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NZS 4211 : 1985

Amendments No 1&2&3
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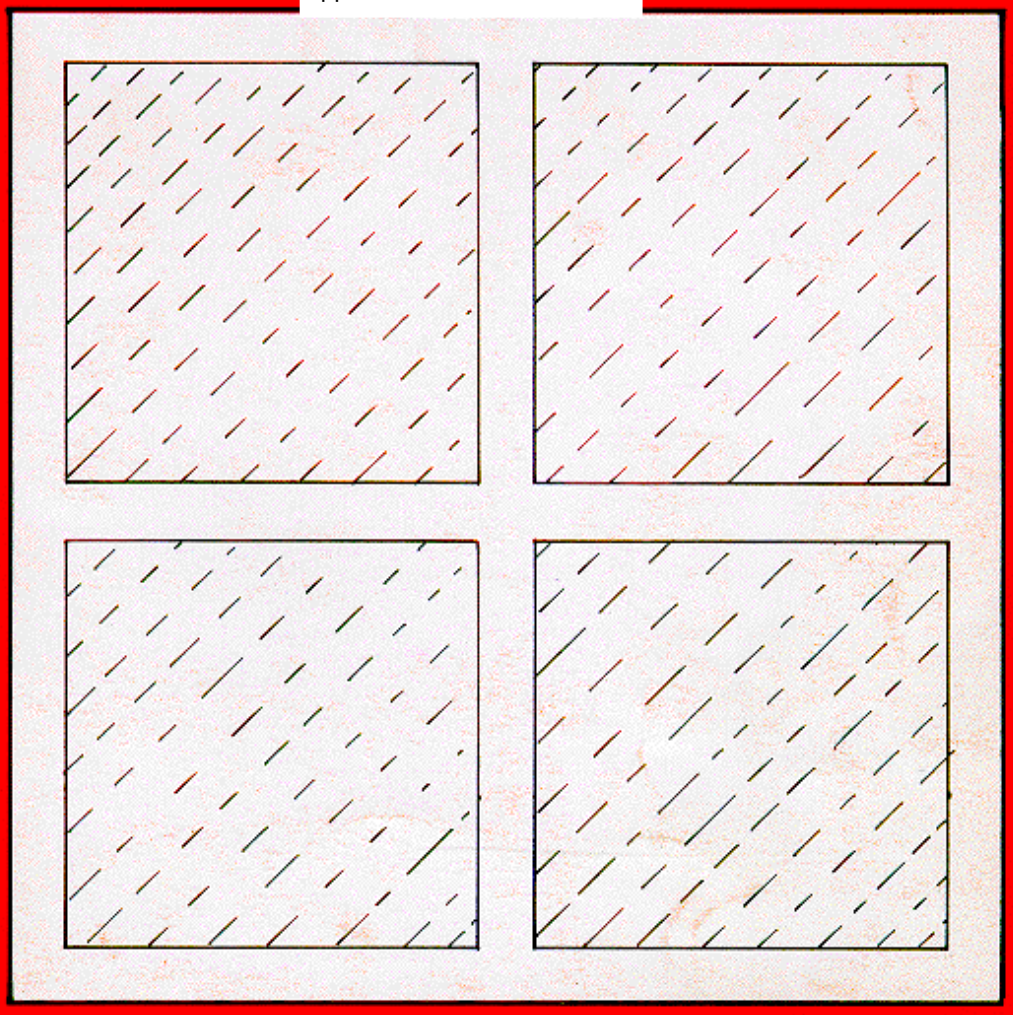

NEW ZEALAND STANDARD

Specification for PERFORMANCE OF WINDOWS

Superseding NZS 4211 : 1979

UDC 692.82-004.15
Pr U

Standards Association of New Zealand

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This Standard was prepared under the supervision of the former Building and Civil Engineering Sectional Committee (38/-) and subsequently the Building and Civil Engineering Divisional Committee (30/-) for the Standards Council, established under the Standards Act 1965. The committee consisted of representatives of the following:

* Building Research Association of New Zealand
Department of Scientific and Industrial Research
Housing Corporation of New Zealand
* Ministry of Works and Development
Municipal Association of New Zealand
New Zealand Contractors Association
New Zealand Counties Association
* New Zealand Institute of Architects
New Zealand Institution of Engineers
New Zealand Manufacturers Federation
New Zealand Master Builders' Federation

The Windows Performance Committee (42/2) was responsible for the preparation of this Standard and consisted of representatives of the following organizations in addition to those marked with an asterisk (*) above:

Architectural Aluminium Association of New Zealand
New Zealand Joinery Manufacturers Federation
Testing Laboratory Registration Council of New Zealand

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AMENDMENTS

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CONTENTS

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NOTES

RELATED DOCUMENTS

NEW ZEALAND STANDARDS

Reference is made in this document to the following:

NZS 1900:----	Model building bylaw Chapter 6:1985 Construction requirements for buildings not requiring specific design - Timber and masonry
NZS 4203:1984	Code of practice for general structural design and design loadings for buildings
NZS 4223:1985	Code of practice for glazing in buildings
MP 3801:1972	A guide to the adoption of the model building bylaw (NZS 1900) by local authorities using the standard adoption and annual updating procedure

INTERNATIONAL COUNCIL FOR BUILDING RESEARCH STUDIES AND DOCUMENTATION

CIB Report Publication 18:1983 CIB master list of headings for the arrangement and presentation of information in technical documents for design and construction.

FOREWORD

This Standard is a revision of NZS 4211:1979. It is referred to in NZS 1900: Chapter 10 as a means of complying with the requirements of that Chapter.

This Standard covers only those properties of a window which are of general importance and which can be quantitatively assessed by tests. Other properties are omitted, either because though important they are not quantifiable, or because they are of limited interest though quantifiable.

The testing of windows by use of a pressurized box is a method which has been developed overseas. This Standard embodies the best available current knowledge, but it is not claimed that the last word on this technique has yet been written. In particular, the method has limitations in dealing with windows having permanent openings and which are therefore incapable of retaining a pressurized atmosphere.

It might also be noted that the relatively low test pressures used for water leakage tests are not claimed to represent actual pressures during rain storms. They are arbitrary pressures which have been found to give results which correlate reasonably with the observed performance of windows installed in buildings.

Windows may be manufactured from many materials or combinations of materials and this Standard does not presume any one. Those presently available in New Zealand - aluminium, steel, timber, are by no means exhaustive.

Reference should also be made to other related standards that define performance related to this Standard, quality of materials, standard of construction and glazing, range of preferred dimensions, installation, protection and cleaning requirements for windows of a particular material.

Windows in buildings not the subject of specific design need not have been precisely calculated as to design wind pressure. Because of this they will also not be accurately related to the site by the use of the various factors used in the method of calculation set out in NZS 4203 : 1984 *Code of practice for general structural design and design loadings in buildings.* Nevertheless microclimate should be taken into account and windows should be selected on the basis of the use of local knowledge. In this way the appropriate wind speed at the site may be higher or lower than the basic wind speeds for the general locality given in table 5 of Appendix B.

The tests referred to in this Standard are intended to be applied to windows, including the seismic subframe if any, in their condition as delivered ex-factory.

NEW ZEALAND STANDARD

Specification for PERFORMANCE OF WINDOWS

1 SCOPE

1.1
This Standard states requirements for the performance of windows to be installed in exterior walls. The properties covered are strength, stiffness, dimensional accuracy, operating facility, air leakage, and water leakage.

2 INTERPRETATION

2.1
In this Standard, unless inconsistent with the context, terms have the meaning stated in Appendix A.

2.2
Where any type of window complied with the previous version of this Standard (NZS 4211 : 1979), it shall be deemed to continue to comply for a period of two years after the declaration of this Standard.

3 GENERAL

3.1
Design wind pressure over all installation sites throughout New Zealand may range from under 200 Pa on a sheltered one storey building to over 4 500 Pa on upper floors of high buildings in windy areas. Hence it is not usually economic to manufacture an all-purpose window which can be installed anywhere.

3.2
The Standard therefore presumes that windows will be manufactured in a variety of strengths. The Standard does not, however, specify any preferred incremental steps in designated strength. How many steps are offered and their bounds are left to each window manufacturer's decision.

3.3
Windows towards the upper end of the strength range are usually installed in designed buildings and are commonly made to order. A specific design wind pressure figure is therefore available from the building designer.

3.4
However, the major numerical demand is for ex-stock windows near the lower end of the strength range. Furthermore, a large proportion of these are installed in houses and other buildings not requiring specific design. On such jobs there may be no one qualified to produce wind pressure calculations. The Standard therefore allows installation of windows of three stated strength ratings anywhere in broad areas, according to the basic wind classification of the area. Recourse to full calculations for the actual site can usually be expected to show a lower strength requirement, though maybe not significantly so in all cases.

4 INTERRELATION OF PROPERTIES

4.1
In this Standard, the following performance properties of a window are numerically related to the design wind pressure:

(a) Overall strength and deflection (section 10)

(b) Water leakage (section 12).

4.2
Other performance properties are either constant for all windows or are related to factors other than the design wind pressure, namely:

(a) Dimensional accuracy (section 8)

(b) Operation of opening sashes (section 9)

(c) Air leakage (section 11)

(d) Torsional strength of sashes (section 13).

4.3
The relations between water leakage and design wind pressure referred to in 4.1 and the other values referred to in 4.2 have been chosen as generally satisfactory for most installations. These choices are not intended to preclude a specifier from requiring different relations or values if he desires a better performance or will accept a lower performance in any particular respect. Any window for which any lower performance is specified shall not be deemed to comply with this Standard.

4.4
The relation between water leakage and design wind pressure specified by this Standard has been chosen with regard for the cost of absolutely excluding water that is under substantial outside wind pressure. A window complying with this Standard may leak a little water in very severe storms, which should occur only infrequently during its life.

4.5
It should be noted that a window with fixed louvres or other permanent openings cannot retain a pressurized atmosphere. It therefore cannot be subjected to the air and water leakage tests specified by this Standard. It therefore cannot comply with the Standard. A specifier may, however, require a window to comply with all the other tests in this Standard. To enable the overall strength and deflection test to be applied, B8.2 of Appendix B provides for permanent openings to be temporarily blanked off.

5
REQUIRED PERFORMANCE RATINGS

5.1
For individual windows rated to this Standard:

(a) For buildings not requiring specific designs, all windows shall be capable of meeting the requirements of section 7. For all other buildings all windows shall be capable of meeting design wind pressure compatible with the requirements of NZS 4203

(b) The wind pressure rating shall be determined as the lower of two figures, one for strength and deflection as in section 10, the other for water leakage as in section 12

(c) An air leakage level shall be determined according to section 11 for a test pressure of 150 Pa. If an actual air leakage rate is required the conditions of B9.5 regarding air chamber extraneous leakage must be strictly adhered to

(d) Results of tests under sections 8, 9 and 13 shall be certified. See 6.9.

5.2
A certified window range consists of those windows for which compliance with this Standard has been demonstrated by means of tests on individual specimens. This range makes use of materials (sections, glass, fittings) having the same description as the tested windows and includes no member larger than the largest corresponding part of the tested window in any direction. In all other respects the description of members of the certified range is the same as that of the windows tested to demonstrate certification.

6
TESTING, MARKING, AND CERTIFICATES

6.1
Tests referred to in this Standard apply to individual windows tested to demonstrate compliance of a window range. A window shall be submitted for test in the same condition as it would be offered for sale.

6.1.1
All such tests shall be performed by an approved laboratory.

6.1.2
A laboratory registered by TELARC for such tests is deemed to comply with 6.1.1.

6.2
Each window claimed by the manufacturer (on the basis of prototype tests) to comply with this Standard shall be marked on the frame in letters not less than 2 mm high with:

(a) The manufacturer's name or brand name

(b) The number of this Standard, 'NZS 4211:1985'

(c) The design wind pressure rating, for example, 'DWP 1 500 Pa'

(d) The air leakage level, for example, 'Level 2'.

The marking label does not have to be affixed during the test.

6.2.1
It must be stressed that any claim of compliance with this Standard is meaningless unless it also states the design wind pressure and air leakage level for which the claim is made.

6.2.2
In the case of windows which have been the subject of specific design and have been so tested the test certificate alone shall satisfy the requirements of this clause.

6.3
The marking referred to in 6.2 shall be on a framework member, or on a durable label fixed thereto and readable after installation.

6.4
When a manufacturer or his authorized franchise holder has established by prototype testing that a particular form of window complies with this Standard, he may without further testing assume and claim compliance for any window built by the same methods from the same sections assembled in the same relative positions provided that the sash sizes used are not larger than those of the tested prototype, that the hardware and associated fittings and accessories are the same and that the selection of glass for thickness complies with NZS 4223.

6.5
For an untested window in which the sashes comply with a tested design range, but which are mounted in a window too large to comply with 6.4, the manufacturer may claim compliance with a stated wind pressure for which the frame can be justified. For this purpose a formal design record must be kept, stating the basis for selection of each member, the relationship to tested windows of the range, and any other relevant data.

6.6
Where a window consists of multiple lights it will be acceptable to test the window in sections provided that:

(a) The window consists of four or more lights

(b) At least three normally adjacent lights are tested at any one time

(c) The final light from the preceding test shall be incorporated in the testing of the next group of lights.

6.7
Where a window is made up from repeated identical adjoining lights, it will only be necessary to test three lights and the test will be sufficient to indicate approval of larger windows created by the addition of further identical adjoining lights.

6.8
Factory supervision or repeated testing to ensure that production windows are as the prototype shall be as agreed between vendor and purchaser.

6.9
Each test certificate supporting a claim of compliance with this Standard shall contain the following information:

(a) The manufacturer's name and address

(b) Full description of the window, including dates of manufacture and testing, manufacturer's coding, a shop drawing of window, registered numbers of all die sections or fully dimensioned drawings of members together with part numbers where applicable, descriptions of all sealings and hardware together with part numbers where applicable

(c) Two wind pressures being the design wind pressure achieved under each of section 10 and section 12, based on deflection and water leakage

(d) Rated design wind pressure

(e) Air leakage level

(f) Operating forces

(g) Deflections under the torsional test.

6.10
In addition to the foregoing, the test certificates shall also record errors in dimensions, straightness and squareness.

7 WINDOWS FOR BUILDINGS NOT REQUIRING SPECIFIC DESIGN

7.1
For any building not requiring specific design, as defined in Chapter 6 of NZS 1900, calculation of design wind pressure at the installation site may be omitted, provided that the design wind pressure rating of any window complying with this Standard is not less than that shown in table 1.

Table 1 SELECTION OF WINDOWS FOR BUILDINGS NOT REOUIRING SPECIFIC DESIGN

Wind area	*Minimum DWP rating of window Pa*
L	550
M	750
H	1100

NOTE — The values in table 1 were set prior to the latest edition of NZS 4203.

Provided that:

(a) Local conditions do not lead to any concentration of wind, for example, valleys, ridges, embankments and funnelling

(b) Building height does not exceed 12 m for urban areas, (ground roughness = 3), 6 m for rural areas (ground roughness = 2), and 3 m for seafront areas (ground roughness = 1).

Basic wind speeds	High 50 m/s Medium 40 m/s Low 34 m/s
Acceleration factor	SI = 1.0 (not exposed to local wind acceleration)
Height and roughness factor	S2 = 0.82
Pressure coefficient	Cp = 0.8 - (-0.3) = 1.1

7.2
The wind area referred to in table 1 means the value for the town or district in which the building not requiring specific design is situated, either:

(a) Read from the wind map in fig. 1, or

(b) Listed in table 2 as a more exact value for the particular town or district or

(c) Specified by the Engineer of the local authority as the town or district value to be used for design purposes.

Table 2 WIND AREAS

Locality	*Wind Areas**	*Locality*	*Wind Areas**
North Island:		**South Island:**	
Kaitaia	H	Nelson	M
Whangarei	H	Blenheim	L
Dargaville	M	Amberley	M
Kaiwaka	M	Christchurch	M
Auckland	L	Port Hills	H
Albany	L	Banks Peninsula	H
East Coast Bays	M	Lyttelton	H
North Shore	L	Timaru	M
Howick	M	Oamaru	M
Clevedon	M	Westport	M
Thames	M	Hokitika	M
Paeroa	L	Dunedin	M
Coromandel	M	Milton	M
Whitianga	H	Gore	M
Tairua	H	Winton	M
Hamilton	L	Invercargill	H
Waihi	M	Alexandra	L
Tauranga	L		
Rotorua	L		
Taupo	L		
Gisborne	L		
Napier	M		
Hastings	M		
New Plymouth	H		
Wanganui	H		
Marton	H		
Palmerston North	M		
Dannevirke	M		
Wellington	H		

* H = High wind area M = Medium wind area L = Low wind area

8 DIMENSIONAL ACCURACY

8.1
Dimensional variations referred to in this section shall be measured to within ±20 % or to within ±1 mm, whichever is the greater.

8.2
Overall dimensions and tolerances. Overall dimensions and tolerances shall be as agreed between manufacturer and purchaser.

8.3
Straightness
The straightness of any framing member in a plane parallel or perpendicular to the face of the window should be within ±2 mm in any length of one metre and within ±3 mm in the total length and total height of the window.

8.4
Squareness
The squareness expressed as the difference in length of diagonals, should be within 3 mm. This recommendation applies to the windows as a whole and to any sash or light.

8.5
Flatness
If restraining the window frame in a flat condition affects any other measurement referred to in this section, such measurement shall be made with the frame so restrained.

9 OPERATING OF OPENING SASHES

9.1
The initial force required to overcome sealing friction of a fully closed sash shall not exceed twice the value stated in table 3.

Table 3 OPERATING FORCE FOR OPEN SASHES

Type of sash	*Maximum force N*
Horizontal sliding	60
All other types	80

9.2
The force required to begin and maintain motion of an open sash shall not exceed the value stated in table 3.

9.3
The maximum operating force required for windows which are to be opened only for maintenance purposes shall be 200 N.

9.4
The numerical values stated in this section shall apply to any opening sash having an overall area of less than 1 m^2. For larger opening sashes, such numerical values shall be increased *pro rata* to area.

9.5
An open vertical sliding sash shall not move when an upward or downward vertical force of 10 N is applied.

9.6
Where friction restraints alone are relied on to control an open, pivoted or projected sash, they shall

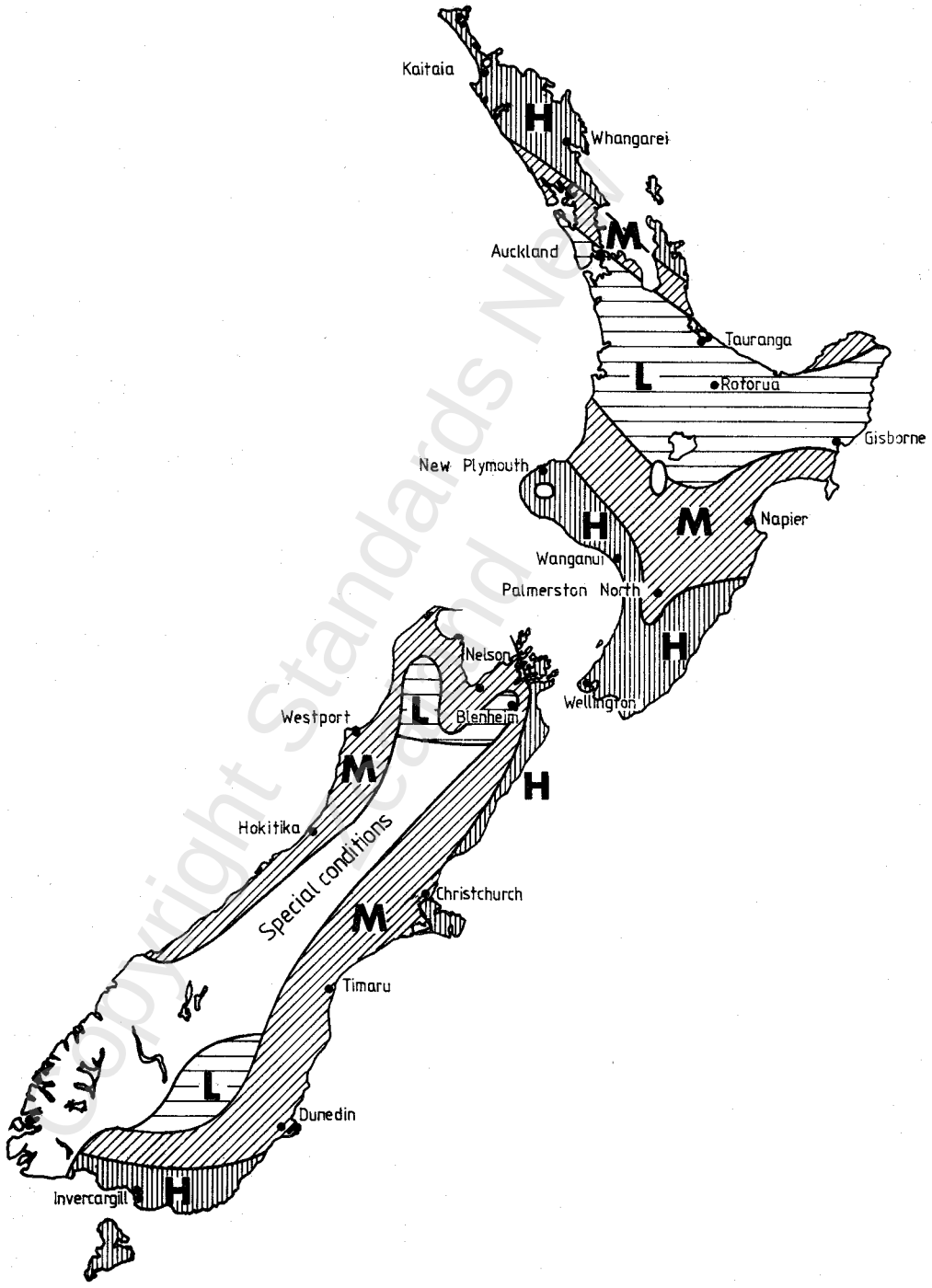

Fig. 1
WIND AREAS

provide sufficient restraint to prevent the window from moving when a force in newtons equal to 35 times the sash area in m^2 is applied to the edge furthermost from the hinges or pivots. This force shall be applied perpendicularly to the plane of the sash at all angles of opening up to 70 % of the maximum opening distance.

9.7
The operating forces referred to in this section shall be applied under still air conditions and (except for the unsealing force referred to in 9.1) in both opening and closing directions. The force shall be applied to the fastener or handle in the direction of motion. If there is no fastener or handle, the force shall be applied midway between the slides or pivots and to the member most likely to be gripped by a user.

9.8
In the case of a building requiring specific design in terms of NZS 1900, the designer may, for special reasons approved by the building permit issuing authority, vary these maximum forces.

9.9
Forces referred to in this section shall be measured to within 5 %.

10 OVERALL STRENGTH AND DEFLECTION

10.1
All windows shall comply with the strength and deflection requirements of this section when tested by the method set out in Appendix B.

10.2
A window shall withstand positive and negative test pressures of 1.3 times design wind pressure.

10.3
The maximum deflection due to bending of any structural member, including the outer window frame, measured relative to the end of the member at 1.0 times the design wind pressure shall not exceed 1/180 of the span of the member. In the case of curtain wall systems the span is the distance between mullion supports.

11 AIR LEAKAGE

11.1
This Standard provides for three levels of window in terms of air leakage performance, namely:

LEVEL 2 This level is recommended for air-conditioned buildings and in other demanding situations.

LEVEL 8 This level is recommended for general use.

LEVEL 17 This level is suitable for undemanding situations or where cost is a prime factor.

NOTE — This Standard provides three levels to signify the air leakage performance of windows instead of the Grades A, B, C used in NZS 4211:1979. The apparently hierarchical grade system encouraged the over-specification of windows to Grade A, in a mistaken attempt to get the best, when a Grade B window would have been adequate for general use and Grade A only necessary for air conditioned spaces. While essentially non-ordinal, levels 2, 8, or 17 are assigned to windows possessing values of air leakages in litres/sec m^2 of total window area which, respectively, shall not be exceeded without moving to a new level.

11.2
All windows shall comply with the air leakage requirements of this section when tested by the method of Appendix B.

11.3
The rate of air leakage at a test pressure of 150 Pa shall not exceed the values set out in table 4. The air leakage shall be expressed relative to:

(a) Window area (total air leakage)

(b) Length of opening joint, if any (air leakage related to opening light).

Table 4 AIR LEAKAGE

Rate of air leakage	*l/s*		
	LEVEL 2	*LEVEL 8*	*LEVEL 17*
Per m^2 of total window area	2	8	17
Per m of opening joint length	0.6	2	4

11.4
Level 2 windows shall be tested for both inward and outward leakage. Levels 8 and 17 shall be tested for inward leakage only.

NOTE — The absence of specific outward leakage figures for levels 8 and 17 results from the fact that air cannot leak outwards from a building unless equivalent inward air leakage occurs. The total air leakage is important in regard to heating loss, and the inward air leakage is indicative of the degree of draught likely to impinge on occupants. For domestic grade windows, it is at present considered that the meeting of inward air leakage criteria will result in adequate comfort performance. Leakage criteria in both directions are considered necessary for air-conditioned buildings, in order to limit the effects of wind pressure distribution, which might otherwise affect the operation of air-conditioning plant.

11.5
Opening joint length referred to in 11.3 shall be measured on the inside face of the closed window at the place where fixed and moving parts meet or where two moving parts meet. Linear measurements for computing the total window area shall be taken over the outer edges of the frame.

12
WATER LEAKAGE

12.1
All windows shall comply with the water leakage requirements of this section when tested by the method set out in Appendix B.

12.2
The maximum test pressure shall be 30 % of the design wind pressure up to 1200 Pa. Above 1200 Pa design wind pressure the maximum test pressure shall be 120 Pa plus 20 % of the design wind pressure.

12.3
Test pressure shall be applied in the positive direction only. Since application of test pressure may improve sealing contacts, the greatest leakage is not necessarily at the highest test pressure.

12.4
Leakage shall be assessed by visual observation. Failure occurs when significant leakage, as defined in 12.6, takes place.

12.5
Prior to significant leakage appearing, minor water penetration may occur, commonly erratic in incidence and behaviour. At this stage neither the amount nor the position of the leakage is such as to be likely to cause any damage to the window or the building fabric, or any inconvenience to the occupants of the building. Such leakage shall be disregarded. The transition point from this stage to significant leakage is normally observed as a definite change.

12.6
Significant leakage occurs when water penetrates beyond the inner face of the window frame.

13
TORSIONAL STRENGTH OF SASHES

13.1
All projected sashes unless agreed otherwise between the manufacturer and the purchaser shall comply with the torsional test requirements of this section when tested by the method set out in Appendix B.

13.2
The maximum deflection of a glazed sash shall not exceed 0.04 times the length of the shortest of two members joined at the point of load, or 50 mm whichever is the less, when loaded with a force equivalent to 0.5 times the relevant maximum operating force for sashes from table 3.

NOTE — The torsional test is intended to measure the rigidity, and thus provide an indication of the likely smoothness of the opening action, of a sash hung on friction stays. The given figure of 0.04 is suitable for residential windows. If a sash possessing characteristics of greater rigidity is required then a figure of 0.025 for the deflection limit should be substituted.

13.3
It is suggested that the manufacturer supplies a separate identical sash for this test.

13.4
Forces in this test shall be measured to within ±5 % and dimensions to within ±0.5 mm.

14
SEQUENCE OF MEASUREMENTS AND TESTS

14.1
Measurements and tests specified by this Standard shall be made in the following sequence:

(a) Dimensional accuracy (section 8)

(b) Operation of opening sashes (section 9)

(c) Overall strength, deflection and leakage (Appendix B, in the sequence stated therein)

(d) Recheck of (a) and (b) to the extent appearing necessary

(e) Torsional strength of sashes (section 13).

15
OTHER PERFORMANCE PROPERTIES

15.1
Other mechanical tests on the frames and hardware of opening sashes are desirable, but are not at present included in the Standard through lack of suitable data on which to base them.

15.2
Other properties of a window, not referred to in the Standard, may be important in particular cases. For a detailed enumeration of properties for which a specifier might consider writing clauses, reference should be made to the CIB master lists.

16
NEW ZEALAND STANDARD CERTIFICATION MARK SCHEME

16.1
As this Standard covers product performance, manufacturers are advised to apply for a licence to use the New Zealand Standard Certification Mark. (For further details see inside back cover).

APPENDIX A
GLOSSARY OF TERMS RELATING TO WINDOWS

A1
Design wind pressure (DWP).
The total differential wind pressure, calculated by the method set out in Part 4 of NZS 4203 at the building site and at the position where the window is installed, or as defined in 7.1. For differing wind directions, this calculation normally gives two values - a maximum positive value, tending to blow the window inwards and a maximum negative (also called 'suction') value, tending to blow the window outwards. For the purposes of this Standard, design wind pressure shall be taken as the greater of these two figures and the window shall be deemed to be exposed to this pressure in each direction.

A2
Fittings
Attachments to the window which are used to operate or secure it, or both.

A3
Fixed glass
Glass fixed into a LIGHT or a SASH.

A4
Frame
The outer surrounding horizontal and vertical members of the window commonly called head and sill and jambs respectively. The frame may or may not incorporate integral linings and facings.

A5
Friction restraint
A rotating or sliding frictional device holding a hinged, pivoted or projected opening light in a selected open position and which is overcome by force during opening and closing. The term does not include any device such as a stay nipped by a thumbscrew in which the friction is manually released during window movement.

A6
Glass and glazing
Include any infill material and its fixing. Glass shall be in accordance with NZS 4223.

A7
Light
The unit of space resulting from the subdivision of a window between its frame members by mullions and transoms.

A8
Mullion
The intermediate vertical members fixed between the head and sill of a window frame subdividing the window into lights.

A9
Rail
A horizontal member of a sash other than an interlocker.

A10
Sash
An assembly of parts, being glass contained by stile and rail members, that moves within, from, or across a light of a window.

A11
Fixed sash
A sash fixed without fittings within a light.

A12
Hinged sash
A sash which opens with rotary motion about one edge, the axis being fixed in space. The term includes folding windows.

A13
Pivoted sash
A sash which opens with rotary motion about an axis which is not on one edge and which need not be fixed in space. The term includes fully reversible (spinner) windows.

A14
Projected sash
A sash supported and held open by frictional restraints, of which an AWNING SASH is a particular type.

A15
Sliding sash
A sash which opens by moving horizontally or vertically without changing plane.

A16
Sightline
The line formed at the intersection of glass with the opaque parts of the window.

A17
Stile
A vertical side member of a sash other than an interlocker.

A18
Transom
The intermediate horizontal members fixed between the jambs, or between jambs and mullion, or between mullion and mullion of a window frame subdividing the window into lights.

A19
Weatherstrip
A gasket of resilient material fixed around the sash, or to the surface which it closes against, to assist tight sealing and limit air leakage.

A20
Window
Includes certain frames which may be called 'doors' in some installations. The name used in practice tends to be based on function rather than on construction and this Standard covers:

(a) Any light enclosing:
  (i) A horizontally or vertically sliding sash;
  (ii) A hinged or pivoted, or projected sash which closes against stops;
  (iii) A reversible (spinner) sash;
  (iv) Fixed glass;
  (v) Closable louvres;
  (vi) Any combination of the foregoing

(b) Curtain wall systems enclosing all or any of the foregoing.

APPENDIX B
TESTS FOR STRENGTH, AIR LEAKAGE, AND WATER LEAKAGE

B1
Torsional test for sashes

B1.1
The sash to be tested complete with glass shall be mounted vertically, and clamped at three corners so that these corners cannot move out of plane.

B1.2
The two corner clamps closest to the free corner shall each consist of a pair of rigid metal strips 5 mm wide, secured approximately parallel to each other, one on each side of the sash. The centreline of each strip shall be aligned across the inside and the outside corner angle of the frame of the sash. The third clamp shall securely hold the corner most remote from the free corner.

B1.3
The fourth corner shall be subjected to a force at right angles to the sash, applied and progressively increased in increments of 10 ±0.1 N at 1 min intervals.

B1.4
The deflection shall be observed at each interval.

B1.5
The sash shall be tested in both directions and the greatest deflection shall be within the limit specified in 13.2.

B2
Tests on complete windows

B2.1
The further sections of this Appendix describe the apparatus and methods of testing a complete window for the purpose of measuring its overall strength, air leakage and water leakage performance. These tests involve the use of a pressure chamber and static air pressure. Although wind gusting is known to influence actual window performance, as yet there is no general agreement on how to simulate gusting in pressure chamber testing.

B2.2
Where both inward and outward air leakage or structural tests are required on a window these can be achieved by

(a) Reversing the window in a booth which can only be pressurized or can only be evacuated

(b) Alternatively evacuating and pressuring the booth for a window which remains fixed in the test chamber.

B3
Pressure chamber

B3.1
The window shall be mounted in a vertical plane in one side of a well-sealed chamber or box which can be evacuated or pressurized or both. The test chamber and the perimeter mounting of the test specimen shall be sealed to reduce extraneous chamber leakage to comply with B9.5.

B3.2
The dimensions of the box should be sufficient to permit access behind the mounted window for stopping joints and adjusting water sprays. An airtight access door should be provided and one or more observation windows are recommended, permitting inspection of the inside face of the window under test.

B4
Air supply system

B4.1
A blower shall be provided capable of establishing the maximum test pressure required within a period of 10 s.

B4.2
The chamber and air supply shall provide an essentially constant pressure differential for the appropriate period specified for the test (See B3).

B4.3
Means shall be provided for measuring:

(a) The differential pressure between the inside and outside of the box with an accuracy within (±10 Pa + 2 % of reading)

(b) The rate of airflow into the box with an accuracy within ±2 %.

B5
Water spray system

B5.1
Means shall be provided for spraying completely and continuously with water the face of the window subjected to positive pressure.

B5.2
Means shall be provided for measuring the rate of water flow. The measuring device shall be calibrated by a time/collection method.

B5.3
The required form of spraying is shown in fig. 2. The minimum rate of water application is 180 1/h per

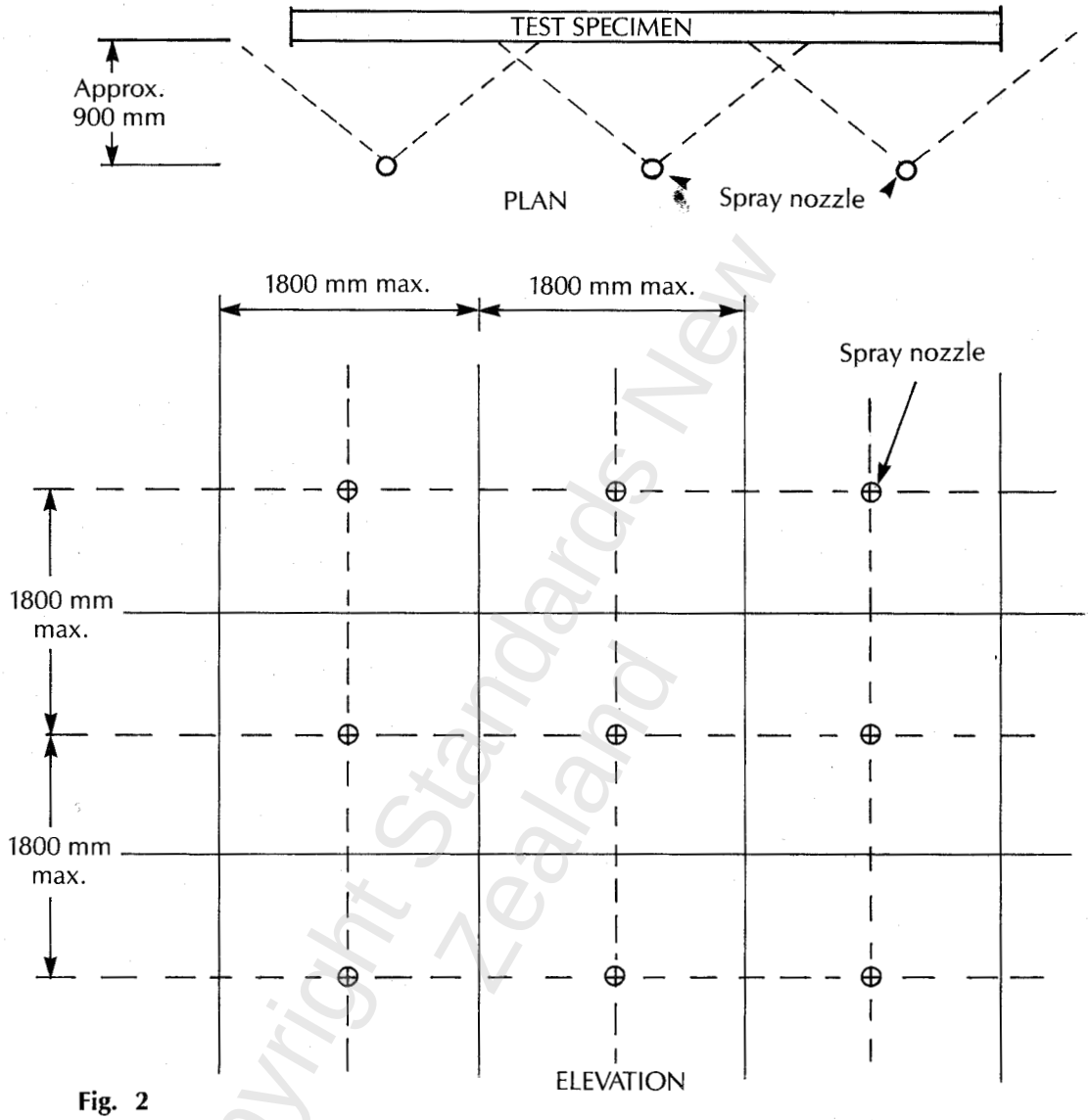

Fig. 2
SPRAY NOZZLE LAYOUT FOR WATER APPLICATION
Spray nozzles shall be solid cone type giving approx.100° spray angle and 50 % droplets exceeding 2-3 mm dia. Water shall be applied at a pressure of approx. 800 kPa.

square metre of operating grid. The nozzles are horizontal. The grid (or window) shall be so positioned that the top horizontal row of nozzles is at the same level as the highest horizontal bar of the specimen and that the remainder of the specimen is completely and continuously wetted by the other nozzles.

B5.4
The water shall be pure as from a normal town supply. Wetting agents shall not be used.

B6
Safety precautions

B6.1
While the window is under pressure, the frame may break or glass may blow out with the release of considerable energy. The order of tests specified in section B7 of this Appendix ensures that the leakage tests (which may require an observer to stand in front of the window) are always preceded by a strength test at higher pressure.

B6.2
The test instruments required for the strength test should be located so that the observer reading them is protected from failure debris. In particular, the deflection measurement required in the strength test should not be read from a position in front of the window. The tester should provide a dial indicator which can be read from a safe side position; or an external bar may be mounted across the window with an electrical contact set to close at limiting deflection; or some other equivalent precaution should be taken.

B6.3
The volume of the room containing the test box and its openings to other air spaces should be sufficient to ensure that sudden release of air pressure cannot cause a harmful pressure rise in the test area.

B7
Sequence of tests

B7.1
The window shall be mounted in the test chamber and subjected to air pressure to simulate positive wind pressure and wind suction on the building wall.

B7.2
Tests shall be carried out in either of the two following sequences:

(a) Overall strength positive wind pressure, air leakage positive wind pressure, water leakage positive wind pressure, overall strength wind suction, air leakage wind suction (if required)

(b) Overall strength positive wind pressure, overall strength wind suction, air leakage positive wind pressure, air leakage wind suction (if required), water leakage positive wind pressure.

B8
Overall strength and deflection test

B8.1
The window shall be mounted in the test box in accordance with any relevant installation instructions of the manufacturer and all joints between window frame and surround sealed.

B8.2
If the window has permanent openings (for example, fixed louvres) or other openings (for example, gaps around closable louvres or against slides) which would prevent establishment of test pressure, such openings shall be temporarily sealed. The method of sealing will require devising to suit the construction. Small gaps may be sealed with adhesive tape. Larger gaps may be covered with a strong plastics sheet sealed at the edges. Such a sheet spanning wide gaps (as between louvre slats may be reinforced with cardboard, hardboard, or other semi-rigid material beneath. However, such reinforcing material shall not transfer direct to the window frame test loading which should be borne by slats or other members within the blanked-off area.

B8.3
The box shall be capable of withstanding safely the maximum test pressures. One vertical face shall contain a cut out sufficient to accommodate the largest window to be tested. The surround in which the window is mounted shall not distort under air pressure in a manner likely to affect the structural properties of the window.

Measurements required by section B8 of the Standard must be made relative to an independent datum and must include measurements of the deflections at the support points of structural members as part of the process of measuring their maximum deflections.

B8.4
Equipment for measuring mullion, transom or rail deflection shall be set up and the zero or no load readings noted. The window shall then be subjected to 50 ±5 % of full test pressure, which shall be held for at least 60 s and released. The readings shall again be checked and any non-elastic slack taken up by the preliminary loading noted and allowed for.

B8.5
The test pressure shall then be applied in steps up to a maximum of 1.3 times the design wind pressure specified by the manufacturer. The pressure selected for each step shall be applied in a time of not less than 5 s. held for at least 60 s and then released.

NOTE — Steps equivalent to test pressures corresponding to the defined lower design pressures, for example, 605 and 825 Pa may provide information to the tester if the window fails to comply with the deflection requirements of the specified design wind pressure.

B8.6
The maximum nett deflection under pressure shall not exceed the value specified in 10.3. The residual nett deflection shall not exceed 5 % of this value or 0.2 mm whichever is the greater.

B8.7
If at any pressure below the maximum stated in B8.5 failure of the window appears imminent or the specified deflection limits are reached, the test shall be stopped at that point and the window shall be rated at a lower design wind pressure to correspond with the test results.

B8.8
The test shall then be repeated once, up to the maximum pressure referred to in B8.5 or B8.7, as the case may be.

B8.9
If a pane of glass fails during any loading cycle, the opening may be reglazed and a further loading cycle attempted. If three loading cycles, not necessarily consecutive, are not successfully withstood without glass breakage in six or fewer total attempts, the window shall be deemed to fail the test.

B8.10
Reglazing referred to in B8.9 may be performed by the window manufacturer, or other sponsor of the testing, if he elects. Reglazing shall be by the original method if practicable. If the tester is satisfied that reglazing by the original method is not practicable at the test site, or would unreasonably delay further testing, he may approve such other arrangements as he considers suitable in the circumstances. These may include for example, the use of a quick-setting compound in lieu of putty.

B9
Air leakage test

B9.1
Before testing, the window shall be totally sealed against air leakage. After completion of the strength test, all opening joints of the window and any other joints likely to leak shall be temporarily sealed on the higher pressure face of the test specimen by covering with adhesive tape. Alternatively it may be more convenient to cover the whole window face with a plastic or other impermeable sheet sealed around the edges.

B9.2
Air pressure differential within the test chamber shall be set at 150 Pa by either exhausting from or introducing air to the test box. Air leakage to or from the test chamber shall then be measured with a calibrated metering device which will achieve the accuracy required by B4.3 (b). The measurement thus made shall be taken as the extraneous leakage of the test chamber and window peripheral sealing. The test shall be made three times from zero pressure to reduce variability.

B9.3
The temporary sealing of the window joints shall then be removed without disturbing the window or its peripheral sealing and the air pressure differential successively reset to 150 Pa three times within a tolerance of ±2 Pa. Air leakage to or from the test chamber at these three pressures is measured as above. These measurements provide values for the total leakage, that is, the extraneous leakage plus the leakage through the window.

B9.4
The air leakage of the window shall be determined by subtracting the readings obtained in B9.2 from those obtained in B9.3 for the same nominal pressure setting and determining their mean.

B9.5
Where a window air leakage numerical value is to be reported, extraneous leakage measured in B9.2 must be less than 50 % of the allowed window leakage for that window for that level. Where a window air leakage level only is to be reported it is sufficient to demonstrate either:

(a) That total leakage measured in B9.2 is less than the allowed window leakage for that level, or

(b) That the difference between the air flows (B9.3 and B9.4) allowing for the measurement errors is less than the allowed window leakage for that level.

B10
Water leakage test

B10.1
Prior to the water leakage test, the window shall be cleaned to ensure removal of manufacturing oils and similar water repellent substances.

B10.2
After the water spray has been turned on, air pressure within the test box shall be increased to a maximum pressure with a minimum of four steps of approximately 25 %, 50 %, 75 % and 100 % of the maximum pressure specified in 12.2 of the Standard. The pressure shall be held for at least 2 minutes at each intermediate pressure and for at least 10 minutes at the maximum pressure.

B10.3
Significant leakage, as defined in 12.6 of the Standard, shall not occur at any stage of the test.

B10.4
Water to be applied from nozzles giving full square pattern mounted in a rectangular grid system. See fig 2.

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NEW ZEALAND STANDARD

NZS 4211:1985

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Specification for
PERFORMANCE OF WINDOWS

AMENDMENT No. 1

EXPLANATORY NOTE - Amendment No. 1 provides for a greater level of flexibility for testing in accordance with the Standard. It identifies a preferred procedure and an alternative if testing facilities are unavailable.

DECLARATION

Amendment No. 1 was declared on 27 March 1987 by the Standards Council to be an amendment to NZS 4211:1985 pursuant to the provisions of section 23 of the Standards Act 1965.

(Amendment No. 1, March 1987)

6
TESTING, MARKING, AND CERTIFICATES

Delete 6.1.1 and 6.1.2 and **substitute:**

"6.1.1
All such tests should be performed by a laboratory registered by TELARC for such tests except as provided for in 6.1.2 and 6.1.3.

6.1.2
Where a laboratory registered by TELARC for such tests is not available in New Zealand, the test shall be performed by an approved laboratory.

6.1.3
In all cases of dispute, the use of a laboratory registered by TELARC or equivalent overseas laboratory referee organization shall be mandatory."

(Amendment No. 1, March 1987)

6.9
Add the following subclause:

"(h) The TELARC endorsement or in the case of testing performed in accordance with 6.1.2, a statement that the laboratory has been approved for such tests together with the origin of approval."

(Amendment No. 1, March 1987)

NEW ZEALAND STANDARD

NZS 4211:1985

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Specification for
PERFORMANCE OF WINDOWS

AMENDMENT No. 2

July 1992

EXPLANATORY NOTE – This Amendment applies when this Standard is used as a Verification Method that is referenced in Approved Document B1 Structure – General, to the New Zealand Building Code. The Amendment need not apply when this Standard is used under the Model Building Bylaw system which remains in operation until 31 December 1992.

APPROVAL

Amendment No. 2 was approved in July 1992 by the Standards Council to be an amendment to NZS 4211:1985 pursuant to the provisions of section 10 of the Standards Act 1988.

(Amendment No. 2, July 1992)

NOTE – References to air leakage, water leakage and operational effectiveness of opening sashes are non-structural considerations and do not apply when this Standard is used as a Verification Method for the purposes of Approved Document B1 Structure – General. However compliance in all respects with this Standard is an alternative acceptable solution for NZBC E2 External moisture, but will exceed the New Zealand Building Code requirements. In particular, the following do not apply to Approved Document B1 Structure – General.

Sections 9, 11 and 12.
Clauses B5, B6, B7.2 and B10 of Appendix B.

(Amendment No. 2, July 1992)

7.1
In line 2 **delete** the words "Chapter 6 of NZS 1900" and **substitute** "NZS 3604 and NZS 4229".

(Amendment No. 2, July 1992)

NEW ZEALAND STANDARD

NZS 4211:1985

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Specification for
PERFORMANCE OF WINDOWS

AMENDMENT No. 3

February 1994

EXPLANATORY NOTE – The loads specified as part of the performance criteria in NZS 4211:1985 have been derived from design wind pressures (DWP) which were determined in accordance with the principles of working stress design (WSD). The 1992 edition of the New Zealand Loadings Standard (NZS 4203:1992) defines load levels for both ultimate limit state and serviceability limit state conditions. Wind loads are specified for both limit states. The wind zones nominated within the 1990 edition of the light timber framing code (NZS 3604) were determined from the ultimate limit state wind speeds as outlined in NZS 4203:1992.

This amendment redefines window performance criteria in limit state terms. Windows tested in accordance with this amendment are required to satisfy three distinct requirements, namely, ultimate limit state criteria (strength and stability when subjected to wind pressures associated with limit state wind speeds), and two serviceability criteria (the first for stiffness when subjected to wind pressures associated with serviceability limit state wind speeds; and the second for water leakage when subjected to a lesser nominal wind pressure). Window ratings are to be determined from the least equivalent ultimate wind speed which satisfies all the above criteria. For windows which are required to satisfy specific design, the window rating is to be the equivalent ultimate design wind pressure (UWP). For windows to be used in non-specific design situations, the window rating is to be the wind zone with the lowest associated design wind speed for each of which the above criteria is satisfied. The wind zones nominated within the amendment are consistent with those specified within NZS 3604. Windows rated as suitable for use within a non-specific design wind zone are suitable for use within that wind zone specified in NZS 3604.

The test criteria for the original three wind zones specified within NZS 4211:1985 are slightly more stringent than those within this amendment and accordingly continue to meet the requirements of the equivalent wind zones (i.e. Low, Medium and High). The Very High zone introduced into the 1990 edition of NZS 3604 is an additional zone added to cater for buildings erected on particularly exposed sites. There was no equivalent zone either in the earlier edition of NZS 3604, or within NZS 4211:1985.

APPROVAL

Amendment No. 3 was approved on 7 February 1994 by the Standards Council to be an amendment to NZS 4211:1985 pursuant to the provisions of section 10 of the Standards Act 1988.

RELATED DOCUMENTS

Delete the references to NZS 1900 and MP 3801:1972.

Delete "NZS 4203:1984" and **substitute** "NZS 4203:1992".

Delete "NZS 4223:1985 Code of practice for glazing in buildings" and **substitute:**

"NZS 4223:- - - -	Code of practice for glazing in buildings
Part 1:1985	The selection and installation of glass in buildings
Part 2:1985	The selection and installation of manufactured sealed insulating glass units
Part 3:1993	Human impact safety requirements"

Add:

"NZS 3604:1990	Code of practice for light timber frame buildings not requiring specific design
NZS 4229:1986	Code of practice for concrete masonry buildings not requiring specific design".

(Amendment No. 3, February, 1994)

Foreword
Delete the first paragraph.

(Amendment No. 3, February, 1994)

2.2
Delete the clause.

(Amendment No. 3, February, 1994)

3.4
In line 8 **delete** the word "three" and **substitute** "four".

(Amendment No. 3, February, 1994)

4.1
Delete the clause and **substitute**:

"**4.1**
In this Standard the following performance properties of a window are related to the wind pressure to which they may be exposed:

(a) Deflection of structural elements (section 10);

(b) Water leakage (section 12);

(c) Overall strength of window and fixings (section 10)."

(Amendment No. 3, February, 1994)

4.2
In line 3 **delete** the word "design".

(Amendment No. 3, February, 1994)

4.3
In line 1 **delete** the word "design".

(Amendment No. 3, February, 1994)

4.4
In line 1 **delete** the word "design".

(Amendment No. 3, February, 1994)

5.1
Delete item (b) and **substitute**:

"(b) The window rating shall be determined as the least demanding wind zone achieved by the test window for:

(i) Deflection in accordance with 10.2,

(ii) Water leakage in accordance with section 12, and

(iii) Ultimate strength in accordance with 10.3."

Add a new item (e) as follows:

"(e) Any window, or range of windows which has been shown by tests, prior to the issue of Amendment No. 3, to be rated as suitable for use within a given non-specific design wind zone defined by this Standard, shall be deemed to continue to be suitable for use within the same wind zone as defined in NZS 3604:1990, without the need for retesting.

(Amendment No. 3, February, 1994)

6.2
Delete the clause and **substitute**:

"**6.2**
Each window to be installed in buildings not requiring specific design (NZS 3604:1990) and claimed by the manufacturer (on the basis of prototype tests) to comply with this Standard, shall be marked on the frame in letters not less than 2 mm high with:

(a) The manufacturer's name or brand name;

(b) The number of this Standard, "NZS 4211:1985";

(c) The rating expressed as the appropriate wind zone (i.e. Low, Medium, High and Very High) for example "Zone M";

(d) The air leakage level, for example "Level 2".

The marking label does not need to be affixed during the test."

(Amendment No. 3, February, 1994)

6.2.1
In line 3 **delete** the words "design wind pressure" and **substitute** "wind zone".

(Amendment No. 3, February, 1994)

6.2.2
Delete the clause and **substitute**:

"**6.2.2**
For windows in buildings requiring specific design, the test certificate alone shall satisfy the requirements of this clause. The rating shall be in terms of both Ultimate Wind Pressure (UWP) and the Serviceability Wind Pressure (SWP) e.g. UWP – 2000 Pa; SWP – 750 Pa."

(Amendment No. 3, February, 1994)

6.9
In item (c) line 1 **delete** the word "design".

Delete item (d) and **substitute**:

"(d) Either rated Wind Zone for windows in building not requiring specific design, or rated Ultimate Wind Pressure and Serviceability Wind Pressure for windows in buildings requiring specific design."

(Amendment No. 3, February, 1994)

7.1
Delete the clause, including table 1, and **substitute**:

"**7.1**
For any building not requiring specific design as defined in NZS 3604 and NZS 4229, the window rating shall be not less than the wind zone of the installation site."

(Amendment No. 3, February, 1994)

7.2
Delete the clause.

(Amendment No. 3, February, 1994)

Table 2
Delete the table.

(Amendment No. 3, February, 1994)

Figure 1
Delete the figure.

(Amendment No. 3, February, 1994)

9.8
Delete the clause.

(Amendment No. 3, February, 1994)

10.2
Delete the clause and **substitute**:

"**10.2**
Unless a smaller value is separately specified for windows in buildings requiring specific design, the maximum deflection due to bending of any structural member, including the outer window frame, measured relative to the end of the member at the Serviceability Wind Pressure (SWP) shall not exceed 1/360 of the span".

(Amendment No. 3, February, 1994)

10.3
Delete the clause and **substitute**:

"**10.3**
A window shall withstand positive and negative test pressure equal to the Ultimate Wind Pressure (UWP) without loss of integrity, breakage or instability."

(Amendment No. 3, February, 1994)

Add a new clause:

"10.4
For windows in buildings not subjected to specific design, the Serviceability Wind Pressure and Ultimate Wind Pressure corresponding to the wind zones of NZS 3604 are shown in Table 5".

Table 5 TEST PRESSURES FOR WINDOWS NOT REQUIRING SPECIFIC DESIGN

Wind Zone as specified in NZS 3604:1990	*Serviceability Wind Pressure (SWP) Pa*	*Ultimate Wind Pressure (UWP) Pa*
Low	250	650
Medium	325	850
High	460	1200
Very High	600	1550

(Amendment No. 3, February, 1994)

Add a new clause:

"10.5
For any building requiring specific design, the Ultimate Wind Pressure and the Serviceability Wind Pressure together with any variation to the above performance criteria, shall be supplied in writing to the testing agency by the design engineer".

(Amendment No. 3, February, 1994)

12.2
Delete the clause and **substitute**:

"12.2
For windows in buildings not requiring specific design, the maximum water leakage test pressure shall be:

For windows to be used in wind zones L and M ..... 225 Pa
For windows to be used in wind zones H and VH ..... 330 Pa

For windows in buildings requiring specific design, the maximum water leakage test pressure shall be 0.40 times the Serviceability Wind Pressure plus 120 Pa".

(Amendment No. 3, February, 1994)

APPENDIX A

A1
Delete the clause and **substitute** the following:

"A1
Design Wind Pressures

A1.1
Ultimate Wind Pressures

The differential wind pressures resulting from wind speeds shall be derived in accordance with the calculation procedures prescribed in NZS 4203:1992 for ultimate limit state conditions (M_{ls} = 0.93). Windows are required to demonstrate adequate strength and stability to endure the resulting pressures (both as positive and as suction pressures). In specific design examples these positive and suction pressures may be different and should be prescribed accordingly by the design engineer in accordance with the requirements of 10.5. For non-specific design situations the UWP has been derived by considering the ultimate design wind speeds for the various wind zones defined in NZS 3604, with an external pressure coefficient, C_{pe}, of ±0.7 and an internal pressure coefficient, C_{pi}, of ±0.5. Positive and suction pressure are considered to be equal.

Table A1 Ultimate Limit State - strength, stability, integrity

	Basic wind speed *m/s*	*Ultimate design wind speed* *m/s*	*Dynamic pressure (Ultimate)* *Pa*	*Ultimate wind pressure (UWP)*	*Rounded UWP* *Pa*
Low	32	30	531	638	650
Medium	37	34	710	853	850
High	44	41	1005	1206	1200
Very High	50	47	1297	1557	1550

A1.2
Serviceability Wind Pressures (SWP)

The differential wind pressures resulting from wind speeds shall be derived in accordance with the calculation procedures prescribed in NZS 4203:1992 for serviceability limit state conditions (M_{ls} = 0.75). Windows are required to demonstrate adequate stiffness to withstand the resulting pressures (both as positive and suction pressures) by meeting the deflection criteria prescribed in 10.2. In specific design examples these positive and suction pressures may be different and should be prescribed accordingly by the design engineer in accordance with the requirements of 10.5. For non specific design situations the SWP has been derived by considering the serviceability design wind speeds for the various wind zones defined in NZS 3604 with an external pressure coefficient C_{pe} = ±0.7 and an internal pressure coefficient, C_{pi} of zero. Positive and suction pressures are considered equal."

Table A2 Serviceability Limit State - deflection

	Basic wind speed	*Serviceability design wind speed*	*Dynamic pressure (Serviceability)*	*Serviceability wind pressure (SWP)*	*Rounded SWP*
	m/s	*m/s*	*Pa*		*Pa*
Low	32	24	346	242	250
Medium	37	28	462	323	325
High	44	33	653	457	460
Very High	50	38	844	591	600

(Amendment No. 3, February, 1994)

APPENDIX B

B7.2
Delete the clause and **substitute**:

"B7.2
Tests shall be carried out in the following sequences:

(a) Deflection tests – positive pressure;

(b) Deflection tests – negative pressure;

(c) Air leakage – positive pressure;

(d) Air leakage – negative pressure (if required);

(e) Water leakage test;

(f) Ultimate Wind Pressure test – positive;

(g) Ultimate Wind Pressure test – negative.

(Amendment No. 3, February, 1994)

B8.5
Delete the first sentence and **substitute**:

"The test pressure shall then be applied in steps up to the maximum appropriate to the test being carried out".

(Amendment No. 3, February, 1994)

B8.6
In line 2 **delete** "10.3" and **substitute** "10.2".

(Amendment No. 3, February, 1994)

THE NEW ZEALAND STANDARD CERTIFICATION MARK SCHEME

The 'S' Mark appearing on a product, container or label is an assurance that the goods are manufactured under a system of supervision, control, and testing (including periodical inspection at the manufacturer's works by SANZ Certification Officers) designed to ensure compliance of the commodity, process, or practice with the relevant New Zealand Standard. The New Zealand Standard Certification Mark, registered as a certification trade mark under the Trade Marks Act 1953, may be used only in terms of a licence issued by SANZ, and must be accompanied by the licence number and the NZS number.

Used correctly in conjunction with advertising the 'S' Mark can provide a strong assurance of product quality for a manufacturer when selling his goods and thus becomes a powerful marketing tool.

Manufacturers may obtain particulars of the conditions of licensing from the Director, Standards Association of New Zealand, Private Bag, Wellington.

Declared on 25 October 1985 by the Standards Council to be a Standard specification pursuant to the provisions of section 23 of the Standards Act 1965.

First Published November 1985

The following SANZ references relate to this Standard:

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Draft for comment No. DZ 4211
CPT ref: LRS 2
Printing Code: 1000-1985/2014/19856
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