EB 09-005: e-STROKE GEN 3 USERS GUIDE for Bus Applications

SECTION 1: INTRODUCTION

The purpose of the e-Stroke Brake Monitoring System is to enhance the operational safety of commercial vehicles. The e-Stroke System accomplishes this by providing a simple and objective means for checking the operation and adjustment of each brake, allowing the operator to perform the necessary Stationary Vehicle Inspection quicker and more accurately, plus gives maintenance personnel enhanced brake inspection and diagnostic capabilities.

Additionally, by providing continuous, real-time monitoring of brake actuator stroke, e-Stroke can detect anomalies in brake function during dynamic, real world operation that may not be detected during routine maintenance and inspections.

Whether the vehicle is undergoing a daily Stationary Vehicle Inspection, or driving down the road, e-Stroke has the ability to detect defects that include: inoperative brakes, out of adjustment brakes, dragging brakes, and other brake related problems affecting brake stroke. By identifying precisely where the problem is located, troubleshooting and repairs can be done much more efficiently.

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WARNING:

THIS MANUAL IS INTENDED TO PROVIDE A GENERAL OVERVIEW OF POTENTIAL BRAKE ISSUES, NOT A SPECIFIC ANALYSIS. IT IS THE CUSTOMER'S RESPONSIBILITY TO FOLLOW AND PERFORM ALL PREVENTATIVE AND / OR SCHEDULED BRAKE MAINTENANCE AS SPECIFIED BY THE VEHICLE OEM.

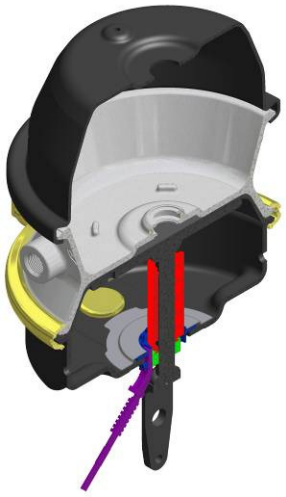
E-STROKE IS INTENDED TO PROVIDE A MONITORING FUNCTION WHICH WILL ALERT THE OPERATOR OR TECHNICIAN OF A POTENTIAL BRAKING ISSUE. VISUAL INSPECTIONS OF THE BRAKING SYSTEM ARE PERIODICALLY REQUIRED TO VERIFY E-STROKE FAULT INDICATIONS OR CONFIRM THAT THE BRAKING SYSTEM IS PROPERLY FUNCTIONING.

CUSTOMER (NOT MGM BRAKES) IS SOLELY LIABLE FOR CUSTOMER'S FAILURE TO PROPERLY MAINTAIN / INSPECT VEHICLE BRAKES.

This document is intended to provide guidance on the usage of the e-Stroke GEN 3 Brake Monitoring System. In addition to the information provided in this guide, the e-Stroke Technical Manual is available with complete technical information for all e-Stroke Systems and Applications. *Contact MGM Brakes Customer Service (877)-4-e-Stroke, for a copy of the e-Stroke Technical Manual (P/N 8090091). The P/N 8090091 e-Stroke Technical Manual CD is also included with the P/N 9090109, 9090110 Diagnostic Kits, See Sections 4.3.2, 4.3.3.*

SECTION 2: SYSTEM COMPONENTS

2.1: Brake Actuators



MGM Brakes e-Stroke brake actuators are denoted by an "ESH" suffix on the part number. Each actuator is assembled with a specified sensor angle orientation, similar to the port and clamp band angle of a standard actuator, and is calibrated at MGM Brakes Manufacturing Facility to insure accuracy. Proper specification of the sensor angle should orient the sensor pigtail toward the centerline of the vehicle, away from the wheel end.

e-Stroke actuator components are not field serviceable, with the exception of single/piggy-back or service diaphragm replacement. For service information, refer to the MGM Service Manual relating to the actuator to be serviced. *Reference EB 03-005 and EB 03-006 for additional ESH Actuator Service Information. DO NOT attempt to rotate, slide or otherwise adjust the magnetic sleeve, sleeve clamp, or the sensor stone shield.*

A stainless steel strain relief bracket (P/N 8090039) is included with the actuator assembly to provide a means for securing the sensor pigtail, preventing the sensor from being inadvertently pulled out of the actuator during normal vehicle operation. The strain relief bracket should be installed on the upper mounting stud of the actuator facing toward the centerline of the vehicle.

2.2: Actuator Sensor

The e-Stroke Sensor (P/N 8290120) provides the e-Stroke Actuator stroke measurement to the CCM. This stroke measurement is monitored with the brake application pressure reading to determine if a fault condition is present.

The sensor is a non-serviceable component, which may be replaced separate from the brake actuator assembly if required. No adjustment or calibration is required when replacing an e-Stroke sensor. Care must be taken during installation to insert the sensor into the actuator sensor port with the proper alignment, parallel to the piston rod. Failure to fully seat the sensor will also directly influence the system accuracy. *Reference EB 08-006 for additional e-Stroke Sensor & Harness information.*

2.3: Pressure Transducer

The pressure transducer (P/N 8090550) provides the e-Stroke CCM with information about the pressure that the driver is applying to the brake system. A brake fault will be indicated when the actuator stroke is not in proportion to air pressure applied by the brake system. For example, if the driver applies the brake treadle and an actuator does not move from the fully retracted position, the e-Stroke system will determine that brake is “non-functional”.

2.4: GEN 3 Chassis Communication Module (CCM)

The Chassis Communication Module or CCM (P/N 8291101, etc.) is the “brains” of the e-Stroke system. The CCM provides regulated power to the actuator sensors and the pressure transducer. The actuator sensor and pressure transducer inputs are continuously monitored by the CCM to determine whether the stroke of each of the actuators is in proportion to the air pressure applied by the brake system.

CCM operation requires 9 to 32 V DC ignition switched power. Multiple Alarm Outputs are available which will energize an external warning light or alarm device during active brake fault conditions. Separate Alarm Outputs are provided for Tractor / Truck / Bus Brake Monitoring and lining wear as well as Trailer Brake Monitoring. The CCM alarm output is commonly connected to vehicle I/O systems to illuminate integrated dash warning lights. *Consult vehicle OEM or installer for specific e-Stroke warning light operation when connected to an I/O system.*

SAE J1939 connection is required for complete system functionality. The SAE J1939 connection is primarily used to monitor vehicle speed and transmit fault codes as fault conditions occur. The e-DT Hand Held Diagnostic Tool communicates with the CCM over the SAE J1939 / J1708 circuits. SAE J1708 may be connected if J1939 is not available, but J1939 is preferred. *Reference EB 08-025 for e-Stroke Published SAE J1939 / J1708 Fault Codes.*

Brake fault history is recorded in the CCM memory for up to 126 counts per fault per wheel. The fault history may be viewed and cleared using the available diagnostic tools. *See Section 4 for more diagnostic Information.*

SECTION 3: SYSTEM OPERATION

3.1: Continuous Brake Monitoring

Upon initial power-up, the CCM will "Bulb Check" the alarm output twice which allows the operator to verify the Warning Light function. *Consult vehicle OEM or installer for specific e-Stroke Warning Light operation when connected to an I/O system.*

During operation of the vehicle, the e-Stroke system continuously monitors the stroke of each actuator to ensure it is appropriate for the current brake application pressure. If any actuator is determined to be Over-Stroked, Dragging, or Non-Functioning the following actions will occur while the fault condition is active:

- The Warning Light will illuminate (Where Applicable). *See Section 7 for Warning Light Interpretation.*
- The CCM will record the fault occurrence in the memory.
- The appropriate SAE J1939 / J1708 Fault code is transmitted over the diagnostic circuit to a diagnostic tool or AVM Type Reporting System while the fault is active.

In addition to the above brake fault conditions; the following conditions will also activate the appropriate CCM alarm output:

- J1939 or J1708 communication error
- The e-Stroke system failing to start up / run
- E-Stroke Sensor Fault
- Pressure Transducer Fault
- Lining Wear Fault (Where Applicable)

Note: While the e-Stroke system can detect brake adjustment issues during real time operation; Over-Stroke conditions should be verified during a Stationary Vehicle Inspection. See section 3.2.

3.2: Stationary Vehicle Inspection

Note: Always follow the CVSA recommended procedures when conducting a Stationary Vehicle Inspection.

e-Stroke can be used to verify the CVSA Visual Inspection Results by following these steps:

1. Park the vehicle and allow the brakes to cool.
2. Properly chock the wheels and release the parking brake.
3. Adjust the Air-Reservoirs to between 90 and 100 psi (as indicated by the dash gauges) by allowing the compressor to build pressure or cycling the brakes to reduce system pressure.
4. Turn OFF the ignition and engine to maintain the appropriate CVSA testing pressure at the air reservoirs (90-100psi).
5. Switch the ignition back ON to the run position without starting the engine. Wait 5 seconds to allow the e-Stroke system to start up and bulb check.

6. Fully depress the Brake Pedal / Treadle for approximately 5 seconds and release. During this time monitor the brake function by watching the Warning Light or using the e-DT Diagnostic Tool.
7. If the Warning Light illuminates or the e-Stroke Diagnostic Tool indicates a fault condition, follow the steps in section 4 to determine the cause of the issue.

Note: The Stationary Vehicle Inspection procedure will detect Over-Stroke and Non-Functioning brake conditions; however Dragging brake conditions can only be detected while the vehicle is moving at speeds over 5mph.

SECTION 4: SYSTEM DIAGNOSTICS & TROUBLESHOOTING

Note: It is the responsibility of the end user to determine how the e-Stroke system will be used. Drivers and Technicians should be instructed on how to respond to an e-Stroke warning as determined appropriate by the end user.

4.1: Active Faults (Warning Light ON)

Brake faults may be caused by many different conditions. When investigating an e-Stroke displayed fault condition, such as a Non-Functioning or Dragging brake, it is necessary to first confirm whether the brake condition is true. If the vehicle braking system and foundation brakes have been inspected and found to be working properly, the e-Stroke Troubleshooting Guide (Section 4.5) should be followed to continue the fault analysis.

If an active fault condition has alerted the Driver or Technician to a brake issue, the following steps should be taken to identify the cause of the issue:

1. If the fault condition is active (Warning Light ON) then the current status of the e-Stroke system should be checked using one of the diagnostic methods in Section 4.3.1, 4.3.2, or 4.3.3 below.

2. The e-Stroke system will output wheel specific information for the fault which is occurring.

3. The foundation brake should then be inspected to confirm the fault condition reported by the e-Stroke system and repaired accordingly.

4. If no issue is found with the foundation brake, then follow the instructions in Section 4.4, 4.5 to repair the e-Stroke system.

5. Always clear the CCM history upon completion of brake or e-Stroke system service. *The CCM fault history can be cleared by pressing the CCM Red Push Button for 5 seconds or using one of the available e-Stroke diagnostic tools.*

4.2: In-Active Faults (Warning Light OFF)

If the vehicle has been reported to have a brake problem, but the Warning Light is OFF during inspection then the CCM fault history should be checked with the following steps:

1. If the fault condition is In-Active (Warning Light OFF) then the fault history of the e-Stroke CCM should be checked using one of the diagnostic methods in Section 4.3.1, 4.3.2, or 4.3.3 below.

2. The CCM records fault history with a simple counter; date and time of the occurrences are not available. Fault counters will increment once per occurrence as faults occur. The CCM history can also be cleared at any time using one of the diagnostic tools or by pressing the CCM Red Push Button for 5 seconds.

   It is necessary to take the time period in which the fault history was recorded into account when reviewing the data. If it is unknown when the CCM history was cleared last, then it is possible that many of the faults recorded may not be recent.

3. Review the fault history looking for wheel ends with fault counts recorded.

4. The foundation brake should then be inspected to confirm the fault condition(s) reported by the e-Stroke system and repaired accordingly.

5. If no issue is found, then the CCM fault history should be cleared and the brake system can then be cycled or the vehicle driven to try to duplicate the fault condition. Use one of the available diagnostic tools (Section 4.3.1, 4.3.2, or 4.3.3) to monitor the e-Stroke system for brake faults during this test.

6. If no issue is found with the foundation brake, then follow the instructions in Section 4.4, 4.5 to repair the e-Stroke system.

7. Always clear the CCM history upon completion of brake or e-Stroke system service. *The CCM fault history can be cleared by pressing the CCM Red Push Button for 5 seconds or using one of the available e-Stroke diagnostic tools.*

4.3: e-Stroke CCM Memory Retrieval

4.3.1: e-Stroke GEN 3 Blink Code Retrieval

The e-Stroke GEN 3 System is capable of displaying both Active and In-Active (stored) fault information using a series of simple blink codes and the system warning lights.

Only blink codes for active faults will be displayed when an Active fault is occurring (Warning Light ON). The Active fault will need to be repaired and the warning light will need to be OFF before In-Active stored faults can be retrieved with this blink code method. If the blink code sequence is initiated when the warning light is OFF then stored fault codes will be displayed.

Blink Code Retrieval Operation:

- Press the Red Push Button on the front of the CCM for 1 second to initiate the warning light fault code blink sequence. The warning light(s) will then respond with a series of blink codes.
- A blink code of 1-1 (1 blink 1.5 second pause followed by 1 blink) indicates that no stored fault codes are present within the CCM.
- Reference the e-Stroke Warning Light Blink Code Definition Table (Section 4.3.1.1 Below) to determine the system condition.
- Press the Red Push Button on the front of the CCM for 5 seconds to clear the fault history.

Reference the e-Stroke GEN 3 Blink Code Operation Guide (MGM Bulletin EB 08-011) for additional instruction on blink code retrieval.

4.3.1.1: e-Stroke Warning Light Blink Code Definition Table

e-S3™ Warning Light Blink Code Operation

Applies to CCMs with P/N 8291xxx Prefix.	***Reference EB 08-011***
CCM Push Button Operation:	
Press CCM Button for 1 second to begin e-Stroke fault blink code sequence	
Press CCM Button for 5 seconds to clear e-Stroke stored fault blink codes	
Blink Code Timing:	
0.5 seconds	Lamp On
0.1 seconds	Lamp Off
1.5 seconds	Pause In-Between Digits
4 seconds	Pause In-Between Faults

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e-S3™ Warning Light Blink Code Definitions

First Digit	Type of Fault	Second Digit	Location of Fault
1	No Fault	1	No Fault (Only with First Digit = 1)
2	Non-Functioning Brake	1	Axle 1 - Left
3	Over-Stroked Brake	2	Axle 1 - Right
4	Dragging Brake	3	Axle 2 - Left
5	e-Stroke Sensor Fault	4	Axle 2 - Right
6	Lining Wear Warning	5	Axle 3 - Left
		6	Axle 3 - Right
		7	Axle 4 - Left
		8	Axle 4 - Right
7	e-Stroke System Fault	1	Pressure Transducer
		2	SAE J1708 / J1939 Communication
10	e-Stroke Fault Codes Cleared		

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4.3.2: e-Stroke GEN 3 RS-232 Diagnostic Program

The e-Stroke RS-232 Diagnostic Kit (P/N 9090109) may be used to acquire the following information from the e-Stroke GEN 3 CCM:

- Current Wheel Specific Brake & Lining Status (Active Faults)
- Stored Fault History (In-Active Faults)
- E-Stroke System & Diagnostic Status
- CCM Information: Software Version, Configuration, Serial Number.

The P/N 9090109 Kit includes the RS-232 Diagnostic Program Software CD and Harnesses which may be used with a standard lap top computer (Customer Supplied).

Reference the e-Stroke GEN 3 RS-232 Program Users Guide (MGM Bulletin EB 08-012) for additional instruction.

4.3.3: e-DT Diagnostic Tool

The e-DT is a hand held diagnostic tool which is designed to work with e-Stroke Systems. The e-DT Kit (P/N 9090110) can be easily used with the supplied Diagnostic Harness which connect to either the 6 or 9-pin diagnostic port (OBD) connector. When connected to the vehicles diagnostic port the e-DT will automatically turn ON and establish communication with the e-Stroke System.

The e-DT displays real time e-Stroke system status, Active brake fault conditions, and lining wear status (if applicable). In addition the brake fault history (In-Active faults) can be acquired from e-Stroke GEN 3 Systems using the e-DT. Vehicle speed and brake application pressure are also available for diagnostic purposes using the e-DT.

Reference the e-DT Diagnostic Tool Users Guide (MGM Bulletin EB 08-013) for additional instruction.

4.4: System Wiring Troubleshooting

As with all electrical systems on vehicles, damaged or incorrectly installed wiring can cause issues with the functionality of the system. If the system is displaying a faulty actuator condition and it has been verified that the actuator and vehicle braking system is working and adjusted properly, then it is advisable to check the system wiring and verify that:

- All connectors are completely plugged together.
- No wires are being pulled, or pinched.
- Check connections for corrosion or bent terminals.
- No wires are cut or broken, and the insulation is intact.
- An adequate amount of slack in the wires is provided around steering and suspension components to prevent tension in the wire.
- The power harness is connected securely to the vehicle power source.
- The sensor and pressure transducer supply power can be verified at the end of each wire harness by unplugging the sensor at the wire harness and measuring voltage between connector terminals A (Red wire, +5 VDC) and B (Black Wire, Ground).

Note: If the e-Stroke sensors or harnesses are suspected to be faulty, that wheel should be considered un-monitored by e-Stroke.

4.5: System Trouble Shooting Guide

- *Reference EB 08-016 e-Stroke GEN 3 Truck - Bus Trouble Shooting Guide for additional Troubleshooting information.*

- *Reference MGM Drawing 9230100 for a generic e-Stroke GEN 3 system schematic. Consult Vehicle OEM for vehicle specific wiring schematics.*

- *All of the documents referenced in this guide are included in the P/N 8090091 e-Stroke Technical Manual CD.*

MGM Brakes *e•STROKE*® Technical Support:

1-877-4-e-STROKE

www.mgmbrakes.com

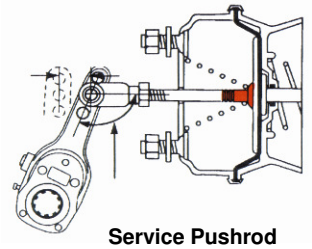
SECTION 5: UNDERSTANDING BRAKE DIAGNOSTICS

In order to simplify the fundamental logic used to determine brake faults, the actuator sensors should be considered as method to determine whether the actuator pushrod is fully retracted, within the normal operating stroke range, or beyond the SAE J1953 adjustment indication threshold. At the same time, the pressure transducer provides an indication as to what region of stroke the actuator should be within. For a single actuator the resulting logic can be expressed in the table below.

Fault Description	Service Brake Air Pressure	Pushrod Stroke Position
Dragging Brake	No Pressure	Pushrod not fully returned
Non-Functioning Brake	Service Pressure Applied	Pushrod remains fully returned
Over-Stroke	Service Pressure Applied	Pushrod beyond stroke limit

5.1: Absolute vs. Relative Stroke

When following up on an e-Stroke fault indication with a brake inspection, it is important to understand that the e-Stroke system monitors absolute stroke of the actuator pushrod. Absolute stroke is measured from the absolute minimum stroke: i.e. actuator pushrod has fully retracted to zero stroke. It is possible to incorrectly set-up actuators and slack adjusters so that the actuator pushrod is not capable of retracting to zero stroke. In this case, the actuator pushrod will be pre-stroked an indeterminate amount.



Service Pushrod Fully Retracted

When measuring stroke in this condition, the inspector will observe only the relative difference between the non pressurized and applied positions. This is known as relative stroke. It is important to consider that the travel limit on a brake actuator is based on absolute stroke, not relative stroke.

For example, the actuator pushrod may be pre-stroked 1/2 in. from absolute zero stroke when the actuator is not pressurized. With the brakes applied, an inspector may observe a 1-3/4 in. relative travel and incorrectly conclude that the brake is within adjustment limits for a 2-1/2 in. stroke actuator. However, the e-Stroke system will observe 2-1/4 in. of absolute stroke and correctly indicate a brake out of adjustment.

To avoid this scenario, it is critical to rule out the influence of pre-stroked actuators. By removing the clevis pin, an inspector can confidently determine if an actuator has been properly set-up to return to absolute zero stroke if the rod moves further into the chamber when the pin is removed.

Note: CAUTION MUST BE USED WHEN REMOVING THE CLEVIS PIN. ACTUATOR PUSHROD MOVEMENT MAY OCCUR. ENSURE THAT THE POWER SPRING IS PROPERLY CAGED IF SO EQUIPPED.

5.2: Dragging Indication

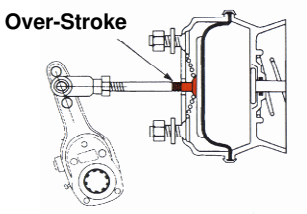
The CCM indicates a dragging brake if an actuator is stroked beyond the first 3/8 in.[1] of absolute stroke AND the Pressure Transducer indicates that the operator has released the brakes. The dragging brake indication is intended to immediately alert the operator of a potentially hazardous braking issue (a dragging brake may cause a wheel fire). e-Stroke is able to determine if the push rod has properly returned but does not discriminate due to cause.

Real world causes are numerous and require a qualified technician to inspect the brake system to determine the root cause. This includes but is not limited to:

- Broken parking brake spring preventing actuator from fully retracting
- Hanging brake shoes
- Mechanical set-up issues
- Malfunctioning slack adjuster
- Worn foundation brake components
- Malfunctioning pneumatic valves that allow pressure to build in actuator
- Spring brake engagement due to low parking brake system pressure
- Non-functioning pressure transducer

Note: Door interlock systems (which apply the service brakes) and parking brake applications are common examples where an actuator will be stroked into the operating region without pressure in the service circuit. The e-Stroke system monitors vehicle speed via J1939 / J1708 and will not indicate a fault condition while the vehicle is at rest with the parking brakes or the interlocks applied. When the vehicle exceeds 5mph a dragging brake fault would be indicated if the parking or service brake fails to release. Consult the vehicle OEM for specific interlock functionality.

5.3: Over-stroke Indication



An over-stroke fault indicates the actuator has stroked beyond the SAE J1953 adjustment indicator threshold. By design this is only applicable during brake applications. If an actuator would stroke beyond the threshold without pressure in the service circuit, the situation is still regarded as a “dragging” brake.

While an over-stroke fault from e-Stroke indicates that the brake may likely be out of adjustment and further investigation is warranted, it should be noted that there are certain conditions when an over-stroke fault can occur on a brake that is not out of adjustment per CVSA criteria. Current published CVSA and FMCSA criteria must be reviewed prior to determining whether an out of adjustment condition is present.

Brake adjustment limits established by state and federal regulations (DOT and CVSA) are based on measuring actuator stroke with the vehicle stationary, the system air pressure (reservoir) is 90 to 100 psi and the brakes relatively cool. If brake stroke is measured outside of these “standard” conditions it may change. Wheel rotation, increased brake pressure and increased brake temperature will increase stroke. On a moving vehicle with

[1] 3/8 in. Dragging brake threshold is normal.

hot brakes, a high pressure brake application can produce strokes that exceed the published adjustment limits even though the brake is properly adjusted.

If e-Stroke indicates an over-stroke condition on any brake, the brake adjustment should be verified using the CVSA test conditions (stationary vehicle, air reservoirs at 90 to 100 psi and cool brake). If there are no over-stroke indications during the proper stationary adjustment test, e-Stroke confirms the actuators comply with the CVSA adjustment guidelines. However, over-stroke indications observed using the proper stationary adjustment test, should be verified with physical measurements to determine if the stroke explicitly exceeds the CVSA limits.

Note: When pushrod travel (actuator stroke) on a brake with an automatic adjuster is at or exceeds the readjustment limits, the need for repairs to the automatic adjuster or other foundation brake components are indicated. Adjustment of automatic brake adjusters, except as required at installation, is a dangerous practice as it gives the driver a false sense of security since the adjusters are likely to go out of adjustment again in the future, unless additional repairs are performed.

5.4: Non-Functioning Indication

A non-functioning brake fault occurs when an actuator fails to stroke beyond 3/8 in. and the operator applied sufficient service pressure to the unit. A brake inspection should be performed by a qualified technician to determine the root cause.

Typical issues include but are not limited to:

- Pinched, crimped, or broken air lines
- Defective air valves
- Leaking actuator diaphragm
- Lack of system pressure
- Removal of e-Stroke sensor from actuator

5.5: Actuator Sensor Fault

An actuator sensor fault indicates the sensor is no longer providing appropriate data to the CCM. A technician should inspect the wiring harness specific to this actuator sensor.

Typical Issues include but are not limited to:

- Damaged or defective sensor
- Chaffed or cut wiring harness with exposed wiring

5.6: Inspections & Maintenance

Section 5 of this document is intended to provide a general overview of potential brake issues, not a specific analysis. It is the customer's responsibility to follow and perform all preventative and / or scheduled brake maintenance as specified by the vehicle OEM. e-Stroke is intended to provide a monitoring function which will alert the operator or technician of a potential braking issue. Visual inspections of the braking system are required to verify e-Stroke fault indications or confirm that the braking system is properly functioning.

SECTION 6: AVM REPORT INTERPRETATION

Automatic Vehicle Monitoring (AVM) Systems such as Clever Devices are commercially available for transit applications. This type of system is configurable allowing the user to monitor vehicle systems by recording SAE J1708 and J1939 fault code activity. Fault reports can be automatically generated summarizing selected system activity on specific vehicles in service.

The e-Stroke Brake Monitoring System transmits SAE J1708 and J1939 fault codes as fault conditions occur during braking activity. These fault codes can be recorded and summarized in AVM reports as described in this section.

Note: This section is intended to provide an overview of e-Stroke related AVM reports, not an analysis of brake related issues or specific AVM System operation. Visual verification of reported faults should always be conducted to insure that potential issues are not overlooked resulting in unsafe vehicle conditions.

Further, if the e-Stroke sensors or harnesses are suspected to be faulty, that wheel should be considered un-monitored by e-Stroke.

Consult the Vehicle OEM or AVM System Provider for specific AVM System Operation.

6.1: AVM Report Overview

AVM reports are typically user configurable, allowing data to be displayed as desired in multiple formats. Figures 1, 2 illustrate two different AVM report formats showing the same fault occurrences.

- **Figure 1 - Summary Report:** Each fault occurrence is counted over the course of the reporting period, typically 24hrs. Each fault is listed with the occurrence count and date & time stamp of the last fault occurrence at the end of the reporting period.

- **Figure 2 - Detailed Report:** Each occurrence will be listed individually with a date & time stamp as each fault occurred. Detailed reports may also include a duration time for each fault.

Figure 1: Example of Summary Report

Bus #123

Last Occurred	Count	Component	Description	Code
08/03/09 07:20 PM	2	Brakes	Brake Stroke - Axle 2 Left - Dragging Brake	11
08/03/09 07:20 PM	2	Brakes	Brake Stroke - Axle 2 Right - Dragging Brake	15

Figure 2: Example of Detailed Report

Bus #123

Occurred On	Component	Description	Code	Duration
08/03/09 19:20:03	Brakes	Brake Stroke - Axle 2 Left - Dragging Brake	11	01s
08/03/09 19:20:03	Brakes	Brake Stroke - Axle 2 Right - Dragging Brake	15	01s
08/03/09 17:55:23	Brakes	Brake Stroke - Axle 2 Left - Dragging Brake	11	02s
08/03/09 17:55:23	Brakes	Brake Stroke - Axle 2 Right - Dragging Brake	15	02s

6.2: e-Stroke Fault Occurrences

6.2.1: Low Occurrence Faults

Figure 3 shows a Dragging Brake occurrence which may have occurred during normal operation of the vehicle.

- The faults occurred only once in this reporting period (24hr).
- The faults occurred as a pair on Axle 2 Left and Right Wheels.
- The faults occurred at the same time during operation.

Figure 3: Typical One Time Fault Occurrence

Bus #123

Last Occurred	Count	Component	Description	Code
08/03/09 07:31 PM	1	Brakes	Tractor Brake Stroke - Axle 2 Left - Dragging brake: the brake rod has not returned after a braking operation.	M253S3F7
08/03/09 07:31 PM	1	Brakes	Tractor Brake Stroke - Axle 2 Right - Dragging brake: the brake rod has not returned after a braking operation.	M253S4F7

Note: While all brake faults detected by the e-Stroke system require timely evaluation by maintenance, it should be noted that a Dragging Brake condition can lead to a hazardous situation such as a wheel fire with only one occurrence. Therefore it is up to the user to properly monitor the warning light function per Section 7.

6.2.2: Increasing Severity Faults

Figure 4, 5, 6 shows an Over-Stroke Fault on Axle 1 Left increasing in severity over the course of 5 days.

- Day 1 accumulated 5 faults which may prompt a Technician to either inspect or watch this vehicle for the next few days.
- Day 2 accumulated 30 faults which may indicate an over-stroke issue is present. It is advisable to inspect the vehicle braking condition.
- Day 5 accumulated 581 faults which indicates that this bus has a sever over-stroke issue and should be inspected and repaired.

Figure 4: Example of a Brake Issue Increasing in Severity – Day 1

Bus #123

Last Occurred	Count	Component	Description	Code
07/31/09 05:16 PM	5	Brakes	Tractor Brake Stroke - Axle 1 Left - Brake overstroke: the brake rod has overstroked during a braking operation.	M253S1F4

Figure 5: Example of a Brake Issue Increasing in Severity – Day 2

Bus #123

Last Occurred	Count	Component	Description	Code
08/01/09 04:28 PM	30	Brakes	Tractor Brake Stroke - Axle 1 Left - Brake overstroke: the brake rod has overstroked during a braking operation.	M253S1F4
08/01/09 11:09 AM	2	Brakes	Tractor Brake Stroke - Axle 1 Left - Non-functioning brake actuator: the brake rod has not actuated during a braking operation.	M253S1F12

Figure 6: Example of a Brake Issue Increasing in Severity – Day 5

Bus #123

Last Occurred	Count	Component	Description	Code
08/04/09 01:11 AM	581	Brakes	Tractor Brake Stroke - Axle 1 Left - Brake overstroke: the brake rod has overstroked during a braking operation.	M253S1F4
08/03/09 02:57 PM	2	Brakes	Tractor Brake Stroke - Axle 1 Left - Non-functioning brake actuator: the brake rod has not actuated during a braking operation.	M253S1F12

6.2.3: Sensor & Harness Fault Conditions

e-Stroke is designed to self diagnose sensor issues. Unfortunately unavoidable harness issues and corrosion occur which may lead to inconsequential faults reported. Figures 7, 8, 9 illustrate patterns in fault reporting which may be interpreted as a sensor or harness issue rather than an actual brake fault.

Note: Reported fault patterns as shown below should always be inspected to verify that a faulty braking condition is not present.

- Figure 7: Axle 2 Right has a significant amount of sensor faults reported. This is typically indicative of a true sensor issue.

- Figure 8: Axle 2 Left has a random mixture of faults reported including sensor fault. In many cases when a sensor or harness begins to fail random faults may be reported.

- Figure 9: Axle 1 Left has a random mixture of faults reported, but not a sensor fault. It is unlikely that the same wheel will have a mechanical issue which results in a Dragging, Non-Functioning, and Over-Stroke condition during the same day.

Note: After the braking system is inspected and verified to be working properly the sensor and harnesses should be inspected and repaired as required.

Figure 7: Typical Sensor or Harness Fault Condition

Bus #123

Last Occurred	Count	Component	Description	Code
08/04/09 12:33 AM	827	Brakes	Tractor Brake Stroke - Axle 2 Right - Actuator sensor fault: the sensor is not connected, damaged, or otherwise responding incorrectly.	M253S4F2
08/03/09 11:59 PM	8	Brakes	Tractor Brake Stroke - Axle 2 Right - Brake overstroke: the brake rod has overstroked during a braking operation.	M253S4F4
08/03/09 08:27 PM	1	Brakes	Tractor Brake Stroke - Axle 2 Right - Dragging brake: the brake rod has not returned after a braking operation.	M253S4F7

Figure 8: Typical Sensor or Harness Fault Condition

Bus #123

Last Occurred	Count	Component	Description	Code
08/03/09 10:29 PM	7	Brakes	Tractor Brake Stroke - Axle 2 Left - Actuator sensor fault: the sensor is not connected, damaged, or otherwise responding incorrectly.	M253S3F2
08/03/09 09:32 AM	2	Brakes	Tractor Brake Stroke - Axle 2 Left - Brake overstroke: the brake rod has overstroked during a braking operation.	M253S3F4
08/03/09 09:48 AM	20	Brakes	Tractor Brake Stroke - Axle 2 Left - Dragging brake: the brake rod has not returned after a braking operation.	M253S3F7
08/03/09 09:28 AM	1	Brakes	Tractor Brake Stroke - Axle 2 Left - Non-functioning brake actuator: the brake rod has not actuated during a braking operation.	M253S3F12

Figure 9: Typical Sensor or Harness Fault Condition

Bus #123

Last Occurred	Count	Component	Description	Code
08/02/09 03:15 PM	1	Brakes	Tractor Brake Stroke - Axle 1 Left - Brake overstroke: the brake rod has overstroked during a braking operation.	M253S1F4
08/02/09 06:30 PM	3	Brakes	Tractor Brake Stroke - Axle 1 Left - Dragging brake: the brake rod has not returned after a braking operation.	M253S1F7
08/02/09 07:03 PM	26	Brakes	Tractor Brake Stroke - Axle 1 Left - Non-functioning brake actuator: the brake rod has not actuated during a braking operation.	M253S1F12

6.3: Inoperable System Conditions

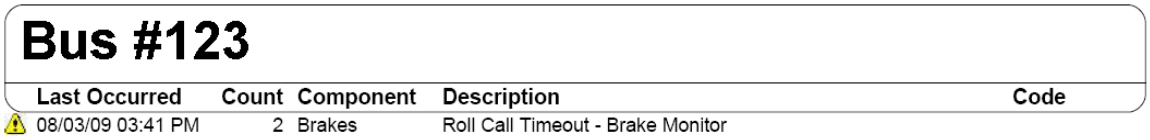
If the AVM system is unable to communicate with the e-Stroke system a “Roll Call Timeout” Fault may be produced depending on the AVM configuration. A “Roll Call Timeout” Fault is typically associated with the following issues:

- ***The e-Stroke System is not receiving power or the power harness is disconnected.***
  Unfortunately, in some cases power is intentionally disconnected from the e-Stroke CCM in efforts to deactivate the warning light with out fixing the condition which is activating the alarm output.

Note: Deactivating the e-Stroke system will result in the vehicle brakes not being monitored. Unsafe brake conditions will not be reported with the e-Stroke system inoperable.

- ***SAE J1708 or SAE J1939 is not functioning properly.***
  The AVM system may not be communicating properly with the e-Stroke system. The CCM diagnostic connections and vehicle diagnostic circuit should be checked.

Figure 10: e-Stroke J1708 or J1939 Communication Issue



SECTION 7: e-STROKE WARNING LIGHT INTURPRETATION

The e-Stroke system alarm output will activate during active fault conditions. The following section describes Warning Light operation and some simple checks which may be conducted to determine the nature of the fault condition with out diagnostic tools.

Section 7 may be referenced by Maintenance, Dispatch, or Roadside Assistance personnel. It is the responsibility of the e-Stroke system end user to determine the appropriate action which must be taken when a driver reports that the Brake Monitor Warning Light is ON.

The Brake Monitor Warning Light operation must be verified by the start up bulb check every time the vehicle ignition is switched ON. This will insure that the Warning Light is operational and will illuminate with a brake fault condition.

Note: It is important to verify the vehicle specific Warning Light designation, location, and operation with the vehicle OEM or system installer prior to reference of this section.

7.1: Warning Light Condition 1

The Brake Monitor Warning Light is ON while driving at speeds OVER 5 MPH, and driver is NOT applying the service brakes.

- If YES, Apply the service brakes. Does the Warning Light turn OFF as soon as the brakes are applied or the vehicle decelerates under 5 MPH?
- If YES, then the vehicle has a potential Dragging Brake condition. DO NOT continue to drive the vehicle as further operation could result in a hazardous situation or wheel fire. Call for roadside assistance.

7.2: Warning Light Condition 2

The Brake Monitor Warning Light is ON when the driver APPLIES the service brakes ONLY (The Warning Light is OFF when the service brakes are NOT applied.).

- The vehicle has a potential Non-Functioning or Out-of-Adjustment Brake condition.
- Contact Road Side Assistance or Dispatch to determine if vehicle operation should be continued.

7.3: Warning Light Condition 3

The Brake Monitor Warning Light is ON continuously with the service brakes APPLIED and RELEASED.

- The e-Stroke system may have a sensor fault or functionality issue.
- A Sensor fault or functionality issue will result in the vehicle brake condition NOT being monitored. Contact Road Side Assistance or Dispatch to determine if vehicle operation should be continued.

Note: Section 7 includes only recommended field warning light interpretation guidelines and MGM is not responsible for any liability associated with these recommendations. Each user must determine if a vehicle should be taken from service on a case by case basis.

MGM Brakes *e•STROKE*® Technical Support:

1-877-4-e-STROKE
www.mgmbrakes.com