SURFACE VEHICLE RECOMMENDED PRACTICE

J3029™ JAN2023

Issued 2015-10
Revised 2023-01

Superseding J3029 OCT2015

Forward Collision Warning and Automatic Emergency Braking Test Procedure and Minimum Performance Requirements - Truck and Bus

RATIONALE

With the commercial availability of forward collision warning (FCW) and automatic emergency braking (AEB) systems for heavy vehicles greater than 10000 pounds (4535 kg) GVWR equipped with pneumatic brake systems, a vehicle test procedure to evaluate and document the effectiveness of these systems is justified. This SAE Recommended Practice (RP) outlines a basic test procedure to be performed under specified operating and environmental conditions. Procedures for managing regenerative brake system interacton with FCW and AEB functions were not included in this practice due to lack of information and commonality in control strategy. When evaluating vehicles with regenerative braking systems, consult with the vehicle manufacturer to ensure operating modes are maintained during testing as intended.

1. SCOPE

This SAE Recommended Practice (RP) establishes uniform powered vehicle-level test procedure for forward collision warning (FCW) and automatic emergency braking (AEB) used in trucks and buses greater than 10000 pounds (4535 kg) GVWR equipped with pneumatic brake systems for detecting, warning, and avoiding potential collisions. This RP does not apply to electric powered vehicles, trailers, dollies, etc., and does not intend to exclude any particular system or sensor technology. These FCW/AEB systems utilize various methodologies to identify, track, and communicate data/information to the operator and vehicle systems to warn, intervene, and/or mitigate in the momentary longitudinal control of the vehicle.

This specification will test the functionality of the FCW/AEB (e.g., ability to detect objects in front of the vehicle), its ability to indicate FCW/AEB engagement and disengagement, the ability of the FCW/AEB to notify the human machine interface (HMI) or vehicle control system that an object is detected under specified operating and environmental conditions, and the ability of the AEB to decelerate the vehicle to avoid impact or reduce the severity of the impact should the human operator not respond. This specification does not define tests for all possible operating and environmental conditions. The HMI is not addressed in this document.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J3029_202301/

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1455 Recommended Environmental Practices for Electronic Equipment Design in Heavy-Duty Vehicle Applications

SAE J1626 Braking, Stability, and Control Performance Test Procedure for Air and Hydraulic Brake Equipped Trucks, Truck-Tractors, and Buses

SAE J3087 Automatic Energency Braking (AEB) System Performance Testing

2.1.2 Federal Motor Vehicle Safety Standard (FMVSS) Publications

FMVSS 571.101 Standard No. 101: Controls and Displays

FMVSS 571.121 Standard No. 121: Air Brake Systems

TP-121V-05 Laboratory Test Procedure for FMVSS No. 121 Air Brake Systems

2.1.3 National Highway Traffic Safety Administration (NHTSA) Publications

Forward Collision Warning System and Advanced Emergency Braking (AEB) System New Car Assessment Program (NCAP) Confirmation Test

DOT HS 812675 Test Track Procedures for Heavy-Vehicle Forward Collision Warning and Automatic Emergency Braking Systes, 14051_AEB_HEAVY_VEHICLS_030419

2.1.4 European Commission (EC) Publications

EC 661/2009 Of the European Parliament and of the Council with Respect to Type-Approval Requirements for Certain Categories of Motor Vehicles with Regard to Advanced Emergency Braking Systems

EU 347/2012 EU Regulation for Advanced Emergency Braking Systems

2.1.5 United Nations Publications

UN ECE R131 Uniform Provisions Concering the Approval of Motor Vehicles with Regard to the Advanced Emergency Braking Systems (AEBS)

2.1.6 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 19206-3: 2021 Road Vehicles - Test Devices for Target Vehicles, Vulnerable Road Users and Other Objects, for Assessment of Active Safety Functions - Part 3: Requirements for Passenger Vehicle 3D Targets

ISO 19206-1:2018 Road Vehicles - Test Devices for Target Vehicles, Vulnerable Road Users and Other Objects, for Assessment of Active Safety Functions - Part 1: Requirements for Passenger Vehicle Rearend Targets

ISO 15623:2013 Intelligent Transport Systems - Forward Vehicle Collision Warning Systems - Performance Requirements and Test Procedures

3. DEFINITIONS

3.1 AUTOMATIC EMERGENCY BRAKING (AEB) SYSTEM

The system responsible for applying and controlling the vehicle service brakes as a means to avoid or mitigate a collision in the direction of vehicle longitudinal travel.

3.2 CONFIGURABLE END USER SETTINGS

Adjustable end user parameters that affect the timing of warnings and AEB or any other features that influence the general performance of the AEB system.

3.3 FORWARD COLLISION WARNING AND AUTOMATIC EMERGENCY BRAKING (FCW/AEB) SYSTEM

A combined FCW/AEB system that can automatically detect a potential forward collision, provide warnings in an adequate time to enable the driver to take appropriate corrective actions, and having the capability of activating the vehicle's service brakes to decelerate the unit with the purpose of avoiding or mitigating an impact.

3.4 FCW/AEB STATUS INDICATOR

A device mounted in front of and in clear view of the driver which will illuminate whenever there is a malfunction or manual action that affects the generation or transmission of response or control signals in the vehicle's FCW/AEB system.

3.5 FOLLOWING DISTANCE GAP

Distance or time between the rear-most surface of the leading target vehicle and the forward-most surface of the following subject vehicle.

3.6 INITIAL BRAKE TEMPERATURE

The average temperature of the service brakes on the hottest axle of the vehicle 0.3 km (0.2 mile) before any brake application of the FCW/AEB system.

3.7 LANE

The area of roadway that a vehicle would be expected to travel along in the absence of any obstruction without the driver's desire to change the path of travel.

3.8 OPERATION/INTERVENTION PHASE

3.8.1 COLLISION WARNING PHASE

The initial reaction of the FCW/AEB system in response to a potential forward collision where the driver is warned of the situation via audible, visual, and/or haptic means.

3.8.2 AUTOMATIC EMERGENCY BRAKING (AEB) PHASE

Initiates when the AEB system requests the activation of the service brakes. This excludes deceleration for haptic warning.

3.8.3 AEB EXIT RAMP-OUT PERIOD

After an active AEB event with braking that achieved the target speed reduction, an external brake request may start an event exit phase that ramps out and reduces the brake system pressure to minimize vehicle jerk at/or near 0 mph.

3.9 VEHICLE LOADING CONDITIONS

3.9.1 BOBTAIL/EMPTY LOAD

No load condition is where no payload or ballast has been added to the vehicle. This condition does require the fuel tanks to be filled to any level between 75% and 100% of capacity for each test, and allows for including up to 500 pounds (227 kg) for driver and instrumentation, plus an additional 1000 pounds (454 kg) for a rollbar and/or a brush guard.

3.9.2 GROSS VEHICLE WEIGHT RATING (GVWR)

The value specified by the manufacturers as the maximum loaded weight of the vehicle.

3.9.3 LOADED

For truck tractors, loaded to its GVWR using an unbraked control trailer in accordance with TP-121V-05. For all other vehicles, loaded to the value specified by the manufacturers as the maximum loaded weight of the vehicle.

3.10 TIME TO COLLISION (TTC)

The value of time, obtained by dividing the distance between the subject vehicle and the target vehicle by the relative speed between the subject vehicle and the target vehicle, at an instant in time.

3.11 UNBRAKED CONTROL TRAILER

An unbraked flatbed semi-trailer which has a single axle with a gross axle weight rating (GAWR) of 18000 pounds (8163 kg) and a length of 258 inches ± 6 inches (655 cm ± 15 cm) when measured from the transverse centerline between the axle to the centerline of the kingpin.

3.12 VEHICLE IDENTIFICATION

3.12.1 SUBJECT VEHICLE

Vehicle being tested.

3.12.2 TARGET VEHICLE

A light vehicle (passenger car, pick-up truck, or other vehicle configuration) with GVWR less than 10000 pounds (4535 kg), or a soft target vehicle that is representative of such a production vehicle. The target vehicle configuration's optical and radar reflectivity shall be documented prior to testing.

3.12.3 SOFT TARGET VEHICLE

A representative vehicle capable of withstanding a collision with a subject vehicle without damage to itself or the subject vehicle. The means to hold the soft target vehicle stationary and to move the soft target vehicle at the test condition speeds specified are to be agreed to and documented prior to testing.

3.13 VEHICLE TARGET IDENTIFICATION

3.13.1 STATIONARY TARGET

A target vehicle at standstill facing the same direction and positioned ahead in the center of the same test lane of travel as the subject vehicle.

3.13.2 DECELERATING/STOPPED TARGET

A target vehicle that was traveling at a constant speed in the same direction and in the center of the same lane of travel as the subject vehicle and then decelerates and comes to a complete stop in the same test lane.

3.13.3 STEADY MOVING TARGET

A target vehicle that achieves a constant speed, traveling in the same direction and in the center of the same lane of travel as the subject vehicle.

4. MEASUREMENT INSTRUMENTATION AND EQUIPMENT

4.1 Anemometer or equivalent device to measure wind velocity of 25 mph (40.2 km/h) range with ±1 mph (±1.6 km/h) accuracy at 15 mph (24.1 km/h), maximum non-linearity of ±2 mph (±3.2 km/h) over the range, and visual output resolution of 1 mph (1.6 km/h).

4.2 Ambient temperature device to record ambient test temperatures, 32 to 100 °F (0 to 38 °C) range with ±0.5 °F (±0.3 °C) accuracy at 70 °F (21 °C), maximum non-linearity ±1.0 °F (±0.6 °C) over the range, and visual output resolution of 1 °F (0.6 °C).

4.3 Brake lining thermocouples [optional instrumentation], ±10.0 °F at 300 °F (± 5.6 °C at 148.9 °C), maximum non-linearity of ±20 °F (± 11.2 °C) over the range, and visual output resolution of 5 °F (2.8 °C) installed per SAE J971, and display for brake lining temperature.

4.4 Tire pressure gauge: ±1.0% of indicated value.

4.5 Fifth wheel optical or other equivalent device to measure and display (or record) vehicle speed, to an accuracy of ±0.5 mph (±0.8 km/h), and distance accuracy of 1% of indicated value, and visual output resolution of 0.1 foot (0.03 m).

4.6 A device to indicate first brake control (treadle or brake pedal) movement, ±1.0% of indicated value, and full brake control displacement, or brake control pressure, ±1.0% of indicated value versus time, capable of 0.1 second resolution.

4.7 Decelerometer or equivalent device to measure vehicle deceleration rate, 32.2 ft/s^2 (9.81 m/s^2) range with ±0.5 ft/s^2 (±0.15 m/s^2) accuracy at 32.2 ft/s^2 (9.8 m/s^2), maximum non-linearity of 0.5 ft/s^2 (0.15 m/s^2) over the range, and visual output resolution of 0.5 ft/s^2 (0.15 m/s^2), at a minimum sample rate of 10 Hz.

4.8 Pressure, ±1.0% of the indicated value, for measuring brake control pressure and system pressure (optional).

4.9 TTC, distance to target, timing of warnings, timing for AEB, clutch position, and throttle position to be measured at a minimum sample rate of 10 Hz.

5. VEHICLE INFORMATION

5.1 Vehicle as Manufactured and Delivered

5.1.1 Record relevant regulated vehicle information including vehicle identification number (VIN), make, model, type (e.g., bus, truck, tractor, 6X4, day cab, sleeper cab), powertrain (engine, motor, transmission, etc.), brakes, tires (manufacturer, size, model, tread depth, cold tire pressure), suspension, wheelbase, axle weight, GVW, and test loads.

5.2 FCW and AEB System and Components

5.2.1 Record component specifications, sensor type, model, part number, firmware/software version of all relevant components.

5.3 Vehicle as Tested - Test Set-Up and Instrumentation

5.3.1 Record test equipment and changes to the vehicle for the purpose of testing.

6. TEST CONDITIONS

6.1 All tests to be conducted on a flat (±1% slope) surface with a peak friction coefficient (PFC) of 0.9 (dry Portland cement concrete or equivalent surface) measured per FMVSS No. 121. Record surface coefficient and date protocol.

6.2 Ambient temperature to be between 32 °F and 100 °F (0 °C and 37.8 °C). Record ambient temperature.

6.3 Wind velocity shall not exceed 15 mph (24 km/h). Maneuvers must not be made with a tail wind component in the direction of travel of the subject vehicle in excess of 5 mph (8.04 km/h). Record wind velocity and direction relative to subject vehicle motion.

6.4 Horizontal visibility range to allow target vehicle to be observed throughout test maneuver.

6.5 All tests to be conducted within 12 feet (3.7 m) lanes. Subject and target vehicles to be centered in the lane. Alignment of the centerlines of the subject and target vehicles to be within ±1.5 feet (±0.46 m). The driver must keep the subject vehicle within the lane during test maneuvers.

6.6 Record type of target used.

7. SUBJECT VEHICLE CONDITIONS

7.1 During GVWR tests, truck tractors to be tested with an unbraked control trailer (49 C.F.R. § 571.121, S5.3.1.1(a), and 6.1.10).

7.2 To achieve GVWR of truck and bus, load the vehicle according to manufacturer's specification.

7.3 For truck tractors, install a 50 in^3 (820 cm^3) pneumatic reservoir at the control "glad hand."

7.4 Recommend vehicle linings to be fully burnished per FMVSS 121 prior to testing.

8. TEST PREPARATION PRIOR TO CONDUCTING TEST MANEUVERS

8.1 Ensure all service brakes are properly adjusted and reservoirs completely charged (i.e., air brake system compressor cut-out) prior to maneuvers.

8.2 Ensure cold tire inflation pressure adjusted to manufacturer's specification.

8.3 Prior to starting the test series, perform five warm-up brake snubs from 40 to 20 mph (64.4 to 32.2 km/h) at 10 ftps^2 (3.05 m/s^2) deceleration according to TP-121V-05 at 1-mile intervals. Optionally brake lining temperatures may be recorded for monitoring purposes.

8.4 Prior to the start of each maneuver ensure that brake temperature meets the initial brake temperature as defined in 3.6. Initial brake lining/pad temperatures to be between 150 °F and 212 °F (65.6 °C and 100 °C) prior to start of each maneuver. When necessary, warm the brakes to required temperature by making a series of 40 to 20 mph (64 to 32 km/h) snubs at deceleration rate of 10 ft/s^2 (3.05 m/s^2).

8.5 If the AEB events/test runs are performed without IBT brake lining temperatures (where run-to-run repeatability is not based on brake lining temperature), then the vehicle AEB brake system must achieve an average longitudinal deceleration rate within ±5% of the external brake request (XBR) longitudinal deceleration rate for a minimum duration of 1 second prior to the AEB event exit, test run completion, and/or brake exit ramp-out phase at the end of each event/test run. If there was an AEB brake exit ramp-out period near the end of the event/test run, this should not be included in the average longitudinal deceleration rate time.

8.6 Test to be conducted with all differential locks disengaged and transmission in gear. Clutch pedal can be depressed when necessary to prevent engine stall.

8.7 A vehicle with a liftable axle is tested at GVWR with the liftable axle down and at bobtail/empty with the liftable axle up.

8.8 For any system with end user configurable settings, the specific settings being evaluated must be documented.

8.9 Stability Control System

8.9.1 If applicable, prior to conducting maneuvers, initialize the vehicle's stability control system per the manufacturer's instructions.

8.10 Crash Imminent Sensor

8.10.1 If applicable, prior to conducting maneuvers, initialize crash imminent sensors per the manufacturer's instructions.

8.11 Prepare tires for testing by turning two circles to the left and two circles to the right at a speed that results in approximately 0.1 g of lateral acceleration—e.g., a 150 foot (45.7 m) radius at 20 mph (32 km/h) if vehicle is stationary longer than 15 minutes.

9. STATIONARY TARGET TEST

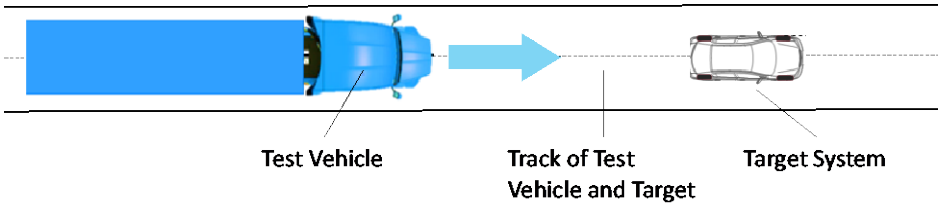

Figure 1 - Overhead view of stationary target test

9.1 Subject vehicle to approach the stationary target vehicle in a straight line for at least 3 seconds prior to the functional part of the test.

9.2 The functional part of the test shall start when the subject vehicle is traveling at the test speed in Appendix A and at a distance of at least 300 feet (91.4 m) ±8 feet (±2.4 m) from the target.

9.3 From the start of the functional part of the test, the driver must maintain initial test speed in the highest appropriate gear and adjust steering to compensate for any vehicle drifting while staying centered in the lane heading directly for the stationary target. Deviation of the subject vehicle from the lane invalidates the test run. Cruise control must not be used to maintain test speed.

9.4 For systems with stationary object braking capability, when the AEB activates, the driver is to release the throttle and remain off clutch until maneuver is over and/or engine is about to stall. The test concludes upon impact with target or when the subject vehicle comes to a complete stop. The driver is to immediately brake when the target is contacted.

9.4.1 Record types of warnings, subject vehicle speed, distance to target at initiation of warnings, and time between initiation of warning and initiation of AEB at a minimum sample rate of 10 Hz.

9.4.2 Record speed reduction that occurs during the warning phase prior to initiation of AEB at a minimum sample rate of 10 Hz.

9.4.3 Record subject vehicle speed, distance to target, and TTC when AEB initiates.

9.4.4 Record total subject vehicle speed reduction at time of impact with stationary target or total subject vehicle speed reduction and distance from target in the event of no impact when AEB event ends.

9.5 For systems without stationary object braking capability, maneuver to be conducted four times, only in bobtail/empty load.

9.6 Test for vehicles with forward collision warning system, without stationary object braking capability.

9.6.1 Vehicles with forward collision warning systems without stationary object braking capability, the maneuver is to be conducted only at bobtail/empty, four times. The driver can brake and/or initiate an evasive maneuver after the forward collision warning is issued by the FCW system to prevent high speed collision with target. Test concludes after last forward collision warning is issued.

9.6.2 Record types of warnings, distance to target, and TTC for each warning issued.

10. DECELERATING/STOPPED TARGET TEST

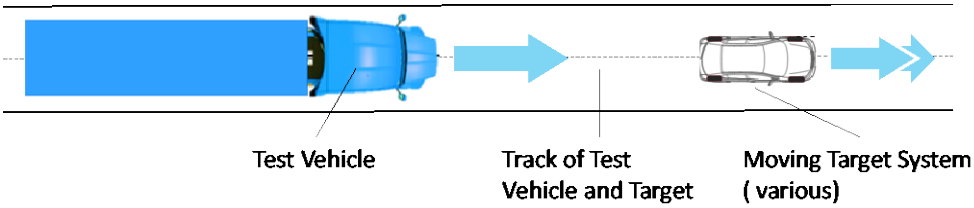

Figure 2 - Overhead view of decelerating/stopped target test

10.1 Subject vehicle and moving target shall travel in a straight line, in the same direction, for at least 2 seconds prior to the functional part of the test.

10.2 The functional part of the test shall start when the subject and target vehicles, traveling at the test speeds in Appendix A, achieve the initial following distance gap of 300 feet (91.4 m) ±8 feet (±2.4 m) contained in Appendix A for a minimum of 2 seconds.

10.3 From the start of the functional part of the test, the driver must maintain initial test speed in the highest appropriate gear and adjust steering to compensate for any vehicle drifting while staying centered in the lane heading directly for the target. Deviation of the subject or target vehicle from the lane invalidates the test run. Cruise control must not be used to maintain test speed.

10.4 Once the appropriate following distance gap of 300 feet (91.4 m) ±8 feet (±2.4 m) and speeds are achieved for 2 seconds, the target decelerates at the rate contained in Appendix A.

10.5 When AEB activates, the driver is to release the throttle and remain off clutch until the maneuver is over and/or the engine is about to stall. The test concludes upon impact with target or when the AEB event ends, and the following distance gap does not decrease for 2 seconds. The driver is to immediately brake when the target is contacted.

10.5.1 Record types of warnings, subject vehicle speed, distance to target at initiation of warnings, and time between initiation of warning and initiation of AEB at a minimum sample rate of 10 Hz.

10.5.2 Record speed reduction that occurs during the warning phase prior to initiation of AEB at a minimum sample rate of 10 Hz.

10.5.3 Record subject vehicle speed, distance to target, and TTC when AEB initiates.

10.5.4 Record total subject vehicle speed reduction at time of impact with target or total subject vehicle speed reduction and distance from target in the event of no impact when AEB event ends.

10.5.5 Maneuver to be conducted four times in the GVWR condition.

11. MOVING TARGET TEST

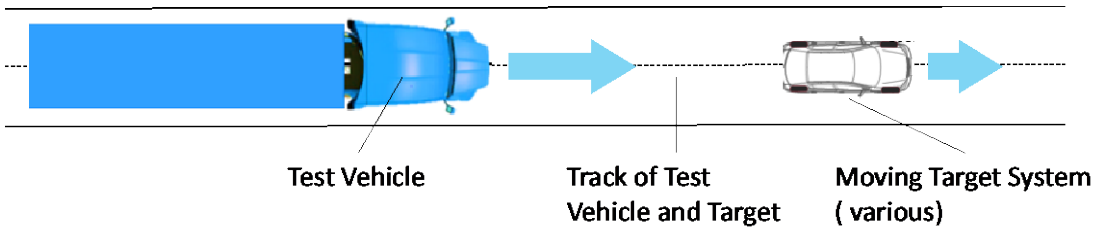

Figure 3 - Overhead view of moving target test

11.1 The subject vehicle and the moving target shall travel in a straight line, in the same direction, for at least 2 seconds prior to the functional part of the test.

11.2 The functional part of the test shall start when the subject and target vehicles, traveling at the test speeds in Appendix A, achieve the following distance gap of 300 feet (91.4 m) ±8 feet (±2.4 m) contained in Appendix A.

11.3 From the start of the functional part of the test, the driver must maintain initial test speed in the highest appropriate gear and adjust steering to compensate for any vehicle drifting while staying centered in the lane heading directly for the target. Deviation of the subject or target vehicle from the lane invalidates the test run. Cruise control must not be used to maintain test speed.

11.4 When AEB activates, the driver is to release the throttle and remain off clutch until maneuver is over and/or engine is about to stall. The test concludes upon impact with target or when the AEB event ends, and the following distance gap does not decrease for 2 seconds. The driver is to immediately brake when the target is contacted. The driver may shift into appropriate gear and release clutch once the test concludes if the target is not contacted and a steady state is achieved.

11.4.1 Record types of warnings, subject vehicle speed, distance to target at initiation of warnings, and time between initiation of warning and initiation of AEB at a minimum sample rate of 10 Hz.

11.4.2 Record speed reduction that occurs during the warning phase prior to initiation of AEB at a minimum sample rate of 10 Hz.

11.4.3 Record subject vehicle speed, distance to target, and TTC when AEB initiates.

11.4.4 Record total subject vehicle speed reduction at time of impact with target or total subject vehicle speed reduction and distance from target in the event of no impact when AEB event ends.

11.5 Maneuver to be conducted four times in the GVWR.

12. FALSE DETECTION TEST

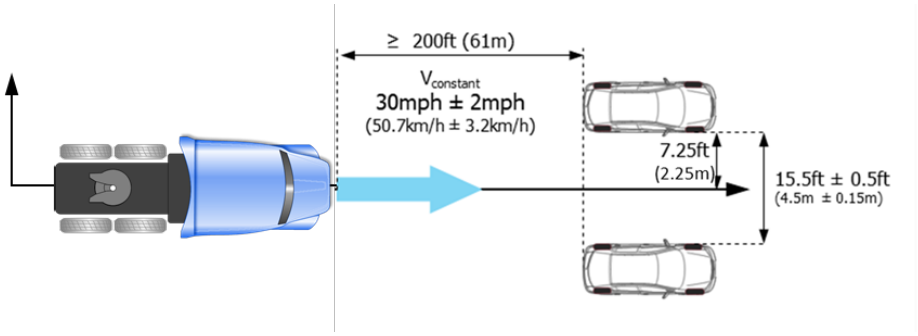

Figure 4 - Overhead view of false detection test

12.1 Three parallel 3.7 m (12 feet) wide straight lanes to be used for the test. Subject vehicle travels in center lane.

12.2 Two stationary targets shall be positioned facing the same direction of travel as subject vehicle, centered in the outer parallel lanes. The rear of each target is aligned with the other. The lateral gap dimension between the nearest tire sidewalls of the two parked passenger cars must be 15.5 feet ± 0.5 feet (4.5 m ± 0.15 m), tire to tire.

12.3 Subject vehicle shall travel in the center lane, for at least 200 feet (61 m) at a constant speed of 30 mph ± 2 mph (50.7 km/h ± 3.2 km/h) in the highest appropriate gear prior to centrally passing between the two stationary targets.

12.4 Record any occurrence of warning and/or AEB activation.

12.5 Maneuver to be conducted four times in the bobtail/empty load condition.

13. FAILURE DETECTION TEST

13.1 With ignition (start) switch off, simulate an electrical failure of a component/system which would lead to disabling the FCW/AEB system. (Example: Disconnect power source to any FCW/AEB system component or electrical connection between FCW/AEB system components.) Record test conditions/disconnected components according to Table C4.

13.1.1 Do not disconnect any driver warning components or the optional manual FCW/AEB system deactivation control switch for this test.

13.2 Turn on ignition (start) switch and drive vehicle at a speed exceeding 10 mph (16.1 km/h) for at least 20 seconds.

13.2.1 Record status of the driver display FCW/AEB status indicator.

13.3 Bring the vehicle to a complete stop. Turn off ignition (start) switch for a minimum of 10 seconds and then turn back on.

13.4 Record status of the driver display FCW/AEB status indicator.

14. DEACTIVATION TEST

14.1 For subject vehicles equipped with the means to manually deactivate the FCW/AEB system, turn the ignition (start) switch to the run (on) position. Wait for the ignition cycle to complete and record the type and presence of the FCW/AEB indicator status/message.

14.1.1 Deactivate the FCW/AEB system. Record the condition of the FCW/AEB status indicator.

14.2 Turn the ignition (start) switch to the off position for a minimum of 10 seconds. Note: Be sure that the power to the system is cycled using the ignition.

14.2.1 Record manufacturer specified deactivation behavior and re-set conditions, e.g., permanent, momentary or start at next ignition cycle

14.3 Turn the ignition (start) switch to the on (run) position.

14.3.1 Record the condition of the FCW/AEB status indicator.

15. MINIMUM PERFORMANCE RECOMMENDATIONS FOR FCW/AEB SYSTEMS WITH STATIONARY VEHICLE DETECTION CAPABILITY

The criteria below were derived from and are intended for truck tractors with integrated camera and radar sensing systems.

15.1 Stationary Target Test

The recommendations listed below must be completely achieved in at least three of the four runs conducted to receive a “passing” mark.

15.1.1 Collision Warning Phase

- At least two collision warning modes, audible, visual, or haptic, are required prior to the initiation of the automatic emergency braking (AEB) phase.
- During the warning phase, any speed reduction that occurs shall not exceed 7.5 mph (12 km/h).

15.1.2 Automatic Emergency Braking Phase

- For AEB systems with static object braking capability only
- AEB must not initiate until time to collision (TTC) is equal to or less than 3 seconds.
- The total Subject Vehicle speed reduction from the initial test speed until contact with target must be equal to or exceed 10 mph (16 km/h).

15.2 Decelerating/Stopped Target Test

The recommendations listed below must be completely achieved in at least three of the four runs conducted.

15.2.1 Collision Warning Phase

- At least two collision warning modes, audible, visual, or haptic, are required prior to the initiation of the automatic emergency braking (AEB) phase.
- During the warning phase, any speed reduction that occurs shall not exceed 7.5 mph (12 km/h).

15.2.2 Automatic Emergency Braking Phase

- AEB must not initiate until Time To Collision (TTC) is equal to or less than 3 seconds.
- The Subject Vehicle must not impact the Target Vehicle.

15.3 Moving Target Test

Subject vehicle speed: 45 mph (72.4 km/h), target vehicle speed: 20 mph (32.3 km/h).

The recommendations listed below must be completely achieved in at least three of the four runs conducted.

15.3.1 Collision Warning Phase

- At least two collision warning modes, audible, visual, or haptic, are required prior to the initiation of the automatic emergency braking (AEB) phase.
- During the warning phase, any speed reduction that occurs shall not exceed 13.5 mph (24 km/h).

15.3.2 Automatic Emergency Braking Phase

- AEB must not initiate until time to collision (TTC) is equal to or less than 3 seconds.
- The subject vehicle must not impact the target vehicle.

15.4 False Detection Test - Minimum Performance Recommendations for Truck Tractor

15.4.1 Subject Vehicle Driven between Two Parked Passenger Cars

The FCW/AEB system shall not provide any collision warnings or activate AEB during the test maneuver in at least three of the four tests conducted.

15.5 Failure Detection Test - Minimum Performance Recommendations for Truck Tractor

15.5.1 Simulate an FCW/AEB Electrical Failure

The FCW/AEB status indicator shall be activated and remain activated not later than 10 seconds after the vehicle has been driven at a speed greater than 10 mph (16.1 km/h) and be reactivated within 5 seconds after a subsequent ignition “off” ignition “on” cycle with the vehicle stationary as long as the simulated failure exists.

15.6 Deactivation Test - Minimum Performance Recommendations for Truck Tractor

15.6.1 For FCW/AEB Systems with a Manual Means for the Driver to Deactivate the System

The FCW/AEB status indicator shall be activated no later than 5 seconds after the FCW/AEB system is deactivated. Immediately after a subsequent ignition “off”/“on” cycle, the FCW/AEB status indicator must not be activated, indicating the FCW/AEB system is in a functional state.

15.7 Aggregate Minimum Performance Recommendations for Truck Tractor

The suite of tests for all systems encompasses five specific tests: Stationary target test, decelerating/stopped target test, moving target test, false detection test, and the failure detection test. (Note that not all systems may allow the system to be deactivated; thus, the deactivation test is not considered for the minimum aggregate perfomance metric.)

Each of these five tests require four test runs, with each individual test receiving passing scores in at least three of four tests and for the suite of 20 (5x4) tests, the system must pass seventeen of the 20 individual tests (85% aggregate).

16. NOTES

16.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE TRUCK AND BUS AUTOMATION SAFETY COMMITTEE

APPENDIX A - TEST PARAMETERS

Table A1

	Stationary Target Test	Decelerating/Stopped Target Test	Moving Target Test
Subject Vehicle Speed	25 mph (40.2 km/h)	25 mph (40.2 km/h)	45 mph (72.4 km/h)
Target Vehicle Speed	0	25 mph (40.2 km/h)	20 mph (32.2 km/h)
Target Vehicle Deceleration	NA	9.65 ft/s^2 (2.94 m/s^2)	NA
Initial Distance/Following Gap	300 feet (91.4 m)	300 feet (91.4 m)	300 feet (91.4 m)

Tolerances:

Subject and target vehicle test speeds: ±1 mph (±1.6 km/h).
Following distance gap: ±8 feet (±2.4 m).
Target vehicle deceleration: ±1.0 ft/s^2 (±0.3 m/s^2).

APPENDIX B - VEHICLE DATA

Table B1

Test No.	Test Date(s)	From:	To:
Test Organization:	Test Location:		

Subject Vehicle:		
Make:	Type:	Model:
VIN:	D.O.M.:	Wheelbase, in:

CG Ht. (above ground)	Unloaded Chassis:	@LLVW:	@GVWR:
Ballast			
Axle Configuration:		Retarder(s) Type(s):	

Forward Collision Warning and Automatic Emergency Braking System			
Sensing and Detection System			
Sensor	No. of Sensors	Make	Type
RADAR			
Camera			

Detection and AEB Capability	
Stationary Object/Vehicle	Moving Vehicle

Driver Warning					
Warning Level	Visual	Audible	Haptic	Type of Haptic Warning	TTC
First					
Second					

Table B2

Foundation Brakes					
Axle	Type	Make	Size (inches)	Lining Make	Lining Edge Code
1					
2					
3					
4					
5					
6					
7					

Brake Drum/Rotor				
Axle	Type	Make	Weight (pounds)	Dust Shields (Y/N)
1				
2				
3				
4				
5				
6				
7				

Air Actuation Details					
Axle	Air Chambers		Slack Adjuster		
	Make	Type	Length or Wedge Angle	Make	Cam Rotation
1					
2					
3					
4					
5					
6					
7					

ABS			
Make:	Model:	Config.:	Axles Sensed