



Commercial Vehicle Brake Systems (Australian Design Rule)

1 Scope

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To determine whether a commercial vehicle meets the brake system performance requirements of Australian Design Rule (ADR) 35/03; Commercial Vehicle Brake Systems 2009.

Equivalent Base Regulation see UN R13H (GMW15112).

Note: ADR 35/03 is the current level of ADR35 in Australia.

In July 2014 – ADR 35/04 comes into effect (which mandates ABS for commercial vehicles), and in November 2015, ADR 35/05 comes into effect – introducing Brake Assist for commercial vehicles.

1.2 Foreword. This standard is used to determine the performance of the brake system as measured during vehicle tests as specified in Part 5 of ADR 35/03. In addition, for vehicles equipped with Electronic Stability Control, this standard covers the functional and dynamic performance requirements specified in Appendix 2 of ADR 35/03 (excluding Attachments 1 to 4). ADR 35/03 also has design requirements (Part 4) for the brake system, visible indicators, parking brake system, brake reservoirs, etc. These design requirements are not validated or verified in this standard.

Note: This standard requires a review for any necessary revisions whenever a new version of ADR 35/XX is released.

1.3 Applicability. This standard is applicable to commercial vehicles installed with hydraulic brake systems in the following ADR classifications:

- MB: Forward-Control Passenger Vehicle.
- MC: Off Road Passenger Vehicle.
- MD: Light Omnibus.
- ME: Heavy Omnibus.
- NA: Light Goods Vehicle.
- NB: Medium Goods Vehicle.

Note: Category MB or MC vehicles shall be equipped with an Electronic Stability Control system that meets the requirements of Appendix A of this standard.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ADR 35/03	ASTM E1337	UN R13H
ASTM E1136	FMVSS 135	

2.2 GM Standards/Specifications.

GMW15112

2.3 Additional References.

02.601ENG/513 “GMW15315 Commercial Vehicle Brake Systems (ADR35/03) Data Sheets”

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Circular 35/03-2-1 Selection of Test Vehicles

Australian Design Rule – Definitions and Vehicle Categories (2005)

3 Resources

3.1 Facilities. General Motors Proving Ground or equivalent test road facility.

3.1.1 The facility shall provide a high peak coefficient of friction track for straight-line stops. Track lanes should be at least 3.7 m wide.

3.1.2 The upward gradient of the test track must not exceed 1% for all deceleration tests and brake fade tests.

3.1.3 The facility shall have a parking brake variable grade ramp or a test hill with a gradient not less than 18 % of sufficient length for the longitudinal axis of the vehicle to be positioned parallel to the direction of the grade.

3.2 Equipment. A General Motors ADR brake data acquisition equipment or equivalent data acquisition system is required. Instrumentation is required to measure vehicle deceleration, vehicle speed, brake pedal force, brake pedal travel, vehicle stopping distance, and brake rotor or drum temperatures. Additional instrumentation may be requested. Refer to the test work request or the test requestor. All instrumentation shall be calibrated as required.

3.3 Test Vehicle/Test Piece.

3.3.1 The test vehicle shall be as specified by the brake test engineer (Refer to Circular 35/03-2-1 Selection of test Vehicles). The test vehicle shall be adjusted to manufacturer's recommendations for injection or ignition timing, engine idle speed, and engine governed speed where applicable. All engine, powertrain, and brake control systems shall have representative calibrations. The test vehicle shall be representative for aerodynamics, if possible.

3.3.2 Test masses shall be provided by the brake test requestor and shall be selected to cover the model range used with the brake system.

3.3.3 The vehicle shall have a powertrain giving a maximum laden vehicle speed of 100 km/h or greater, if available.

3.3.4 Tires shall be fitted having the largest diameter (or within 2 % of the largest diameter) and the least nominal section width relative to the Gross Vehicle Weight (GVW) of the vehicle range. The tire must be of a type and size specified as original equipment for the vehicle. Tires shall be inflated to not less than the pressures recommended by the manufacturer for GVW.

3.3.5 Full wheel covers shall be used to minimize ventilation to the brake system. Side skirts (desirable, not mandatory) and the worst case air dams and spoilers among the vehicle options shall be fitted to provide worst cooling effect to brakes.

3.3.6 The vehicle shall be fitted with a new foundation brake system prior to testing. Where appropriate, the test requestor may specify that only the friction material and surfaces need be new. The friction elements must be of the make and grade specified for the brake system or a specified by the test requestor.

3.4 Test Time.

Calendar time: (4 to 6) days

Test hours: (24 to 30) h

Coordination hours: (8 to 16) h

3.5 Test Required Information.

3.5.1 Data sheets (02.601ENG/513) shall be used during the testing. These data sheets are available from the brake test facility at GM Holden Proving Ground. The data sheets should contain the instructions and requirements specific to the vehicle type being tested.

3.5.2 Determine if the test facility has any restrictions on the weight of the test vehicle. Select the test vehicle appropriately.

3.5.3 Review and comply with all safety regulations of the test facility.

3.6 Personnel/Skills. A technician or engineer trained to perform brake system tests during vehicle testing is required.

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4 Procedure

4.1 Preparation.

4.1.1 Test Vehicle Preparation.

4.1.1.1 Document the following vehicle information:

4.1.1.1.1 Vehicle identification information, i.e. model, body style, Vehicle Identification Number (VIN).

4.1.1.1.2 Engine type and displacement.

4.1.1.1.3 Powertrain transmission type and axle ratio.

4.1.1.1.4 Tires make, model, size, and inflation pressures.

4.1.1.1.5 Wheel type and size.

4.1.1.1.6 Curb weight.

4.1.1.2 Check and adjust the following:

4.1.1.2.1 Engine fluid levels.

4.1.1.2.2 Brake pedal adjustment.

4.1.1.2.3 Wheel alignment.

4.1.1.2.4 Brake drag.

4.1.2 Brake System Preparation.

4.1.2.1 The brake system components shall be:

4.1.2.1.1 Drawn from production supplies and have passed the appropriate controls to ensure their conformance with specifications, or:

4.1.2.1.2 Have been manufactured in accordance with the specifications relevant to their respective designs and physically inspected with regard to their features to ensure that they reflect design intent.

4.1.2.2 In either case, brake components must be identified against part drawings.

4.1.2.3 Build the brake system as per manufacturer's instructions with the specified brake components. Where a test vehicle is supplied in a condition suitable for testing, the test requestor takes responsibility for the origin of the parts by signing a certificate of test material. Endorse the specification as achieved with tester's signature on the relevant instruction drawing provided in the vehicle book or other appropriate documentation. Make all necessary brake system adjustments.

4.1.2.4 Check that all hydraulic and/or air line fittings are dry and secure at junctions.

4.1.3 Instrumentation. Install instrumentation per test request.

4.1.4 Test Preparation.

4.1.4.1 Load the vehicle to specified test weights of Lightly Loaded Vehicle Weight (LLVW) and GVW when appropriate. Document the weights, weight distributions and position of ballast in the test record.

4.1.4.2 Install the appropriate safety warning device(s), as required.

4.1.4.3 Prior to commencement of the test, determine the test vehicle's maximum laden vehicle speed:

4.1.4.3.1 Load vehicle to GVW.

4.1.4.3.2 Measure the speed attainable at 1.6 km from a standing start under maximum acceleration. Make four separate time versus distance measurements. Calculate the vehicle speed from each measurement. Average of four speeds, and report this average in the test record.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.1.1 The ambient temperature at the test site shall be between 0 °C and +40 °C.

4.2.1.2 The tests shall be conducted on dry roads.

4.2.1.3 Except when burnishing, the head wind shall not exceed 15 km/h during any stop. All decelerations shall be completed at points on the track where the wind direction shall be either across to, or tending in the same direction as the vehicle's forward travel.

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4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 Vehicle openings are to be closed during stops.

4.2.2.2 Unless otherwise instructed, perform only as many effectiveness tests, within the allowable number, as are necessary to meet the requirements. The performance requirement is considered met if one of the performed stops meets the requirements.

4.2.2.3 During any deceleration during the procedure, test vehicle must remain within a 3.7 m lane.

4.2.2.4 Except in the case of parking brake test, each test procedure may be preceded by instrument decelerations (up to ten decelerations from 40 km/h and at 3 m/s² maximum), provided the brake temperatures measured at the surface of the brake disc or drum do not exceed +100 °C immediately prior to test decelerations.

4.2.2.5 Brakes shall not be adjusted during the deceleration testing. If the brake system is equipped with automatic adjusters, the adjusters shall be operational during the testing unless otherwise specified by the test requestor. If adjusters are made inoperative before the brake burnish by request, the adjusters must be inoperative for the duration of the testing.

4.2.2.6 Tolerance on all speeds specified during procedure is +5 km/h or -1 km/h. If the vehicle is not capable of attaining the initial speed specified for a particular deceleration test, then the test speed must be within 10 km/h of the maximum laden vehicle speed. Also refer to ADR 35/03 Clause 6.8.

4.2.2.7 Where an Anti-Lock Brake System (ABS) is fitted, the ABS must be operational throughout all tests except partial failure tests where a failure in the ABS is simulated.

4.2.2.8 The test sequence within this standard should be maintained, however 4.3.21 Parking Brake Test (Item 11) may be conducted at any time, such as between Items 2 and 3, or between 5 and 6.

4.2.2.9 Unless otherwise specified, the effectiveness decelerations shall be a driver's best effort, with a rapid pedal apply not exceeding the maximum pedal force.

4.2.2.10 Each failure mode must simulate the actual failure, i.e. a leak in a pipe of one circuit cannot be simulated by blocking off one of the circuits. Tests should be run with the relevant failure indicator light illuminated (where appropriate).

4.2.2.11 Check vehicle behaviour during all Secondary brake tests. If any instability occurs during braking, this should be reported. The same stability requirements apply as for Service Braking System tests.

4.2.2.12 Check and record brake pedal travel versus pedal effort before and after the partial failure test that requires disconnection of a brake fluid line. Results should be the same as those obtained prior to disconnection, otherwise re-bleed brake system and recheck.

4.2.2.13 Disconnect the primary source of power to the brake power assist unit or brake power unit. If two or more independent subsystems are provided, test each system individually by disconnecting the relevant power supply. If the brake power unit or power assist unit operates in conjunction with a backup system and the backup system is automatically activated in the event of a primary power service failure, the backup system is operative during this test. Exhaust any residual brake power reserve capability of the disconnected system. On vehicles with brake power units, disconnect the primary source of power.

4.3 Instructions.

4.3.1 Service Brake System Check. Measure brake pedal effort versus pedal travel up to 600 N pedal forces with and without power assist.

4.3.2 Instrumentation Check (Item 1).

4.3.2.1 Check calibration of all instrumentation.

4.3.2.2 Perform pre-test Instrumentation checks as required. At least one deceleration is required to check for correct functioning of instrumentation. A maximum of twenty decelerations are allowed. For these decelerations, the maximum initial speed shall be 40 km/h and the maximum instantaneous deceleration shall be 3 m/s².

4.3.3 Service Brake Burnish (Item 2).

4.3.3.1 With the vehicle loaded to GVW, conduct 200 decelerations as follows:

4.3.3.1.1 Target deceleration: 3.0 m/s²

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4.3.3.1.2 Interval between decelerations (per FMVSS 135): The interval from the start of one brake application to the start of the next is the time necessary to reduce the IBT to +100 °C or less, or the distance of 2 km, whichever occurs first.

4.3.3.1.3 Initial speed: 80 km/h.

4.3.3.1.4 Accelerate to initial speed and maintain until next stop.

4.3.3.1.5 Gear selector in **DRIVE** if automatic transmission or, if manual transmission, use appropriate gear for vehicle speed and release clutch as necessary to avoid engine stall.

4.3.4 System Adjustment and Check.

4.3.4.1 Service Brake. On completion of the brake burnish, check the adjustment of the service brake system per the manufacturer's recommendation. Adjust as necessary. If adjusted, measure the brake pedal force versus brake pedal travel up to 600 N pedal forces with power assist, before and after brake system adjustment.

4.3.4.2 Parking Brake. Check the adjustment of the parking brake system. Reset to manufacturer's recommendations as necessary. Cycle parking brake lever to maximum load (590 N for hand apply; 685 N for foot apply) five times, then recheck adjustment. Repeat until successive parking brake checks give same results.

4.3.5 Service Brake Lightly Laden Effectiveness Test (Item 3). Perform effectiveness stops: gear selector **NEUTRAL**; vehicle mass LLVW, maximum of six decelerations allowed; maximum pedal force 685 N; initial vehicle speed from Table 1 per vehicle type.

Table 1: Service Brake Lightly Laden Effectiveness Test

Vehicle Category	Initial Speed (km/h)	Average Deceleration (m/s ²)	
		With 15 % Margin	ADR 35/03
MB, MC, MD, ME	100	4.82	4.19
NA, NB	100	4.35	3.78

4.3.6 Lightly Laden Secondary Brake Test (Item 4).

4.3.6.1 Secondary brake is applied by service brake control.

4.3.6.2 Perform effectiveness stops: gear selector **NEUTRAL**; vehicle mass LLVW, maximum of six decelerations allowed; pedal force 685 N maximum; initial vehicle speed from Table 2 per vehicle type.

4.3.6.3 Vehicle shall meet parameters as shown below in at least one stop within a number of stops not exceeding six in any one mode for each single failure of a fluid system, including:

4.3.6.3.1 Each subsystem of a split service brake system.

4.3.6.3.2 Failure of energy assistance in a brake power assist unit.

Table 2: Lightly Laden Secondary Brake Test

Vehicle Category	Initial Speed (km/h)	Average Deceleration (m/s ²)	
		With 15 % Margin	ADR 35/03
MB, MC, MD, ME	60	2.42	2.10
NA	70	2.30	2.00
NB	50	2.13	1.85

4.3.7 Lightly Laden Partial Failure Test (Item 5).

4.3.7.1 Only applicable where secondary brake is actuated by service brake control.

4.3.7.2 Perform effectiveness stops: gear selector **NEUTRAL**; vehicle mass LLVW, maximum of six decelerations allowed; maximum pedal force 685 N; initial vehicle speed from Table 3 per vehicle type.

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4.3.7.3 Vehicle shall meet parameters as shown below in at least one stop within a number of stops not exceeding six in any one mode for each single failure of a fluid system, including:

4.3.7.3.1 Inoperative antilock.

4.3.7.3.2 Inoperative variable proportioning valve.

4.3.7.4 Document the process used to induce the partial failures in the test record.

4.3.7.5 The vehicle shall be restored at the completion of each set of decelerations.

Table 3: Lightly Laden Partial Failure Test

Vehicle Category	Initial Speed (km/h)	Average Deceleration (m/s ²)	
		With 15 % Margin	ADR 35/03
MB, MC, MD, ME	60	2.42	2.10
NA	70	2.30	2.00
NB	50	2.13	1.85

4.3.8 Service Brake Laden Effectiveness Test (Item 6). Repeat 4.3.5 except required vehicle mass is GVW.

4.3.9 Laden Secondary Brake Test (Item 7). Repeat 4.3.6 except required vehicle mass is GVW.

4.3.10 Laden Partial Failure Test (Item 8). Repeat 4.3.7 except required vehicle mass is GVW.

4.3.11 Service Brake System Check. Measure brake pedal effort versus pedal travel up to 600 N pedal force with power assist.

4.3.12 Service Brake Fade Test (Item 9).

4.3.12.1 The first deceleration mode shall be at a sustained deceleration of $\geq 3.0 \text{ m/s}^2$. Document the pedal effort to achieve this retardation. Subsequent decelerations shall be conducted employing a control force not less than the pedal force from the first deceleration and not greater by more than 100 N of the pedal force from the first deceleration, without regard to the actual deceleration achieved. For each deceleration, the sustained deceleration level should be attained within 1 s of the commencement of the deceleration.

4.3.12.2 During all decelerations, the transmission and axle where applicable, shall be continuously engaged in the gear which produces the lowest numerical drive ratio, appropriate to the speed of the vehicle, at the commencement of the deceleration. For automatic transmission vehicles, use **DRIVE** gear unless otherwise specified.

4.3.12.3 Accelerate at Wide Open Throttle (WOT) between snubs to regain specified initial speed in the shortest possible time. Maintain the specified initial speed for a minimum of 10 s. See Table 4 for the test speeds, number of decelerations, and time between decelerations per vehicle type.

4.3.12.4 Immediately on completion of the specified number of decelerations, conduct 4.3.13 (Item 10).

Table 4: Service Brake Fade Test

Vehicle Category	Initial Speed (km/h)	Final Speed (km/h)	Maximum Time Between Decelerations (s)	Number of Decelerations
MB, MC, MD, NA	100	50	55	15
ME, NB	60	30	60	20

4.3.13 Service Brake Fade Effectiveness Check (Item 10). The vehicle shall be accelerated over a distance not exceeding 1.6 km from the final speed at the fade test to the initial speed per vehicle type as shown in Table 5. The vehicle shall be brought to a stop without exceeding a pedal effort of 685 N with the gear selector in NEUTRAL.

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Table 5: Service Brake Fade Effectiveness Check

Vehicle Category	Initial Speed (km/h)	Average Deceleration (m/s ²)	
		With 15 % Margin	ADR 35/03
MB, MC, MD, ME	60	3.47	3.02
NA	70	3.27	2.84
NB	50	3.02	2.63

4.3.14 Service Brake System Check. Measure brake pedal effort versus pedal travel up to 600 N pedal force with power assist.

4.3.15 Parking Brake Test (Item 11).

4.3.15.1 For vehicles having a parking brake system that does not utilize the service brake friction elements, the friction elements of the parking brake may be burnished to manufacturer's recommendation prior to the test.

4.3.15.2 The test shall be conducted on a grade as specified in 3.1.3.

4.3.15.3 With the vehicle loaded to GVW, slowly drive up the 20 % test hill facing uphill. The service brake shall be applied to hold the vehicle, the transmission shall be disengaged, and then the parking brake applied with a single application of the following effort:

4.3.15.3.1 For hand operated parking brake systems, up to 590 N applied at the center of the handgrip, or not closer than 35 mm from the free end of the parking brake lever (not including release button, if applicable).

4.3.15.3.2 For foot operated parking brake systems, up to 685 N.

Note: A series of applications to achieve the specified force may be made in the case of a parking brake design that does not allow the application to the specified force in a single application.

4.3.15.4 Release the service brake, and, if the vehicle does not remain stationary, then re-apply above effort used with one application and without release of the ratcheting mechanism or other mechanism of the parking brake.

4.3.15.5 Release the service brake, and, if the vehicle does not remain stationary for at least five minutes, repeat load application.

4.3.15.6 Release service brake. The vehicle must remain stationary for at least five minutes.

4.3.15.7 Repeat the above procedure except facing downhill. The requirements are the same.

4.3.16 Service Brake Actuation Time Test (Item 12). For air brake system vehicles only. Refer to ADR 35/03 for instructions and specifications.

4.3.17 Service Brake Compatibility Test (Item 13). For vehicles equipped to tow a trailer which uses air at positive pressure. Refer to ADR 35/03 for instructions and specifications.

4.3.18 Special Provisions for Vehicles Incorporating an Anti-lock Brake System (ABS).

4.3.18.1 Test requirement is that at speeds > 15 km/h, wheels must remain unlocked and vehicle must maintain stability when a pedal force of 685 N is suddenly applied. Locking of the wheels for brief periods of time is allowed, provided stability is not affected.

4.3.18.2 This testing may be done in conjunction with 4.3.5 Service Brake Lightly Laden Effectiveness Test (Item 3) and 4.3.8 Service Brake Laden Effectiveness Test (Item 6).

4.3.18.3 Up to six decelerations at each condition are allowed, but the requirements of this test must be met on each deceleration.

4.3.18.4 The test road surface shall have approximately uniform surface friction on both sides of the vehicle.

4.3.18.5 Tests at LLVW. Perform decelerations: Gear selector **NEUTRAL**; vehicle mass LLVW, maximum of six decelerations allowed; control force suddenly applied to 685 N; both 1st mode test and 2nd mode test initial speeds from Table 6 per vehicle type.

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