Transport Roads & Maritime Services

NSW GOVERNMENT

Test method T189

Determination of skid resistance by sideways force measuring equipment

November 2013

Revision Summary

Ed/Rev Number	Clause Number	Description of Revision	Authorisation	Date
Ed 1/ Rev 0		Reformatted and Revision Summary Added	D.Dash	May 1999
Ed 1/ Rev 1		Date on Test Method Revised to Agree with Date on Revision	D.Dash	Feb 2001
Ed 2/ Rev 0		Reformatted and Revision Summary added	George Vorobieff	April 2012
Ed 2/Rev 1		Generally revised	J Friedrich	Nov 2013

Note that Roads and Maritime Services is hereafter referred to as 'RMS'.

The most recent revision to Test method T189 (other than minor editorial changes) are indicated by a vertical line in the margin as shown here.

Test method T189

Determination of skid resistance by sideways force measuring equipment

1. Scope

(a) This test method defines the procedure for measuring the skid resistance of a road pavement using a Sideways Force Measuring System such as the Sideways-force Coefficient Routine Investigation Machine (SCRIM).

(b) Testing can be carried out on both, Rigid and Flexible pavements. The pavements to be tested should be free of ice and snow and should be in a stable condition, (without large potholes or excessive patching), and should not include speed humps.

(c) The pavement is always tested with a film of water under the test tyres to simulate wet weather conditions. The tests are normally carried out at 50 km/h, however, the method allows for test speeds of 20 km/h, to be adopted in specific conditions such as roundabouts and curves with radius less than 100 m.

(d) The values measured represent the Skid Resistance properties obtained with the equipment and procedures stated herein and do not necessarily agree or correlate directly with those obtained by other pavement friction measuring methods.

(e) The values are intended for use in evaluating the Skid Resistance of a pavement relative to that of other pavements or for evaluating changes in the Skid Resistance of a pavement with the passage of time.

2. Definition

Term	Definition
Term	
The sideways-force coefficient	A measure of resistance to skidding. In dry conditions all clean, surfaced, roads have a high level of skid resistance whereas icy or snow covered roads are invariably slippery. Under wet conditions, the Skid resistance of these same roads lies between these extremes and is much less uniform. It will depend on a number of factors, including the aggregates used in the road surface, the physical layout of the site, the preceding weather conditions, the surface texture and the number and type of vehicles using the road. Skidding is most likely to occur during braking, acceleration or sudden changes in direction.
A freely rotating test wheel	A wheel fitted with a standard smooth tyre is inclined at a 20 degree angle to the direction of motion of the vehicle to generate the maximum sideways-force on all surfaces requiring testing. This makes testing less sensitive to small changes in the angle of the test wheel when the vehicle turns. The ratio of the force developed at right angles to the plane of the axis of the wheel to the load on the wheel, is the Sideways Force Coefficient (SFC).

3. Apparatus

3.1 Vehicle Specification

3.1.1 A Vehicle capable of:

(a) Maintaining constant specified speed during testing.

(b) Maintaining flow of the required volume of water to the road during testing.

(c) Mounting the inclined ballasted test wheel assemblies, including provision for raising and lowering.

(d) Maintaining the test wheel in the required test wheel path (particularly in difficult conditions such as tight radius curves).

(e) Providing storage of sufficient serviceable test wheels and tyres for expected duration of the test. This includes having all necessary tools, spares and associated equipment on board, such that any minor breakdown can be rectified in the field.

3.1.2 Other Equipment

(a) Standard test tyres and tubes of size 3.00 * 20 (Manufactured by the Avon Tyre Co., England), or equivalent.

(b) Suitable instrumentation, signal conditioning and a Data Acquisition System (DAS) capable of capturing and recording Skid Resistance values. The components of the system must confirm to manufacturers specifications. The exposed portions of the system shall tolerate 100% relative humidity (rain or spray) and all other adverse conditions, such as dust, shock, and vibrations which may be encountered in highway operations.

(c) Analogue strain gauges capable of measuring up to 4.5 kN with non linearity not exceeding 0.04%, linked to a data acquisition system capable of capturing and recording values for test intervals of 5 m.

(d) Suitable odometer or distance measuring device and relevant road location referencing system.

(e) Two test wheel assemblies positioned to test both pavement wheel paths. Each test wheel assembly is to be ballasted so that the load under the test wheel is 200 ± 2 kgs.

(f) Means of filling the water tank, with suitable water. A license may be required by the Local Water Authority to draw water, including a certificate for the use of a stand pipe.

(g) Means of checking test tyres to a working pressure of 350 ± 20 kPa.

(h) Means of determining air and road surface temperatures with an accuracy ± 1°C.

(i) Personal and vehicular hazard warning and safety devices, as required by governing law including WHS requirements.

4. Procedure

(a) Ascertain the exact start and end points of the survey. If there is any doubt, a check must be made with the client, or the Unit Supervisor.

(b) Record the surface temperature of the pavement in a non-shaded area.

(c) Follow instructions in the SCRIM - DAS software user manual for operating and enter the header information.

(d) Provide a regulated flow of water to maintain a mean film thickness of between 1.0 and 1.2 mm at the assembly contact point.

(e) Engage test assembly with road surface.

(f) Approach start of test lane at appropriate constant test speed.

(g) Start data acquisition at the nominated start point of the test site.

(h) Check data is being recorded and corresponds with distance measured and features observed, during testing.

(i) Follow the instructions as set out in the SCRIM-DAS User Manual and enter the relevant Site Categories and Features.

(j) On completion, stop data acquisition system, disengage test assembly and stop water flow.

(k) Punctured or damaged test tyres must be replaced. New test tyre(s) which must be worn in for 1 km before testing may continue from the last recorded feature before tyre failure. Damaged tyres must be discarded.

5. Driving

5.1 Speed

(a) Individual readings are affected by fluctuations in test speed, so a constant specified standard test speed of 50 ± 4 km/h must be maintained during testing. However, provision exists for a test speed of 20 ± 4 km/h for difficult sites such as roundabouts and curves of radius less than 100 metres.

(b) In some circumstances a particular speed may not be safe therefore the maximum safe speed must be adopted that is below the standard speed and within the prevailing speed limits. The minimum prevailing speed limit as set out in the Skid Resistance Guide is 30 km/h and the software program can apply a speed correction if required. If in such circumstances a minimum of 30 km/h cannot be safely maintained consideration must be given to testing at the 20 km/h speed level. Data captured outside specified test speed ranges must be flagged.

5.2 Test lane

(a) The lane tested shall be that used by the majority of the traffic, generally the slow (kerb) lane in a multi lane rural situation. Any exception to this must be noted.

(b) The skid resistance test vehicle must be driven with the test wheels in the observed worn wheel paths on the road pavement.

(c) The selected lane must be followed throughout the survey wherever possible. On the change from single to dual carriageway or dual climbing lanes, the kerb lane must be followed to its end. The change back to single carriageway is recorded as a lane change.

(d) Examples of correct lane testing configurations are given in Figures 2 to 8.

5.3 Overtaking

(a) Overtaking must be avoided where possible and is permitted only where it can be carried out without a change in test speed and providing that each lane is of similar pavement surface seal and wear as determined by the Operator. A note should be made of all such events that may influence the readings.

5.4 Road Surface Conditions

(a) Tracking of the vehicle must not be changed either to avoid or to encounter road irregularities such as potholes, excessive patching etc. unless it is likely to cause damage to the test assembly or the vehicle.

(b) Testing must be terminated if continuation is likely to cause damage of the test assembly or vehicle.

5.5 Rain

(a) The amount of rain may influence the Skid Resistance reading measured. Testing must be abandoned during sustained heavy rain (refer to section on "Safety" for details).

5.6 Data Collection and Reporting

(a) Data is collected every 5 metres and routinely reported in one hundred (100) metre intervals.

(b) The SCRIM reading is expressed as a positive, unsigned integer equivalent to SFC × 100

(c) Unedited raw data and vehicle calibration history must be retained in a secure long-term repository for up to 6 years.

(d) All data (where possible) must be collected using the relevant road location referencing system (eg. RoadLoc).

(e) Non-RoadLoc sites can be tested by noting features such as Kilometre signposts, cross streets, rivers/creeks, bridge abutments etc. All such reference points must be noted during the test and can be edited later, either at the time of a water fill up or at the end of the test run. Survey results shall be available for reporting in spreadsheet or database format.

6. Calibration

6.1. Frequency of Calibration

(a) Calibration is carried out every 1000 km of testing or every week, whichever comes first. After the completion of calibration, a copy of the data file is downloaded, stored and an entry must be made into a calibration log maintained in the office.

(b) After calibration replace test wheels, if required, and where possible, perform on-road verification at calibration sites with known Skid Resistance values.

(c) Standard equipment is a calibration jig complete with the load cell and a digital output. The load cell must have a current certificate of calibration, the validity of which is for 12 months only.

(d) Calibration should also be carried out under the following circumstances:

- When components likely to influence calibration are replaced, repaired or adjusted.
- Where damage could reasonably be anticipated, such as after striking a kerb.
- Before returning from a remote site, to ensure the authenticity of prior work.

6.2. Apparatus

The following equipment is required:-

(a) A digital voltmeter with the ranges of 0 to 24 volts and 0 to 20 millivolts.

(b) A stabilized power supply to provide voltages in the range of 0-24 volts.

(c) A jig which fits across the axle-box and wheel-flange of the equipment's test wheel assembly and carries the calibrated cell and a screw adjustment for loading the calibrated cell. (The calibration jig is shown in Figure 1).

(d) On-board computer to run the data acquisition system and store the information.

6.3. Calibration Procedure

The calibration procedure involves the following steps:

(a) Remove the test wheel from the test assembly, if necessary.

Note: Care must be taken to ensure that the ball on the load-cell is correctly aligned with the corresponding dimple on the axle. The jig must be designed to provide sufficient adjustment on the fixing screws to facilitate this alignment.

(b) Check that the brackets that support the calibration jig are not touching the axle housing as this will adversely affect the calibration, making it non-linear.

(c) The calibration load-cell is then connected to the digital display and power supply.

(d) The data cables should now be connected to the on-board computer.

(e) Turn on the vehicle's main power supply.

(f) Turn on the on-board computer.
When the SCRIM main menu appears on the computer screen, select the Calibration option and select left or right load cell for calibration.

(g) Ensure that there is no horizontal force on the test wheel axle, that is, set the load cell to the initial reading corresponding to 0 kgf as per the calibration certificate.

(h) The reading for the measurement at 0 is now accepted in the computer.

(i) To take the next measurement, tighten the loading screw until the output of the calibrated load-cell shows the digital display corresponding to 20 kgf per the calibration certificate.

(j) The SCRIM reading of 10 can now be accepted in the computer.

(k) Repeat the previous two steps in increments of 20 kgf until the SCRIM reading of 100 is reached and accepted in the computer.

(l) The graph generated on the computer screen should have a minimum best fit of 0.9999 to the straight line datum; these calibration data are then saved. If the line of best fit is less than 0.9999 repeat the procedure until an accuracy of 0.9999 is achieved.

(m) Perform calibration for both test assemblies.

6.4. Component Calibration

(a) Care should be taken to check and maintain any component(s) of the vehicle or testing system that could potentially influence the values obtained when recording results.

6.4.1. Odometer

(a) As far as possible the odometer must be calibrated each time the test wheel assembly is calibrated, as follows:

- Drive the vehicle to a known site where the start and end points have been accurately marked 1000 m apart on a straight stretch of road.
- Set up the computer to the Odo calibration mode and calibrate the odometer of the truck by carrying out at least 3 runs each, with the water tank full and empty, ensuring to start and stop (stationary to stationary) at the marks set on the pavement.
- An average of these runs is used for calibration purposes.

(b) At remote sites, where it is difficult to find an accurately marked 1000 m straight stretch of road, the odometer calibration need not be performed. In this case the last odometer calibration factors will be used

6.4.2. Water Flow

(a) The water flow through the nozzles must be within the range of 1.0 ± 0.2 litre/second with a water jet 300 mm wide wetting the pavement in front of the test tyres to ensure correct water film thickness.

(b) The water jets must be directed towards the test tyres and pointed towards the pavement at an angle of 20 to 30 degrees.

(c) Water used for testing must be reasonably clean and have no chemicals such as wetting agents, detergents, oil or oil based compounds added.

(d) Checks for water flow must be performed at every calibration using a stop watch and a measurable rectangular container which can fit under the nozzle.

7. Maintenance measures and logs

(a) Reasonable care of the vehicle is required between testing applications. It should be expected that people called upon for repairs, service or even installation will be unfamiliar with the maintenance of a skid resistance vehicle. For example linkages may be over tightened or components pre-stressed without knowledge of its effect. The following control is required.

- Only the particular fault which has been identified must be repaired and all other items MUST be left in their initial state (unless with the express permission of RMS personnel).
- Air pressure in the test tyres (fitted on rims) must be maintained to avoid tyre wall or tyre degeneration problems during storage.
- The test assembly on both sides must be greased every week at the time of calibration, using non water absorbent grease. Excess grease should be removed to prevent the accumulation of dirt.
- A compilation of the calibration history of a skid resistance vehicle must be maintained for up to 6 years.

(b) Records must detail:

- Modifications and adjustments that were required to achieve initial calibration.
- Any damage and subsequent repairs to the test equipment.
- Times and details of each calibration.

8. Filling of Water Tank and/or Auxiliary Tanker

(a) Only trained personnel are permitted to use a stand-pipe and a license may be required by the local water authority.

(b) Fill only at legal outlets.

(c) Fill or transfer at safe locations (off road and away from traffic).

9. Stoppages during Testing

(a) During the course of a survey it is inevitable that interruptions will occur. Some examples of abnormal stoppages are blown tyres, unexpected construction sites, debris on the road etc. Abnormal stoppages must be noted.

(b) Normal interruptions are usually the downloading of files, and the filling of the water tank and these could be planned at a feature point.

9.1. Construction Sites without Deviation

(a) Wheel up and wheel down are used to flag the beginning and end of a construction site.

9.2. Construction Sites with Deviation

(a) Testing should stop and continue from the next control point on the other side of the site.

(b) The final report should note that the RoadLoc link(s) covering the site does not contain valid data. If possible the link(s) should be tested using Non-RoadLoc format, and reported separately.

(c) A clearly defined start point as near as possible to the end of the deviation may be used. Details of the new start point and the reason for its use must be recorded on the header and the section should be tested as Non-RoadLoc.

10. Safety

(a) The test vehicle and attached instruments, must comply with all applicable State and Commonwealth laws. All necessary precautions must be taken beyond those imposed by laws and regulations to ensure maximum safety of operating personnel and other road users.

(b) In any circumstance either the driver or operator may nominate to cease operation (or not to commence) where safety to themselves or other road users is of concern.

(c) If testing of the site in the normal manner offers the possibility of danger to the testing staff or the public, the local RMS Office or the police should be consulted and any recommendations made must be complied with. If in the opinion of either, the prevailing conditions are unsafe for testing, the survey must not commence.

(d) When it is decided that it is not possible to carry out the survey safely, work must be abandoned, and the client informed.

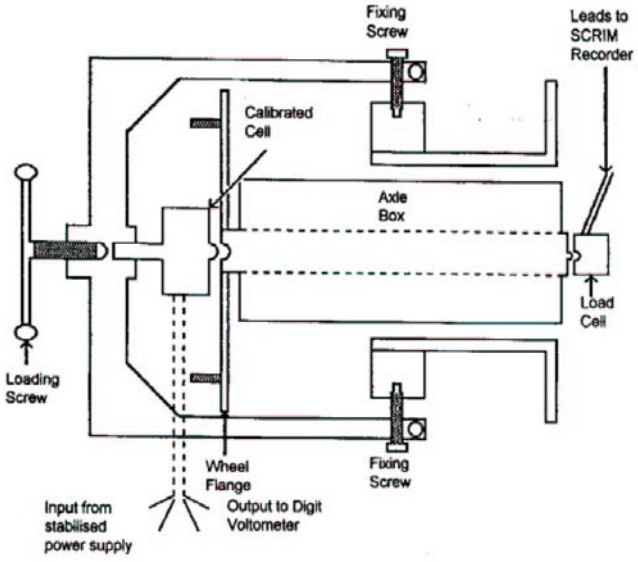

Fig 1. Calibration Jig

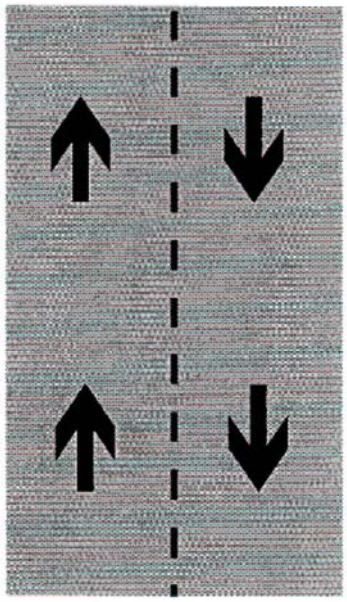

Fig 2. Single Carriageway
(lanes to be tested and direction of test)

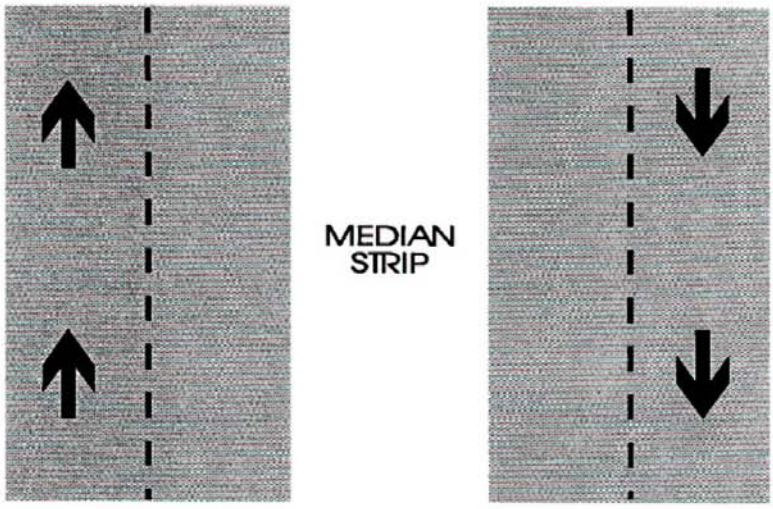

Fig 3. Dual Carriageway
(lanes to be tested and direction of test)

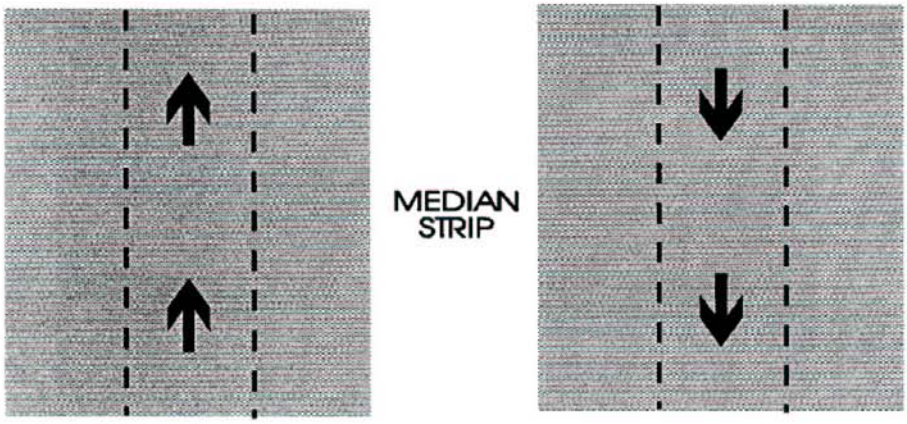

Fig 4. Three lane configuration
(lanes to be tested and direction of test)

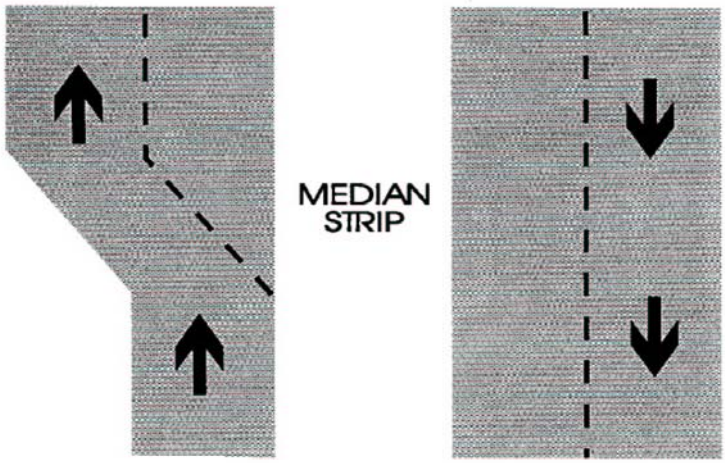

Fig 5. Slow Lane Hill Climb

NOTE: Follow the road markings into the slow lane until the lane ends and flag as a change of lane on re-entry to single carriageway.

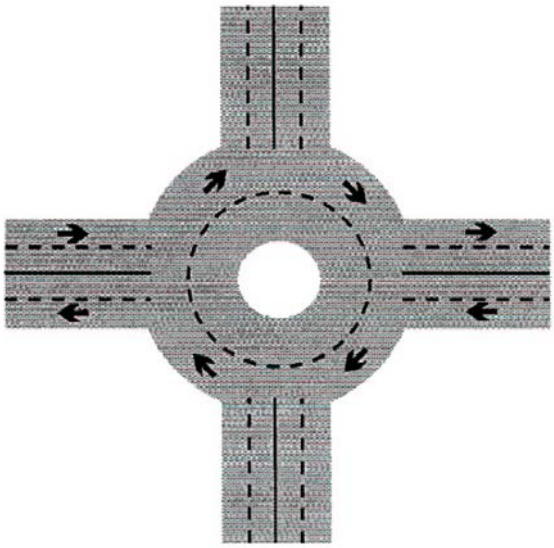

Fig. 6 Roundabout - Test Path Straight ahead

(lanes to be tested and direction of test)

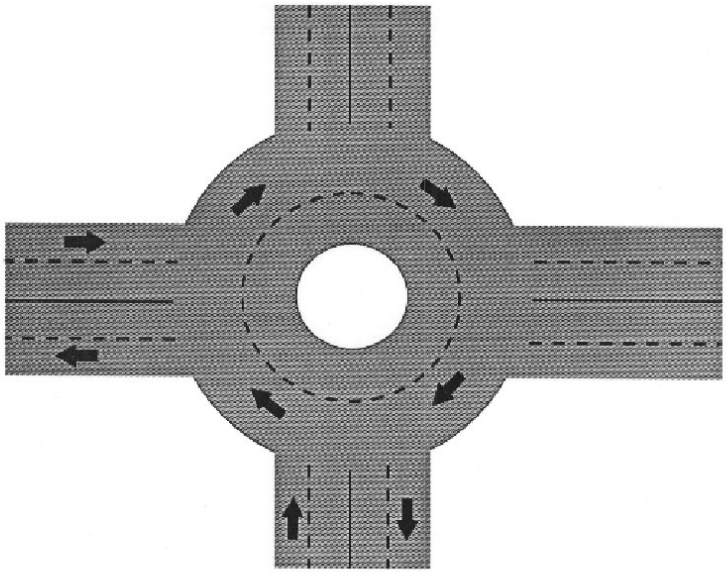

Fig 7. Roundabout - Test Path,
both left and right hand turn
(lanes to be tested and direction of test)

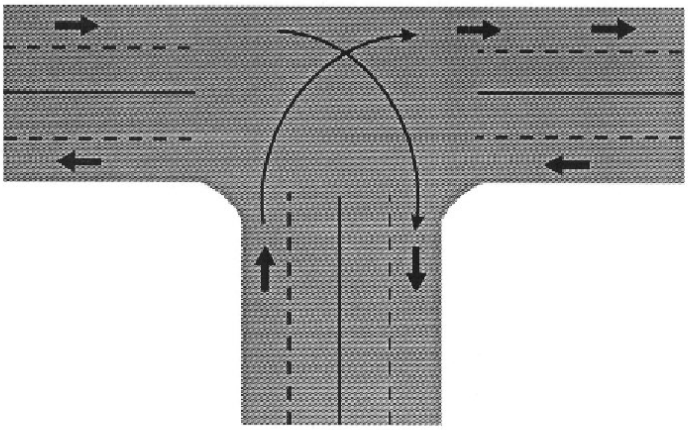

Fig 8. Multi-lane T-Junction into One Way Street
(lanes to be tested and direction of test)