CIRCULAR 35/00-9-1

TEST PROCEDURES

ADR 35/00-COMMERCIAL VEHICLE BRAKE SYSTEMS

“A Guide for Inspectors”

This Circular is relevant to the Third Edition of the
Australian Design Rules gazetted as
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SCOPE</td>
<td>5</td>
</tr>
<tr>
<td>2 SELECTION OF TEST VEHICLES</td>
<td>5</td>
</tr>
<tr>
<td>3 IDENTIFICATION OF TEST VEHICLES</td>
<td>5</td>
</tr>
<tr>
<td>4 NUMBER OF TEST VEHICLES</td>
<td>5</td>
</tr>
<tr>
<td>5 EQUIPMENT</td>
<td>5</td>
</tr>
<tr>
<td>5.1 Brake Failure Indicator Test</td>
<td>5</td>
</tr>
<tr>
<td>5.2 Spring Brake Operation Test</td>
<td>6</td>
</tr>
<tr>
<td>5.3 Stored Energy Regeneration Test</td>
<td>6</td>
</tr>
<tr>
<td>5.4 Performance Test</td>
<td>6</td>
</tr>
<tr>
<td>6 PROCEDURE</td>
<td>7</td>
</tr>
<tr>
<td>6.1 Brake Failure Indicator Test</td>
<td>7</td>
</tr>
<tr>
<td>6.2 Spring Brake Operation Test</td>
<td>9</td>
</tr>
<tr>
<td>6.3 Stored Energy Regeneration Test</td>
<td>9</td>
</tr>
<tr>
<td>6.4 Performance Tests</td>
<td>10</td>
</tr>
<tr>
<td>7 ANALYSIS OF RESULTS</td>
<td>35</td>
</tr>
<tr>
<td>8 SUMMARY OF EVIDENCE REPORT</td>
<td>35</td>
</tr>
<tr>
<td>9 PROCEDURE FOR DESIGNS WITH CERTIFICATION TO ALTERNATIVE STANDARDS</td>
<td>35</td>
</tr>
<tr>
<td>10 REFERENCES</td>
<td>35</td>
</tr>
<tr>
<td>ANNEX A</td>
<td></td>
</tr>
<tr>
<td>TEST EQUIPMENT DIAGRAMS</td>
<td>36</td>
</tr>
</tbody>
</table>
1 SCOPE

This procedure when read in conjunction with Circulars issued by the Administrator, provides sufficient information, without reference to other standards, to conduct and audit tests related to Commercial Vehicle Braking Systems as described in Australian Design Rule No. 35/00 and Circular 35A-2-1 - ADR 35A Commercial Vehicle Braking Systems. For convenience, reference to the ADR clause number is quoted in brackets against each appropriate paragraph of this procedure.

The equipment, orders of accuracy and step by step actions described in this procedure are drawn from the standards and recommended practices quoted in the ADR and from accepted laboratory and testing practices. The ADR has been written in a non design restrictive form whereby operating parameters of the brake power unit were referred to in such terms as ‘energy level’. Compressed air provides the energy in the majority of contemporary power brake units and thus the energy level in this Circular is referred to as pressure. This should not be taken to exclude the use of other systems which might use other forms of energy.

While conformance with this procedure is sufficient to demonstrate compliance with the ADR, other equipment, orders of accuracy and procedures may be used provided it can be shown that they demonstrate compliance with the ADR.

This ADR requires validation by test in two specific areas, these being:-(i) Design Criteria and,
(ii) Minimum Operational Performance.

This procedure is intended primarily as a guide for Officers of the Australian Department of Transport and Communications or Agents acting on behalf of the Administrator when they carry out audit inspections of Test Facilities or witness tests for compliance with the ADR. This and other Circulars dealing with Test Procedures for ADRs may also be useful to vehicle manufacturers and testing organizations.

Nothing in these Circulars, however, absolves the manufacturer from complying with the requirements as specified in the ADR which always remains the primary reference.

2 SELECTION OF TEST VEHICLES

The selection of test vehicle or vehicles is to be carried out in accordance with the implementation procedure as detailed in Circular 35A-2-1.

3 IDENTIFICATION OF TEST VEHICLES

All test related components of the test vehicle(s) shall be representative of the design condition as reflected in the production drawings.

In most cases the test vehicle(s) will be assembled using production components which have passed through normal quality assurance procedures. If prototype components are used they should be individually inspected for both dimensional and material specification compliance with their respective drawings.

For each test program all relative components are to be uniquely identified by part number, drawing number and revision or issue status. Such information is to be included in all test records and reports.

Component identification lists should include at least the following:-
(i) All components of the braking system.
(ii) Vehicle Body identification, in particular
   - front air dam or spoiler
   - wheel opening flares and
   - air ducting (excluding occupant space).
(iii) Wheels and Tyres.
(iv) Wheel trim or ornamentation attachments.

4 NUMBER OF TEST VEHICLES

The selection of number of test vehicles is to be carried out in accordance with the implementation procedure as detailed in Circular 35A-2-1.

5 EQUIPMENT

The equipment details below is the minimum requirement to conduct ADR 35/00 testing. Alternative equipment or system approaches would be valid if the system accuracy and response characteristics can be shown to demonstrate compliance with the ADR.

5.1 Brake Failure Indicator Operation Test

5.1.1 Instrumentation

5.1.1.1 Measurement. The following parameters are to be determined during this test:
(i) pressure and
(ii) service brake effort.

Pressure gauges of a suitable range are required for hydraulic line pressure, air line pressure, power unit and power assist unit storage pressure. Service brake pedal effort can be determined by hydraulic or electronic transducers.

5.1.1.2 Recording. A recording or display system would, depending on transducer type, be by pressure gauge or via signal conditioning to meter or recorder packages. All results are to be entered on a suitable data sheet.

5.1.1.3 Order of Accuracy. Except where specified in the ADR or referred documents the orders of accuracy indicated in this procedure are suggested as being commercially achievable and should be taken as a guide. Instrumentation of lesser accuracy is acceptable provided it is taken into account in determining the certainty of results. Pressure gauges are to be scaled and calibrated to ensure an accuracy in the order of 72.5%. Total system accuracy for pedal effort determination should be no less than 75%.

5.1.1.4 Calibration. Pressure gauges are to be calibrated in accordance with Circular 0-12-3. Hydraulic pedal equipment should be calibrated against a reference force testing system at least every six months. Electronic pedal effort
equipment should have a field check calibration performed prior to use in each test.

5.2 Spring Brake Operation Test

5.2.1 Instrumentation

5.2.1.1 Measurement. The only parameter to be determined during the test is pressure. A pressure gauge of a suitable range is required for brake power unit storage pressure.

5.2.1.2 Recording. All results are to be entered on a suitable data sheet.

5.2.1.3 Order of Accuracy. Pressure gauges are to be scaled and calibrated to ensure an accuracy in the order of ±2.5%.

5.2.1.4 Calibration. Pressure gauges are to be calibrated in accordance with Circular 0-12-3.

5.3 Stored Energy Regeneration Test

5.3.1 Instrumentation

5.3.1.1 Measurement. The following parameters are to be determined during the test:

(i) pressure
(ii) time
(iii) engine speed

Pressure gauges of a suitable range are required for power unit and power assist unit storage pressure. Time periods can be determined by a hand held stop watch. Engine speed can be determined by a suitably calibrated tachometer.

5.3.1.2 Recording. A recording or display system would, depending on transducer type, be by pressure gauge or via signal conditioning to meter or recorder packages. All results are to be entered on a suitable data sheet.

5.3.1.3 Order of Accuracy. Pressure gauges are to be scaled and calibrated to ensure an accuracy in the order of ±2.5%. Total system accuracy for pedal effort determination should be no less than ±5%. Timing should be carried out to an accuracy in the order of ±1 second. Engine speed should be determined at not more than ±50 r/min.

5.3.1.4 Calibration. Pressure gauges, stopwatches and tachometers are to be calibrated in accordance with Circular 0-12-3.

5.4 Performance Tests

5.4.1 Basic Equipment

The following basic equipment is required:

(i) test track;
(ii) test slope;
(iii) water conditioning equipment;
(iv) vehicle mass determination equipment;
(v) ambient temperature determination equipment;
and
(vi) wind speed determination equipment.

5.4.1.1 Test track. A suitable test site would be substantially flat with no upward gradient greater than 1%. If any gradient exists all decelerations shall be conducted down that gradient. The test track shall be of sufficient length to satisfy the distance requirements of the fade cycle. The track can take the form of a circuit or a straight track with suitable turning facilities at each end. Lane width of 3.7m is required to be identified.

5.4.1.2 Test slopes. A test slope of not less than 18% gradient is required for parking brake tests. This slope is best surfaced with smooth clean finish concrete.

5.4.1.3 Water conditioning equipment. Water conditioning of brakes may be conducted by either immersion or spray methods.

5.4.1.3.1 Immersion. Conditioning by immersion requires the use of a water bath. This bath is to have a water depth of not less than 60% of the static loaded rolling radius of the wheels and tyres of the test vehicle and to be of sufficient length to satisfy the stationary/mobile time requirement of Clause 35.5.11.1 of the ADR. The bath should have entry/exit ramps and be located in close proximity to the brake test site.

5.4.1.3.2 Spray method. The braking surfaces may be conditioned by directing water over the brake assemblies for not less than 5 minutes. The water is to be introduced through an aperture in the brake backing plates in the case of drum brakes and the delivery rate is to be such that each assembly receives water at not less than 25 litres per minute. (Clause 35.5.11.2)

5.4.1.4 Mass Determination Equipment. Suitable mass determination equipment is required to measure vehicle mass and front/rear weight distribution. This equipment should satisfy the calibration requirements of Circular 0-12-3.

5.4.1.5 Temperature Determination Equipment. A mercury in glass or thermocouple type thermometer is required for the measurement of ambient temperatures. An accuracy of no less than ±1 degree C would be necessary.

5.4.1.6 Wind Speed Determination. An anemometer with an operational accuracy of ±5% in the 0-20 km/h range would be suitable.

5.4.2 Instrumentation

This instrumentation description is a minimum system based on the use of general instrument packages and does not cover systems incorporating purpose built counters or processor type data loggers.

5.4.2.1 Measurement. The following parameters are to be determined and in some cases permanent recording with respect to a fixed time base is required:

(i) Displacement (distance)
(ii) Velocity
(iii) Acceleration
(iv) Service brake pedal effort
(v) Park brake actuation effort
(vi) Brake temperature equipment
(vii) Actuation time equipment.

5.4.2.1.1 ITEMS (i) to (v). Refer to Annex A for a general arrangement of a vehicle instrument package. Each function block of this general
arrangement will be discussed individually.

5.4.2.1.1 Fifth Wheel. A suitable fifth wheel, light beam doppler system or displacement sensing device is required and would incorporate pulse signal generation capability to satisfy the accuracy requirements as detailed in Section 5.4.2.3.

5.4.2.1.2 Displacement Counter. A pulse counter with a minimum 10 kHz input capability with a minimum six digit display is required to provide a satisfactory resolution and level of accuracy. The counter is to include start and reset input facilities.

5.4.2.1.3 Velocity Counter. A frequency counter suitable for a 10 kHz signal would be satisfactory. The counter would require remote reset and stop/hold input facilities.

5.4.2.1.4 Brake Signal. Provision is to be made for a control signal to be generated on actuation of the service brake. This signal is to be produced within the first 3 mm of pedal travel. The control signal can be sourced from the brake light switch or from a suitably mounted micro switch at the brake pedal. Depending on the counter system utilized, some form of signal conditioning may be required. Isolation switching of this signal from the displacement counter is required for some sections of the test procedure.

5.4.2.1.5 Deceleration Sensing. An accelerometer of low frequency response and signal conditioning equipment is satisfactory for determining sustained decelerations. Operator monitoring facilities can be provided by use of a calibrated analogue meter or by direct use of the chart recorder.

5.4.2.1.6 Brake Actuation Effort. Brake actuation effort can be measured by a ‘Mintex’ type hydraulic force gauge or an electronic force measurement system. If a hydraulic system is utilized a pressure transducer is required to facilitate recording of sustained pedal effort. Either transducer output would require conditioning to suit the recorder input requirements.

5.4.2.1.7 Recorder. A chart recorder is required to log sustained decelerations and sustained pedal effort. Such a recorder would have full scale write response of less than 0.25 s. and chart speed in the order of 5 cm/s.

5.4.2.4 Calibration. Actuation effort equipment should be calibrated against a reference force testing system every six months. Temperature measurement equipment and pressure transducers should be calibrated in accordance with Circular 0-12-3. The actuation time equipment should be calibrated, as a system, against the pressure transducer prior to testing. Refer to Section 6.4 for the installation procedure for displacement, velocity and deceleration equipment.

6 PROCEDURE

6.1 Brake Failure Indicator Test

6.1.1 Preparation for Test

6.1.1.1 Review program. This test sequence is required to validate the system design in terms of conditional operation of the failure lamp. The conditions required to initiate illumination of the lamp will have been determined at the design stage. These conditions are detailed in Clause 35.2.1.2 of the ADR. Dependent on brake system design one or more of the following six parameters will require validation: (a) System differential line pressure
(b) Brake pedal effort (unassisted system)
(c) Brake pedal effort (assisted system)
(d) Brake power unit supply pressure
(e) Brake fluid level
(f) Power unit pressure loss.

6.1.1.2 Setting up:
- Parameter (a): Fit pressure gauges to master cylinder outlets or, if fitted, to slave cylinder outlets associated with a booster unit. Fit each outlet with an adjustable bleed valve.
- Parameter (b) and (c): Fit a force transducer to the brake pedal so that it is centrally located on the pedal pad with the line of action coincident with the line of travel of the pedal. Mount the pedal force indicator in a convenient position for
operator use.
- Parameter (d): Fit a pressure gauge to the brake power unit so that the supply pressure can be monitored. Fit a bleed valve in such a position so that supply pressure can be progressively vented.
- Parameter (e): Determine the design maximum fluid volume for the master cylinder reservoir. This is to be determined by reference to the production drawings or by practical measurement as follows. Fit a bleed valve to a master cylinder outlet. Connect the discharge outlet of this valve to a burette or graduated cylinder. Open the valve and pass fluid from the master cylinder until the fluid drains into the measuring cylinder. Close the valve and top up the reservoir to the design fluid level. Record measured fluid volume of reservoir.
- Parameter (f): Fit a pressure gauge to each power unit so that the stored pressure can be monitored. Fit a bleed valve to each power unit so that stored pressure can be progressively vented.

6.1.1.3 Review Instrumentation. Ensure that all instrumentation zero and span calibrations are correct. Record any instrument correction factors as required.

6.1.2 Tests

6.1.2.1 Parameter (a):
System differential line pressure
(i) Ensure the bleed valves are fully closed.
(ii) Start the engine and apply a sustained pedal effort to the brake system approximating normal service use.
(iii) Open one only bleed valve to provide a slow drop in line pressure.
(iv) Monitor the Brake Failure Indicator and line pressure.
(v) On activation of the Failure Indicator record line pressures for both the active and failed systems.
(vi) Stop the engine and restore the braking system to normal function.
(vii) Calculate the percentage of fluid displaced by this procedure.

6.1.2.2 Parameter (b) and (c): Brake pedal effort
(i) Start the engine.
(ii) Apply a progressively increasing effort to the brake pedal.
(iii) Monitor the pedal control force and the Brake Failure Indicator.
(iv) On activation of the Failure Indicator record the achieved pedal effort.

6.1.2.3 Parameter (d): Brake power unit supply pressure
(i) Start the engine.
(ii) Ensure the power unit is charged to the ‘average operating pressure’ and then isolate the unit from the energy source.
(iii) Record the initial pressure.
(iv) Progressively vent the power unit until activation of the Brake Failure Indicator.
(v) Record the pressure level on activation.
(vi) Repeat procedure for any additional power units.

6.1.2.4 Parameter (e): Brake fluid level
(i) Start the engine.
(ii) Open the bleed valve at the master cylinder outlet.
(iii) Displace brake fluid to the measuring cylinder by controlled pedal movement.
(iv) On activation of the Brake Failure Indicator close the bleed valve and stop the engine.
(v) Determine and record the volume of fluid displaced by this procedure.
(vi) Restore the braking system to normal function.
(vii) Calculate the percentage of fluid displaced with respect to the total volume of the reservoir.

6.1.2.5 Parameter (f): Power unit pressure loss
(i) Start the engine and charge all power units to at least 80% of Average Operating Pressure.
(ii) Progressively vent pressure from the power unit whilst monitoring the stored pressure by gauge. Continue until the brake failure indicator is activated, note and record the residual pressure.
(iii) Repeat this procedure for each power unit.
(iv) Restore the brake system to normal function.

6.1.3 Determination of Results
From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in Clause 35.2.1.2. All original data that is used for determining results is to be retained as either part of the Testing Facility’s internal report or in a separate original data file. In any case the direct readings and the computation showing the method of determining the results are to be given in the internal report.

6.1.4 Reporting of Results
For these tests a complete internal report giving a full description of the material tested, equipment used, results and order of accuracy is to be prepared. For submission to the Administrator the report number(s) for the above test(s) is to be entered in the appropriate section of the Summary of Evidence Report - see Section 8.

6.2 Spring Brake Operation Test

6.2.1 Preparation for Test

6.2.1.1 Review program. This procedure is intended to ensure that in the event of failure of the energy supply that the spring brakes, when used as the Secondary Brake System, have sufficient supply of stored energy to action an emergency stop.

6.2.1.2 Setting up. The power unit that services the spring brake system is to be fitted with a pressure gauge so as to be able to monitor the stored pressure.

6.2.2 Test. The spring brakes are to be adjusted optionally to either:
(a) Maximum actuation travel of each spring
6.3 Stored Energy Regeneration Test

6.3.1 Preparation for Test

6.3.1.1 Review program. This procedure tests for minimum performance of the energy generation device related to an energy storage system excluding spring brakes. This procedure covers positive and negative pressure systems and both power units and power assist units.

6.3.1.2 Setting up. The test vehicle is to be fitted with suitable instrumentation so that the following parameters can be monitored:

(i) Pressure
(ii) Time
(iii) Engine speed.

Pressure gauges are to be fitted to relevant storage units and the tachometer located in a position suitable for monitoring from the drivers seat.

6.3.2 Test. Three procedures follow and applicability is determined on the following basis:

Procedure ‘A’: Required for all positive pressure storage systems, except spring brake systems.

Procedure ‘B’: Relates to all systems incorporating power assist units.

Procedure ‘C’: Required for all negative pressure storage systems.

6.3.2.1 Procedure ‘A’:

- For the system to be tested, calculate the pressure equal to 85% of the Average Operating Pressure.
- Deplete the storage systems of all energy or ensure that the pressure level is well below the value determined above.
- Start the engine and maintain the RPM at the manufacturer’s maximum recommended level.
- Stop the engine and record the determined time period on the test data sheet.
- This procedure should be repeated to ensure accuracy of the timing process.

6.3.2.2 Procedure ‘B’:

Refer to the test procedure detailed in Section 6.4.2 Test Item 7.

6.3.2.3 Procedure ‘C’:

For systems utilizing a pump as the energy source.
- For the system to be tested determine an engine speed which is not greater than 65% of either the governed speed or the speed at which maximum power is developed.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed is to be maintained at the level determined above.
- Terminate timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This procedure may be repeated to ensure accuracy of the timing process.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in Clause 35.2.3.6. A minimum of two complete application cycles are to be achieved when the actuators are adjusted to option (a) or three complete cycles when adjusted in accordance with option (b).

6.2.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in Clause 35.2.3.6. A minimum of two complete application cycles are to be achieved when the actuators are adjusted to option (a) or three complete cycles when adjusted in accordance with option (b).

6.2.4 Reporting of Results

For this test a complete internal report giving a full description of the material tested, equipment used, results and order of accuracy is to be prepared. For submission to the Administrator the report number for the above test is to be entered in the appropriate section of the Summary of Evidence Report - see Section 8.

6.3 Stored Energy Regeneration Test

6.3.1 Preparation for Test

6.3.1.1 Review program. This procedure tests for minimum performance of the energy generation device related to an energy storage system excluding spring brakes. This procedure covers positive and negative pressure systems and both power units and power assist units.

This test procedure may be repeated to ensure accuracy of the timing process.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This procedure may be repeated to ensure accuracy of the timing process.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.

6.3.3 Determination of Results

From the data recorded, compliance can be determined by reference and comparison with the minimum requirements as detailed in the ADR.

For systems where the engine itself is the energy source.
- Set the engine idle speed to the manufacturer’s specification.
- Deplete all stored energy in the system.
- Start the engine and timing device.
- The engine speed must maintain the specified idle speed.
- Terminate the timing on reaching the stored pressure as specified by the manufacturer for the system to be fully charged. (Note: This pressure must satisfy the requirements of Clause 35.2.5.6 of the ADR).
- Stop the engine and record the determined time period on the test data sheet.
- This test procedure may be repeated to ensure accuracy of the timing process.
The braking performance must satisfy the requirements of Clause 35.5.7 of the ADR.

For Procedure 'C':

In cases 'A' and 'C' the regeneration period must not be more than 3 minutes.

### 6.3.4 Reporting of Results

For these tests a complete internal report giving a full description of the material tested, equipment used, results and order of accuracy is to be prepared. For submission to the Administrator the report number(s) for the above test(s) is to be entered in the appropriate section of the Summary of Evidence Report - see Section 8.

### 6.4 Performance Tests

#### 6.4.1 Preparation for Tests

**6.4.1.1 Review program.** Ensure that the test vehicle is in accordance with Circular 35A-2-1. Confirm the test program sequence determined is within the constraints of Clause 35.3.1 of the ADR.

**6.4.1.2 Setting up**

**6.4.1.2.1 Instrumentation.** The test vehicle is to be fitted with suitable instrumentation as described in Section 5 so that the following parameters can be monitored:

(i) Displacement (distance)
(ii) Velocity
(iii) Acceleration
(iv) Brake pedal effort
(v) Parking brake effort
(vi) Brake chamber pressure

Refer to Annex A for the general arrangement of the instrumentation package. Install the individual components related to Displacement, Velocity and Acceleration. When locating these components, provision for the interconnection of components, the loading and removal of ballast during the test program and operator visual access to the appropriate displays should be considered.

Provision of a trigger signal is required to indicate commencement of a deceleration cycle. Such a signal is to be initiated by brake pedal movement and can utilize the test vehicle brake signal lamp circuit or a suitable switching system mounted at the pedal. In either case the system must be capable of being adjusted so that activation occurs within the first 3.0 mm of pedal travel. This signal is to be connected so that on activation:

- the displacement counter is reset, counting initiated and
- the velocity count is inhibited and the current value held.

Depending on the particular instrumentation used, it may be necessary to condition the trigger signal with 'debounce' circuits etc. to provide a satisfactory interface. It is recommended that an event counter be connected to this source and a deceleration cycle counter as required. Install the brake pedal effort instrumentation ensuring the display is mounted in a location to suit operator use. The parking brake effort test equipment package and actuation time test equipment package need only be installed for those particular test sequences. A pedal microswitch must be fitted for the actuation test if not used for a trigger signal for the performance tests.

**6.4.1.2.2 Vehicle preparation.** In preparation of the test vehicle, provision must be made to induce failure of specific functions of the brake system. These functions are:

- pressure failure of each independent sub-system
- failure of a brake antilock system
- failure of a variable proportioning system and
- failure of the energy supply or storage components of a power assist unit.

The failure of a pressure sub-system can be induced by the fitting of a vent valve facility to each relevant brake power unit. The fitting of an electrical power isolation switch to an antilock control circuit will simulate total failure of such a system. A variable proportioning system can be rendered inoperative by disconnection of the control input of a mechanical system or the isolation of the electrical power source of an electronic system. Power assist units are to be fitted with a suitable valve to negate continued supply from the energy source. The energy storage unit is to be fitted with a pressure gauge and vent valve and these components are to be mounted so that monitoring and valve control can be carried out by the test operators. Provision for the fitting of the pressure transducer to the most remote brake chamber unit for the activation time test must be made.

The test vehicle’s braking system and engine are to be adjusted to meet the manufacturer’s specifications.

Tyre inflation pressures are to be set to the manufacturer’s specification for maximum loaded vehicle mass. The performance test procedures require tests to be conducted under two vehicle mass conditions. These conditions are 'Lightly Loaded' and 'Maximum Loaded' and are defined in Clause 35.1.12 and Clause 35.1.15 respectively of the ADR. Use ballast suitable for installation and removal from the test vehicle when determining the test load conditions. When determined, the identification and location of each ballast component is to be recorded on data sheets. Each vehicle load condition is to be confirmed by use of suitable mass determination equipment. Provision is to be made on the test site of a 3.7 m lane. This lane is to be identified by marking or placement of suitable indicators.

**6.4.1.3 Review instrumentation.** Ensure that all instrumentation is securely restrained. Conduct pretest calibration procedures as required for each instrument sub-system (not to involve dynamic braking). Record any instrument correction factors. Accurate fifth wheel calibration is...
essential for total instrumentation package accuracy and therefore frequent checks, as permitted, are to be carried out over a surveyed road test distance.

6.4.1.4 Determination of ‘Maximum Laden Vehicle Speed’. Prior to commencement of the test program, it is necessary to establish the test vehicle ‘Maximum Laden Vehicle Speed’ as described in Clause 35.1.14 of the ADR. This result is to be recorded on the test data sheets.

6.4.2 Tests
The seventeen test ‘items’ as described in the ADR will be presented as individual procedures and as such can be sequenced to suit each unique test program within the constraints of Clause 35.3.1 of the ADR. The following test conditions are to be adhered to during the test program:
- Manual adjustment of the brakes can only be carried out on one occasion, this being on completion of Test Item 2 ‘Service Brake Burnishing Procedure’. If automatic adjusters are fitted it is optional to render these inoperative prior to conducting the ‘Service Brake Burnishing Procedure’. If so rendered the system must remain inoperative for the complete test program.
- No repair or replacement of brake system components may be carried out.
- For all effectiveness and partial failure tests the vehicle must be maintained within the 3.7 m test lane.
- If the vehicle is not capable of attaining the required initial speed the initial speed shall be within 10 km/h of the vehicle’s maximum laden speed and the required deceleration levels are to be amended as detailed in Clause 35.4.8 of the ADR.
- Prior to any deceleration no brake drum or disc can have a surface temperature in excess of 100 degrees C.
6.4.2.1 Test Item 1. ‘Pre-Test Instrumentation Check’ (Clause 35.5.1) This test provides for a series of decelerations to check the function of the test equipment etc.

Test Conditions:
- Vehicle Category = All
- Maximum number of decelerations = 20
- Maximum initial velocity = 40 km/h
- Maximum sustained deceleration = 3 m/s²

Procedure:
This test sequence is not subject to environmental constraints and any number of decelerations up to 20 may be conducted. Prior to conducting any deceleration checks, calibrate the fifth wheel and instrumentation as a package over a measured test distance. (In the order of 5 km). It is recommended that the deceleration test sequence be used by the operator to confirm test control technique for parameters such as sustained deceleration and sustained pedal effort. During this test, record no less information than that shown on the following sample data sheet.

RESULTS: ‘Pre-Test Instrumentation Check’ (Test Item 1)

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Sustained decel. (m/s²)</th>
<th>Maximum pedal effort (N)</th>
<th>Average decel (calc) (m/s²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>3</td>
<td></td>
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<tr>
<td>4</td>
<td></td>
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<tr>
<td>5</td>
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<td>6</td>
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<td>7</td>
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<td>8</td>
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<td>9</td>
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<td>10</td>
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<td>11</td>
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<td>12</td>
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<td>13</td>
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<td>14</td>
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<tr>
<td>15</td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td>16</td>
<td></td>
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<tr>
<td>17</td>
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<tr>
<td>18</td>
<td></td>
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<tr>
<td>19</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculate Minimum Average Deceleration using the following formula:

\[ \text{Av decel} = \frac{\text{Init. velocity}}{3.6} \times \frac{\text{Stopping dist}}{2} \]

Comments
### 6.4.2.2 Test Item 2 ‘Service Brake Burnishing Procedure’

This procedure permits brake burnishing, at the manufacturer’s discretion, to be conducted within the following constraints.

**Conditions:**
- **Vehicle Category** = All
- **Maximum number of decelerations** = Unrestricted
- **Maximum initial velocity** = 65 km/h
- **Ambient temperature** = 0-40 degrees C.

**Procedure:**
- Measure and record ambient temperature.
- Determine total number of decelerations.
- Accelerate the vehicle to within the specified speed range.
- Retard the vehicle, monitoring pedal effort, instantaneous deceleration and total distance.
- Reset the distance counters.
- Repeat sequence for the desired number of cycles.

On completion of this procedure the brakes may be adjusted in accordance with the manufacturer’s recommendations. During this procedure it is recommended that no less information than that shown on the following sample data sheet be recorded. This procedure can be used to ensure that instrumentation procedures are correct.

### DATA: ‘Service Brake Burnishing Procedure’ (Test Item 2)

<table>
<thead>
<tr>
<th>Test site:</th>
<th>Date:</th>
<th>Ambient temperature:</th>
<th>Degrees C.</th>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Initial Cycle distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Maximum Inst. decel (m/s²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxx</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxx</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:

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During this procedure it is recommended that no less information than that shown on the following sample data sheet be recorded. This procedure can be used to ensure that instrumentation procedures are correct.
6.4.2.3 Test Item 3 ‘Service Brake Lightly Laden Effectiveness Test’ (Clause 35.5.3).  This test specifies required deceleration levels from three particular initial speed ranges. These deceleration levels must be achieved in no more than six attempts in each case.

Test conditions:

Vehicle mass = Lightly Loaded Test Mass.

Gear selector position = Neutral.

Vehicle Category Initial velocity Minimum average deceleration

<table>
<thead>
<tr>
<th>MB, MC, MD, ME</th>
<th>(i) 30 km/h.</th>
<th>Velocity (i)</th>
<th>3.03 m/s²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(ii) 60 km/h.</td>
<td></td>
<td>3.78 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td></td>
<td>4.19 m/s²</td>
</tr>
<tr>
<td>NA</td>
<td>(i) 35 km/h.</td>
<td>Velocity (i)</td>
<td>2.97 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 70 km/h.</td>
<td></td>
<td>3.55 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td></td>
<td>3.78 m/s²</td>
</tr>
<tr>
<td>NB</td>
<td>(i) 25 km/h.</td>
<td>Velocity (i)</td>
<td>2.62 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 50 km/h.</td>
<td></td>
<td>3.29 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td></td>
<td>3.78 m/s²</td>
</tr>
<tr>
<td>NC</td>
<td>(i) 20 km/h.</td>
<td>Velocity (i)</td>
<td>2.38 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 40 km/h.</td>
<td></td>
<td>3.09 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td></td>
<td>3.78 m/s²</td>
</tr>
</tbody>
</table>

Maximum pedal effort = 685 N.

Ambient temperature = 0–40 degrees C.

Wind component = not to exceed 15 km/h opposing direction of vehicle travel.

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Ensure that brake disc and drum temperatures are not in excess of 100 degrees C.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Modulate the brake control effort to achieve maximum retardation whilst monitoring display to ensure that 685 N is not exceeded.
- Determine initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts.
- This procedure is repeated for all three required initial speeds.

During this test record no less information than that shown on the following sample data sheet.

RESULTS: ‘Service Brake Lightly Laden Effectiveness Test’ (Test Item 3)

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum control effort (N)</th>
<th>Average decel (m/s²)</th>
<th>Vehicle within lane? Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
6.4.2.4 Test Item 4 ‘Lightly laden Secondary Brake Test’ (Clause 35.5.4). This test specifies required deceleration levels from a particular initial speed range. One of two alternate procedures will be applicable to this test sequence. Procedure ‘A’ relates to secondary brakes which are not applied by the service brake control. Procedure ‘B’ relates to secondary brakes applied by the service brake control and includes test conditions relating to component failure. In either procedure these deceleration levels must be achieved in no more than six attempts.

Test conditions:

Vehicle mass = Lightly Loaded Test Mass
Gear selector position = Neutral
Vehicle Category
- MB, MC, MD, ME = Initial velocity = 60 km/h = 2.10 m/s²
- NA = 70 km/h = 2.00 m/s²
- NB = 50 km/h = 1.85 m/s²
- NC = 40 km/h = 1.80 m/s²

Maximum control effort
- Foot 685 N
- Hand 590 N

Ambient temperature = 0-40 degrees C
Wind component = not to exceed 15 km/h opposing direction of vehicle travel.

Procedure:
- Determine which procedure is to be conducted, i.e. is the Secondary Brake applied through the service brake control or not.
- Procedure ‘A’ (Not by service brake control)
  - Measure and record ambient temperature, wind speed and wind direction.
  - Ensure that brake disc and drum temperatures are not in excess of 100 degrees C.
  - Accelerate the vehicle to a speed in excess of the required initial velocity.
  - Place the transmission in the neutral position.
  - Coast down to required initial velocity and commence deceleration.
  - Modulate the brake control effort to achieve maximum retardation whilst monitoring display to ensure that 685 N for foot control or 590 N for hand control is not exceeded.
  - Determine initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
  - Calculate minimum average deceleration.
  - Repeat test sequence as required but not exceeding a total of six attempts.

RESULTS: ‘Lightly Laden Secondary Brake Test’. Procedure ‘A’ (Test Item 4A)

<table>
<thead>
<tr>
<th>Test site</th>
<th>Date:</th>
<th>Vehicle Category:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature:</td>
<td>degrees C.</td>
<td></td>
</tr>
<tr>
<td>Wind speed:</td>
<td>km/h</td>
<td></td>
</tr>
<tr>
<td>Wind direction relative to vehicle travel</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>Decel No.</td>
<td>Initial velocity (km/h)</td>
<td>Stopping distance (m)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculate Minimum Average Deceleration using the following formula:

\[ \text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2 \times (\text{Stopping dist})} \]

Comments:
- The following modes of failure are to be induced individually prior to each test:
  (i) Each sub-system of a split system.
  (ii) Failure of a brake power assist unit. In each case failure is induced by venting the appropriate storage unit or pressure line.
- Measure and record ambient temperature, wind speed and wind direction.
- Measure and ensure that brake disc and drum temperatures are not more than 100 degrees C.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Modulate the brake control effort to achieve maximum retardation whilst monitoring display to ensure that 685 N for foot control or 590 N for hand control is not exceeded.
- Determine initial velocity, stopping distance and maximum pedal effort and record on the test data sheets.
- Calculate minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts for each failure condition.
- Restore the braking system to normal function on completion of testing to each failure condition.
During this test record no less information than that shown on the following sample data sheet.

RESULTS: ‘Lightly Laden Secondary Brake Test’. Procedure ‘B’. (Test Item 4B)

<table>
<thead>
<tr>
<th>Test site:</th>
<th>Date:</th>
<th>Vehicle Category:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature:</td>
<td>degrees C.</td>
<td></td>
</tr>
<tr>
<td>Wind speed:</td>
<td>km/h</td>
<td></td>
</tr>
<tr>
<td>Wind direction relative to vehicle travel</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>Mode of Failure: (identify)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- sub-system of split system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- power assist unit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity</th>
<th>Stopping distance</th>
<th>Maximum pedal effort</th>
<th>Average decel</th>
<th>Vehicle within lane?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(km/h)</td>
<td>(m)</td>
<td>(N)</td>
<td>(m/s^2)</td>
<td>Y/N</td>
</tr>
</tbody>
</table>

**Required Initial Speed ..... km/h**

1
2
3
4
5
6

Calculate Minimum Average Deceleration using the following formula:

\[ \text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2 \times (\text{Stopping dist})} \]

Comments:
6.4.2.5 Test Item 5. ‘Unladen Partial Failure Test’ (Clause 35.5.5). This procedure applies to systems where the secondary brake is applied by the service brake control and evaluates the system for minimum performance under specific component failure conditions. The following areas of failure are to be induced individually:
- Inoperative Antilock System
- Inoperative Variable Proportioning Brake System.

Test conditions:

Vehicle mass

Gear selector position

Vehicle Category

Initial velocity

MB, MC, MD, ME

NA

NB

NC

Maximum control effort

Ambient temperature

Wind component

= Lightly Loaded Test Mass
= Neutral
= 60 km/h
= 70 km/h
= 50 km/h
= 40 km/h
= 685 N
= 0-40 degrees C.
= not to exceed 15 km/h opposing direction of vehicle travel.

Test conditions:

Vehicle Category Initial velocity Minimum average deceleration
MB, MC, MD, ME = 60 km/h = 2.10 m/s²
NA = 70 km/h = 2.00 m/s²
NB = 50 km/h = 1.85 m/s²
NC = 40 km/h = 1.80 m/s²

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Induce one only system failure as described in vehicle preparation (Section 6.1.1.2).
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place transmission in neutral position.
- Coast down to the required initial speed and commence deceleration.
- Modulate the brake pedal effort to achieve maximum retardation whilst monitoring the display to ensure that 685 N is not exceeded.
- Determine the initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate the minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts.
- Restore the brake system to normal condition.
- Repeat this procedure for each applicable mode of failure.

During this test sequence record no less information than that shown on the following sample data sheet.
RESULTS: ‘Unladen Partial Failure Test’. (Test Item 5)
One data sheet required for each test and failure mode.

<table>
<thead>
<tr>
<th>Test site:</th>
<th>Date:</th>
<th>Vehicle Category:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature:</th>
<th>degrees C.</th>
<th>System Partially Failed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind speed:</th>
<th>km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Wind direction relative to vehicle travel | -----
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Average decel (calc) (m/s²)</th>
<th>Vehicle within lane?</th>
<th>Y/N</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

Required Initial Speed ...... km/h

**INOPERATIVE ANTILOCK SYSTEM**

1

2

3

4

5

6

**VARIABLE PROPORTIONING BRAKE SYSTEM FAILURE**

1

2

3

4

5

6

Calculate Minimum Average Deceleration using the following formula:-

\[
\text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2x(\text{Stopping dist})}
\]

Comments:
6.4.2.6 Test Item 6. ‘Service Brake Laden Effectiveness Test’ (Clause 35.5.6). This test specifies required deceleration levels from three particular initial speed ranges. These deceleration levels must be achieved in no more than six attempts in each case.

Test conditions:
Vehicle mass = Maximum loaded test mass
Gear selector position = Neutral

Acceptance criteria:

<table>
<thead>
<tr>
<th>Vehicle Category</th>
<th>Initial test velocity</th>
<th>Minimum average deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB, MC, MD, ME</td>
<td>(i) 30 km/h</td>
<td>Velocity (i) 3.03 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 60 km/h</td>
<td>: (ii) 3.78 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td>: (iii) 4.19 m/s²</td>
</tr>
<tr>
<td>NA</td>
<td>(i) 35 km/h</td>
<td>Velocity (i) 2.97 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 70 km/h</td>
<td>: (ii) 3.55 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td>: (iii) 3.78 m/s²</td>
</tr>
<tr>
<td>NB</td>
<td>(i) 25 km/h</td>
<td>Velocity (i) 2.62 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 50 km/h</td>
<td>: (ii) 3.29 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td>: (iii) 3.78 m/s²</td>
</tr>
<tr>
<td>NC</td>
<td>(i) 20 km/h</td>
<td>Velocity (i) 2.38 m/s²</td>
</tr>
<tr>
<td></td>
<td>(ii) 40 km/h</td>
<td>: (ii) 3.09 m/s²</td>
</tr>
<tr>
<td></td>
<td>(iii) 100 km/h</td>
<td>: (iii) 3.78 m/s²</td>
</tr>
</tbody>
</table>

Maximum pedal effort = 685 N
Ambient temperature = 0-40 degrees C
Wind component = not to exceed 15 km/h opposing direction of vehicle travel

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Measure and ensure that brake disc and drum temperatures are not greater than 100 degrees C.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Modulate the brake pedal effort to achieve maximum retardation whilst monitoring display to ensure that 685 N is not exceeded.
- Determine initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts.
- This procedure is repeated for all three required initial speeds.

During this test record no less information than that shown on the following sample data sheet.
# RESULTS: ‘Service Brake Laden Effectiveness Test’ (Test Item 6)

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Average decel (calc) (m/s²)</th>
<th>Vehicle within lane? Y/N</th>
</tr>
</thead>
</table>

Initial Speed Ref (i)

1
2
3
4
5
6

Initial Speed Ref (ii)

1
2
3
4
5
6

Initial Speed Ref (iii)

1
2
3
4
5
6

Calculate Minimum Average Deceleration using the following formula:

\[
\text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2x(\text{Stopping dist})}
\]

Comments:
6.4.2.7 Test Item 7 ‘Laden Secondary Brake Test’. (Clause 35.5.7). This test specifies required deceleration levels from a particular initial speed range. One of two alternate procedures will be applicable to this test sequence. Procedure ‘A’ relates to secondary brakes which are not applied by the service brake control. Procedure ‘B’ relates to secondary brakes applied by the service brake control and includes test conditions relating to component failure. In either procedure these deceleration levels must be achieved in no more than six attempts.

Test conditions:

<table>
<thead>
<tr>
<th>Vehicle mass</th>
<th>= Maximum Loaded Test Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear selector position</td>
<td>= Neutral</td>
</tr>
<tr>
<td>Initial velocity</td>
<td>Minimum average deceleration</td>
</tr>
<tr>
<td>MB, MC, MD, ME</td>
<td>= 60 km/h</td>
</tr>
<tr>
<td>NA</td>
<td>= 70 km/h</td>
</tr>
<tr>
<td>NB</td>
<td>= 50 km/h</td>
</tr>
<tr>
<td>NC</td>
<td>= 40 km/h</td>
</tr>
<tr>
<td>Maximum control effort</td>
<td>= Foot 685 N</td>
</tr>
<tr>
<td>= Hand 590 N</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>= 0-40 degrees C</td>
</tr>
<tr>
<td>Wind component</td>
<td>= not to exceed 15 km/h opposing direction of vehicle travel</td>
</tr>
</tbody>
</table>

Procedure:

- Determine which procedure is to be conducted, i.e. is the Secondary Brake Applied through the service brake control or not.

Procedure ‘A’. (Not by service brake control)
- Measure and record ambient temperature, wind speed and wind direction.
- Measure and ensure that brake disc and drum temperatures are not above 100 degrees C.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Modulate the brake control effort to achieve maximum retardation whilst monitoring display to ensure that 685 N for foot control or 590 N for hand control is not exceeded.
- Determine initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts.


Test site:

<table>
<thead>
<tr>
<th>Date:</th>
<th>Vehicle Category:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature:</th>
<th>Wind speed: km/h</th>
<th>Wind direction relative to vehicle travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>degrees C.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Decel No. | Initial | Stopping | Maximum | Average | Vehicle |
|-----------| velocity| distance | control | decel   | within |
|           |         |          | effort  | (calc)  | lane?  |
|           | (km/h)  | (m)      | (N)     | (m/s²)  | Y/N    |

<table>
<thead>
<tr>
<th>Required Initial Speed..... km/h</th>
</tr>
</thead>
</table>

1
2
3
4
5
6

Calculate Minimum Average Deceleration using the following formula:

\[ \text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2 \times \text{Stopping dist}} \]

Comments:
**Test Item 7  Laden Secondary Brake Test.**

Procedure ‘B’. (By service brake control)

- The following modes of failure are to be induced individually prior to each test:
  (i) Each sub-system of a split system.
  (ii) Failure of a brake power assist unit. In each case failure is induced by venting the appropriate storage unit or pressure line.

- Measure and record ambient temperature, wind speed and wind direction.
- Measure and ensure that brake disc and drum temperatures are not more than 100 degrees C.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Modulate the brake control effort to achieve maximum retardation whilst monitoring display to ensure that 685 N for foot control or 590 N for hand control is not exceeded.
- Determine initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts for each failure condition.
- Restore the braking system to normal function on completion of testing to each failure condition.

During this test record no less information than that shown on the following sample data sheet.


One data sheet required for each mode of failure.

Test site:

| Ambient temperature: degrees C | Date |
| Wind speed: km/h | Vehicle Category: |
| Wind direction relative to vehicle travel | |

Mode of Failure: (identify) - sub-system of split system............................ - power assist unit..............................

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Average decel (m/s²)</th>
<th>Vehicle within lane? Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
</tbody>
</table>

**Required Initial Speed ..... km/h**

Calculate Minimum Average Deceleration using the following formula:-

\[
\text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2 \times (\text{Stoppin dist})}
\]

Comments:
6.4.2.8 Test Item 8. ‘Laden Partial Failure Test’. (Clause 35.5.8). This procedure applies to systems where the secondary brake is applied by the service brake control and evaluates the system for minimum performance under specific component failure conditions. The following areas of failure are to be induced individually.
- Inoperative Antilock System
- Inoperative Variable Proportioning Brake System

Test conditions:
Vehicle mass = Maximum Loaded Test Mass
Gear selector position = Neutral

Acceptance criteria:
Vehicle Category
Initial velocity
Minimum average deceleration
MB, MC, MC, ME
60 km/h
2.10 m/s²
NA
70 km/h
2.00 m/s²
NB
50 km/h
1.85 m/s²
NC
40 km/h
1.80 m/s²

Maximum control effort = 685 N
Ambient temperature = 0-40 degrees C
Wind component = not to exceed 15 km/h opposing direction of vehicle travel

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Induce one only system failure as described in vehicle preparation. (Section 6.1.1.2).
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place transmission in neutral position.
- Coast down to the required initial speed and commence deceleration.
- Modulate the brake pedal effort to achieve maximum retardation whilst monitoring the display to ensure that 685 N is not exceeded.
- Determine the initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate the minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts.
- Restore the brake system to normal condition.
- Repeat this procedure for each applicable mode of failure.
During this test sequence record no less information than that shown on the following sample data sheet.
RESULTS: ‘Laden Partial Failure Test’. (Test Item 8)

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Average decel (calc) (m/s²)</th>
<th>Vehicle within lane? Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Required Initial Speed .... km/h

INOPERATIVE ANTILOCK SYSTEM

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

VARIABLE PROPORTIONING BRAKE SYSTEM FAILURE

<p>| | | | |</p>
<table>
<thead>
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</thead>
<tbody>
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<td></td>
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<tr>
<td>6</td>
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</tr>
</tbody>
</table>

Calculate Minimum Average Deceleration using the following formula:-

\[
Av \text{ decel} = \frac{(Init. \text{ velocity} / 3.6)^2}{2x(\text{Stopping dist})}
\]

Comments:
6.4.2.9 Test Item 9. ‘Service Brake Fade Test’. (Clause 35.5.9). This test evaluates the braking system under induced fade conditions. The test specifies a sequence of decelerations from a particular initial speed range to a final speed range. One of two alternate procedures will be applicable to this test. Procedure ‘A’ Track testing and Procedure ‘B’ Dynamometer testing.

Test conditions:
- Vehicle mass = Maximum Loaded Test Mass
- Gear selector position = Drive
- Vehicle Category
  - Initial velocity
  - Final velocity
  - MB, MC, MD, NA = 100 km/h = 50 km/h
  - ME, NB, NC = 60 km/h = 30 km/h
- Initial and final speeds may be varied if required. If this option is taken speeds must comply with the requirements of clause 35.5.9.1.1.2 of the ADR. If the test vehicle is not able to attain the required initial velocity to meet the requirements of above tests, Tests shall be conducted at 80% of the maximum laden vehicle speed and the final velocity shall not be more than half of the initial speed.
- Maximum pedal effort = 685 N
- Maximum period between consecutive decelerations
  - MB, MC, MD, NA = 55 s
  - ME, NB, NC = 60 s
- Minimum time period at initial speed = 10 s
- Number of decelerations
  - MB, MC, MD, NA = 15
  - ME, NB, NC = 20
- Ambient temperature = 0-40 degrees C
- Wind component = not to exceed 15 km/h opposing direction of vehicle travel.

Acceptance criteria:
- Nil. (Conditioning procedure only.)

Procedure ‘A’: Track Testing
- Measure and record ambient temperature, wind speed and wind direction.
- Accelerate the vehicle to a speed slightly in excess of the required initial velocity. (On the second and subsequent decelerations the time period from the start of the previous deceleration to the start of the current one is not to exceed the time specified. Gear selection is to be as recommended by the manufacturer for that speed range (Initial Speed).
- Commence deceleration.
- Modulate the brake pedal effort to achieve a sustained retardation not less than 3.0 m/s$^2$ for the first retardation. Note and record the pedal control effort required to achieve this retardation value. All subsequent decelerations shall be conducted by modulation of the brake pedal effort to this determined value.
- The sustained deceleration level should be attained within one second of commencement of the deceleration. The control force must be maintained until the vehicle velocity is equal to or less than the specified value.
- On completion of the retardation the vehicle is to be immediately accelerated at wide open throttle to the required initial velocity and maintained for no less than 10 seconds. Commence next deceleration.
- The following information is to be recorded on the data sheets by the observer or by instrumentation for each cycle: Cycle times, initial/final velocity, maximum pedal effort and minimum sustained deceleration (optional).
- Repeat for a total of deceleration cycles as applicable to the category of test vehicle.

NOTE: Immediately on completion of this procedure, Test Item 10 must be conducted.

During this procedure record no less information than that shown on the following sample data sheets
## RESULTS: ‘Service Brake Fade Test’.

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Time at initial speed (sec)</th>
<th>Final velocity (km/h)</th>
<th>Cycle time (sec)</th>
<th>Maximum pedal effort N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>19</td>
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<td>20</td>
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</tr>
</tbody>
</table>

**Comments:**

**NOTE:** Proceed immediately to Test Item 10.

### Service Brake Fade Test

Procedure ‘B’: Dynamometer testing

Testing is to be conducted to the requirements of clause 35.5.9.2 and clause 35.6 of the ADR.

On completion of this test proceed to Test Item 11.
6.4.2.10 Test Item 10 ‘Service Brake Fade Effectiveness Test’. (Clause 35.5.10). This test calls for a single sustained deceleration which is to be conducted immediately on completion of Test Item 9.

Test Conditions:
Vehicle mass = Maximum Loaded Test Mass
Gear selector position = Neutral
Vehicle Category Initial velocity Minimum average deceleration
MB, MC, MD, ME = 60 km/h = 3.02 m/s²
NA = 70 km/h = 2.85 m/s²
NB = 50 km/h = 2.63 m/s²
NC = 40 km/h = 2.47 m/s²
Maximum control effort = 685 N
Ambient temperature = 0-40 degrees C
Wind component = not to exceed 15 km/h opposing direction of vehicle travel

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Accelerate the vehicle to the specified initial speed over a distance of no more than 1.6 km from commencement of acceleration.
- Place transmission in neutral position.
- Ensure that the required initial velocity is maintained and commence deceleration.
- Modulate the brake pedal effort to achieve maximum deceleration whilst monitoring the pedal control effort. The control effort is not to exceed 685 N.
- On completion of the deceleration record all results on the test data sheet.

RESULTS: ‘Service Brake Effectiveness Test’. (Test Item 10)

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Within lane? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Initial Speed ...... km/h</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculate Minimum Average Deceleration using the following formula:-
\[
Av \text{ decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2 \times (\text{Stopping dist})}
\]

Minimum Average Deceleration.........................m/s².

Comments:
6.4.2.11 Test Item 11 ‘Service Brake Water Conditioning Procedure’ (Clause 35.5.11). This procedure prepares the vehicle braking system for the water recovery procedure and effectiveness test. Two optional procedures are permitted to condition the brakes. Procedure ‘A’ is by appropriate immersion of the brakes in a water facility and Procedure ‘B’ is by pump delivered water spray.

Procedure ‘A’ (Immersion)

Test Conditions:
- Vehicle mass = Maximum Loaded Test Mass
- Gear selector position = Drive/Reverse
- Maximum velocity = 10 km/h
- Minimum velocity = 5 km/h Except for change of direction in water facility
- Conditioning period = Not less than 2 minutes
- Maximum period below 5 km/h = 1 minute
- Ambient temperature = 0-40 degrees C

Procedure:
- Measure and record ambient temperature.
- Ensure that the water facility level is not below 60% of the static loaded radius of the tyres fitted.
- On driving the vehicle into the facility total time period count is to be commenced.
- During this procedure a cumulative time count is to be maintained of the periods of vehicle velocity below 5 km/h.
- Accelerate the vehicle to not more than 10 km/h and maintain for sufficient length of the facility to allow slow down space to the end of the facility.
- Select reverse gear and accelerate to not more than 10 km/h and maintain as above.
- Repeat these operations until an elapsed period of greater than two minutes is achieved.
- The vehicle is to be removed from the facility and the water recovery procedure (Test Item 12) is to be commenced immediately.

During this procedure record no less information than that shown on the sample data sheet following the Service Brake Water Effectiveness Test (Test Item 13).

Procedure ‘B’ (Water Spray)

Test Conditions:
- Vehicle mass = Maximum Loaded Test Mass
- Conditioning period = 5 minutes
- Water delivery rate = Not less than 25 litres per minute for each brake assembly.

Procedure:
- Connect water delivery hoses to each brake assembly.
- Start pump and timing device.
- Continue conditioning process for a period of not less than 5 minutes.
- Disconnect pump from the delivery manifold.
- Test Item 12 is to be commenced immediately.

During this procedure record no less information than that shown on the sample data sheet following the Service Brake Water Effectiveness Check. (Test Item 13).

RESULTS: ‘Service Brake Water Conditioning Procedure’ (Test Item 11)

By Immersion:
- Test site: Date: 
- Required water depth............... Actual............... 
- Maximum speed during conditioning = ........... km/h 
- Total conditioning period = .......... seconds 
- Total period below 5 km/h = .......... seconds 

By Water Spray:
- Test Site: Date: 
- Total water delivery rate required = .......... litres/min. (@ 25 litres/min/brake assy.) 
- Total conditioning period = .......... seconds
6.4.2.12 Test Item 12 ‘Service Brake Water Recovery Procedure’. (Clause 35.5.12). This procedure is to be conducted immediately following the water conditioning procedure. The procedure calls for four sustained decelerations at a specified level. During this procedure the test vehicle braking system may not be applied except for the specified deceleration.

Test Conditions:
- Vehicle mass = Maximum loaded test mass
- Gear selector position = Drive
- Vehicle Category
  - MB, MC, MD, ME = 60 km/h
  - NA = 70 km/h
  - NB = 50 km/h
  - NC = 40 km/h
- Minimum deceleration level = 2.00 m/s²
- Maximum pedal effort = 685 N
- Ambient temperature = 0-40 degrees C
- Wind component = not to exceed 15 km/h opposing direction of vehicle travel
- Number of stops = Four

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Accelerate the vehicle to the specified initial speed and maintain for no more than 1.6 km from commencement of acceleration.
- Ensure that the required initial velocity is maintained and commence deceleration.
- Modulate the brake pedal effort to achieve no less than 2.0 m/s² deceleration whilst monitoring the pedal control effort. The control effort is not to exceed 685 N.
- On completion of the deceleration immediately accelerate the vehicle and repeat the test sequence until a total of four complete cycles have been carried out.
- The Service Brake Water Effectiveness Test (Test Item 13) is to be conducted immediately on completion of this procedure.

During this procedure record no less information than that shown on the sample data sheet following the Service Brake Water Effectiveness Test (Test Item 13).

RESULTS: ‘Service Brake Water Recovery Procedure’ (Test Item 12)

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Sustained decel (m/s²)</th>
<th>Cycle distance (m)</th>
<th>Maximum pedal effort (N)</th>
<th>Vehicle in lane? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
6.4.2.13 Test Item 13 ‘Service Brake Water Effectiveness Test’ (Clause 35.5.13). This test calls for a single sustained deceleration which is to be conducted immediately on completion of Test Item 12.

Test Conditions:

<table>
<thead>
<tr>
<th>Vehicle mass</th>
<th>Maximum Loaded Test Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gear selector position</td>
<td>Neutral</td>
</tr>
<tr>
<td>Vehicle Category</td>
<td>Initial velocity</td>
</tr>
<tr>
<td>MB, MC, MD, ME</td>
<td>= 60 km/h = 2.27 m/s²</td>
</tr>
<tr>
<td>NA</td>
<td>= 70 km/h = 2.13 m/s²</td>
</tr>
<tr>
<td>NB</td>
<td>= 50 km/h = 1.97 m/s²</td>
</tr>
<tr>
<td>NC</td>
<td>= 40 km/h = 1.85 m/s²</td>
</tr>
<tr>
<td>Maximum control effort</td>
<td>= 685 N</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>= 0-40 degrees C</td>
</tr>
<tr>
<td>Wind component</td>
<td>= not to exceed 15 km/h opposing direction of vehicle travel</td>
</tr>
</tbody>
</table>

Acceptance criteria:

<table>
<thead>
<tr>
<th>Vehicle Category</th>
<th>Initial velocity</th>
<th>Minimum average deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB, MC, MD, ME</td>
<td>= 60 km/h</td>
<td>= 2.27 m/s²</td>
</tr>
<tr>
<td>NA</td>
<td>= 70 km/h</td>
<td>= 2.13 m/s²</td>
</tr>
<tr>
<td>NB</td>
<td>= 50 km/h</td>
<td>= 1.97 m/s²</td>
</tr>
<tr>
<td>NC</td>
<td>= 40 km/h</td>
<td>= 1.85 m/s²</td>
</tr>
</tbody>
</table>

Procedure:
- Measure and record ambient temperature, wind speed and wind direction. Accelerate the vehicle to the specified initial speed and maintain for no more than 1.6 km from commencement of acceleration.
- Ensure that the required initial velocity is maintained and commence deceleration after placing transmission in neutral.
- Modulate the brake pedal effort to achieve maximum deceleration whilst monitoring the pedal control effort. The control effort is not to exceed 685 N.
- On completion of the deceleration record all results on the test data sheet.

During this procedure record no less information than that shown on the following sample data sheet.

RESULTS: ‘Service Brake Water Effectiveness Check’ (Test Item 13)

<table>
<thead>
<tr>
<th>Test Site:</th>
<th>Date:</th>
<th>Vehicle Category:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature:</td>
<td>degrees C</td>
<td></td>
</tr>
<tr>
<td>Wind speed:</td>
<td>km/h</td>
<td></td>
</tr>
<tr>
<td>Wind direction relative to vehicle travel</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>Decel No.</td>
<td>Initial velocity</td>
<td>Stopping distance</td>
</tr>
<tr>
<td></td>
<td>(km/h)</td>
<td>(m)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Required Initial Speed</th>
<th>.... km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Calculate Minimum Average Deceleration using the following formula:-

\[
\text{Av decel} = \frac{(\text{Init. velocity} / 3.6)^2}{2 \times (\text{Stopping dist})}
\]

Minimum Average Deceleration .................m/s².

Comments:
6.4.2.14 Test Item 14 ‘Service Brake Spike Stop 35/00 Procedure’. (Clause 35.5.14). This test specifies a series of decelerations to be conducted in the manner of ‘panic’ stops. This sequence is a conditioning procedure for the Spike Stop Effectiveness Test.

Test conditions:
- Vehicle mass = Maximum Loaded Test Mass
- Gear selector position = Neutral
- Initial velocity = 40 km/h
- Number of stops = Ten (10)
- Ambient temperature = 0-40 degrees C
- Wind component = not to exceed 15 km/h opposing direction of vehicle travel

Acceptance criteria:
- Systems with Brake Power Units:
  - Minimum actuation time = 400 ms for full travel of the pedal
- Systems without Brake Power Units:
  - Minimum pedal effort = 885 N
  - Minimum actuation time = 500 ms from point of application to attainment of 885 N effort

Procedure:
- Measure and record ambient temperature, wind speed and wind direction.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Apply full brake pedal effort as rapidly as possible and maintain until the vehicle is stationary.
- Check pedal effort trace to ensure that in excess of 885 N or full travel was achieved.
- Repeat this sequence for a total of ten stops.

During this procedure record no less information than that shown on the following sample data sheet.

RESULTS: ‘Service Brake Spike Stop 35/00 Procedure’ (Test Item 14)

<table>
<thead>
<tr>
<th>Test Site</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ambient temperature</th>
<th>degrees C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind speed</th>
<th>km/h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wind direction relative to vehicle travel</th>
<th>-----</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System with Brake Power Unit</th>
<th>(Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Minimum pedal effort (N)</th>
<th>Time to min. pedal effort (ms)</th>
<th>Time for full ped. travel (m/s)</th>
<th>Vehicle within lane? Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td></td>
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<tr>
<td>4</td>
<td></td>
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<td></td>
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<tr>
<td>5</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
6.4.2.15 Test Item 15 ‘Service Brake Spike Stop 35/00 Effectiveness Check’ (Clause 35.5.14). This test specifies required deceleration levels from a particular initial speed range. These deceleration levels must be achieved in no more than six attempts.

**Test conditions:**

- **Vehicle mass** = Maximum Loaded Test Mass
- **Gear selector position** = Neutral
- **Initial velocity**
  - **MB, MC, MD, ME** = 60 km/h = 3.02 m/s
  - **NA** = 70 km/h = 3.68 m/s
  - **NB** = 50 km/h = 2.63 m/s
  - **NC** = 40 km/h = 2.47 m/s
- **Maximum control effort** = 685 N
- **Ambient temperature** = 0-40 degrees C
- **Wind component** = not to exceed 15 km/h opposing direction of vehicle travel

**Acceptance criteria:**

<table>
<thead>
<tr>
<th>Vehicle Category</th>
<th>Initial velocity</th>
<th>Minimum average deceleration</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB, MC, MD, ME</td>
<td>60 km/h</td>
<td>3.02 m/s²</td>
</tr>
<tr>
<td>NA</td>
<td>70 km/h</td>
<td>2.84 m/s²</td>
</tr>
<tr>
<td>NB</td>
<td>50 km/h</td>
<td>2.63 m/s²</td>
</tr>
<tr>
<td>NC</td>
<td>40 km/h</td>
<td>2.47 m/s²</td>
</tr>
</tbody>
</table>

**Procedure:**

- Measure and record ambient temperature, wind speed and wind direction.
- Measure and ensure that brake disc and drum temperatures are not above 100 degrees C.
- Accelerate the vehicle to a speed in excess of the required initial velocity.
- Place the transmission in the neutral position.
- Coast down to required initial velocity and commence deceleration.
- Modulate the brake control effort to achieve maximum retardation whilst monitoring display to ensure that 685 N is not exceeded.
- Determine initial velocity, stopping distance, maximum pedal effort and record on the test data sheets.
- Calculate minimum average deceleration.
- Repeat test sequence as required but not exceeding a total of six attempts.

During this test record no less information than that shown on the following sample data sheet.

**RESULTS: ‘Service Brake Spike Stop 35/00 Effectiveness Check’ (Test Item 15)**

<table>
<thead>
<tr>
<th>Decel No.</th>
<th>Initial velocity (km/h)</th>
<th>Stopping distance (m)</th>
<th>Maximum control effort (N)</th>
<th>Average decel (m/s²)</th>
<th>Vehicle within lane? Y/N</th>
</tr>
</thead>
</table>
| Required Initial Speed ...... km/h
| 1          |
| 2          |
| 3          |
| 4          |
| 5          |
| 6          |

Calculate Minimum Average Deceleration using the following formula:-

\[
\text{Av decel} = \frac{(\text{Init. velocity})^2}{2x(\text{Stopping dist})}
\]

Minimum Average Deceleration

Comments:
6.4.2.16 Test Item 16 ‘Parking Brake Test’ (Clause 35.5.16). This test validates the Parking Brake System by retention of the test vehicle on a specified test slope.

Test Conditions:
- Vehicle mass = Maximum Loaded Test Mass
- Maximum Actuation Effort = Hand operated 590 N
  = Foot operated 685 N
- Test slope = 18% grade
- Ambient temperature = 0-40 degrees C

Acceptance Criteria:
For each test condition the test vehicle must remain stationary on the test slope for not less than 5 minutes.

Procedure:
- Measure and record the ambient temperature.
- Position the test vehicle in a forward position on a 18% grade test slope so that the longitudinal vertical plane of the vehicle lies along the maximum gradient.
- Apply the service brake, disengage the transmission, and hold the vehicle on the slope.
- Apply the parking brake with a force not exceeding that specified in the test conditions. This application is to be in a single movement except in the case where the mechanism is designed to be applied by multiple actions.
- The service brake is then to be released.
- On release of the service brake a timing count is to be initiated.
- The vehicle must remain stationary for a period of not less than 5 minutes.
- If the vehicle does not remain stationary, apply the service brake and reapply the specified force without releasing the parking brake mechanism. Release the service brake and commence timing count again. This sequence may be carried out twice only.
- Note if park brake indicator lamp is operating during test.
- Record test data.
- Remove the vehicle from the test slope and reposition in a reversed orientation and repeat the full procedure.
- Record test data.

During this procedure record no less information than that shown on the following sample data sheet.

---

**RESULTS: ‘Parking Brake Test’**

<table>
<thead>
<tr>
<th>Test Site:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature:</td>
<td>degrees C</td>
</tr>
<tr>
<td>Test slope gradient?</td>
<td></td>
</tr>
<tr>
<td>Parking brake operation mode:</td>
<td>Hand</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vehicle attitude</th>
<th>Up</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake application force (N)</td>
<td>......</td>
<td>......</td>
</tr>
<tr>
<td>Number of applications</td>
<td>......</td>
<td>......</td>
</tr>
<tr>
<td>Indicator lamp operation (Y/N)</td>
<td>......</td>
<td>......</td>
</tr>
<tr>
<td>Period stationary on slope (min.)</td>
<td>......</td>
<td>......</td>
</tr>
</tbody>
</table>

Comments:
6.4.2.17 Test Item 17 ‘Service Brake Actuating Time Test’ (Clause 35.5.16) This test evaluates systems which use air at positive pressure as the energy media. The test assesses the energy transmission capability in terms of actuation times. The test is also to be conducted, in addition, on trailer brake line attachments if vehicle is equipped to tow a trailer which uses air at positive pressure as the brake operating medium.

Test Conditions:
- Vehicle stationary.
- Acceptance Criteria:
  - Actuation time within 600 ms from initial pedal movement to 65% of Average Operating Pressure at farthest Brake Chamber.

Procedure:
- Set up the instrumentation as per section 6.4.1.
- Ensure that the pedal microswitches trigger with the least possible initial movement of the pedal.
- The pressure transducer is to be fitted to the brake chamber on the longest line from the control pedal.
- Charge the energy storage devices to not more than Average Operating Pressure.
- Start the chart recorder and actuate the control pedal. The pedal is to be moved to full travel in the shortest time possible.
- Stop the recorder after approximately 2 seconds of operation.
- Examine chart recording and determine results.
- In the case of vehicles fitted with trailer air brake attachments repeat the test with the pressure transducer fitted to the supply coupling via a pressure line of not less than 13 mm internal diameter and not less than 2.5 m long.

During this procedure record no less information than that shown in the following sample data sheets.

**RESULTS: ‘Service Brake Actuation Time Test’ (Test Item 17)**

<table>
<thead>
<tr>
<th>Test Site:</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Vehicle System Only:**
- Nominate brake chamber tested: .................................................. (Longest brake line)
- Nominate Charge Pressure .........................................................
- Nominate Average Operating Pressure (AOP) ............................
- From chart recording: Time to 65% of AOP .............................

**Trailer Coupling:**
- 2.5 m x 13 mm ID extension added? Y/N ..............................
- Nominate Charge Pressure .........................................................
- Nominate Average Operating Pressure (AOP) ............................
- From chart recording: Time to 65% of AOP .............................

**Comments:**
6.4.3 Determination of Results. Results are determined directly from the test data sheets and no computation is required. All original data that is used for determining results is to be retained as either part of the Testing Facility’s internal report or in a separate original data file.

6.4.4 Reporting of Results. For these tests a complete internal report giving a full description of the material tested, equipment used, results and order of accuracy is to be prepared. For submission to the Administrator the report number(s) for the above test(s) is to be entered in the appropriate section of the Summary of Evidence Report - see Section 8.

7 ANALYSIS OF RESULTS

The vehicle is deemed to meet the appropriate requirements of ADR 35/00 if the results achieved satisfy the acceptance criteria, as detailed in each test item of the procedure, following correction for instrument accuracy.

8 SUMMARY OF EVIDENCE REPORT

The Summary of Evidence Report SE 35/00 and Selection of Test Fleet SF 35/00 are the only documents to be sent to the Administrator for demonstration of compliance to ADR 35/00. The original test report identification number, the location of the test report, the test facility identification number and the determined results are to be recorded in the appropriate place in the SE 35/00 form for each relevant clause of the ADR.

The technical requirements of ECE R 13/01 to 13/06 “Braking” shall be deemed to be equivalent to the technical requirements of the following Clauses of this Rule, provided that forward-control passenger vehicles (MB) and off-road passenger vehicles (MC) comply with ECE vehicle category M1 requirements and subject to the following:

The requirements of Clause 35.2 (except Clauses 35.2.3.6.3, 35.2.5.6 and 35.2.5.7) shall be met.

In the case of vehicle categories MB, MC and MD1, the requirements of Clauses 35.5.11, 35.5.12 and 35.5.13 shall be met.

In the case of service brake systems without a ‘Brake Power Unit 35/00’, the requirements of Clauses 35.5.14 and 35.5.15 shall be met.

In these cases the Evidence Summary SE 35/00 is to be completed.

10. REFERENCES

ADR References
ADR Definitions
ADR 18/00 - Instrumentation
ADR 35/00 - Commercial Vehicle Braking Systems
ECE R13/01 to 13/05 - Braking
Circulars
Circular 0-12-2 General Requirements for Test Facilities
Circular 0-12-3 - General requirements for Calibration of Test Equipment
ANNEX A

TEST EQUIPMENT DIAGRAMS