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W-0344 – Evacuation for Life Safety Reasons at Eastern Market Station – February 15, 2024

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, 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 January 28, 2025

WMSC staff recommend adoption of this investigation.

This evacuation for life safety reasons event demonstrates deficiencies regarding communication and compliance with written operations policies and procedures, including those related to evacuation procedures and safe train operations. In February 2022, the WMSC issued its first triennial audit of Metrorail's Emergency Management and Fire and Life Safety Programs which evaluated Metrorail's physical assets such as standpipes and emergency egress paths or shafts as well as other critical aspects of emergency management such as emergency procedures and communications. Following the findings and recommendations of this audit Metrorail implemented 19 corrective action plans. Of the 19 CAPs created, 5 are open and in progress. The WMSC conducted its second audit related to Metrorail's fire and life safety preparedness and emergency management programs in late 2024. A final audit report will be issued in early 2025.

Safety event summary:

Train 638 and Eastern Market Station were evacuated after the train entered the station with sparking beneath one of the railcars, causing fire and smoke in the station. This event resulted in eight riders being medically treated on the scene and one being transported to an area hospital due to smoke inhalation.

At approximately 12:50 p.m., as the train entered the platform limits at the station third rail power de-energized on track 2 under the train. At the same time, trains on tracks 1 and 2 at Potomac Ave Station reported smoke in the station. The Advanced Information Monitoring System (AIMS) in the Control Conter showed third rail power down at Stadium-Armory Station, but not at Potomac Ave Station.

During post-incident interviews, witnesses reported hearing what they described as several explosions during the event. This was the flashing and electrical arcing, which caused loud popping sounds. The Train Operator of Train 638 exited the train through the left-side operator's cab window onto the platform at Eastern Market Station due to a loss of power, which left the operator console dark. During an investigative interview, the Train Operator stated that the dark console caused them to believe they could not control passenger door operations. Riders on Train 638 and

at Eastern Market Station began to self-evacuate, The Eastern Market Station Manager reported arcing and smoke in the station to a communications agent in the Control Center and requested fan activation. Shortly after, a security officer notified the Metro Transit Police Department, who requested an emergency response from District of Columbia Fire and Emergency Medical Services (DCFEMS). At 12:51 p.m., third rail power was restored at Eastern Market Station on track 2. The Train Operator climbed back through the cab window into the operator's cab and entered the train through the lead car, manually opening doors using a key to evacuate remaining customers.

Under-Platform Exhaust fans were activated in the station at 12:53 p.m. At 12:55 p.m., 5 minutes after the initial report of fire and arcing from the Station Manager, the Assistant Operations Manager in the Control Center requested an emergency response from DCFEMS, who had already been contacted by MTPD.

DCFEMS arrived at 12:58 p.m. and third rail power was de-energized at 1:00 p.m., approximately 8 minutes after the initial report to the Control Center from the Station Manager. Train service was suspended at the station and personnel from various WMATA departments responded.

At approximately 6:18 p.m., after the tracks and train were inspected by Emergency Response Team and Car Maintenance personnel, the station was reopened. Train 638 was transported to New Carrollton Yard for further inspection.

Prior to this event, at approximately 11:44 a.m., the same train, while operating as Silver Line Train 621 to Downtown Largo Station, experienced a loss of traction motor torque and dynamic braking between Rosslyn and Foggy Bottom-GWU stations and data showed intermittent loss of third rail voltage. Data also showed this issue continued intermittently to Downtown Largo Station and again at Stadium-Armory Station, after the train went back into service as Train 638 toward Ashburn Station. At approximately 12:48 p.m., after identifying that the third rail was briefly de-energized at Stadium-Armory, and just 2 minutes prior to the safety event described above, the Button Rail Traffic Controller contacted a Power Desk Controller to report the observation and was told "it's fine, rate of rise." Rate of rise is the speed at which a variable increases over a defined period, in this case, the current.

During this event, there were multiple requests to reconfigure fans by several departments due to the ineffectiveness of the fans while in their initial configuration as outlined in the Emergency Ventilation Playbook.

WMATA's Office of Chief Mechanical Officer Incident Investigations Team found the following on rail car 7663:

- #1 Collector Shoe Assembly disintegrated
- #4 Collector Shoe Assembly missing, and the shoe fuse still attached to the primary cable
- Signs of flashing on the primary cable to the #6 Brake Disc

In addition to internal departments, Metrorail also involved Kawasaki Railcar, TransTech (current collector original equipment manufacturer, (OEM), and Applied Technical Services.

The cause of this event was determined to be due to a cracked collector shoe mounting rail bracket, which led to the dislodgement of the collector shoe assembly and caused excessive current to flow through the primary high voltage cables. This resulted in arc flashing, fire and smoke.

Contributing factors include:

- Collector mounting brackets were prone to fatigue and fracture under increased load magnitude and frequency.
- Areas of the revenue tracks had high-end approaches and track perturbations, which introduced higher loads at a higher frequency than desired
- Lack of supervisory oversight:
    - Third rail installation was completed incorrectly
    - TRST 1000 Track Standards Manual contained unclear guidelines and instructions regarding the measurement of third rail end approach height
- Non-compliance with written operational rules and procedures. For example, while located outside the Eastern Market Station platform limits, the Operator of Train 427 was instructed to turn off the train's environmental system and operate through the station with passengers aboard. Metrorail SOP 678 prohibits trains from entering locations where smoke is present while in passenger operation. Other examples of non-compliance during this event included, the Eastern Market Station Manager not manually activating the station's fire alarm using the pull station located in the kiosk and not opening faregates to allow for the quick evacuation of customers from the station.

Following this event, TRST engineering inspected the entire system using a Track Geometry Vehicle to verify third rail height measurements, which later identified third rail defects. TRST procured a third rail height tool to measure the third rail height with energized power and modified TRST 1000 standards.

As a result of this investigation, Metrorail developed and implemented several corrective actions, including:

- Conducted a fleet-wide campaign to inspect collector shoe assemblies and identify cracks or fractures in the plastic mounting brackets MSI 100001.
- Issued an Operations Personnel Notice on Identifying and Reporting Power and Propulsion Issues.
- Updated the TRST 1000 Third rail maintenance manual to reflect the correct measurement and installation procedures

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

FINAL REPORT OF INVESTIGATION A&I E24129

Date of Event:	February 15, 2024
Type of Event:	Evacuation for Life Safety Reasons
Incident Time:	12:49 Hours
Location:	Eastern Market Station, track 2
Time and How received by SAFE:	12:52 Hours – SAFE/MAC
WMSC Notification Time:	14:29 Hours
Responding Safety Officers:	WMATA: Office of Emergency Preparedness (OEP) Office of Safety Investigations (OSI) WMSC: None Other: None
Rail Vehicle:	Train ID 638 L7104/05x7341/42x7663/62T
Injuries:	Eight passengers were exposed to smoke inhalation
Damage:	#1 collector shoe fuse assembly disintegrated from excessive arcing – Rail Car 7663 #4 collector shoe assembly on the rear truck missing – Rail Car 7663
Emergency Responders:	Metro Transit Police Department (MTPD), District of Columbia Fire and Emergency Services (DCFEMS), Emergency Response Team (ERT)
SMS I/A Incident Number:	20240215#114802MX

Eastern Market Station – Evacuation for Life Safety Reasons

February 15, 2024

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Abbreviations and Acronyms

AIMS	Advanced Information Management System
AOM	Assistant Operations Manager
ARS	Audio Recording System
ATC	Office of Automatic Train Control
BTRA	Office of Bus Transportation
CAP	Corrective Action Plan
CCTV	Closed-Circuit Television
CENV	Office of Vehicle Program Services
CM	Chain Marker
CMNT	Office of Car Maintenance
CMOR	Office of the Chief Mechanical Officer
DCFEMS	District of Columbia Fire and Emergency Medical Services
ERT	Emergency Response Team
ESR	Event Scene Release
EV	Environmental System
EVP	Emergency Ventilation Playbook
FLO	Fire Liaison
IIT	Incident Investigation Team
MAC	Mission Assurance Coordinator
MICC	Metro Integrated Command and Communications Center
MOC	Maintenance Operations Center
MOR	Metrorail Operating Rulebook
MSI	Maintenance and Service Instructions
MTPD	Metro Transit Police Department
NOAA	National Oceanic and Atmospheric Administration
OEP	Office of Emergency Preparedness
OM	Operations Manager
OSI	Office of Safety Investigations
PASS	Positive Alarm Sequence System
PLNT	Office of Plant Maintenance
RM	Road Mechanic
RPM	Rail Performance Monitoring
RTC	Rail Traffic Controller
RTRA	Office of Rail Transportation
SAFE	Department of Safety
SMS	Safety Measurement System
SOCC	Security Operations Control Center
SOP	Standard Operating Procedure
SPOTS	System Performance On-Time Summary
TGV	Track Geometry Vehicle
TRST	Office of Track and Structures
UPE	Under-Platform Exhaust
VMDS	Vehicle Monitoring and Diagnostic System
WMATA	Washington Metropolitan Area Transit Authority
WMSC	Washington Metrorail Safety Commission
WSAD	Warning Strobe and Alarm Device

Executive Summary

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

On Thursday, February 15, 2024, at 12:49 hours, Train ID 638 (L7104/05x7341/42x7663/62T) entered Eastern Market Station on track 2 when sparking beneath rail car 7663 caused fire and smoke within the station. The train stopped at the 8-car marker, and passengers began evacuating the train and station.

At 12:50 hours, the Eastern Market Station Manager contacted the Metro Integrated Command and Communications Center (MICC) communications agent, reporting arcing[1] and smoke in the station, and requested fan activation. The communications agent notified the Button Rail Traffic Controller (RTC) of the incident.

At 12:51 hours, the Button RTC informed the Assistant Operations Manager (AOM) of the event. An Allied Security Officer notified the Metro Transit Police Department (MTPD). At 12:52 hours, the Security Operations Control Center (SOCC) contacted the District of Columbia Fire and Emergency Services (DCFEMS) to respond to the station.

By 12:53 PM, the Under-Platform Exhaust (UPE) fans[2] at Eastern Market Station were activated. Shortly after, a Rail Supervisor was dispatched, and MTPD confirmed the train and station were clear of passengers. The MICC Bus Section established a bus bridge between Federal Center SW Station and Stadium-Armory Station.

At 12:58 PM, DCFEMS arrived and established Unified Command at 7th Street and Pennsylvania Avenue. By 13:00 hours, third rail[3] power was de-energized, suspending train service between Eastern Market Station and Capitol South Station.

Representatives from various departments responded, including the Offices of Emergency Preparedness (OEP), Safety Investigations (OSI), Car Maintenance (CMNT), Track and Structures (TRST)[4], Automatic Train Control (ATC), and Power. Eight passengers received medical attention for smoke exposure, and one of the eight customers was transported to the hospital for further evaluation.

ERT and CMNT personnel inspected the track and assessed Train ID 638. At 16:02 hours, third rail power was restored. At 16:18 hours, Train ID 638 departed Eastern Market Station for inspection at New Carrollton Yard. By 16:23 hours, normal service resumed at Eastern Market Station.

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[1] Arcing occurs when electrical current jumps or 'arcs' across a gap in a circuit, often creating sparks or a visible flash. This can be hazardous and lead to fire or equipment damage.

[2] Under-Platform Exhaust (UPE) is a ventilation system installed beneath train station platforms. It is designed to extract smoke, heat, and other pollutants from the station environment, primarily in emergency situations such as fires or other safety incidents.

[3] The third rail is a high-voltage power source typically used in electric railway systems to supply power to trains. It is distinct from the running rails, which guide the train's movement.

[4] TRST refers to the Track and Structures department to include the Emergency Response Team (ERT) and related infrastructure.

In compliance with Standard Operating Procedure 102-01-02 for Removing an Employee from Service due to involvement in an operational safety event, the train operator was removed from duty but did not undergo post-incident testing.

The Office of Chief Mechanical Officer Incident Investigations Team (CMOR IIT) inspected rail car 7663, finding the #1 Collector Shoe Assembly[5] disintegrated, the #4 Collector Shoe Assembly missing, and the shoe fuse still attached to the primary cable. Signs of flashing on the primary cable to the #6 Brake Disc were also observed.

Following the incident, WMATA initiated a comprehensive investigation involving multiple internal departments and external parties, including Kawasaki Railcar (KRC), TransTech (current collector original equipment manufacturer, (OEM), and Applied Technical Services (Lab). The investigative efforts included thorough inspections of the railcar and third rail, data analysis of the incident train, fleet-wide inspection of collector assemblies, Track Geometry Vehicle (TGV) data analysis, third rail testing with an instrumented 7000 series railcar, and laboratory testing of sample current collector assemblies.

Probable Cause and Contributing Factors

The probable cause of the February 15, 2024, evacuation for life safety reasons at Eastern Market Station was a cracked collector shoe mounting rail bracket on car 7663, which led to the dislodgement of the collector shoe assembly. This dislodgement caused excessive current to flow through the primary high voltage cables, resulting in a rapid temperature increase, fire, and arc flash resulting in a smoke in condition.

Contributing Factors:

- Improper Third Rail Installation: Variances in third rail height[6] were due to unclear or incorrect maintenance standards outlined in the TRST 1000 Track Standards Manual. The manual lacked clear guidelines for measuring third-rail end approach [7]heights.

- Susceptibility of Collector Mounting Brackets: The collector mounting brackets were prone to fatigue and fracture under increased load magnitude and frequency.

- High-End Approaches and Track Perturbations: Areas of the revenue tracks had high-end approaches and track perturbations, which introduced higher loads at a higher frequency than desired, exacerbating the issue.

WMATA's corrective actions aim to address these contributing factors and prevent future incidents by improving inspection protocols, updating maintenance standards, and enhancing coordination between departments. Measures include revising the fleet periodic inspection maintenance

[5] The collector shoe assembly is a component on a train that makes contact with the third rail, allowing the train to draw electrical power for operation. Dislodgement or damage to this component can cause power interruptions and other safety issues.

[6] Height discrepancies refer to the uneven or misaligned height of the third rail compared to the expected standard. Such discrepancies can cause operational issues and safety risks.

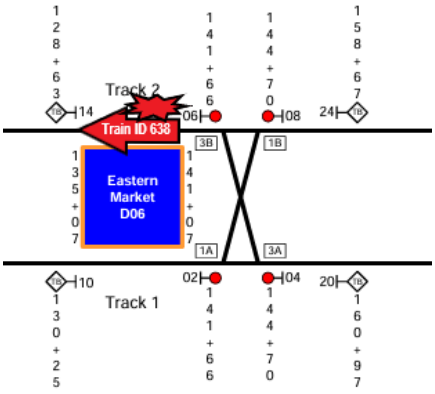
[7] The "end approach" refers to the third rail section that transitions to the main rail line. Proper alignment of this section is crucial for smooth contact with the collector shoe on the train.

manual to include detailed inspections and overhauls of collector shoe assemblies, updating the TRST 1000 standards to include modified end approach criteria and specifications, and establishing a working group to monitor both railcar and track variables.

Incident Site

Eastern Market Station is an indoor station with a center platform and direct fixation tracks. There is an interlocking on the outbound end of the station. The incident occurred on track 2.

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 thirteen (13) individuals as part of this investigation. The Interviews 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 638
    - Train Operator – Train ID 427
    - Station Manager
    - Radio RTC
    - CMNT Road Mechanic
    - Mission Assurance Coordinator (MAC) #2
    - MAC #1
    - MICC Operations Manager
    - MICC Assistant Operations Manager #1
    - MICC Assistant Operations Manager #2
    - Fire Liaison (FLO)

- MOC - Maintenance 1
- Senior Vice President MICC

- 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.

- Documentation Review – Collection of relevant work history information and process documentation contained in WMATA systems of record. These records include:
  - Train Operator Training Records
  - Train Operator Certifications
  - Train Operator 30-Day work history review
  - Train Operator Post-Accident/Incident Interview Questionnaire
  - Train Operator Manifest
  - Train Operator Written Statement
  - RTRA Managerial Incident Investigation Report
  - RTRA Supervisor's Report
  - MICC Rail Section Incident Report
  - MICC Phase II Activation Overview
  - MOC Emergency Tunnel Fan Activation Report
  - Maintenance Section Emergency Tunnel Fan Operation Form
  - Emergency Ventilation Playbook
  - OEP Hot Wash Report
  - OEP After Action Report Summary
  - WMATA Incident Commander Playbook
  - SOP 1003-3-02/00: Roles and Responsibilities of Incident Management Personnel
  - Maximo Data

- System Data Recording Review – Collection of information contained in Metro Data Recording Systems. This data includes:
  - Audio Recording System (ARS) playback
  - The Office of Chief Mechanical Officer (CMOR) Incident Investigation Team (IIT) Vehicle Monitoring and Diagnostic System (VMDS)
  - Closed-Circuit Television (CCTV)
  - Advanced Information Management System (AIMS)
  - System Performance On-Time Summary (SPOTS) Report
  - Track Geometry Vehicle (TGV) Data
  - Rail Performance Monitor (RPM)

Investigation

On Thursday, February 15, 2024, the System Performance On-Time Summary (SPOTS) report indicated that at 05:18 AM, a six-car, 7000-series (7104/05X7341/40X7663/62) train began operating in revenue service on the Silver Line as Train ID 606, between Downtown Largo Station and Ashburn Station. Throughout the morning, the train's ID changed among five different train IDs: 606, 633, 602, 621, and 638. At 10:47 hours, the train was operating as Train ID 621, completing a second round trip from Ashburn Station to Downtown Largo Station when it experienced its first mechanical issue.

According to the CMOR IIT analysis, at 11:44 hours, Train ID 621 began to experience a loss of traction motor torque and dynamic braking while departing from Rosslyn Station and approaching Foggy Bottom Station on track 1. The VMDS logs showed intermittent loss of third rail voltage around that same time. The train continued to exhibit intermittent propulsion traction torque and dynamic braking for the remainder of the trip to Largo Station.

At 12:25 hours, Train ID 621 arrived at Downtown Largo Station on track 2. At 12:30 hours, the train departed Downtown Largo Station as Train ID 638. At 12:45 hours, Train ID 638 arrived at Stadium-Armory Station and departed at 12:46 hours.

The Advanced Information Management System (AIMS) indicated that at 12:47 hours, third rail power was briefly de-energized, then re-energized seconds later as Train ID 638 was departing Stadium-Armory Station.

The Audio Recording System (ARS) recorded that at 12:48 hours, the Button RTC contacted the Power Desk and requested that they "check Stadium-Armory Station, track 2 because it just flashed on us," to which the Power Desk Controller replied, "it's fine, rate of rise."[8]

Closed-Circuit Television (CCTV) footage showed that at 12:49 hours, Train ID 638 entered Eastern Market Station on track 2. Five customers descended the escalator onto the platform, and two Allied Security Officers were walking towards the 8-car marker on track 2.

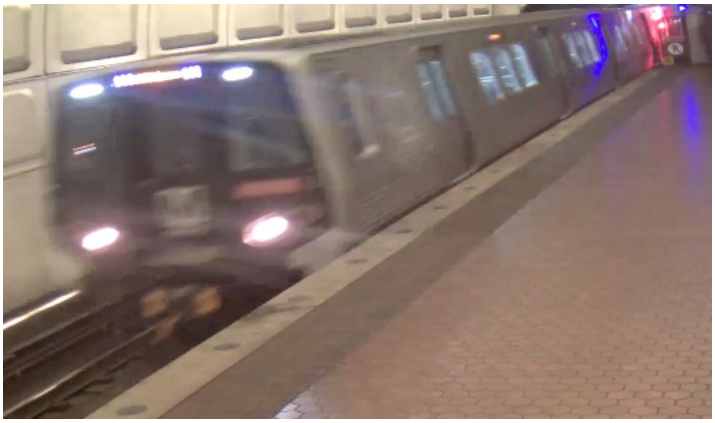


Image 1 – Image of Train ID 638 entering Eastern Market Station on track 2 at 12:49 hours.

[8] The rate of rise is the speed at which a variable increases over a defined period. It is commonly used to measure changes in temperature, financial markets, or physiological metrics, indicating how quickly the value is escalating.

As the train continued within the platform limits sparking, and a fire appeared as the third car entered the platform, extreme arcing occurred, causing smoke.

Image 2 – Image of the sparking that appeared as the third car entered the platform at 12:49 hours.

At 12:50 hours, the train emergency lighting activated, then slowed until it stopped near the 8-car marker. AIMS revealed third rail power de-energized at Eastern Market Station on track 2. The AIMS alarm alerted the MICC personnel of a potential issue at Eastern Market Station.

Figure 1 - Shows as Train ID 638 entered Eastern Market platform limits, third rail power dropped uncommanded.

Figure 2 - *Shows seconds later, third rail power was re-energized at Eastern Market Station track 2.*

Simultaneously, Train ID 902, located at Potomac Avenue Station on track 2, reported to the Radio RTC that there was a lot of smoke at Potomac Avenue Station and that they had turned off the train's environmental system (EV). The Radio RTC instructed Train ID 902 to hold on the platform. Train ID 903, located at Potomac Avenue Station on track 1, reported that they could see a lot of smoke. The report of smoke at Potomac Avenue caused confusion because AIMS was showing third rail power de-energized at Eastern Market Station.

A recently certified RTC was performing the radio communication duties at the time of the incident; the AOM interchanged the RTCs, replacing the new RTC (in training) with a more experienced RTC to manage the emergency. This new RTC (in training) identified Train ID 638 as the source of the smoke, which was now located at Eastern Market Station, track 2.


Image 3 – *Image of an explosion that occurred, causing smoke at 12:50 hours.*

After the train stopped, the Train Operator opened the left-side cab window, and the two Security Officers on the platform motioned to the smoke emitting from the train's rear. Moments later, there were a series of explosions. Four (4) customers on the platform ascended the escalator to the mezzanine level and exited the station.

The ARS revealed that the Station Manager contacted the communications agent and reported that they were located at Potomac Avenue Station, although they were located at Eastern Market

Station, and that the train on track 2 was arcing and on fire. The Station Manager did not open the fare gates to allow the customers to exit nor initiate the Manual Pull Station[9] in the kiosk.

Image 4 – Image of an explosion occurring beneath the train at 12:50 hours.

At 12:51 hours, the Train Operator jumped out of the left-side cab window[10], and the two Security Guards began to run towards the trailing end of the train to assist the customers. A customer aboard rail car 7663 activated the emergency door release, allowing customers to exit that car. A second person jumped out of the left-side cab window onto the platform and evacuated the station.

[9] Once activated, a Fire Zone Alarm indication and audible PA announcement "Evacuation" message shall be immediately played without delay throughout the station. Along with the station evacuation signals, audible and visual alarm signals will be automatically and immediately activated.

[10] The train's exterior signage remained active and illuminated, indicating the train was still keyed up, and the Train Operator did not attempt to open the train doors by pushing the left-side doors open pushbutton to allow the customers to exit the train.

Image 5 - Images of the Train Operator evacuating through the Operator's cab window and a Security Guard assisting a customer evacuate between two railcars.

At 12:51 hours, third rail power re-energized at Eastern Market Station on track 2, and the train's interior lighting returned. The Train Operator climbed back through the cab window into the Operator's Cab and ran through the lead car to evacuate the customers by opening the emergency doors. The Train Operator ran to the second, third, and fourth rail cars and keyed open the train doors to rescue the customers.

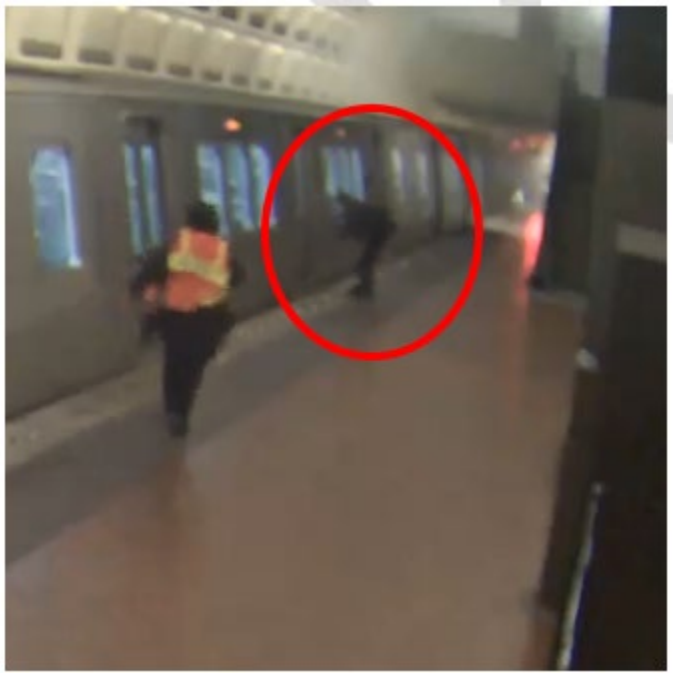


Image 6 - Image of the Train Operator manually keying the door open.

A customer aboard the trailing railcar 7662 activated the emergency door release, allowing customers to exit that car. The Train Operator returned to the lead car to retrieve their belongings and then continued to the mezzanine level. A Security Officer walked to the trailing car to confirm the train was clear of customers.

A Security Officer contacted MTPD via handheld radio and reported the train traveling towards Ashburn Station was on fire. The MTPD Dispatcher instructed units to respond to Eastern Market Station. The Station Manager contacted the communication agent again and requested fan activation. The Radio RTC instructed Train ID 902 on Track 2 at Potomac Avenue Station and 939 on Track 1 at Potomac Avenue Station to turn off the train's EV.

At 12:52 hours, the Eastern Market Station Manager advised the communications agent that the customers were exiting the station, and then the communications agent instructed the Station Manager to close and exit the station. The SOCC made the initial notification to DCFEMS and requested a response to Eastern Market Station.

Also, at 12:52 hours, the Train Operator of Train ID 638 contacted the Radio RTC via Ops. 2 radio channel and reported an emergency, including an explosion on the back of the train, including smoke. The Train Operator confirmed that the train was berthed on the platform. The Radio RTC instructed the Train Operator to offload the train and to use caution while checking the trailing two cars. The Train Operator advised that the consist lost power as the train entered the platform limits. They did not attempt to make announcements or open the doors because the train had no

power, and the display screen was dark. The Train Operator reported that once the train stopped, they heard loud explosions, panicked, and exited the consist through the Operator's cab window.

At 12:53 hours, the Station Manager exited the kiosk and walked towards the escalators to turn them off; the Station Manager never checked to ensure that the platform was clear. At 12:54 hours, a Security Officer walked towards the train that was stopped just before the platform limits at Eastern Market Station on track 1 and, a short time later, walked away from the train. The customer that remained on the platform as the train entered the station and was not aboard the train at the time of the incident exited the station. A total of twenty-six (26) customers were evacuated from the train. Eight (8) customers received medical attention outside of the station for smoke exposure. One (1) customer was transported to George Washington Hospital for further evaluation.

At 12:54 hours, the Operations Manager (OM) contacted the Maintenance Operations Center (MOC) to request fan activation at Eastern Market Station. Initially, the reports of smoke were at Potomac Avenue Station, and Maintenance 1 was waiting for additional details as to the location of the smoke. The Office of Plant Maintenance (PLNT) advised the OM that according to the fan activation playbook if they turned on Eastern Market Station fans, they would have to turn off Potomac Avenue Station fans, and then confirmed that they would turn the fans on at Eastern Market Station.

AIMS revealed that the under-platform exhaust (UPE) fans were activated inbound and outbound and set to exhaust. The UPE, refers to a ventilation system designed to extract air from underneath train station platforms. It plays a crucial role in managing air quality within a station by removing smoke, heat, and other pollutants in the event of a fire or other emergency.

In an emergency situation, such as a fire or significant smoke condition, activating the UPE system helps maintain a safer environment by rapidly extracting hazardous air, reducing the risk to passengers, and aiding emergency response efforts. By removing smoke and improving visibility, it also assists first responders in reaching and addressing the source of the issue more efficiently.

This system is part of a broader safety and ventilation infrastructure in transit systems designed to ensure the safety and well-being of passengers and personnel.

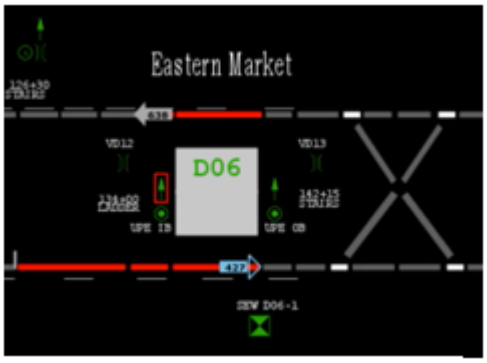


Figure 3 - UPE Inbound to the left of the station, and UPE Outbound to the right of the station set to exhaust at 12:54 hours.

At 12:54 hours, the Radio RTC instructed Rail Supervisor #1, located at L'Enfant Plaza Station, to respond to Eastern Market Station and that MTPD would transport them to the station. Next, the Radio RTC inquired if anything impeded the movement of Train ID 427, located between Capitol South Station and Eastern Market Station on track 1. The Train Operator of Train ID 427

responded that there was smoke in front of the train, and they were stopped in the tunnel. The Train Operator also advised that a Security Officer was instructing them to stop.

Figure 4 - 5Image of an Allied Security Guard walking towards Train ID 427.

The Radio RTC instructed Train IDs 427 and 638 to turn off the train's EV system.

At 12:54 hours, MTPD Officer #1 arrived at Eastern Market Station, and MTPD Officer #2 advised that they would set up the Incident Command Post at 7th Street and Pennsylvania Avenue. MTPD Officer #1 reported passing the kiosk and seeing heavy smoke in the station, which appeared to be clear of customers. A Fire Zone Alarm Indication was activated, and the fare gates opened.

Image 7 – Image of MTPD arriving at Eastern Market Station and heading to the platform at 12:54 hours.

At 12:55 hours, the Radio RTC instructed Train ID 939 to confirm a clear track ahead of the train and continue to Stadium-Armory Station on track 1.

At 12:56 hours, the two Security Officers exited Eastern Market Station.

At 12:57 hours, DCFEMS arrived at Eastern Market Station. The Radio RTC instructed Train ID 902, located at Potomac Avenue Station on track 2, to offload the train.

MTPD Officer #1 reported that Train ID 638, located at Eastern Market Station, was clear of customers.

At 12:58 hours, the Radio RTC instructed the Train Operator of Train ID 902 to remain in the lead car, and then instructed Train ID 427 to continue to the next station and not to service Eastern Market Station. Train ID 427 continued in service to Downtown Largo Station. According to the SPOTS report, Train ID 427 held in the tunnel for approximately seven minutes.

Select Platform: and/or Select ID: 427 Leave blank to remove criteria
and/or Select 4-digit car number: Leave blank to remove criteria
Select Date: Feb 15 2024 Select Times (0-24HRS): From 12:00 To 14:00
Generate Report

ID	Platform	length	dcode	Right door open	Right door close	dwell	Left door open	Left door close	dwell	Head Arrived	Tail cleared	cars	Travel Time door open to door open
427	J02-1	0	72				12:03:12	12:03:24	12	12:02:29	12:03:55	3085-3084.3107-3106.3038-3039	-
427	C13-1	6	72				12:08:57	12:09:12	15	12:08:26	12:09:36	3085-3084.3107-3106.3038-3039	5:45
427	C12-1	6	72				12:10:40	12:10:56	16	12:10:12	12:11:19	3085-3084.3107-3106.3038-3039	1:43
427	C11-1	6	72	12:13:20	12:13:35	15				12:12:52	12:13:55	3085-3084.3107-3106.3038-3039	2:40
427	C10-1	6	72							12:17:06	12:18:23	3085-3084.3107-3106.3038-3039	-
427	C09-1	6	72	12:19:45	12:19:59	14				12:19:15	12:20:20	3085-3084.3107-3106.3038-3039	6:25
427	C08-1	6	42	12:21:40	12:21:58	18				12:21:11	12:22:18	3085-3084.3107-3106.3038-3039	1:55
427	C07-1	6	72				12:26:19	12:26:41	22	12:25:45	12:27:03	3085-3084.3107-3106.3038-3039	4:39
427	C06-1	6	72	12:29:12	12:31:07	115				12:28:44	12:31:28	3085-3084.3107-3106.3038-3039	2:53
427	C05-1	6	72				12:33:19	12:33:36	17	12:32:47	12:34:00	3085-3084.3107-3106.3038-3039	4:07
427	C04-1	6	72				12:36:04	12:37:28	84	12:35:30	12:37:54	3085-3084.3107-3106.3038-3039	2:45
427	C03-1	6	72	12:38:53	12:39:09	16				12:38:24	12:39:28	3085-3084.3107-3106.3038-3039	2:49
427	C02-1	6	72	12:40:19	12:40:36	17				12:39:48	12:40:56	3085-3084.3107-3106.3038-3039	1:26
427	C01-1	6	72				12:41:52	12:42:16	24	12:41:22	12:42:39	3085-3084.3107-3106.3038-3039	1:33
427	D01-1	6	72				12:43:20	12:43:35	15	12:42:50	12:43:59	3085-3084.3107-3106.3038-3039	1:28
427	D02-1	6	72	12:44:48	12:46:55	127				12:44:17	12:47:18	3085-3084.3107-3106.3038-3039	1:28
427	D03-1	6	72				12:48:20	12:48:40	20	12:47:42	12:49:06	3085-3084.3107-3106.3038-3039	3:32
427	D04-1	6	72				12:49:52	12:50:08	16	12:49:17	12:50:39	3085-3084.3107-3106.3038-3039	1:32
427	D05-1	6	72				12:51:46	12:52:02	16	12:51:16	12:52:27	3085-3084.3107-3106.3038-3039	1:54
427	D06-1	6	72							12:53:04	13:00:03	3085-3084.3107-3106.3038-3039	-
427	D07-1	6	72				13:01:21	13:01:35	14	13:00:41	13:01:57	3085-3084.3107-3106.3038-3039	9:35
427	D08-1	6	72				13:03:23	13:03:42	19	13:02:48	13:04:07	3085-3084.3107-3106.3038-3039	2:02
427	G05-1	6	51				13:04:51	13:05:22	31	13:04:17	13:09:39	2009-2008.3081-3080.2023-2022	1:28
427	G01-1	6	72				13:08:00	13:08:39	39	13:07:30	13:09:11	3085-3084.3107-3106.3038-3039	3:09

Table 1 - *Shows how long Train ID 427 sat in the tunnel while at Eastern Market Station.*

At 12:59 hours, DCFEMS entered Eastern Market Station and began inspecting the train.

Image 8 – Image of DCFEMS on the platform at 12:59 hours.

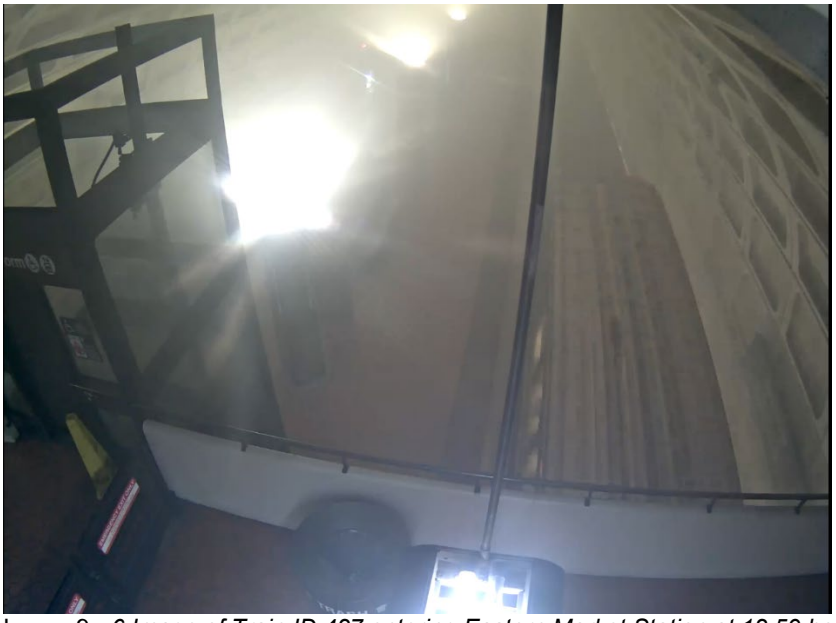


Image 9 - *6 Image of Train ID 427 entering Eastern Market Station at 12:59 hours with moderate smoke present.*

At 13:00 hours, third rail power was de-energized between Eastern Market Station and Capitol South Station on track 2.

Figure 7 – Shows AIMS indicating third rail power was de-energized between Eastern Market and Capitol South Stations.

At 13:00 hours, the Radio RTC instructed the CMNT Road Mechanic (RM) located at Stadium-Armory Station to respond to Eastern Market Station and that MTPD would transport them to the station.

At 13:01 hours, the Train Operator of Train ID 638 and the Station Manager exited the station.
At 13:04 hours, Rail Supervisor #1 reported that they were at Eastern Market Station and were with the On-Scene Commander (MTPD).

At 13:09 hours, the Stair Fan was turned on to supply. Station fans in a transit system are used to manage air flow, temperature, and smoke control, especially in enclosed environments like underground train stations. These fans can operate in two primary modes: supply and exhaust.

Supply Mode In this mode, the fans push fresh air into the station, improving ventilation and helping to maintain comfortable air quality for passengers and staff. This mode is typically used in normal operations to circulate air and ensure a steady flow of fresh air through the station.

Exhaust Mode, in exhaust mode, the fans draw air out of the station, removing smoke, heat, or other pollutants. This mode is crucial in emergency situations, such as a fire or smoke condition. By activating the exhaust mode, the system can quickly clear hazardous air, reduce smoke levels, and improve visibility, facilitating safe evacuation and aiding emergency response efforts.

Station fans can be activated in different situations, depending on the specific needs of the station or the nature of the incident:

Routine Ventilation, Fans in supply mode might be turned on during normal operations to maintain air quality and temperature.

Heat Management, on hot days or in crowded stations, fans may be used to maintain a cooler environment.

Emergency Situations, in case of fire, smoke, or other emergencies, fans are usually switched to exhaust mode to clear the station of smoke and hazardous gases, aiding in evacuation and emergency response. This is often controlled by a central command center, with predefined protocols guiding when and how to activate the fans.

Overall, the decision to turn on station fans, whether in supply or exhaust mode, depends on both routine operational needs and emergency response requirements, with safety being the primary focus in each case.

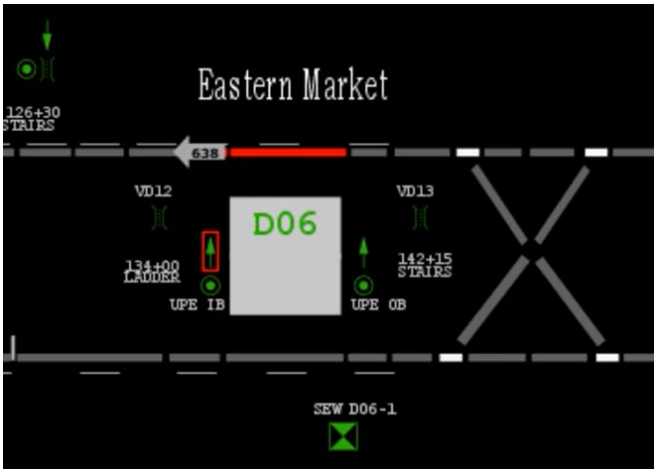


Figure 8 – Shows the Stair Fan was turned to supply.

At 13:10 hours, MTPD Officer #2 advised that Unified Command was established on 8th Street and Pennsylvania. At 13:13 hours, third rail power was de-energized at Eastern Market Station on track 1.

Figure 9 – *Shows AIMS indicating third rail was de-energized on both tracks 1 & 2.*

At 13:20 hours, the Radio RTC contacted Rail Supervisor #1 to inquire about an update and if they were at the Command Post. Rail Supervisor #1 advised they were at the Command Post and would provide an update. The CMNT RM was still waiting at Stadium-Armory Station.

At 13:28 hours, Rail Supervisor #1 contacted communication agent from the Command Post to inquire if the bus bridge had been established. The Office of Bus Transportation (BTRA) was still positioning buses so Rail Supervisor #1 left their contact information so they could be notified when it was established.

At 13:34 hours, the OM contacted MOC and informed them that DCFEMS was on the scene and requested to change the fan configuration. The OM informed MOC that DCFEMS and the Fire Liaison (FLO) requested that FD7 set to exhaust and FD6 set to supply.

At 13:38 hours, the Incident Commander advised the MTPD Dispatcher that emergency communications were being moved to Radio Ops 6 as noted within the Incident Management Framework (IMF) procedures.

At 13:39 hours, the Radio RTC announced that there was no train service between Potomac Avenue Station and Capitol South Station and that a bus bridge was established.

CMNT, ERT, ATC, RTRA, BTRA, OEP, OSI, and MTPD departments arrived at Eastern Market Station and were the initial departments that checked in at the Command Post.

At 13:41 hours, AIMS revealed that blue block and human form were in place at Eastern Market Station on track 2 for personnel to enter the roadway. At 13:42 hours, ERT entered Eastern Market Station with DCFEMS to conduct their initial inspection.

At 13:46 hours, MTPD contacted the FLO to advise that there was still smoke at Potomac Avenue Station, and one end still required ventilation to clear the smoke; they also asked if the fans were turned off. The FLO advised that they were focused on Eastern Market Station because that was

the source of the smoke and where personnel were working. At 13:52 hours, OEP personnel provided the Incident Commander with a description of what they believed could be the issue.

At 13:55 hours, ERT contacted the Incident Commander to request Power personnel to the scene. The Incident Commander informed ERT that Power personnel had not checked in at the Incident Command Post and were waiting for an estimated arrival time. The Mission Assurance Coordinator (MAC) informed the Incident Commander that they were advised that Power personnel were on the scene.

At 14:06 hours, ERT contacted the Incident Commander to request a Train Operator or Rail Supervisor to move the train. At 14:11 hours, an OEP Unit informed the Incident Commander that two Power personnel were on the platform, and they did not check in at the Incident Command Post.

At 14:19 hours, the Incident Commander contacted ERT to advise that DCFEMS cleared the scene and required confirmation that tracks 1 & 2 were clear of personnel so that power could be restored on track 2 only.

At 14:22 hours, the Incident Commander contacted the MAC and advised that DCFEMS were clearing the scene and that the Incident Command would be turned over to Rail Supervisor #1. At 14:23 hours, the Incident Commander informed the MAC that it was safe to restore power on track 2 only.

At 14:38 hours, the human form was removed at Eastern Market Station on track 2. At 14:43 hours, third rail power was restored at Eastern Market Station on track 2.

Figure 10 - Shows third rail power was restored on track 2 only to move the incident train.

At 14:44 hours, the blue block was removed at Eastern Market Station on track 2. At 14:45 hours, the MAC informed the Incident Commander that power was restored on track 2. At 14:49 hours, blue block and human form were in place at Eastern Market Station on track 2. The incident train was moved forward inside the tunnel so the hanging cable could be secured, and the tracks could be inspected.

At 14:50 hours, the Incident Commander informed the MAC that third rail power could be restored on track 1 for trains to bypass the station. At 15:07 hours, third rail power was restored at Eastern Market Station on track 1. At 15:09 hours, the third rail power de-energized at Eastern Market Station on track 2. At 15:11 hours, the Incident Commander informed the MAC that they would discontinue utilizing Radio Ops 6 and switch to Radio Ops 2 for all communications.

At 15:16 hours, the Radio RTC advised Train ID 902 that they would be the first train to bypass Eastern Market Station. At 15:19 hours, the Radio RTC announced that trains would single-track and not service Eastern Market Station. At 15:26 hours, Train ID 902 was the first train to single track and continued towards Vienna Station.

At 15:33 hours, the Radio RTC announced that trains would service Eastern Market Station. At 15:35 hours, the Incident Commander informed the Radio RTC that power could be restored on track 1, and trains could only service Eastern Market Station on track 1.

At 15:56 hours, the Incident Commander informed the Radio RTC that the collector shoe assembly was removed from the roadway on track 2, WSADs were removed, and third rail power was requested to be restored to move the incident train. At 16:02 hours, third rail power was restored at Eastern Market Station on track 2. At 16:17 hours, blue block and human form were removed at Eastern Market Station on track 2.

At 16:18 hours, the Radio RTC instructed Train ID 638 (738) to verify that signal D06-06 was lunar and granted a permissive block to the turnback, crossing over from track 2 to track 1 towards New Carrollton Yard.

At 16:20 hours, Train ID 914 arrived at Eastern Market Station on track 1. At 16:21 hours, the Radio RTC announced that service was restored at Eastern Market Station on tracks 1 and 2. At 16:23 hours, Train ID 640 arrived at Eastern Market Station on track 2.

At 16:47 hours, Train ID 638 arrived at New Carrollton Yard and was secured on track 20 south.

CMNT inspected railcars 7662 and 7663 and reported that the collector assembly on the rear truck of railcar 7663 was disengaged from the railcar and suspended by the shunt strap. Additionally, the collector assembly on truck one [front truck] of railcar 7663 exhibited signs of burning and melting. Heat damage was also observed on all collector shoes of both railcars.

Later that day, after revenue service, ERT performed a walking inspection between Foggy Bottom Station and Court House Station on track 1. Signs of equipment dragging between Foggy Bottom Station and Rosslyn Station were observed beginning four to six hundred feet west of the platform at Foggy Bottom Station in the direction of Rosslyn Station.

TRST conducted system-wide track inspections by walking and utilizing the Track Geometry Vehicle (TGV).[11] to identify and verify third-rail defects. Initially, the TGV testing data not compared to the third rail test train data. After comparing the data, TRST equipped the TGV with two optical cameras, thermal cameras, current transducers, linear potentiometers, accelerometers, and laser

[11] A Track Geometry Vehicle (TGV) is a specialized railcar or train used to inspect railway tracks for safety and maintenance purposes. Equipped with advanced sensors and measurement systems, TGVs assess critical aspects of track geometry, such as alignment, curvature, elevation, and gauge. This allows railway operators to detect and address track defects or irregularities, contributing to safer and more reliable railway operations. TGVs play a key role in maintenance planning and safety assurance by providing comprehensive data for railway maintenance and operational safety.

displacement sensors to identify the defects. After adding the noted equipment, on February 26, 2024, TRST reported that the TGV detected an abnormality on the red line between Forrest Glen Station and Wheaton Station on track 2, a high third rail on the right side, damage to one-third rail splicer bar, and three insulators were out of gauge. No collector shoes or collector shoe assemblies were observed. On the Orange line between East Falls Church Station and West Falls Church Station, a narrow third gauge rail on the right side was reported, with three missing cover boards and damage to cover board brackets identified. Emergency track rights were executed and completed to correct the defects in both areas.

TRST completed the third rail geometry testing with TGV. All critical locations have been hand-measured and corrected as necessary. TRST updated specs and tightened tolerances for third rail gauge. TRST has acquired a third rail measuring gauge that can be used for live rail. The TGV run included distance from running rail verification as well.

CENV initiated a fleet-wide campaign to inspect collector shoe assemblies to identify cracks or fractures to the Collector Shoe Assembly plastic mounting brackets. On February 26, 2024, all 7K Series active car inspections were completed, and 55 discrepancies were observed on 40 cars.

On February 29, 2024, the fleet-wide inspection campaign concluded with 100% of the Legacy fleet inspections completed and 24.71% with identified discrepancies. On March 1, 2024, CENV released Maintenance and Service Instructions (MSI) for all series rail cars on Collector Shoe Assembly component cleaning, inspection, and qualification procedures that were approved for assemblies with cracks found on mounting brackets.

Chronological Event Timeline

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

Time	Description
11:44:00 hours	Train ID 621 experienced a loss of Traction Motor Torque and Dynamic Braking beginning when the train departed Rosslyn Station while in approach to Foggy Bottom Station. [CMOR Analysis]
12:25:21 hours	Train ID 621 entered Downtown Largo Station on track 2. [AIMS]
12:30:10 hours	Train ID 621 changed to 638 when it departed Downtown Largo Station on track 2. [AIMS]
12:45:45 hours	Train ID 638 entered Stadium-Armory Station on track 2. [SPOTS]
12:46:59 hours	Train ID 638 departed Stadium-Armory Station on track 2. [SPOTS]
12:47:24 hours	Third rail power de-energized at Stadium-Armory Station on track 2. [AIMS]
12:47:36 hours	Third rail power re-energized at Stadium-Armory Station on track 2. [AIMS]
12:48:16 hours	Button RTC: Contacted the Power Desk and requested that they check Stadium-Armory Station, track 2 because “it just flashed on us.” Power Desk: Responded, “it’s fine Rate of Rise.” [Phone Bl/Or]
12:49:48 hours	Train ID 638 entered Eastern Market Station on track 2. [CCTV]
12:49:57 hours	The fire appeared as the third car entered the platform. [CCTV]
12:50:02 hours	An explosion occurred, causing smoke. [CCTV]
12:50:11 hours	AOM: Contacted the Button RTC and inquired if they saw Eastern Market, track 2. Instructed to hold trains 902, 434, 640 and 904, and contact the Power Desk. [Phone Bl/Or]

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

Time	Description
12:50:12 hours	Third rail power de-energized at Eastern Market Station on track 2. [AIMS]
12:50:20 hours	Train ID 638 stopped at the 8-car marker at Eastern Market Station. [CCTV]
12:50:26 – 12:50:53 hours	A series of explosions occurred, and customers began to evacuate the train and exit the station. [CCTV]
12:50:37 hours	Radio RTC: Advised to check Eastern Market Station, track 2. Power Desk: Responded, that they were working on it. Radio RTC: Advised, “it came back, but went out.” Power Desk: Responded, “something is going on there, we’re dispatching units.” [Phone Bl/Or]
12:50:34 hours	Station Manager: Reported located at Potomac Avenue Station (but meant they were located at Eastern Market Station), and the train on track 2 was arcing and on fire. [Phone, Communications]
12:50:34 hours	Train ID 902: Reported a lot of smoke at Potomac Avenue Station and turned off the EV. Radio RTC: Instructed the train at Potomac Avenue on track 2 to hold. Train ID 939: Reported located on track 1 and could see a lot of smoke. [Radio Ops 2]
12:50:50 hours	Communications Agent: Contacted the Button RTC and reported the train at Potomac Avenue on track 2 had an arcing insulator. [Phone Bl/Or]
12:51:00 hours	Third rail power re-energized at Eastern Market Station on track 2. [AIMS]
12:51:02 hours	Radio RTC: Inquired if Train ID 902 could see where the smoke was coming from. Train ID 902: Responded, negative and the train was not properly on the platform. [Radio Ops 2]
12:51:04 hours	Allied Security Officer: Reported located at Eastern Market Station, and the train towards Ashburn Station was on fire. [Radio MTPD 1X]
12:51:13 hours	Radio RTC: Reported an arcing insulator at Potomac Avenue Station on track 2. AOM: Instructed to offload Train ID 902. [Phone Bl/Or]
12:51:32 hours	SOCC: Contacted the Button RTC, advised an Officer reported a fire at Eastern Market Station. [Phone Bl/Or]
12:51:35 hours	MTPD Dispatch: Instructed units to report to Eastern Market Station. [Radio MTPD 1X]
12:51:46 hours	Station Manager: Reported located at Potomac Avenue Station (but meant they were located at Eastern Market Station) and requested fan activation. [Phone, Communications]
12:51:53 hours	Radio RTC: Inquired if Train ID 902 could see anything. Train ID 939: Reported yes and had shut off the EV. Advised heavy smoke ahead.(Located oat Potomac Avenue, track 1.) Radio RTC: Acknowledged. Instructed Train ID 902 to turn off the EV when properly berthed on the platform. [Radio Ops 2]
12:52:13 hours	Station Manager: Reported smoke in the station at Eastern Market Station. Advised that customers were exiting the station. Communications Agent: Instructed to close and exit the station. [Phone Communications 2]
12:52:42 hours	SOCC: Notified DCFEMS. [Phone SOCC 5B]

Time	Description
12:52:58 hours	Train ID 638: Reported an emergency; an explosion on the back of the train, and smoking. Radio RTC: Inquired if the train was properly berthed on the platform. Train ID 638: Responded, yes. Radio RTC: Instructed to offload the train. Train ID 638: Responded, already offloaded. Radio RTC: Acknowledged. Train ID 638: Advised they had not checked the trailing 2 cars. Radio RTC: Instructed to use caution and, if unsafe, do not check the trailing 2 cars. [Radio Ops 2]
12:53:32 hours	UPE inbound fans were activated at Eastern Market Station. Turned on to exhaust. [AIMS]
12:54:14 hours	UPE outbound fans were activated at Eastern Market Station. Turned on to exhaust. [AIMS]
12:54:09 hours	Radio RTC: Instructed Rail Supervisor #1 located at L'Enfant Plaza Station to respond to Eastern Market Station via MTPD. [Radio Ops 2]
12:54:14 hours	Radio RTC: Inquired if anything was impeding the movement of Train ID 427. Train ID 427: Responded that there was smoke in front of the train and stopped in the tunnel. Advised that a Security Officer was at the 8-car marker instructing to stop. Radio RTC: Instructed to turn off the EV, and Train ID 638 turn off the EV. [Radio Ops 2]
12:54:32 hours	MTPD Officer #1: Reported located at Eastern Market Station. [Radio MTPD 1X]
12:54:45 hours	MTPD Officer #2: Advised they would set up the Incident Command Post at 7th & Pennsylvania Avenue. [Radio MTPD 1X]
12:54:51 hours	AOM: Requested fans activated at Eastern Market Station. MOC Desk: Advised that according to the playbook, if they turn on Eastern Market Station fans, they must turn off Potomac Avenue Station fans, and then confirmed that they would turn the fans on at Eastern Market Station. [Phone Rail 2]
12:55:09 hours	MICC AOM: Contacted DCFEMS to have emergency responders dispatched. [Phone Rail 2]
12:55:09 hours	MTPD Officer #1: Reported passing the kiosk, heavy smoke in the station, and the station appeared to be cleared of customers. [Radio MTPD 1X]
12:55:36 hours	Radio RTC: Instructed Train ID 939 to confirm a clear track and continue to Stadium-Armory Station on track 1. Train ID 939: Responded, no smoke, and EV was off. [Radio Ops 2]
12:55:41 hours	Both inbound and outbound UPEs at Potomac Avenue Station were commanded off.
12:56:54 hours	FD6 Tunnel Fan (between Eastern Market Station and Potomac Avenue Station) commanded emergency off [AIMS] per Emergency Ventilation Playbook (EVP)
12:57:03 hours	DCFEMS arrived at Eastern Market Station. [CCTV]
12:57:04 hours	FD7 Tunnel Fan (between Eastern Market Station and Potomac Avenue Station) was commanded emergency off [AIMS] per Emergency Ventilation Playbook (EVP)
12:57:11 hours	Radio RTC: Instructed Train ID 902, located at Potomac Avenue Station on track 2, to offload. [Radio Ops 2]

Time	Description
12:57:21 hours	MTPD Officer #1: Reported the train was clear of customers. [Radio MTPD 1X]
12:58:13 hours	Radio RTC: Instructed Train ID 902 to turn off the EV and remain in the lead car. [Radio Ops 2]
12:58:41 hours	Radio RTC: Inquired if Train ID 427 had clear track and if anything was impeding the train movement. Train ID 427: Responded, yes heavy smoke in front of the train. Advised that the train had readouts. Radio RTC: Instructed Train ID 427 to continue and not to service Eastern Market Station. Train ID 427: Acknowledged. [Radio Ops 2]
12:59:32 hours	Train ID 427 entered Eastern Market Station on track 1 and did not stop. [CCTV]
12:59:44 hours	DCFEMS: Began conducting an inspection of the incident train and source of the smoke. [CCTV]
13:00:12 hours	Third rail power de-energized between Eastern Market Station and Capitol South Station on track 2. [AIMS]
13:00:28 hours	Radio RTC: Instructed the CMNT RM located at Stadium-Armory Station to respond to Eastern Market Station via MTPD. [Radio Ops 2]
13:02:39 hours	AOM: Instructed the RTC to have customers on Train ID 427 checked out since they were sitting in the tunnel. [Phone Communications 2]
13:03:45 hours	Rail Supervisor #1: Advised located at Eastern Market Station. [Radio Ops 2]
13:04:58 hours	Rail Supervisor #1: Advised the Radio RTC that they were with the On-Scene Commander. (MTPD) [Radio Ops. 2]
13:05:20 hours	Command Post established at 7th & Pennsylvania. [Radio Ops. 2]
13:09:00 hours	Both FD6 and FD7 Tunnel Fans changed to supply. [AIMS]
13:10:56 hours	MTPD Officer #2: Advised that Unified Command was established on 8th & Pennsylvania. [MTPD 1X]
13:11:28 hours	Rail Supervisor #1: Informed the Radio RTC that Unified Command was established on 8th & Pennsylvania. [Radio Ops. 2]
13:13:00 hours	Third rail power de-energized at Eastern Market Station on track 1. [AIMS]
13:13 – 13:19 hours	Radio RTC: Coordinated the movements of trains to keep service moving outside of the effected area. [Radio Ops. 2]
13:20:06 hours	Radio RTC: Asked Rail Supervisor #1 if they were at the Command Post. Rail Supervisor #1: Advised they were and would update them momentarily. [Radio Ops. 2]
13:20:18 hours	CMNT Personnel: Contacted the OM to inquire if someone was still transporting the CMNT RM from Stadium-Armory. OM: Advised MTPD was enroute to get them. [Phone Rail 1]
13:28:44 hours	Rail Supervisor #1: Contacted the communication agent to inquire if the Bus Bridge was established and provided their contact number for when it was. [Phone Communications]
13:31:24 hours	Metro 1: Contacted the Power Desk to inquire if Power personnel was on scene at Eastern Market Station. Power Desk: Advised Power personnel were with DCFEMS checking the Traction Power Room at Eastern Market Station, Eastern Market and Capitol South Tiebreaker Rooms, and both stations. [Phone Rail 1]

Time	Description
13:32:51 hours	MICC Assistant Director: Contacted the OM and instructed them to ensure ERT checked in with ICP because they got word, they didn't check in. [Rail 2]
13:34:59 hours	OM: Contacted the MOC desk to advise that DCFEMS were on the scene and wanted to change the fan configuration. [Phone Rail 1]
13:35:29 hours	FD7 Tunnel fan changed to exhaust. [AIMS]
13:38:32 hours	Incident Commander: Advised that Emergency communications switched to Radio Ops 6. [MTPD 1X]
13:39:24 hours	Radio RTC: Announced no train service between Potomac Avenue Station and Capitol South Station, and a bus bridge has been established. [Radio Ops 2]
13:39:58 hours	Incident Commander: Advised there were 6 people evaluated and 1 transported. CMNT, ERT, ATC, RTRA, BTRA, OEP, and MTPD all checked in at the Command Post. [Radio Ops 6]
13:41:12 hours	Blue block and human form in place at Eastern Market Station on track 2. [AIMS]
13:41:16 hours	DCFEMS exited the station to get ERT so they could begin their inspection. [CCTV]
13:42:00 hours	ERT entered Eastern Market Station with DCFEMS. [CCTV]
13:43:08 hours	MAC: Advised Power was de-energized on tracks 1 & 2 at Eastern Market. [Radio Ops. 6]
13:46:59 hours	MTPD: Contacted the Fire Liaison to advise there was still smoke at Potomac Avenue Station and one end still needs ventilation to clear the smoke. Asked if the fans were turned off. Fire Liaison: Advised they were focused on Eastern Market Station because that was the source of the smoke and where personnel were working. [Phone FLO]
13:51:07 hours	ERT: Contacted the Incident Commander to request CMNT personnel to assess the train. [Radio Ops 6]
13:52:37 hours	OEP Unit: Contacted the Incident Commander and provided a description of what they believed the issue was. [Radio Ops 6]
13:53:27 hours	OEP Unit: Advised the Incident Commander that they hot stick and replaced the DCFEMS WASAD. [Radio Ops 6]
13:55:11 hours	ERT: Contacted the Incident Commander to request Power personnel. Incident Commander: Informed ERT that Power personnel had not checked in at the Incident Command Post and were waiting on an ETA. [Radio Ops 6]
13:55:40 hours	MAC #1: Informed the Incident Commander that they were advised that Power personnel were on the scene. [Radio Ops 6]
13:58:01 hours	Both UPE inbound and outbound fans were activated at D07. Turned to exhaust. [AIMS]
13:59:00 hours	MAC #2: Received the Event Scene Release (ESR) from the WMSC. [Phone MAC]
14:00:24 hours	Incident Commander: Informed the MAC that Power personnel still had not checked in and DCFEMS was conducting a press conference if Media Relations were coming to check in at the Incident Command Post. [Radio Ops 6]
14:06:01 hours	ERT: Contacted the Incident Commander to request a Train Operator or Rail Supervisor to move the train. [Radio Ops 6]

Time	Description
14:11:43 hours	OEP Unit: Informed the Incident Commander that two Power personnel were on the platform, and they did not check in with Incident Command Post. [Radio Ops 6]
14:19:58 hours	Incident Commander: Contacted the ERT Unit to advise that DCFEMS were clearing to scene and needed confirmation that tracks 1 & 2 were clear of personnel so that power could be restored on track 2 only. ERT Unit: Confirmed all personnel were cleared from both tracks. [Radio Ops 6]
14:22:05 hours	Incident Commander: Contacted the MAC advised the DCFEMS were clearing the scene and the Incident Command would be turned over to Rail Supervisor #1. [Radio Ops 6]
14:23:08 hours	Incident Commander: Informed the MAC that it was safe to restore power on track 2 only. [Radio Ops 6]
14:25:09 hours	Incident Commander: Contacted the ERT Unit to inquire if it would be possible to restore power to track 1 to bypass the station. ERT Unit: Responded negative they were not sure if a negative return would occur on track 2. [Radio Ops 6]
14:38:12 hours	Human form was removed at Eastern Market Station on track 2. [AIMS]
14:43:12 hours	Third rail power was restored at Eastern Market Station on track 2. [AIMS]
14:44:24 hours	Blue block was removed at Eastern Market Station on track 2. [AIMS]
14:45:51 hours	MAC #1 Informed the Incident Commander that power was restored on track 2. [Radio Ops 6]
14:49:12 hours	Blue block and human form in place at Eastern Market Station on track 2. [AIMS]
14:50:06 hours	Incident Commander: Informed the MAC that third rail power could be restored on track 1 to bypass the station. MAC #1 Acknowledged. [Radio Ops 6]
15:07:48 hours	Third rail power was restored at Eastern Market Station on track 1. [AIMS]
15:09:00 hours	Third rail power de-energized at Eastern Market Station on track 2. [AIMS]
15:11:58 hours	Incident Commander: Informed the MAC that they were going to discontinue utilizing Radio Ops 6 and switch to Radio Ops 2 for all communications. [Radio Ops 6]
15:16:05 hours	Radio RTC: Advised Train ID 902 that they would be the first train to bypass Eastern Market Station. [Radio Ops 2]
15:19:06 hours	Radio RTC: Announced that trains would single track and would not service Eastern Market Station. [Radio Ops 2]
15:23:18 hours	Third rail power de-energized on track 2 at Eastern Market Station, and WSADs were reinstalled. [Radio Ops. 2]
15:26:48 hours	Train ID 902: Continued towards Vienna Station. [AIMS]
15:33:22 hours	Radio RTC: Announced that trains would service Eastern Market Station. [Radio Ops 2]
15:35:10 hours	Incident Commander: Informed the Radio RTC that power could be restored on track 1, and trains could service Eastern Market Station on track 1 only. [Radio Ops 2]
15:56:00 hours	Incident Commander: Informed the Radio RTC that the collector shoe assembly was removed from the roadway on track 2, WSADs were removed and requested third rail power restored to move the incident train. Radio RTC: Acknowledged. [Radio Ops 2]
16:02:00 hours	Third rail power was restored at Eastern Market Station on track 2. [AIMS]

Time	Description
16:17:48 hours	Blue block and human form were removed at Eastern Market Station on track 2. [AIMS]
16:18:16 hours	Radio RTC: Instructed Train ID 638 (738) to verify that signal D06-06 was lunar, granted a permissive block to the turnback, crossing over from track 2 to track 1 towards New Carrollton Yard. Rail Supervisor #2: Acknowledged and repeated. [Radio Ops 2]
16:19:53 hours	Incident Commander: Contacted the Radio RTC to advise the incident train had cleared the station and inquired if they were going to restore service on track 2. Radio RTC: Responded if the roadway was clear they would put the trains in service on track 2. [Radio Ops 2]
16:20:48 hours	Train ID 914 arrived at Eastern Market Station on track 1. [AIMS]
16:21:03 hours	Radio RTC: Announced that service was restored at Eastern Market Station on tracks 1 and 2. [Radio Ops 2]
16:23:36 hours	Train ID 640 arrived at Eastern Market Station on track 2. [AIMS]
16:44:45 hours	Train ID 638 (738) arrived at New Carrollton Station. [Radio NC-YD1]
16:47:59 hours	Train ID 638 (738) arrived at New Carrollton Yard and was secured on track 20 south. [Radio NC-YD2]

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

Digital Images and Photographs

Image 10 - The above photo shows the arcing location at Eastern Market Station, approximately 450 feet from the 8-car marker.

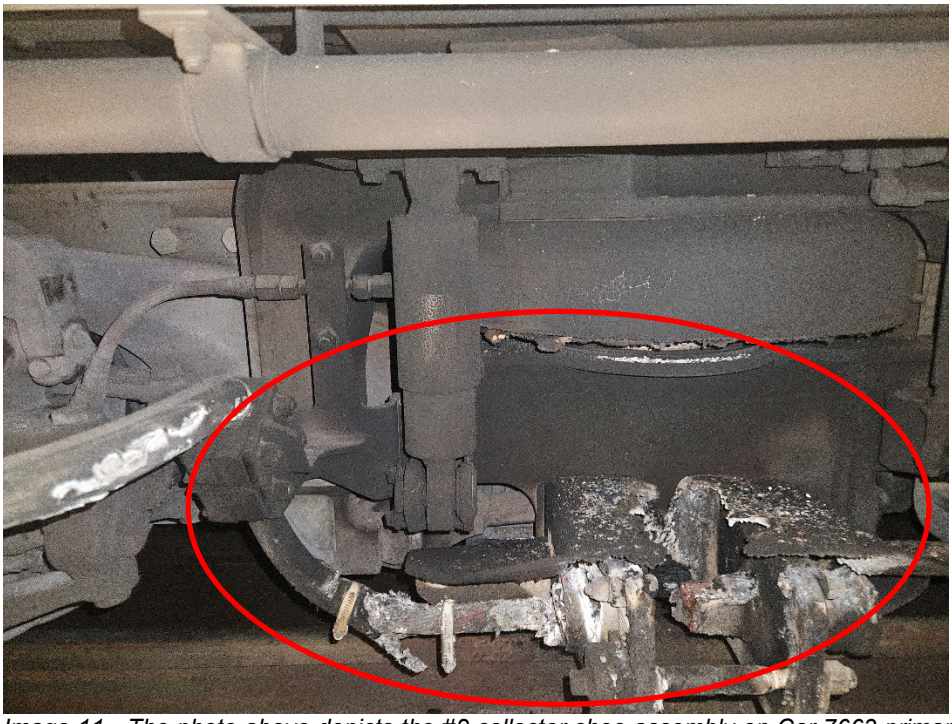


Image 11 - The photo above depicts the #2 collector shoe assembly on Car 7663 primary power cable and mounted collector shoe assembly affected by the arcing event.

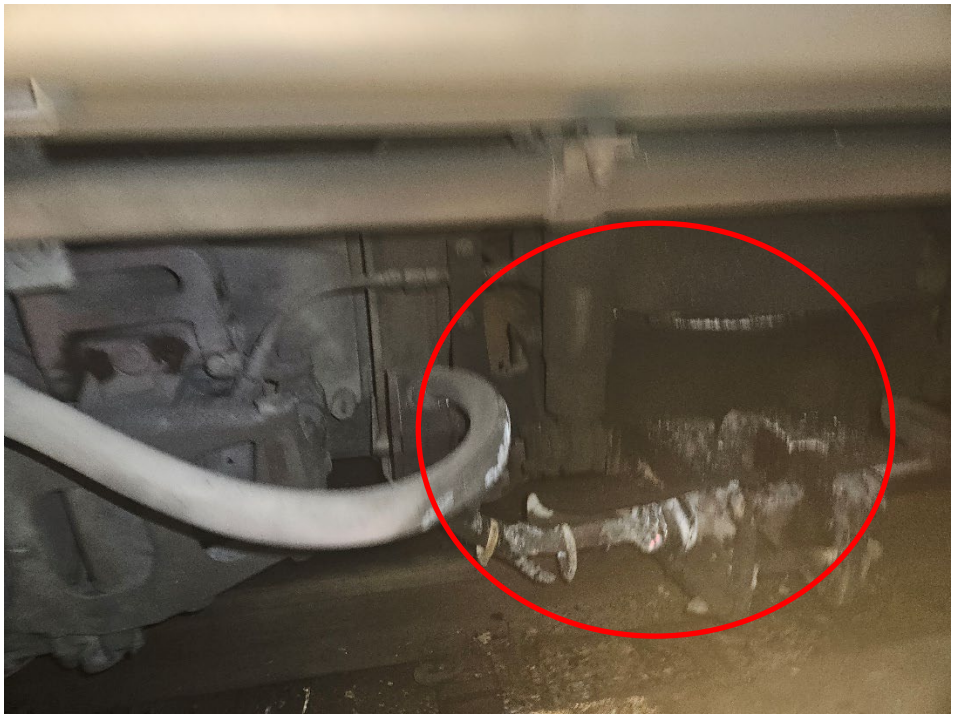


Image 12 - The above photo depicts a different angle of damage assessment of the #2 collector shoe assembly and power cable positioned on the front truck of Car 7663.

Image 13 - The above photo shows the collector shoe fuse dislodged from the missing collector shoe assembly and damage to the #6 brake disc on car 7663.

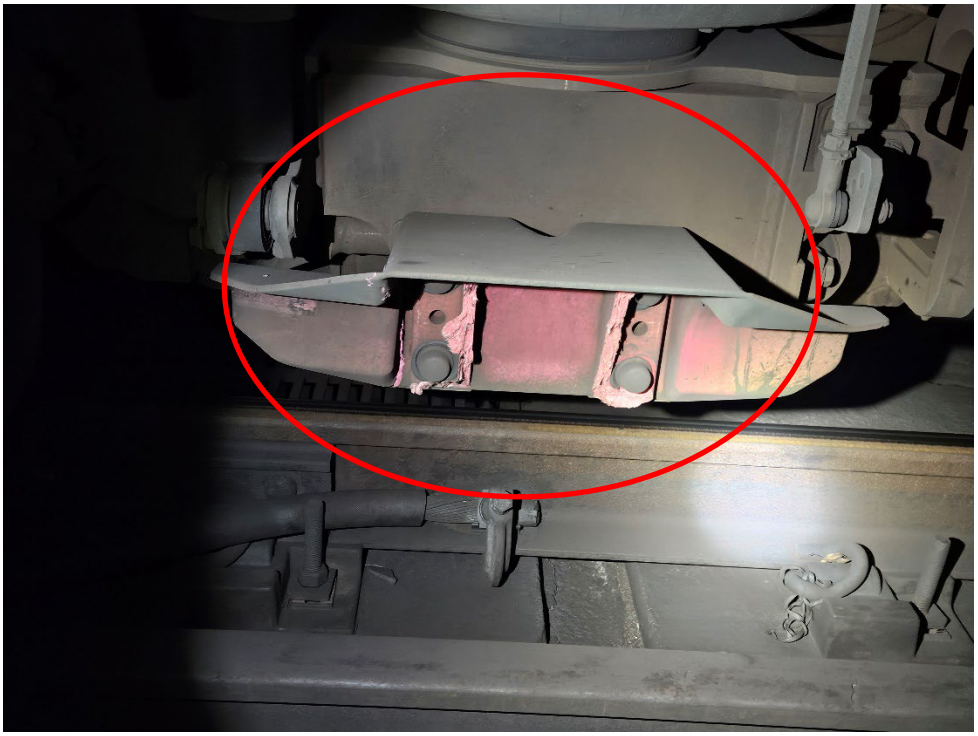


Image 14 - The above photo shows Car 7663 mounting bolts, fiberglass arc shield, and clean break, indicating Foreign Object Damage on the rear truck at the #4 collector shoe assembly position.

Image 15 - Shows the fire damage to the side of railcar 7663.

The Office of Chief Mechanical Officer (CMOR) / Vehicle Monitoring and Diagnostic System (VMDS)

Adopted from CMOR IIT report with minor formatting and grammatical edits:

The Incident Investigations Team (IIT) has completed the data download and initial investigation of Train ID 638, on rail cars L7104-05x7341-40x7663-62T, reported for smoke emitting from rail car 7663.

Based on ER data, Train ID 638 showed a loss of Traction Motor Torque and Dynamic Braking beginning when the train departed Rosslyn Station while in approach to Foggy Bottom Station at 11:44 on track 1, 1,896 feet before the station 8-Car marker (1,296 feet before station entry).

The VMDS logs show intermittent loss of third rail voltage around that same time. The train continued to exhibit intermittent propulsion traction torque and dynamic braking for the remainder of the trip to Largo Station.

Based on NVR video of the trailing car 7662, on the return trip towards Ashburn Station, after servicing Stadium-Armory Station on track 2, the train experienced an extreme arcing event at 12:47 hours. The ER data at that time shows the Traction Motor Torque and Dynamic Braking of car 7663 signals going low and remaining low, indicating a total loss of third rail power to rail car 7663.

During the undercar inspection, the #1 Collector Shoe fuse assembly on rail car 7663 was mostly disintegrated from excessive arcing.

The #4 Collector Shoe Assembly was found to be missing with the shoe fuse dangling, still attached to an approx. A 3-foot section of the primary cable, which was flashed open, separated from the remainder of the primary cable. There is evidence of flashing of the primary cable to the #6 brake disc.

The #4 Collector Shoe Assembly appears to have sustained damage from a foreign object.

IIT suspects: a wayside object made contact with the #4 Collector Shoe Assembly on rail car 7663, causing the assembly to break loose from the rear truck, which resulted in a dangling Collector Shoe Assembly, likely making contact with the running rail, creating a direct short to the ground. This caused the collector shoe fuses #2 and #3 from rail car 7663 to blow as indicated by blown shoe fuse indicators on that car.

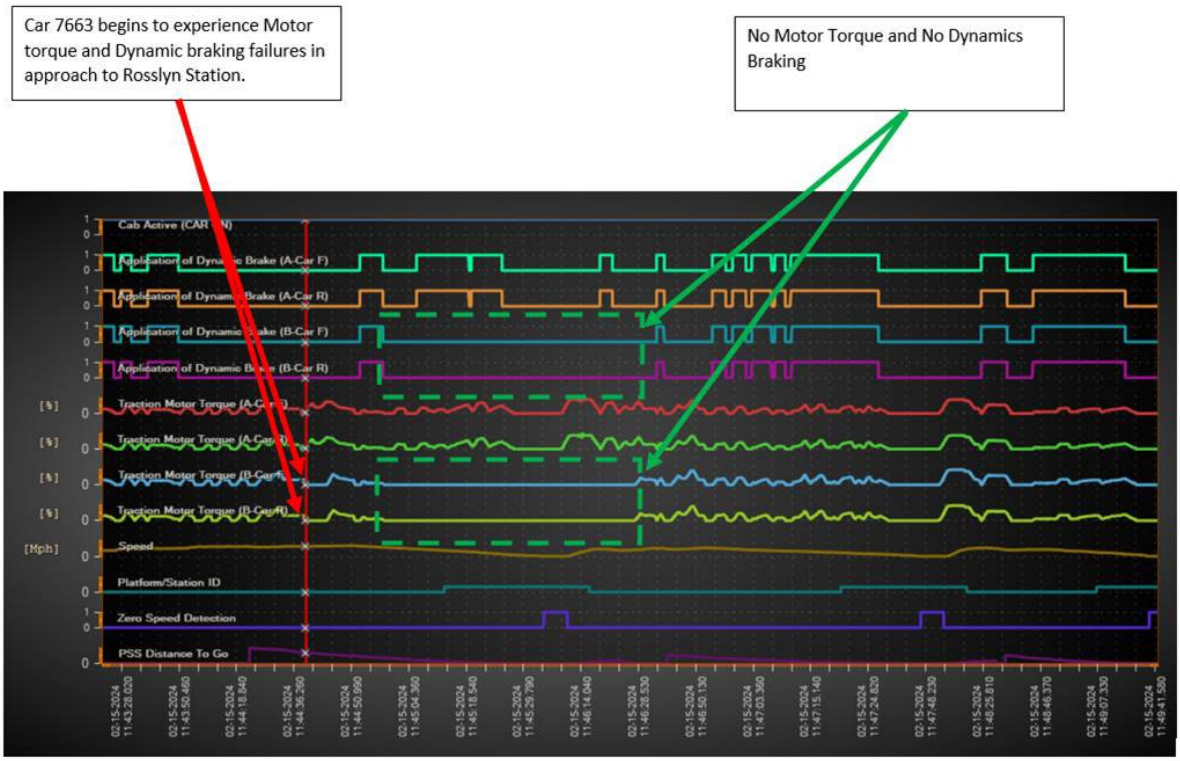
IIT also suspects the shoe fuse on the #1 collector shoe on car 7663 shorted to the ground, resulting in excessive arcing.

7662-63 VMDS Fault Logs:

7663	VMDS	MAIN	2/15/2024	17:45:11	2/15/2024	12:45:11	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:45:11	2/15/2024	12:45:11	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:45:06	2/15/2024	12:45:06	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:45:06	2/15/2024	12:45:06	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:43:15	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:43:15	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:43:15	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638

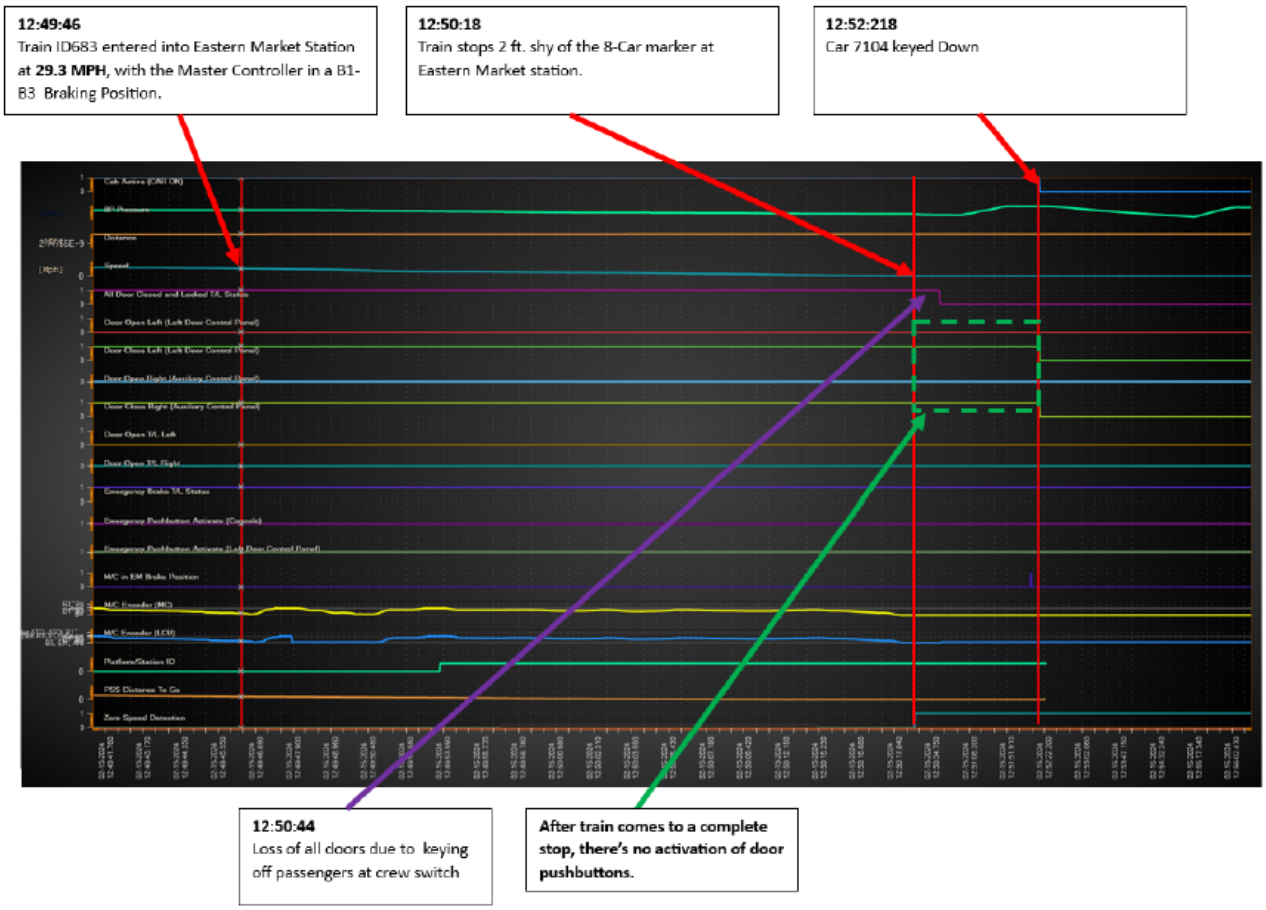
7663	VMDS	MAIN	2/15/2024	17:43:15	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:35:20	2/15/2024	12:35:20	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:34:58	2/15/2024	12:34:58	APS	APS002	NO THIRD RAIL VOLTAGE		2	638
7663	VMDS	MAIN	2/15/2024	17:34:30	2/15/2024	12:34:30	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:34:30	2/15/2024	12:34:30	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:34:26	2/15/2024	12:34:26	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:34:26	2/15/2024	12:34:26	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:32:32	2/15/2024	12:32:32	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:31:33	2/15/2024	12:31:33	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:31:33	2/15/2024	12:31:33	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:31:30	2/15/2024	12:31:30	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:31:30	2/15/2024	12:31:30	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:31:25	2/15/2024	12:31:25	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:31:25	2/15/2024	12:31:25	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:31:23	2/15/2024	12:31:23	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:31:23	2/15/2024	12:31:23	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:31:12	2/15/2024	12:31:12	APS	APS002	NO THIRD RAIL VOLTAGE		2	638
7663	VMDS	MAIN	2/15/2024	17:30:38	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:30:38	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	638
7663	VMDS	MAIN	2/15/2024	17:30:38	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7663	VMDS	MAIN	2/15/2024	17:30:38	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	638
7662	VMDS	MAIN	2/15/2024	17:26:44	2/15/2024	12:26:44	EVENT	EVT001	CONTROL LOCK KEY ON	Reset	3	1000
7663	VMDS	MAIN	2/15/2024	17:23:20	2/15/2024	12:23:20	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:22:54	2/15/2024	12:22:54	APS	APS002	NO THIRD RAIL VOLTAGE		2	621
7663	VMDS	MAIN	2/15/2024	17:20:28	2/15/2024	12:20:28	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:16:00	2/15/2024	12:16:00	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:16:00	2/15/2024	12:16:00	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:16:00	2/15/2024	12:16:00	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:15:59	2/15/2024	12:15:59	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:13:09	2/15/2024	12:13:09	APS	APS002	NO THIRD RAIL VOLTAGE		2	621
7663	VMDS	MAIN	2/15/2024	17:12:47	2/15/2024	12:12:47	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:12:47	2/15/2024	12:12:47	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:12:44	2/15/2024	12:12:44	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:12:44	2/15/2024	12:12:44	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:11:46	2/15/2024	12:11:46	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:11:34	2/15/2024	12:11:34	APS	APS002	NO THIRD RAIL VOLTAGE		2	621
7663	VMDS	MAIN	2/15/2024	17:11:28	2/15/2024	12:11:28	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:11:28	2/15/2024	12:11:28	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:11:24	2/15/2024	12:11:24	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:11:24	2/15/2024	12:11:24	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:09:42	2/15/2024	12:09:42	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	621

7663	VMDS	MAIN	2/15/2024	17:05:36	2/15/2024	12:05:36	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:05:36	2/15/2024	12:05:36	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:05:32	2/15/2024	12:05:32	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:05:32	2/15/2024	12:05:32	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:00:13	2/15/2024	12:00:13	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:00:13	2/15/2024	12:00:13	PROPULSION	PRP009	NO DYNAMIC BRAKE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	17:00:11	2/15/2024	12:00:11	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	17:00:11	2/15/2024	12:00:11	PROPULSION	PRP009	NO DYNAMIC BRAKE		2	621
7663	VMDS	MAIN	2/15/2024	16:57:04	2/15/2024	11:57:04	APS	APS002	NO THIRD RAIL VOLTAGE		2	621
7663	VMDS	MAIN	2/15/2024	16:54:20	2/15/2024	11:54:20	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	621
7663	VMDS	MAIN	2/15/2024	16:51:10	2/15/2024	11:51:10	APS	APS002	NO THIRD RAIL VOLTAGE		2	621
7663	VMDS	MAIN	2/15/2024	16:46:26	2/15/2024	11:46:26	APS	APS002	NO THIRD RAIL VOLTAGE	Reset	2	621
7663	**VMDS**	**MAIN**	**2/15/2024**	**16:46:00**	**2/15/2024**	**11:46:00**	**APS**	**APS002**	**NO THIRD RAIL VOLTAGE**		**2**	**621**



Cars 7105-05 VMDS Fault LOG NO HVAC SHUT DOWN FAULTS LOGGED

7105	VMDS	MAIN	2/15/2024	17:59:51	2/15/2024	12:59:51	DOOR	DOR003	DOOR EXTERIOR EM HANDLE	Reset
7104	VMDS	MAIN	2/15/2024	17:52:33	2/15/2024	12:52:33	EVENT	EVT001	CONTROL LOCK KEY ON	Reset
7105	VMDS	MAIN	2/15/2024	17:51:21	2/15/2024	12:51:21	DOOR	DOR003	DOOR EXTERIOR EM HANDLE	
7104	VMDS	MAIN	2/15/2024	17:50:46	2/15/2024	12:50:46	EVENT	EVT102	AIR SUPPLY INOPERATIVE	Reset
7104	VMDS	MAIN	2/15/2024	17:50:46	2/15/2024	12:50:46	BRAKE	BRK017	INSUFFICIENT AIR SUPPLY	Reset
7104	VMDS	MAIN	2/15/2024	17:50:46	2/15/2024	12:50:46	BRAKE	BRK017	INSUFFICIENT AIR SUPPLY	Reset
7104	**VMDS**	**MAIN**	**2/15/2024**	**17:50:43**	**2/15/2024**	**12:50:43**	**EVENT**	**EVT051**	**LOAD SHEDDING STAGE A**	**Reset**
7104	VMDS	MAIN	2/15/2024	17:50:32	2/15/2024	12:50:32	EVENT	EVT102	AIR SUPPLY INOPERATIVE	
7104	VMDS	MAIN	2/15/2024	17:50:31	2/15/2024	12:50:31	BRAKE	BRK017	INSUFFICIENT AIR SUPPLY	
7104	VMDS	MAIN	2/15/2024	17:50:31	2/15/2024	12:50:31	BRAKE	BRK017	INSUFFICIENT AIR SUPPLY	
7104	**VMDS**	**MAIN**	**2/15/2024**	**17:50:05**	**2/15/2024**	**12:50:05**	**EVENT**	**EVT051**	**LOAD SHEDDING STAGE A**	



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

Vehicle Program Services (CENV)

"On February 15th, 2024, WMATA experienced an incident involving train ID 638 (**L 7104-05 X 7341-40 X 7663-62 T)** where current collector assembly #4 broke off from the rear truck of car 7663. This incident caused excessive current to flow through the primary high voltage cables of both the front and rear trucks, resulting in a rapid increase in temperature, fire, and arc flash that damaged surrounding components in the railcar.

Following the incident, WMATA initiated an investigation to determine the potential root cause of the current collector assembly #4 breaking off from the truck on railcar 7663. The investigation was conducted in collaboration with various WMATA internal departments, including Traction

Power (POWER), Track and Structures TRST, and RTRA, SAFE, MICC and external parties Kawasaki Railcar (KRC), TransTech (current collector original equipment manufacturer, and Applied Technical Services. The investigative efforts included railcar and third rail inspections, data analysis of the incident train, fleet-wide inspection of collector assemblies, analysis of TGV data, third rail testing (using an instrumented 7000 series railcar), and laboratory testing of sample current collector assemblies.

The investigation identified several contributing factors to the incident, such as the susceptibility of the collector mounting brackets to fatigue and fracture under increased load magnitude and frequency, and areas of the revenue tracks with high end approaches. The susceptibility of the collector mounting brackets was exacerbated by the high-end approaches and track perturbations on revenue lines, introducing higher than desired loads at a higher than desired frequency. This led to an investigation of the operating condition of the revenue lines' third rail, identifying areas requiring corrective maintenance to comply with the Track and Structures Standards (TRST 1000). Furthermore, railcar maintenance procedures were updated to require detailed inspections and overhauls of collector shoe assemblies.

WMATA has taken steps to mitigate future occurrences of similar incidents. These steps include revising the fleet periodic inspection maintenance manual (Task 60) to include inspection of damages to the collector shoe assembly structures, creating a collector assembly overhaul procedure, updating the TRST 1000 to include modified end approach criteria and specifications for wide/narrow third rail gauges based on results from the third rail test, TGV analysis, and track structures inspections.

Additionally, WMATA has established a working group between Fleet and TRST to monitor both railcar and track variables and address issues as they arise."

CENV conclusion, based on the inspections, data analysis, and testing conducted, this incident was the result of several contributing factors, the operating environment of the railcar, and the need for enhanced maintenance practices by both FLEET (rail cars) and TRST.

Fleet Services has replaced the current collector assemblies that exhibited surface cracks.
TRST has replaced track components such as grout pads, third rail cover boards, face plates, and adjusted the end approach height to allowable range per the TRST 1000 standards at various locations on the mainline.

FLEET, and TRST have updated respective maintenance manuals to proactively monitor third rail integrity (height and gauge alignment) and the condition of collector shoe assemblies. These updates aim to mitigate excessive damage to current collector assemblies when railcars are operating on the mainline.

Line	Height and Acceleration Exceptions				
	Hard Bounce - Dip	Hard Bounce - End Approach	Hard Bounce – Mid-rail	High Rail	
Green	1	6	1	4	12
Yellow	2	1	0	7	10
Blue	2	6	3	45	56
Orange	17	10	2	25	54
Silver	0	0	10	0	10
Red	5	1	9	31	46
Total	27	24	25	112	188

Figure 14, Shoe Height, and Acceleration Exceptions

CONCLUSION AND RECOMMENDATIONS

The test results revealed several locations across the system that exceed WMATA's internal track standards for high rail (6" max). These sections also introduce hard bounces to the current collector which could damage the current collector assembly. For the full report and recommendations, refer to Attachment B

Currently, no maintenance criteria exist to maintain short length of 3rd rail dips at expansion joint locations, but criteria will be developed to mitigate these hard impacts to the current collector assemblies.

Figure 11 - The above depict describes findings of third rail height measurements found during inspection.

Office of Track and Structures (TRST)

On February 15, 2024, ERT performed a walking inspection between Foggy Bottom and Court House on track 1 after revenue service. The team observed signs of equipment being drug between Foggy Bottom and Rosslyn, about four to six hundred feet west of the platform at Foggy Bottom Station in the direction of Rosslyn Station.

- The inspection team observed one (1) recently broken insulator at C1 75+20.
- Fractured pieces of plastic from what appeared to be off a collector shoe assembly between the 3rd rail and the right running rail between C1 76+00 to 77+00.

Image 16 – Image of the first fragments of the broken collector shoe assembly at CM C1 76+00 – 77+00.

- From C1 76+00 to 79+00 the team discovered scuffs on the invert and several chipped 3rd rail insulator grout pads from equipment being dragged recently.

Image 17 – Image of the scuffs along the invert and third rail grout pad.

Following these findings, TRST engineering utilized a TGV to inspect the entire metro rail system to verify third rail height measurements, which later identified third rail defects. The TRST engineering group identified high third rails in the incident locations improperly installed, which contributed to the collector shoe damage but not the root cause.

TRST Engineering and TRST reviewed the TRST 1000 Third Rail Maintenance Manual and noted that it was unclear and incorrect. TRST is procuring a third rail height tool to measure the third rail height with energized power and modifying the current TRST 1000 standards.

Office of Rail Transportation (RTRA)
Adopted from RTRA report with minor grammatical and format edits:

RTRA investigated the event and determined the Train Operator was not at fault based on the nature of the event and utilized just culture. The Train Operator and Station Manager will be enrolled in refresher training to review emergency procedures, with emphasis on the Importance of keying down when departing the cab area, the Proper way(s) to disembark and embark trains, Activating manual pull station in the kiosk which triggers the 'evacuation' PA Announcement.

Interview Findings
As part of the investigation launched into the event, SAFE interviewed thirteen (13) people. The interviews identified the following key findings associated with this event. The 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 638

- The Train Operator stated that they picked up the train at Court House Station and operated it to Downtown Largo Station.
- They departed Downtown Largo Station on their return trip to Court House Station when the incident occurred.
- The Train Operator stated that when they arrived at Eastern Market Station, the train began to slow down and stopped not too far from the 8-car marker. Then the train lost power, and the lights went out.
- The Train Operator stated that the security officers were saying that the back of the train was smoking, and when they looked back further, they saw explosions.
- The Train Operator said they climbed out of the cab window, then back in, and unlocked the lead car door with their key.
- The Train Operator stated that they continued to move down the train and used the emergency door release to open the train doors.
- The Train Operator stated they had no knowledge of train issues, and no one reported any issues with the train.
- The Train Operator stated that they did not try to open the doors, talk on the radio, or make announcements because the train lost power, the lights on the console were dying out, and the lights inside the train started going out.
- The Train Operator stated that they tried to get the customers off the train before making the report to the MICC, and it took approximately 30 seconds to open the doors.

Train Operator – Train ID 427

- The Train Operator certified as a Train Operator in December 2023.
- The Train Operator is assigned to Alexandria Division and has only operated on the Blue Line since certifying as a Train Operator.
- The Train Operator was completing their second-round trip at the time of the incident.
- They saw a Security Officer at the 8-car marker waving them to stop as they approached Eastern Market Station.
- As they waited, they saw smoke in Eastern Market Station.
- The Train Operator was instructed to turn off the EV system.
- The Train Operator was instructed not to service Eastern Market Station and proceed to the next station.

Station Manager – Eastern Market

- The Station Manager stated that they have been in the Station Manager for four (4) years.
- The Station Manager stated they have been employed at WMATA for 21 years.
- The Station Manager stated that Eastern Market is assigned one (1) Station Manager.
- When asked if there was a Positive Alarm Sequence System (PASS) at Eastern Market Station, the Station Manager was unsure. Once the Station Manager was informed that it was part of the Fire Alarm System, they believed there should be one at Eastern Market Station.
- The Station Manager stated they were sitting inside the Station Manager kiosk when the incident occurred. They heard a "loud boom," stood up, observed a train entering the station, and witnessed electrical arcing. The Station Manager stated a second "loud boom occurred followed by more electrical arcing.
- The Station Manager stated they called communication agent, notified them of the incident, and requested assistance.
- The Station Manager stated that they did not manually trigger the fire alarm. They believed the smoke in the station triggered the system automatically.
- The Station Manager recalled hearing the automated station evacuation message playing over the public address system.
- The Station Manager stated that there were two (2) Allied Security Officers assigned to patrol the platform area at Eastern Market.
- The Station Manager stated that the two (2) Allied Security Officers and the Train Operator from the incident train were directing customers to the station's Mezzanine level. The Station Manager directed customers from the Mezzanine level to the street level.
- The Station Manager stated the kiosk is equipped with a bullhorn, Public Address (PA) system and a wireless microphone. The PA system and wireless microphone are tested daily.
- The Station Manager stated that they made announcements over the PA system, informing customers that there was an emergency in the station, they must exit the station, and the station was closing. They did not recall mentioning a fire being the reason for the evacuation on the PA system.
- The Station Manager stated that they did not go to the platform level during the incident. They stood near the Mezzanine level escalators directing customers to the street level
- The Station Manager stated that they asked the Allied Security Officers if the platform was clear of customers and were informed that it was. The Station Manager stated they attempted to go to the platform to verify but were unable enter to due to the heavy smoke.
- The Station Manager stated that it is their responsibility to identify customers who were involved, sick or injured. However, the Rail Station Supervisor (RSS) would be the person to gather the customer information, if possible. If they were unable to get any information from the customer, they would reach out to the Fire Department personnel at the scene.
- The Station Manager stated that they believe that having the assistance of the two (2) Allied Security Officers helped to evacuate the station faster than if only the Station Manager and Train Operator were the only employees on location.

<u>MICC – Rail Section</u>

Metro-1

- oversees the entire Metro Integrated Command and Communications Center, to ensure there are no silos of information between the different departments, and to keep Executive Leadership updated on any issues or areas of concern within the bus and rail system.

- Metro-1 stated they are stationed on the Command Line with the Fire Liaison Officer (FLO), Mission Assurance Coordinator (MAC), Rail-1, Bus-1, Metropolitan Transit Police Department (MTPD-1), and COMMS-1.
- Metro-1 stated that Executive Leadership is given frequent updates via a TEAMS chatgroup; also, depending on the event, a conference call may be warranted.
- Due to the length of time between the incident date to the interview date Metro-1 was unable to give a full and accurate account of the event.
- Metro-1 stated that OPS-6 radio channel utilization is directed by the MAC.
- Metro-1 stated that the OPS-6 channel is not used for every incident.
- Metro-1 did not recall asking for tunnel fans to be activated for the incident at Eastern Market.
- Metro-1 stated that if there was smoke in the station and there were customers aboard the train, the train should not have passed through the station. However, they could not give a reasonable answer without looking at the AIMS playback to see if there was a train at the previous station.
- Normally the RTC informs field operations when the MAC is utilizing OPS-6 channel and instructs them to switch channels.

MICC OM – Rail 1

- The OM stated that they were first made aware of the incident at Eastern Market when they saw on AIMS that third rail power had de-energized at Eastern Market.
- The OM stated that this occurs sometimes when 7000 series railcars draw too much energy, causing the breakers to open un-commanded. However, these instances are very brief.
- The OM heard RTCs inform the Train Operator to offload the train. There was a newly certified student RTC operating the radio.
- The OM stated that initially due to the two (2) reported incidents, trains were being moved out of the area.
- The OM requested a bus bridge from BUS 1 on the Command Line.
- The OM contacted PLNT (MOC) to have the tunnel fans turned on.
- It was confirmed that there was no incident at Potomac Avenue, and the MICC staff identified the incident location solely at Eastern Market Station.
- Once a ground walkaround was performed at Eastern Market, a damaged collector shoe assembly hanging from the right side of the train was identified as the possible causal factor.
- The OM stated that train service was suspended once DCFEMS arrived on location.
- The OM believed Train ID 427 was instructed to turn off their EV and continue on.
- The OM stated the instruction for the Train Operator to continue would have come from the Radio RTC.
- The OM stated that there was a good service plan in place to remove trains from the affected area.
- The OM believed Metro 1 informed Executive Leadership, however, the Executive Leadership came into the MICC, to the Command Line, for more details.
- The confusion in the beginning was whether to activate the fans at Potomac Avenue Station.
- The OM went to MOC and stated that the tunnel fans should be activated and was told that the correct configuration was activated according to the playbook.
- The OM stated they FLO also did not like the fan configuration and thought it should be changed.
- The fan configuration was then changed at the request of the FLO and DCFEMS on scene.

- The OM stated they have a rule that when an emergency takes place, METRO 1 must open a conference call within the first 10 minutes of the incident.

MICC AOM #1

- AOM #1 stated when they initially heard of the incident at Eastern Market, they went down to the floor but now in the MICC the RTCs wear headsets so it can be difficult hearing the radio transmissions.
- AOM #1 said there was a newly certified RTC on the radio, so they wanted them to verify the radio transmission because the initial report was smoke at Potomac Avenue Station, track 2 but third rail power had dropped at Eastern Market Station, track 2.
- AOM #1 said its uncommon for third rail power to drop under a train, but it is common for third rail power to drop between Eastern Market to Stadium-Armory Stations.
- AOM #1 said they called to have DEFEMS dispatched.

MICC AOM #2

- AOM #2 stated that in the MICC, the RTCs are required to wear headsets, and this limits the AOMs ability to hear what is being said between the RTCs and personnel.
- The original Radio RTC was a newly certified controller and had not managed a major incident of this nature.
- AOM #2 left from behind their desk without their handheld radio, which sits directly behind Ops.2 to instruct a more experienced RTC, to take over the incident.
- AOM #2 could not recall Train ID 427 waiting in the tunnel for an extended period of time.
- AOM #2 mentioned there is a fan ventilation activation playbook that PLNT uses to determine the correct fan configuration.

Radio RTC

- The Radio RTC stated that they have been a Rail Traffic Controller for four (4) years.
- The Radio RTC stated that they were training a new RTC at the time the incident occurred.
- The Radio RTC stated that they felt moderately alert during the incident.
- The Radio RTC stated that they usually work as a pair but may work alone when short-staffed.
- The Radio RTC stated that they were informed of the incident by the incident Train Operator, who reported hearing “a loud noise or explosion”
- The Radio RTC stated that they do not receive Fire Alarm activity notifications and does not request Fire Department assistance.
- The Radio RTC stated that when the Incident Commander arrived on the scene, the emergency operations communications were changed to channel 6 (OPS 6). At that time, the RTC was no longer managing the incident, but continued to manage rail vehicle movement.
- The Radio RTC stated that circuit breakers at Eastern Market were flashing “uncommanded open” for approximately a week prior to this incident. The RTC is not sure if there is any correlation to this incident. The RTC stated that a work order ticket was put in with the Power department.
- The Radio RTC stated that the circuit breakers at Stadium-Armory on Track 2 flashed “uncommanded open” for a short while, the day before the incident. The Power department was informed about the event.

- The Radio RTC stated that they did not receive any reports of arcing or smoke prior to the incident at Eastern Market
- The Radio RTC stated that they believed they asked the Train Operator of Train ID 427 if they were properly berthed at the station and then instructed the Train Operator to keep their doors closed and continue past the station.
- The Radio RTC stated that they were not aware if the Train Operator reported the smoke condition in approach to Eastern Market or once they arrived at the station.
- The Radio RTC stated that Rail Management was present when decisions were being made regarding rail movement during the incident.

FLO

- The FLO stated there are required baseline training for Metro, as well as completing a workbook with various scenarios such as medical, smoke in the station, smoke in a tunnel, etc.
- The FLO said their main responsibility is to monitor calls and react to any notification of any type of incident that occurs in the Metro system, whether it be medical or fire-related.
- The FLO said the first notification of the incident was from the MTPD Sergeant, who sits two desks away from them.
- The MTPD Sergeant thought they heard an Allied Security Officer come over the radio and say something about arcing or smoke in the station or that the train was on fire.
- The FLO said they do not make any decisions; they relay information from the Incident Commander to Metro's personnel in the MICC.
- The MAC would give the FLO pieces of information, and then the FLO would make the transmission over the radio or over the phone so the MAC would never communicate directly with the Incident Commander.
- The FLO said they do not have a copy of the fan ventilation playbook and were never trained to determine the configurations using it.
- The FLO said they do not have an Ops. 6 radio terminal, so any information that comes from them would just be relayed to the MAC, which would then utilize Ops. 6.

Maintenance 1

- Maintenance 1's responsibility is to manage and maintain incidents that occur with Communications, ATC, PLNT, or TRST.
- Maintenance 1 supervises the four Controllers at those respective department desks.

Fan Controller/Maintenance Controller

- The Maintenance Controller stated that there are four (4) department desks within the Power Operations Section of the MICC, including ATC, Communications, PLNT, and TRST.
- Each Desk Controller is cross-trained to answer each department's inquiries.
- The PLNT desk's duties and responsibilities are to send resources for any PLNT-related issues reported by Station Managers and to check the Preventative Maintenance Inspections being performed on the fan systems, including tunnel fans, inbound and outbound dome fans, and jet fans.
- The Maintenance Controller stated that when fan activation is requested, they must gather as much information as possible: the station, the location, whether on the platform or in the tunnel, the nearest chain marker number, and the direction that the train is headed.

- That information is used to configure and exercise the fans according to the Fan Activation Playbook.
- The Fan Activation Playbook determines which fan configuration is used depending on the situation and location.
- The Maintenance Controller stated that they do not deviate from the playbook unless directed by the Fire Department on the scene.
- The Maintenance Controller stated that when a fan configuration outside the playbook is requested, their supervisor and the Operations Manager are notified.
- The request is documented on their Tunnel Fan Form.
- The Maintenance Controller stated the initial reports of smoke in the station were at Potomac Avenue. In the middle of configuring the fan at Potomac Avenue, the location of the smoke was identified as Eastern Market.
- The Maintenance Controller believes that during the incident, some managers may have been worried that the smoke was not dissipating quickly enough and may have wanted something else to be done.
- The Maintenance Controller stated that they did not deviate from the playbook until the request was made by the on-scene Fire Department.

<u>OEP</u>

MAC #1 (AM Shift)

- The MAC #1 said when the incident occurred, the MAC #2 had just relieved them of their duty. Once it was confirmed that there was an active incident, they remained to assist.
- The MAC #1 said the MAC desk was experiencing technical issues with their computer when the incident intially started. The MAC #1 contacted Information Technology (IT) for support.
- The MAC #2 continued coordinating the event response.
- The FLO had their computer open and had begun looking at the CCTV cameras at the affected station.
- The MAC #1 said they observed a train was stopped in a portal near the incident for approximately 10 minutes and brought it to the attention of Metro 1.
- The MAC #1 asked if the train could reverse ends away from the incident station, and the train, Train ID 427, was moved immediately after.
- The MAC #1 stated that the Rail Operations Control Center (ROCC) Director requested an update from the Command Line regarding the number of people injured while the MAC #2 was managing the incident due to receiving conflicting information.
- They stated that the ROCC Director became “confrontational” with the MTPD 1 due to receiving conflicting information.
- The MAC #1 observed the ROCC Director make a request of the FLO regarding restoring power so the incident train issue could be examined.
- This was the first time they observed the Director at the Command Line during an incident.
- The MAC #1 stated they asked the FLO if DEFEMS on scene performed a walkthrough of the incident train because they only observed a platform inspection.
- The FLO informed the MAC #1 that DEFEMS completed its primary search for life safety and would perform a walkthrough inspection of the train during its secondary search.
- The MAC #1 said they made a request to have Train ID 427 reverse ends to the platform away from Eastern Market, but did not receive an answer from Metro 1.

MAC #2 (PM Shift)

- When the PM MAC arrived at the MICC to relieve the MAC #1, the initial reports began coming in. The MAC #1 said the MAC desk was experiencing technical issues with their computer
- Reports of the incident at Eastern Market began coming through towards the middle of the AM and PM MAC's information handoff.
- The PM MAC stated that during the shift change, they received reports from either the Train Operator or Station Manager that there was smoke in the station, possibly from an arcing insulator, underneath the train at Eastern Market.
- The PM MAC heard the Station Manager give instructions to evacuate the station.
- They requested MTPD and DCFEMS to respond to the location.
- They also notified CMNT, ERT, and Power desk of the incident to deploy resources.
- The PM MAC stated DCFEMS arrived on the scene approximately five (5) minutes after the initial dispatch and set up an Incident Command Post (ICP), at 8th Street SE and D Street SE outside of the rail station.
- The PM MAC requested Bus 1 to start a bus bridge.
- At approximately 13:26 hours, the PM MAC stated according to their notes Power and ERT were on location at Eastern Market, however Power did not report to the ICP to check in with the Incident Commander.
- DCFEMS treated nine (9) individuals. One (1) person was transported to the hospital. There was some initial confusion on the amount of people transported, due to conflicting reports coming from both the FLO and MTPD.
- The PM MAC stated that they contacted the Washington Metrorail Safety Commission (WMSC) and received an ESR at approximately 13:59 hours.
- A conversation was held regarding single tracking. ERT expressed concerns with a negative energy return on the opposite track.
- The MAC #1 did state that there was a lot of confusion and chaos in the MICC due to additional personnel outside of the command line being in the area.

<u>CMNT</u>

Road Mechanic

- The CMNT Road Mechanic stated that they have been a Road Mechanic for ten years.
- The CMNT Road Mechanic stated that they have been employed at WMATA for 35.5 years.
- The CMNT Road Mechanic stated that they are stationed at Stadium-Armory Station
- The CMNT Road Mechanic stated that they were fully alert during the incident.
- The CMNT Road Mechanic stated that when the incident occurred, they received a call from their supervisor directing them to go to Eastern Market. They were told a MTPD unit would pick them up at the street level at Stadium-Armory and escort them the Eastern Market.
- The CMNT Road Mechanic stated that they arrived at Eastern Market, and reported to a Road Mechanic Supervisor at the Incident Command Post.
- The CMNT Road Mechanic stated that they were not allowed to enter Eastern Market Station for approximately one-half hour after they arrived on scene.
- The CMNT Road Mechanic stated that they did not experience any radio communication issues.
- The CMNT Road Mechanic stated that they were informed by the Emergency Response Team (ERT) of collector shoe assembly damage on the non-platform side of the railcar. The damage on the non-platform side was observed by the CMNT and ERT walking along the metal light fixture cover. The CMNT RM performed a ground walkaround of the rail

vehicle and observed additional collector shoe assembly damage on the platform side of the rail vehicle. The damage on the platform side was observed by looking into the space between the train and the platform.
- The CMNT Road Mechanic stated they did not see or smell any signs of arcing when the power was restored.
- The CMNT Road Mechanic stated that once power was restored, the train was moved forward off of the platform so a visible inspection of the platform side could be performed.
- The CMNT Road Mechanic stated that they observed a loose collector shoe power cable on the platform side. They secured the power cable. Once the power cable was secured third rail power was re-energized.

TRST

Track Emergency Response (ERT) Roadway Worker In Charge (RWIC)

- The ERT RWIC stated that their roles and responsibilities in ERT are to respond to Emergencies and report their findings to the MICC MOC and Upper Management.
- ERT's main job function is track maintenance. This may include cracks in the running rail, broken fasteners, and third rail issues.
- The ERT RWIC stated that when they arrived on the platform at Eastern Market, the incident train was still berthed at the platform. They were unable to check the tracks while the train was still at the platform. They were able to look at some identified problem areas from aboard the train.
- A roadway safety briefing was conducted by the Incident Commander.
- The ERT RWIC recounted several instances of negative return on de-energized roadways.
- At Eastern Market Station, based on the ERT RWIC's experience, the request was made to halt single tracking and requested a red tag lockout.
- The ERT RWIC stated that the request for a red tag lockout was denied.
- The ERT RWIC stated that their manager contacted them and informed them that it was safe to begin single-tracking.
- Once single tracking began, Incident Command was transferred to Rail Operations.
- ERT performed a track inspection on the incident track and found no defects.

Track Emergency Response (ERT) Specialist #1

- ERT Specialist #1 stated that ERT Specialist are required to respond to all track related emergencies.
- ERT Specialist #1 stated that they communicated solely with their ERT Supervisor (RWIC)
- ERT Specialist #1 stated that they were on standby until the incident train could be moved out of the area.
- ERT Specialist #1 stated they were not involved in any conversation regarding negative current returns.
- The ERT Specialist #1 stated that once the incident train was moved from the location, they performed a track inspection from Eastern Market to Potomac Avenue Station.

Track Emergency Response (ERT) Specialist #2

- The ERT Specialist #2 stated that they had to stand by until they were given authorization to enter Eastern Market Station. They stated that they waited approximately 30 minutes until they were allowed to enter the station.

- The ERT Specialist #2 stated they did not experience any radio communication issues during the incident.
- Once they arrived at the station platform, they waited again for Car Maintenance to inspect the incident train and for the train to be moved in order for them to conduct a track inspection.
- The ERT Specialist #2 stated that no track defects were identified once the track inspection was completed.
- ERT Specialist #2 stated they were not involved in any conversation regarding negative current returns or single tracking.
- ERT Specialist #2 stated that during the recovery phase, their job was to inspect the track and check for debris.

Senior Vice President (MICC)

Incident Timeline

- The smoke incident at Eastern Market occurred on April 24, 2024, with the initial notification received at 1520 hours.
- The source of the smoke was identified as arching on the tracks, resulting in smoke accumulation on the platform.

Evacuation Response

- Upon observing the smoke, the station was evacuated, and the affected train was offloaded for safety.
- Ventilation systems were activated to clear smoke from the platform area.

Emergency Coordination

- The Metro Integrated Command and Communication Center worked with emergency services to establish a bus bridge for continued transportation between key locations.
- Coordination was maintained with multiple departments to ensure a seamless response and avoid disruption to other services.

Restoration of Service

- Power on the track was restored in phases, with single-tracking resuming at 15:20 hours and full power restoration occurring at 16:01 hours.
- Following power restoration, a thorough inspection was conducted to identify and address the cause of the arching and collector assembly loss.

Communication and Safety

- During the incident, there were extensive communications at various command levels to ensure safety and proper restoration of service.
- The senior vice president reported that communication was calm and professional, with no elevated voices or unsafe demands.
- The focus remained on adhering to standard operating procedures (SOPs) to ensure the safety of passengers and staff.

Incident Follow-Up

- Further inspection and assessment were conducted after the incident to identify underlying causes and prevent future occurrences.

- The senior vice president highlighted the importance of maintaining clear communication with all stakeholders to ensure a coordinated response in case of emergencies.

Human Factors

Fatigue

Signs and Symptoms of Fatigue

The biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied for this event.

Fatigue Risk

The biomathematical fatigue modeling application (SAFTE-FAST Web SFC) was not applied for this event.

Post-Incident Toxicology Testing

No post-incident testing was conducted for this event because neither the Train Operator nor the Station Manager was found to be at fault.

Weather

At the time of the incident, NOAA recorded the temperature at 45° F, with overcast skies, winds of 14 mph, and 42% humidity. This event occurred within a tunneled section of the system. The weather was not a contributing factor in this incident (Weather source: NOAA – Location: Washington, DC).

Related Rules and Procedures

Standard Operations Procedures (SOP)
678 - Procedure for Managing Fire and Smoke on the Metrorail System

Metrorail Operating Rules (MOR)
3.85 Train Operators who observe smoke in their immediate area are authorized and required to shut off the train's Environmental (EV) System and inform ROCC.

Additional Collector Shoe Assembly Events

There were other incidents in February involving collector shoe assemblies, the summaries of which are below.

On Sunday, February 11, 2024, at 04:23 hours, a CMNT Supervisor reported to the Shady Grove Yard Interlocking Operator that the #2 Collector Shoe Assembly on rail car 7191 (L7028/29x7089/88x7278/79x7191/90T), located on track 20, was dislodged, leaving the power cable hanging on the third rail. IIT completed an analysis and determined that the lead car 7028 was 1,070 feet away from Twinbrook Station on track 2 when rail car 7191 lost Traction Power and Dynamic Braking. TRST performed a track inspection between Twinbrook Station and Rockville Station at 23:10 hours and reported recovering the Collector Shoe Assembly near chain marker (CM) A2 735+00.

On Wednesday, February 14, 2024, at 07:22 hours, the Station Manager located at Smithsonian Station reported to the MICC that the train on track 1 had an object hanging from a rail car, causing damage to the third rail. At Potomac Avenue Station, a CMNT Road Mechanic was dispatched to inspect Train ID 621 (L7744/45x7569/68x7556/57x7677/76T). The CMNT Road Mechanic reported that the Collector Shoe Assembly on the rear truck of railcar 7677 was dislodged, the power cable was hanging, and additional collector shoe damage on the front truck. TRST performed a track inspection at L'Enfant Plaza Station at 08:43 hours and reported recovering the Collector Shoe Assembly and collector shoes on track 1.

On Wednesday, February 28, 2024, at 14:12 hours, the Train Operator of Train ID 833, a non-revenue, four-car consist (L3291/90x3164/95T), reported hearing a loud bang as the train entered the platform limits at Waterfront Station on track 2. A CMNT Road Mechanic was dispatched to inspect and then reported observing the #1 Collector Shoe Assembly hanging from railcar 3291. The Road Mechanic secured the hanging Collector Shoe Assembly to allow the train to continue to Branch Avenue Yard. ERT performed a track inspection between Waterfront Station and L'Enfant Plaza Station on track 2. During the track inspection, no foreign objects were found. However, signs of dragging and pieces of the collector shoe assembly, with markings on the third rail cover board, were observed within the platform limits at Waterfront Station.

Findings

- CENV identified a cracked collector shoe assembly on car 7663 at the mounting bolt locations
- The consist incurred a loss of Traction Motor Torque and Dynamic Braking prior to the event.
- Intermittent third-rail power as Train ID 638 departed Stadium-Armory Station.
- Rail car 7663 began to exhibit sparking and produced smoke after departing Stadium-Armory Station and through Potomac Avenue Station.
- Upon entering Eastern Market Station, sparks and fire ignited beneath rail car 7663, causing smoky conditions.
- The Train Operator remained keyed up in the lead car as they assisted customers with exiting the train.
- The fare gates were closed, making it difficult for customers to evacuate the station.
- Two (2) Allied Security Officers were on the platform and assisted with the train and station evacuation.
- Twenty-six customers evacuated Train ID 638.
- The Station Manager did not activate the Manual Pull Station within the kiosk.
- Train ID 427 remained stationed outside the platform limits of Eastern Market Station on track 1 for seven minutes after reporting smoke ahead of the train.
- Train ID 427 was instructed to bypass Eastern Market Station after ensuring the train's EV system was switched off.
- The Train Operator of Train ID 427 felt it was unsafe but followed the instructions of the Radio RTC.
- Unified Command was established in accordance with the IMF Framework.
- Challenges with fan configuration were observed during the event.
- Emergency communications were transferred to Radio Ops 6, although all responding personnel did not have access to Ops 6. All responding personnel should have access to ops 6.
- All emergency response teams provided a timely response.

Immediate Mitigation to Prevent Recurrence

- Third-Rail Power De-energized: As a safety precaution, the power to the third rail was turned off, allowing emergency personnel to access the station and train safely.
- Station Evacuation: The station was evacuated promptly to ensure customer safety and allow emergency personnel to assess the situation.
- Fan Activation: The Under-Platform Exhaust (UPE) fans were activated to clear smoke from the station and adjacent areas.
- Bus Bridge Implementation: To maintain transportation services, a bus bridge was established between Federal Center SW Station and Stadium-Armory Station.
- Unified Command: A unified command structure was established to coordinate the response between MTPD, DCFEMS, and other relevant departments.
- Train service was suspended.
- Emergency personnel were dispatched to the scene.
- Preliminary inspection of the train and track area was conducted.
- Post-Incident Hot Wash was conducted.
- The consist was transported to New Carrollton Yard for post-incident inspection.
- The Track Geometry Vehicle (TGV) was utilized to identify any track abnormalities.
- CENV initiated a fleet-wide campaign to inspect collector shoe assemblies.
- RTRA issued an Operations Personnel Notice on Identifying and Reporting Power and Propulsion Issues.

Probable Cause Statement

The probable cause of the February 15, 2024, evacuation for life safety reasons at Eastern Market Station was a cracked collector shoe mounting rail bracket on car 7663, which led to the dislodgement of the collector shoe assembly. This dislodgement caused excessive current to flow through the primary high voltage cables, resulting in a rapid temperature increase, fire, and arc flash resulting in a smoke in condition.

Contributing Factors:

- Improper Third Rail Installation: Variances in third rail height were due to unclear or incorrect maintenance standards outlined in the TRST 1000 Track Standards Manual. The manual lacked clear guidelines for measuring third-rail end approach heights.

- Susceptibility of Collector Mounting Brackets: The collector mounting brackets were prone to fatigue and fracture under increased load magnitude and frequency.

- High-End Approaches and Track Perturbations: Areas of the revenue tracks had high-end approaches and track perturbations, which introduced higher loads at a higher frequency than desired, exacerbating the issue.

WMATA's corrective actions aim to address these contributing factors and prevent future incidents by improving inspection protocols, updating maintenance standards, and enhancing coordination between departments. Measures include revising the fleet periodic inspection maintenance manual to include detailed inspections and overhauls of collector shoe assemblies, updating the TRST 1000 standards to include modified end approach criteria and specifications, and establishing a working group to monitor both railcar and track variables.

Eastern Market Station was misaligned third rail height due to unclear or incorrect maintenance standards. The TRST 1000 Track Standards Manual lacked specific guidelines for measuring third-rail end approach heights for WMATA system design.

This inconsistency in third rail height caused the collector shoe assembly to make contact with the misaligned end approach and dislodge from rail car 7663. This led to intermittent power loss, sparking from a damaged primary power cable, and ultimately, arcing, fire, and smoke, which necessitated the evacuation of Eastern Market Station.

Recommended Corrective Actions

Corrective Action Code	Description	Responsible Party	Estimated Completion Date
[114802]_SAFECAPS_CMNT_001	Conducted a fleet-wide campaign to inspect collector shoe assemblies and identify cracks or fractures in the plastic mounting brackets MSI 100001.	CENV	Completed
[114802]_SAFECAPS_RTRA_001	Issued an Operations Personnel Notice on Identifying and Reporting Power and Propulsion Issues.	RTRA	Completed
[114802]_SAFECAPS_RTRA_002	Train Operator to attend refresher training to review emergency procedures, emphasizing the importance of keying down the train when departing the cab area, and the proper way(s) to disembark and embark trains.	RTRA	Completed
[114802]_SAFECAPS_RTRA _003	The Station Manager to attend refresher training to review emergency procedures, with an emphasis on activating the manual pull station in the kiosk and making proper PA announcements.	RTRA	Completed
[114802]_SAFECAPS_TRST _001	TRST will inspect and correct any improperly installed Third Rail within the rail system.	TRST	Completed
[114802]_SAFECAPS_TRST _002	TRST will update the TRST 1000 Third rail maintenance manual to reflect the correct measurement and installation procedures	TRST	Completed
[114802]_SAFECAPS_TRST _003	TRST will procure third rail height measuring tool.	TSRT	Completed
[114802]_SAFECAPS_MICC _001	Develop a procedure for initiating incident coordination calls	MICC	Completed
[114802]_SAFECAPS_OEP _001	Through the COG Fire Chiefs Committee, add the WMATA Fan playbook to the upcoming meeting's agenda and determine what follow-up actions are required.	OEP/Fire Marshal	Completed
[114802]_SAFECAPS_OEP _002	Facilitate a coordination meeting with DCFEMS to review ventilation configurations at Eastern Market station.	OEP	Completed
[114802]_SAFECAPS_ SAFE/TRST_001	A JHA will be conducted for installation of third rail.	SAFE/TRST	Completed [12]

[12] This corrective action is completed; however, contingent on rule change, TRST 100 revision and third rail measuring tool procurement.

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

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 638

The Train Operator is a WMATA employee with eight years of service and nine months of experience as a Train Operator. The Train Operator was recently certified as a Train Operator in May 2023.The Train Operator holds a Roadway Worker Protection (RWP) Level 2 certification that expires in March 2024.

During the formal interview, the Train Operator stated that they picked up the train at Court House Station and operated to Downtown Largo Station. The Train Operator stated that they did not notice any issues with the train when they initially departed Court House Station. When they departed Downtown Largo Station and was headed back to Court House Station is when the incident occurred.

The Train Operator stated that everything was going fine after they departed Downtown Largo Station. The Train Operator stated that when they arrived at Eastern Market Station the train began to slow down on its own and stopped not too far from the 8-car marker, then the train lost power, and the lights went out. The Train Operator stated that they looked out of the cab window and saw security guards on the platform, and thought they were coming to ask for the Train ID.

The Train Operator stated that the security officers were saying that the back of the train was smoking, and when they looked back further, they saw explosions. The Train Operator stated that they thought it was a terrorist attack.

The Train Operator stated that the train did not have power, and they could not open the train doors. The Train Operator stated that they climbed out of the cab window, then climbed back in the cab window, and unlocked the lead car door with their key. The Train Operator stated that they continued to move down the train and used the emergency door release to open the train doors. The Train Operator stated that the last two doors were already open, and there was heavy smoke. The Train Operator stated that a customer informed them that they had pulled the emergency door release.

The Train Operator stated that they did not have any knowledge, and no one reported any issues with the train. The Train Operator stated that when they arrived outside Eastern Market Station, a customer was recording and told them that they were aboard the fourth or fifth car and said that the flashing started at Stadium-Armory Station, a little bit at Potomac Avenue Station, then it flared up at Eastern Market Station, and showed them the video of flashing against the wall while the train was moving. The Train Operator stated that the customer with the video began to do press interviews. The Train Operator stated that they reviewed the video, and it appeared to be an arcing insulator.

When asked if the Train Operator could open the doors, talk on the radio, or make announcements, The Train Operator stated that they didn't and did not try because the train lost

power, the lights on the console were dying out, and the lights inside the train started going out. The Train Operator stated that they were in panic mode when they saw the explosions.

The Train Operator stated that they tried to get the customers off the train before making the report to the MICC, and it took approximately 30 seconds to open the doors.

Train Operator – Train ID 427

The Train Operator of Train ID 427 is a WMATA employee with nine and half years of service and three months as a Train Operator. The Train Operator was recently certified as a Train Operator in December 2023. The Train Operator is Roadway Worker Protection (RWP) Level 2 certified and must recertify by August 2024. The Train Operator reported feeling fully alert right before the incident.

During the formal interview, the Train Operator stated that they worked the day shift in the week leading up to the incident. The Train Operator has been assigned to the Alexandria Division since they were certified as a Train Operator. The Train Operator said they had a positive training experience. The Train Operator said the most challenging aspect of the training was radio communication.

The Train Operator has only operated on the Blue line since certifying as a Train Operator. The Train Operator was completing their second-round trip as they approached Eastern Market Station. As they approached Eastern Market Station, they saw a Security Guard at the 8-car marker telling them to stop. Once they stopped, they heard the other Train Operator reporting an emergency. The Train Operator said while they were stopped, they saw smoke midway on the platform, but the smoke kept moving towards them. The Radio RTC instructed them to turn off their EV system.

The Train Operator said they saw the smoke increase as they waited for instructions. They said the Radio RTC never asked if it was safe or not to proceed through Eastern Market Station. They said there was never a discussion about reversing ends and going back to the previous station. The Train Operator said they were instructed not to service Eastern Market Station and proceed to the next station. The Train Operator felt it was unsafe but followed the instructions of the Radio RTC.

Station Manager – Eastern Market

The Station Manager is a WMATA employee with 21 years of service and 4 total years of experience as a Station Manager. The Station Manager holds a Roadway Worker Protection (RWP) Level 2 certification that expires in December 2024.

During the formal interview, the Station Manager stated that they pick their assigned work locations by seniority preference. The Station Manager has been assigned to Eastern Market for almost one (1) year. Eastern Market is assigned one (1) Station Manager

The Station Manager was asked if there was a Positive Alarm Sequence System (PASS) at Eastern Market Station. The Station Manager was not sure what that was. Once the Station Manager was informed that it was part of the Fire Alarm System, they believed there should be one at Eastern Market Station.

They were sitting inside the Station Manager kiosk when the incident occurred. They heard a “loud boom”, stood up, observed a train entering the station, and witnessed electrical arcing. The Station Manager stated a second “loud boom occurred followed by more electrical arcing. They called the communication agent and notified them of the incident and requested assistance.

They did not manually trigger the fire alarm. They believed the smoke in the station triggered the system automatically. They recalled hearing the automated station evacuation message playing over the public address system.

There were two (2) Allied Security Guards that were assigned to patrol the platform area at Eastern Market. The two (2) Allied Security Guards and the Train Operator from the incident train were directing customers to the Mezzanine level of the station. The Station Manager was directing customers from the Mezzanine level to the street level.

The Station Manager kiosk is equipped with a bullhorn, Public Address (PA) system and a wireless microphone. The PA system and wireless microphone are tested daily. The Station Manager stated that in the event of an emergency, such as fire or smoke in the station, the following automatic processes take place: the fare gates open, the elevator goes to the street level, the elevator doors remain open, and the escalator shuts off.

They made announcements over the PA system, informing customers that there was an emergency in the station, they must exit the station, and that the station was closing. They did not recall mentioning a fire being the reason for the evacuation over the PA system. The Station Manager stated that they did not go to the platform level during the incident. They stood near the Mezzanine level escalators directing customers to the street level.

They met with the Train Operator and the two (2) Allied Security Guards near the escalator when they came up to the Mezzanine level. They asked the Allied Security guards if the platform was clear of customers and were informed that it was. The Station manager stated they attempted to go to the platform to verify but were unable enter to due to the heavy smoke.
They were standing outside of the station when the Fire Department arrived.

The Station Manager was asked whose duty or responsibility it is to track or identify customers during an incident. The Station Manager stated it is typically their responsibility to identify customers who were involved in an incident; those who are sick or claiming injury. However, the Rail Station Supervisor (RSS) would be the person to gather the customer’s contact information, if possible. If they were unable to get any information from the customer, they would reach out to the Fire Department personnel at the scene.

They believe that having the assistance of the two (2) Allied Security Guards helped them to evacuate the station faster than if only the Station Manager and Train Operator were the only employees on location.

MICC – Rail Section

Rail Traffic Controller - Radio

The Rail Traffic Controller is a WMATA employee with 4 years of service and 4 total years of experience as a Rail Traffic Controller. The Rail Traffic Controller holds a Roadway Worker Protection (RWP) Level 4 certification that expires in May 2024.

During the formal interview, the Rail Traffic Controller stated that their last RTC certification was in July of 2023. They currently work in the Metro Integrated Command & Communications (MICC) center. The primary roles and responsibilities of the Radio RTC are to be the line of communication for personnel out in the field on that particular Operations radio channel.

They felt moderately alert during the incident. RTCs usually work in pairs (a radio RTC and a Button RTC) but may work alone when short-staffed, but that rarely occurs. The duration for one (1) RTC working alone is usually from one-half hour up to an hour. They may work an entire shift working both the button and the radio, depending on employee availability.

During an incident the Radio RTC still maintains communication for the MICC with staff in the field. Train Operators, Supervisors dispatched to the incident, and other personnel working in the area.

They were informed of the incident at Eastern Market by the incident Train Operator who reported hearing a loud noise or explosion.

The Radio RTC stated that the Advanced Information Management System (AIMS) does not inform the RTC of smoke conditions in the system. It only informs the RTC of damages occurring on the roadway. RTC does not receive Fire Alarm activity notifications and does not request Fire Department assistance. The Radio RTC stated that the communications agent might receive that information and distribute it to the RTC.

RTC Incident Management training is limited to 1. Initial Certification, 2. Annual Refresher Training, and 3. Training received to review certain incidents and scenarios in order to maintain their certification.

There are different checklists for various types of “smoke” incidents (e.g., smoke in the station, smoke on the train, or smoke in the tunnel), which would activate different levels of evacuation. These checklists are not submitted to a manager at the end of the incident; they are used just to ensure everything runs smoothly.

When asked about the procedure when a Train Operator reports a smoke condition ahead, the RTC stated the Train Operator should be instructed to stop, reverse ends, turn around, and have the Environmental Controls (EV) turned off on the rail vehicle to prevent smoke from entering the railcar. The RTC also dispatch supervisors as close as possible to the incident location, evacuate people in the affected area, prevent other rail vehicles from entering the area, and ensure the Fire Department and Transit Police have been dispatched.

When asked if there is ever an occasion where a train can proceed through a station with smoke present the RTC answered, “If they can, yes”.

The Radio RTC recalled a train in approach to Eastern Market on track 1 had attempted to service the station but continued on without servicing. All Train Operators were instructed to turn off their EV systems.

Once the Incident Commander arrived on the scene, the emergency operations communications were changed to channel 6 (OPS 6). At that time, the RTC was no longer managing the incident, but continued to manage rail vehicle movement.

When asked to walk through the events that occurred at Eastern Market the RTC Radio stated there was a train on track 2 at Eastern Market that reported hearing a loud bang. This was the incident train. They believe there were two (2) trains behind the incident train reporting seeing smoke. One was off the platform, and one was at the station behind Eastern Market. There was a train in approach to Eastern Market on track 1 that also reported smoke conditions ahead. The RTC began turning trains around on track 2. The train on track 1 continued through Eastern Market. All other trains were turned around. The train in the station behind Eastern Market was off-loaded and held on the platform. Eastern Market Station was then evacuated. A bus bridge was established from Stadium-Armory to an unknown station. Once the station was cleared and the train on track 1 was out of the area, the incident channel was changed to OPS 6. Trains were being rerouted through the D&G Junction on track 1 before reaching Eastern Market.

The Radio RTC was asked if they remained the RTC when the OPS 6 channel was relinquished, and if they were in communication with the RTRA Supervisor that was appointed the Incident Commander at that time, the RTC stated they did not believe they were.

At the time the incident occurred, they were training a new RTC when the Radio RTC was asked if it was considered to have Train ID 427, in approach to Eastern Market, reverse ends away from the station once they reported a heavy smoke condition ahead; The RTC stated that they did not recall if it was considered by all who were involved at the MICC. They did recall asking the Train Operator if they were properly berthed at the station, instructing them to keep their doors closed, do not service Eastern Market, and proceed to the next station. The Train Operator continued without servicing. Several Train Operators from different locations reported seeing smoke. The Radio RTC does not recall if the Train Operator reported seeing the heavy smoke in approach to the station or while they were at the platform. Rail Management was in the MICC during the incident and provided input and asked for advice on rail vehicle movement.

When asked if the RTC recalled any transmissions regarding issues leading up to the incident at Eastern Market from any trains at the previous station the RTC stated that circuit breakers at Eastern Market were flashing “uncommanded open” for approximately a week prior to this incident. The RTC is not sure if there is any correlation to this incident. The RTC stated that a work order ticket was put in with the Power department. The RTC also stated the circuit breakers at Stadium-Armory on Track 2 flashed “uncommanded open” for a short while the day before the incident. The Power department was informed about the event. The RTC did not receive any reports of arcing or smoke prior to the incident at Eastern Market.

The RTC does not recall when the Eastern Market incident was moved to OPS 6. The RTC do not receive any advanced notification. The On Scene Commander establishes the channel once a Command Post has been established. The RTC believes OPS 6 was started being used in late 2023.

The RTC expressed concerns with the radio communication system. They stated some transmissions can be clearly heard on different channels which may lead to someone taking the

incorrect instructions. The quality of radio transmissions varies constantly. Another concern is the breakers un-commanded open not being repaired in a timely manner.

Operations Manager (OM) – RAIL 1

The Operations Manager is a WMATA employee with 9.5 years of service and 2 months of experience as an OM. The OM holds a Roadway Worker Protection (RWP) Level 4 certification that expires in September 2024.

During the formal interview, the OM stated that:

On the date of the incident, they started working at 05:30 hours. The OM stated that their title in the MICC is Operations Manager. However, their role in the MICC is RAIL 1. RAIL 1 oversees all rail operations within the MICC. Their daily duties are to coordinate with the FLO, MAC, METRO 1, COMMS 1, and BUS 1 on the Command Line as a Unified Command to resolve incidents and relay information to various departments. RAIL 1 manages rail operations. Metro 1 manages all operations in the MICC. Metro 1 receives information from the other department and reports that information to Executive Leadership. All rail operations must go through RAIL 1. Assistant Operations Managers (AOM) report directly to the OM.

The OM stated that they were first made aware of the incident at Eastern Market when they saw on the monitor that third rail power had de-energized at Eastern Market. The OM stated that this occurs sometimes when 7000 series railcars draw too much energy, causing the breakers the open un-commanded. However, these instances are very brief.

The OM waited for the breakers to close, and when they did not, they went to their desk, monitored both the OPS 2 radio channel and their computer, and began drafting their notifications for the Command Line. While drafting the notifications, they received a report of smoke at Potomac Avenue Station. The OM was listening to the radio in an effort to ascertain if there was any correlation to the incidents reported at two separate stations. Approximately two minutes later, Train ID 638 Train Operator went directly over the radio, announced “emergency, emergency, emergency,” and reported a loud explosion from their train. The OM heard RTCs inform the Train Operator to off-load the train. A newly certified RTC was operating the radio. The OM asked a more experienced RTC to take over radio operations. Information continued to come into the MICC. Train Operators were instructed to turn off their Environmental Controls (EV) due to the reported smoke.

The OM stated that initially, due to the two (2) reported incidents, trains were being moved out of the area. Trains were being turned around at the Federal Center and Stadium-Armory, and the Assistant Operations Managers (AOM) began suspending service. Potomac Avenue Station was not being serviced due to the initial report of smoke at the station. The OM requested a bus bridge from BUS 1 on the Command Line. The OM also contacted PLNT (MOC) to have the tunnel fans turned on. The OM then reported the information they obtained to METRO 1. The initial suspicion was an arcing insulator event had occurred. It was confirmed that there was no incident at Potomac Avenue, and the MICC staff identified the incident location solely at Eastern Market Station. Once a ground walkaround was performed at Eastern Market, a damaged collector shoe assembly hanging from the right side of the train was identified as the possible causal factor.

The OM stated that train service was suspended once DCFEMS arrived on location. When they were given permission to start single tracking, single tracking began after the smoke dissipated. CMNT requested to move the train off the platform in order to secure loose cables in order for the train to be sent to the yard. Once the train was moved, CMNT secured the cable, and the train was sent to the yard.

The OM was asked about Train ID 427 which was stopped outside of Eastern Market Station during the incident and the Train Operator reported visible smoke outside of the train. The OM stated from their recollection this was in the beginning stages of the incident when they were collecting information attempting to narrow down the incident location. They believe the Train Operator was instructed to turn off their EV and continue on. The OM stated the instruction for the Train Operator to continue would have come from the Radio RTC.

The OM stated that the environment in the MICC on the date of the incident was operating normally until the incident occurred. The Metro 1 and two (2) AOMs were on duty. When the incident began the OM reported their findings to the METRO 1 and the Command Line. The Metro 1 reports that information to Executive Leadership.

The OM states that usually every situation is chaotic until more information evolves, and the situation unfolds. Once the information was obtained, the OM stated that there was a good service plan in place to remove trains from the affected area. Silver Line trains were being turned around at Clarendon Station and a bus bridge was established quickly. All train stations other than those with reported events were being serviced.

The OM stated that although no incident is perfect, there is always something to take away from each event. However, they believed the AOMs and RTCs performed their job pretty well.

The OM believes Metro 1 informed Executive Leadership. However, the Executive Leadership came into the MICC to the Command Line for more details. They were on their cellphones providing updates to their Leadership. The OM believes that it did become somewhat chaotic with the additional people at the Command Line making requests and wanting questions answered.

The OM stated that when Executive Leadership arrived in the MICC the incident was in a stable state. It was unusual for the Executive Leadership to come down to the MICC floor because, typically, they do not. They believe due to the severity of the incident involving the smoke and videos of the incident being displayed on social media prompted the visit to obtain the information in real-time rather than receiving updates from METRO 1.

When asked if there was any confusion regarding the ventilation fan configuration at Eastern Market, the OM stated that in the past, the RTC was responsible for activating fans. Maintenance Operations Center (MOC) PLNT personnel operate the tunnel fans based on the information provided in an incident playbook. The OM reiterated that they did contact MOC regarding fan activation once the affected station was identified.

Once the OM made their TEAMS notifications, they checked AIMS to ensure the tunnel fans were activated. They observed that the platform fans were active at Eastern Market Station. The confusion, in the beginning, was whether to activate the fans at Potomac Avenue Station. The OM went to MOC and stated that the tunnel fans should be activated. They were told that the correct configuration was activated according to the playbook. The OM stated that the FLO also did not like the fan configuration and thought it should be changed. The fan configuration was then changed at the request of the FLO and DCFEMS on the scene.

The OM was asked if VIDEO 1 was on the Command Line when the incident occurred and if the affected station CCTV was displayed on the “Big Board”. The OM stated that they believed VIDEO 1 was present and believed that the video at Eastern Market was being displayed. They were not sure when it was displayed. VIDEO 1, MTPD 1, and the FLO have access to the rail station CCTV. Typically, RAIL on looks on with MTPD 1 and observed the smoke at Eastern Market was not

dissipating with only the platform fans operating. COMMS 1 also showed a clip from social media showing the smoke rising to the Mezzanine level at Eastern Market.

The OM stated they have a rule that when an emergency takes place, METRO 1 must open a conference call within the first 10 minutes of the incident. On this conference call Metro 1 provides a summary and everyone on the Command Line reports out. This is while the incident investigation is ongoing.

The OM stated several things were occurring at the time of the incident. There was a shift change occurring when the incident was first reported. The conference call within the first ten minutes of the incident and the Executive Leadership in the MICC requesting information.

When asked if the conference call 10 minutes into the incident hinders the incident investigation, the OM stated it may hinder some aspects of the investigation, such as information gathering, especially when there is not much information to report out in that timeframe.

Assistant Operations Manager (AOM) #1 – RAIL 2

AOM #1 is a WMATA employee with four (4) years of service and has been in their current role for over a year. AOM # 1 is RWP Level 4 certified and must recertify in April 2024. As the AOM, they oversee the RTCs during daily operations and emergencies, ensure the RTCs handle incidents safely and efficiently, and dispatch fire life safety. During this incident, they dispatched DEFEMS. AOM #1 communicates directly with Rail 1 for information sharing. They stay in constant communication with the MOC and COMMS Assistant Superintendents. AOM #1 has two RTCs that reports directly to them.

AOM #1 stated when they initially heard of the incident at Eastern Market, they went down to the floor, but now, in the MICC, the RTCs wear headsets, so it can be difficult to hear the radio transmissions. AOM #1 said there was a newly certified RTC on the radio, so they wanted them to verify the radio transmission because the initial report was smoke at Potomac Avenue Station, track 2, but third rail power had dropped at Eastern Market Station, track 2. AOM #1 said it is uncommon for third rail power to drop under a train, but it is common for third rail power to drop between Eastern Market to Stadium-Armory Stations.

AOM #1 stated SOP 678 gives the Train Operators the discretion to proceed or not if they feel it's safe to do so. AOM #1 said if the Train Operator felt it was safe enough to turn off the train's EV and proceed, then they would. Train ID 427 was the last train to enter or exit Eastern Market Station, track 1, before third rail power was de-energized.

Assistant Operations Manager (AOM) #2 – RAIL 3

AOM #2 is a WMATA employee with twenty-four (24) years of service, including six (6) years in their current position. AOM #2 previously worked as a Bus Operator, Train Operator, Interlocking Operator, and RTC. On the day of the incident, AOM #2 was working with AOM #1 manage the four Ops. channels. The two AOMs work interchangeably, managing the Ops. lines. AOM #2 stated that in the MICC, the RTCs are required to wear headsets, and this limits the AOMs ability to hear what is being said between the RTCs and personnel. AOM #2 was focused on obtaining information from the RTCs so they could pass it along to Rail 1.

They overheard the Station Manager on the radio stating that smoke was coming from the train's trailing car. AOM #2 left from behind their desk without their handheld radio, which sits directly behind Ops.2, to instruct a more experienced RTC to take over the incident. The original Radio

RTC was a newly certified controller who had not managed a major incident of this nature. AOM #2 could not recall Train ID 427 waiting in the tunnel for an extended period of time.

AOM #2 stated getting the fans activated is the RTCs responsibility. The RTC called the PLNT desk to have the fans activated. AOM #2 said they walked to the PLNT desk to confirm the fans were activated. AOM #2 mentioned there is a fan ventilation activation playbook that PLNT uses to determine the correct fan configuration.

MICC Assistant Director – Metro-1

The Metro-1 is a WMATA employee with 12 years of service and two months of experience as a MICC Assistant Director. The Metro-1 holds a Roadway Worker Protection (RWP) Level 2 certification that expires in May 2024.

During the formal interview, the Metro-1 stated that their roles and responsibilities as Metro-1 is to oversee the entire Metro Integrated Command and Communications Center, to ensure there are no silos of information between the different departments, and to keep Executive Leadership updated on any issues or areas of concern within the bus and rail system.

When asked about the new command structure in the newly established MICC Metro-1 explained that Rail-1 oversees all rail operations and Bus-1 oversees all bus operations. Rail-1 gives instructions regarding service patterns, incident management, controls, and commands to Rail-2. Rail-2 relays those directives to the front-line employees. Metro-1 oversees both Bus and Rail operations.

When asked how information flows during an incident, Metro-1 stated that they are stationed on the Command Line with the Fire Liaison Officer (FLO), Mission Assurance Coordinator (MAC), Rail-1, Bus-1, Metropolitan Transit Police Department (MTPD-1), and COMMS-1. The Metro-1 receives information from everyone on the Command Line and also from listening to radio communications. During a rail incident the Radio Rail Traffic Controller notifies Rail-2, Rail-2 transfers that information to Rail-1, and Rail-1 gives that information to Metro-1. Prior to the implementation of the new configuration, the Command Line consisted of Rail-1, the FLO, and the MAC.

The Metro-1 stated that during an emergency incident each member on the Command Line may or may not have a role depending on the situation. COMMS-1 is responsible for sending information to customers regarding any service disruptions. During a rail emergency, Bus-1 is not involved unless a shuttle/bus bridge is requested. Also, if the incident is a fire/life safety matter, then the FLO and MAC are the liaison between the jurisdictional fire department and assist with setting up a Unified Command.

Metro-1 stated that Executive Leadership is given frequent updates via a TEAMS chatgroup; also, depending on the event, a conference call may be warranted. When asked to recall the incident, Metro-1 recalled that Video-1 had no CCTV access; they began evacuating the station and requested a bus shuttle. The point of origin for the smoke was not identified so several track inspections were performed by non-revenue trains. The Fire Department was notified and requested. MTPD was dispatched. Once the location was identified, Unified Command was established. They could not see any fire at the station but did see hazy smoke. A conference call was initiated to update Executive and Senior Leadership.

When asked about several attempts to restore rail service by single tracking, Metro-1 stated that they received authorization from the Fire Department. Metro-1 stated they wanted some

clarification and asked the FLO to speak with the Fire Department Chief on-scene to find out if the incident was a smoke or maintenance issue. They believed that if it was a smoke issue that was cleared, then normal service could be restored. The Metro-1 stated that they were unsure who requested the Fire Department to authorize single tracking. However, they did note that the Fire Department authorized single tracking.

When asked if it was common for upper management to enter the MICC during an emergency the Metro-1 stated that their position was fairly new however, they did not believe so because it is the Metro-1's responsibility to oversee the room and be part of the Command Line. Metro-1 disseminates all information to Senior Leadership.

It should be noted that it was brought to the attention of Metro-1 that there were no track inspections performed as part of this event or an RTU issue, and Metro-1 may be recalling a separate incident. The Metro-1 was reminded that the incident in question was regarding a collector shoe issue. Metro-1 stated that this was correct, and they were recalling a separate incident at either Eastern Market or Potomac Avenue, which caused smoke in the station.

Metro-1 stated that OPS-6 radio channel utilization is directed by the MAC. Once the MAC has assigned the OPS-6 incident channel, they will inform Rail-1, who will disseminate that information. The RTC will inform all involved parties to switch over to the OPS-6 channel. The use of the OPS-6 channel was part of the Incident Management Framework (IMF) training.

When asked if the Metro-1 recalled asking for tunnel fans to be activated for the incident at Eastern Market, the Metro-1 stated they did not recall.

The Metro-1 was asked about the train in the tunnel in approach to Eastern Market that reported smoke ahead of the train once the incident occurred. They were asked if they recalled any instructions given to the Train Operator; the Metro-1 stated that if there was smoke in the station and there were customers aboard the train, the train should not have passed through the station. However, they could not give a reasonable answer without looking at the AIMS playback to see if there was a train at the previous station.

Metro-1 stated that the OPS-6 channel is not used for every incident. The use of the OPS-6 channel normally comes from the MAC to the Command Line and is disseminated downward. The RTC should be informing ERT, RTRA Supervisors and Car Maintenance to switch channels. The Metro-1 stated that they do not know if the MAC or OEP personnel at the scene determine when the OPS-6 channel is used.

Fire Liaison (FLO)

The Fire Liaison (FLO) is a Captain for the DC Fire Department. The FLO has been working for Metro since January 2023. The FLO stated there are required baseline training for Metro, as well as completing a workbook with various scenarios such as medical, smoke in the station, smoke in a tunnel, etc. The FLO said they have to demonstrate that they have knowledge and that they can respond appropriately for each of those types of related calls. They mentioned it could be anything from operating the radios, operating the cameras, making proper notifications, being on the correct tack channel or radio channel that the incident's operating on.

The FLO said their main responsibility is to monitor calls, react to any notification of any type of incident that occur in the Metro system whether it be medical or fire related. Then find, locate them on camera, and assist units to get there. The FLO said they do not make any decisions; they rely information from On-Scene Command to Metro's personnel in the MICC.

The FLO said the first notification of the incident was from the MTPD Sergeant who sits two desks away from them. The MTPD Sergeant thought they heard an Allied Security Officer come over the radio and say something about arcing or smoke in the station or that the train was on fire. The FLO said as soon as they have a report of anything, it doesn't matter the nature of the call, the first thing they do is try to verify the report on camera. The FLO said it is not their responsibility to get Emergency Responders to a location but some in the MICC would notify DCFEMS. They said if there's a delay or what they perceive as a delay, then they'll make the phone calls to make sure responders are dispatched. The MAC would give the FLO pieces of information and then the FLO would make the transmission over radio or over the phone so the MAC would never communicate directly with the Incident Commander.

The FLO said ventilation is one of the key components of knowing how to mitigate a Metro incident especially smoke in the station. The FLO said they will ask Rail 1 what the status of the ventilation is and it sometimes they'll inform them without asking but it just depends on if they're busy at the moment. The FLO said they do not have a copy of the fan ventilation playbook nor were they ever trained on how to determine the configurations using the playbook.

The FLO was never on Ops. 6 during the incident. The FLO said they do not have an Ops. 6 radio terminal, so any information that would come from them would just be relayed to the MAC and then the MAC would then utilize Ops. 6. The FLO said there's typically a bit of a push to get at least some sort of track service, station service restored in some capacity by single tracking or even bypassing stations that usually happens and understood why that happens. There was some confusion for single tracking, and the fire department had ultimately made the decision that they were not going to allow single tracking.

Maintenance 1

Maintenance 1 is a WMATA employee with seventeen (17) years of service including three (3) years in their current role as Maintenance Manager for the Maintenance Operations Center (MOC). Maintenance 1 previously worked as an Interlocking Operator, RTRA Supervisor, Train Operator, and Bus Operator. Maintenance 1 is RWP Level 2 certified and must recertify in February 2025.

One of the roles of Maintenance 1 is to manage and maintain incidents that occur with Communications, ATC, PLNT, or TRST. Maintenance 1 supervises the four Controllers at those respective department desks. PLNT deals with like clean up of anything with dealing with any infrastructure. For example, broken glass or broken doors, or a gas spill in the yard, fan activation, janitorial issues or plumbing issues in the stations or any type of any of the other buildings that Metro has.

Fan Controller/Maintenance Controller (RAIL)

The Maintenance Controller is a WMATA employee with three years of service and three total years of experience as a Maintenance Controller. The Maintenance Controller holds a Roadway Worker Protection (RWP) Level 2 certification that expires in January 2025.

The Maintenance Controller stated that they received training related to their job role last year but stated that the training is not on an annual basis. The Maintenance Controller stated that there are four (4) department desks within the Power Operations Section of the MICC, including ATC, Communications, PLNT, and TRST. Although they specialize in the subject matter of ATC, they have been cross-trained to answer each department's inquiries. On the date of the incident, they were in command of the PLNT desk.

On February 15, 2024, the Maintenance Controller stated that they were assigned to the PLNT desk. The PLNT desk's duties and responsibilities are to send resources for any PLNT-related issues reported by Station Managers and to check the Preventative Maintenance Inspections being performed on the fan systems, including tunnel fans, inbound and outbound dome fans, and jet fans. In addition, they adjust fans in specific configurations as requested or as determined by the Fan Playbook in the event of smoke or fire. On the date in question, the Maintenance Controller stated that they were working alone and that all communications to the PLNT desk are made via telephone.

When asked about the normal volume of PLNT related issues received at the PLNT desk the Maintenance Controller stated that it varies daily and may increase depending on inclement weather in the region.

When asked if the transition to the MICC had affected any operational duties or flow of information, the Maintenance Controller replied, “No.”

When asked how to request a fan activation when there is smoke or fire, the Maintenance Controller stated that as much information as possible is gathered: the station, the location, whether on the platform or in the tunnel, the nearest chain marker number, and the direction that the train is headed. That information is used to configure and exercise the fans according to the Fan Activation Playbook. Once the incident has been addressed, the MICC will be notified to restore the fans to the normal configuration.

When asked who determines which play from the playbook is used, the Maintenance Controller stated that the playbook determines which fan configuration is used depending on the circumstance. The Maintenance Controller stated that they do not deviate from the playbook unless directed by the Fire Department on the scene. If the fire department directs any other fan configuration, the Maintenance Controller documents the request on their Tunnel Fan Form.

When asked if there were any processes other than documenting when the Fire Department requests a fan configuration other than the one prescribed by the playbook, the Maintenance Controller stated that they also inform their supervisor and the Operations Manager of the request. Maintenance Controller stated that this was the first time they had been directed to change the fan configuration from what was prescribed in the playbook.

When asked if there was any training provided when Maintenance began controlling the fan operations the Maintenance Controller stated they had to complete fan training and complete a skills test before being certified.

The Maintenance Controller stated that on the date of the incident, smoke was initially reported at Potomac Avenue Station. The Maintenance Controller began configuring the fans for that station according to the playbook. Shortly thereafter, it was confirmed the incident location was Eastern Market D06. The Maintenance Controller then configured the fan at Eastern Market according to the playbook. Once the fans at Eastern Market were configured according to the playbook the Maintenance Controller documented the information on their Tunnel Fan Form. This information included the incident time, location, Train ID, the playbook reference, and proposed evacuation route. This was signed and dated by the Maintenance Controller and Maintenance-1. The Maintenance Controller stated that Rail-1 informed them that the Fire Department on scene requested for the fan configuration to be modified. Once the requested fan configuration was confirmed, the fans were exercised, and the request was documented.

When asked if there was any concern with smoke at Potomac Avenue Station when the fan configuration was changed, the Maintenance Controller stated, “Yes.” according to the playbook, if the incident occurred at Eastern Market, the fans at Potomac Ave had to be turned off and the inbound and outbound UPE fans at Eastern Market had to be in the exhaust position, and everything else was to be shut off. The Maintenance Controller stated playbook page D53 explained the exact fan configuration for the tunnel fans and station platform fans.

When asked if there were any additional fan configurations other than the initial playbook configuration and the Fire Department's requested fan configuration, the Maintenance Controller stated that, from their recollection, they configured the fans as per the direction of the Fire Department, whether they wanted the fans in the supply position or later changed to the exhaust position. The request was completed.

When asked if any additional fan configuration requests were made or multiple requests, the Maintenance Controller stated that they could not recall any other request other than the location change from Potomac Avenue to Eastern Market. The Maintenance Controller believes that during the incident, some managers may have been worried that the smoke was not dissipating quickly enough and may have wanted something else to be done. However, the Maintenance Controller stated that they do not deviate from the playbook.

OEP

Mission Assurance Coordinator (MAC) – AM Shift

The AM MAC is a WMATA employee with 2 years of service and 2 total years of experience as a MAC. The MAC #1 holds a Roadway Worker Protection (RWP) Level 4 certification that expires in April 2024.

During the formal interview, the MAC #1 stated that:
When the incident occurred, the MAC #2 had just relieved them of their duty. Once it was confirmed that there was an active incident, they remained to assist.

They stated the MAC #2 arrived at approximately 12:45 hours. The MAC #1 stated that they signed off the MAC desk computer and overheard personnel from the MICC Rail section state there was an arcing insulator. The MAC #2 was waiting for the computer to log off. The Fire Liaison Officer’s (FLO) had their computer open and had begun looking at the CCTV Cameras at the affected station.

The MAC desk computer would not log off and eventually crashed. The MAC #1 contacted Information Technology (IT) for support. The MAC #2 was coordinating the event response.

The MAC #1 observations during the incident where a confirmation request for power de-energization came in. The AIMS screen showed power was down. The MAC #2 reported that power was down to personnel on scene. The MAC #1 informed the MAC #2 to standby and stated that they walked to the Power desk to confirm power was down. Once they confirmed power was down the MAC #1 updated the MAC #2.

IT arrived shortly after and was able to get the MAC desk computer operating. The MAC #1 was managing the scene, and the MAC #2 stated they were managing ancillary duties. They observed a train stopped in a portal near the incident for approximately 10 minutes and brought it to Metro 1's attention. They asked if the train could reverse ends away from the incident station, and the train was moved immediately after.

The MAC #1 stated that the Rail Operations Control Center (ROCC) Director requested an update from the Command Line regarding the number of people injured while the MAC #2 was managing the incident due to receiving conflicting information. They stated that the ROCC Director became "confrontational" with the MTPD 1 due to receiving conflicting information. The MAC #1 explained to the ROCC Director that the information they provide is received from the Fire Department on the scene. The information may change during the course of the investigation due to individuals initially accepting medical transport and later refusing to be transported. They observed the ROCC Director made some request of the FLO regarding restoring power some the incident train issue could be examined. The FLO seemed confused about the request, and the MAC #1 attempted to explain.

The MAC #1 continued to assist until the incident command was shifted. They asked the MAC #2 if they needed further assistance due to a second incident occurring at West Falls Church but were informed that their assistance was no longer needed. They left at approximately 14:55 hours.

When asked if the ROCC Director normally enters the Command Line area to request information the MAC #1 stated that this was the first time they have had any interaction. This was the first time they observed the Director at the Command Line during an incident.

When asked if there were any issues or concerns with the Command Line prior to the interaction with the ROCC Director, the MAC #1 stated things were operating as normal during incident management. They deal with similar incidents regularly. This incident was a little more complex due to rail vehicles in the area and the reported fire underneath the incident train.

The MAC #1 stated they asked the FLO if the Fire Department on scene performed a walkthrough of the incident train because they only observed a platform inspection. The FLO stated to the MAC #1 that the Fire Department completed its primary search for life safety and would perform a walkthrough inspection of the train during its secondary search.

When asked about the Metro 1's response when informed of the train stopped in the portal, the MAC #1 stated they did receive that the message was acknowledged but did not recall the exact response. When they returned to the MAC desk, they observed that the train was moving. The MAC #1 then asked MTPD 1 if there were Transit Police at the platform who could assist any patrons who were possibly injured. They are not certain if the train was checked for injured patrons.

The MAC #1 recalled that Train ID 427 was the train stopped in the portal for 10 minutes. The train did not reverse ends. It moved through Eastern Market Station.

The MAC #1 did observe smoke from the rail station CCTV cameras at Eastern Market but does not know the smoke condition at the train level. They observed Fire Department personnel on the platform working without the use of their Self-Contained Breathing Apparatus (SCBA). They believed if there was smoke at the train level it was minimal.

The MAC #1 did make the request to have Train ID 427 reverse ends to the platform away from Eastern Market but did not receive an answer from Metro 1. The also informed the MAC #2 that the request was made. At that time, they observed that the train was moving via the CCTV cameras on the FLO's computer. At that time, the MAC desk computer was inoperable.

When asked was the MICC Director on their phone updating other people, the MAC #1 stated the Director did have their phone and believes they were updating Executive staff. Was told by the Director that they were sending updates due to receiving false or incorrect information.

When asked under normal circumstances would the Metro 1 provide updates to Executive staff, the MAC #1 stated they believe this was the case under the new [MICC] structure. They have not had any interactions with the Director on any previous incidents that they've managed.

Mission Assurance Coordinator (MAC) – PM Shift

The Mission Assurance Coordinator is a WMATA employee with 6.5 years of service and two total years of experience as a Senior Response Coordinator. The MAC holds a Roadway Worker Protection (RWP) Level 4 certification that expires in October 2024.

During the formal interview, the MAC stated that:
They arrived on duty at 12:30 hours. The MAC #2 was asked about the incident involving Train ID 638 Train Operator reporting smoke emanating from the rear of the train. They stated when they arrived at the MICC to relieve the MAC #1; initial reports began coming in. The AM and MAC #2 were doing an information handoff of all events. Reports of the incident at Eastern Market began coming through towards the middle of the information handoff. The Incident response did not fully begin until approximately 12:50 hours.

The MAC #2 stated that during the shift change, they received reports from either the Train Operator or Station Manager that there was smoke in the station, possibly from an arcing insulator, underneath the train at Eastern Market. The MAC listens to five to six separate radio channels simultaneously, and sometimes, it is difficult to determine who is transmitting and which channel the transmission originated from. There were reports of smoke filling the station. The Fire Liaison Officer (FLO) and MAC #1 were reviewing station CCTV cameras. They stated that they were logging into the MAC desk computer but were unable to view the station CCTV cameras from their computer. Looking at the FLO's computer monitor, a significant amount of smoke was observed enveloping Eastern Market station.

The MAC #2 heard the Station Manager give instructions to evacuate the station. They requested MTPD and DCFEMS to respond to the location. They also notified CMNT, ERT, and Power desk of the incident to deploy resources. The MAC #1 contacted with Senior Director of Emergency Preparedness while the MAC #2 dispatched staff from the Office of Emergency Preparedness (OEP) to Eastern Market and continued to manage the incident.

The MAC #2 stated DCFEMS arrived on the scene approximately five (5) minutes after the initial dispatch and set up an Incident Command Post (ICP), at 8th Street SE and D Street SE outside of the rail station. DCFEMS reported smoke conditions and requested ventilation fans to be turned on. The MAC #2 stated that the fans were already operating. The MAC requested Bus 1 to start a bus bridge.

At approximately 13:26 hours, the MAC stated according to their notes Power and ERT were on location at Eastern Market, however Power did not report to the ICP to check in with the Incident Commander. The incident radio channel was moved to OPS 6 at the request of EP 12 or EP 10 (it was later confirmed that EP 10 requested OPS 6). It took some time for the radio channel switch to transition. DCFEMS treated nine (9) individuals. One (1) person was transported to the hospital. There was some initial confusion on the amount of people transported, due to conflicting reports coming from both the FLO and MTPD. It was believed one person that was treated at the scene refused medical transport.

The MAC #2 stated that they contacted the Washington Metrorail Safety Commission (WMSC) and received an ESR at approximately 13:59 hours.

DCFEMS cleared the scene, and permission to restore third rail power was granted. Power was restored, and CMNT inspected the train. The conversation was held regarding single tracking. ERT expressed concerns with a negative energy return on the opposite track. Single tracking was halted until they could further investigate.

The MAC #2 stated the incident recovery progressed with the station being cleared and ERT verifying that there were no negative return issues. Full Station power was then brought up at approximately 14:30 hours. Normal service was resumed shortly after.

The MAC #1 stayed in the MICC to assist during the incident for approximately 1.5 hours.

The MICC Command line consists of the FLO, the MAC, MTPD 1, Rail 1, and Bus 1.

The MAC #2 does not recall who initially reported an arcing insulator.

When asked if it was chaotic during the incident, the MAC #2 expressed that it is normal for there to be confusion initially during an incident. This is the reason for a National Incident Management System (NIMS) to be established in order to control the chaos and to establish a good Unified Command. The initial chaos smoothed out pretty well once all the responders were in place. The MAC #2 did state that there was a lot of confusion and chaos in the MICC due to additional personnel outside of the command line being in the area.

The MAC #2 stated in closing that staff needs more guidance on the Standard Operating Procedure (S.O.P.) regarding communication and following the established lines of communication. They expressed a particular concern regarding Power and ERT personnel bypassing the command line, causing additional confusion.

TRST

Track Emergency Response (ERT) Roadway Worker In Charge (RWIC)

The ERT RWIC is a WMATA employee with 23 years of service and 13 total years of experience as an ERT Track Supervisor. The ERT RWIC holds a Roadway Worker Protection (RWP) Level 4 certification that expires in August 2024.

During the formal interview, the ERT RWIC stated as an ERT Track Supervisor they are required to complete an annual certification. Their last certification was in August of 2023.

The ERT RWIC stated that their roles and responsibilities in ERT are to respond to Emergencies and report their findings to the MICC MOC and Upper Management.

The ERT RWIC stated that their work crew normally consists of two (2) to three (3) people. Their normal days consist of responding to an incident and cleaning the platform. ERT's main job function is track maintenance. This may include cracks in the running rail, broken fasteners, and third rail issues.

The ERT RWIC stated that during the incident at Eastern Market, they checked in at the Incident Command Area. They are not sure if the Incident Commander was from the Police or Fire department. They stated they did not experience any confusion at the Incident Command. The ERT RWIC was in communication with the Incident Commander. During large-scale incidents, the ERT RWIC communicates solely with the Incident Commander. If the Incident Commander is at the Street Level, the ERT RWIC communicates to the Incident Commander through the

Forward Liaison. A job safety briefing was conducted by the Incident Commander before entering the roadway.

When asked their thoughts on the amount of time it takes to complete the new roadway job safety briefing form, the ERT RWIC stated that the previous form was fairly quick to complete and was straight to the point. The ERT RWIC believes that the bottom section of the new roadway job safety briefing form does not apply to their job duties and delays emergency response time.

ERT RWIC stated that when they arrived on the platform at Eastern Market the incident train was still berthed at the platform. They were unable to check the tracks while the train was still at the platform. They were able to look at some identified problem areas from aboard the train.

When asked about their concerns about a negative electrical current return, the ERT RWIC recounted an incident at the Brentwood Yard where they were working on the mainline with a red tag lockout and power re-energized. The ERT RWIC stated that the source of the power re-energization could not be explained. However, the Yard and CSX Rail line are adjacent to the mainline. The ERT RWIC explained that in areas near interlockings, there are spider cables on the roadway, which would draw electrical current from the opposite track, causing a negative current to exist. The ERT RWIC recounted another incident that occurred at Addison Road Station involving an arcing stud bolt. They stated that as they were on the platform they observed a negative current return on the empty track from trains moving on the opposite track. The ERT RWIC requested that train movement be stopped to prevent a negative current return. The ERT RWIC then went to the roadway. They were unable to identify the incident stud bolt, so they requested a train to pass through on the opposite platform, and once a train passed, the stud bolt in question produced an arc from the negative return.

At Eastern Market Station, based on the ERT RWIC's experience, the request was made to halt single tracking.

When asked to give a summary of the incident at Eastern Market, the ERT RWIC stated that they checked in at the Incident Command and went to the platform with personnel from the Office of Emergency Management (OEM). They stated the Fire Department was already on the platform and had identified the source of the issue. The ERT RWIC and OEM personnel identified hanging cables with blown fuses that were still receiving energy. The ERT RWIC requested third rail power be de-energized, and Car Maintenance (CMNT) be dispatched to the location. Power and CMNT arrived and verified third rail de-energization. CMNT then performed a ground walkaround and discovered another hanging cable on the platform side of the train. The CMNT had to secure the cable and needed to temporarily restore third rail power to have the train moved forward to get to the cable. The ERT RWIC stated that a red tag lockout should have been in place to move the incident train because of the negative current. The MICC was also requesting single tracking. The ERT RWIC advised against single tracking, requested a red tag lockout, and explained to the Incident Commander their safety concerns.

The ERT RWIC stated that the Incident Commander contacted the MICC to request a red tag lockout, and the request was denied. The Incident Commander informed the ERT RWIC that the MICC wanted to single track, and the ERT RWIC said, "No." They stated that when an incident train is at the emergency location in contact with a de-energized third rail, there should be a red tag lockout in place due to the safety concern of a negative return from the opposite track.

The ERT RWIC stated that the Incident Commander informed the MICC of their concerns and there was a back-and-forth discussion regarding single tracking. At the end of the conversation, the Incident Commander did not authorize single tracking. The ERT RWIC stated that they then

received a call from their upper management to inquire about their request for a red tag lockout and denying single tracking. The ERT RWIC explained their safety concerns of a negative return and was informed that SAFE gave authorization to begin single tracking. The ERT RWIC reiterated their concerns to their manager and relented. The Incident Command was transferred to Rail Operations. The incident train was moved forward to secure the hanging cable, and power was de-energized on the incident track. Single tracking was operating on the opposite track. ERT then performed a track inspection on the incident track and observed no issues related to the track.

When asked about any concerns they wanted to bring forth, the ERT RWIC stated that as the subject matter expert at the scene of an emergency, they believe their experience and expertise should be utilized in the decision-making process.

Track Emergency Response (ERT) Specialist #1

The ERT Specialist #1 is a WMATA employee with 20 years of service and 1 total years of experience as an ERT Specialist. The ERT Specialist #1 holds a Roadway Worker Protection (RWP) Level 4 certification that expires in August 2024.

During the formal interview, ERT Specialist #1 stated that as a Track Specialist, they are required to complete annual certification.

As an ERT Specialist they are required to respond to all track related emergencies. ERT Specialist #1 stated that their assigned coverage area is the Bethesda region. ERT works as a crew. This crew is normally comprised of the same individuals. Changes may be made to due staffing challenges.

The ERT Specialist stated that when they arrived at the Incident Command Post for the incident at Eastern Market, they checked in with the Incident Commander. They believed the Incident Commander at the time was a Police Officer. The ERT Specialist #1 did not recall any radio communication issues during the incident. The ERT Specialist #1 stated that they communicated solely with their ERT Supervisor, and a roadway job safety briefing was conducted. The safety briefing was led by the Incident Commander. After the safety briefing was conducted, they then entered Eastern Market Station. The ERT Specialist stated that the Washington DC Fire Department and personnel from Car Maintenance also entered the station during that time. Once on location the groups were assessing the damages and communicating how to begin recovery.

The ERT Specialist #1 stated that they were on standby until the incident train could be moved out of the area. When the ERT Specialist #1 was asked if they were party to discussion about concerns of single tracking on the opposite track causing a negative electrical current return on the incident track. The ERT Specialist #1 stated they had no knowledge of that conversation taking place. They stated that may have been a conversation with the On-Call Supervisor.

The ERT Specialist #1 stated that once the incident train was moved from the location, they performed a track inspection from Eastern Market to Potomac Avenue Station.

Track Emergency Response (ERT) Specialist #2

The ERT Specialist #2 is a WMATA employee with 23 years of service and 8 total years of experience as an ERT Specialist. The ERT Specialist #2 holds a Roadway Worker Protection (RWP) Level 4 certification that expires in November 2024.

During the formal interview, the ERT Specialist #2 stated that as a Track Specialist they are required to complete annual certification for Blood Borne Pathogens, but there is no ERT Specialist refresher training.

As an ERT Specialist, they are required to conduct emergency repairs to cracked railroad tracks, conduct track inspections, and assist injured persons. ERT Specialist #1 stated that when they arrived at the Incident Command Post for the incident at Eastern Market, they checked in with the Incident Commander.

The ERT Specialist #2 stated that they had to stand by until they were given authorization to enter Eastern Market Station. They stated that they waited approximately 30 minutes until they were allowed to enter the station. The ERT Specialist #2 stated they did not experience any radio communication issues during the incident. Once they arrived at the station platform, they waited again for Car Maintenance to inspect the incident train, and for the train to be move in order for them to conduct a track inspection.

The ERT Specialist #2 stated that no track defects were identified once the track inspection was completed. When the ERT Specialist #2 was asked if they were in the presence of the ERT Supervisor when single track operations were being conducted or party to a discussion about concerns of single tracking on the opposite track causing a negative electrical current return on the incident track. The ERT Specialist #1 stated they were not present during single tracking or during the discussion.

The ERT Specialist #2 stated that during the recovery phase their job was to inspect the track and check for any debris.

CMNT

Road Mechanic

The CMNT Road Mechanic is a WMATA employee with 35.5 years of service and 10 total years of experience as a Road Mechanic. The Road Mechanic holds a Roadway Worker Protection (RWP) Level 4 certification that expires in April 2024.

During the formal interview, the Road Mechanic stated that their last CMNT Road Mechanic certification was in February of 2024. The CMNT Road Mechanic stated that their duties include responding to trains experiencing issues such as destination signs, windows issues, electrical or mechanical problems. They make all attempts to correct the issue and determine if the rail vehicle can remain in service or needs to be removed from service.

The CMNT Road Mechanic stated they were stationed at Stadium-Armory on a daily basis. They have been stationed at that location since June 2023. Although they are stationed at Stadium-Armory, they are dispatched to trains at any location along the Orange Blue and Silver Lines. When the incident occurred, they received a call from their supervisor directing them to go to Eastern Market. They were told an MTPD unit would pick them up at the street level at Stadium-Armory and escort them to the Eastern Market. While the CMNT Road Mechanic was at Stadium-Armory, they believe they heard two loud noises.

Once they arrived at Eastern Market, they reported to a Road Mechanic Supervisor at the Incident Command Post outside of the station. District of Columbia Fire Department, MTPD, and other WMATA departments were on location. The CMNT Road Mechanic stated they were not allowed to enter Eastern Market station for approximately one-half hour after they arrived on the scene.

They stated they did not experience any confusion when they arrived on the platform at Eastern Market. They also stated they did not experience any radio communication issues.

When they went to the platform at Eastern Market, they were escorted to the incident railcar by the WMATA personnel on the scene, whom they believed were from the Emergency Response Team (ERT). They performed a ground walk around the rail vehicle. The WMATA personnel reported damage on the non-platform side of the railcar to the Road Mechanic. The Road Mechanic observed additional damage on the platform side of the railcar. The damage on the platform side was observed by looking into the space between the train and the platform.

When they arrived on the platform third rail power was de-energized. They observed that the emergency doors were opened for the entire consist. Third rail power was restored to observe if any additional smoke conditions existed. The CMNT Road Mechanic did not see or smell any signs of arcing when the power was restored. Once power was restored, the train consist was moved forward off of the platform so a visible inspection of the platform side could be performed. Once the train was moved, third rail power was once again de-energized.

The CMNT Road Mechanic observed a loose collector shoe assembly power cable on the platform side. They secured the power cable. Once the power cable was secured third rail power was re-energized. They then boarded the train, and it was transported to New Carrollton Yard.

When asked if there was any miscommunication regarding their pick-up location from Stadium-Armory, the CMNT Road Mechanic stated that they informed Central that there are two (2) entrances at Stadium-Armory, and they were waiting at the entrance near the hospital on 19th Street and C Street, SE. They called back after a short while later and was picked up after the second call to Central. The CMNT Road Mechanic stated that the amount of time spent waiting to be picked up did not delay their assistance at Eastern Market because they were not allowed to enter the station until one-half hour after their arrival.

Stated the damage that they observed on the platform side of the railcar was the collector shoe power cable in the opposite direction of its normal position and was sitting up. It also appeared that the collector shoe assembly was missing. The collector shoe assembly on the non-platform side was found to have burn damage.

Senior Vice President

On April 24, 2024, at 1602 hours (4:02 PM), a virtual interview was conducted with a Senior Safety Investigator and the Senior Vice President of the Metro Integrated Command and Communication Center to discuss the Eastern Market event evacuation due to a smoke incident.

The interview started with the senior safety officer introducing the session. The officer mentioned that the recording is part of an investigation undertaken under Washington Metropolitan Areas Authority policy instruction 10.4. The officer highlighted that the recording could contain sensitive or confidential information, requiring prior consultation with relevant authorities before disclosure.

The senior safety officer then explained the context of the investigation, noting that it concerns a life safety incident at the Eastern Market. The senior vice president provided insights into the incident and described the timeline of events:

A notification of a smoke incident at Eastern Market triggered immediate action. The SVP went downstairs to assess the situation, noticing arching as a train entered the platform, leading to smoke accumulation. As a safety measure, the train was offloaded, and the station was evacuated. Ventilation was activated, and station evacuation protocols were followed.

The command center coordinated with emergency services to establish a bus bridge to maintain transportation between key locations. The SVP oversaw coordination with other departments to ensure safe and timely responses. Multiple communications took place with different levels of command to ensure safety and proper restoration of service.

Power on the track was restored in phases, with single-tracking resuming at 1520 hours and full power restoration occurring at 16:01 hours. After the power restoration, further inspection and assessment were carried out to determine the cause of the collector assembly loss.
The interview explored the communication process during the incident. The senior vice president mentioned that, despite various questions and coordination efforts, no elevated voices or unsafe demands were encountered. The focus remained on ensuring safety and adhering to SOPs.

The interview concluded with a discussion of the SVP's responsibilities during such incidents, emphasizing safety and proper communication with the incident command and other relevant parties. Additional questions from other interview participants sought further details about phone communications and response actions during the incident.

Appendix B – Written Statements

WMATA/RTRA Incident/Accident Report (Other than Motor Vehicle) Page ___ of ___

Incident Information: This page must be completed for all incidents

Date:	Incident Time:	Time Reported:	Reported by: Customer ☐ Employee ☑ ROCC ☐ Other ☐
Feb 15 2024	Approx 12:50pm	Approx 12:55pm	

Location

Station	Mezzanine #	Track #/Destination	Chain Marker/Signal Number
Eastern Market			

TYPE OF INCIDENT

☐ Property Damage	☑ Smoke	☑ Fire	☐ Customer Complaint
☐ Customer injury	☐ Customer Illness	☐ Employee Injury	☐ Employee Illness
☐ Criminal Activity	☐ Elevator Entrapment	☑ Rail Vehicle Incident	☐ Other (Explain in description of incident)

WEATHER	LIGHT CONDITIONS (natural lighting)	LIGHTING (artificial lighting)
Clear ☑ Rain ☐	Dawn/Dusk ☐ Daylight ☐	Lights On ☑ Lights Off ☐
Snow ☐ Sleet/Ice ☐	Dark ☐ Tunnel/Underground ☑	Lights Not Working ☐

STATION INCIDENTS: Always include equipment number you use for MOC/AFC/EOC

Elevator/Escalator#:	AFC #:	Room Number/Location:

Failure Number(s):

Parking Lot ☐ Paid Area ☐ Free Area ☐ Garage ☐ Station Entrance ☐ Stairway # ___☐ Platform ☐ Ancillary Room ☐
Injury/Illness reported aboard Train ☐ Other ☐

Name of Responding Supervisor:	Name/Department of PLNT/AFC or other WMATA responder

TRAIN INCIDENTS

Train ID	Destination	Car Numbers(list all cars in consist):	Lead Car:
638	Ashburn		

Name of Responding Supervisor [redacted]	Name/Department of CMNT/TRST or other WMATA responder

DESCRIBE THE INCIDENT: Include what you did to correct the problem and who you notified and when.

Describe any property damage and the extent of any injuries.

While approaching 8 car marker I started losing power. I noticed the power shut off on train. I looked out window and the platform security was coming to tell me the back of the train smoking. While they was talking to me explosions started going off from trailing end of train. I had a 6 car consist I opened the lead car with key and from outside opened the doors on next 3 cars from EERD switch to release doors to get passengers out. last 2 cars passengers used emergency door release. I then notified ROCC and let them know train was clear of passengers. I exited the station and got checked out by ambulance. I later moved the train so maintenance could secure the collector shoe assembly.

Employee Completing Report

Employee Name:(print) [redacted]	Employee Signature:(sign) [redacted]	Employee #: [redacted]	Date: Feb 15 2024
Division: West Falls Church	Run # 29	Block # 638	Assigned Days: M/T

To Be Completed By Reviewing Manager

Supervisor Name:(print) [redacted]	Supervisor Signature [redacted]	Employee # 215731	Date: 2-15-2024

Action Taken/needed

SMS Number:

50.753A 04/12 White Copy: Division or Supervisor Yellow Copy: For any incident involving escalators or elevators; remains in kiosk for use of elevator/escalator inspectors

Appendix C – Fan Activation Logs

Maintenance Section Emergency Tunnel Fan Operation Form

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MOC-FRM-0001-R00.0

Approved: 1/24/2024

Call Time:	Incident Description: *(Arcing Insulator / Trash Fire / etc.)*		
12:52	Hrabriary report of Smoke emitting From train 638		
Nearest Station: *(Metro Center A01)*	**Chainmarker:** *(xxx-xx)*	**Track #:**	**Train ID:**
D06	platform ~~Trk~~	2	638
Proposed Evacuation Route: *(towards which station)*	**Playbook/Page Reference:**	**Incident Zone(s):**	
D06	D53		
Fan Controller Name:	**Date:**	**MAINT 1 Name:**	**Date:**
[redacted]	2/15/24	[redacted]	2/15/24

Remote Fan Configuration

Station	Fan Name	Configuration (E/S/OFF)	Station	Fan Name	Configuration (E/S/OFF)

Manually-Operated UPE Fan Configuration

Station[1]	Manual Fan (IB/OB)	Location	Room Sequence	Config. (E/S/OFF)	X[2]
A01	UPE-A	North Mezzanine Level	#N200, #N200A, #300N		
	UPE-B	East Mezzanine Level	#E202		
A02	UPE-IB	Behind End Gate on Track 2	#301		
	UPE-OB	Behind End Gate on Track 2	#108		
A03	UPE-IB	Upper Mezzanine Level	#201, #222		
	UPE-OB	Upper Mezzanine Level	#201, #217		
B01	UPE-IB	East Mezzanine Level	#E222		
	UPE-OB	West Mezzanine Level	#W200, #W202		
B02	UPE-IB	Mezzanine Level	#200, #204		
	UPE-OB	Mezzanine Level	#201, #205		
B03	UPE-IB	Behind End Gate on Track 2	#113		
	UPE-OB	Behind End Gate on Track 2	#108		

[1]Incidents occurring at stations with manual UPE fans may require remote operation of fans at adjacent stations (ex. A04 and A05)

[2]Mark "X" in the right-hand box for all fans that needed to be configured

MAINT 1 shall scan and save this form in the "R" Shared Network Drive.

Maintenance Section Emergency Tunnel Fan Operation Form

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

MOC-FRM-0001-R00.0

Approved: 1/24/2024

Call Time:	Incident Description: *(Arcing Insulator / Trash Fire / etc.)*
13:08	Changed Fan Configuration Per FD via OM [redacted]

Nearest Station: *(Metro Center A01)*	Chainmarker: *(xxx-xx)*	Track #:	Train ID:
D06	Platform	2	638

Proposed Evacuation Route: *(towards which station)*	Playbook/Page Reference:	Incident Zone(s):
D06		

Fan Controller Name:	Date:	MAINT 1 Name:	Date:
[redacted]	2/15/24	[redacted]	2/15/24

Remote Fan Configuration

Station	Fan Name	Configuration (E/S/OFF)
D06	FD6	S
D06	FD7	S

Station	Fan Name	Configuration (E/S/OFF)

Manually-Operated UPE Fan Configuration

Station[1]	Manual Fan (IB/OB)	Location	Room Sequence	Config. (E/S/OFF)	X[2]
A01	UPE-A	North Mezzanine Level	#N200, #N200A, #300N		
	UPE-B	East Mezzanine Level	#E202		
A02	UPE-IB	Behind End Gate on Track 2	#301		
	UPE-OB	Behind End Gate on Track 2	#108		
A03	UPE-IB	Upper Mezzanine Level	#201, #222		
	UPE-OB	Upper Mezzanine Level	#201, #217		
B01	UPE-IB	East Mezzanine Level	#E222		
	UPE-OB	West Mezzanine Level	#W200, #W202		
B02	UPE-IB	Mezzanine Level	#200, #204		
	UPE-OB	Mezzanine Level	#201, #205		
B03	UPE-IB	Behind End Gate on Track 2	#113		
	UPE-OB	Behind End Gate on Track 2	#108		

[1]Incidents occurring at stations with manual UPE fans may require remote operation of fans at adjacent stations (ex. A04 and A05)

[2]Mark "X" in the right-hand box for all fans that needed to be configured

MAINT 1 shall scan and save this form in the "R" Shared Network Drive.

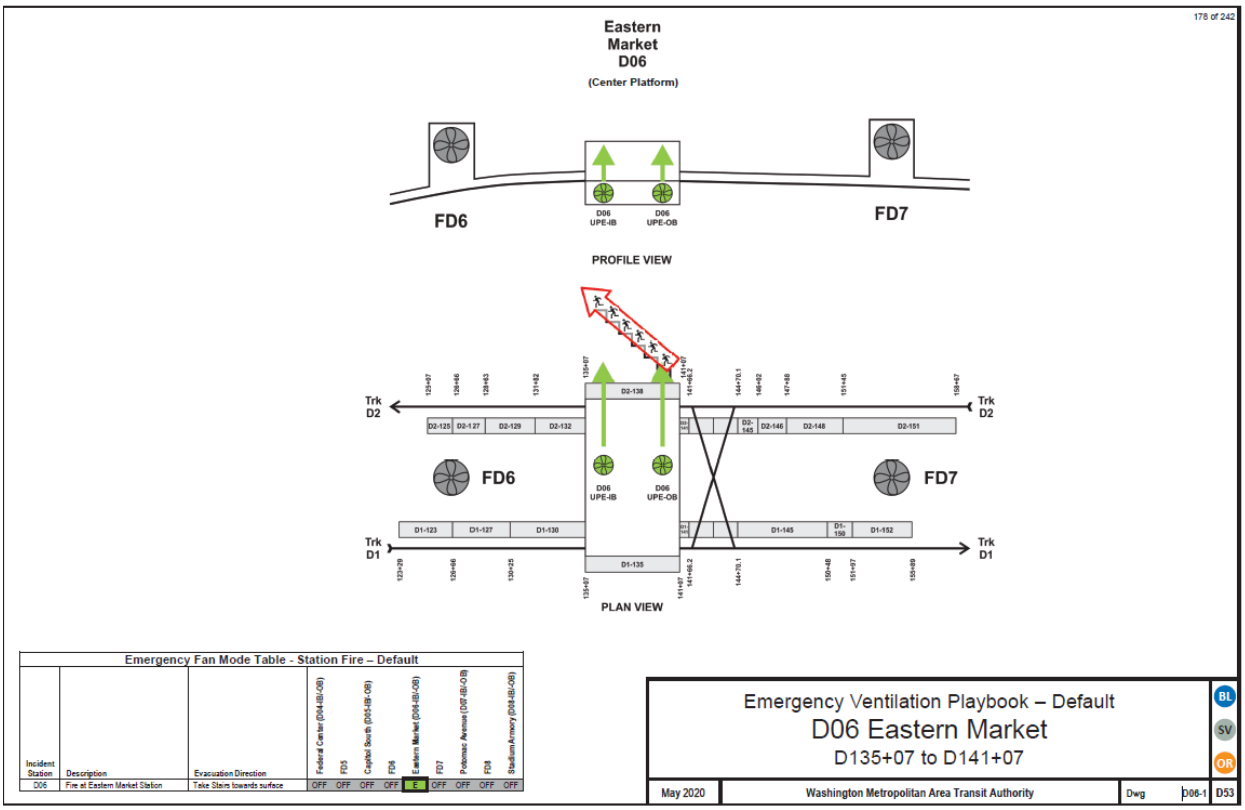


Figure 12 - Fan Ventilation Playbook for the affected area, page 1 of 1.

MOC EMERGENCY TUNNEL FAN ACTIVATION REPORT

Date	**2/15/2024**
Incident Report Time	12:52
Reported Incident	Report of smoke emitting from train #638 on track 2 of Eastern Market Station
Location/CM	Eastern Market (D06) within platform limits
Track #	2
Maximo Incident #	8732685
Fan Controller	[redacted]
Maintenance 1	[redacted]
Assessment	At 12:52, Rail 2 (AOM [redacted]) notified MOC of the presence of smoke at Potomac Avenue Station. MOC began the process of smoke mitigation procedures at this location, until receiving a correction from Rail 2 (AOM [redacted]) that the incident location was Eastern Market Station. Upon confirmation with Rail 1 (OM [redacted]) of the accurate location, Maintenance 1 directed fans be deployed at Eastern Market Station for the removal of smoke within the platform limits. All fans commanded in accordance with Page D53 of the Emergency Ventilation Playbook with the first fan activation at 12:53, and the final fan activation at 12:57. At 13:08 MOC received a request from Rail 1 (OM [redacted]) to change the configuration of the fans adjacent to the incident location from "OFF" to "Supply" at the request of the on-scene fire department. Tunnel fans FD6 and FD7 were reconfigured to the requested orientation in response to this directive.

Completed PLNT Desk Emergency Tunnel Fan Operation Form (included all necessary information)	Yes ☒ No ☐
PLNT Desk Emergency Tunnel Fan Operation Form stored in correct location on M Drive	Yes ☒ No ☐

Reviewed By:

[redacted], MICC Business Manager 02/16/2024

Report Submitted by: [redacted]

Incident Management Framework
Hot Wash Report

Office of Emergency Preparedness

Basic Incident Information

Incident Date: 2024-02-15

Incident Time: 1258

Incident Type: Fire/Smoke from Rail Vehicle

Location of the Incident: Eastern Market

Rail Line: D Line

Track #: 2

Train #: 638

Train Consist: 6

Bus Number: N/A

Bus Route: N/A

Incident Timeline

Incident Start: 1252

Time Command was Established: 1300

Jurisdictional FD on Scene: 1257

Jurisdictional FD Clear: 1400

Recovery Phase Start: 1530

Return to Partial Service:

Return to Full Service: 1630

Command Terminated: 1615

Incident Management

Incident Command Post Location: 8th and Pennsylvania ave

3rd Rail Power Outage: Supervisory Outage

1

Attachment D: IMF Hot Wash Report page 1 of 3.

Report Submitted by: [redacted] -

Red Tag/Supervisory Outage Number: N/A

Bus Bridge: Yes

Ops Channel: Ops 2

MTPD Channel: 4x

Personnel On Scene

WMATA Incident Commander: [redacted]

Metro Initial Responder: [redacted]

Jurisdictional Incident Commander:

Deputy Incident Commander:

Metro Operations Section Chief:

Investigation Group Supervisor (SAFE):

Investigation Group Supervisor (MTPD):

Media Relations:

Scene Safety Officer:

Maintenance Group Supervisor: [redacted]

Transportation Group Supervisor- RAIL: [redacted]

Transportation Group Supervisor-BUS: [redacted]

Staging: 8th and Pennsylvania ave

Roadway Worker in Charge: N/A

Other:

Control Center Personnel

Mission Assurance Coordinator: N/A

RAIL 1: N/A

MTPD ROCC Liaison: N/A

Fire Liaison Officer: [redacted]

Other:

Attachment D: IMF Hot Wash Report page 2 of 3.

Report Submitted by: [redacted]

Narrative

Incident Narrative: Report of smoke in the station from arching insulator under the train at Eastern Market. Smoke filled the station. Collector Shoe assembly was damaged

What went well during the incident: Quick response from all jurisdictions, Fire Dept, ERT, Safety, Transit Police, OEP. All departments worked well together removing the incident train and getting revenue service restored. Mr. [redacted] did an excellent job communicating pertinent information.

What could have gone better during the incident: There is a disconnect between if SOP 1A is in effect or IMF. Things would run smoother is RTRA Operations personnel are updated and refreshed on IMF.

What would you do differently next time: Be better prepared to be the On Scene Commander

Robust scene handoff was carried out with the Metro Initial Responder: Strongly Disagree

All personnel that were required responded to the incident: Strongly agree

Communication between all incident personnel was clear, concise, and effective: Strongly agree

All responding incident personnel carried out their responsibilities effectively in accordance with the incident objectives: Strongly agree

The WMATA Incident Commander received good and timely information from the OCC(s)/MAC: Agree

Administration

Name of the person completing this form: [redacted]

Email address of the person completing this form: [redacted]

Contact number for the person completing this form: [redacted]

3

Attachment D: IMF Hot Wash Report page 3 of 3.

Appendix G – MTPD Event Report

Event Report

Metro Transit Police Department — **ORI-DCMTP0000**

Type of Report	MTPD CCN	Local Jurisdiction
Closed	2024-02469	District of Columbia

Event Location

Street	City, State
725 Pennsylvania Ave SE	WASHINGTON, DC 20003

Date and Time of Event	Date and Time Reported
From: 2/15/2024 12:45:00 PM To: 2/15/2024 2:36:29 PM	2/15/2024 12:52:38 PM

Reporting Officer (Print) / Badge #	Second Officer (Print) / Badge #
[redacted]	[redacted]

Supervisor's Name (Electronically Approved)

Incidents

Incident:	Location Type:
Fire/Smoke Local Alarm	Rail Station

Incident Detail:

Involved Party

Last Name, First MI:	DOB:
[redacted]	12/4/1963

Address Type:	Address (Street) City, State Zip:
H - Home	[redacted]

Email:

Age:	Sex:	Race:	Ethnicity:	Resident Status:
60	Female	Black or African American	Not of Hispanic Origin	

Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:

Driver's License #:	D/L State:	SSN:

Occupation:	Place of Employment:	Place of Birth:

Work/School Address – Addl. Contact Info:

Notes:
Smoke exposure

Involved Party

Last Name, First MI:	DOB:
[redacted]	

Attachment A: MTPD Event Report page 1 of 9.

Type Phone: H - Home	Phone Number: [redacted]				
Email:					
Age:	Sex:		Race:	Ethnicity:	Resident Status:
Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:
Driver's License #:			D/L State:		SSN:
Occupation:	Place of Employment:				Place of Birth:
Work/School Address – Addl. Contact Info:					
Notes: **Smoke exposure**					

Involved Party					
Last Name, First MI: [redacted]					DOB:
Type Phone: H - Home	Phone Number: [redacted]				
Email:					
Age:	Sex:		Race:	Ethnicity:	Resident Status:
Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:
Driver's License #:			D/L State:		SSN:
Occupation:	Place of Employment:				Place of Birth:
Work/School Address – Addl. Contact Info:					
Notes: **Smoke exposure**					

Involved Party					
Last Name, First MI: [redacted]					DOB:
Type Phone: H - Home	Phone Number: [redacted]				
Email:					
Age:	Sex:		Race:	Ethnicity:	Resident Status:
Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:
Driver's License #:			D/L State:		SSN:
Occupation:	Place of Employment:				Place of Birth:
Work/School Address – Addl. Contact Info:					
Notes:					

Attachment A: MTPD Event Report page 2 of 9.

Smoke exposure

Involved Party					
Last Name, First MI: [redacted]					DOB:
Type Phone: H - Home	Phone Number: [redacted]				
Email:					
Age:	Sex: Female		Race:	Ethnicity:	Resident Status:
Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:
Driver's License #:			D/L State:		SSN:
Occupation:	Place of Employment:				Place of Birth:
Work/School Address – Addl. Contact Info:					
Notes: Smoke exposure					

Involved Party					
Last Name, First MI: [redacted]					DOB:
Type Phone: H - Home	Phone Number: [redacted]				
Email:					
Age:	Sex: Female		Race:	Ethnicity:	Resident Status:
Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:
Driver's License #:			D/L State:		SSN:
Occupation:	Place of Employment:				Place of Birth:
Work/School Address – Addl. Contact Info:					
Notes: Smoke exposure					

Involved Party					
Last Name, First MI: [redacted]					DOB:
Type Phone: H - Home	Phone Number: [redacted]				
Email:					
Age:	Sex:		Race:	Ethnicity:	Resident Status:
Description	Height:	Weight:	Eyes Color:	Complex:	Clothing:

Attachment A: MTPD Event Report page 3 of 9.

Driver's License #:			*D/L State:*		*SSN:*
Occupation:		*Place of Employment:*			*Place of Birth:*
Work/School Address – Addl. Contact Info:					
Notes: **Smoke exposure**					

Involved Party					
Last Name, First MI: [redacted]					*DOB:*
Type Phone: **H - Home**	*Phone Number:* [redacted]				
Email:					
Age:	*Sex:*		*Race:*	*Ethnicity:*	*Resident Status:*
Description	*Height:*	*Weight:*	*Eyes Color:*	*Complex:*	*Clothing:*
Driver's License #:			*D/L State:*		*SSN:*
Occupation:		*Place of Employment:*			*Place of Birth:*
Work/School Address – Addl. Contact Info:					
Notes: **Smoke exposure**					

Involved Party					
Last Name, First MI: [redacted]					*DOB:*
Type Phone: **M - Mobile**	*Phone Number:* [redacted]				
Email:					
Age:	*Sex:*		*Race:*	*Ethnicity:*	*Resident Status:*
Description	*Height:*	*Weight:*	*Eyes Color:*	*Complex:*	*Clothing:*
Driver's License #:			*D/L State:*		*SSN:*
Occupation:		*Place of Employment:*			*Place of Birth:*
Work/School Address – Addl. Contact Info:					
Notes: **Witness**					

Involved Party	
Last Name, First MI: [redacted]	*DOB:*

Attachment A: MTPD Event Report page 4 of 9.

Email:					
Age:	*Sex:*		*Race:*	*Ethnicity:*	*Resident Status:*
Description	*Height:*	*Weight:*	*Eyes Color:*	*Complex:*	*Clothing:*
Driver's License #:			*D/L State:*		*SSN:*
Occupation:	*Place of Employment:*				*Place of Birth:*
Work/School Address – Addl. Contact Info:					
Notes: **Train ID #638**					

Property Information								
Type	*Code*	*Class*	*WMATA Owned*	*Age*	*Fair Market Value*	*Recovered Value*	*Recovered Date*	
Other	**77**							
				Value Totals				
Veh. Year	*Make*	*Model*	*Color*	*Style*	*Tag #*	*State*	*Year*	*VIN*
			SIL-Silver or Aluminum					
Property Recovered Date		*# Stolen Vehicles*	*# Recovered Vehicles*		*Is any property in custody of a police agency? (If Yes, explain below)*			
Property Status **Burned (Includes Damage Caused In Fighting The Fire)**								
Suspected Drug Type (If this event is a drug case, check up to three applicable boxes and write the estimated amount on the line.) Note: If more than 3 drug types, select the 2 most important listing amounts. Then select "Over 3 Drug Types", as the third, to represent the remaining drugs.								
Property Notes:								

Attachment A: MTPD Event Report page 5 of 9.

Narrative Information	
TSOC TSA-02-05121 [redacted] Arching insulator cause rail car to catch fire at the Eastern Market Metro Station. DC Fire notified. 9 reported injured. Non life threaten.	
If second CCN is available, insert here:	Additional Narrative on Supplemental Report

Attachment A: MTPD Event Report page 6 of 9.

Additional Narrative

Officer [redacted] reports responding to the Eastern Market Metro station for reports of a fire on WMATA Train ID #638. Allied Special Police Officer reported from the platform he observed the train car on fire. Upon arrival I established command at 7th and Pennsylvania. I issued command that all units immediately evacuate the station. This command was relayed via rail personnel and MTPD CCU. Confirmation of all clear was received and DC Fire arrived on scene to begin their operation. DVEU was notified and relayed heavy smoke in the station and residual smoke was observed at Potomac Metro Station and Capital South Metro Station. DC Fire/EMS and MTPD units were deployed to the effected stations and provided updates upon request. Rail operation turned on the fans to assist with smoke in the effected stations. DC Fire concluded their investigation and determined the matter was an arcing insulator causing the lower portion of the Metro rail car to catch fire. DC Fire turned the scene over to MTPD and we turned it over to Rail Operations.

TSOC TSA-02-05121 [redacted]
****
8 reported injuries (smoke exposure)
1 person transported by DC medic (smoke exposure)
***
Personnel on scene:
MTPD [redacted] (Initial Command)
MTPD [redacted] (Primary Command)
MTPD [redacted]
DC Fire Incident Command Chief [redacted]
DC Fire Assistant Chief [redacted]
DC Fire/Medic 7,15,18,7
Battalion 2
Rail Supervisor [redacted] *** Scene released by DC/Fire and MTPD to her at 1415 HRS
WMATA EP 10,22,12,2
WMATA ERT
WMATA Car maintenance
WMATA Safety
WMATA Structure
WMATA units by ID# [redacted]
***
Entry Exit Log

Station manager - [redacted]
Supervisor - [redacted]

Entry / EXIT
Engine 7 15 25 10
@1306 hrs. Exit@1340

[redacted]

[redacted]

[redacted]

Attachment A: MTPD Event Report page 7 of 9.

[redacted]

ERT. 1358-

[redacted]

OEM @1356 EXIT 1413-

[redacted]

Attachment A: MTPD Event Report page 8 of 9.

[redacted]

OEP

[redacted]

POWER ENTER 1400EXIT@1410-

[redacted]

SAFETY. ENTER@1423- 1440

[redacted]

ATC-1430

[redacted]

PLANT-1430

[redacted]

Chief of mechanic

[redacted]

Attachment A: MTPD Event Report page 9 of 9.

After Action Report / Improvement Plan

Eastern Market Smoke/Fire February 15, 2024

After-Action Review Report and Improvement Plan

DOCUMENT NUMBER:
AAR #2024-01

RELEASE/REVISION DATE:
NEW

CONTENT OWNER:
DEPARTMENT OF SAFETY & READINESS – OFFICE OF EMERGENCY PREPAREDNESS

Attachment E: WMATA After Action Report page 1 of 6.

AAR Executive Summary

AAR	2024-01
Incident	Smoke/Fire
Incident Date	February 15, 2024,
Location	Eastern Market, track #2
Scope of AAR	From initial report of smoke to single tracking.
Participants	WMATA, DCFD, WMSC
Point of Contact	[redacted] Prevention and Mitigation, Office of Emergency Preparedness, Department of Safety and Readiness, Washington Metropolitan Area Transit Authority, Phone: [redacted], [redacted]
Incident Response Summary	On Thursday, February 15, 2024, at approximately 12:52pm, train ID 638 reported hearing an explosion and smoke emitting from the rear of the train while at Eastern Market station track #2. The train operator and station manager began evacuating customers. There were approximately nine (9) people who required medical evaluation with one (1) person being transported to the hospital. The District of Columbia Fire Department (DCFD) and Metropolitan Transit Police Department (MTPD) arrived and established unified command. Additional personnel from Rail Transportation, Office of Emergency Preparedness, Bus Transportation, Track and Structures, Car Maintenance and Power joined in support of command. Train service was suspended between Federal Center SW and Stadium Armory with shuttle bus established. The smoke in the station eventually dissipated. DCFD cleared the scene turning command over to WMATA. Third rail power was restored on track #1 and trains began to service Eastern Market track #1 only.
Strengths	Operational Coordination Use of Ops #6
Needs Improvement	Procedures of switching to Ops #6 Command to MICC Coordination

Attachment E: WMATA After Action Report page 2 of 6.

Incident Observations

Lessons Learned / Needs Improvement

Core Capability	Operational Communication
Observation	MTPD radios currently are not programmed with the rail incident channels which prevented on-scene MTPD personnel from directly communicating on Ops #6 during the incident. Additionally, some responding personnel were not aware of their ability to utilize Ops #6 as a single point of communication.
Recommendation	A dedicated Incident channel is important to unify communications and part of IMF. All MTPD radios should be re-programmed to include each rail incident channel. During incidents when an emergency incident channel is designated, on-scene personnel should be re-directed to switch over to the specified incident channel for all incident communications.

Core Capability	Operational Communication
Observation	The delay in the establishment of the executive coordination call contributed to delayed customer messaging due to a lack of situational awareness of the incident by the Customer Service and Communications team.
Recommendation	The development of a standardized procedure for keeping the Customer Experience and Engagement team situationally aware and defining when a coordination call should be initiated.

Core Capability	Operational Communication
Observation	A unified consensus between the MICC (Metro Integrated Command & Communications) and on-scene personnel concerning if single tracking could be established was delayed. Initially the requests to restore third rail power on track #1 was denied after DCFD personnel reported some confusion at the incident command post regarding if personnel were clear of the roadway. Additionally, ERT personnel had concerns of a negative return affecting track #1 posing a safety issue. There were also reports that personnel on the scene received incident coordination related requests directly via telephone calls around the incident commander.
Recommendation	All incident communication should consistently flow through a single incident channel so that situational awareness and critical information is shared amongst all key personnel assisting on an incident scene. Additionally, communications between MICC and Incident command need to follow established procedures.

Core Capability	Infrastructure Systems

Attachment E: WMATA After Action Report page 3 of 6.

Observation	DCFD had concerns over the vent shaft's configuration at Eastern Market. The configuration in the station's playbook and the training that DCFD received differed from what occurred during the incident.
Recommendation	A follow-up meeting between DCFD and WMATA (Washington Metropolitan Area Transit Authority) personnel to review and discuss the configuration of the ventilation shaft and station's playbook in more detail to ensure a cohesive understanding for future incidents like this.

Lessons Learned / Strengths

Core Capability	**Operational Coordination**
Observation	Overall incident coordination flowed well. Responding personnel were aware of the expectations when they arrived at the scene. Departmental group leads reported to the incident command post and checked in with the incident commander. The swift coordination between DCFD and WMATA at the onset of the incident established a solid incident command foundation that was carried out through most of the incident. Although rail transportation personnel did not feel comfortable assigned in the incident commander role, having the presence of OEP (Office of Emergency Preparedness) primary responder personnel on scene and by their side to help provide guidance was helpful.
Recommendation	N/A

AAR Information

Data Sources	AAR meeting, responder interviews, hot wash report.
AAR Meeting	Friday, February 23, 2024
AAR Meeting Participants	WMATA, DCFD, WMSC
AAR Review Team	[redacted]

Conclusion

This AAR met the goals of collaboratively reflecting upon and analyzing the event, documenting findings, and developing an improvement plan. In addition, a critical discussion occurred that will improve future operations. The improvement plan represents prudent and preventative actions that will enhance future readiness. It should be adopted by all named parties in a timely manner.

Attachment E: WMATA After Action Report page 4 of 6.

Signature Page

I hereby approve the findings in this After-Action Report.

_____

Recommended:

Senior Director, Office of Emergency Preparedness
Department of Safety and Readiness
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

Attachment E: WMATA After Action Report page 5 of 6.

APPENDIX A: IMPROVEMENT PLAN

There is currently an IP in place that was previously developed (see **AAR #2023-11 Appendix A**) which will also specifically address the areas of improvement identified for this incident.

Core Capability	Improvement Action	Hazard Ranking	Primary Responsible Organization	Organization POC	Completion Date
Infrastructure Systems	Facilitate a coordination meeting with DCFD to review ventilation configurations at Eastern Market station.	2C	OEP	[redacted]	February 2024
Infrastructure Systems	Through the COG Fire Chiefs Committee, add WMATA Fan playbook as an agenda item to the upcoming meeting and determine what follow-up actions are required.	2C	OEP/Fire Marshal	[redacted]	March 2024
Operational Communication	Develop a procedure for initiating incident coordination calls	3C	MICC	[redacted]	March 2024

Attachment E: WMATA After Action Report page 6 of 6.

ALWAYS CHECK SOURCE DOCUMENT FOR CURRENT REVISION

VEHICLE PROGRAM SERVICES (CENV)
MAINTENANCE AND SERVICE INSTRUCTIONS PROCEDURES

MSI 100001
Rev. 00

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

TABLE OF CONTENTS

Attachment C: MSI 100001 page 1 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

REVISION HISTORY		
Rev. #	Date	Description
00	3/1/2024	Initial release to revision 00 on March 1, 2024

Attachment C: MSI 100001 page 2 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

1.0 PURPOSE

Provide an approved procedure for the inspection and qualification of the Current Collector subassemblies with cracks found on mounting brackets.

2.0 BACKGROUND

On February 15, 2024, Car 7663 was involved in a smoke related incident due to damage to primary power cable and current collector assembly. As a result, a fleetwide campaign was initiated to inspect collector shoe assemblies and defective units were quarantined. This MSI provides instructions for inspection of the removed collector assemblies identified during the campaign to disposition for return to service.

3.0 APPLICABLE CARS

- Alstom-Breda 2000/3000 Series Railcars
- Alstom 6000 Series Railcars
- Kawasaki 7000 Series Railcars

4.0 APPLICABLE EQUIPMENT

- 2000/3000 Series Current Collector, Left/Right (M18355002/M18355001)
- 6000 Series Current Collector, Left/Right (M18356017/M18356016)
- 7000 Series Current Collector, Left/Right (K18354020/K18354019)

5.0 REFERENCES

- MSI will affect/update the following:
  - 2K/3K Series HRMM, Chapter 3
  - 6K Series, HRMM Chapter 5
  - 7K Series, HRMM Chapter 5

Attachment C: MSI 100001 page 3 of 20.

6.0 TOOLS

- Standard mechanic's tool set
- Soft wire brush
- Rubber mallet/hammer
- Pry bar
- Putty knife and wire brush
- Steam cleaner or parts washer
- Micrometer caliper (calibrated equipment)
- Scouring pad
- Feeler gauges (Up to 0.30")
- Electric impact tool

7.0 MATERIALS

- Clean shop cloths (067-00-0672)
- Degreaser (R79-30-0130)
- Safety glasses
- Sealing compound: RTV (R80-30-0006)
- Sharpie marker (Staples P/N 036619)
- White paint marker

8.0 GENERAL SAFETY

All work shall be conducted in a safe manner and in accordance with the latest edition of the Metrorail Safety Rules and Procedures Handbook. All work shall be performed in such a manner that there is no danger to WMATA personnel or damage to WMATA Property.

Attachment C: MSI 100001 page 4 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

9.0 PROCEDURE

9.1 Cleaning and Preliminary Inspection of Current Collector Subassembly Parts

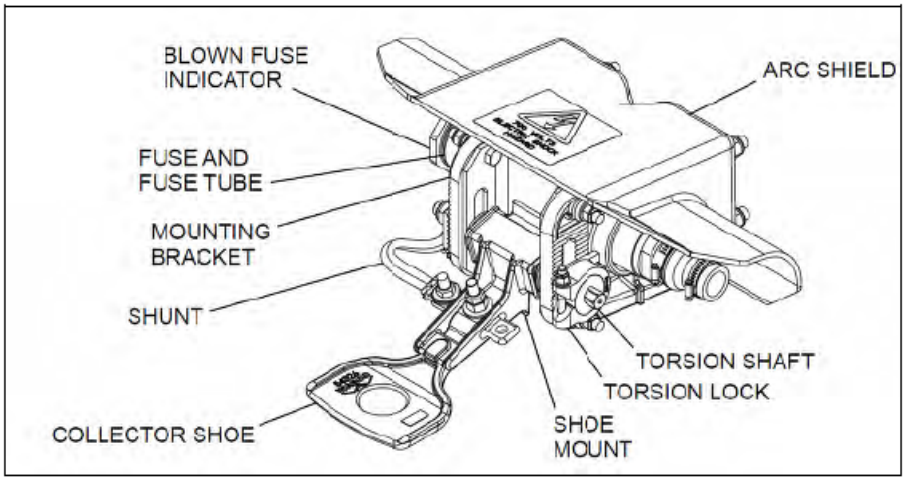


Figure 1.

Notice: The arc shield must be removed prior to steam-cleaning.

9.1.1 Remove four hex head bolts, four rubber shims, and four washers to disconnect arc shield from collector assembly. Discard all hardware.

Attachment C: MSI 100001 page 5 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

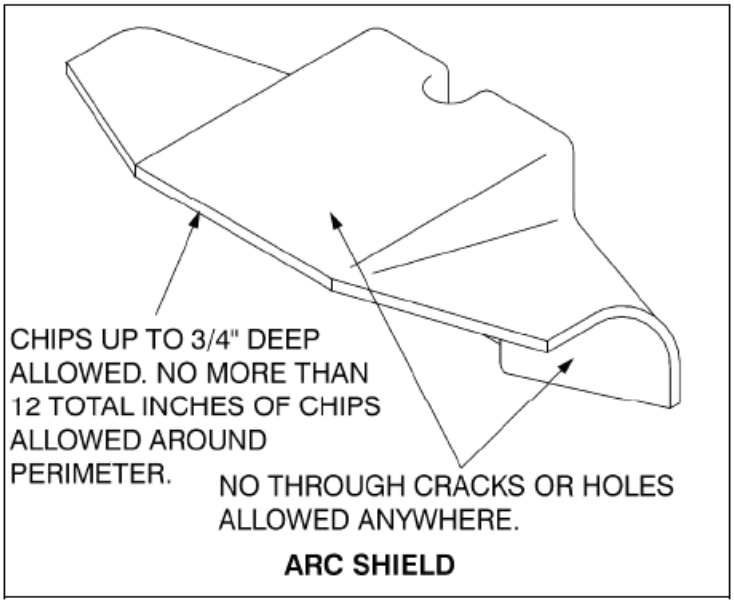


Figure 2.

9.1.2 Inspect arc shield for damage. Refer to Figure 2 for condemning criteria. If condemned, discard arc shield. If inspection passes, set arc shield aside for future reassembly.

9.1.3 Mark any cracks on assembly with black permanent marker to ensure marks/cracks do not disappear during heavy cleaning.

Warning: Steam cleaning presents a significant heat hazard. Ensure proper PPE **(safety glasses, hearing protection, face shield, hard hat, splash goggles, gloves, apron, safety shoes, hair/beard cover)** is worn during cleaning operations and ensure components have sufficient time to cool. Failure to comply may result in severe injury.

9.1.4 Remove failure data tag.

9.1.5 Clean all parts in the parts washer or steam cleaning machine to remove dirt and grime.

Attachment C: MSI 100001 page 6 of 20.

9.1.6 Return collector assembly(s) to inspection area.

9.1.7 If any light corrosion or rust is still on metal parts, use a soft wire brush to finish the cleaning and wipe down with clean shop cloths.

9.1.8 Remove any RTV coating with a scouring pad to allow for clear visual inspection.

9.1.9 Clean the collector assembly using a clean rag and Cleaner/Degreaser (WMATA P/N: R79-30-0130). Wipe all plastic parts down with clean shop cloths.

9.1.10 Perform post-cleaning visual inspection of assembly for cracks/discrepancies/flash/arc damage/burn damage/loose hardware/missing parts. Refer to Figure 3 for examples of a condemning through crack (for metal or plastic components). Refer to Figure 4 for an example of a non-condemning defect. If the assembly is excessively damaged, it may be necessary to disqualify and discard the entire assembly. If unsure, consult with your supervisor. The following defects shall be condemning criteria:

9.1.10.1 Through cracks on multiple (metal or plastic) components.

9.1.10.2 Severe/excessive arc or foreign object damage (FOD).

9.1.11 Begin current collector inspection procedure, starting with mounting brackets, shunt, and fuse box.

Notice: If any component is condemned, discard the component and continue with the inspection procedure as normal.

Attachment C: MSI 100001 page 7 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

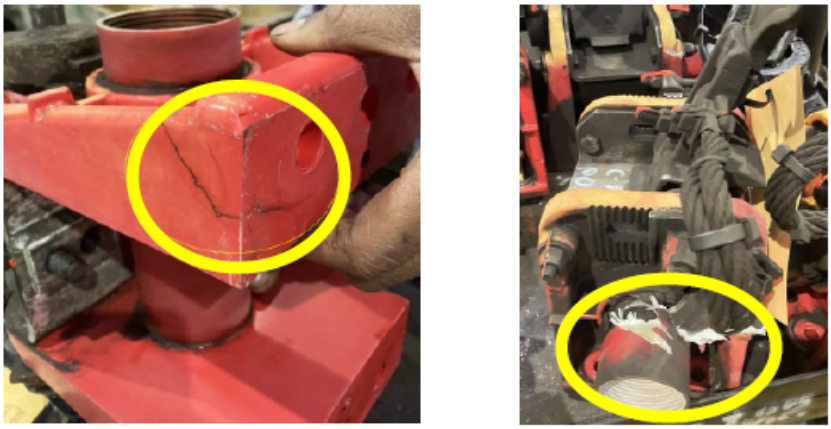


Figure 3. Examples of condemning defects for collector shoe assembly.

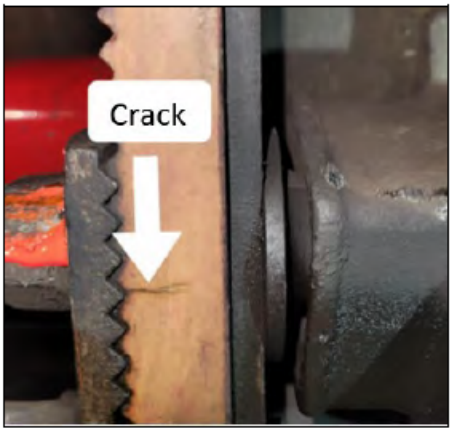


Figure 4. Example of a non-condemning defect

Attachment C: MSI 100001 page 8 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

9.2 Inspect Mounting Brackets, Fuse Box and Shunt

Caution: Current collector assembly weighs approximately 25 pounds (lbs.) and can cause back injury if lifted incorrectly

9.2.1 Set collector shoe assembly on base. Secure with mounting nuts, hand-tighten (see Figure 5).

Figure 5. Mounting of collector shoe assembly.

9.2.2 Inspect plastic mounting brackets for cracks. Refer to Figure 6 for inspection criteria.

9.2.3 Inspect Fuse Box and Blown Fuse Indicator per criteria in Figure 7.

Attachment C: MSI 100001 page 9 of 20.

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

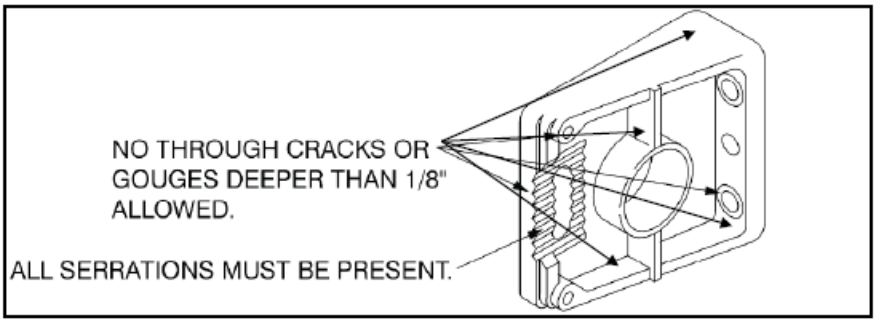


Figure 6. Mounting Bracket inspection.

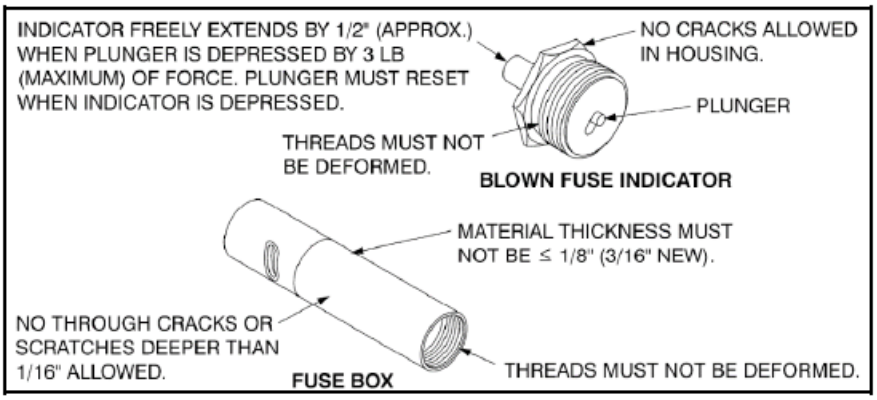


Figure 7. Fuse Box inspection.

9.2.4 Remove torque marks and/or RTV from all mounting hardware and torque surfaces with acetone or putty knife and wire brush prior to beginning disassembly.

9.2.5 Disconnect shunt from buss bar and torsion unit. Discard mounting hardware (see Figure 8). Inspect shunt for fraying or damage to copper strands. Replace if 30% of the strands are broken or frayed.

Attachment C: MSI 100001 page 10 of 20.

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

Figure 8. Removal of shunt

9.3 Inspect Collector Shoe and Torsion Unit Assembly

9.3.1 Disconnect collector shoe from torsion unit by removing both sets of nuts and bolts. Discard mounting hardware (see Figure 9). Inspect collector shoe for damage.

Figure 9. Removal of contact shoe

Attachment C: MSI 100001 page 11 of 20.

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

9.3.2 Loosen nut on torsion shaft locking ring (see Figure 10).

Figure 10. Torsion shaft locking ring.

Attachment C: MSI 100001 page 12 of 20.

9.3.3 Remove nut and height adjustment washer from torsion unit shaft (see Figure 11).

Figure 11. Height adjustment washer and nut

9.3.4 Temporarily reinstall nut on height adjustment side (hand tighten by a few threads). Use mallet to dislodge and remove torsion shaft.

Attachment C: MSI 100001 page 13 of 20.

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

9.3.5 Inspect torsion shaft and locking ring for cracks, severe oxidation, or deformation (see Figures 12 and 13). Discard if cracked or deformed. If oxidized, clean with wire brush and wipe clean.

Inspect torsion shaft assembly and both height adjustment washers for damage.

Figure 12. Torsion shaft assembly

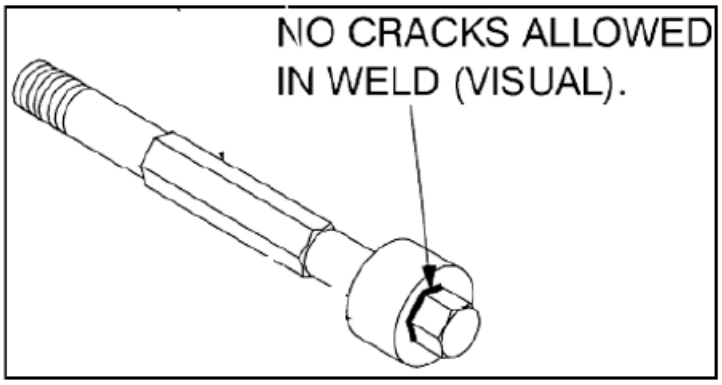


Figure 13. Torsion shaft inspection

9.3.6 Remove torsion unit with pry bar. Inspect paddle mount and spacers at each end of unit for cracks (see Figures 14, 15, and 16). Discard any failing components.

Attachment C: MSI 100001 page 14 of 20.

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

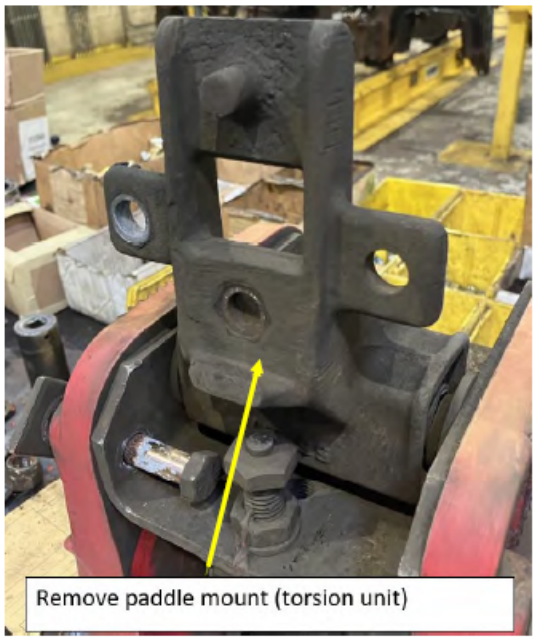


Figure 14. Paddle mount

Figure 15. Paddle mount (torsion unit) and spacers

Attachment C: MSI 100001 page 15 of 20.

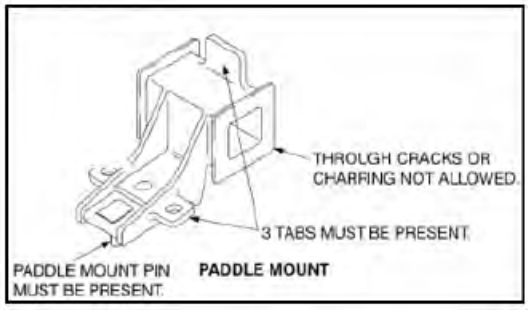


Figure 16. Paddle Mount inspection

9.3.7 Remove height adjuster bolt and jam nut. Remove buss bar bolt (see Figure 17).

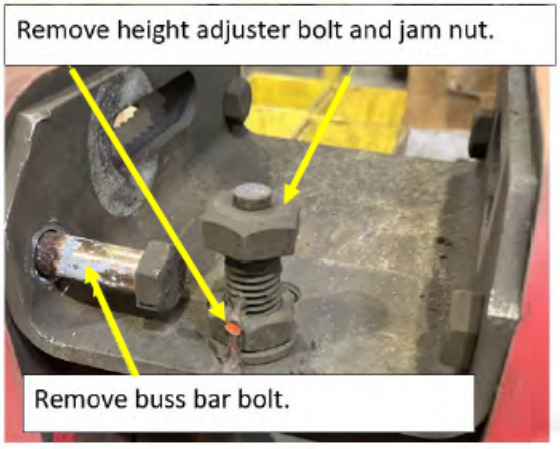


Figure 17. Height adjuster bolt, jam nut, and buss bar bolt.

Attachment C: MSI 100001 page 16 of 20.

9.3.8 Use pry bar to remove buss bar and grommet. Discard grommet and inspect bus bar for damage (see Figure 18).

Figure 18. Buss bar and grommet

Attachment C: MSI 100001 page 17 of 20.

9.3.9 Remove 3 bolts securing metal mounting bracket. Inspect bracket for cracks/wear marks/damage (see Figure 19 and Figure 20). Discard metal bracket if cracked or excessively worn.

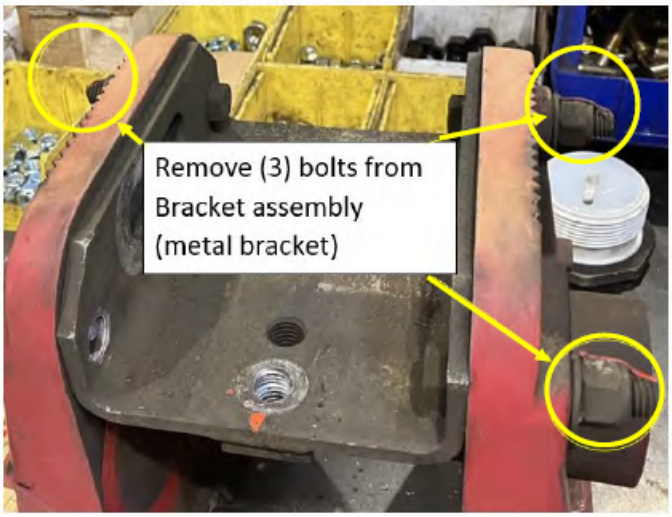


Figure 19. Bracket assembly mounting bolts

Attachment C: MSI 100001 page 18 of 20.

Figure 20. Metal bracket assembly

9.3.10 Remove mounting nuts from stand.

9.3.11 Discard all mounting hardware. Condemn all damaged/failed parts.

9.3.12 Clean all non-condemned parts for reuse to rebuild collector shoe assembly.

END OF PROCEDURE

Attachment C: MSI 100001 page 19 of 20.

COLLECTOR SHOE ASSEMBLY COMPONENT CLEANING, INSPECTION, AND QUALIFICATION

ALL SERIES RAILCARS

10.0 TEST

There are no testing requirements for cleaning and disassembly of the current collector assembly.

11.0 DOCUMENTATION

Document any major discrepancies and/or condemned components in MAXIMO.

12.0 ATTACHMENTS

None.

Attachment C: MSI 100001 page 20 of 20.

RTRA OPERATIONS PERSONNEL NOTICE

Monday, February 19, 2024

RTRA-603-135-00

Identifying and Reporting Power and Propulsion Issues

As the Office of Car Maintenance continues to inspect the 7000 series fleet collector assemblies, beginning tomorrow, Tuesday, February 20, 2024, Metrorail service will be modified to operate 6-car trains on all lines except the Red Line.

In the interim, all operating personnel shall pay close attention to any power and propulsion issues to include the following:

- current issues,
- dynamics issues,
- motor overloads,
- brake odor,
- no third rail voltage,
- unusual/loud noises,
- indication of smoke,

Any of these propulsion issues shall be communicated to the MICC immediately.

Your conscientious actions contribute to rail safety and minimize rail related incidents. If you have questions or concerns, please contact your Division Management team.

To report a potential safety risk, please scan the QR code or use this link: ***tinyurl.com/RTRARisk***

Electronic devices shall only be used in designated areas and in accordance with the WMATA Electronic Device Policy.

Appendix K – 7K Collector Shoe Fleet Inspection

7K List of Cars - Collector Shoe Assembly Defects

Index	Car No.	ASM No.	Component
1	7002	#2	Mounting Bracket
2	7028	#4	Mounting Bracket
3	7048	#1	Mounting Bracket
4	7048	#2	Mounting Bracket
5	7058	#2	Mounting Bracket
6	7058	#3	Mounting Bracket
7	7059	#2	Mounting Bracket
8	7059	#3	Mounting Bracket
9	7095	#3	Mounting Bracket
10	7118	#1	Mounting Bracket
11	7193	#2	Mounting Bracket
12	7208	#1	Mounting Bracket
13	7237	#3	Mounting Bracket
14	7241	#3	Mounting Bracket
15	7252	#1	Mounting Bracket
16	7309	#1	Mounting Bracket
17	7320	#2	Mounting Bracket
18	7333	#1	Mounting Bracket
19	7356	#2	Mounting Bracket
20	7357	#2	Mounting Bracket
21	7357	#3	Mounting Bracket
22	7390	#2	Mounting Bracket
23	7390	#3	Mounting Bracket
24	7451	#1	Mounting Bracket
25	7478	#2	Mounting Bracket
26	7479	#3	Mounting Bracket
27	7509	#2	Mounting Bracket
28	7509	#3	Mounting Bracket
29	7526	#2	Mounting Bracket
30	7527	#1	Mounting Bracket
31	7541	#1	Mounting Bracket
32	7560	#1	Mounting Bracket
33	7560	#3	Mounting Bracket
34	7561	#1	Mounting Bracket
35	7561	#3	Mounting Bracket
36	7580	#2	Mounting Bracket
37	7590	#1	Mounting Bracket
38	7590	#4	Mounting Bracket
39	7591	#2	Mounting Bracket
40	7591	#3	Mounting Bracket
41	7591	#4	Mounting Bracket
42	7604	#2	Mounting Bracket
43	7648	#3	Mounting Bracket

Attachment 1 – 7K List of Cars Collector shoe assembly defects page 1 of 2

44	7659	#3	Mounting Bracket
45	7667	#2	Mounting Bracket
46	7672	#2	Mounting Bracket
47	7672	#3	Mounting Bracket
48	7673	#4	Mounting Bracket
49	7682	#1	Mounting Bracket
50	7683	#2	Mounting Bracket
51	7683	#4	Mounting Bracket
52	7738	#2	Mounting Bracket
53	7739	#2	Mounting Bracket

Attachment 1 – 7K List of Cars Collector shoe assembly defects page 2 of 2

Washington Metropolitan Area Transit Authority

Vehicle Program Services (Fleet)

Incident Report

Current Collector Assembly Burned Up on Right Front Truck of Car 7663 at Eastern Market Station

Date of Incident: 02/15/2024

CENV Form 41.008

Document 1 – Vehicle Program Services (Fleet) Indent Report, Page 1 of 24

Washington Area Metropolitan Transit Authority
Incident Summary Report

Document 2 - Vehicle Program Services (Fleet) Indent Report, Page 2 of 24

1. INCIDENT INFORMATION

LOCATION: Eastern Market

INCIDENT #: 8732769

DATE: 02/15/2024

TIME: 12:54 PM

INVESTIGATION TEAM MEMBERS

1. [redacted]
2.
3.
4.
5.
6.
7.

REPORT PREPARED BY:

[redacted]

REPORT APPROVED BY:

[redacted]

[redacted] – DEPUTY CHIEF MECHANICAL OFFICER – FLEET

Document 3 - Vehicle Program Services (Fleet) Indent Report, Page 3 of 24

2. EXECUTIVE SUMMARY

On February 15th, 2024, WMATA experienced an incident involving train ID 638 (**L 7104-05 X 7341-40 X** 7663-62 **T)** where current collector assembly #4 broke off from the rear truck of car 7663. This incident caused excessive current to flow through the primary high voltage cables of both the front and rear trucks, resulting in a rapid increase in temperature, fire, and arc flash that damaged surrounding components in the railcar.

Following the incident, WMATA initiated an investigation to determine the potential root cause of the current collector assembly #4 breaking off from the truck on railcar 7663. The investigation was conducted in collaboration with various WMATA internal departments, including Traction Power (POWER), Track and Structures (TRST), and Rail Transportation (RTRA), Department of Safety (SAFE), Metro Integrated Command and Communications Center (MICC) and external parties Kawasaki Railcar (KRC), TransTech (current collector original equipment manufacturer, OEM), and Applied Technical Services (Lab). The investigative efforts included railcar and third rail inspections, data analysis of the incident train, fleet-wide inspection of collector assemblies, analysis of Track Geometry Vehicle (TGV) data, third rail testing (using an instrumented 7000 series railcar), and laboratory testing of sample current collector assemblies.

The investigation identified several contributing factors to the incident, such as the susceptibility of the collector mounting brackets to fatigue and fracture under increased load magnitude and frequency, and areas of the revenue tracks with high end approaches. The susceptibility of the collector mounting brackets was exacerbated by the high-end approaches and track perturbations on revenue lines, introducing higher than desired loads at a higher than desired frequency. This led to an investigation of the operating condition of the revenue lines' third rail, identifying areas requiring corrective maintenance to comply with the Track and Structures Standards (TRST 1000). Furthermore, railcar maintenance procedures were updated to require detailed inspections and overhauls of collector shoe assemblies.

WMATA has taken steps to mitigate future occurrences of similar incidents. These steps include revising the fleet periodic inspection maintenance manual (Task 60) to include inspection of damages to the collector shoe assembly structures, creating a collector assembly overhaul procedure, updating the TRST 1000 to include modified end approach criteria and specifications for wide/narrow third rail gauges based on results from the third rail test, Track Geometry Vehicle (TGV) analysis, and track structures inspections.

Additionally, WMATA has established a working group between Fleet and TRST to monitor both railcar and track variables and address issues as they arise.

Document 4 - Vehicle Program Services (Fleet) Indent Report, Page 4 of 24

3. INTRODUCTION

On February 15th, 2024, while train ID 638 (**L 7104-05 X 7341-40 X 7663-62 T) travelled westbound on track #2 of the Orange/Silver line,** the railcar operator reported hearing a loud explosion upon arrival at Eastern Market Station. The road mechanic on the scene observed that the collector shoe assembly on the right front truck of car 7663 had burned, and the primary cable on the left side, rear truck of car 7663 was also burned.

The train was removed from service and sent to the New Carrollton Rail Yard for inspection. Based on the railcar inspections, it was found that the primary cable dangling from the left side of car 7663 (rear truck, current collector #4) had contacted the running rail. This contact created a direct short circuit to ground, blowing collector shoe fuses #2 and #3, producing excessive arcing and heat on collector assembly #1. The short circuit continued until the primary power cable, at rear truck above wheel #6 burned through thereby opening the primary power circuit.

4. THEORY OF PRIMARY POWER OPERATION

The third rail is the source of the nominal 700 VDC power supply to the consist. The current collector provides the initial contact to the third rail. Each car has four current collectors, two on each side. Depending on the track configuration, two current collector shoes on one side are normally in contact with the third rail.

The current flows from the third rail through the current collectors into a fuse and then through a sensor and switch, which directs the current. One path supplies power to various systems, including heaters and an inverter that converts the voltage for general use. The other path directs power through a circuit breaker to the propulsion inverter, which powers the railcars' traction motors.

5. INVESTIGATION AND CORRECTIVE ACTIONS

Post incident, WMATA initiated a root cause investigation to identify the potential factors related to wayside influences – track and wayside infrastructure, and rail vehicles - that caused collector shoe #4 to break off from the truck. The investigation was led by Fleet Services in collaboration with several departments, including Traction Power (POWER), Track and Structures (TRST), and Rail Transportation (RTRA), Department of Safety (SAFE), and Metro Integrated Command and Communications Center (MICC). This section discusses the investigative efforts performed, findings, and the corrective actions.

Document 5 - Vehicle Program Services (Fleet) Indent Report, Page 5 of 24

5.1 RAILCAR INSPECTION

The incident cars were transported to the New Carrollton Rail Yard for undercar inspection and damage assessment. **Figure 1** below provides a general overview of the nomenclature of the collector shoe assembly. The primary components involved in this incident are the mounting bracket, mounting channel, collector paddle, and collector fuse.

1- The mounting bracket affixes the collector shoe assembly to the truck.

2- The mounting channel is a U-channel which is fastened to the mounting brackets.

3- The paddle mount is fastened to the mounting brackets and mounting channel.

4- The collector paddle (shoe) is mounted to the paddle mount.

5- The Blown Fuse Indicator is used to indicate the status of the current limiting fuse housed within the fuse tube.

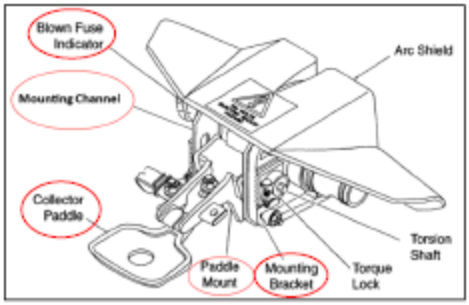


Figure 1 - Current Collector Assembly

During the undercar inspection, the shoe fuse assembly for current collector #1, on B-Car 7663, was found to be mostly disintegrated, likely due to excessive arcing. **Figure 2** below depicts the condition of the current collector assembly at time of inspection.

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Figure 2, Car 7663 Current Collector Assembly # 1 and Fire Location

Current collector assembly #4 was completely broken, with the majority of the assembly components missing. **NOTE:** TRST found fractured pieces of a collector shoe assembly between the Third Rail and Running Rail, located between chain markers C1 76+100 and C1 77+00. Based on the location, it is believed, those were remnants of collector assembly #4. **Figure** 3 below shows the collector fuse (which was flashed open) & the mounting channel, which remained hanging from an approximately 3 ft. section of the primary cable.

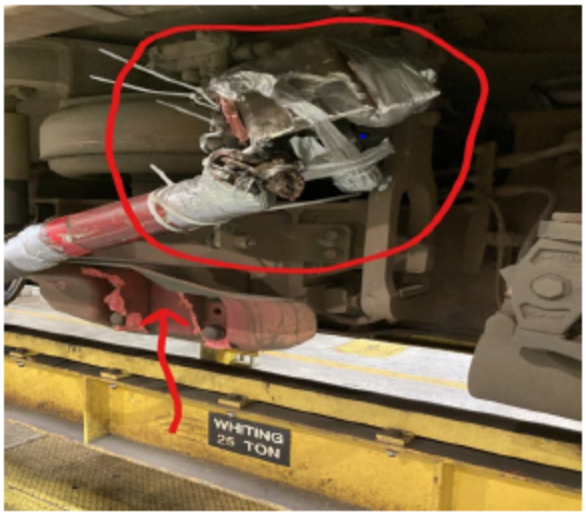

Figure 3, Car 7663 Current Collector Assembly # 4

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Figure 4 below depicts evidence of flashing of the primary cable to the #6 brake disc. Additionally, circular scrapes were found on the back of the collector assembly mounting channel #4, indicating it was lodged against the brake disc as shown in **Figure 5**.

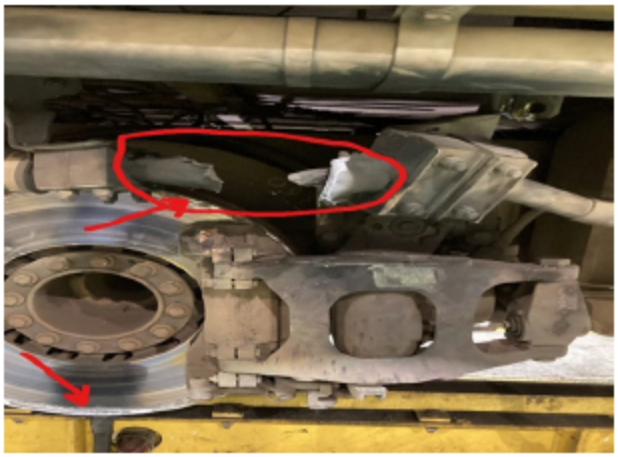

Figure 4, Car 7663 Primary Cable, and Brake Disc # 6

Figure 5, Circular scrapes on back of Collector Shoe Assy # 4

Current collector assemblies # 2 and # 3 remained intact with the fuses activated (or opened). Several truck components such as brake calipers, leveling valve linkage, air

Document 8 - Vehicle Program Services (Fleet) Indent Report, Page 8 of 24

bags, primary power cable, holding brake release cables, cable cleats on car 7663 were burnt and/or melted from the excessive heat of the short circuit.

All the collector shoes (paddles) on the A-car (7662) showed signs of overheating and flashing but did not exhibit physical damage or electrical discrepancies. The remaining cars in the train consist revealed no discrepancies.

Following the incident, FLEET initiated and completed a comprehensive fleet-wide visual inspection of all current collector shoe assemblies according to MSI 140043. This inspection specifically checked for loose mounting bolts, ensuring bolts are torque striped, and identifying any worn collector shoes or frayed collector shunts. Additionally, the inspection verified that blown fuse indicators were not activated. FLEET also conducted and completed a fleet-wide inspection and verification of current collector shoe height and tension per SBF 128, SBE 153, and SBB 652, which included inspecting the collector shoe assembly mounting brackets for defects, such as cracks.

In response to the findings from the inspections, FLEET developed a procedure to rebuild and overhaul collector shoe assemblies removed from railcars and revised the periodic inspection procedures to include damage inspection criteria for the current collector assemblies.

In addition, WMATA included the railcar builder, Kawasaki Railcar (KRC), and the original equipment manufacturer (OEM) for the collector shoe assemblies, Trans Tech, in the investigation. WMATA requested these vendors to provide detailed maintenance procedures, drawings, material specifications, qualification test procedures, and certificates of conformance for all 7K current collector assemblies. The collaboration aimed to thoroughly examine all aspects of the collector shoe assemblies and ensure any necessary corrective actions are based on the comprehensive information provided by the vendors.

5.2 TRACK INSPECTION

Following the incident, TRST performed a track walk inspection between Foggy Bottom and Court House Stations on Track 1 of the Orange Line. The inspection revealed a long stretch of scratch marks on the track cement, resembling signs of equipment being dragged, between Foggy Bottom and Rosslyn stations. These marks began approximately 400-600 feet west of the Foggy Bottom Platform and were likely caused by collector assembly #4 on car 7663 being dragged as the train traveled between stations.

Additional findings from the track walk inspections included:

1. A recently broken insulator at chain marker C1 75+20.

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2. Fractured pieces of a collector shoe assembly were found between the Third Rail and Running Rail, located between chain markers C1 76+100 and C1 77+00.
3. Evidence of equipment being dragged, such as scuff marks and several chipped third rail grout pads, from chain marker C1 76+00 to C1 79+00.
4. Damaged face plates and third rail between chain markers C1 79+00 and C1 81+00.

Figures 6 and 7 below illustrate the areas where damaged components and remnants of collector shoe assembly were found on a track map and the system map.

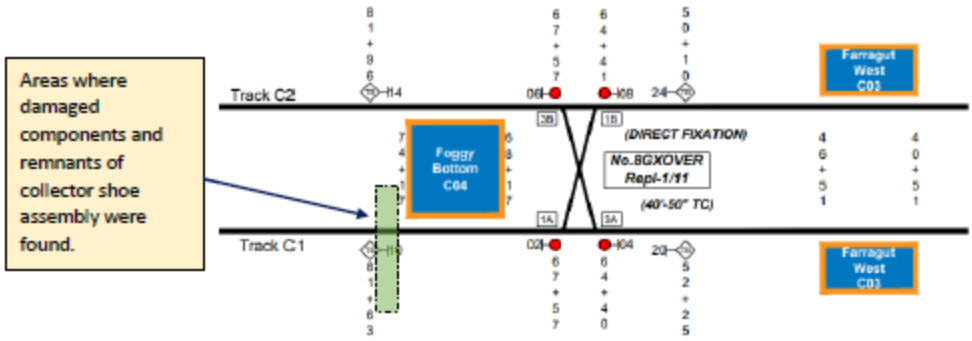

Figure 6, C1 Track Location of the Areas Affected

Figure 7, System Map Location of the Areas Affected

CENV Form 41.008

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5.3 RAILCAR DATA ANALYSIS

Before the incident at Eastern Market Station, Train ID 638 travelled eastbound on Track #1. While approaching Rosslyn station the event recorder (ER) data shows several motor torque and dynamic braking failures, starting at 11:44pm as seen in **Figure** 8. In addition, the VMDS fault logs also show intermittent loss of third rail voltage around the same time (see Appendix 1).

NOTE: This coincides with the track inspection, during which "fractured pieces of a collector shoe assembly were found" between Foggy Bottom and Rosslyn.

Figure 9 below, shows loss of third rail power on both trucks when traveling westbound toward Eastern Market Station.

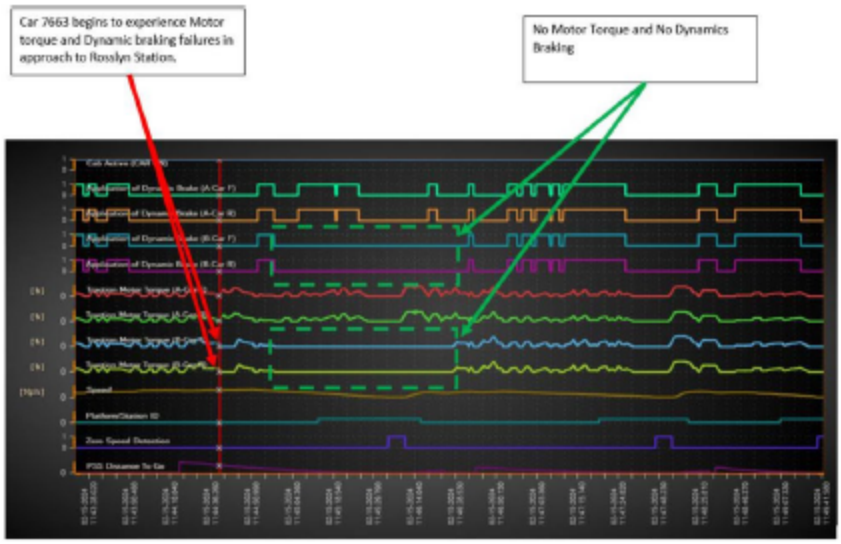

Figure 8, Car 7663 Propulsion Signals Approaching Rosslyn Station on Track #1

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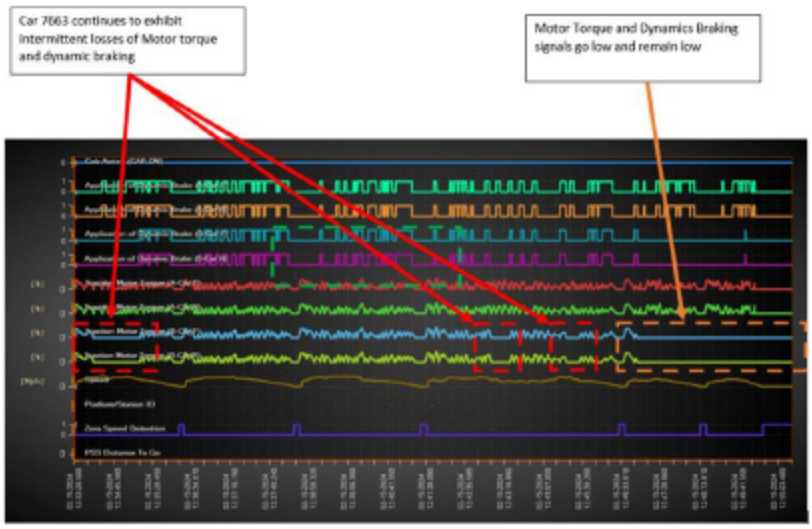

Figure 9, Car 7663 Front and Rear Trucks Loss of 3rd Rail- Traveling Westbound toward Eastern Market Station

5.4 TRACTION POWER SUBSTATION

The Traction Power Substation Logs also indicate Tie Breakers began tripping at 12:45a, when Train ID 638 was moving from the D&G junction toward Eastern Market station (See Appendix B: Table1).

5.5 TRACK GEOMETRY VEHICLE (TGV) DATA ANALYSIS

TRST uses the TGV as part of the maintenance equipment for rail defect inspection. Normally, TRST operates the TGV 3 times per year on the entire system. TGV data is supplemented by walking track inspections. Metro performs walking track inspections of the entire system twice per week. The Track Geometry Vehicle (TGV) is designed to measure key geometry parameters while traveling over the track at 40 mph, the Maximum Authorized Speed (MAS). Following the incident, the TGV was operated on all WMATA revenue lines to measure parameters such as track gauge, horizontal and vertical alignment of both the track and the third rail, track profile, cross level, and rail wear.

The TGV data was compared against data received from the third rail test train (details of the test train are provided in Section 4.6.1 below). The data comparison identified exceptions potentially impacting the performance and structure of the current collector

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assembly over time including third rail sections that are 1 ¼" higher than nominal (third rail height standard is 4 ½"), dips at expansion joints, high end approaches (end approach height or the distance below standard third rail height of 4 ½" was previously measured 10" from the tip of the end approach), and broken rails.

Figure 10 below illustrates an example of an expansion joint area with no dip (left) and a location identified on the Orange Line with an expansion joint that significantly impacts collector shoes due to the "dip" (right).

Figure 10, Expansion Joints

TRST has been proactive in addressing the critical areas identified by the third rail test train. The maintained locations were re-inspected by TGV to ensure compliance with TRST 1000 standards.

TRST has revised the criteria in the TRST 1000 for end approach measurements. Measurements are now to be taken 1 inch back from the tip of the end approach, ensuring a smooth path for the collector shoe to glide onto the contact rail. Additionally, the specifications for the High, Narrow, and Wide contact rails in the TRST 1000 have been refined to provide better clarity for maintenance personnel. **Figures** 11 and 12 below show the old and revised TRST standards respectively.

TRST will also modify the TRST 1000 to include tolerances for expansion joints, which impact the performance of the current collector assemblies.

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Table 107.7B: Running Rail

Elevation Above top of Running Rail				
Normal	Medium	Slow*	OOS	Standard
Up to +1 inch or -3/4 inch	More than +1 inch up to +1 1/4 inch	Over +1 ¼ inch	Less than-3/4 inch**	4 1/2"
Gauge to Nearest Running Rail**				
Normal	Medium	Slow*	Standard	
Up to -3/4 inch and +2	Less than -3/4 inch up to -1 inch, and More than 2 inches up to 3 inches	Less than -1 inch and +3 inches	24"	

Figure 11, TRST 1000 Old standard

Table 107.7D: Wide Contact Rail Defects

Width Wider than 24" Standard	Level	Operating Speed
Up to +2"	Green	Normal
More than +2" up to +3"	Yellow	Medium
More than +3" up to +3 ½"	Red	Slow
More than +3 ½"	Black	OOS

Table 107.7C: Narrow Contact Rail Defects

Width Narrower than 24" Standard	Level	Operating Speed
Up to -3/4"	Green	Normal
More than -3/4" up to -1"	Yellow	Medium
More than -1" up to -1 ¼"	Red	Slow
More than -1 ¼"	Black	OOS

Table 107.7A: High Contact Rail Defects

Height Above 4 ½" Standard	Level	Operating Speed
Up to +1"	Green	Normal
More than +1" up to +1 1/4"	Yellow	Medium
More than +1 1/4" up to +1 1/2"	Red	Slow
Over +1 1/2"	Black	OOS

Table 107.7E: End Approach Height

Distance Below Standard 4 ½"	Level	Operating Speed
More than -1 ½"	Green	Normal
Less than -1 ½" down to -1 ¼"	Yellow	Medium
Less than -1 ¼" to -1 1/8"	Red	Slow
Less than -1 1/8"	Black	OOS

Figure 12, TRST 1000 Revised Standards

5.6 TESTING

Following the incident, WMATA initiated two tests discussed below.

5.6.1 THIRD RAIL TEST TRAIN

OBJECTIVE

WMATA conducted a thorough inspection of the entire fleet to assess the condition of the current collector assemblies and specifically inspect for cracks in the mounting brackets. As a result, a significant number of current collectors were identified as "cracked". The results of the fleet wide inspection are available in Attachment A. In response to these

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findings, WMATA performed an inspection of the third rail across all lines to determine if inconsistencies in the 3rd rail alignment may have contributed to excessive loads being imparted on the current collector assembly, resulting in cracks in the mounting brackets. The complete Third Rail Test Train report generated by Hatch is available in Attachment B.

TEST PROCESS AND RESULTS

Test Plan

An eight-car consist was used for this test, where the instrumented married pair (7492-7493) was always on the open end, either leading or trailing the consist.

A series of track tests was conducted between March,12, and March, 15 of 2024 that covered tracks 1 and 2 of all rail lines. The collector shoe heights were adjusted to the 7000 series off-rail height (3.5"). Calibration of the equipment was then performed and verified.

Additionally, a different series of tests were conducted between April 29, and May 3, 2024. Prior to this second round of tests, the collector shoe heights of the instrumented shoes were adjusted to the legacy fleet off-rail height (3.75"), and calibration of the equipment was then performed and verified.

Instrumentation

One collector shoe from both A-car (7492) and B-car (7493) were instrumented with.

1) Current transducers
2) Linear potentiometer and voltage divider for measuring shoe height displacement.
3) Accelerometers (to measure shocks and vibrations due to impacts)
4) Laser displacement sensors for measuring the distance between the running rail and the third rail.
5) Three different cameras where installed:
    a. FLIR Thermal Camera (front): Records imagery from the track and third rail in front of the instrumented A-car (7492).
    b. Optical Camera (front): Records imagery from the track and third rail in front of the instrumented A-car (7492), and
    c. Optical Camera (shoe): There is an optical camera installed on each of the instrumented shoes. Records imagery of the collector shoe to third rail interface, allowing the identification of defects of the third rail and any unusual behavior.

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6) GPS to provide instant and accurate location.

7) Four (4) additional channels were obtained from the test car ports:

   a. Car Speed

   b. Line Voltage (A Car)

   c. Line Voltage (B-Car)

   d. Master Controller Position PWM.

Below, **Figure 13** presents the front cameras and an example of an instrumented collector shoe assembly.

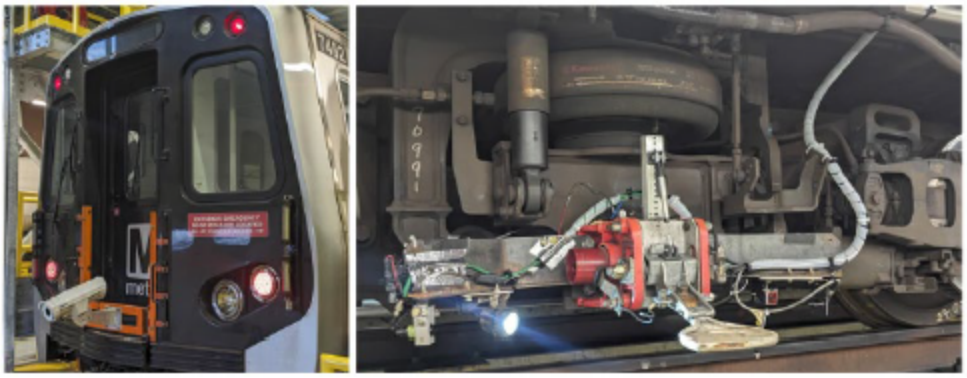

Figure 13, 7000 Series Third Rail Test car

Results

The data acquisition system used to collect the data was a Dewetron with the Dewesoft version 7.1 software installed. Hatch performed analysis using the data collected from this systemwide test.

1- Shoe Height/Acceleration

Several locations of 3rd rail were identified as exceptions, either for exceeding WMATA's internal track standards for high rail (6" max), or for hard bounces to the current collector which could damage the current collector assembly over time.

2- Thermal Data

A limited number of 3rd rail locations were identified as having a high temperature relative to ambient and were provided to the track department for further investigation. These

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findings had minimal impact on the condition of/causing damage to the collector shoe assemblies.

3- Current Draw

Several current spikes throughout the system were analyzed, but none had the profile of a cracked 3rd rail.

4- Acceleration

This analysis utilized two equivalent acceleration channels: Accelerometers installed on top of each instrumented collector shoe assembly, and calculated acceleration values derived from the second derivative of the shoe height displacement, as recorded by a linear potentiometer. Both channels produced similar results and effectively identified exceptions through perturbations in height and/or acceleration of the collector shoe. Refer to **Figure 14** below for the identified acceleration and shoe height exceptions on the revenue lines.

Line	Height and Acceleration Exceptions				
	Hard Bounce - Dip	Hard Bounce - End Approach	Hard Bounce – Mid-rail	High Rail	
Green	1	6	1	4	12
Yellow	2	1	0	7	10
Blue	2	6	3	45	56
Orange	17	10	2	25	54
Silver	0	0	10	0	10
Red	5	1	9	31	46
Total	27	24	25	112	188

Figure 14, Shoe Height, and Acceleration Exceptions

CONCLUSION AND RECOMMENDATIONS

The test results revealed several locations across the system that exceed WMATA's internal track standards for high rail (6" max). These sections also introduce hard bounces to the current collector which could damage the current collector assembly. For the full report and recommendations, refer to Attachment B

Currently, no maintenance criteria exist to maintain short length of 3rd rail dips at expansion joint locations, but criteria will be developed to mitigate these hard impacts to the current collector assemblies.

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5.6.2 APPLIED TECHNICAL SERVICES LABORATORY TESTS

OBJECTIVE

One of the methods used by WMATA for root cause analysis was sending collector assembly samples for lab testing. Four cracked current collector assembly brackets were submitted to Applied Technical Services (ATS) for fractographic and material analysis to determine the failure mechanism, contributing factors, and if possible, the cause of failure. An exemplar sample was provided for compositional comparison. Eight current collector shoes were also provided for hardness testing. The complete report generated by ATS is available in Attachment C.

TEST PROCESS AND RESULTS

Visual Inspection

ATS performed a visual inspection of the current collector assembly brackets and shoes in their as-received condition. Cracks were predominantly found around the base of the brackets, with additional cracks observed in other areas. Yellow discoloration, typical of UV degradation, was noted on the bracket surfaces, mainly towards the top. Brinell hardness testing was conducted on the wear surfaces of the shoes. Microscopic examination revealed that cracks often occurred along indentations from washers and near bolt holes.

When sectioned and examined, service fractures displayed smoother and darker surfaces compared to the coarser texture of lab-induced fractures. The smoother and darker surfaces of the service cracks indicate that these cracks had been propagating over a longer period, exposing the fibers and developing a duller appearance due to prolonged environmental exposure. In contrast, the coarser texture of the lab-induced fractures suggests that these cracks were formed quickly, without significant environmental interaction.

Scanning Electron Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS)

The fracture surfaces of the samples were further analyzed using SEM coupled with EDS. The fracture surfaces were predominantly smooth, following the length of exposed fibers. Contamination was observed along the edges of the fracture surface, causing a dark discoloration. The base material typically showed high levels of carbon, oxygen, aluminum, and silicon along with common filler materials identified as kaolinite and calcium carbonate. Large voids were also observed along the service fracture surfaces, which typically appeared smooth with grooves or longitudinally exposed fibers with minimal matrix adhesion.

Cross Sections Summary

Transverse and longitudinal cross sections were taken from Sample 2-1, both from a cracked area and an area remote from any cracking. Cross sections through the cracked

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area revealed large voids and cracks throughout the material, with the primary fracture surface exhibiting grooves where the matrix material detached from fibers. Cracks were observed connecting and emanating from these large voids. The cross sections from areas remote from any cracking also showed large voids with cracks connecting to and emanating from them. Automated image analysis with an SEM, measured the void content. The void content was approximately 5% higher in the transverse orientation than in the longitudinal orientation in the cracked area, indicating elongated voids that promote crack formation. The void content in the remote sections was similar but showed more circular voids.

Mechanical Testing Summary

Hardness testing was performed on the exemplar and two cracked current collector assembly brackets using a durometer and a Rockwell indenter. The results indicated no significant differences in hardness between the cracked and exemplar samples, with values ranging from 84-86 Shore D and 85-90 HRM. The current collector shoes were tested for hardness on the wear surfaces with new winter and summer shoes showing the largest differences in hardness between manufacturers. Wabtec had a higher measured hardness for the winter shoe, while IPS had a higher hardness for the summer shoe.

Chemical Analysis Summary

Chemical analysis of the current collector assembly bracket Sample 2-1 was conducted to measure density and glass fiber content. Sub-samples near cracked and remote areas were analyzed. Results demonstrated the density and measured glass fiber content were slightly lower near the cracked area compared to the remote area. Fourier transform infrared spectroscopy (FT-IR) was performed on exemplar, cracked, and contaminated fracture surface. The spectra were consistent with polyester resin and some filler materials, with no significant differences between samples, indicating that chemical composition or degradation was not a contributing factor to the cracking.

Differential Scanning Calorimetry (DSC) Summary

Differential scanning calorimetry (DSC) was performed on material from Sample 2-1 to determine the glass transition temperature, enthalpies of fusion (ΔHf), and melting temperature. The material exhibited a melting point of 102.6°C, with the enthalpy of fusion being slightly higher during the first heat compared to the second heat, indicating a higher crystallinity in the manufactured sample versus the annealed condition. No glass transition temperature or residual exotherms indicating incomplete curing were observed from the DSC thermogram.

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Thermogravimetric Analysis (TGA) Summary

Thermogravimetric analysis (TGA) was conducted on both the exemplar sample and Sample 2-1 from the cracked area to determine their volatile, combustible, and ash content. The results revealed minor differences in volatile and ash content between the two samples. These slight variations are not significant enough to be considered contributing factors to the observed cracking, indicating that the compositional properties measured by TGA do not play a critical role in the material's failure. Additionally, chemical and mechanical testing results confirmed minimal material differences between the cracked areas and the exemplar sample, further supporting the conclusion that the TGA results are not a contributing factor.

Dynamic Mechanical Analysis (DMA) Summary

Dynamic mechanical analysis (DMA) was conducted on material from Sample 2-1 to determine the glass transition temperature (Tg). During the analysis, the sample was heated at a rate of 3°C/min while subjected to a force at a frequency of 1.0 Hz with an oscillating strain of 0.1%. The results indicated a broad glass transition temperature range, with the median value measured at 136.0°C. Despite this variability, these findings do not suggest a direct link to the cracking issue. Therefore, the thermal properties and glass transition behavior of the material are not likely contributing factors to the observed structural failures. Additionally, chemical and mechanical testing results confirmed minimal material differences and no residual exotherm indicating incomplete resin cure, further supporting the conclusion that the DMA results are not a contributing factor.

CONCLUSION AND RECOMMENDATION

Based on the test lab results, the final failure occurred due to fatigue failure of the bracket from cracks originating at material voids. **NOTE:** TransTech does not utilize a "void content" criterion for this service proven assembly as part of their manufacturing process. Acknowledging the material's susceptibility to fatigue and fracture, WMATA has incorporated periodic inspections of the bracket into its maintenance practices as a mitigation measure.

Throughout the investigation and corrective action processes, WMATA established real-time information-sharing protocols and conducted daily meetings with stakeholders to review action items and track mitigation efforts.

6. CONCLUSION

Based on the inspections, data analysis, and testing conducted, this incident was the result of several contributing factors, the operating environment of the railcar, and the need for enhanced maintenance practices by both FLEET (rail cars) and TRST (track structures).

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Fleet Services has replaced the current collector assemblies that exhibited surface cracks.

TRST has replaced track components such as grout pads, third rail cover boards, face plates, and adjusted the end approach height to allowable range per the TRST 1000 standards at various locations on the mainline.

FLEET, and TRST have updated respective maintenance manuals to proactively monitor third rail integrity (height and gauge alignment) and the condition of collector shoe assemblies. These updates aim to mitigate excessive damage to current collector assemblies when railcars are operating on the mainline.

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7. APPENDIX A – 7662/63 VMDS FAULT LOGS

Table 1

7663	VMDS	MAIN	2/15/2024	12:45:11	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:45:11	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:45:06	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:45:06	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:43:15	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:35:20	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:34:58	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:34:30	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:34:30	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:34:26	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:34:26	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:32:32	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:31:33	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:33	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:30	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:30	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:25	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:25	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:23	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:23	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:31:12	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:30:38	PROPULSION	PRP009	NO DYNAMIC BRAKE
7662	VMDS	MAIN	2/15/2024	12:26:44	EVENT	EVT001	CONTROL LOCK KEY ON

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7663	VMDS	MAIN	2/15/2024	12:23:20	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:22:54	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:20:28	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:16:00	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:16:00	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:16:00	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:15:59	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:13:09	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:12:47	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:12:47	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:12:44	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:12:44	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:11:46	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:11:34	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:11:28	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:11:28	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:11:24	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:11:24	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:09:42	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	12:05:36	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:05:36	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:05:32	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:05:32	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:00:13	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:00:13	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:00:11	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	12:00:11	PROPULSION	PRP009	NO DYNAMIC BRAKE
7663	VMDS	MAIN	2/15/2024	11:57:04	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	11:54:20	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	11:51:10	APS	APS002	NO THIRD RAIL VOLTAGE
7663	VMDS	MAIN	2/15/2024	11:46:26	APS	APS002	NO THIRD RAIL VOLTAGE
7663	**VMDS**	**MAIN**	**2/15/2024**	**11:46:00**	**APS**	**APS002**	**NO THIRD RAIL VOLTAGE**

CENV Form 41.008

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8. APPENDIX B – TRACTION POWER SUB-STATION FAULT LOG

Table 1

2024 Feb 15 12:45:49 EST D08 Status F02 W2 B06 DC Feeder Tie Breaker 42 Tripped
2024 Feb 15 12:45:55 EST D08 Status F02 W2 B06 DC Feeder Tie Breaker 42 CLOSED
2024 Feb 15 12:47:10 EST D08 Status F02 W2 B10 DC Feeder Tie Breaker 44 Tripped
2024 Feb 15 12:47:16 EST D08 Status F02 W2 B10 DC Feeder Tie Breaker 44 CLOSED
2024 Feb 15 12:47:09 EST D07 Status F02 W2 B02 DC Feeder Tie Breaker 34 Tripped
2024 Feb 15 12:47:14 EST D07 Status F02 W2 B02 DC Feeder Tie Breaker 34 CLOSED
2024 Feb 15 12:47:23 EST D07 Status F02 W2 B02 DC Feeder Tie Breaker 34 Tripped
2024 Feb 15 12:47:26 EST D07 Status F02 W2 B02 DC Feeder Tie Breaker 34 CLOSED
2024 Feb 15 12:49:10 EST D07 Status F02 W1 B12 DC Feeder Tie Breaker 32 Tripped
2024 Feb 15 12:49:13 EST D07 Status F02 W1 B12 DC Feeder Tie Breaker 32 CLOSED
2024 Feb 15 12:49:47 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 Tripped
2024 Feb 15 12:49:47 EST D06 Status F04 W2 B04 DC Feeder Tie Breaker 42 Tripped
2024 Feb 15 12:49:49 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 CLOSED
2024 Feb 15 12:49:50 EST D06 Status F04 W2 B08 DC Feeder Tie Breaker 44 Tripped
2024 Feb 15 12:49:50 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 Tripped
2024 Feb 15 12:49:53 EST D06 Status F04 W2 B04 DC Feeder Tie Breaker 42 CLOSED
2024 Feb 15 12:50:03 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 CLOSED
2024 Feb 15 12:50:03 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 Tripped
2024 Feb 15 12:50:05 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 Tripped
2024 Feb 15 12:50:05 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 CLOSED
2024 Feb 15 12:50:09 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 CLOSED
2024 Feb 15 12:50:10 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 Tripped
2024 Feb 15 12:50:14 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 CLOSED
2024 Feb 15 12:50:14 EST D06 Status F04 W2 B08 DC Feeder Tie Breaker 44 CLOSED
2024 Feb 15 12:50:15 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 Tripped
2024 Feb 15 12:50:15 EST D06 Status F04 W2 B00 DC Feeder Tie Breaker 34 Tripped
2024 Feb 15 12:50:15 EST D06 Status F04 W2 B08 DC Feeder Tie Breaker 44 Tripped
2024 Feb 15 12:50:17 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 CLOSED
2024 Feb 15 12:50:26 EST D06 Status F04 W1 B12 DC Feeder Tie Breaker 33 Tripped
2024 Feb 15 12:50:38 EST D06 Status F04 W2 B08 DC Feeder Tie Breaker 44 CLOSED
2024 Feb 15 12:59:50 EST D06 Status F04 W2 B08 DC Feeder Tie Breaker 44 CLOSED
2024 Feb 15 12:59:51 EST D06 Status F04 W2 B08 DC Feeder Tie Breaker 44 Tripped
2024 Feb 15 13:00:15 EST D06 Status F04 W1 B10 DC Feeder Tie Breaker 32 CLOSED
2024 Feb 15 13:00:17 EST D06 Status F04 W1 B10 DC Feeder Tie Breaker 32 Tripped
2024 Feb 15 13:12:38 EST D06 Status F04 W2 B06 DC Feeder Tie Breaker 43 CLOSED
2024 Feb 15 13:12:39 EST D06 Status F04 W2 B06 DC Feeder Tie Breaker 43 Tripped
2024 Feb 15 13:12:39 EST D06 Status F04 W2 B10 DC Feeder Tie Breaker 45 Tripped

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Appendix M – 2k3k List of Cars – Collector Assembly Defects

2K3K List of Cars - Collector Assembly Defects

Index	Car No.	Trucks	Truck S/N	ASM No.	Component
1	2006	Front	9A4-559	1	Mounting Bracket
2	2006	Front	9A4-559	2	Mounting Bracket
3	2006	Rear	9A4-275	4	Mounting Bracket
4	2014	Front	9A4-236	2	Mounting Bracket
5	2014	Rear	9A4-539	3	Mounting Bracket
6	2015	Rear	9A4-139	4	Mounting Bracket
7	2017	Front	9A4-556	1	Mounting Bracket
8	2017	Front	9A4-556	2	Mounting Bracket
9	2020	Front	9A4-745	1	Arc Shield
10	2020	Rear	9A4-745	3	Arc Shield
11	2023	Front	9A4-210	2	Mounting Bracket
12	2023	Rear	9A4-148	3	Mounting Bracket
13	2032	Rear	9A4-600	4	Mounting Bracket
14	2033	Front	9A4-080	2	Mounting Bracket
15	2033	Rear	9A4-070	4	Mounting Bracket
16	2038	Front	94A-212	2	Mounting Bracket
17	2058	Front	9A4-506	1	Mounting Bracket
18	2064	Front	9A4-616	1	Mounting Bracket
19	2065	Rear	9A4-071	3	Mounting Bracket
20	2066	Front	9A4-367	1	Mounting Bracket
21	2066	Front	9A4-367	2	Mounting Bracket
22	3000	Front	9A4-079	2	Arc Shield
23	3000	Rear	9A4-027	3	Arc Shield
24	3001	Front	9A4-504	1	Arc Shield
25	3002	Rear	9A4-551	3	Mounting Bracket
26	3004	Rear	9A4-061	4	Mounting Bracket
27	3005	Front	9A4-171	1	Mounting Bracket
28	3016	Rear	9A4-472	4	Mounting Bracket
29	3017	Front	9A4-108	2	Mounting Bracket
30	3017	Rear	9A4-265	3	Mounting Bracket
31	3019	Front	9A4-186	1	Mounting Bracket
32	3019	Rear	9A4-540	3	Mounting Bracket
33	3020	Rear	9A4-492	4	Mounting Bracket
34	3024	Front	9A4-420	2	Mounting Bracket
35	3028	Rear	9A4-681	4	Mounting Bracket
36	3028	Rear	9A4-681	3	Mounting Bracket
37	3028	Front	9A4-233	1	Mounting Bracket
38	3029	Front	9A4-228	2	Mounting Bracket
39	3029	Front	9A4-228	1	Mounting Bracket

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40	3030	Front	9A4-217	2	Mounting Bracket
41	3030	Rear	9A4-406	3	Mounting Bracket
42	3031	Front	9A4-096	1	Mounting Bracket
43	3031	Front	9A4-096	2	Mounting Bracket
44	3031	Rear	9A4-693	3	Mounting Bracket
45	3031	Rear	9A4-693	4	Mounting Bracket
46	3035	Rear	9A4-179	3	Mounting Bracket
47	3035	Front	9A4-134	2	Mounting Bracket
48	3035	Front	9A4-134	1	Mounting Bracket
49	3038	Front	9A4-215	2	Mounting Bracket
50	3038	Rear	9A4-426	3	Mounting Bracket
51	3038	Rear	9A4-426	4	Mounting Bracket
52	3039	Front	9A4-100	2	Mounting Bracket
53	3039	Front	9A4-100	2	Mounting Bracket
54	3042	Rear	9A4-022	3	Mounting Bracket
55	3044	Front	9A4-663	1	Mounting Bracket
56	3045	Rear	9A4-156	3	Mounting Bracket
57	3046	Front	9A4-383	1	Mounting Bracket
58	3046	Rear	9A4-095	3	Mounting Bracket
59	3046	Rear	9A4-095	4	Mounting Bracket
60	3047	Front	9A4-252	1	Mounting Bracket
61	3047	Front	9A4-252	2	Mounting Bracket
62	3047	Rear	9A4-192	4	Mounting Bracket
63	3049	Rear	9A4-172	3	Mounting Bracket
64	3049	Rear	9A4-172	4	Mounting Bracket
65	3052	Front	9A4-014	1	Mounting Bracket
66	3052	Front	9A4-014	2	Mounting Bracket
67	3052	Rear	9A4-631	3	Mounting Bracket
68	3052	Rear	9A4-631	4	Mounting Bracket
69	3053	Rear	9A4-665	3	Mounting Bracket
70	3053	Rear	9A4-665	4	Mounting Bracket
71	3054	Front	9A4-382	1	Mounting Bracket
72	3054	Rear	9A4-593	3	Mounting Bracket
73	3054	Rear	9A4-593	4	Mounting Bracket
74	3055	Rear	9A4-660	3	Mounting Bracket
75	3058	Front	9A4-196	2	Mounting Bracket
76	3058	Rear	9A4-577	3	Mounting Bracket
77	3059	Front	9A4-164	1	Mounting Bracket
78	3059	Front	9A4-164	2	Mounting Bracket
79	3059	Rear	9A4-291	4	Mounting Bracket
80	3060	Front	9A4-163	2	Mounting Bracket

81	3060	Rear	9A4-005	3	Mounting Bracket
82	3061	Rear	9A4-450	3	Mounting Bracket
83	3064	Rear	9A4-561	3	Mounting Bracket
84	3064	Rear	9A4-561	4	Mounting Bracket
85	3065	Front	9A4-497	1	Mounting Bracket
86	3065	Front	9A4-497	2	Mounting Bracket
87	3065	Rear	9A4-500	3	Mounting Bracket
88	3065	Rear	9A4-500	4	Mounting Bracket
89	3070	Rear	9A4-063	3	Mounting Bracket
90	3071	Front	9A4-104	2	Mounting Bracket
91	3071	Rear	9A4-358	4	Mounting Bracket
92	3072	Front	9A4-656	1	Mounting Bracket
93	3072	Front	9A4-656	2	Mounting Bracket
94	3072	Rear	9A4-334	4	Mounting Bracket
95	3078	Rear	9A4-714	4	Mounting Bracket
96	3080	Rear	9A4-471	3	Mounting Bracket
97	3081	Rear	9A4-691	4	Mounting Bracket
98	3084	Front	9A4-568	1	Mounting Bracket
99	3084	Rear	9A4-630	3	Mounting Bracket
100	3085	Rear	9A4-486	4	Mounting Bracket
101	3091	Front	9A4-712	2	Arc Shield
102	3099	Rear	9A4-198	3	Mounting Bracket
103	3101	Rear	9A4-685	3	Mounting Bracket
104	3102	Front	9A4-018	1	Mounting Bracket
105	3102	Front	9A4-018	2	Mounting Bracket
106	3102	Rear	9A4-716	4	Mounting Bracket
107	3105	Front	9A4-528	1	Mounting Bracket
108	3105	Front	9A4-528	2	Mounting Bracket
109	3105	Rear	9A4-384	4	Mounting Bracket
110	3106	Front	9A4-677	1	Mounting Bracket
111	3106	Front	9A4-677	2	Mounting Bracket
112	3106	Rear	9A4-075	3	Mounting Bracket
113	3106	Rear	9A4-075	4	Mounting Bracket
114	3107	Front	9A4-288	2	Mounting Bracket
115	3107	Rear	9A4-330	3	Mounting Bracket
116	3107	Rear	9A4-330	4	Mounting Bracket
117	3111	Rear	9A4-622	3	Mounting Bracket
118	3112	Front	9A4-592	2	Mounting Bracket
119	3112	Rear	9A4-398	3	Mounting Bracket
120	3113	Front	9A4-296	1	Mounting Bracket
121	3113	Rear	9A4-010	3	Mounting Bracket

122	3130	Rear	9A4-043	3	Mounting Bracket
123	3142	Front	9A4-040	2	Mounting Bracket
124	3142	Rear	9A4-648	4	Mounting Bracket
125	3143	Front	9A4-266	1	Mounting Bracket
126	3143	Rear	9A4-180	4	Mounting Bracket
127	3154	Front	9A4-144	2	Mounting Bracket
128	3154	Rear	9A4-626	4	Mounting Bracket
129	3155	Rear	9A4-365	3	Mounting Bracket
130	3155	Rear	9A4-365	4	Mounting Bracket
131	3157	Front	9A4-109	1	Mounting Bracket
132	3157	Front	9A4-109	2	Mounting Bracket
133	3160	Rear	9A4-502	4	Mounting Bracket
134	3161	Front	9A4-253	2	Mounting Bracket
135	3161	Rear	9A4-208	3	Mounting Bracket
136	3163	Front	9A4-327	1	Mounting Bracket
137	3165	Front	9A4-183	2	Mounting Bracket
138	3166	Rear	9A4-045	4	Mounting Bracket
139	3167	Front	9A4-025	2	Mounting Bracket
140	3167	Rear	9A4-373	3	Mounting Bracket
141	3168	Front	9A4-583	1	Mounting Bracket
142	3168	Front	9A4-583	2	Mounting Bracket
143	3168	Rear	9A4-124	4	Mounting Bracket
144	3169	Rear	9A4-475	4	Mounting Bracket
145	3172	Rear	9A4-304	4	Mounting Bracket
146	3175	Rear	9A4-717	4	Buss Bar
147	3185	Front	9A4-234	2	Mounting Bracket
148	3185	Rear	9A4-719	3	Mounting Bracket
149	3185	Rear	9A4-719	4	Mounting Bracket
150	3189	Rear	9A4-052	4	Mounting Bracket
151	3192	Rear	9A4-298	3	Mounting Bracket
152	3193	Front	9A4-338	2	Mounting Bracket
153	3201	Rear	9A4-705	4	Mounting Bracket
154	3202	Rear	9A4-285	3	Mounting Bracket
155	3202	Front	9A4-007	1	Mounting Bracket
156	3202	Rear	9A4-285	4	Mounting Bracket
157	3203	Rear	9A4-736	3	Mounting Bracket
158	3203	Rear	9A4-736	4	Mounting Bracket
159	3208	Front	9A4-017	1	Arc Shield
160	3208	Front	9A4-017	2	Arc Shield
161	3211	Rear	9A4-092	3	Mounting Bracket
162	3212	Front	9A4-177	1	Mounting Bracket

163	3213	Front	9A4-606	1	Mounting Bracket
164	3213	Front	9A4-606	2	Mounting Bracket
165	3219	Front	9A4-595	2	Mounting Bracket
166	3220	Rear	9A4-449	4	Mounting Bracket
167	3222	Rear	9A4-379	3	Mounting Bracket
168	3224	Rear	9A4-294	4	Mounting Bracket
169	3225	Rear	9A4-220	4	Shunt
170	3226	Front	9A4-710	1	Mounting Bracket
171	3227	Rear	9A4-536	4	Mounting Bracket
172	3230	Front	9A4-385	1	Mounting Bracket
173	3230	Rear	9A4-289	3	Mounting Bracket
174	3230	Rear	9A4-289	4	Mounting Bracket
175	3231	Front	9A4-602	1	Mounting Bracket
176	3231	Rear	9A4-722	4	Mounting Bracket
177	3236	Front	9A4-315	2	Mounting Bracket
178	3240	Rear	9A4-476	4	Mounting Bracket
179	3241	Front	9A4-638	1	Mounting Bracket
180	3241	Rear	9A4-094	3	Mounting Bracket
181	3249	Front	9A4-364	1	Mounting Bracket
182	3249	Rear	9A4-389	3	Mounting Bracket
183	3251	Front	9A4-363	1	Arc Shield
184	3254	Rear	9A4-682	4	Mounting Bracket
185	3258	Front	9A4-123	2	Mounting Bracket
186	3258	Rear	9A4-103	4	Mounting Bracket
187	3259	Front	9A4-072	1	Mounting Bracket
188	3259	Rear	9A4-643	3	Mounting Bracket
189	3260	Front	9A4-277	1	Mounting Bracket
190	3260	Front	9A4-277	2	Mounting Bracket
191	3261	Rear	9A4-313	3	Mounting Bracket
192	3264	Front	9A4-654	2	Mounting Bracket
193	3264	Rear	9A4-416	4	Mounting Bracket
194	3265	Front	9A4-670	1	Mounting Bracket
195	3265	Front	9A4-670	2	Mounting Bracket
196	3270	Rear	9A4-645	4	Mounting Bracket
197	3272	Front	9A4-684	1	Mounting Bracket
198	3280	Rear	9A4-690	3	Mounting Bracket
199	3280	Rear	9A4-690	4	Mounting Bracket
200	3282	Front	9A4-589	2	Mounting Bracket
201	3283	Rear	9A4-620	3	Mounting Bracket
202	3286	Front	9A4-344	2	Mounting Bracket
203	3287	Front	9A4-615	1	Mounting Bracket

204	3287	Rear	9A4-361	4	Mounting Bracket
205	3291	Front	9A4-219	2	Mounting Bracket

Appendix N –6k List of Cars – Collector Assembly Defects

6K List of Cars - Collector Shoe Assembly I

Index	Car No.	Truck	Truck S/N	ASM No.
1	6009	Front	6107	1
2	6024	Rear	6204	3
3	6025	Front	6051	2
4	6030	Rear	6282	3
5	6034	Front	6191	1
7	6070	Front	6199	1
8	6070	Rear	6105	4
9	6071	Front	6335	1
10	6071	Rear	6021	4
11	6080	Front	6301	1
13	6096	Front	6252	2
14	6098	Front	6049	1
15	6099	Rear	6014	4
16	6100	Rear	6179	3
17	6100	Rear	6179	4
18	6101	Front	6213	1
19	6111	Rear	6154	4
20	6118	Front	6316	1
21	6118	Front	6316	2
22	6140	Front	6332	2
23	6140	Rear	6360	3
24	6141	Front	6120	2
25	6144	Front	6080	1
26	6144	Front	6080	2
27	6144	Rear	6006	3
28	6155	Rear	6087	3
29	6165	Front	6260	2
30	6178	Rear	6281	4
31	6006	Rear	6099	4
32	6077	Front	6239	1

)efects

Component
Mounting Bracket
Mounting Bracket
Mounting Bracket
Arc Shield
Arc Shield
Mounting Bracket
Bracket Assembly/Metal Plate
Mounting Bracket
Mounting Bracket
Mounting Bracket
Mounting Bracket
Mounting Bracket
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Mounting Bracket
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Mounting Bracket
Mounting Bracket

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7K List of Cars - Collector Shoe Assembly Defects

Index	Car No.	Truck	Truck S/N	ASM No.	Component
1	7002	Front	70004	2	Mounting Bracket
2	7028	Rear	70064	4	Mounting Bracket
3	7048	Front	120992	1	Mounting Bracket
4	7048	Front	120992	2	Mounting Bracket
5	7058	Front	70120	2	Mounting Bracket
6	7058	Rear	70121	3	Mounting Bracket
7	7059	Front	70122	2	Mounting Bracket
8	7059	Rear	70123	3	Mounting Bracket
9	7095	Rear	70313	3	Mounting Bracket
10	7118	Front	70197	1	Mounting Bracket
11	7193	Front	70388	2	Mounting Bracket
12	7208	Front	70420	1	Mounting Bracket
13	7237	Rear	70479	3	Mounting Bracket
14	7241	Rear	70487	3	Mounting Bracket
15	7252	Front	70508	1	Mounting Bracket
16	7309	Front	70622	1	Mounting Bracket
17	7320	Front	70644	2	Mounting Bracket
18	7333	Front	70770	1	Mounting Bracket
19	7356	Front	70020	2	Mounting Bracket
20	7357	Front	70718	2	Mounting Bracket
21	7357	Rear	70717	3	Mounting Bracket
22	7390	Front	70784	2	Mounting Bracket
23	7390	Rear	70785	3	Mounting Bracket
24	7451	Front	70906	1	Mounting Bracket
25	7478	Front	70960	2	Mounting Bracket
26	7479	Rear	70963	3	Mounting Bracket
27	7509	Front	71022	2	Mounting Bracket
28	7509	Rear	71023	3	Mounting Bracket
29	7526	Front	71056	2	Mounting Bracket
30	7527	Front	71058	1	Mounting Bracket
31	7541	Front	71086	1	Mounting Bracket
32	7560	Front	71124	1	Mounting Bracket
33	7560	Rear	71125	3	Mounting Bracket
34	7561	Front	71126	1	Mounting Bracket
35	7561	Rear	71127	3	Mounting Bracket
36	7580	Front	71164	2	Mounting Bracket
37	7590	Front	71184	1	Mounting Bracket
38	7590	Rear	71185	4	Mounting Bracket
39	7591	Front	71186	2	Mounting Bracket

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40	7591	Rear	71187	3	Mounting Bracket
41	7591	Rear	71187	4	Mounting Bracket
42	7604	Front	71212	2	Mounting Bracket
43	7648	Rear	71301	3	Mounting Bracket
44	7659	Rear	71323	3	Mounting Bracket
45	7667	Front	71338	2	Mounting Bracket
46	7672	Front	71348	2	Mounting Bracket
47	7672	Rear	71349	3	Mounting Bracket
48	7673	Rear	71351	4	Mounting Bracket
49	7682	Front	71368	1	Mounting Bracket
50	7683	Front	71370	2	Mounting Bracket
51	7683	Rear	71371	4	Mounting Bracket
52	7738	Front	70089	2	Mounting Bracket
53	7739	Front	71482	2	Mounting Bracket

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APPLIED TECHNICAL SERVICES

ISO 9001

1049 Triad Court, Marietta, Georgia 30062 • (770) 423-1400 Fax (770) 424-6425

COLLECTOR ASSEMBLY ANALYSIS

ATS JOB # 422050

PURCHASE ORDER # 20982

Prepared for

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

Prepared by [redacted]

Reviewed by [redacted]

ATS 968B. 02/2014

APPLIED TECHNICAL SERVICES

ISO 9001

1049 Triad Court, Marietta, Georgia 30062 • (770) 423-1400 Fax (770) 424-6415

TEST REPORT

Ref. 422050 **Date:** May 3, 2024 **Page** 1 **of** 21

Samples

QTY (4) Collector Assemblies and QTY (38) Current Collector Shoes

Test Procedure

Three testing configurations were assembled for various loading conditions: static loading of collector shoes, ultimate strength loading of a collector assembly, and a dynamic drop test. Static loading of the collector shoes consisted of affixing the assembly to a fatigue frame horizontally as shown in Figure 1, measuring a specified distance of 17.01" from the base of the assembly to the top of the paddle, and loading normal to the side at a rate of 0.5 in/min until ultimate failure at the v-notch occurred. Ultimate strength loading of the collector assembly was similar to the static loading of the shoes, except a custom moment arm was created to replace the shoes, shown in Figure 3, and to induce a force onto the assembly until ultimate failure. The dynamic drop test involved two collector assemblies, one new and one used, affixed between two rails, shown in Figure 4, with a 138 lbf weight released onto the attached shoes causing failure of the shoes.

Penetrant testing was conducted before and after the drop tests. Penetrant tests were also conducted on a new unit that developed cracks, which is shown in Figure 8. The used collector assembly was monitored visually in between each strike from the drop tester. The drop test began with a height of 12" but was increased to 18" due to some shoes not breaking from the drop. Every collector shoe was torqued per E-1-55958-3001-0A, where the 0.5" nut on the washer was set to 30 ft-lbf and the 0.5" lock nut was torqued to 45 ft-lbf.

Figures 1–5 show the testing configurations. Figures 6 and 11 show the data acquisition from load testing, while Tables 1–3 list the results from testing. Additionally, Figures 7–9 and Figures 12–23 show the failure modes, crack growth, and penetrant testing. Testing was performed in ambient temperature and humidity conditions.

Testing Equipment

The samples were tested with an 11-kip fatigue frame ATS-06172 (Cal. Due: 03/21/25), a load cell ATS-20501 (Cal. Due: 03/21/25), and a dial torque wrench ATS-10620 (Cal. Due: 06/15/24).

Testing Configurations

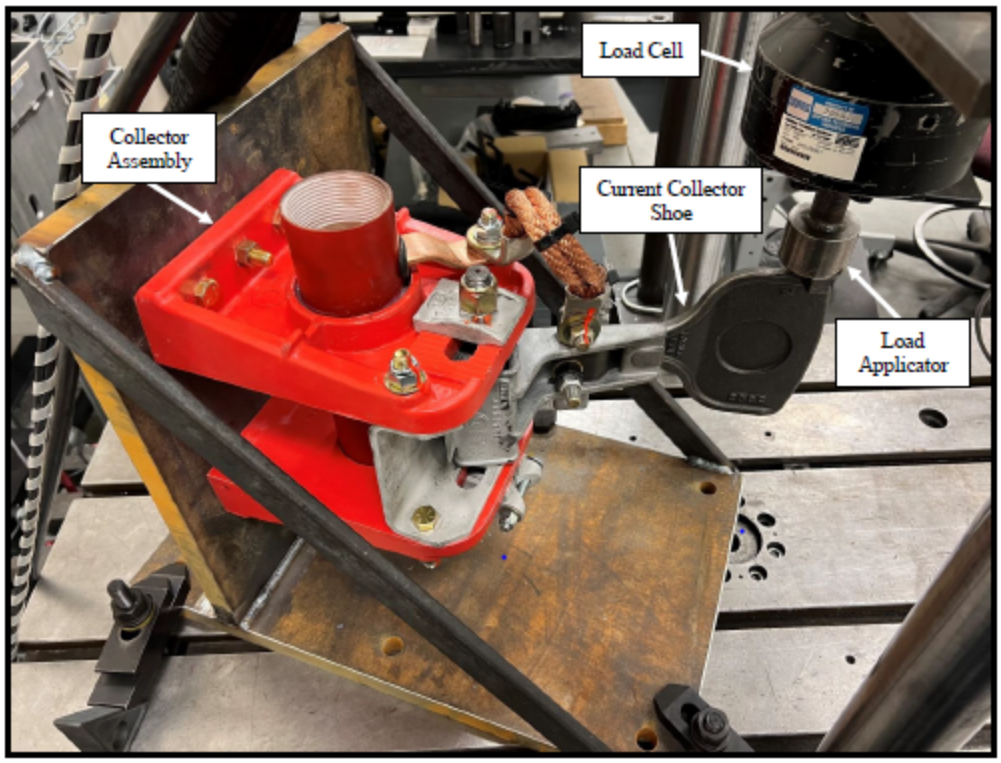

Figure 1: Static loading testing configuration

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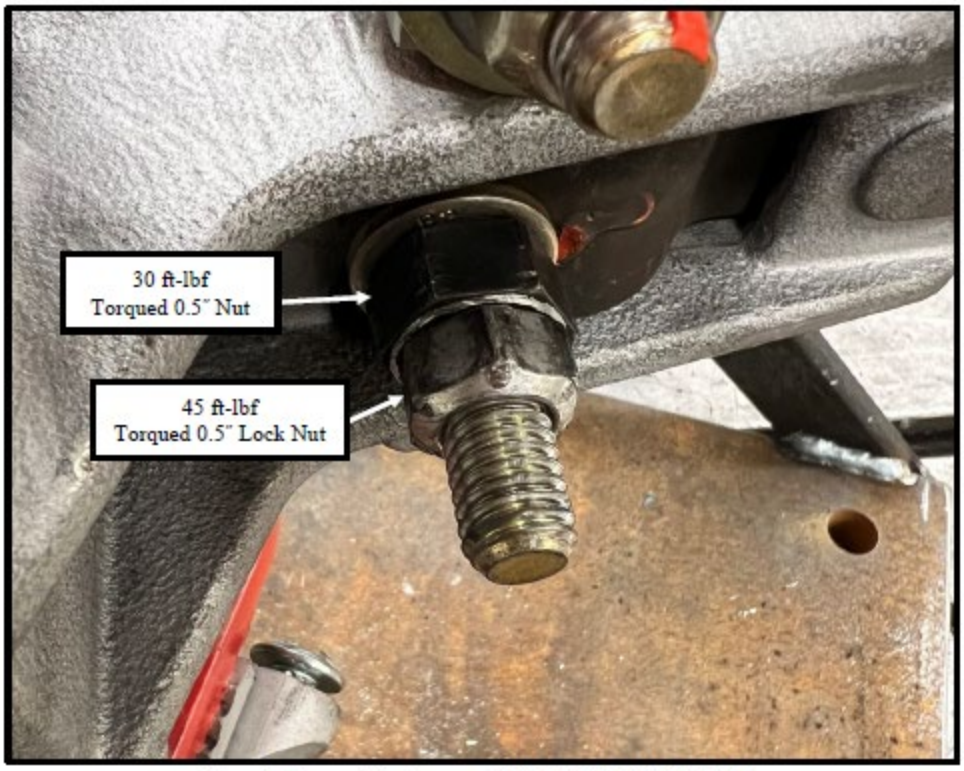

Figure 2: Torqued fasteners per DWG # E-1-55958-3001-0A

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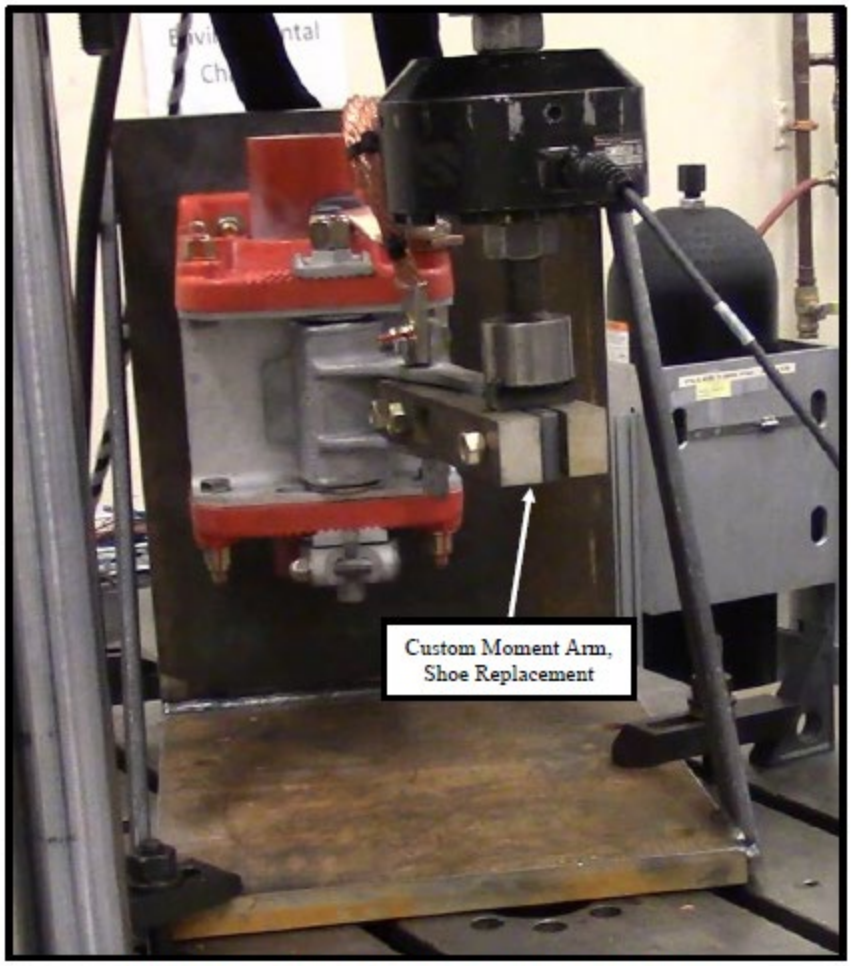

Figure 3: Assembly ultimate strength load testing configuration

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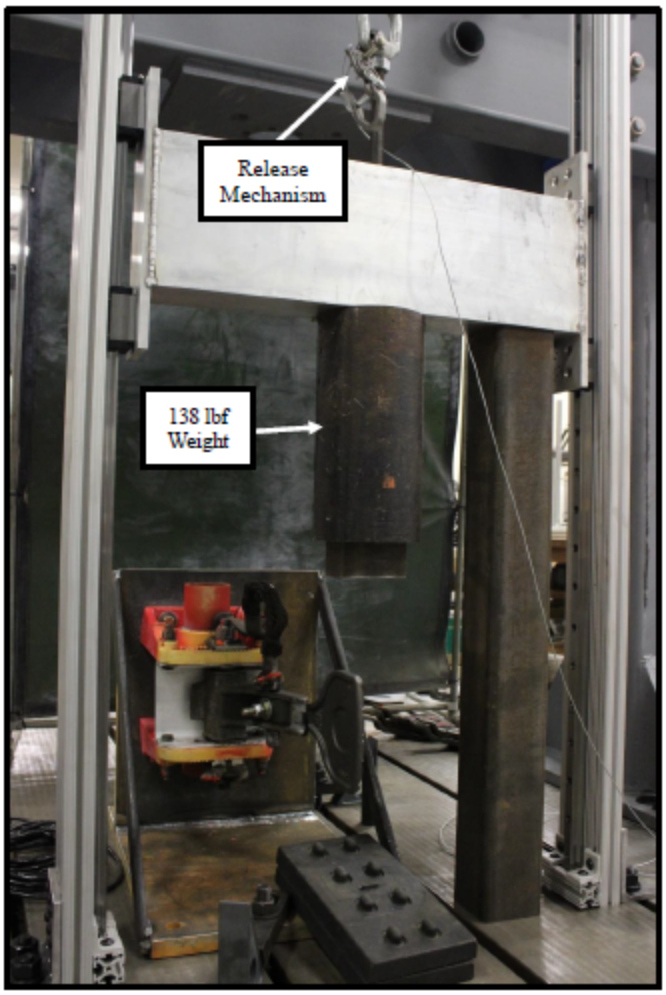

Figure 4: Used collector assembly drop testing configuration

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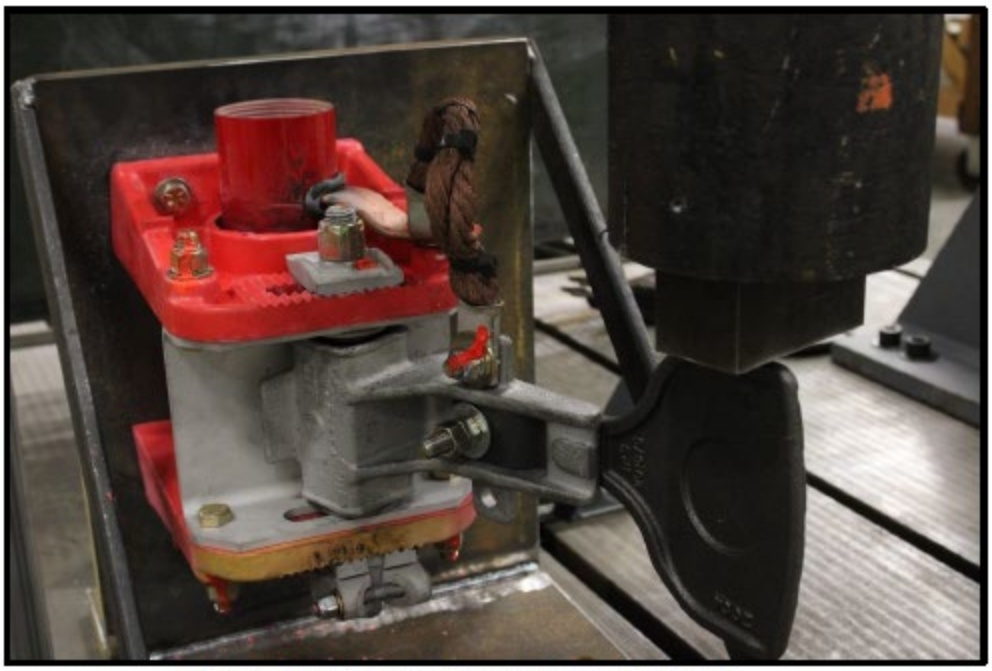

Figure 5: New collector assembly drop testing configuration

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Static Load Testing Results

Table 1: Static Load Testing

Condition	Company	Season	Sample	Failure Load (lbf)
New	IPS	Summer	1	-1,477
New	IPS	Summer	2	-1,585
New	Wabtec	Summer	1	-1,331
New	Wabtec	Summer	2	-1,355
New	Wabtec	Summer	3	-1,352
New	IPS	Winter	1	-1,609
New	IPS	Winter	2	-1,496
New	Wabtec	Winter	1	-1,486
New	Wabtec	Winter	2	-1,503
Used	IPS	Summer	1	-1,588
Used	IPS	Summer	2	-1,305
Used	Wabtec	Summer	1	-2,122
Used	Wabtec	Summer	2	-1,849
Used	IPS	Winter	1	-1,337
Used	IPS	Winter	2	-1,639
Used	IPS	Winter	3	-1,527

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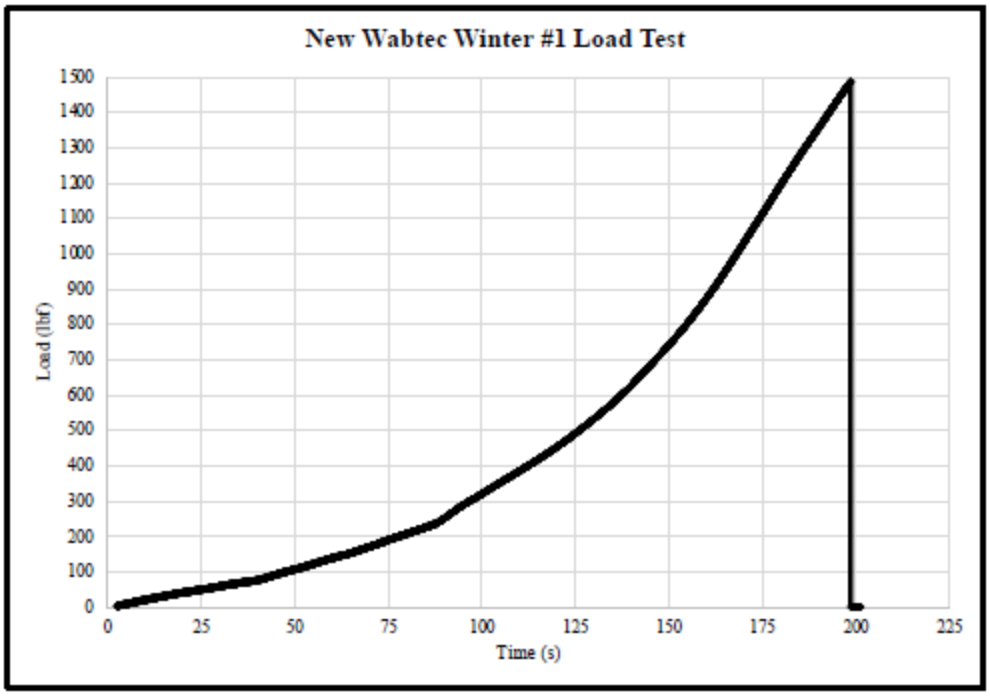

Figure 6: Example of the typical compression data from static testing

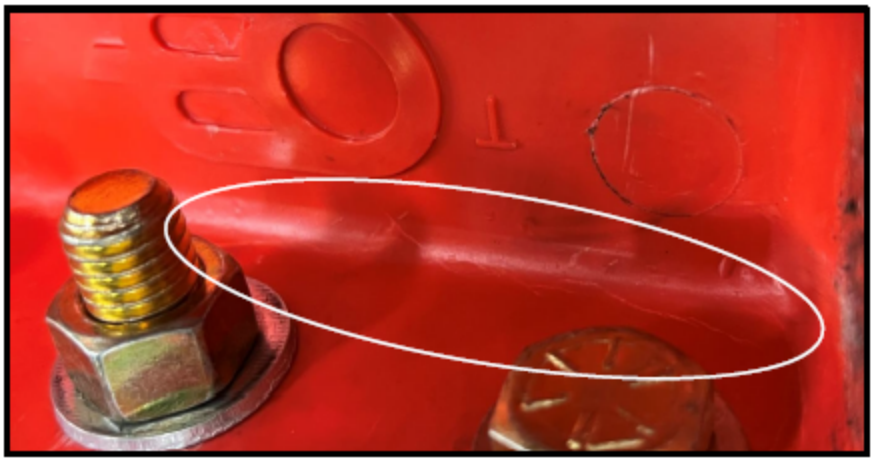

Figure 7: Crack propagation observed after static loading on a new assembly

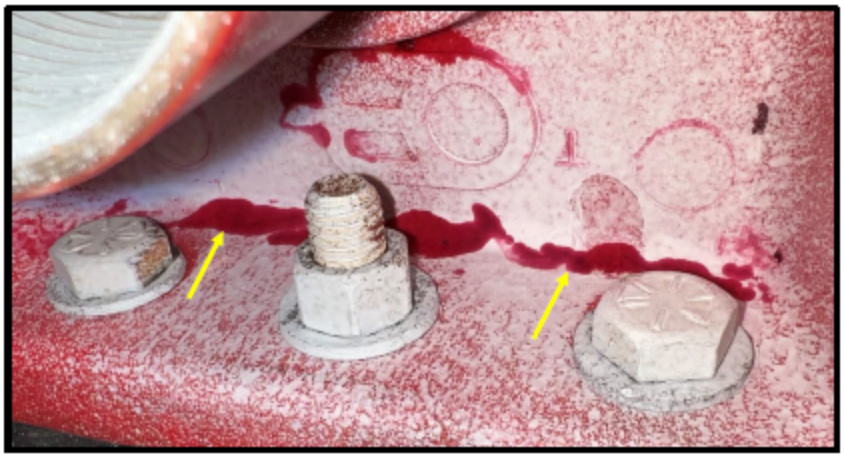

Figure 8: Dye penetrant testing after static loading on a new assembly

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Figure 9: Typical failure mode for static loading of the shoes

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Collector Assembly Ultimate Strength Load Testing Results

Table 2: Assembly Ultimate Strength Load Testing Results

Sample #	Maximum Load (lbf)	Remarks
1	3,035	The assembly deformed and split along the base. See Figures 10 & 12.

Figure 10: Failure at the base of the assembly during the assembly ultimate strength load test

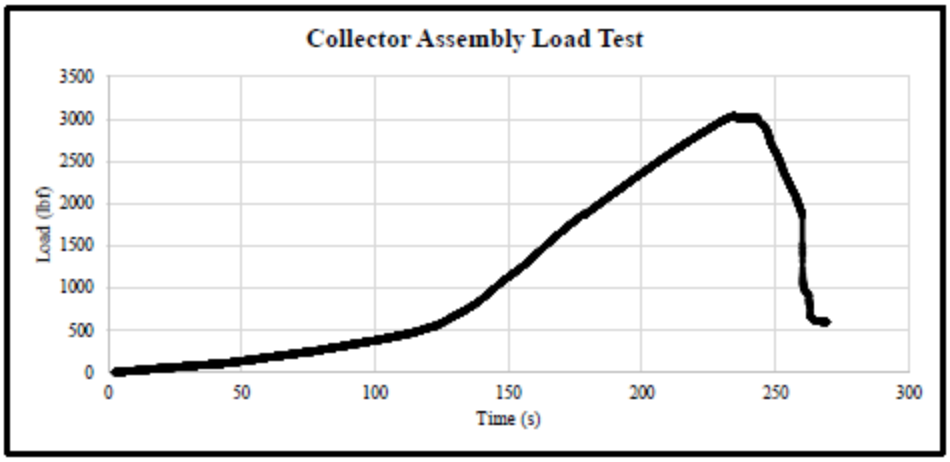

Figure 11: Collector assembly data acquisition during assembly ultimate strength load test

Figure 12: Failure at the base of the assembly during the ultimate strength load test

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Dynamic Drop Testing Results

Table 3: Dynamic Drop Test Results

Sample #	Drop Height (in)	Current Collector Type	Notes
Used Collector Assembly			
1	12	New IPS Winter	Crack propagation observed.
2		New IPS Winter	
3		Used IPS Winter	Crack propagation and separation
4	12 & 18	Used IPS Winter	The load ricocheted off the paddle at 12". Height was increased to 18", then the unit failed without shoe breakage. Refer to Figures 17–19.
New Collector Assembly			
1	12 & 18	New IPS Winter	The load ricocheted at 12". The drop height was increased to 18", which then broke the paddle.
2	18	New IPS Winter	Height changed to 18" for remainder of the samples for consistency.
3		Used IPS Winter	Clean paddle break.
4		Used IPS Winter	Crack growth was initially observed.
5		Used IPS Winter	Further development of cracks around the base of the collector assembly on each impact.
6		New IPS Summer	
7		New IPS Summer	
8		Used IPS Summer	
9		New Wabtec Winter	
10		New Wabtec Summer	
11		Used Wabtec Summer	
12		Used Wabtec Summer	
13		Used Wabtec Summer	
14		Used Wabtec Summer	
15		Used Wabtec Summer	

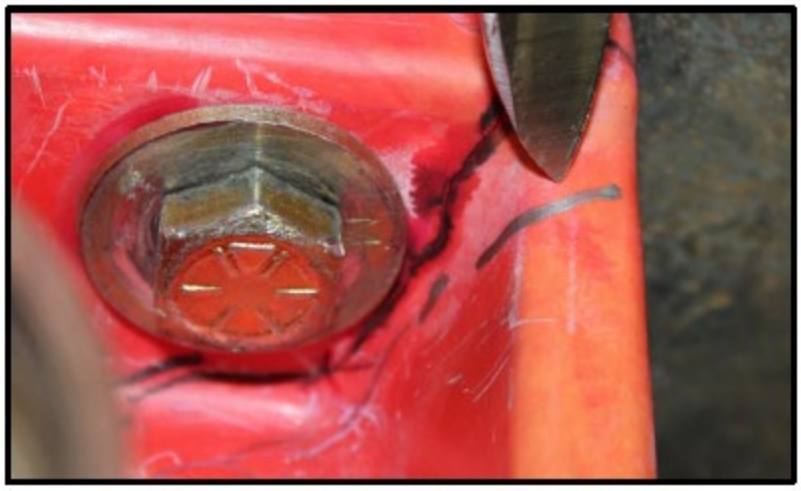

Figure 13: Crack growth on the used assembly during drop tests

Figure 14: Separation of the surface because of crack propagation from the drop tests on the used unit

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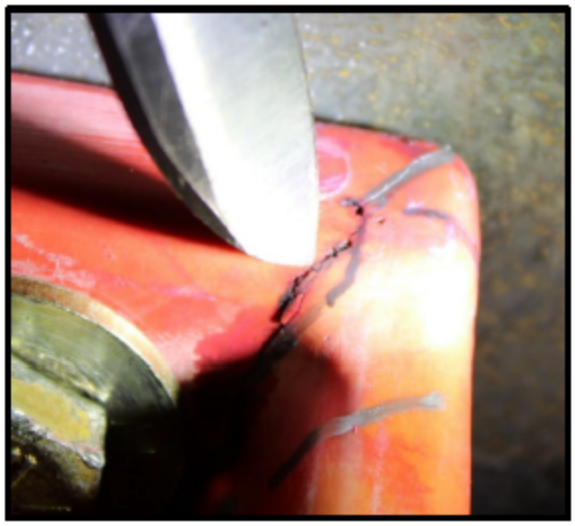

Figure 15: More crack propagation on the used assembly during the drop tests

Figure 16: Additional separation observed on the used assembly during drop tests

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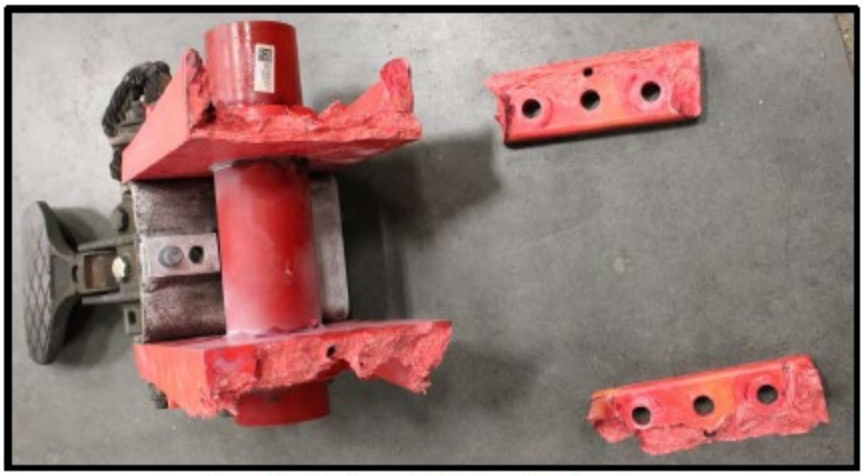

Figure 17: Used assembly failure from drop tests

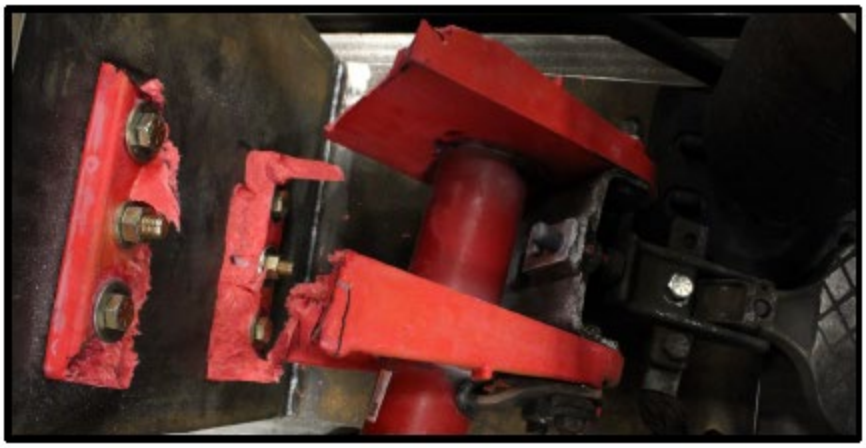

Figure 18: Top view of used assembly failure while mounted during the drop tests

Figure 19: Additional view of the used unit failure from drop tests

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Figure 20: Crack propagation observed on the new collector assembly from drop tests

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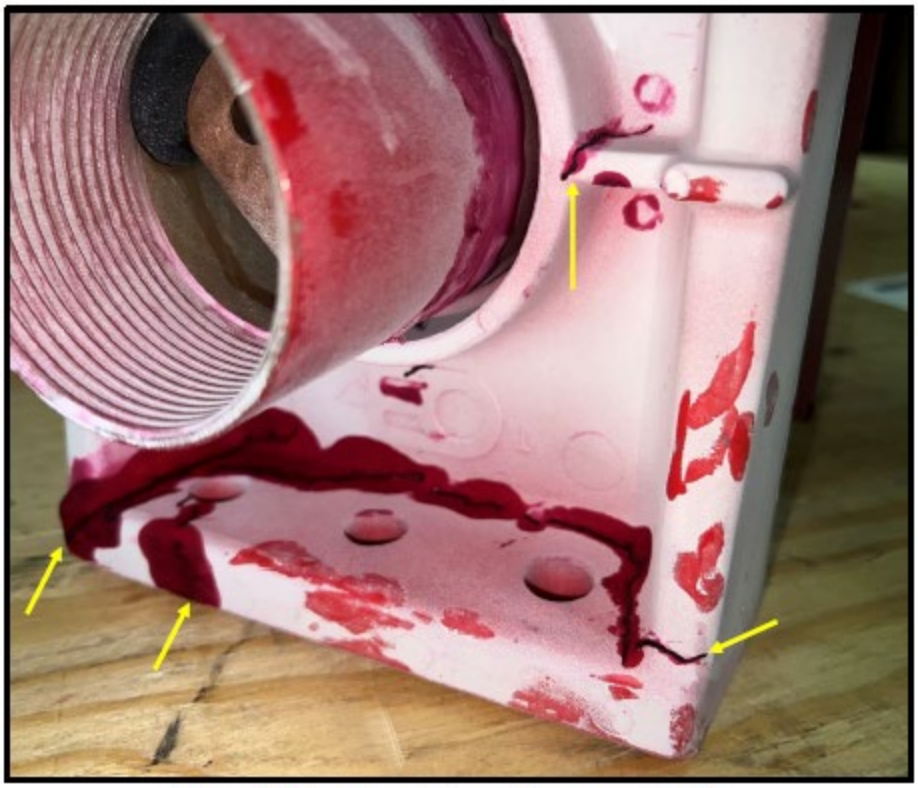

Figure 21: Dye penetrant testing on the new assembly after dynamic loading

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Figure 22: Second photo of dye penetrant testing used on the new assembly following the drop tests

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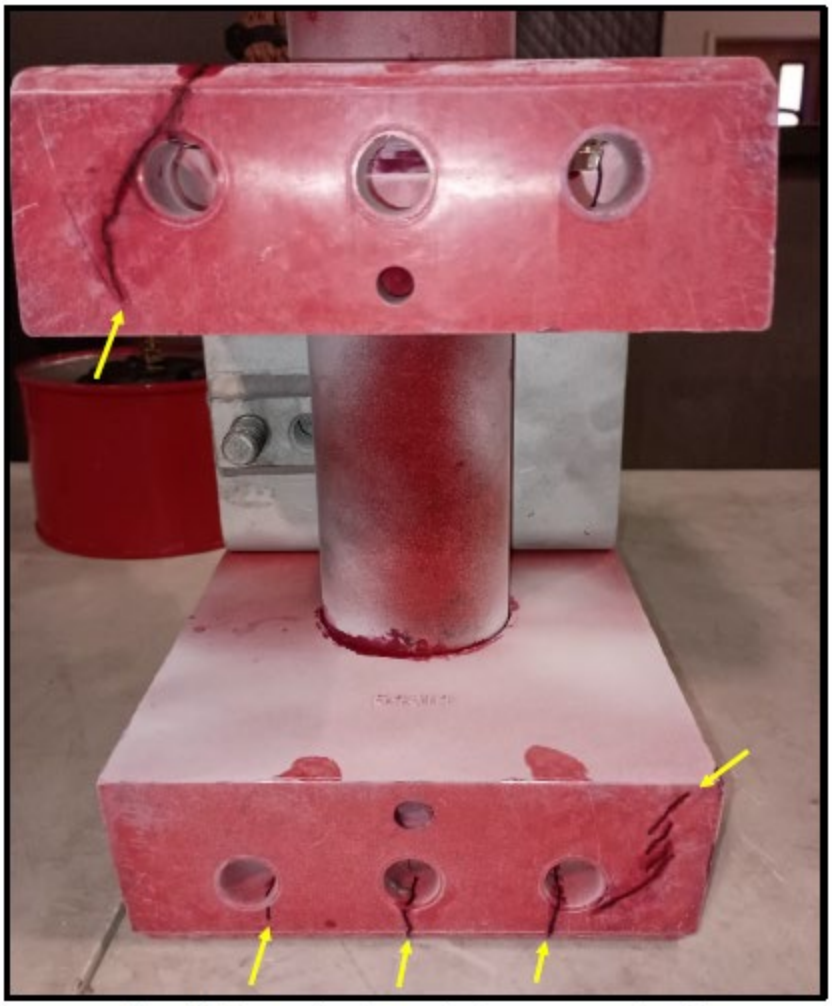

Figure 23: Bottom view of new unit after penetrant testing and drop tests

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Applied Technical Services
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MATERIAL ANALYSIS OF CURRENT COLLECTOR ASSEMBLY BRACKETS

ATS JOB # 422050-1

PURCHASE ORDER # 20982

Prepared for

WASHINGTON METROPOLITAN AREA
TRANSIT AUTHORITY
(WMATA)

Digitally signed by Cody Hennessy
Date: 2024.05.07 09:38:18 -04'00'

*Prepared by*_____
Cody Hennessy, Metallurgist II

Digitally signed by Ronald J. Parrington
Date: 2024.05.07 09:49:40 -04'00'

*Reviewed by*_____
Ronald J. Parrington, P.E., FASM, Group Manager

ISO 9001

Customer	Washington Metropolitan Area Transit Authority (WMATA)	**Date**	May 7, 2024
		Purchase Order	20982

Subject

Material Analysis of Current Collector Assembly Brackets

Material

Glass Fiber Reinforced Plastic (GFRP) – Polyester Matrix

Summary

1. Relatively large voids were observed along service fracture surfaces and in the material cross sections in the cracked and remote areas of the bracket material. Cracks were observed connecting and emanating from the voids in the cross sections. Void content analysis showed that the voids were likely more elongated in one direction in the cracked area as compared to the remote area, indicating the voids as crack initiation sites.
2. The failure mechanism of the current collector assembly brackets is fiber de-bonding and/or fatigue based on the observation of smooth fracture surfaces following the lengths of fibers on the macroscale and minimal matrix adhesion on fibers along the fracture surface as well as grooves in the fracture surface on the microscale.
3. Poor matrix adhesion leading to fiber de-bonding is characterized by fibers pulled out of the matrix leaving smooth grooves or channels in the fracture surface as well as smooth (resin-free) fiber surfaces, which was observed on all the examined service fracture surfaces. Potential causes for poor fiber-matrix adhesion include: the presence of residual processing aids, insufficient surface treatment, and the ingress of liquids, which can lead to matrix-fiber debonding[1].
4. Cross sections through the fracture surface of a bracket showed that the fracture followed a relatively straight path, typical of fatigue fracture. Fatigue often causes diffuse failure in composites such as fiber de-bonding throughout the material[2]. No macroscopic or microscopic progressive crack growth fracture surface features such as crack arrest lines or striations were observed. However, few meaningful fractographic features can be discerned from heavily filled polymeric composites, especially on the microscale.
5. A yellow discoloration was observed on the brackets, typical of UV degradation. However, UV degradation was not determined to be a contributing factor since the discoloration was not observed at the base of the brackets where most of the cracking occurred.
6. Chemical and mechanical testing results of the bracket material showed minimal material differences between the cracked areas, areas remote from any cracking, and the exemplar sample. No residual exotherm was detected during thermal analysis of the bracket material that would indicate an incomplete cure of the resin.

Conclusions

1. The cause of failure is related to the processing of the bracket materials leading to excessive void content and possibly poor matrix-fiber adhesion making the material more susceptible to fatigue and fracture from service operation.
2. Recommended actions to prevent failures are to: (1) Consult with the manufacturer to minimize the void content of the material, (2) Optimize matrix-fiber adhesion, and/or (3) Use a more fatigue and fracture resistant material.

[1] John Scheirs, Compositional and Failure Analysis of Polymers: A Practical Approach, 2000, P. 454.
[2] John Scheirs, Compositional and Failure Analysis of Polymers: A Practical Approach, 2000, P. 469.

Objective and Background

Four cracked current collector assembly brackets were submitted to Applied Technical Services (ATS) for fractographic and material analysis to determine the failure mechanism, contributing factors, and if possible, the cause of failure per ATS Procedure MAT-P-931 Rev. 2. An exemplar sample was provided for compositional comparison. Eight current collector shoes were also provided for hardness testing. A failure occurred with a current collector on a railcar that resulted in high voltage, which created a fire and damaged surrounding components on the railcar. The current collector brackets fractured at the base of the brackets, and cracks have been observed in many other current collector brackets in the same area.

Test Procedure and Results

Visual Inspection

The current collector assembly brackets and shoes were documented in the as-received condition (Figure 1). Two pairs of cracked brackets, an extra cracked bracket, and exemplar bracket were received. Eight current collector shoes were received, post-mechanical testing, consisting of new and used shoes from different manufacturers for different seasons. Brinell hardness testing was conducted on the wear surfaces of the shoes.

The current collector assembly brackets, arbitrarily designated as Samples 1-1, 1-2, 2-1, and 2-2, exhibited cracking predominantly around the base of the brackets on the outward face, or front, of the brackets, but cracks were also observed in other areas throughout the samples (Figure 2). A yellow discoloration, typical of UV degradation was also observed on areas of the bracket surfaces, predominantly towards the top of the brackets. A cracked area from each bracket was further examined using a stereomicroscope capable of magnifications up to 100X (Figures 3-4). Cracks observed on the base of the brackets typically occurred along indentations from washers and followed along the inside radius of the bracket above the base. Cracks were also observed in the bracket base in-plane with or connected to bolt holes, and on the top surface of the brackets within the yellow discolored material.

Cracks were sectioned from each bracket and forced open to examine the fracture surfaces (Figures 5-7). The fracture surfaces of the service cracks were predominantly smooth with areas of exposed fibers and exhibited a duller appearance as compared to the lab-induced fractures. The lab-induced fractures also exhibited a coarser texture as compared to the service fractures. A dark discoloration was observed on the service fracture surfaces along the exposed surfaces.

Scanning Electron Microscopy

The opened fracture surfaces of the samples were further documented using a scanning electron microscope (SEM) coupled with energy dispersive spectroscopy (EDS), per ASTM E1508-12a(19), *Standard Guide for Quantitative Analysis by Energy-Dispersive Spectroscopy*. The fracture surfaces were predominantly smooth and followed along or parallel to the length of exposed fibers (Figure 8). Contamination was observed along the edges of the fracture surface near the exposed surfaces, which caused the appearance of a dark discoloration on the fracture surface. Typical EDS spectra (Figure 9) collected from the contamination exhibited elevated levels of iron and minor amounts of sodium, copper, sulfur, and phosphorus as compared to the base material which typically exhibited high levels of carbon, oxygen, aluminum, and silicon. Kaolinite ($Al_2Si_2O_5(OH)_4$) and calcium carbonate ($CaCO_3$) are common filler materials in thermosetting resins, such as polyester.

Large voids in the material were also observed along the service fracture surfaces (Figure 10). The typical service fracture surfaces observed exhibited a smooth appearance with either grooves in the surface of the matrix material where fibers had de-bonded or were covered with longitudinally exposed fibers with minimal matrix adhesion (Figure 11). The typical lab-induced fracture surface exhibited a coarser texture with fiber pull-out of transversely oriented fibers.

Cross Sections

Transverse and longitudinal cross sections were taken from Sample 2-1 from a cracked area and an area remote from any cracking (Figure 12). The cross sections were prepared per ASTM E2015-04(21), *Standard Guide for Preparation of Plastics and Polymeric Specimens for Microstructural Examination*. Cross-sections through the cracked area exhibited relatively large voids and cracks throughout the material (Figure 13). The primary fracture surface was predominantly flat and exhibited grooves along the fracture surface where the matrix material detached from fibers (Figure 14). Cracks were also observed connecting and emanating from the large voids within the material. The cross sections taken remote from any observed cracking also exhibited large voids within the material with cracks connecting and emanating from the large voids (Figure 15). Various other cracks were also observed in the remote sections.

Void content of the cross sections was measured using automated image analysis with an SEM, using ASTM E1245-03(23), *Standard Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis*, as a guide. The measured void content of the samples is shown in Table I. The void content of the cracked area was approximately 5% higher in the transverse orientation than the longitudinal orientation, which indicates that the voids are likely elongated in one direction, which would promote crack formation. The void content in the remote cross sections approximated that of the cracked area, but there was less of a difference between the orientations, indicating more circular or equiaxed voids.

Mechanical Testing

The exemplar and two cracked current collector assembly brackets were tested for hardness using a durometer per ASTM D2240-15(21), *Standard Test Method for Rubber Property—Durometer Hardness*, and using a Rockwell indenter per ASTM D785-23, *Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials*. Results are shown in Table II. The average measured hardness values from the samples ranged from 84-86 Shore D and 85-90 HRM. No significant differences in hardness were observed between the cracked samples and the exemplar sample.

The current collector shoes were tested for hardness on the wear surfaces per ASTM E10-23, *Standard Test Method for Brinell Hardness of Metallic Materials*. The average measured hardnesses of the collector shoes are shown in Table III. The new winter and summer shoes exhibited the largest differences in hardness between manufacturers with Wabtec having a higher measured hardness for the winter shoe and IPS having a higher measured hardness for the summer shoe.

Chemical Analysis

The density and glass fiber content of the current collector assembly bracket Sample 2-1 was measured using ASTM D3171-22, *Standard Test Methods for Constituent Content of Composite Materials*, as a guide. Sub-samples were taken near a cracked area and remote from any cracking for digestion using Procedure A. Results are shown in Table IV. The full constituent content of the composite material could not be determined due to the amount of filler material and the unknown resin density. The density of the material and the measured glass fiber content was slightly less near the cracked area as compared to the remote area.

Fourier transform infrared spectroscopy (FT-IR) was conducted on material from an exemplar sample, a cracked sample, and from a fracture surface covered in contamination per ASTM E1252-98(21), *Standard Practice for General Techniques for Obtaining Infrared Spectra for Qualitative Analysis*. The collected spectra were primarily consistent with polyester resin with some contributions from filler materials. No remarkable differences were observed between the analyzed samples, indicating chemical composition and/or degradation was not a contributing factor.

Differential scanning calorimetry (DSC) was conducted on material from Sample 2-1 to determine the glass transition temperature, enthalpies of fusion (ΔH_f), and the melting temperature per ASTM D3418-21, *Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry*. The glass transition temperature is the temperature at which the polymer undergoes a reversible change from a rigid to a rubbery state as it is heated. The enthalpy of fusion is the energy required to melt the crystalline material present in the sample. DSC results are shown in Table V and the collected thermogram is shown in Figure 16.

The material exhibited a melting point at 102.6 °C. The measured enthalpy of fusion was slightly higher during the first heat as compared to the second heat, which may indicate a slightly higher crystallinity of the manufactured sample as compared to the annealed condition. No glass transition temperature could be determined from the DSC thermogram. No residual exotherms were observed that would indicate the material was incompletely cured.

Thermogravimetric analysis (TGA) was conducted on the exemplar sample and Sample 2-1 from the cracked area per ASTM E1131-20, *Standard Test Method for Compositional Analysis by Thermogravimetry*. Tabulated results of the volatile, combustible, and ash contents of the samples are shown in Table VI. TGA thermograms are shown in Figure 17. Sample 2-1 exhibited slightly higher volatile and slightly less ash content than the exemplar sample.

Dynamic mechanical analysis was conducted on material from Sample 2-1 to determine the glass transition temperature (T_g) of the material per ASTM E1640, *Standard Test Method for Assignment of the Glass Transition Temperature by Dynamic Mechanical Analysis*. The sample was heated at a rate of 3 °C/min while a force was applied to the sample at a frequency of 1.0 Hz with an oscillating strain of 0.1%. Tabulated results for the measured glass transition temperatures are shown in Table VII, and the collected DSC curve is shown in Figure 18. The glass transition occurred over a wide temperature range of 103.5 °C, determined from the storage modulus (E'), to 158.8 °C, determined from tan delta. The median glass transition temperature, determined from the loss modulus (E'') was measured to be 136.0 °C.

The storage modulus is a measure of the ability of a material to store energy during loading, and the loss modulus refers to the energy lost or dissipated from the material during a loading cycle. The tan delta is the ratio of the loss modulus to the storage modulus. The glass transition temperature range is determined using these three different measures.

Table I: Current Collector Assembly Bracket Sample 2-1 Void Content Results

Location	Orientation	Void Area (%)
At Crack	Transverse	10.2
	Longitudinal	4.7
Remote from Crack	Transverse	8.3
	Longitudinal	9.7

Table II: Current Collector Assembly Bracket Hardness Results

Sample	Average Durometer Hardness (Shore D)	Average Rockwell Hardness (HRM)
Exemplar	85	90
1-1	84	85
2-1	86	88

Table III: Current Collector Shoe Hardness Results

Condition	Company	Season	Average Brinell (HBS (10/3000))
New	IPS	Winter	240
New	Wabtec	Winter	286
Used	IPS	Winter	229
Used	IPS	Winter	238
New	IPS	Summer	314
New	Wabtec	Summer	233
Used	IPS	Summer	257
Used	Wabtec	Summer	255

Table IV: Density and Glass Fiber Content from Sample 2-1

Location	Density (g/cm³)	Glass Fiber Content (%)
Near Crack	0.577	4.89
Remote from Crack	0.590	5.43

Table V: DSC Results for Enthalpies of Fusion (ΔH_f) and Melting Point (T_m)

Sample	ΔH_f 1st Heat (J/g)	ΔH_f 2nd Heat (J/g)	T_m 2nd Heat (°C)
2-1	2.0288	1.7827	102.55

Table VI: Summary Test Results for TGA

Sample	TGA (wt.%)		
	Volatile	Combustible	Ash
	RT-600°C in N_2	600°C in air	765°C in air
Exemplar	41.4	6.5	52.1
2-1, Cracked Area	44.9	6.4	48.7

Table VII: DMA Results for Glass Transition Temperature

Sample	T_g (°C) at 1.00 Hz		
	by E'	by E''	by Tan Delta
2-1	103.5	136.0	158.8

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

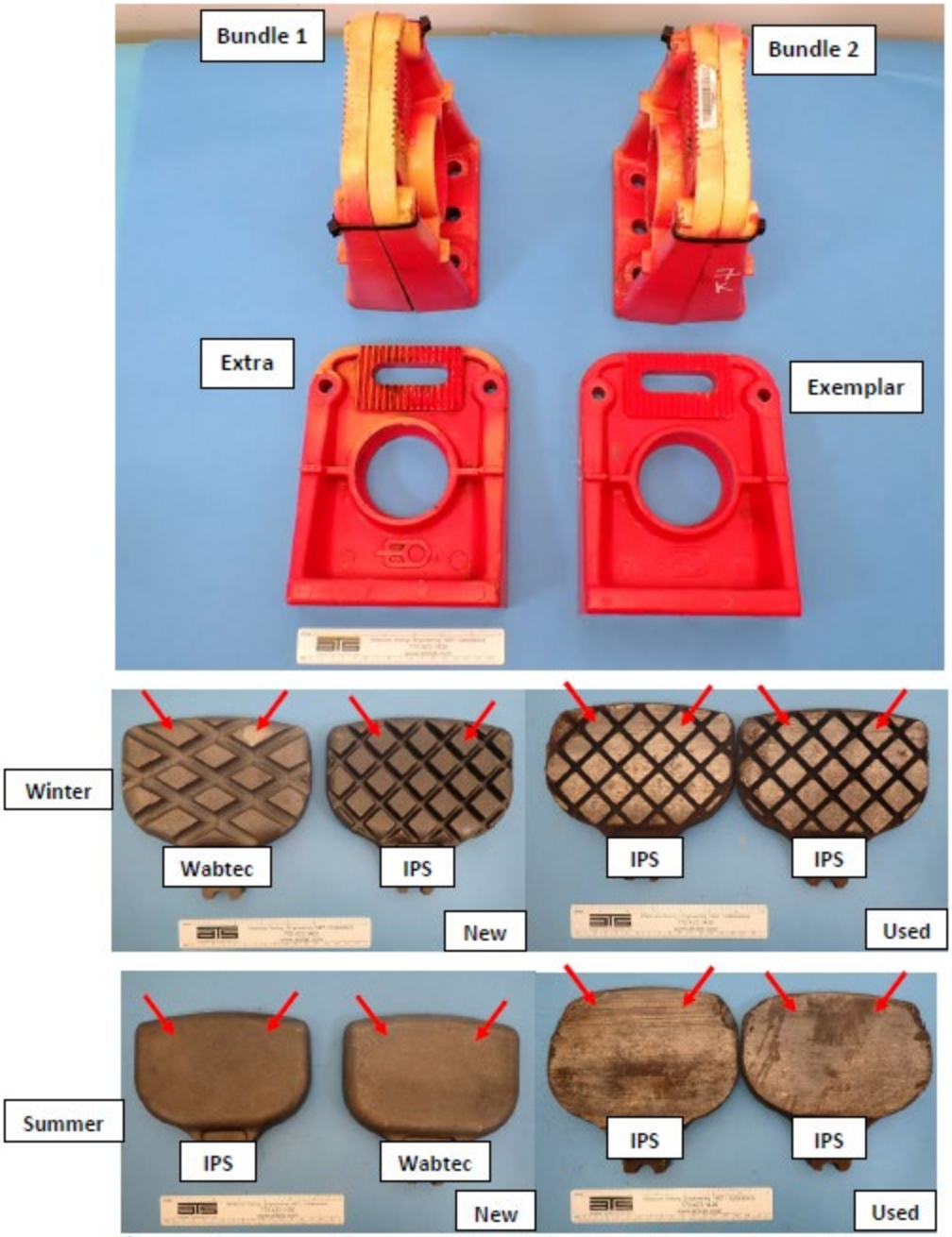


Figure 1: Photograph of the current collector brackets in the as-received condition showing two bundles from assemblies, an extra bracket, and an exemplar bracket (top). Photographs of the current collector shoes received post-mechanical testing (bottom) show areas of the shoe surface that were tested for Brinell hardness (red arrows).

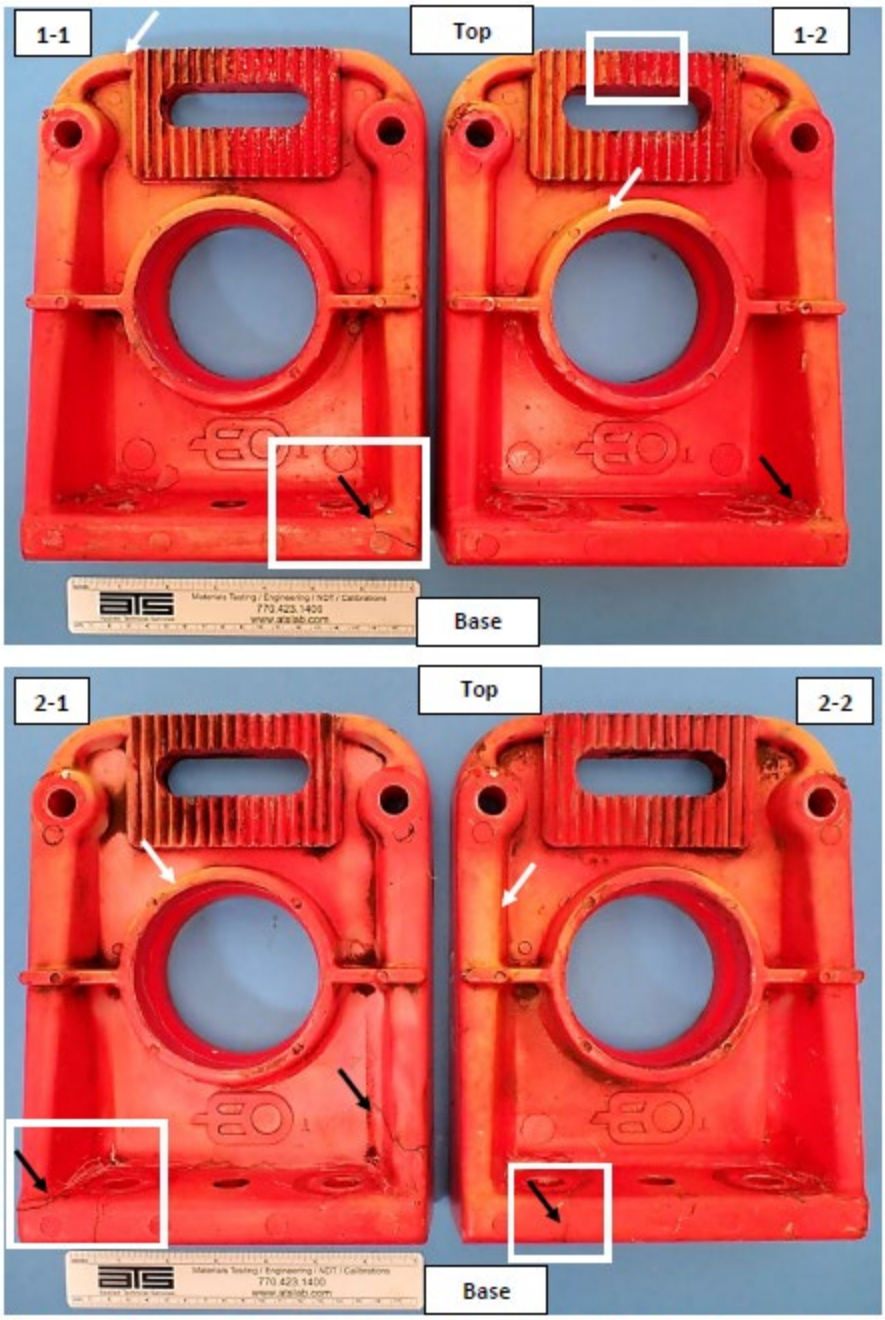
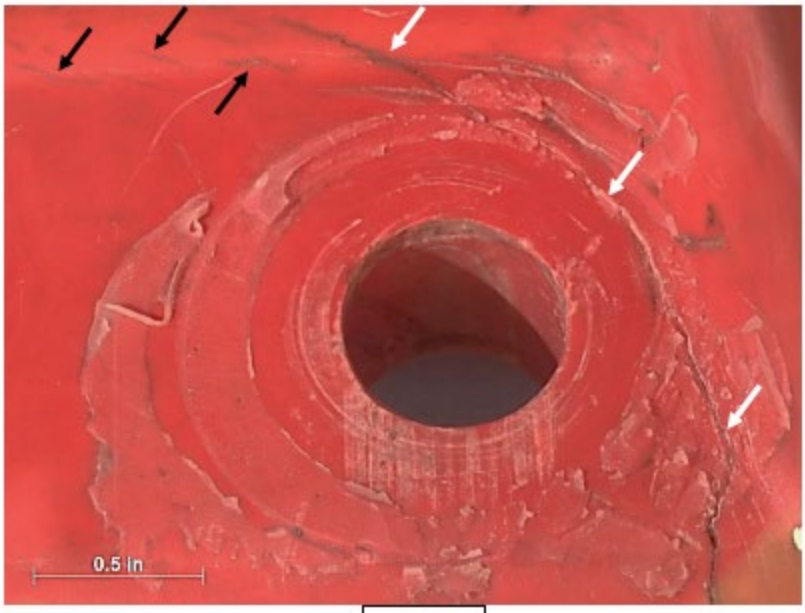


Figure 2: Photographs of the outer facing surfaces, or front, of the collector assembly brackets from Bundle 1 (top) and Bundle 2 (bottom) exhibiting a yellow discoloration (white arrows) and cracking predominantly at the base of the brackets (black arrows). A cracked area from each sample was further examined (white rectangles)



Front

Figure 3: Macrograph of the base of Sample 1-1 showing cracking along the circumference of a washer indentation (white arrows) and dispersed secondary cracks along the radius of the bracket base (black arrows). Cracking was also observed in the yellow material at the top of Sample 1-2 (bottom).

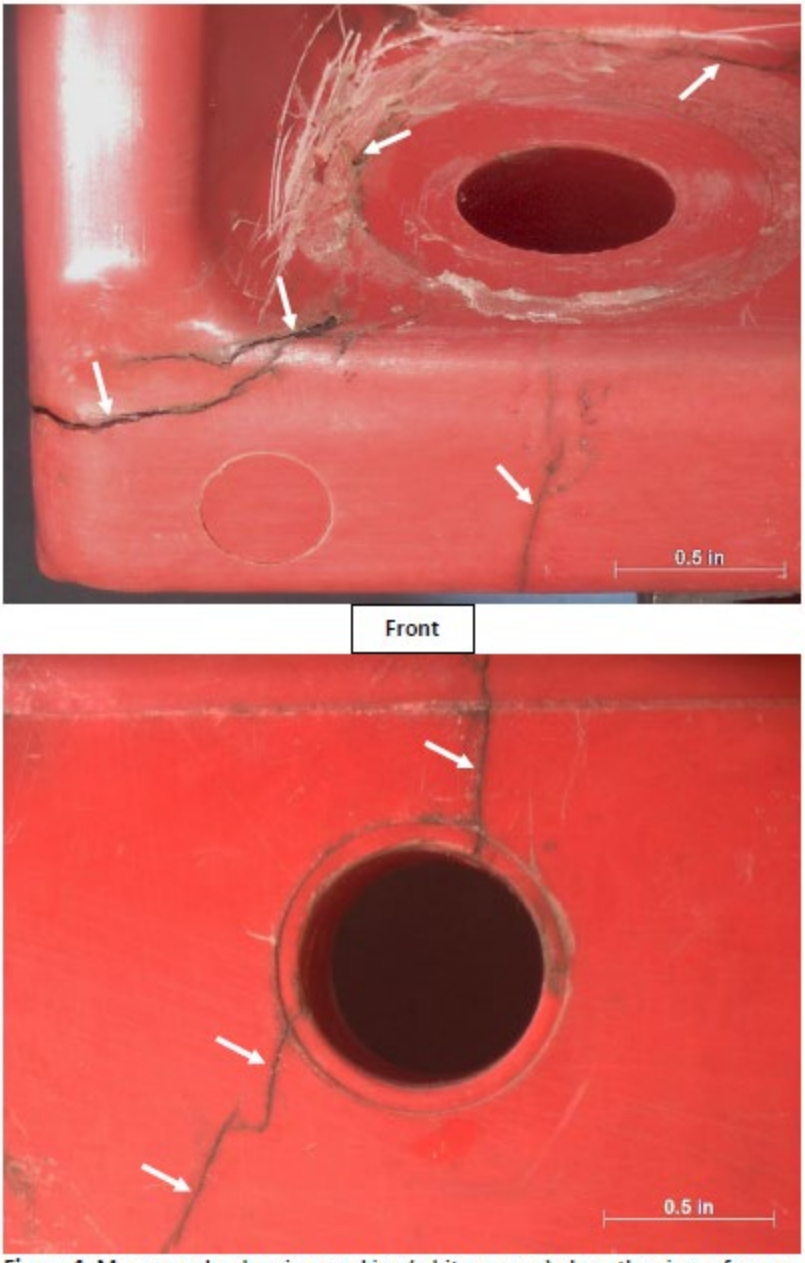


Figure 4: Macrographs showing cracking (white arrows) along the circumference of a washer indentation, along the radius of the bracket base, and in the bracket base in plane with a bolt hole of Sample 2-1 (top). Sample 2-2 also exhibited cracking from the front of the bracket base to one of the bolt holes and further within the material along the bottom of the bracket base (bottom).

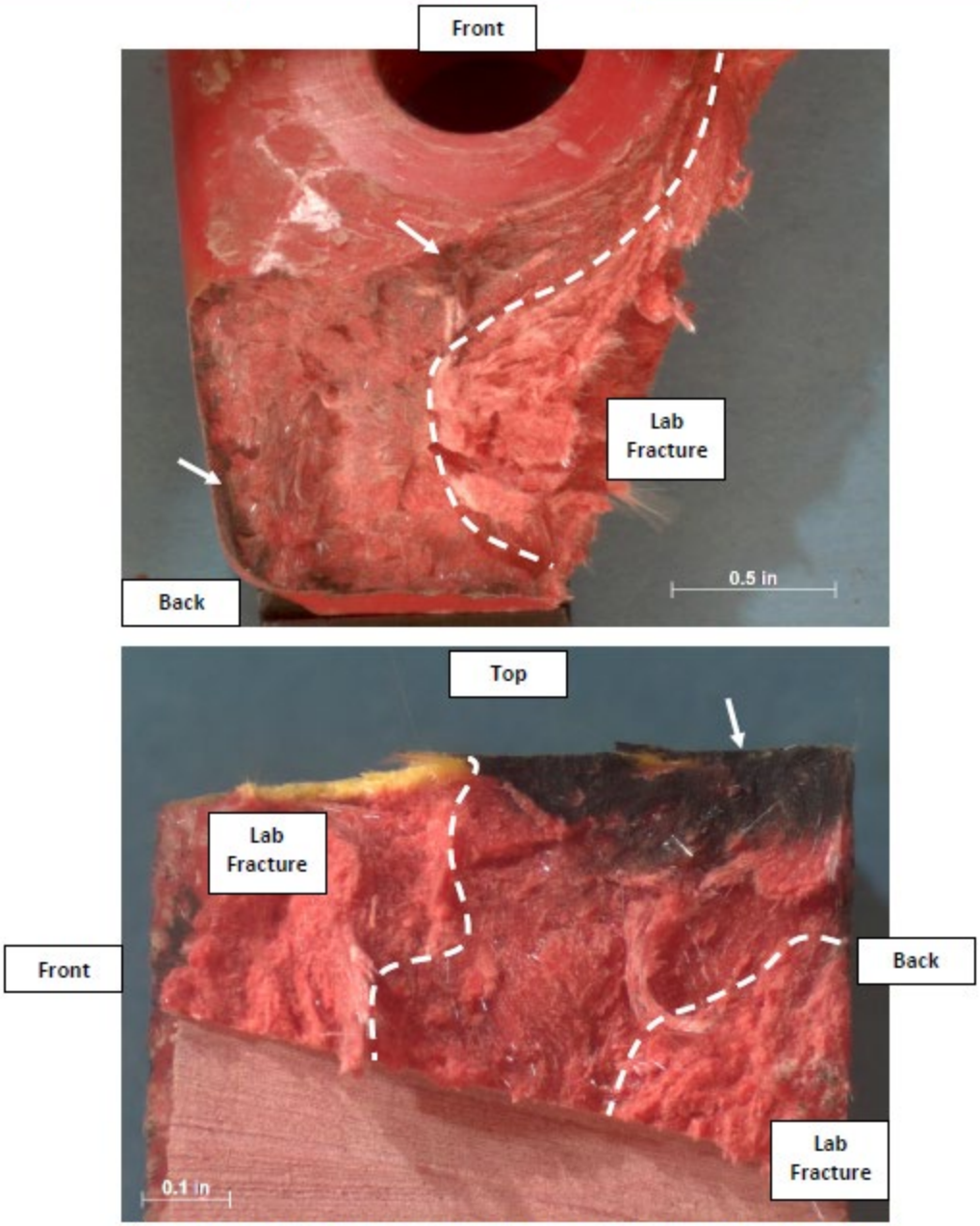


Figure 5: Macrographs of the opened fracture surfaces from the base of Sample 1-1 (top) and the yellow material at the top of Sample 1-2 (bottom). The service fracture of Sample 1-1 follows the circumference of the washer indentation and leads down the back of the bracket base at an angle. Both service fracture surfaces were smoother and exhibited a duller appearance compared to the lab fractures. A dark discoloration was observed on the fracture surfaces along the exposed surfaces (white arrows).

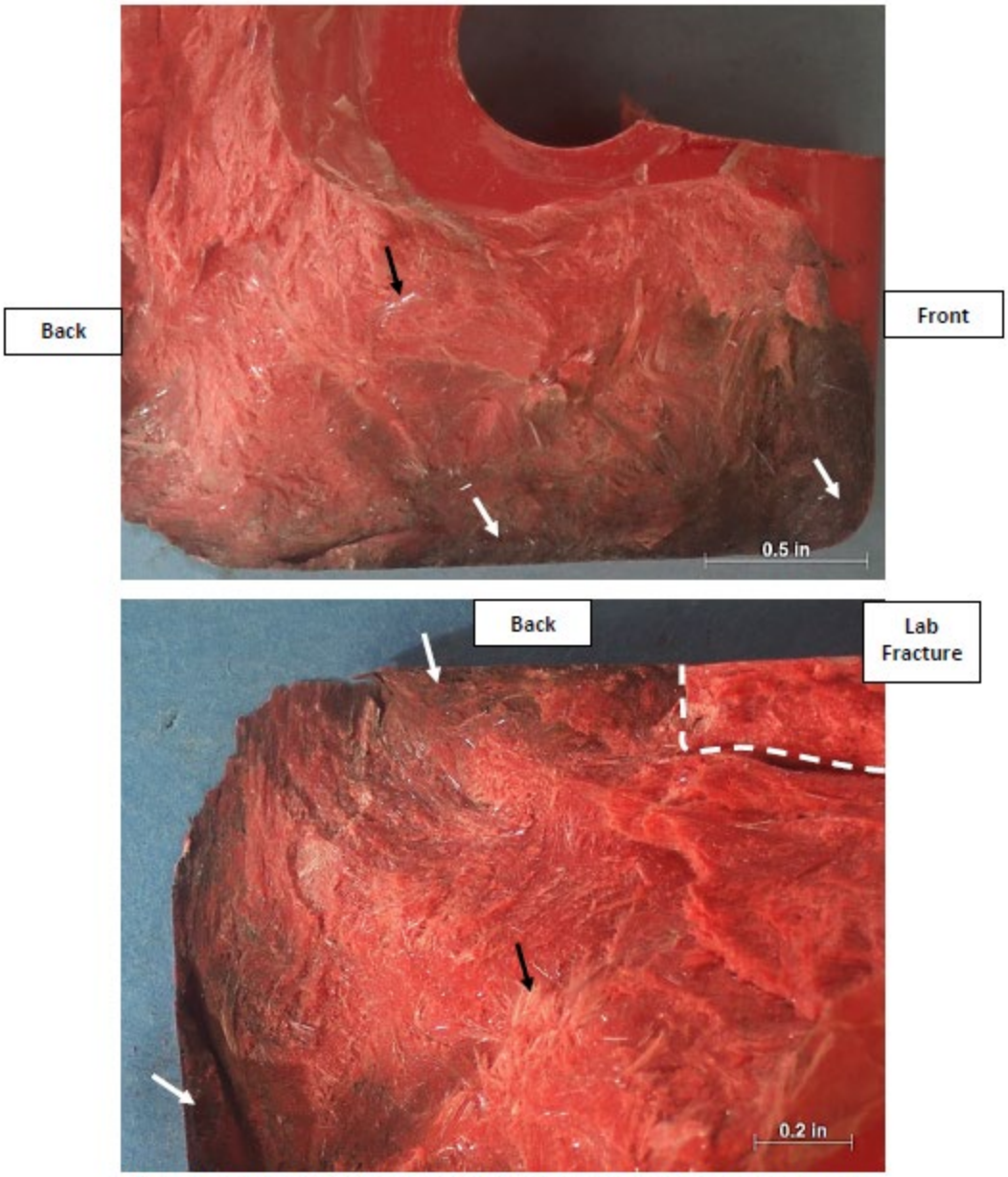


Figure 6: Macrographs of the opened fracture surface from the base of Sample 2-1 showing a smooth fracture surface with dispersed exposed fibers (black arrows). A dark discoloration was observed along the exposed surfaces of the sample (white arrows). The service fracture of Sample 2-1 follows the circumference of the washer indentation and leads down the back of the bracket base at an angle.

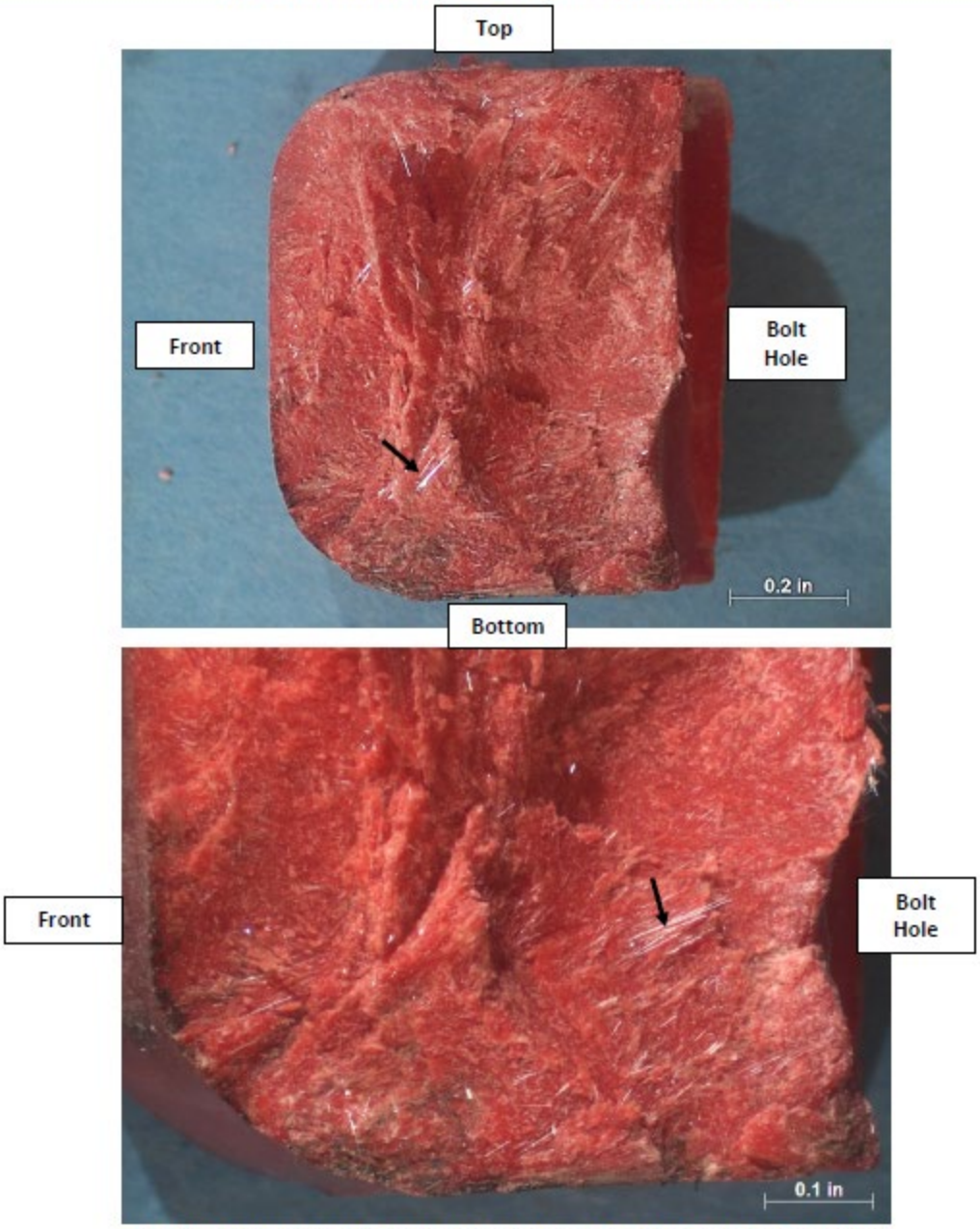


Figure 7: Macrographs of the opened fracture surface from Sample 2-2 showing a smooth and relatively flat fracture surface with areas of exposed fibers (black arrows).

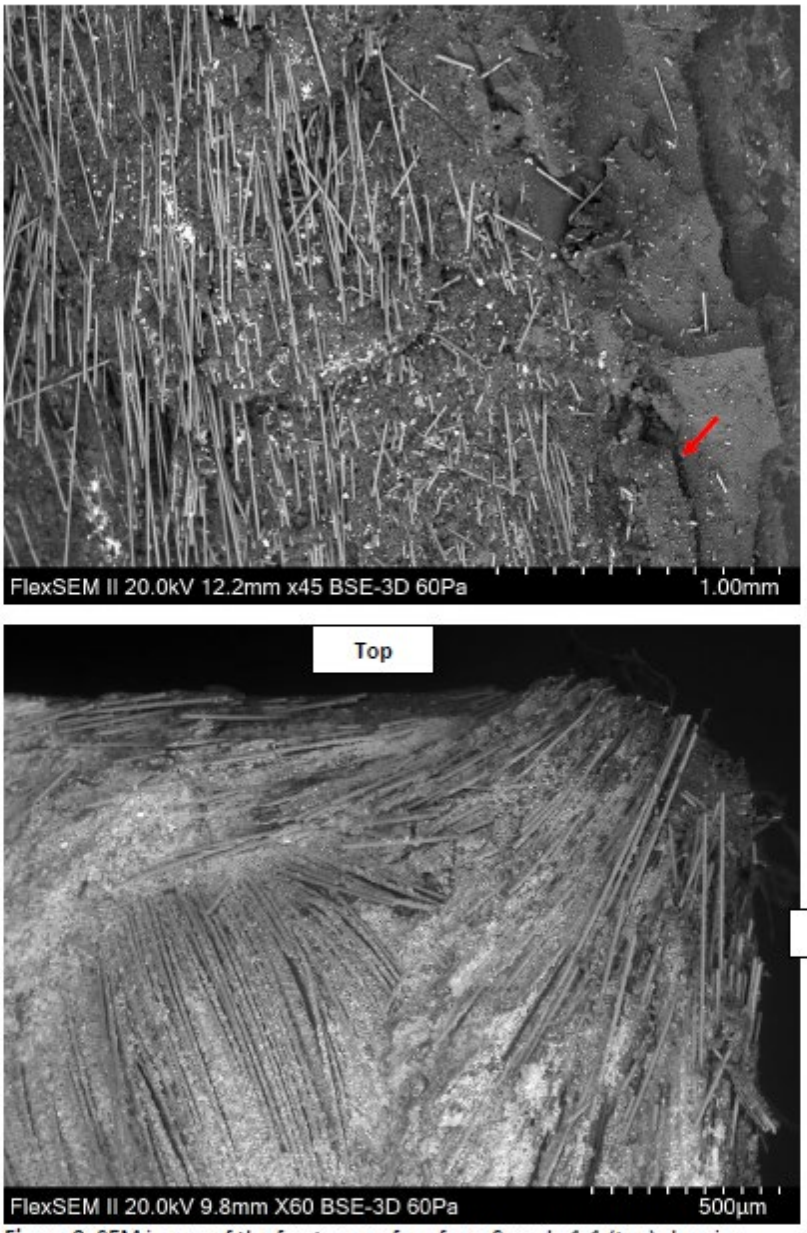


Figure 8: SEM image of the fracture surface from Sample 1-1 (top) showing exposed fibers all along the circumference of the washer indentation (red arrow) at the top of the bracket base. An SEM image of the fracture surface from Sample 1-2 shows exposed fibers along the fracture surface covered in contamination (bright) (bottom)

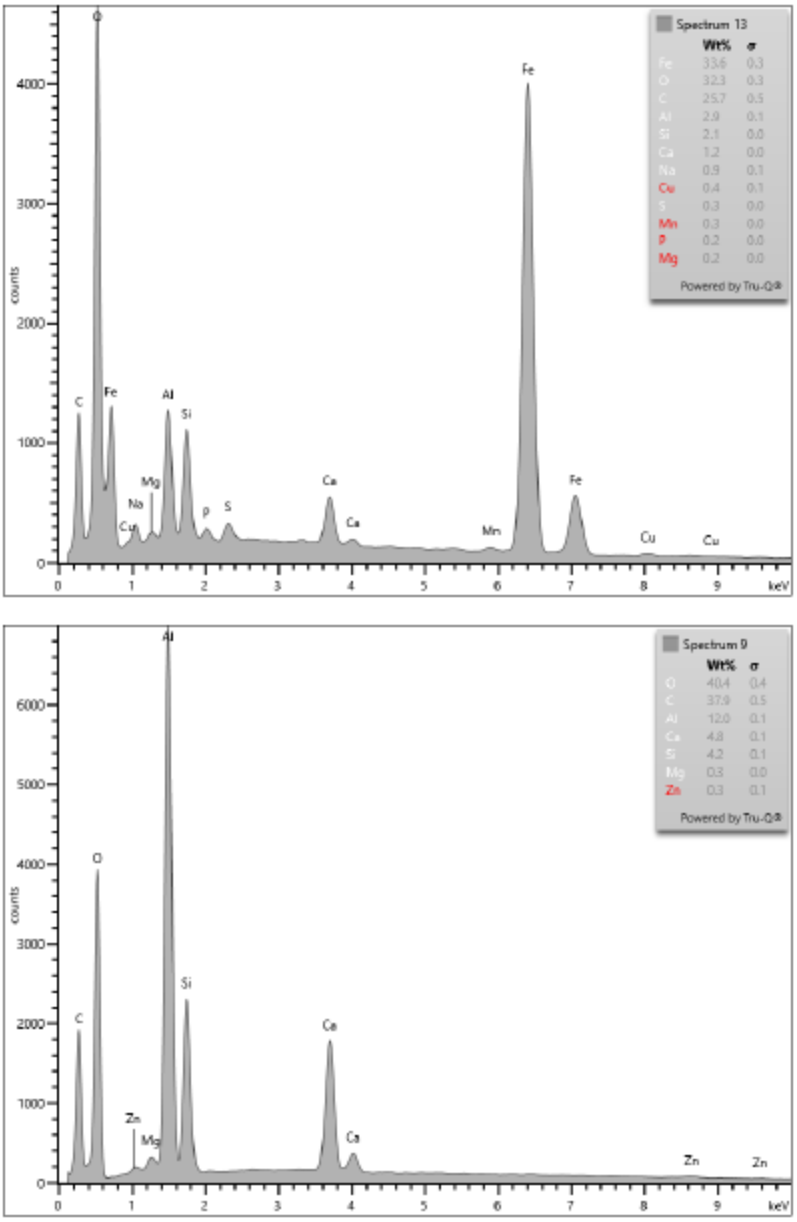


Figure 9: EDS spectra collected from the contamination (top) and base material (bottom) from Sample 1-2.

Top: Carbon (C), oxygen (O), iron (Fe), copper (Cu), sodium (Na), magnesium (Mg), aluminum (Al), silicon (Si), phosphorus (P), sulfur (S), calcium (Ca), and manganese (Mn) were detected.

Bottom: Carbon (C), oxygen (O), zinc (Zn), magnesium (Mg), aluminum (Al), silicon (Si), and calcium (Ca) were detected.

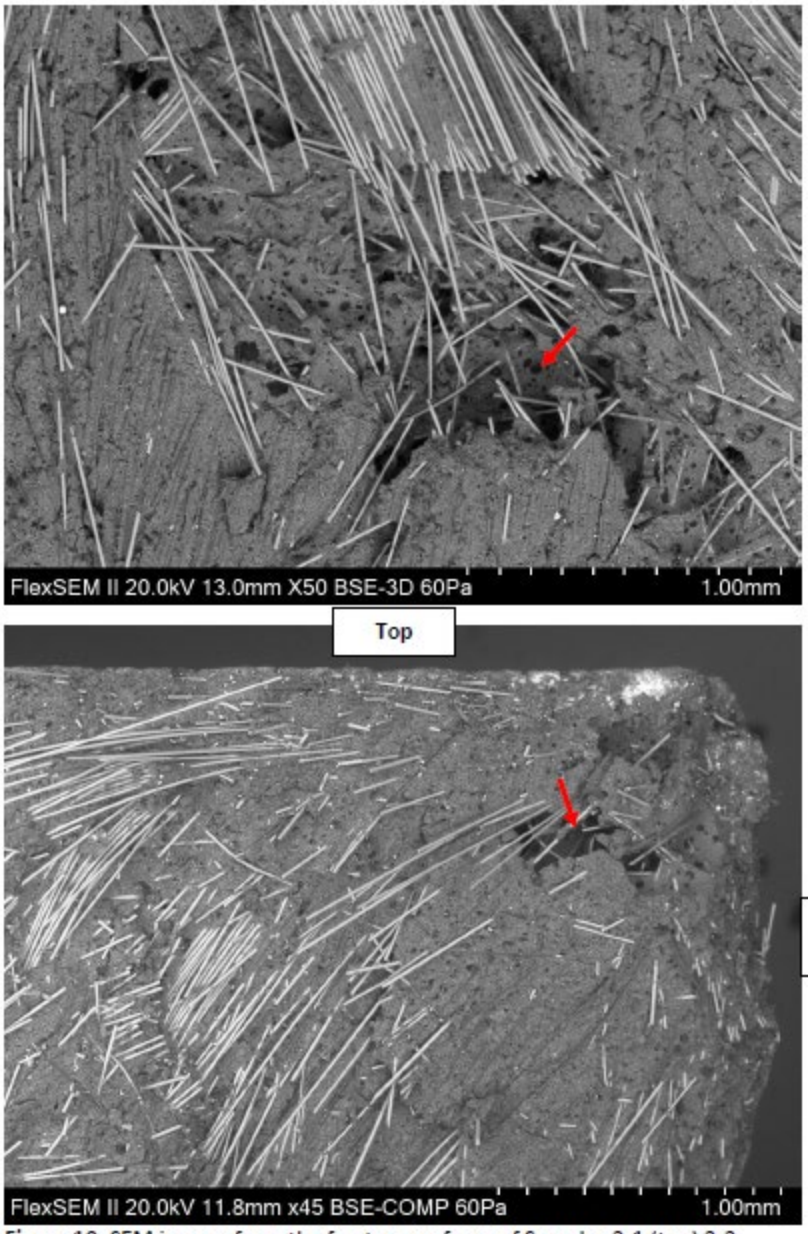


Figure 10: SEM images from the fracture surfaces of Samples 2-1 (top) 2-2 (bottom) exhibiting exposed fibers and relatively large voids along the fracture surface (red arrows).

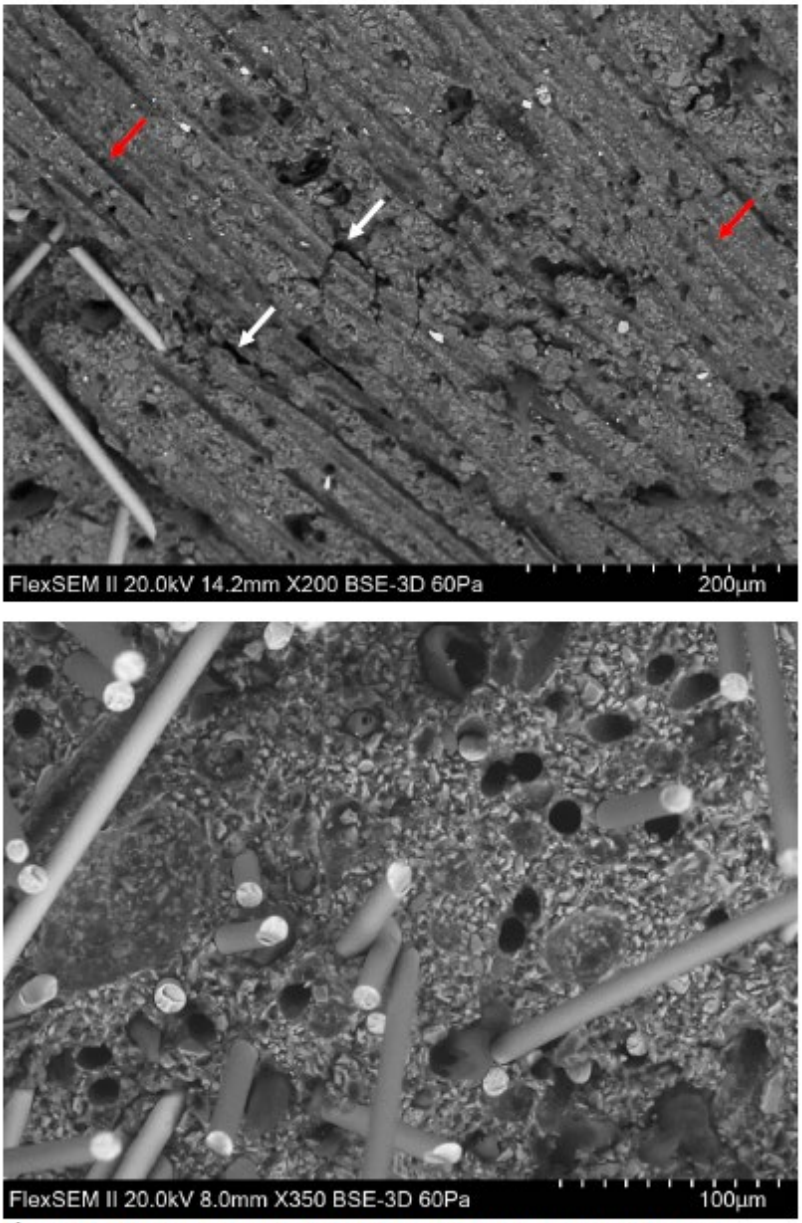


Figure 11: SEM image from Sample 2-1 (top) showing the typical fracture surface observed exhibiting a smooth surface with grooves (red arrows), indicative of fiber debonding, and micro-cracking of the matrix material (white arrows). An SEM image from Sample 1-2 shows the typical lab-induced fracture surface observed exhibiting fiber pull out (bottom).

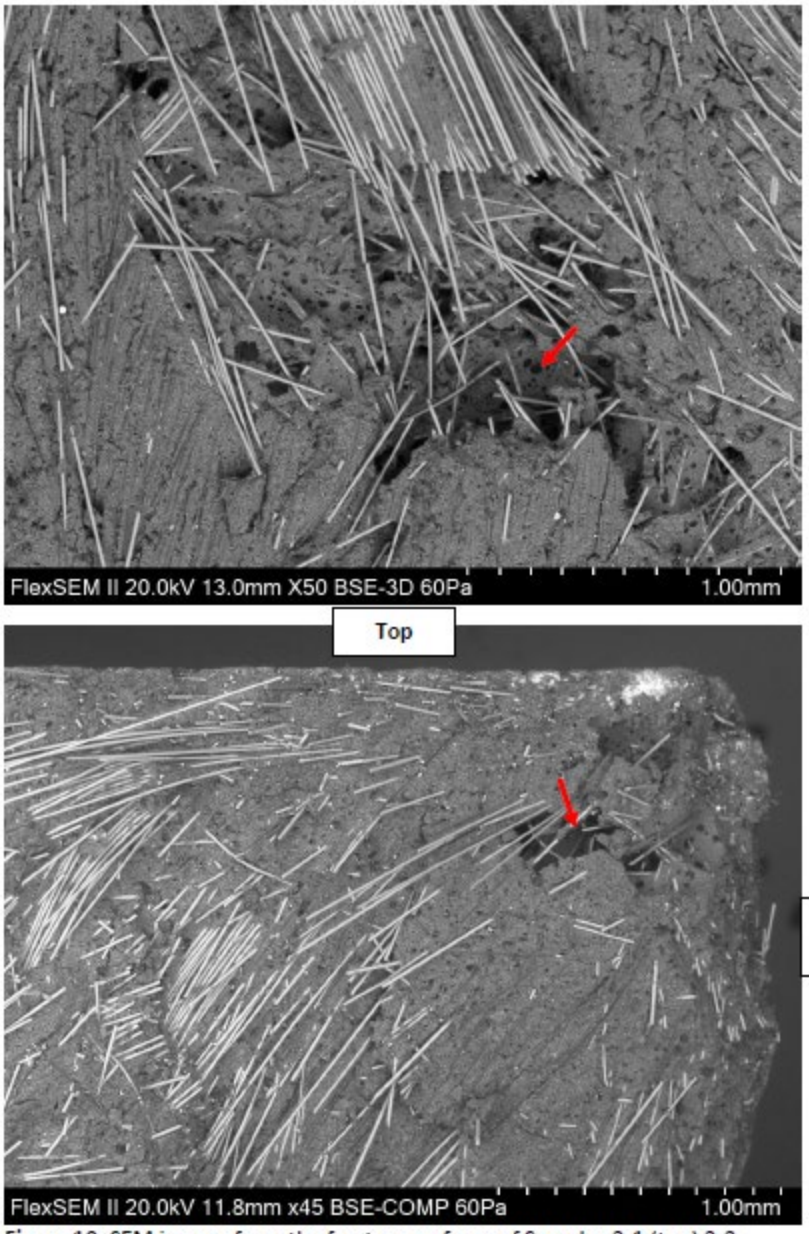


Figure 10: SEM images from the fracture surfaces of Samples 2-1 (top) 2-2 (bottom) exhibiting exposed fibers and relatively large voids along the fracture surface (red arrows).

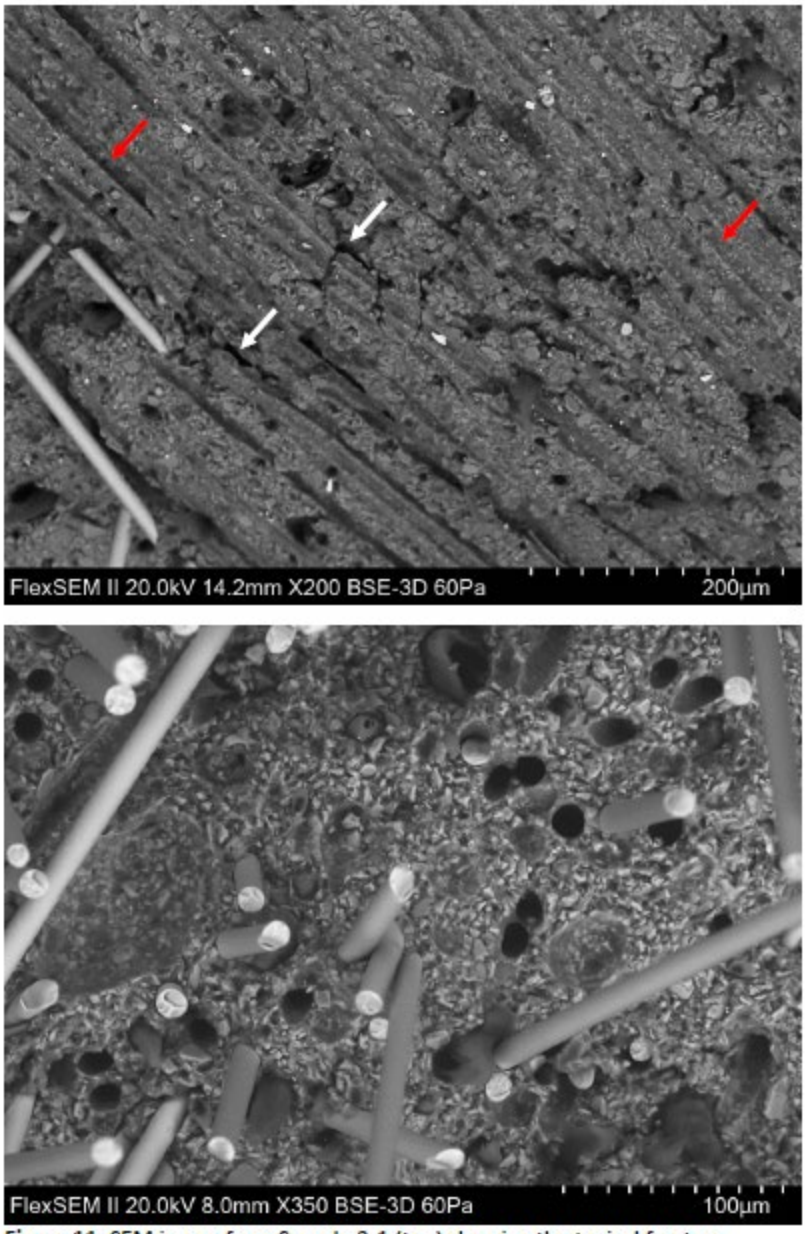
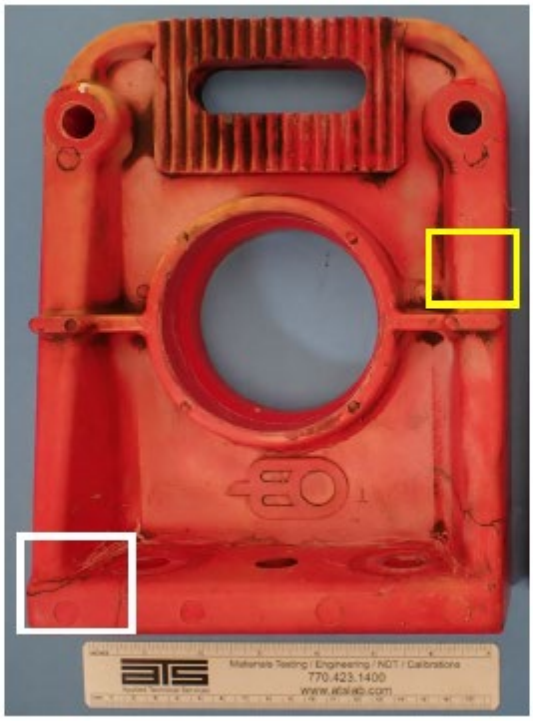


Figure 11: SEM image from Sample 2-1 (top) showing the typical fracture surface observed exhibiting a smooth surface with grooves (red arrows), indicative of fiber debonding, and micro-cracking of the matrix material (white arrows). An SEM image from Sample 1-2 shows the typical lab-induced fracture surface observed exhibiting fiber pull out (bottom).



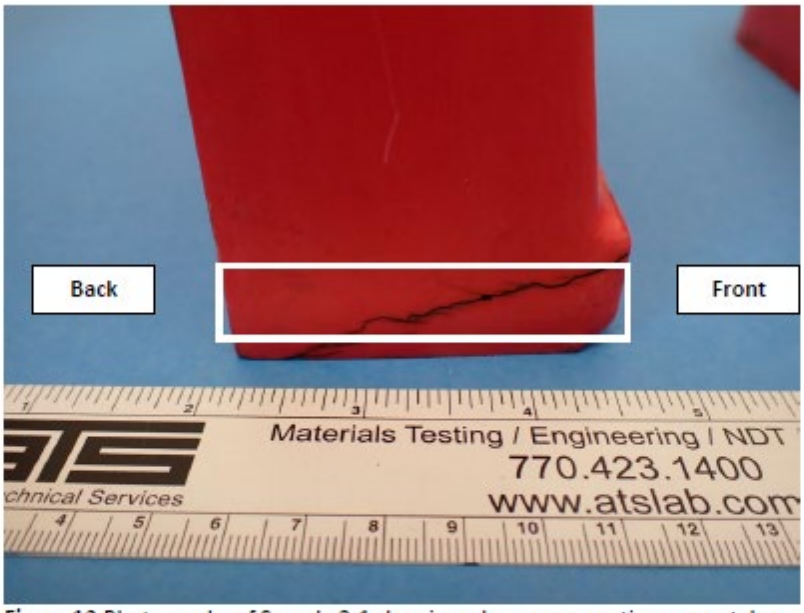


Figure 12:Photographs of Sample 2-1 showing where cross sections were taken from the cracked area (white rectangle) and a remote area (yellow rectangle) of the sample.

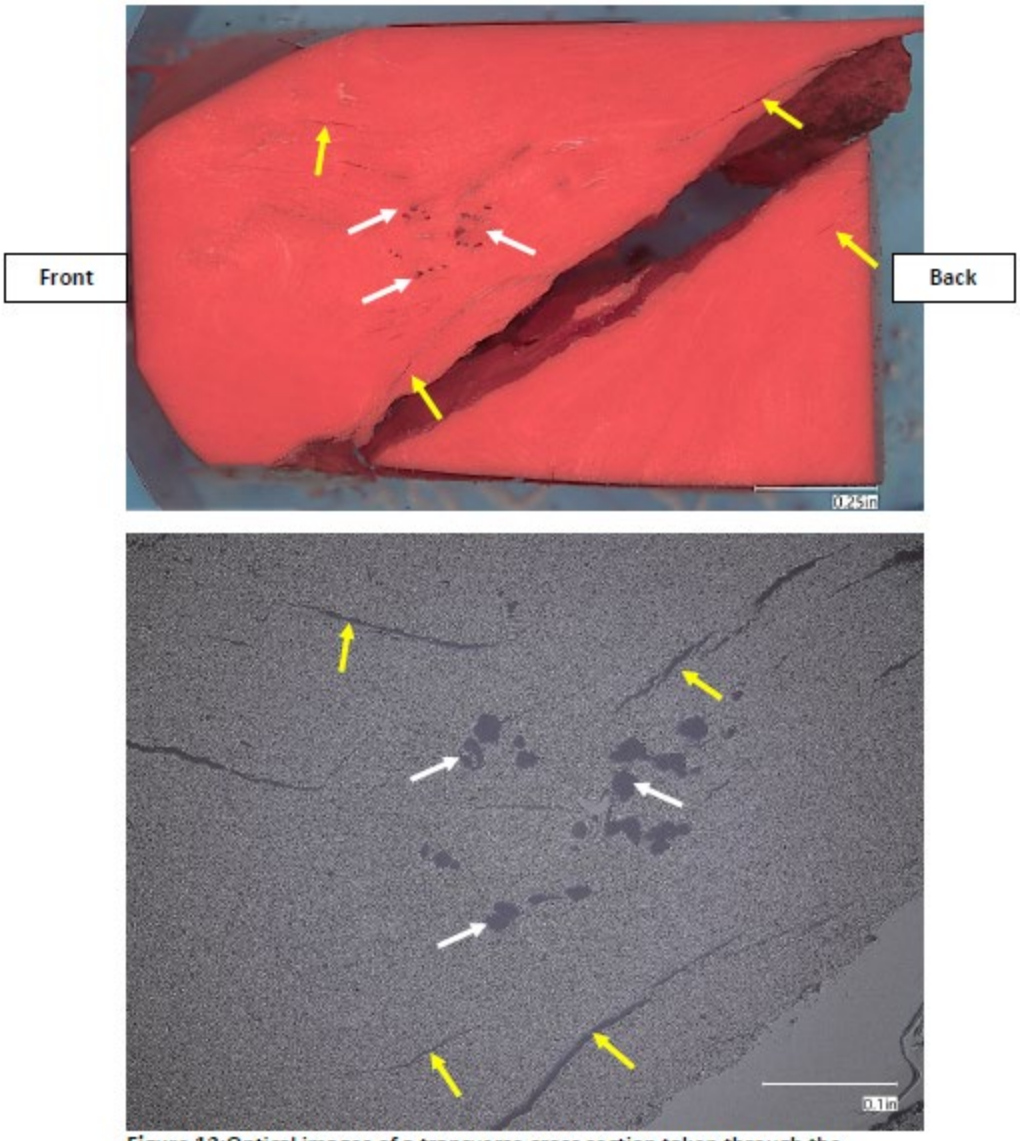


Figure 13:Optical images of a transverse cross section taken through the fracture surface of Sample 2-1 (top) showing voids (white arrows) and cracks (yellow arrows) throughout the material (bottom).

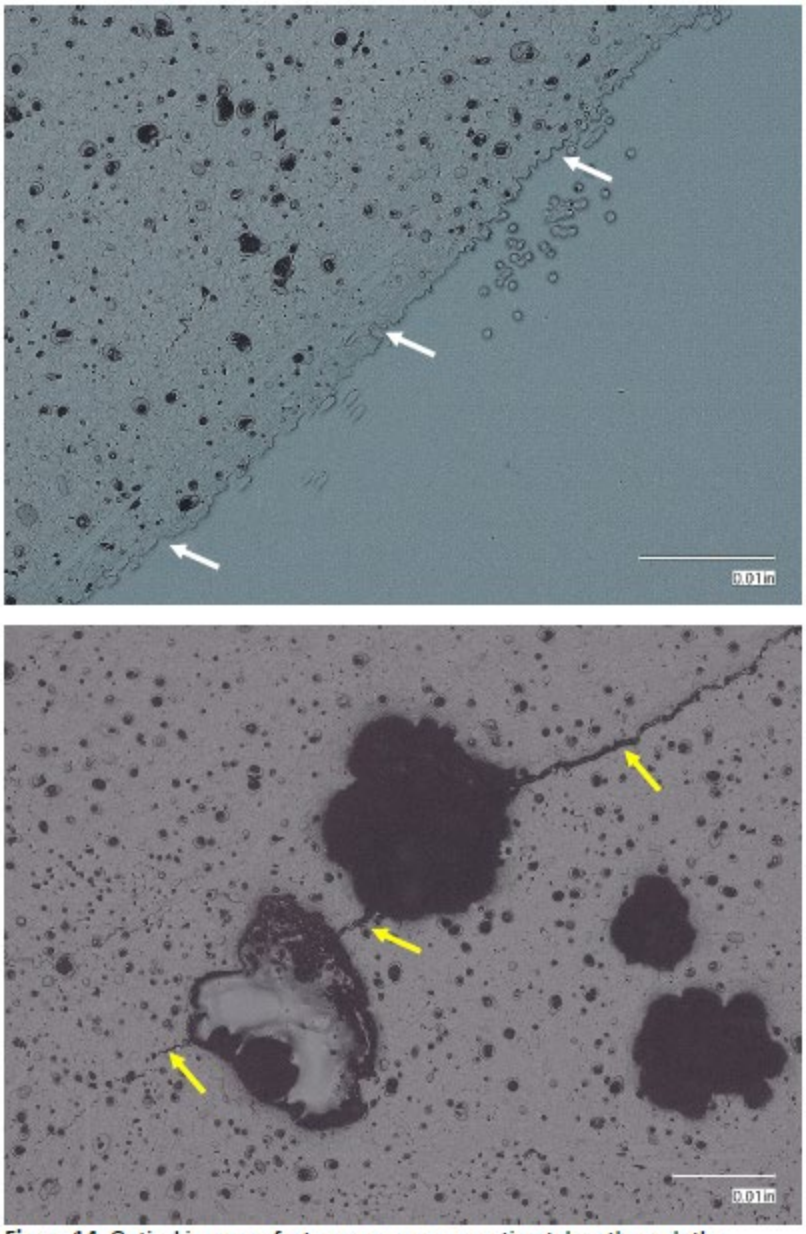


Figure 14: Optical images of a transverse cross section taken through the fracture surface of Sample 2-1 showing the fracture surface (top) and the large voids observed within the material (bottom). The fracture surface was predominantly flat and exhibited grooves (white arrows) where fibers used to be. Cracks (yellow arrows) were observed connecting and emanating from the large voids within the material.

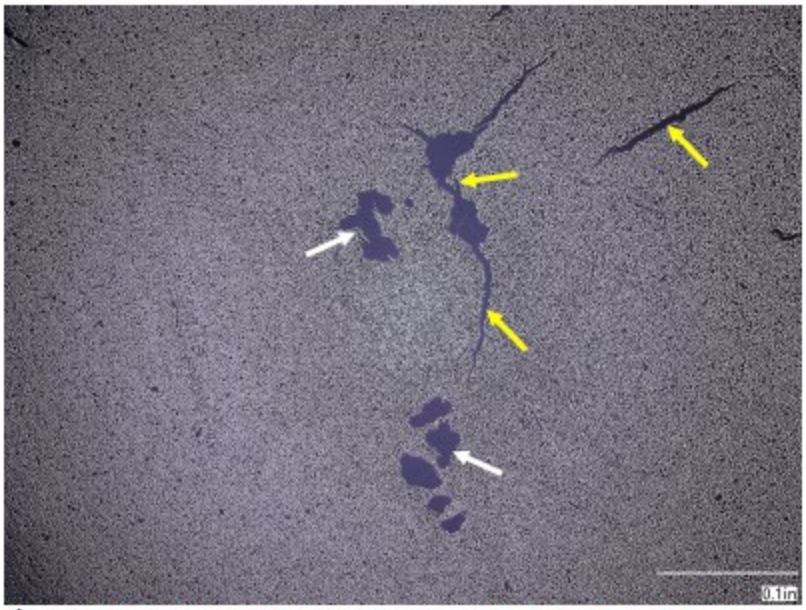


Figure 15: Optical images of a transverse cross section from Sample 2-1 taken remote from any cracks (top) exhibiting voids (white arrows) and internal cracking (yellow arrows). Cracks were also observed connecting and emanating from the large voids within the material (bottom).

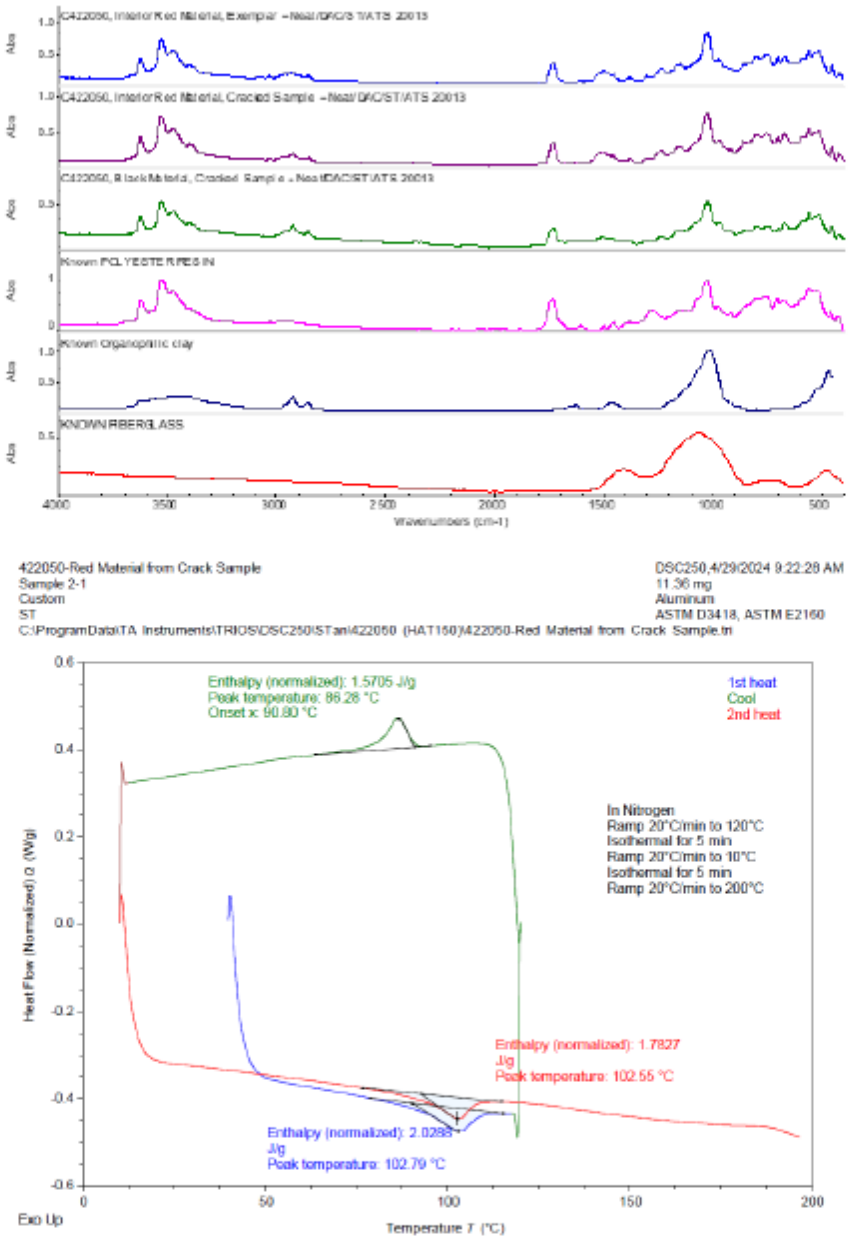


Figure 16:FT-IR spectra (top) collected from the exemplar sample (blue), a cracked sample (Sample 2-1, purple), and the black contamination observed on many of the fracture surfaces (green) compared to library spectra of polyester resin (pink), organophilic clay (indigo), and fiberglass (red). A DSC thermogram from material taken from Sample 2-1 exhibited no exothermic peaks that would indicate an incomplete cure of the resin (bottom).

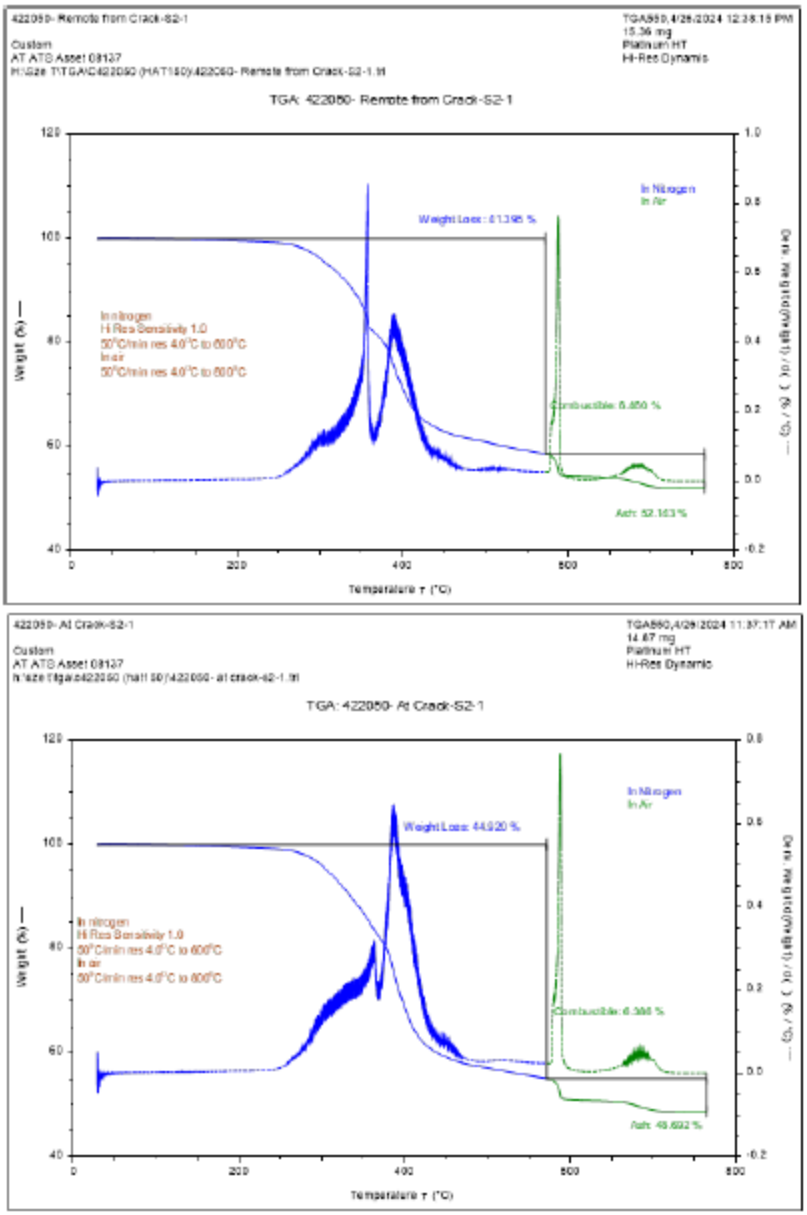


Figure 17: TGA thermograms from Sample 2-1 of material taken remote from any cracking (top) and near cracking at the bracket base (bottom).

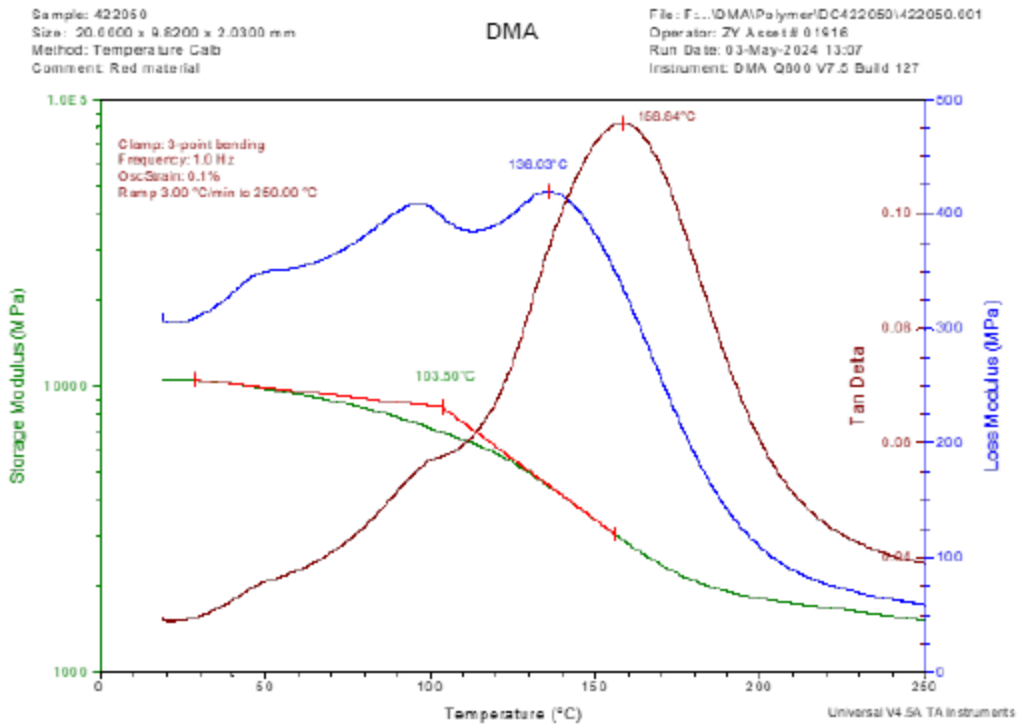


Figure 18: DMA thermograms collected from Sample 2-1 showing the glass transition temperatures determined from the storage modulus (green), the loss modulus (blue), and tan delta (brown).

Drafted By: SAFE704 - 07/05/2024
Reviewed By: SAFE 707 – 07/12/2024
Approved By: SAFE 707 – 07/12/2024

Appendix Q - Job Hazard Analysis

Job Hazard Analysis

Activity/Work Task:	Third rail gauging
Work Location:	Throughout the rail system, revenue track and yards
Date Prepared:	3/11/2024
Prepared by (Name/Title):	[redacted] Manager, Corporate Safety and Analysis
Safety Reviewed by (Name):	
Frequency/Duration:	1 Hour
Contract Number:	N/A
Contractor/Subcontractor:	N/A
Overall Risk Assessment Code (RAC) Use the highest RAC code from below:	1E
Notes:	CPR training and task specific training is required for personnel performing this task.
Equipment to be used:	Safety approved contact rail gauge, non-conductive ruler.
Required PPE:	Hard hat. Safety glasses. Safety footwear. Safety vest. Class 0 electrical gloves with leather protectors.

Risk Assessment Matrix

	Risk Severity			
	Catastrophic	Critical	Marginal	Negligible
Risk Probability	1	2	3	4
Frequent – A	1A	2A	3A	4A
Probable – B	1B	2B	3B	4B
Occasional – C	1C	2C	3C	4C
Remote – D	1D	2D	3D	4D
Improbable – E	1E	2E	3E	4E

Probability is how often a risk is expected to occur
Severity is the consequence expected from the risk occurring

Job Tasks	Hazards	Controls	S	P	RAC
1. Gather equipment and enter the roadway.	1. Energized third rail. 2. Train Movement. 3. Slip/trip/fall hazards. 4. Weather.	1a. Utilize appropriate level of RWP protection. 1b. Maintain clearance from third rail and its components. 2. Be alert for rail vehicle movement. 3. Be mindful of uneven surfaces and trip hazards. 4. Dress appropriately and be alert for changing weather conditions.	1	E	1E
2. Prepare contact rail gauge.	1. Energized third rail. 2. Train Movement. 3. Slip/trip/fall hazards.	1a. Utilize appropriate level of RWP protection. 1b. Stand in a place of safety. 1c. Maintain clearance from third rail and its components. 2. Be alert for rail vehicle movement. 3. Be mindful of uneven surfaces and trip hazards.	1	E	1E

Attachment 1 – Job Hazard Analysis for third rail gauging page 1 of 2

Job Hazard Analysis

3. Take third rail measurements.	1. Energized third rail. 2. Train Movement. 3. Slip/trip/fall hazards.	1a. Only perform this task during dry conditions. 1b. Utilize appropriate level of RWP protection 1c. Stand in-between the running rails to take measurements. 1d. Maintain clearance from third rail and its components. 1e. Use class 0 electrical gloves with leather protectors. 2. Be alert for rail vehicle movement. 3. Be mindful of uneven surfaces and trip hazards.	1	E	1E
4. Gather equipment and clear the roadway or move to the next location.	1. Energized third rail. 2. Train Movement. 3. Slip/trip/fall hazards.	1a. Utilize appropriate level of RWP protection. 1b. Maintain clearance from third rail and its components. 2. Be alert for rail vehicle movement. 3. Be mindful of uneven surfaces and trip hazards.	1	E	1E

Attachment 1 – Job Hazard Analysis for third rail gauging page 2 of 2

	TRST – 1000 TRACK INSPECTION & SAFETY STANDARDS		
TRST – 1000	VOLUME 1	REVISION: 2	MAY 2024

107.7. Contact Rail Assembly

The purpose of the contact rail is to provide an electrical power supply for the operation of trains. The rail must have a smooth horizontal and vertical geometry matching that of the track. The contact surface of the rail must be smooth and absent of divots, gaps/breaks, corrosion, and excessive wear.

(A) Contact rail and other components are considered defective if any of the following conditions exist:

a. Vertical or horizontal distance of contact rail to the running rail exceeds the tolerance as shown in Table 107.7A
b. End approaches must also be in tolerance as shown in Table 107.7E.
c. Vertical wear of contact rail surface exceeds the tolerance shown in Table 107.7F.
d. The insulators are no longer able to support the contact rail (3rd rail) in proper position. This may be due to cracked or broken insulator, broken or deteriorated grout pads, broken or displaced insulators, or ineffective hold down bolts.
e. Cover board and brackets are cracked or broken. If a cover board section is loose or presents a hazard, it should be removed until such time as it can be replaced.
f. Expansion joints or welded ends are mismatched.
g. Tie extension plates are cracked or broken and do not provide proper level for positioning of insulators.
h. Anchor arm parts are too loose to support to the contact rail.
i. Signs of collector shoe striking the end approach. Collection of broken collector shoes near the end approach is a sign of misaligned end approach.
j. Grout pads for insulators are cracked, broken, or do not provide support to the contact rail assembly.

(B) Contact rail should be measured in refence to the standard gauge measurement tool. When place on the running rails, this tool provides a template for the design position of the contact rail. By design, the top of the contact rail is 4 ½" above the top of the running rail, and the gauge face of the contact rail is 24" from the gauge face of the nearest running rail, as shown in Figure 107.7A. Third Rail geometry is measured in relation to the standard template.

(C) Any defects to contact rail heat tape, such as charring, corrosion, or dangling pieces or brackets, should be reported to the office of Traction Power Maintenance

Attachment 1 – TRST 1000 Measurement and Procedural Change page 1 of 1.

Appendix S - Why-Tree Analysis