CIRCULAR 21/00-9-1

TEST PROCEDURES
ADR 21/00-INSTRUMENT PANEL

“A Guide for Inspectors”

This Circular is relevant to the Third Edition of the
Australian Design Rules gazetted as
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1 SCOPE

This procedure, when read in conjunction with other Circulars issued by the Administrator, provides sufficient information, without reference to other standards, for the conducting and auditing of tests on instrument panels to demonstrate compliance with Australian Design Rule No. 21/00 Instrument Panel. For convenience reference to the ADR Clause Number is quoted in brackets against each appropriate section 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. 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 covers three (3) aspects:-
(i) Determination of Head Impact Areas
(ii) Instrument Panel Impact Tests
(iii) Interior Compartment Door Latch Security

This procedure is intended primarily as a guide for Officers of the Australian Department of Transport and Communications and 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 organisations.

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

2 SELECTION OF TEST COMPONENTS

This procedure applies to vehicles which are of the category specified in the ADR. The Instrument Panel Assembly is required, except for components shielded by the steering wheel or specifically excluded (Clause 21.2.2), to be impacted by a 6.8 kg, 165 mm head form at a velocity of 6.7 m/s or 5.31 m/s if the vehicle is fitted with a passenger side inflatable supplementary restraint system meeting the requirements of ADR 69/00. The head form deceleration shall not exceed 80 times the acceleration due to gravity continuously for more than 3 milliseconds. The assembly shall include all supporting structure.

3 IDENTIFICATION OF TEST COMPONENTS

The components submitted for test must be representative of the design condition as reflected in the production drawings.

If production parts are being tested they shall be drawn from a batch which has passed normal quality assurance procedures. They should then be identified against the production drawings. If prototype parts are being tested they should be individually inspected on a component by component basis for both dimensional and material compliance with the drawings.

In both cases the revision or issue status of the drawing to which the assemblies have been checked should be stated on all test records.

4 NUMBER OF TEST ASSEMBLIES

One complete assembly of the instrument panel and its supporting structure is usually required. Where designated impact points defined in Section 6.2.1.3 are within 100 mm of each other or where a dash compartment door is to be tested additional assemblies or sub-assemblies will be required. The assembly should include substructure, braces, instruments and other components located between the instrument panel and the vehicle bulkhead which could significantly influence the impact performance of the installed assembly.

5 EQUIPMENT

5.1 Head Impact Area Determination

5.1.1 Basic Equipment. The head impact area may be determined by drawing methods or by test. Where the head impact area is determined by test a spherical headform 165 mm in diameter attached to a measuring device having a pivot point to top of head dimension which is infinitely adjustable from 736 mm to 838 mm should be used. A headform is shown in Annex A Figure (c).

5.1.1.1 Measurement. The areas of the instrument panel assembly defined as being contactable by the procedure shall be determined.

5.1.1.2 Recording. The contactable areas determined shall be marked on the instrument panel or drawing so that the head impact area can be located.

5.2 Instrument Panel Impact Tests

5.2.1 Basic Equipment. The head impact test equipment shall consist of a rigid moving head form of 165 mm diameter with an effective mass
of 6.8 ±0.1 kg, and a rigid fixture to which the complete instrument panel can be mounted. The head form shall have sufficient offset with respect to its supporting structure to preclude contact of the structure with the instrument panel assembly during impact. The moving head form shall be mounted on a suitable fixture to enable impact with the instrument panel at a velocity of not less than 6.7 m/s or 5.31 m/s if the vehicle is fitted with a passenger side inflatable supplementary restraint system meeting the requirements of ADR 69/00. Various means are employed to provide the required velocity; some form of mechanical stored energy such as bungee cords or compression springs being generally used together with some form of release mechanism. (Clause 21.2.1).

A transducer mounted on the moving head form such that a complete deceleration/time curve is obtained using an oscillograph or other recording device. (Clause 21.2.1).

Test equipment which may be used for this test is shown in Annex A Figure (b).

5.2.2 Instrumentation

5.2.2.1 Measurement. Two items are required to be determined; velocity of the moving head just prior to impact and the deceleration/time curve of the moving head during impact. Velocity measurement is typically achieved by measuring the time taken for the head to pass through a ‘gate’ using photoelectric cells or similar devices with corresponding electronic circuits. Readout may be direct via a device on the electronic package or indirect via a light beam recorder. Deceleration/time measurement is generally achieved by the use of accelerometers, a system of amplifiers and a high speed output display device. The accelerometer output may be recorded in some other way and then fed into an analyser to provide the required deceleration/time trace remote from the test site.

5.2.2.2 Recording. Typical recording systems employ a light beam chart recorder with built in facility for producing accurate timing lines together with the necessary signal conditioners and pre-amplifiers.

5.2.2.3 Order of Accuracy. Except where specified in the ADR or referred documents, the following orders of accuracy are considered to be 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.

The velocity readout should be within ±5% of the actual velocity. The deceleration channel must have a frequency response flat to within ±5% from 1 to 1000 Hz.

To achieve these accuracies a chart recorder with a paper speed approaching 3 m/s is required and timing line generation with 0.1% accuracy is usually used. The accelerometer should have a frequency response from 1 to 1000 Hz. Instruments in accordance with the recommendations of SAE J211 Instrumentation for Impact Tests are satisfactory. Refer to Annex A Figure (a) for Table.

5.2.2.4 Calibration. Routine calibration of the velocity measuring system, the accelerometer and measurement recorder should be conducted in accordance with Circular 0-12-3.

5.2.3 Fixtures. The fixture used to mount the instrument panel assembly for the test shall provide a mounting at least as rigid as the actual vehicle mounting. The assembly shall be secured to a rigid support structure such that the leading edge and ends of the panel are rigidly affixed to the support.

5.3 Interior Compartment Door Tests

5.3.1 Door Position Tests. These tests involve observation of the position of any interior compartment door during Head Impact Tests conducted in accordance with Section 6.2 of this procedure and during the Barrier Collision Tests conducted in accordance with Section 6.2 of the Test Procedure relating to ADR 10/00 or 10/01 - Steering Column contained in Circular 10/01-9-1.

5.3.1.1 Basic Equipment. The equipment used for these tests is as described in Section 5.2 of this Procedure and that described in Section 5.2 of the Test Procedure for ADR 10/00 - Steering Column contained in Circular 10/01-9-1.

5.3.2 Door Latch Inertia Tests. To determine the ability of the latch systems of interior compartment doors fitted to the instrument panel to remain latched during specified inertia loads a mathematical analysis is usually adopted.

5.3.2.1 Basic Equipment. Measuring equipment to determine the mass of the components of the latching mechanism and their centres of gravity.

6 PROCEDURE

6.1 Head Impact Area Determination

6.1.1 Preparation for Test

6.1.1.1 Prepare vehicle or front compartment representation of vehicle for tests by fitment of instrument panel assembly in the standard installation condition.

6.1.1.2 Review Instrumentation. Ensure that the sphere is of the correct diameter, that the pivot point to ‘top of head’ dimension is infinitely adjustable from 736 to 838 mm Annex A Figure(c) and that some form of marking pen or alternative is available.

6.1.2 Tests

6.1.2.1 At each designated front seating position place the pivot point of the measuring device on the Seating Reference Plane:
6.2 Instrument Panel Impact Tests

6.2.1 Preparation for Tests

6.2.1.1 Review Program. Review the proposed test program.

6.2.1.2 Review Mounting Environment. Mount the instrument panel assembly in the actual vehicle or on a fixture that is at least as rigid as the actual vehicle mounting. Should the test be on a vehicle, the windscreen and header rail need not be installed.

Include substructure, braces, instruments and other components located between the instrument panel and the dash panel which could significantly influence the impact performance of the installed assembly.

Age any energy absorbing material components of the instrument panel assembly for a minimum of two days after moulding.

Condition the instrument panel assembly at a temperature between 19 and 25 degrees Celsius for twelve hours immediately prior to testing.

6.2.1.3 Selection of Impact Points. Inspect the instrument panel assembly and select points in the head impact area that could be expected to give the highest deceleration rates on the head form upon impact. Mark these points on the assembly. No two points should be closer than 100 mm to ensure that one impact does not influence the results of another.

Where interior compartments are fitted in the head impact area and regarded as an area to be impacted they shall be tested when in the closed condition.

6.2.1.4 Setting Up. Install the instrument panel assembly on the test rig so that one (1) of the impact points is coincident with the moving head from at impact. The direction of impact shall be in a plane normal to the surface at the point of impact or in a vertical plane parallel to the vehicle longitudinal axis. (Clause 21.2.3.1.2)

Where interior compartment door assemblies are fitted the tests are to be conducted with the doors closed. If the doors are fitted with a locking device they shall be tested in the unlocked position.

6.2.1.5 Review Test Fixture. Ensure that the test fixture meets the requirements specified in Section 5.2.1 in regard to head form and mounting arrangements.

6.2.1.6 Review Instrumentation. Ensure that all instrumentation is on the correct scale, that all zeroes are correctly set and that any feasible in situ calibration has been performed.

6.2.2 Tests

6.2.2.1 Operate the test rig and determine the results as in 6.2.3. Observe and record the position of all interior compartment doors after the impact.

6.2.2.2 Reposition the instrument panel assembly and its fixture to another designated impact position ensuring that the correct direction of impact is maintained. Repeat 6.2.2.1.

6.2.2.3 Repeat 6.2.2.2 and 6.2.2.1 until all the designated impact points have been impacted.

6.2.3 Determination of Results. From the data recorded the head impact area of the instrument panel assembly can be determined. This information should be retained as original data either in the form of a drawing, photograph or retention of the test sample.
recorded the impact speed and deceleration/time trace are determined either by direct read out or analysis of result records.

Confirm that the head form impacted the component at a velocity of at least 6.7 m/s or 5.31 m/s, if the vehicle is fitted with a passenger side inflatable supplementary restraint system meeting the requirements of ADR 69/00, after allowing for instrumentation error. (Clause 21.2.1). Using the deceleration/time trace determine the time or times during which the deceleration exceeded 80 'g' . (Clause 21.2.1).

Record the final position of all interior compartment doors after each impact. (Clause 21.3.1).

All original data used for determining results is to be retained either as part of the Testing Facility’s Internal Report or in a separate original data file. In any case the deceleration/time traces are to be contained in the internal report.

6.3 Interior Compartment Door Tests

6.3.1 Preparation for Test. Review the vehicle model range and establish the number of interior compartment doors fitted to the instrument panel assembly. Examine each of these and record if any are fitted with a locking device. Such locking devices shall be in the unlocked position during impact testing on the instrument panel assembly.

6.3.2 Tests

6.3.2.1 Position During Impact Tests. The tests for interior compartment door position are conducted concurrently with the Head Impact Tests detailed in Section 6.2 of this Procedure.

6.3.2.2 Position During Barrier Collision Test. The test for interior compartment door position is conducted concurrently with the Barrier Collision Test detailed in Section 6.2 of the Test Procedure relating to Steering Columns contained in Circular 10/01-9-1.

6.3.2.3 Latch Inertial Tests. To determine the ability of the interior compartment door latch systems to resist inertia loading, one acceptable method is a mathematical analysis of the component parts in their true car relationship.

For this analysis spring forces are the average of the minimum spring output in the installed position and the minimum spring output in the released position. Friction effects and work to be done are not considered in the calculations. Gravitational pull on components may also be omitted if it tends to restrict unlatching. These omissions from the calculations are permissible because they provide additional factors of safety.

Each component or subassembly can be analysed to determine its minimum inertia load resistance in a particular direction by measurement and/or calculation. Their combined resistance to the unlatching operation must ensure that the door latch system (when properly assembled in the installed condition) will remain latched when subjected to the following inertia loadings:-
- 10 'g' in a horizontal transverse direction (Clause 21.3.2.1).
- 10 'g' in a vertical direction (Clause 21.3.2.1).
- 30 'g' in a horizontal longitudinal direction (Clause 21.3.2.3).

Annex B gives an example of the components and combinations of components to be considered for transverse acceleration in one sense only. This type of calculation must be repeated for vertical, longitudinal and transverse accelerations in both senses. The example given is shown on a vehicle external door but the principles shown are those applicable.

These calculations are to be recorded in report form, duly checked and approved and the corresponding drawing reference numbers recorded.

6.3.3 Determination of Results

6.3.3.1 Interior Compartment Door Position

6.3.3.1.1 Position During Impact Tests. Record the position of each interior compartment door after each impact of the head form during the head impact test series.

6.3.3.1.2 Position During Barrier Collision. Record the position of each interior compartment door following the Barrier Collision Test conducted as part of the Compliance Testing required for ADR 10/... - Steering Column.

6.3.3.1.3 Latch Inertial Tests. Record the latch position resulting from the specified inertial loadings in the required directions.

6.4 Reporting Results

For each test series a complete internal report giving a full description of material tested, equipment used, results and the order of accuracy achieved should be prepared. For submission to the Administrator, the determined results for the Head Impact Tests and Interior Compartment Door and Latch Security Tests are to be recorded together with the Internal Report Reference in the appropriate section of the Summary of Evidence Report - see Section 8.

7 ANALYSIS OF RESULTS

The instrument panel assembly will be considered to have complied with ADR 21/00 if the following results have been achieved after making the appropriate allowance for instrument uncertainty.

ADR CLAUSE RESULT

21.2.1 The Moving Head impacted the instrument panel assembly at a velocity of not less than 6.7 m/s or 5.31 m/s if the vehicle is fitted with a passenger side inflatable supplementary restraint system meeting the requirements of ADR 69/00. The deceleration of the Moving Head did not exceed 80 'g' continuously for more than 3 milliseconds.

21.2.3.1.2 The direction of Impact of the Moving Head
was in a plane normal to the surface at the point of impact or in a vertical plane parallel to the vehicle longitudinal axis.

21.3.1 All Interior Compartment Door Latches fitted with locking devices remained in the unlocked position for: the Moving Head Impact Tests, the Barrier Collision Test, the Latch Inertial Tests.

21.3.1 All Interior Compartment Doors remained closed during the Moving Head Impact Tests.

21.3.2.1 All Interior Compartment Door Latches remained in the latched position when the mechanisms were subjected to an inertial load of 10 'g' in a horizontal transverse direction and to an inertial load of 10 'g' in a vertical direction.

All Interior Compartment Door Latches remained in the latched position when the mechanisms were subjected to an inertial load of 30 'g' in a horizontal longitudinal direction.

OR

All Interior Compartment Doors remained closed during a vehicle Barrier Collision Test conducted as part of the Compliance Testing required for ADR 10/01 - Steering Column.

8 SUMMARY OF EVIDENCE REPORT

The Summary of Evidence Report SE 21/00 is the only document to be sent to the Administrator for demonstration of compliance to ADR 21/00. 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 21/00 form for each clause of the ADR.

9 PROCEDURES FOR DESIGNS WITH CERTIFICATION TO ALTERNATIVE STANDARDS

There are no Alternative Standards for ADR 21/00.

10 REFERENCES

ADR References
ADR definitions
ADR 21/00 - Instrument Panel.
SAE - Recommended Practices.
J921 (June 65) - Instrument Panel Laboratory Impact Test Procedure.
J839B (May 65) - Passenger Car Side Door Latch Systems.
J977 (Nov 66) - Instrumentation for Laboratory Impact Tests.
Circulars
Circular 0-12-2 - General Requirements for Test Facilities.
Circular 0-12-3 - General Requirements for Calibration of Test Equipment and Instrumentation.
Other References
SAE-J211 (June 80) Recommended Practice - Instrumentation for Impact Tests. Recommended Data Channel Dynamic Accuracy Diagram and Chart.
ANNEX A

Figure (a) SAE J211 RECOMMENDED DATA CHANNEL
DYNAMIC ACCURACY DIAGRAM AND CHART
ANNEX A

Figure (b) SAE J921 - PASSENGER COMPARTMENT IMPACT TEST RIG DIAGRAM
ANNEX A

Figure (c) DIAGRAM OF TYPICAL SPHERICAL HEAD FORM
(a) SAMPLE IMPACT TEST TRACE ANALYSIS
ANNEX B

GIVEN:

DOOR LATCH SYSTEM SUBJECTED TO 30g DECELERATION

\[ F_1 \times W_1 \times 30g = \text{AVE PUSH BTN SPRING OUTPUT} = (0.0163 \times 294.2) \times 4.5 = 0.30 \text{ N} \]
\[ F_2 = W_2 \times 30g = 0.0227 \times 294.2 = 6.68 \text{ N} \]
\[ F_3 \times W_3 = 0.0122 \times 294.2 = 1.80 \text{ N} \]
\[ \Sigma M = \Sigma (F_1 \times d_1 + F_2 \times d_2 - F_3 \times d_3 + 0.30 \times 31.5 + 6.68 \times 10.67 + 1.80 \times 4.83 = 72.0 \text{ N.mm} \]
\[ F_5 = \frac{M_o}{d} = \frac{72}{34} = 2.15 \text{ N} \]
\[ F_6 = W_4 \times 30g = 0.0422 \times 294.2 = 12.42 \text{ N} \]
\[ \Sigma M = \text{Pawl SPRING OUTPUT} = (F_5 d_5 + F_6 d_6) = 0.45 \left(2.30 \times 37.6 + 12.42 \times 1.91\right) = 0.34 \text{ N.m} \]

(b) SAMPLE CALCULATION FOR DOOR LATCH MECHANISM INERTIA LOADING