10:21 Cars Used: 7280 + 7486
20. Troubleshooting #1	/	No all doors closed (GEDR) 4:45 min
#2	/	TB#2 No Brakes off (Friction Brake TCCB No Reset) 7:06 min

RTRA-906-01-00 TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION Page 2

Figure 5 - Train Operator and Road Supervisor Job Task Proficiency Evaluation – Page 2 of 2



TRAIN OPERATOR AND ROAD SUPERVISOR
JOB TASK PROFICIENCY EVALUATION

[redacted] Emp.No: [redacted] Division: NC Date: 10/5/22

Reason for Certification: *Please place a check in an area below.*

☐ Certification: Student ☐ Pre-certification: Student ☐ Division Request
☐ Re-Certification ☐ Return to Duty ☐ Other_____

Training Time Received: *Please record training time in an area below.*

Rail Training: Weeks: ____ Days: ____ Hours: ____ OJT: ____
Division Training: Weeks: ____ Days: ____ Hours: ____ OJT: ____
NOTE: OJT time is not separate from Weeks/Days/Hours.

Exam Administered	Score	Date Taken
MSRPH version #:	90 %	10/5/22
TVOIM/TOIM	82 %	10/5/22
Supervisor Combination	%	
Practical attempt #: 1	QL- 1	10/5/22

Equipment *(current/working condition)*	Yes	No
MSRPH	✓	
Perm/Temp/Special Orders	✓	
Troubleshooting Guide	✓	
Flashlight	✓	
Safety Vest	✓	
Footwear	✓	
Identification (One Badge, RWP)	✓	

Corrective Actions Required	Date Due	Complete	Initials

Forwarded to: Date:

[redacted] [redacted]

Rev. June 5, 2020 - RTRA QA/QC TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION Page 1

Figure 6 - Train Operator and Road Supervisor Job Task Proficiency Evaluation – Page 1 of 2

TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION (continuation sheet)

CATEGORIES / SUBCATEGORIES	QUALITY LEVEL	REMARKS (*Remarks are required for a quality level score of 2 or 3*) – ALL TIMES (*are in minutes*)
I. Preparation for Service	Q-1	Cars Used: 7258 7495 7400 7245
1. Exterior Inspection	1	
2. Interior Inspection - Trailing Cab	1	Brakes
3. Interior Inspection - Each Car	1	Horn Radio
4. Interior Inspection – Oper. Cab	1	Window B&O Book
5. Rolling Test / Rolling Brake Test	1	A/C Cab Paddle
		Time Allotted: 35:00 / Actual Time: :
II. Mainline Operation	Q-1	
6. Communications	1	
7. Door Oper. & Station Stopping	1	
8. Use of Horn	1	
9. Speed Adherence/Manual Oper.	1	
10. Turn Back Moves	1	Location: West Hyattsville Time Allotted: 02:00 / Actual Time: / :
11. Manual Route Selection	1	Location: N/A
12. EV Shutoff	1	Time Allotted: 00:30 (01:00) / Actual Time: : 38
III. Yard Operation	Q-1	
13. Communications	1	
14. Yard Movements	1	
15. Coupling	1	Time Allotted: 08:00 (12:00) / Actual Time: 6 :00 Cars Used: 7400 + 7495
16. Uncoupling	1	Time Allotted: 05:00 (07:30) / Actual Time: 3 :50 Cars Used: < 7435 > 7460
17. Isolation (Self-Recovery)	1	Time Allotted: 15:00 (22:30) / Actual Time: 12 : 44 Cars Used: 7258 7495 7400 7285
18. Manual Switch Operation	1	#1261
IV. Miscellaneous	Q-1	
19. Recovery Train Operation	1	Time Allotted: 12:00 (18:00) / Actual Time: 9 : 52 Cars Used: 7400 + 7495
20. Troubleshooting	1	
Door problems C7403		
Bell C7245		

Rev. June 5, 2020 - RTRA QA/OC TRAIN OPERATOR AND ROAD SUPERVISOR JOB TASK PROFICIENCY EVALUATION Page 2

Figure 7 - Train Operator and Road Supervisor Job Task Proficiency Evaluation – Page 2 of 2

Appendix C – Photographs

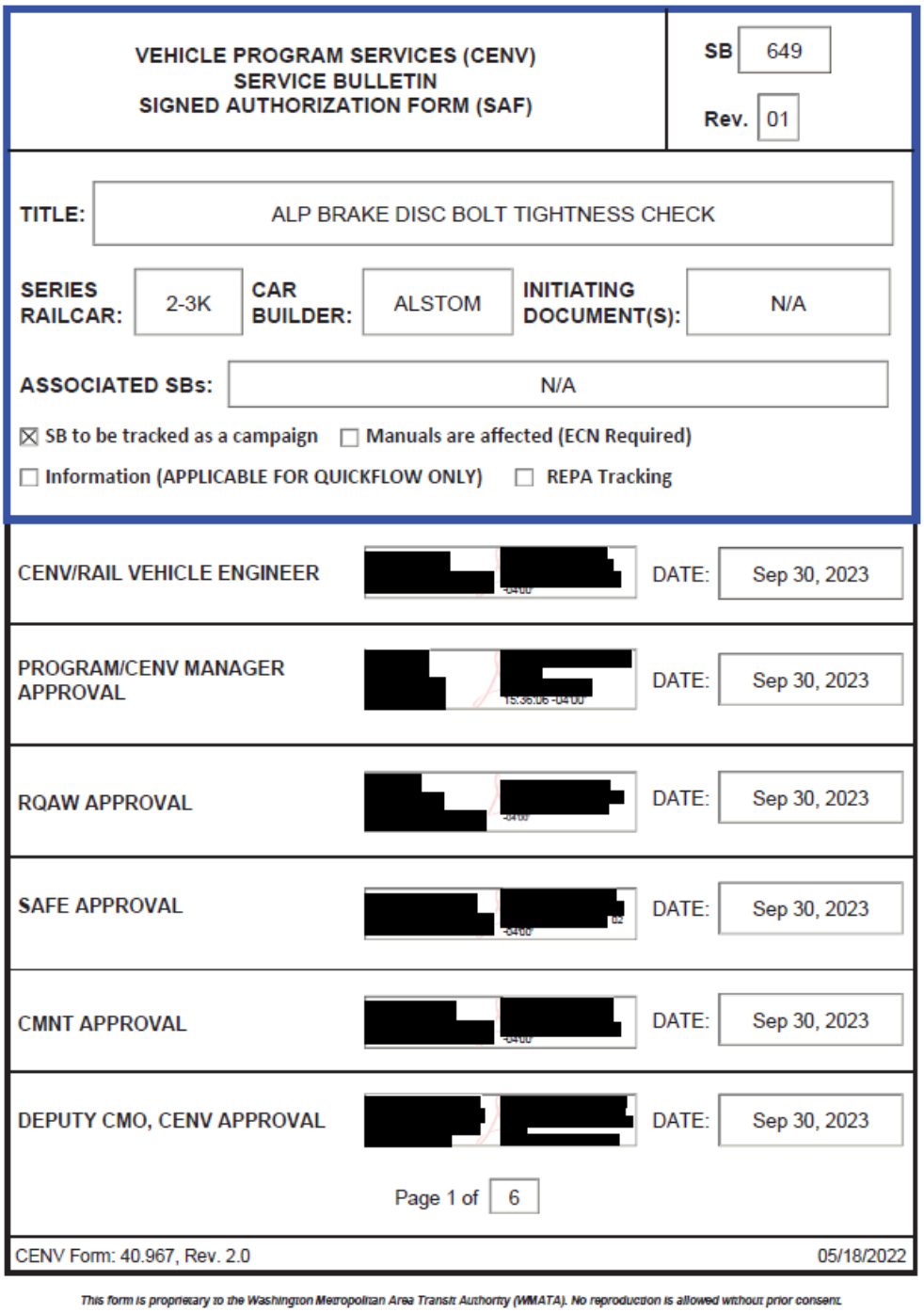
Image 1 – Collector Shoe parts and a missing brake disc from Train ID 308.

Image 2 - Missing Collector Shoe assembly from Train ID 308.

Image 3 - Derailment of Train ID 406 lead car

Image 4 - Brake Disc that separated from Train ID 308, lodged under Train ID 406.

Appendix D – CENV Service Bulletin (ALP Brake Disc Bolt Tightness Check)



VEHICLE PROGRAM SERVICES (CENV)
SERVICE BULLETIN
SIGNED AUTHORIZATION FORM (SAF)

SB 649

Rev. 01

TITLE: ALP BRAKE DISC BOLT TIGHTNESS CHECK

SERIES RAILCAR: 2-3K | CAR BUILDER: ALSTOM | INITIATING DOCUMENT(S): N/A

ASSOCIATED SBs: N/A

☒ SB to be tracked as a campaign ☐ Manuals are affected (ECN Required)

☐ Information (APPLICABLE FOR QUICKFLOW ONLY) ☐ REPA Tracking

CENV/RAIL VEHICLE ENGINEER	[redacted]	DATE: Sep 30, 2023
PROGRAM/CENV MANAGER APPROVAL	[redacted]	DATE: Sep 30, 2023
RQAW APPROVAL	[redacted]	DATE: Sep 30, 2023
SAFE APPROVAL	[redacted]	DATE: Sep 30, 2023
CMNT APPROVAL	[redacted]	DATE: Sep 30, 2023
DEPUTY CMO, CENV APPROVAL	[redacted]	DATE: Sep 30, 2023

Page 1 of 6

CENV Form: 40.967, Rev. 2.0 05/18/2022

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Document 1 – CENV Service Bulletin for 2k/3k Rail Cars – Page 1 of 6

VEHICLE PROGRAM SERVICES (CENV) SERVICE BULLETIN INSTRUCTIONS	SBB 649 Rev. 01

ALP BRAKE DISC BOLT TIGHTNESS CHECK

ALSTOM 2-3K SERIES RAILCARS

NOTICE:

1. This service bulletin supersedes and obsoletes SBB 649, Rev. 00.
2. This revision includes the following updates:
   - Added process for estimating the torque of failed bolts.
   - Added instructional not to save, label, and send failed bolts to CENV.
   - Provided additional clarification for creation of W/Os.
   - Addition of Job Plan number MSI180246.

1.0 PURPOSE

This Service Bulletin requests CMNT to conduct a one-time fleetwide Tightness Check of all ALP bolts installed on the 2K3K fleet and all 2K3K trucks.

This procedure was designed to identify the following:

- Bolts that were never fully tightened.
- Bolts that have failed by breaking and/or yielding.
- Over-torqued bolts that have significantly stretched or broken.

2.0 BACKGROUND

On September 29, 2023, a disc separated from 3069 which caused the lead car (7246) of the following train to derail near Ronald Reagan Washington National Airport.

The torque for installing ALP bolts is 70 ft-lbs wet; this Service Bulletin will be testing bolts using a lower torque of 60 ft-lbs.

Document 2 - CENV Service Bulletin for 2k/3k Rail Cars – Page 2 of 6

VEHICLE PROGRAM SERVICES (CENV) SERVICE BULLETIN INSTRUCTIONS	SBB 649 Rev. 01

ALP BRAKE DISC BOLT TIGHTNESS CHECK

ALSTOM 2-3K SERIES RAILCARS

3.0 PROCEDURE

3.1 Procedural Steps

3.1.1 Make a new and noticeable white mark under the highest ALP bolt on the first disc to be checked. This white mark will identify the first bolt to be checked (see Figure 1).

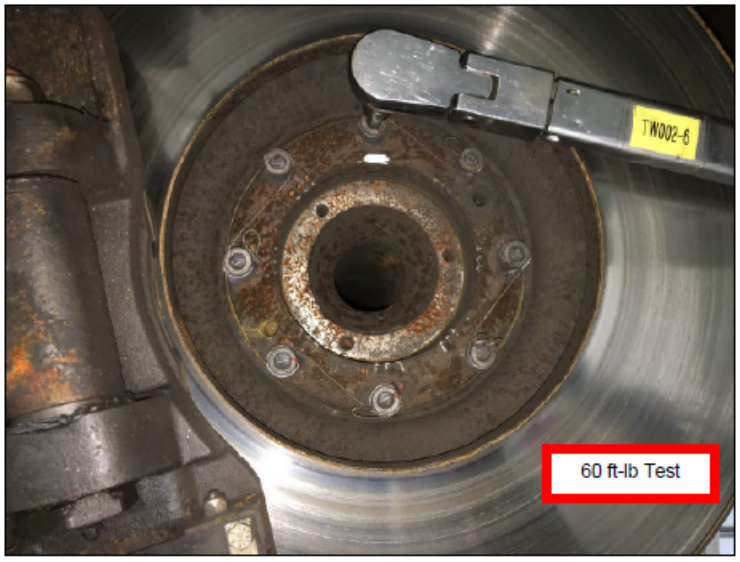

Figure 1. Torque wrench set-up with white mark under the highest bolt, which marks it as the first bolt to be checked, then progress in a clockwise direction.

3.1.2 Without removing the safety wire, apply a tightening torque of 60 ft-lbs. If any bolt turns, then all 8 bolts in this disc must be replaced with new ALP bolts per **MSI 180246 Rev. 01 (2-3K Instruction And Replacement of ALP Brake Discs Hub-to-Wheel Mounting Hardware)** (See Attachment A).

Uploaded to Document Control on 09/30/2023

Document 3 - CENV Service Bulletin for 2k/3k Rail Cars – Page 3 of 6

VEHICLE PROGRAM SERVICES (CENV) SERVICE BULLETIN INSTRUCTIONS	SBB 649 Rev. 01

ALP BRAKE DISC BOLT TIGHTNESS CHECK

ALSTOM 2-3K SERIES RAILCARS

Notice: MSI 180246 Rev. 01 (2-3K Instruction And Replacement of ALP Brake Discs Hub-to-Wheel Mounting Hardware)
(See Attachment A) The disc must be temporarily removed, and the mating surfaces must be cleaned as part of the process of replacing the bolts for the disc.

Important:

- **For any and all failed bolts,** Estimate the actual torque of the failed bolt by setting the torque wrench to 20 ft-lbs then attempt to tighten/turn the bolt. Repeat the process by increasing the torque setting by 5 ft-lbs (i.e. 25 ft-lbs, 30 ft-lbs etc.) until the bolt tightens/turns. Record this second torque on the data sheet and the CM work order.
- **Save all bolts that failed;** label and return the failed bolts to CENV in Greenbelt. The passing bolts on the same disc can be properly discarded.

3.1.3 Proceed to the next bolt, in a clockwise direction, and repeat the previous step until all 8 ALP bolts are checked on this disc. (This clockwise process has a starting point, and it creates a standard process that is less likely to miss bolts.)

3.1.4 Proceed to the next disc in a clockwise direction around the married pair and repeat the previous steps until all 128 ALP bolts on the married pair have been checked for tightness (8 bolts x 16 discs = 128 bolts).

3.1.5 If a loose bolt is detected CMNT is to open a CM Work Order against the rail car for each disc that has a discrepancy using Job Plan # MSI180246.

3.1.6 Record car numbers and discrepancies with Wheel #; write "None" if none. Use the ALP Disc Bolt Tightness Check Data Sheet, which is on the following page.

Uploaded to Document Control on 09/30/2023

Document 4 - CENV Service Bulletin for 2k/3k Rail Cars – Page 4 of 6

VEHICLE PROGRAM SERVICES (CENV) SERVICE BULLETIN INSTRUCTIONS	SBB 649 Rev. 01
ALP BRAKE DISC BOLT TIGHTNESS CHECK ALSTOM 2-3K SERIES RAILCARS	

ALP Disc Bolt Tightness Check Data Sheet							
Name:		Employee ID:		Shop:		Date:	
Car #	Discrepancies. Write "None" If None. (Include Wheel # As Required)						

CENV Form: 40.968, Rev. 0 Page 5 of 6 09/08/2020

Uploaded to Document Control on 09/30/2023

Document 5 - CENV Service Bulletin for 2k/3k Rail Cars – Page 5 of 6

VEHICLE PROGRAM SERVICES (CENV) SERVICE BULLETIN INSTRUCTIONS	SBB 649 Rev. 01
ALP BRAKE DISC BOLT TIGHTNESS CHECK ALSTOM 2-3K SERIES RAILCARS	

4.0 ATTACHMENTS

4.1 Attachment 'A'

Attachment A - MSI 180246 (Rev. 01)

Document 6 - CENV Service Bulletin for 2k/3k Rail Cars – Page 6 of 6

Appendix E – Track Engineering Report

M E M O R A N D U M

SUBJECT: C10 Incident and Findings DATE: October 10, 2023

[redacted]

INTRODUCTION

On the morning of September 29, 2023, at approximately 10:45 a.m., a Blue-Line revenue service train leaving National Airport (C10) and heading towards Potomac Yard (C11) on the outbound track (Track 2) derailed while traversing a right-hand curve on the C10 aerial structure (Figure 1).

The approximate area of impact occurred on the C-Line Curve #3 CM 379+00 TO CM 383+00 (approx. 400-ft total length)

Track Engineering staff arrived on the scene at approximately 11:30 a.m. after being notified to conduct and support the discipline-specific incident investigation.

The lead car (#7246) of the eight-car consist experienced a partial derailment; the lead axle of the car derailed. The left wheel dropped outside the field-side of the track, while the right wheel fell inside the track gauge (Figures 6 & 7 and Diagram 1).

Damage was observed to many track components, including broken rail fasteners, broken fastener studs, dislodged/broken e-clips, and strikes to the Emergency Guard Rail,

Washington Metropolitan Area Transit Authority

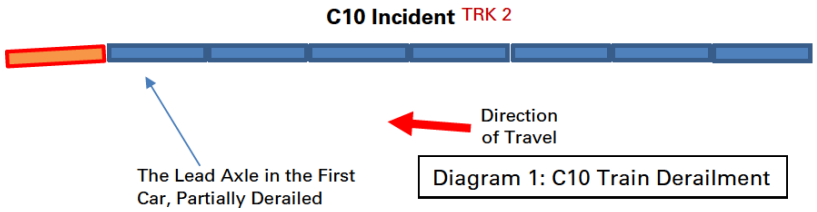

Diagram 1: C10 Train Derailment

Document 7 - Track Engineering Report and Photos - Page 1 of 12

C10 Derailment Incident & Findings

PRIOR TO DERAILMENT

On this track portion, the fastening system consists of SW-31 fasteners on Direct Fixation (DF) track. Continuous grout pads are the foundation for all fasteners and emergency guard rails on the gauge side of both left and right rails.

An inspection of the area (C-Line Curve #3) prior to the derailment was conducted by track engineering and track inspectors. Based on information gathered from defect tracking software like Maximo and Optram, three fastener-related defects were reported between the months of May through July 2023. Running rail spalling was also reported in the area in March 2023. All these defects had a severity color (rating) of green. On August 24, 2023, Track Engineering conducted an inspection within this curve with no significant defects reported; it was noted during the inspection that the area was mostly torqued with a small number of loose nuts/washers on the fasteners. On September 26, 2023, ENSCO's geometry vehicle took measurements of the area and reported a wide gauge with yellow severity (maximum 57.4"). According to the TRST Table 106.2B, yellow severity equals a medium speed restriction. August VTI data in this area only reported axle vertical hits at Switch #7. (Not near the derailment area)

According to the C99 morning report (See the complete report attached below). On September 29, 2023 (early morning, hours before the derailment), night shift track maintenance worked in this curve, performing routine torque maintenance from C2 381+00 – 371+00. Also, another track maintenance crew was in the vicinity performing VERSE testing on both rails a few feet outside the curve (C2 382+00 - 384+00). We do not believe maintenance work that night contributed to the derailment.

09-28-23.docx

AFTER DERAILMENT

Upon arrival (after the derailment), an inspection of the area (approximately 400 feet) was conducted by track engineering. From the rear car, no defects were observed on the rails, grout pads, and fasteners. When approaching the lead car, several fastener studs were sheared on the field side of the left rail (Figures 2 & 3). A noticeable number of damaged fasteners and e-clips (twisted/broken/cracked) were observed near the impact area (Figure 5).

As per TRST-Structures, the grout pads were observed to be damage-free, except for a few isolated existing concrete cracks that appeared insignificant for repairs. A complete observation of the deck surface was made. No signs of damage or cracks were found on the deck surface. The deck was also observed from the underside, and no signs of damage were noted.

C10 Derailment Incident & Findings

OTHER FINDINGS AFTER TRAIN REMOVAL

One broken grout pad (Figure 13), improper-seated fasteners, debris under the EGR (Figure 10), and a broken grout pad under the third rail insulator (Figure 12).

CONCLUSION

Prior to the derailment, the curved section of the track (Curve #3) between National Airport and Potomac Yard was in good condition. The derailment occurred when the train struck a large metal object on the rail. A previous 3K-series revenue train heading outbound on track 2 experienced a mechanical failure of a brake disc rotor. The brake disc had fallen and struck several track components before completely detaching from the axle and resting on the left running rail (Figures 8 & 9).

The approximate point of derailment (POD) was determined to be on track 2 along the left rail at CM 379+19.

While the train was traversing Curve #3, the left wheel of the lead axle stuck the brake disc and climbed on top of the object, resulting in the left wheel being displaced and falling outside the field-side left rail, while the right wheel fell inside the gauge (Figures 6 & 7).

POST-INCIDENT

The derailed train was re-railed during the night of September 29 (Figure 11)

Track Maintenance began repair work on Saturday morning (September 30th) and finished work Monday evening (October 2nd). The work zone was from CM 379+30 to 382+40 (310 linear feet)
Work that was done:

- Core drilled 494 holes. (Figure 14)
- Replaced 247 direct fixation (Figure 17)
- Re-gauged area (Figure 15)

The track Geometry Vehicle measured the area and performed ultrasonic testing on Monday afternoon (October 2nd).

- Measurement and Ultrasonic Testing produced acceptable results.

Stray Current testing of the area was performed on Monday evening (October 2nd).

- Test produced passing results.

PHOTOS OF THE C10 DERAILMENT

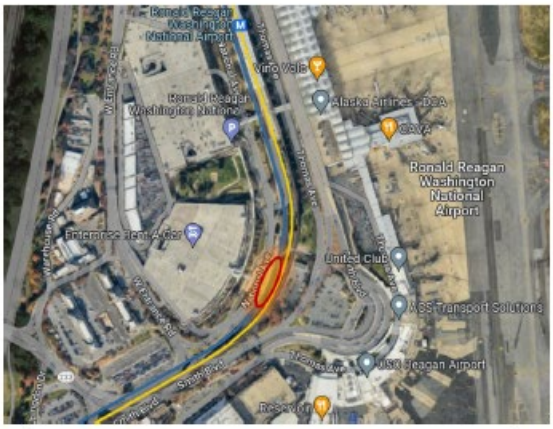

Figure 1: Satellite View of Derailment Area

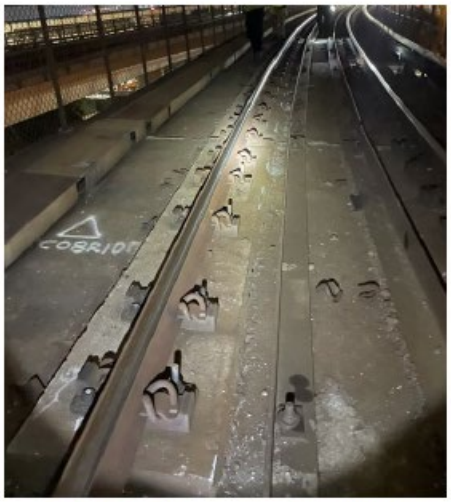

Figure 2: Multiple sheared studs on the field-side

Figure 3: Sheared Field-Side Stud

Figure 4: Damaged Fastener

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Figure 5: Derailed Left Wheel and Damaged fasteners & e-clips

Figure 6: Derailed Left Wheel of Lead Axle

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Figure 7: Derailed Right Wheel of Lead Axle

Figure 8: Damaged Fasteners and Detached 3K Disc Rotor

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Figure 9: Detached 3K Disc Rotor

Figure 10: Debris around EGR

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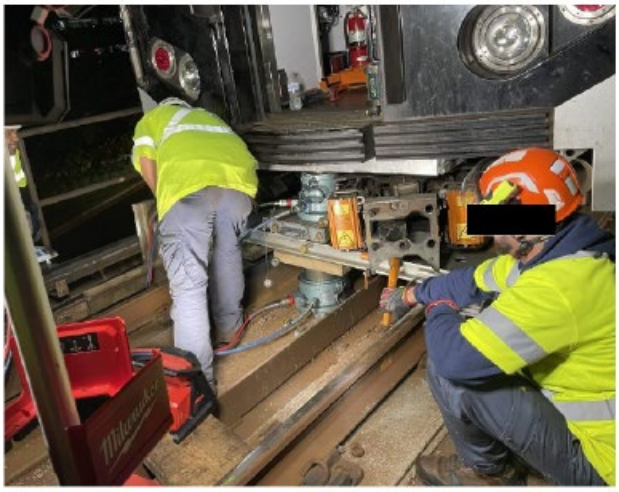

Figure 11: Lead Car Re-railed

Figure 12: Damaged Insulator Grout Pad

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Figure 13: Damaged Grout Pad

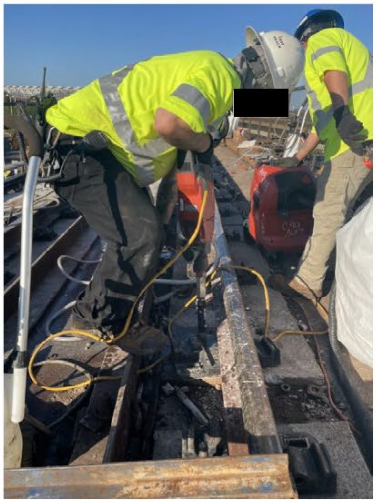

Figure 14: Core Drilling New Studs

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Figure 15: Track Gauge Verification

Figure 16: Fastener Torquing

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Figure 17: New SW-31 Installed

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Appendix F – Maximo Work Orders

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Washington Metropolitan Area Transit Authority
Maintenance and Material Management System
Work Order Details

Page 1 of 2
MX76PROD

Work Order #: 18151943
Type: CM

Status: CLOSE
10/10/2023 08:56

Work Description: DERAILMENT, FRNT TRK
Job Plan Description:

Work Information

Asset:	R7246 7246, RAIL CAR, KAWASAKI, 7000 AC, A CAR	**Owning Office:**	CMNT-CMNT-CMNT	**Parent:**	
Asset Tag:	R7246	**Maintenance Office:**	CMNT-DULL-INSP	**Create Date:**	09/30/2023 04:28
Asset S/N:	7246	**Labor Group:**	CMNT	**Actual Start:**	09/30/2023 04:30
Location:	2280 N99, DULLES YARD	**Crew:**		**Actual Comp:**	10/08/2023 21:13
Work Location:	1213 C99, ALEXANDRIA YARD	**Lead:**		**Item:**	K18050001
Failure Class:	CMNT011 TRUCK	**GL Account:**	WMATA-02-33395-50499160-041-**********-*****-OPR**		
Problem Code:	1025 ACCIDENT/COLLISION/DERAIL	**Supervisor:**	[redacted]	**Target Start:**	
Requested By:		**Requestor Phone:**	[redacted]	**Target Comp:**	
Chain Mark Start:		**Chain Mark End:**		**Scheduled Start:**	
Create-Mileage:	524219.0	**Complete-Mileage:**	524378.0		

Task IDs

Task ID							
10	REMOVED F/TRUCK,DERAIL OFF:70496(723566)						
Component:	000-300-K02 TRUCK&SUSPENSION: TRUCK ASSY; 2K/3K/6K/7K	**Work Accomp:** REMOVED	**Reason:** INCIDENT//ACCIDENT	**Status:** CLOSE	**Position:** 557	**Warranty?:** Y	
20	INSTALLED SERVICABLE F/TRUCK ON: 71537(1015537)						
Component:	000-300-K02 TRUCK&SUSPENSION: TRUCK ASSY; 2K/3K/6K/7K	**Work Accomp:** REPLACED REBUILT	**Reason:** INCIDENT//ACCIDENT	**Status:** CLOSE	**Position:** 557	**Warranty?:** Y	
30	TWC ANTENNA WAS PREVIOUSLY REMOVED TO FACILLITATE TRUCK INSTALLATION. RE-INSTALLED TWC ANTENNA. DST PASSES.						
Component:	000-300-S37-001 ATS ANTENNA (TWC TRANSMIT-FRONT OF CAR); 7K	**Work Accomp:** INSTALLED	**Reason:** MISSING	**Status:** CLOSE	**Position:**	**Warranty?:** N	

Planned Materials

Task ID	Item	Description	Storeroom	Issue Unit	Quantity	Unit Cost	Line Cost
	K18354014	LUBRICANT, SOLID STICK (WHEEL FLANGE GREASER INSERT)	255	EA	4	$35.00	$140.00
	R53100019	NUT, LOCK: TYPE: NYLON INSERT, DIAMETER: 3/8 IN, FINISH: ZINC, THREADS: 16 TPI, MATERIAL: STEEL	255	EA	10	$0.02	$0.20
					Total Planned Materials:		$140.20

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Washington Metropolitan Area Transit Authority
Maintenance and Material Management System
Work Order Details

Work Order #: 18151943
Type: CM

Status: CLOSE
10/10/2023 08:56

Work Description: DERAILMENT, FRNT TRK
Job Plan Description:

Actual Labor

Task ID	Labor	Start Date	End Date	Start Time	End Time	Approved?	Regular Hours	Premium Hours	Line Cost
20	[redacted]	10/02/2023	10/02/2023	05:00	10:00	Y	05:00	00:00	$210.71
20		10/02/2023	10/02/2023	05:00	10:00	Y	05:00	00:00	$248.61
20		10/02/2023	10/02/2023	05:00	10:00	Y	05:00	00:00	$223.53
20		10/02/2023	10/02/2023	05:00	10:00	Y	05:00	00:00	$245.01
30		10/02/2023	10/02/2023	15:30	18:30	Y	03:00	00:00	$129.58
30		10/02/2023	10/02/2023	15:30	17:30	Y	02:00	00:00	$103.29
						Total Actual Hour/Labor:	25:00	00:00	$1,160.74

Actual Materials

Task ID	Item	Assetnum	Description	Storeroom	Trans Date	Issue Unit	Quantity	Unit Cost	Line Cost
	K18354014		LUBRICANT, SOLID STICK (WHEEL FLANGE GREASER INSERT)	255	10/02/2023	EA	4	$35.00	$140.00
	R53100019		NUT, LOCK: TYPE: NYLON INSERT, DIAMETER: 3/8 IN, FINISH: ZINC, THREADS: 16 TPI, MATERIAL: STEEL	255	10/02/2023	EA	10	$0.02	$0.20
								Total Actual Materials:	$140.20

Related Incidents

Ticket	Description	Class	Status	Relationship
8699756	DERAILMENT	SR	CLOSED	ORIGINATOR

Failure Reporting

Cause		Remedy		Supervisor	Remark Date
1021	ACCIDENT HIT SOLID OBJECT	0004	REPLACED	[redacted]	10/08/2023
Remarks:	MRO REPLACED FRONT TRUCK, OPS CHECK GOOD				

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Washington Metropolitan Area Transit Authority
Maintenance and Material Management System
Work Order Details

Work Order #: 18152104
Type: CM

Status: CLOSE
10/17/2023 11:41

Work Description: REQUIRES UNDER CAR INSPECTION.
Job Plan Description:

Work Information

Asset:	R7247	7247, RAIL CAR, KAWASAKI, 7000 AC, B2 CAR	**Owning Office:**	CMNT-CMNT-CMNT	**Parent:**
Asset Tag:	R7247		**Maintenance Office:**	CMNT-DULL-INSP	**Create Date:** 09/30/2023 11:11
Asset S/N:	7247		**Labor Group:**	CMNT	**Actual Start:** 09/30/2023 11:22
Location:	2280	N99, DULLES YARD	**Crew:**		**Actual Comp:** 10/07/2023 15:47
Work Location:	1213	C99, ALEXANDRIA YARD	**Lead:**		**Item:** K18060001
Failure Class:	CMNT001	RAIL CAR	**GL Account:**	WMATA-02-33395-50499160-041-**********-*****-OPR**	
Problem Code:	1025	ACCIDENT/COLLISION/DERAIL	**Supervisor:**	[redacted]	**Target Start:**
Requested By:			**Requestor Phone:**		**Target Comp:**
Chain Mark Start:			**Chain Mark End:**		**Scheduled Start:**
Create-Mileage:	524219.0		**Complete-Mileage:**	524378.0	

Task IDs

Task ID	
10	REQUIRES UNDER CAR INSPECTION.

DID UNDERCAR INSPECTION. THIS UNDERCAR INSPECTION WAS REQUIRED DUE TO LEAD CAR 7246 DERAILED BECAUSE OF BROKEN BRAKE DISC OF 3069 ON TRACK. NOTE THAT FRONT TRACK ON LEAD CAR 7246 IS REPLACED AND WHEELS CUT FOR OUT-OF-SPEC. ALSO 7247 WHEELS RESURFACED DUE OUT-OFF-ROUND WHEELS. NO DAMAGE FOUND. OK FOR SERVICE.

Component: 000-300 RAIL CAR; 2K/3K/6K/7K **Work Accomp:** INSPECTED **Reason:** INCIDENT//ACCIDENT **Status:** CLOSE **Position:** **Warranty?:** N

Actual Labor

Task ID	Labor	Start Date	End Date	Start Time	End Time	Approved?	Regular Hours	Premium Hours	Line Cost
10	[redacted]	10/07/2023	10/07/2023	09:45	10:30	Y	00:45	00:00	$33.69
						Total Actual Hour/Labor:	00:45	00:00	$33.69

Related Incidents

Ticket	Description	Class	Status	Relationship
8699756	DERAILMENT	SR	CLOSED	ORIGINATOR

Failure Reporting

Cause		Remedy		Supervisor	Remark Date
1023	ACCIDENT OTHER VEHICLE INVOLVEMENT	3192	TESTED / INSPECTED	[redacted]	10/07/2023
Remarks:	INSPECTION CW AFTER FRT TRK R/R'D & CUT TO MATCH. REFER TO WO 181648853.NO DAMAGE FOUND.				

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Washington Metropolitan Area Transit Authority
Maintenance and Material Management System
Work Order Details

Work Order #: 18152198
Type: CM

Status: INPRG
09/30/2023 14:07

Work Description: SBB-649 WHEEL #4 FOUND LOOSE HARDWARE
Job Plan Description:

Work Information

Asset:	R3069	3069, RAIL CAR, BREDA, 3000 AC, B CAR	**Owning Office:**	CMNT-CMNT-CMNT	**Parent:**
Asset Tag:	R3069		**Maintenance Office:**	CMNT-WFCH-INSP	**Create Date:** 09/30/2023 14:06
Asset S/N:	3069		**Labor Group:**		**Actual Start:** 09/30/2023 14:07
Location:	2494	K99, WEST FALLS CHURCH YARD	**Crew:**		**Actual Comp:**
Work Location:	1213	C99, ALEXANDRIA YARD	**Lead:**		**Item:** L18060002
Failure Class:	CMNT011	TRUCK	**GL Account:**	WMATA-02-33370-50499160-041-**********-*****-OPR**	
Problem Code:	1615	BRAKE DISC DEFECT // DISC WORN BEYOND LIMITS	**Supervisor:**		**Target Start:**
Requested By:			**Requestor Phone:**	3[redacted]	**Target Comp:**
Chain Mark Start:			**Chain Mark End:**		**Scheduled Start:**
Create-Mileage:	2792152.0		**Complete-Mileage:**	0.0	

Failure Reporting

Cause	Remedy	Supervisor	Remark Date

Remarks:

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Washington Metropolitan Area Transit Authority
Maintenance and Material Management System
Work Order Details

Work Order #: 18152362
Type: ACT

Status: CLOSE
10/03/2023 07:55

Work Description: CMNT, SAFETY CRITICAL SBB 649, REV.00 2/3K ALP BRAKE DISC BOLT TIGHTNESS CHECK
Job Plan Description: CMNT, SBB-649 REV.00, 2/3K ALP BRAKE DISC BOLT TIGHTNESS CHECK

Work Information

Asset: R3069	3069, RAIL CAR, BREDA, 3000 AC, B CAR	**Owning Office:** CMNT-CMNT-CMNT		**Parent:** 18152025	
Asset Tag: R3069		**Maintenance Office:** CMNT-WFCH-INSP		**Create Date:** 09/30/2023 14:43	
Asset S/N: 3069		**Labor Group:** CMNT		**Actual Start:** 10/01/2023 01:42	
Location: 2494	K99, WEST FALLS CHURCH YARD	**Crew:**		**Actual Comp:** 10/02/2023 14:01	
Work Location: 1213	C99, ALEXANDRIA YARD	**Lead:**		**Item:** L18060002	
Failure Class: CMNT007	FRICTION BRAKE	**GL Account:** WMATA-02-33370-50499160-041-**********-*****-OPR**			
Problem Code: 2434	N/A CODE (FRICTION BRAKE SYSTEM)	**Supervisor:**		**Target Start:**	
Requested By:		**Requestor Phone:**		**Target Comp:**	
				Scheduled Start:	
Create-Mileage: 2792152,0		**Complete-Mileage:** 2792152,0			

Task IDs

Task ID	
10	PERFORM SBB649 (SEE LOND DESCRIPTION FOR DETAILS)
	SEE ATTACHED PROCEDURE STARTING AT SECTION 3,0 FOR STEPS REQUIRED.
	PLEASE NOTE THIS INSPECTION WILL COVER THE 2 TRUCKS, TOTAL OF 8 BRAKE DISC'S INSTALLED WITH A TOTAL CHECK ON 64 DISC BOLTS AND SAFETY WIRES PER RAILCAR.
	IF ANY DISCREPANCY IS NOTED PLEASE CREATE AN CM "MSI" ONE WORK ORDER PER DISC AGAINST THE RAILCAR AS A CHILD OF THIS SBB WO USING JOB PLAN "MSI180246".

Component: 000-300-K10-005 BRAKE DISC; TRUCK; 2K/3K/6K/7K **Work Accomp:** INSPECTED **Reason:** INSPECTION **Status:** CLOSE **Position:** 232 **Warranty?:** N

Actual Labor

Task ID	Labor	Start Date	End Date	Start Time	End Time	Approved?	Regular Hours	Premium Hours	Line Cost
10		10/02/2023	10/02/2023	09:45	10:30	Y	00:45	00:00	$32,88
						Total Actual Hour/Labor:	00:45	00:00	$32,88

Failure Reporting

Cause		Remedy		Supervisor	Remark Date
2475	NO DEFECT; NO REPAIRS PERFORMED	3192	TESTED / INSPECTED		10/02/2023
Remarks:	COMPLIED WITH CMNT, SAFETY CRITICAL SBB 649, REV.00 2/3K ALP BRAKE DISC BOLT TIGHTNESS CHECK				

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Appendix G – Why Tree Analysis