Noise Fence Panel - Registration Requirements

May 2019

Queensland Government

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Feedback

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Contents

1 Overview

This document describes the approval process by which the Department of Transport and Main Roads registers noise fence panels to meet the department's Technical Specification MRTS15 *Noise Fences*. Panels are approved for use on Queensland departmental projects.

The purpose of registration is to minimise the risk associated with purchasing non-conforming panels for use in departmental projects.

This document specifies conditions in relation to:

- Requirements for submitting new noise fence panel products for approval (or resubmitting those previously approved and lapsed).
- Requirements for extending currently approved noise fence panels products prior to the three year approved period concluding, and
- Submission requirements, standards and required inclusions.

The registration of panels as described in this document is managed by Engineering and Technology Branch.

2 Communication and responsibilities

The Deputy Chief Engineer (Geospatial, Design and Capability) or the Manager (Noise and Vibration) are the delegated authorities responsible for this Registration Scheme. All enquiries regarding this registration covered this document should be directed to:

Senior Engineer (Road Traffic Noise Management) - (07) 3066 8215.

3 Reference documents

- Transport and Main Roads Technical Specification MRTS15 *Noise Fences*
- Transport and Main Roads Standard Drawings for Noise Fences
- Third-party registration rules by the relevant International Standard Organisations (ISO) standards or by the Joint Accreditation System for Australia and New Zealand (JAS-ANZ) to the relevant standards.
- Clause 9 of MRTS50 *Specific Quality System Requirements*
- Relevant Australian and International Standards and Technical Specifications for noise fence panels.

4 Approval of new products

For noise fence panel products to be approved, a performance report shall be submitted to the officer nominated in Section 2 with full details of assumptions and parameters used including:

<u>General</u>

1. Name of product.
2. Name of manufacturer / supplier.
3. Type of panel (reflective / absorptive).

4. Cross sectional drawings with dimensions showing all types of materials.
5. Full description on raw material(s) used for manufacturing the panel including the manufacturer / supplier (if sourced from different manufacturer), including with their elastic modulus, elastic limits, water permeability and other relevant data.
6. Theoretical basis of calculations or details of desktop studies.
7. Load testing results showing satisfactory performance for the specified loads in accordance with the relevant Standards.
8. Results of calculations and assessment of resistance to environmental degradation relating to environmental factors including solar radiation, atmospheric pollution and cleaning and maintenance procedures for transparent and plastic materials.
9. Estimated fail-safe life.
10. Quality management system certified to AS/NZS ISO 9001. Certification shall be undertaken by a conformity assessment body accredited by the Joint Accreditation System for Australia and New Zealand (JAS / ANZ). The certifier shall be acceptable to the Administrator.
11. Product usage history, and
12. A physical sample.

Essential

1. Evaluation of performance shall be carried out according to the requirements of Transport and Main Roads Technical Specification MRTS15 *Noise Fences* that is:
    a. Acoustic requirements stated in the MRTS15 relevant to the type of panel.
    b. The following physical requirements:
        i. demonstrate that Impact Resistance tests confirm compliance with MRTS15 requirements – Appendix A
        ii. durability, taking into account, such possibilities as defacement by sharp implements
        iii. fire resistance in accordance with the requirements of Appendix B
        iv. water absorption characteristics in accordance with Standards appropriate for the panel, and
        v. assessment of performance by load testing according to recognised Standards for the panel – Appendix C, if applicable is resisted by simulated environmental resistance to ultraviolet radiation, elevated temperatures, moisture, atmospheric pollutants and cleaning and graffiti removal – Appendix D or Appendix E.
2. All material testing in Australia shall be undertaken at NATA (National Association of Testing Authorities Australia) certified laboratories. Such tests shall have been carried out not more than 72 months for accelerated exposure tests and 36 months for other tests, before the time of submitting the panel for approval. All samples delivered to the testing institute shall be indelibly printed with the manufacturer's brush mark for clear identification. If testing is undertaken outside Australia the test results shall be certified by NATA.

3. Manufacturer in Australia:

    a) In Australia manufacturers shall operate a 3rd party quality system certified to AS/NZS ISO 9001. Certification shall be undertaken by a conformity assessment body accredited by the Joint Accreditation System for Australia and New Zealand (JAS / ANZ). The certifier shall be acceptable to the Administrator.

    b) Demonstrate technical conformance to MRTS15.

    c) Provide traceability of all materials.

    d) Maintain records of all products placed on the market for a minimum of 10 years, and

    e) Make available all relevant documentation when product is supplied.

Section 3 outlines the minimum requirements which must be satisfied for a manufacturer wishing to supply panels in Australia.

All manufacturers are required to provide the name and contacts from referees, who can attest to the quality of the panel, before any audits are undertaken.

Approval is granted to the manufacturer and not the supplier.

Manufacturer outside Australia:

a. Outside Australia manufacturers shall operate a 3rd party quality system certified to AS/NZS ISO 9001. The system will be audited by an Auditor acceptable to Transport and Main Roads. The Auditor shall ensure that the manufacturer/s are working as stated in their system documentation and the system conforms with the requirements of Transport and Main Roads.

b. The Auditor shall ensure that the manufacturer can demonstrate technical conformance to MRTS15.

c. Provide traceability of all materials.

d. Maintain records of all products placed on the market for a minimum of 10 years, and

e. Make available all relevant documentation when product is supplied.

Section 4 outlines the minimum requirements which must be satisfied for a manufacturer wishing to supply panels in Australia.

All manufacturers are required to provide the name and contacts from referees, who can attest to the quality of the panel, before any audits are undertaken.

Approval is granted to the manufacturer and not the supplier.

4. Design of panel shall be by a recognised design method acceptance by the Administrator if there is no Standard design method available. Detail design calculations shall be submitted to the Administrator including any desktop study reports.

5. Assessment of performance by load testing – Appendix C.

5 Evaluation

Panel shall be evaluated against the MRTS15 and other relevant specifications and standards and, if found conforming, will be listed in the Register.

6 Approval conditions

The approval of panel is based on the information provided by the manufacturer on the conditions that:

- panel composition does not change
- panel dimensions do not change, and
- performance is maintained.

A panel approval will remain valid for the three years from the date nominated on the approval confirmation. If, during this three years period, the panel composition or design changes, or the specification / drawing is updated, or there is a change to any governing manuals or associated specifications and guidelines, the approval ceases and a new application submission will be required.

Within two months of any three year approval period expiring, the manufacturer is to notify the contact officer (nominated in this document) of their intention to extend for further three years and nominate either of the following:

- there has been no redesign of the product – further approval period granted
- the product has been redesigned – further approval period granted based on submission of relevant test results and test reports.

If the approval period is allowed to expire, the product will need to be reassessed as per Section 4.

Appendix A - Impact Resistance Test

A.1 General

Noise panels placed alongside roads are exposed to the impacts of stones thrown up from the road surface and other sources. It is essential that they are resistant to such impacts, only sustaining superficial damage.

This Appendix provides a standard laboratory test which simulates minor impacts such as those caused by stones thrown up from the road surface and other sources.

A.2 Requirements

When testing in accordance with A.3:

a) a hardened 4 kg shot-put steel ball of 102 mm diameter

b) the impact energy of 118 J is simulated by freely drop the steel ball from a height of 3.0 m

c) damage shall be confined to the outer parts of the construction and internal elements shall not be damaged or displaced by the impacts

d) the ball shall not penetrate the outer wall of any hollow elements

e) depth of deformation considered to be acceptable is 4 mm damage to the surface of material in the form of crater diameter of 20 mm and not larger than 40 mm.

A.3 Test method

A.3.1 The impact stones and other material shall be simulated by testing with shot-put ball described in A.3.2 to A.3.4 on the longest span for the panel and witnessed by the Administrator.

A.3.2 The test is used to determine the resistance of the panel, with posts or other supports like those intended for use in practice. The support shall be held in the horizontal plane and restrained from lateral movement and rotation.

A.3.3 The panel shall be supported at its edges horizontally a minimum of 100 mm above the ground and opposite the point of impact as shown in Figures A.3.3.

A.3.4 The 4.0 kg steel ball is suspended 3.0 m above the panel and dropped freely on the following three points within a test area bounded by a margin of 125 mm around the edge of the test panel, a minimum of four times of each exposed face as shown in Figure A.3.4.

a) near minimum two corners of the test area

b) near the centre of the test area

c) at one other point within the test area, chosen at random.

A.3.5 The exact position of the points to be tested shall be chosen to be representative of the panel as whole, by avoiding ribs, or other obvious places of local strength.

A.3.6 The diameter and depth of the resulting indentation shall be measured.

A.4 Test report

Test report shall include a full description of the test arrangement, including details of supports, procedures and location of points of impact.

It shall also include:

a) identification of the tested panel and the name of the manufacturer

b) testing location with a dated signature of the witnessing person responsible

c) full description of the panel and its thickness

d) drawing showing the cross section of the tested panel

e) results of tests; and assessment as to whether these indicate satisfactory performance.

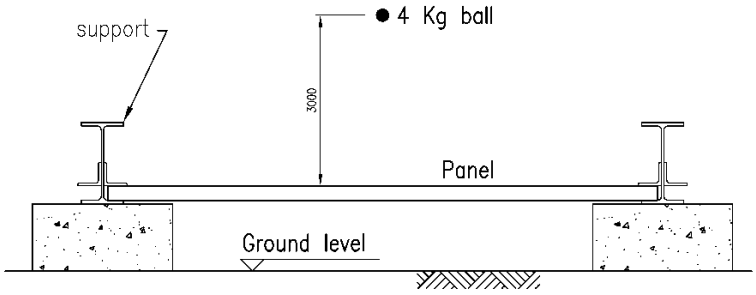


Figure A 3.3

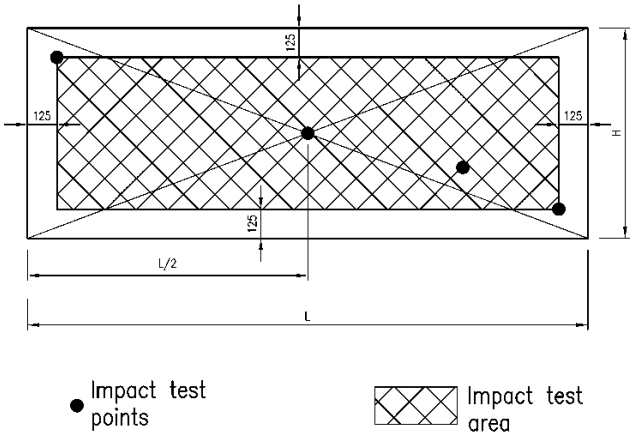


Figure A 3.4

Appendix B - Resistance to fire

B.1 General

A noise panel can be exposed to fire arising from dry vegetation or other materials in close proximity. More severe fires from spilt fuel can arise as result of traffic accidents.

Where a noise fence is near property it can also be necessary to consider the need to ensure that fire is not spread from the road.

This Appendix describes a test for a representative panel of a vertical noise fence under normal exposure to fires at the roadside.

B.2 Requirements

The noise panel, after being tested by the method given in B.3, shall be classified as follows:

- Class 1: if there is no damage other than discoloration.
- Class 2: if the damaged area above either source is less than 0.06 m^2 and extends to no more than 200 mm above the base of the panel, and the panel has not been burnt through to the other side.
- Class 3: if the panel has been damaged to a greater extent than as defined for Classes 1 and 2.

B.3 Fire test

B.3.1 The panel element of at least 2.0 m long by 1.5 m high shall be tested by exposure to localised sources of fire at its base next to the front and rear faces independently. Panels shall be free of absorbed water before testing; the moisture content shall be reduced to 18% by an approved drying method.

The weight and dimensions of the panel to be tested shall be measured and the panel shall be photographed. An identical panel shall be examined to determine its construction. Dimensions of its elements, including wall thickness of hollow sections, shall be measured and noted on a sketch at 1:20 scale.

B.3.2 Testing shall be carried out in an enclosed fireproof and draught-free chamber having a volume of at least 150 m^3.

Fume extraction devices may be installed in or near the ceiling but shall be prevented from fanning any flames during the test.

The temperature of the chamber, including the floor, before the test begins shall be between 15^0C and 25^0C. The chamber should be fitted with an observation port or window in a suitable position to observe the panel during testing.

B.3.3 Two identical sources of fire shall be prepared as follows:

a) a rectilinear wire mesh basket 300 mm by 200 mm by 300 mm high shall be made from welded steel wire mesh, having square mesh of 3 mm diameter drawn steel wire at 50 mm centres

b) in addition, three 3 mm diameter wires 300 mm long shall be secured in a vertical position inside the basket, equally spaced along the central line of the shorter dimension.

The flammable material shall comprise shavings of spruce, 0.2 mm thick by 2.0 mm wide, and approximately 50 mm long. The material shall be free from splinters and have a maximum moisture content of 30%; it shall be acclimatised at 20^0C and 65% relative humidity until its weight is constant.

600 g of the shavings shall be lightly pressed down into each basket so that it is just filled.

B.3.4 The test panel shall be supported in a vertical position corresponding to its orientation in use, on a plinth supporting the full length of the panel. The plinth shall be of masonry or concrete and have a vertical step to a level of 250 mm above the floor of the chamber. The base of the test panel shall be completely in contact with the plinth and the face to be tested shall be flush with the edge. The two sources of fire shall be placed on the floor of the chamber with their longer dimension flush against the plinth and face of the test panel. Both sources shall be lit simultaneously, and the time taken for the test shall start at this point.

B.3.5 The performance of the panel shall be observed during the test and the time at which any significant change takes place recorded. After the sources of fire and any part of the panel which may have ignited have burnt out, the panel shall be examined, and the extent of any damage photographed and measured. The opposite face of the panel shall not be tested until it and the floor of the chamber have cooled to below 25°C.

B.4 Test report

B.4.1 The certified Registered Professional Engineers Queensland (RPEQ) test procedure shall be described together with the timing of significant stages, indication of, for example maximum intensity of flames, the incidence of any observed changes to the test panel and the number of samples tested.

B.4.2 Photographs of the test panel before, during and after the test shall be supplied and shall include an appropriate means of judging scale.

Appendix C - Load testing

C.1 General

This Appendix has been formulated in general terms to be applicable to any type of panels. It is recognised that different panel materials have different strengths, load-deformation characteristics and variations in properties. Testing of structures or elements is specified in the relevant Standard for the material, such as:

1. AS 3600 for Concrete Structures
2. AS 4100 for Steel Structures
3. AS 1720 for Timber Structures
4. AS/NZS 1664.1 for Aluminium Structures, and
5. AS/NZS 2908.2 Cellulose-Cement products.

Adopt the procedure for load testing, the test load factors and statistical variability factors specified in the relevant Standard.

The test to be conducted in a safe manner, without any damage to the adjacent structure or risk to workers.

Load testing shall be undertaken by a person competent in, and with appropriate expertise for, performing such tests, preferably at a NATA certified material laboratory or University, approved by the Administrator. The laboratory of the manufacturer can be used. In case of dispute, the tests shall be undertaken in the presence of both parties.

C.2 Requirements

C.2.1 Strength

The test pressure load shall be determined by multiplying the ultimate limit state design load calculated in accordance with Clause 6.6.9 of MRTS15 by the factor to allow for variability of 1.5.

C.2.2 Serviceability deflection

The test pressure load shall be determined by multiplying the serviceability limit state design load calculated in accordance with Clause 6.6.9 of MRTS15 by the factor to allow for variability of 1.2.

C.3 Apparatus

C.3.1 Loading system

The required static wind pressure shall be applied by method (A) or (B) that will reproduce the distribution of load, suitably factored, appropriate to the part of the panel being tested and maintain such distribution irrespective of the extent of deflection. The test load shall be applied gradually at a rate as uniform as practicable and without impact.

A 2.0 mm thick steel plate cut exactly to size ($\pm$ 10 mm) excluding the supporting frame shall be carefully placed onto the exposed area of the panel.

The loading shall be arranged so that the relationship between bending moment and reaction in the prototype are reproduced in the test panel.

Whatever method is used for testing the resistance to wind pressure, it is emphasised that it is the panel and its fastening that are under test.

Method A – Rigid unit material

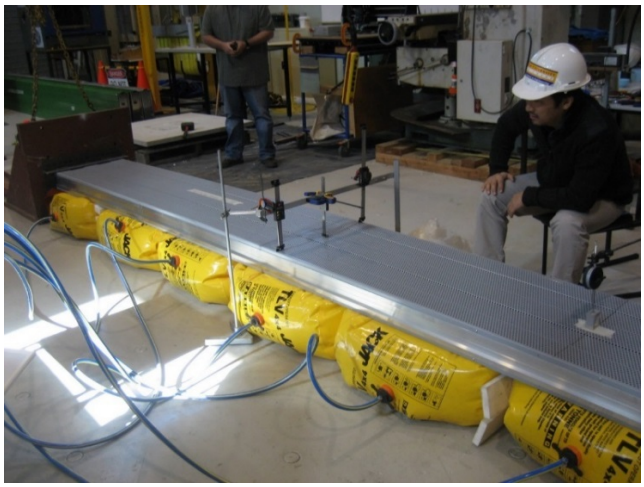
The rigid unit materials may be used as a loading medium. Stacks of these should be arranged so that no bridging from stack to stack takes place. If such rigid materials are used to load a wide panel they should be positioned so that they do not span across the panel. In ultimate load test it may necessary to use denser materials to reduce the height of the stacks. Typical arrangement is shown in Figure C.3.1(a).

Figure C.3.1(a) – Typical arrangement – Rigid unit material

Method B – Airbag

If inflatable airbags are used as a loading medium, the bags should be sufficiently flexible to apply pressure evenly to the area under test by making contact, over the entire soffit of the area of panel to be loaded, and to maintain such contact, irrespective of the deflection. The airbags are placed between the panel and the bed of the test rig and inflated. The load is measured on the test rig and converted to an equivalent pressure. Care must be taken to ensure that the air pressure as measured by a manometer, is the pressure in the bag. Gauges on the inlet side may not always give a correct reading and it has been found in such cases that the pressure on the outlet side of the system is necessary. The typical arrangement is shown in Figure C.3.1(b).

Figure C3.1(b) – Typical arrangement - Airbag



C.3.2 Measuring devices

Deflection shall be determined by means of a device capable of measuring to an accuracy of not less than ± 0.05 mm. The pressures or load shall be determined to an accuracy of not less than 5%.

C.4 Test procedure

The load test either Method A or Method B shall be carried out on a representative panel which shall include an appropriate number of acoustic panels of the longest span for the element type, with posts or other supports like those used in a manner representative of the intended application. The support shall be held in the horizontal plane and restrained from lateral movement and rotation.

The test panel shall be allowed to reach equilibrium laboratory conditions for at least seven days in a controlled atmosphere of 23°C ± 5°C and 50% ± 10% relative humidity, and in such a manner that all faces are adequately ventilated.

A 2.0 mm thick steel plate cut exactly to size (± 10 mm) excluding the supporting frame shall be carefully placed onto the exposed area of the panel.

The point at which the vertical deflection under the loading is greatest shall be determined and all measurements of deflection relative to a fixed datum level shall be taken at this point. An initial deflection reading shall be taken 30 minutes after placing the steel sheet. The steel sheet shall then be removed and the deflection reading repeated after 30 minutes. The difference between these two readings shall be described as the deflection under self-weight.

The steel sheet shall be replaced and an appropriate number of structural steel sections of the same length as the support shall be uniformly distributed across the steel sheet parallel to the support. The total weight of the structural sections including the steel sheet shall be equal to ultimate and serviceability loading (pressure x area) requirements for which the panel is being tested. After 30 minutes under this loading, the deflection reading shall be repeated. The difference between this and the previous reading for loading by the steel sheet alone shall be described as the deflection under simulated wind load. Note that once serviceability testing is completed, the same test panel can then be tested for strength.

The structural sections shall be carefully removed and after 30 minutes the deflection reading shall be repeated. The difference between this and the previous reading by the steel sheet alone shall be described as the permanent deflection.

The following information shall be provided to the Administrator for the preferred loading system described in C.3.1:

1. drawing showing the test setup
2. method of loading
3. method of measuring loads and deflections
4. number of units to be tested (minimum of three)
5. variability factor for ultimate loads
6. variability factor for serviceability loads
7. test load applied for ultimate limit state
8. test load applied for serviceability limit state

9. number of load increments
10. rate of loading
11. time for which test load must be maintained (30 minutes)
12. rate of unloading
13. time after which deflection recovery must be measured (30 minutes)
14. locations of deflection measurements
15. maximum serviceability deflection
16. name and place of the testing institute or NATA accredited laboratory.

C.5 Test report

The test report shall include a full description of the test arrangement, including details of supports, procedures and loading of elements submitted to the Administrator as described in C.4.

a) name and address of the testing institute with a dated signature of the person responsible
b) exact identification of the tested panel
c) full description of the panel and their thickness, length and width
d) weight of the panel both wet and dry
e) drawing showing the cross section of the tested panel
f) number of panel tested, and
g) full results of the tests including a load-deflection curve and assessment as to whether these indicate satisfactory performance for the specified load.

Appendix D - Accelerated exposure test – Composite panels

D.1 General

Over the design life, composite panels need to resist degradation from environmental influences such as wet and dry conditions. Performance characteristics of the composite panels shall be assessed in wet and dry environment in addition to the load test described in Appendix C.

D.2 Requirements

D.2.1 Strength

The test pressure load shall be determined by multiplying the ultimate limit state design load calculated in accordance with Clause 6.6.9 of MRTS15 by the factor to allow for variability of 1.5.

D.2.2 Serviceability deflection

The test pressure load shall be determined by multiplying the serviceability limit state design load calculated in accordance with Clause 6.6.9 of MRTS15 by the factor to allow for variability of 1.2.

D.3 Apparatus

D.3.1 Condition for ambient temperature

Controlled atmosphere of 23°C ± 5°C and 50% ± 10% relative humidity.

D.3.2 Condition for wet temperature

Minimum water temperature of 5°C.

D.3.3 Wet and dry

The apparatus includes the following items:

a) Ventilated oven capable of achieving a temperature of 60°C ± 5°C and relative humidity of less than or equal to 20% with a full load of panel, and

b) Bath filled with water at an ambient temperature of more than 5°C.

D.3.4 Loading system

As described in C.3.1 of Appendix C.

D.3.5 Measuring devices

As described in C.3.2 of Appendix C.

D.4 Test procedure

D.4.1 Ambient assessment

Minimum of three panels shall be placed in a controlled ambient temperature stated in the Clause D.3.1 for seven days.

D.4.2 Wet assessment

Minimum of three panels shall be immersed in water at the temperature stated in the Clause D.3.2 for 24 hours.

D.4.3 Wet and dry assessment

Minimum of three samples shall be tested for the 25 wet-dry cycles consisting of:

- immersion in water at an ambient temperature (more than 5°C) for 18 hours
- drying in a ventilated oven of 60°C ± 5°C and relative humidity of less than 20% for six hours.

If necessary, an interval up to 72 hours between cycle is allowed. During this interval, panels shall be stored in immersed conditions.

After 25 cycles, place the panels in a laboratory atmosphere for seven days.

At the end of this period, carry out the wet loading test as specified in Appendix C.

D.5 Test report

The test report shall include a full description of the test arrangement, including details of supports, procedures and loading of elements submitted to the Administrator as described in D.4.

a) name and address of the testing institute with a dated signature of the person responsible

b) exact identification of the tested panel

c) full description of the panel and their thickness, length and width

d) weight of the panel both wet and dry

e) drawing showing the cross section of the tested panel

f) number of panel tested, and

g) full results of the tests including a load-deflection curve and assessment as to whether these indicate satisfactory performance for the specified load.

Appendix E - Accelerated environmental exposure test – Transparent or Plastic panels

E.1 General

The proposed laboratory test consists of measuring the performance characteristics of the panel materials in the as-received condition and after exposure to various environmental factors. Laboratory environments shall be chosen to include typical elements of the roadside environment, notably solar UV radiation, vehicle exhaust fumes and graffiti removal. In order to obtain, within a test program of two or three years duration, an indication of likely performance over a 40 year design life, it is necessary for a laboratory exposure to “accelerated” by comparison with natural outdoor conditions in Queensland.

If any detectable transmission loss is detected in the UV region of the spectrum (200 – 350 nm) by simple UV / visible spectrophotometry testing, the acrylic or polycarbonate panel shall be rejected for further testing.

The Appendix is derived from the guidelines given in I.S. EN ISO 4892-1, I.S. EN ISO 4892-2 and I.S. EN ISO 4892-3. Reference shall be made to the above I.S. EN ISO standards for any areas not covered by this Appendix.

The following panel properties shall be measured:

- Optical clarity - use UV / Visible spectrometer to determine total transmission and spectral distribution.
- Tensile or flexural properties such as elastic modulus, yield strength and rupture strength, and
- Impact resistance.

The forms of simulated environmental exposure to be applied are:

- up to 6400 hours of accelerated UV-B radiation in standard QUV weatherometer
- cyclic elevated temperature of 60°C with humidity, and condensation temperature of 40°C with active moisture (QUV weatherometer)
- high concentrations of exhaust emissions from both diesel and petrol engines
- simultaneous long-term loading and UV exposure, and
- chemical exposure to cleaning and graffiti removal products.

The accelerated exposure test shall be undertaken by person competent in, and with appropriate expertise for, performing such tests, preferably at a NATA certified material laboratory or University, approved by or specified by the Administrator.

E.2 Apparatus

E.2.1 Radiation system

The ration system shall consist of a xenon arc lamp or fluorescent lamp fitted with suitable filters that can produce radiation with a spectral energy distribution similar to terrestrial sunlight in the ultraviolet region of the spectrum, that is a wavelength range of 290 nm to 800 nm.

An air or water-cooled absorber shall be used as the heat absorbing system. For water-cooled absorber, distilled or deionised water shall be circulated through the lamp assembly. To prevent contamination and minimise the formation of deposits, the water shall be purified using a mixed-bed

deioniser just ahead of the lamp. The recirculated lamp water shall be cooled without contamination using heat exchange unit employing either tap water or a refrigerant as the heat-transfer medium.

The radiation system shall emit irradiance of 550 W/m^2 to 800 W/m^2 in the wavelength range of 290 nm to 800 nm on the specimen surface.

The UV-radiation distribution of the filtered xenon arc and fluorescent arc source together with tolerance limits shall comply with the values as given in Table 1 of I.S EN ISO 4892-2 and Table 1 of I.S EN ISO 4892-3 respectively.

E.2.2 Test chamber

The exposure chamber shall contain a frame carrying specimen holders if necessary, with provision for passing air over the specimens for temperature control.

E.2.3 Radiometer

A radiometer which complies with the requirements outlined in I.S EN ISO 9370 may be used to measure the irradiance or spectral irradiance and the radiant exposure or spectral radiant exposure on the specimen surface.

The radiometer shall be mounted so that it receives the same radiation as the specimen surface. If it is not positioned in the specimen plane, it shall have a sufficient field of view and be calibrated for irradiance at the specimen distance.

The radiometer shall be calibrated in the emission region of the light source used. Calibration shall be checked in accordance with the manufacturer's instructions for the radiation measuring instrument.

E.2.4 Black-panel temperature sensors

A black-panel temperature sensor shall be used to measure and control the temperature within the test chamber. Two types of black-panel temperature sensor may be used:

a) Black-standard thermometers complying with Clause 5.2.2.1 of I.S EN ISO 4892-1.

b) Black-panel thermometers comply with Clause 5.2.2.2 of I.S EN ISO 4892-1.

The black-panel temperature sensor shall be mounted on a support within the specimen exposure area so that it receives the same radiation and experiences the same cooling conditions as a flat test panel surface using the same support.

E.2.5 Humidity control device

Depending on the type of apparatus, the test chamber shall be air-conditioned by adding moisture to the air using an ultrasonic humidifier or by means of water atomized by an aerosol device and fed into the air stream. The relative humidity in the test chamber shall be measured and controlled using either a capacitive sensor or a contact hydrometer.

The sensors used to measure the humidity shall be placed within the test chamber air flow and shielded from direct radiation and water spray.

Any device intended to simulate the effects of moisture shall have a means to programme intervals with and without wetting of the specimens.

E.2.6 Spray system

The specimens shall be sprayed with distilled or demineralised water (having a conductivity below 5 μS/cm and containing a maximum of 1 μg/g of solids and a maximum of 0.2 μg/g of silica) intermittently with spray cycles as specified below in Clause E.4.4. The spray system shall be made from inert materials that do not contaminate the water employed. The water shall leave no observable stains or deposits on test specimens. In addition to distillation, a combination of deionization and reverse osmosis can be used to produce water of the required quality. The pH of the water used shall be reported.

Recirculation of water used for specimen spray is not recommended and shall not be done unless the recirculated water meets the purity requirements listed above.

If bacterial contamination is detected, the entire system used for specimen water spray shall be flushed with a chlorination solution such as sodium hypochlorite and thoroughly rinsed prior to resuming exposures.

E.2.7 Specimen holders

Specimen holders may be in the form of an open frame, leaving the back of the specimen exposed. They shall be made from inert materials that will not affect the test results, for example non-oxidizing alloys of aluminium or stainless steel. Brass, steel or copper shall not be used in the vicinity of the test specimens. Provision of solid backing shall be avoided and can only be used with prior agreement of the Administrator.

Depending on the apparatus, the specimen holders can be designed to be mounted on a vertical or inclined cylindrical frame or rack which is rotated 1 rpm around the lamp which is centred both horizontally and vertically with respect to the exposure area in the sample holders.

E.2.8 Temperature control device

The temperature control device shall consist of a ventilation system which provides a constant stream of air through the test chamber and over the test specimens. The temperature of the air is automatically controlled by recirculating warm air from the test chamber mixed with cooler room air.

The device shall incorporate temperature sensors shielded from direct radiation and water spray and shall be able to control the temperature of the black temperature sensors to within ± 3°C of the desired temperature. They shall be designed such that the temperature of a black panel temperature sensor placed anywhere within the specimen exposure area is within ± 5% of the desired celsius temperature.

E.3 Specimen

A minimum of three replicate specimens shall be selected from each batch of transparent / plastic panels, two of which shall undergo accelerated exposure tests. The third specimen shall be properly protected and maintained at its original condition and shall be taken as control specimen for comparison with the other two specimens after the exposure test.

The form and shape of the test specimens shall be those specified in the appropriate test method for the properties to be measured after exposure. The method used for the preparation of the test specimens shall be submitted to the Administrator for approval.

E.4 Test condition

E.4.1 Irradiance

The irradiance on the specimen surface shall comply with Clause E.2.1.

Exposure devices shall be designed such that the radiance at any location in the area used for specimen exposures is at least 70% of the maximum irradiance measured in this area. Procedures for measuring irradiance uniformity shall be in accordance with Appendix B of I.S EN ISO 4892-1.

If the irradiance at any position in the area used for specimen exposure is at least 90% of the maximum irradiance, periodic repositioning of the specimens during exposure is not necessary.

If irradiance at any position in the area used for specimen exposure is between 70% and 90% of the maximum irradiance, the specimens shall be periodically repositioned during the exposure period to ensure that each receives an equal amount of radiant exposure. The repositioning schedule shall be agreed by the Administrator.

E.4.2 Temperature

The black-panel temperature shall be 65°C ± 3°C.

If water spray is used, the temperature requirements shall apply to the end of the dry period. If the thermometer does not attain equilibrium during a short cycle, the specified temperature shall be established without water spray and the maximum temperature attained during the dry cycle shall be reported. Even if the exposure apparatus is opened in an alternating mode, measurement by black-standard / panel thermometer shall be carried out in the continuous mode.

E.4.3 Relative humidity

The relative humidity shall be 75% ± 5%.

E.4.4 Spray cycle

Duration of spray: 18 min ± 0.5 min

Dry interval between spray: 102 min ± 0.5 min

E.5 Submission

Prior to commencement of the test, the supplier shall submit the following information to the Administrator for approval:

- detail of all apparatus used in the test including but not limited to shop drawings, catalogue, user manuals and so on
- calibration reports of all measuring devices
- proposed method statement and test procedures with calculations to substantiate the specified period of exposure based on meteorological data obtained from the Queensland Observatory
- form and shape of the specimens
- method used for the preparation of test specimens.

E.6 Procedure

E.6.1 Mounting the test specimens

Attach the specimens to the specimen holders in the equipment in such a manner that the specimens are not subject to any applied stress. Identify each test specimen by suitable indelible marking, avoiding areas to be used for subsequent testing.

When instructed by the Administrator, a portion of the test specimen shall be shielded by an opaque cover throughout the test with a view to obtaining an unexposed area adjacent to the exposed area for comparison.

E.6.2 Exposure

Before placing the specimens in the test chamber, ensure that the apparatus is operating under the specified test conditions and maintain these conditions throughout the specified exposure period.

Expose the test specimen for the specified period of exposure. It is desirable to vary the position of the test specimens in the apparatus from time to time to reduce any local inequalities of exposure. When the specimens are so adjusted, they shall remain in the same orientations as when initially mounted.

If it is necessary to remove a test specimen for a periodic inspection, care shall be taken not to handle or disturb the test surface. After inspection, the test specimen shall be returned to its holder or to the test chamber with its test surface in the same orientation as before.

The period of exposure shall follow Table E.6.2 and shall be worked out based on the power of the proposed fluorescent lamp.

Table E.6.2 – Exposure time

Lamp Irradiance in W/m^2	Exposure Time in Hours
550	8300
600	7600
650	7000
700	6500
750	6100
800	5700

E.6.3 Measurement of radiant exposure

Mount the light-dosage measurement instrument so that the radiometer indicates the irradiance at the exposed surface of the test specimen.

The exposure interval shall be expressed in terms of incident spectral radiant energy/m^2 of the exposure plane, in Joules/m^2, for the range of wavelength selected.

E.7 Test report

The test report shall contain the following information:

1. **Specimen description**
    i. a full description of the specimens and their origin
    ii. compound details, cure time and temperature where appropriate

iii. a complete description of the method used for preparation of the test specimens.

2. Description of exposure test conducted including:

i. A description of the exposure device and light source, including:

a) type of device and light source

b) description of the filters used

c) irradiance at the specimen surface (including the range of wavelength in which the radiation was measured)

d) number of hours that the filters and the light source had been used prior to commencement of the exposure.

ii. The type of black panel temperature sensor used and the exact position of the sensor.

iii. The type of instrument used to measure the humidity.

iv. The type of thermometer, and the way in which it is mounted on the specimen holder, and the selected temperature of operation.

v. A complete description of the exposure cycle including:

a) the mean and the tolerance limits for the temperature recorded

b) the mean and the tolerance limits for the relative humidity of the air passing over the specimens

c) the duration of the water spray and whether the water was sprayed on the exposed face, the back or both surfaces of the specimens, if the total solids of the water used for the spray is greater than 1 μg/g, report the total solids and the silica content.

vi. A description of the method used to mount the specimens in the exposure in the exposure frame, including a description of any material used as backing for the test specimens.

vii. The procedure for test specimen repositioning, if used.

viii. A description of the radiometer used for measuring the light dosage.

3. Test results

i. A complete description of the test procedure used for measurement of any properties reported.

ii. The results, presented in accordance with ISO 4582, and including:

a) the results of property measurements on the test specimens

b) the result of property measurements on control specimens

c) the exposure period (the time in hours, the radiant energy in J/m^2 and the range of wavelength in which it was measured).

4. The date of the test.

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