Specification for COPPER TUBES for Water Gas,and Sanitation

Amendments No 1&2&3
Appended

Metric units

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NEW ZEALAND STANDARD

SPECIFICATION FOR

COPPER TUBES FOR WATER, GAS, AND SANITATION

Metric units

Superseding NZS 1755

STANDARDS ASSOCIATION OF NEW ZEALAND
WORLD TRADE CENTER, 15-23 STURDEE STREET, WELLINGTON 1
Postal address: Private Bag, Wellington
Telegrams: *Standards*, Wellington

January 1976

Price code: Gr N

REQUEST FOR NEXT AMENDMENT

NZS 3501 : 1976
Amendment No. 1

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This is your request and mailing label for the next amendment to this New Zealand Standard. Please mail to Standards Association of New Zealand, Private Bag, Wellington.

Declared on 30 January 1976 by the Standards Council to be a standard specification pursuant to the provisions of section 23 of the Standards Act 1965.

First published January 1976

Reprinted March 1977

The following SANZ references relate to this standard:

Project No. P 3501

Draft for comment No. DZ 3501

Printing code 0.4M-1975/63/35683

0.4M.1977/44/38868

AMENDMENTS

No.	Date of issue	Remarks	Entered by, and date

CONTENTS

COMMITTEE REPRESENTATION

This standard was prepared under the supervision of the Non-ferrous Metals Sectional Committee (35) for the Standards Council established under the Standards Act 1965. The committee consisted of representatives of the following:

Architectural Aluminium Association of New Zealand
Auckland Manufacturers Association
*Department of Scientific and Industrial Research
New Zealand Government Railways Department
New Zealand Institute of Architects
New Zealand Institute of Chemists
New Zealand Institute of Foundrymen
*New Zealand Institution of Engineers
*New Zealand Manufacturing Engineers' Federation
New Zealand Photo-process Federation
*New Zealand Society of Master Plumbers
University of Canterbury

The Copper Tubes Committee (35/1) was responsible for the preparation of the standard and consisted of representatives of the following together with representatives of those organizations listed above marked with an asterisk (*).

Department of Health
Ministry of Works and Development
New Zealand Master Builders Federation
New Zealand Wholesale Plumbers Merchants Guild
Wellington Regional Water Board

FOREWORD

This standard is a "soft" metric revision of NZS 1755 : 1965 in which all dimensions and properties are specified in metric (SI) units but no physical change in the copper tubes is effected.

This revision is intended as an interim measure only since a "hard" metric revision involving actual changes in tube dimensions is envisaged at a later date. Such a change is not considered desirable until such time as similar "hard" metric changes in copper tube dimensions have been introduced in those countries, such as Australia and Canada, from which New Zealand's supplies of large diameter tubing and alternative supplies of smaller tubing are obtained.

The opportunity has also been taken to extend the scope of the standard to permit two sizes of tube to be supplied in coil.

Some re-editing has also been undertaken, partly to remove certain ambiguities and inconsistencies in the previous standard, and partly to more closely align the standard with current style.

RELATED DOCUMENTS

This standard requires reference to the following standards:

	Clause reference herein
NEW ZEALAND STANDARD	
NZS 914 : 1951 (BS 1499 : 1949) *Sampling non-ferrous metals*	*9.1*
INTERNATIONAL STANDARD	
R 401 : 1964 *Tensile testing of copper and copper alloy tubes of circular section*	*6.1*

The following standard is cited for information:

BRITISH STANDARD	
BS 18 : ---- *Methods for tensile testing of metals* - Part 1 : 1970 *Non-ferrous metals*	*6.1*

NEW ZEALAND STANDARD

SPECIFICATION FOR
COPPER TUBES FOR WATER, GAS, AND SANITATION

1 Scope

1.1 This standard applies to copper tube suitable for connection by means of compression fittings or by bronze or autogenous welding. Tubes are normally supplied in random straight lengths in the half-hard condition but tubes of 15 mm and 20 mm nominal bore may be supplied in coil form in the fully annealed condition.

1.2 Maximum working pressures at temperatures up to 65 °C, calculated in accordance with the following formula are given in table 1, based on a stress value F = 60 MPa:

$$P = \frac{2Ft}{D - t}$$

where P = pressure (MPa)
F = stress (MPa)
t = thickness (mm)
D = outside diameter (mm)

If tubes are annealed, then the maximum working pressures should be recalculated using a stress value F = 46 MPa.

1.3 Where any other standard named in this standard has been declared or endorsed in terms of the Standards Act 1965, then -

(a) Reference to the named standard shall be taken to include any current amendments declared or endorsed in terms of the Standards Act 1965; *or*

(b) Reference to the named standard shall be read as reference to any standard currently declared or endorsed in terms of the Standards Act 1965 as superseding the named standard, including any current amendments to the superseding standard declared or endorsed in terms of the Standards Act 1965 -

as appropriate.

NOTE - The date at which amendments or superseding standards are regarded as "current" is a matter of law depending upon the particular method by which this standard becomes legally enforcible in the case concerned. In general, if this is by contract the relevant date is the date on which the contract is created, but if it is by Act, Regulation, or bylaw then the relevant date is that on which the Act, Regulation, or bylaw is promulgated; for bylaws, promulgation includes updating by the procedure set out in MP 3801, *A guide to the adoption of the model building bylaw (NZS 1900) by local authorities using the standard adoption and annual updating procedures.*

2 Manufacture

2.1 The tubes shall be solid drawn and in no case shall they be redrawn from used tubes. Unless otherwise ordered all tubes shall be supplied in straight lengths and their ends shall be cut clean and square with the axis of the tube.

3 Chemical composition

3.1 The tubes shall be manufactured from phosphorus deoxidized copper complying with the following specification:

	Minimum	Maximum
Copper percent *	99.85	-
Phosphorus percent	0.013	0.050
Arsenic percent	-	0.05
Nickel percent	-	0.10
Total impurities percent †	-	0.060

* Copper includes silver.

† No individual impurity shall exceed the following values:

	Percent		*Percent*
Antimony	0.005	Tellurium	0.010
Bismuth	0.003	Selenium plus tellurium	0.020
Iron	0.030		
Lead	0.010	Tin	0.01

4 Dimensions

4.1 All tubes shall comply with the values for outside diameter given in table 1 or 2 as appropriate. The outside diameter shall be half the sum of two diameters measured at right angles on one cross-section of the tube.

4.2 The thickness of the tube shall be that specified in table 1 or 2 as appropriate to the diameter of the tube and shall not vary at any point from that specified, by more than ± 10 percent for outside diameters of 108 mm and less, or by more than ± 12 percent for outside diameters of more than 108 mm.

5 Freedom from defects

5.1 The tubes shall be straight, round, clean, smooth, free from

harmful defects and free from deleterious films in the bore.

5.2 All tubes shall meet the minimum hydrostatic test pressures specified in table 1 or table 2 as appropriate. The manufacturer shall make tests using such methods as he deems necessary to ensure that all tubes comply with the above requirement but whatever method may be used the hydrostatic pressure test shall be the reference method.

NOTE - The hydrostatic pressure test values in tables 1 and 2 have been calculated in accordance with the following formula:

$$P = \frac{80t}{D}$$

where P = internal pressure (MPa)
t = thickness (mm)
D = outside diameter (mm).

Table 1

COPPER TUBES FOR WATER AND GAS

Nominal* bore	Outside diameter		Thickness	Hydrostatic test pressure	Maximum working pressure
	Maximum	Minimum			
mm	mm	mm	mm	MPa	MPa
10 ($\frac{3}{8}$)	11.35	11.27	0.91	6.45	10.50
15 ($\frac{1}{2}$)	14.73	14.65	1.02	5.55	8.95
20 ($\frac{3}{4}$)	21.08	21.00	1.02	3.90	6.10
25 (1)	27.43	27.35	1.02	2.95	4.65
32 ($1\frac{1}{4}$)	34.19	34.11	1.22	2.85	4.45
40 ($1\frac{1}{2}$)	40.54	40.46	1.22	2.40	3.70
50 (2)	53.24	53.16	1.22	1.85	2.80
65 ($2\frac{1}{2}$)	65.94	65.79	1.22	1.50	2.25
80 (3)	79.45	79.30	1.63	1.65	2.50
90 ($3\frac{1}{2}$)	92.56	92.41	1.83	1.60	2.40
100 (4)	105.66	105.51	2.03	1.55	2.35

* The figures in parenthesis are the inch dimensions by which the tubes were previously designated.

Table 2

COPPER TUBES FOR SANITATION

Nominal* bore	Outside diameter		Thickness	Hydrostatic test pressure
	Maximum	Minimum		
mm	mm	mm	mm	MPa
25 (1)	27.43	27.35	1.02	2.95
32 ($1\frac{1}{4}$)	34.19	34.11	1.22	2.85
40 ($1\frac{1}{2}$)	40.54	40.46	1.22	2.40
50 (2)	53.24	53.16	1.22	1.85
65 ($2\frac{1}{2}$)	65.94	65.79	1.22	1.50
80 (3)	79.04	78.89	1.42	1.45
90 ($3\frac{1}{2}$)	92.15	92.00	1.63	1.40
100 (4)	104.85	104.70	1.63	1.25
125 (5)	130.25	130.00	1.63	1.00
150 (6)	156.06	155.76	1.83	0.95
200 (8)	194.50	194.25	3.00	1.25
250 (10)	268.00	266.40	3.00	0.90
300 (12)	324.90	323.30	4.00	1.00

* The figures in parenthesis are the inch dimensions by which the tubes were previously designated.

NOTE - Dimensions for tubes of 25 mm to 65 mm nominal bore (inclusive) duplicate those given in table 1.

6 Mechanical tests

6.1 *Tensile test.* When tested in accordance with the requirements of ISO R 401*, the tubes shall have a tensile strength of not less than 250 MPa for tubes supplied in straight lengths and between 200 and 250 MPa for tubes supplied in coil.

NOTE - Testing in accordance with Part 1 of BS 18* ensures compliance with ISO R 401*.

6.2 *Drift test.* When expanded over a taper drift until the

* *See* list of related documents, p. 5.

diameter of the drifted end measures at least 25 percent more than the original diameter, the tubes shall show neither crack nor flaw. The taper drift shall have an included angle of 45 degrees. The test piece shall have a length of between 2 and 3 times the outside diameter of the tube, or alternatively the test may be made on the end of a tube without removing the test piece. (*See* fig. 1.)

6.3 All mechanical tests shall be carried out on tubes in the as supplied condition.

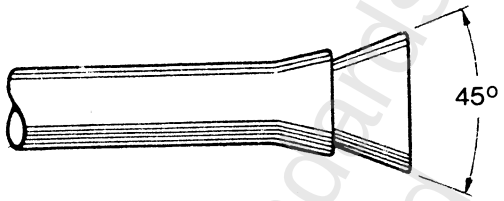

Fig. 1

TAPER DRIFT

7 Selection of test samples

7.1 *Testing facilities*

7.1.1 For orders of 0.25 tonne or more of tubes of any one diameter and thickness the manufacturer shall, at his own expense, prepare the necessary test pieces and supply labour and appliances for such testing as may be carried out on his premises in accordance with this standard. Failing facilities at his own works for making the prescribed tests the manufacturer shall bear the cost of carrying out the tests elsewhere.

7.1.2 For orders of less than 0.25 tonne of tubes of any one diameter and thickness the cost of testing shall be borne by the purchaser, and the selection of samples and the arrangements for testing shall be the subject of agreement between the purchaser and the manufacturer.

7.2 *Number of tests and selection of test specimens*

7.2.1 When the size of the order permits, tubes of the same diameter and thickness shall be grouped in batches of 300 tubes or 1.25 tonne, whichever is the heavier, and the purchaser or his representative shall select at random one tube from each batch or the remaining part of a batch for testing.

7.2.2 When the size of the order does not permit of batching in the above quantities, one sample of each diameter and thickness shall be selected for testing.

7.3 *Re-tests*

7.3 Should any one of the test specimens first selected by the purchaser or his representative fail to pass the mechanical tests, the tube from which the specimen was taken shall be rejected and two further tubes from the same batch shall be selected for testing. Should any of the test specimens from these additional samples fail, the batch represented by them shall be rejected.

8 Inspection

8.1 The manufacturer shall afford the purchaser or his representative all reasonable facilities to satisfy himself that the tubes are in accordance with this standard. If the purchaser wishes to inspect the tubes at the manufacturer's works, he shall notify the manufacturer when ordering.

8.2 All tests and inspection shall be made at the manufacturer's works prior to dispatch, unless otherwise agreed, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

9 Independent tests

9.1 In the case of dispute between the manufacturer and the purchaser as to whether or not the tubes comply with the standard specification, in the absence of other agreement, either party shall have the right to have the tests made by an independent testing authority to be mutually agreed upon. The method of sampling adopted for such independent tests shall be in accordance with the standard methods given in NZS 914*. The analytical methods shall be subject to agreement by the parties concerned.

9.2 In all cases the test results obtained by the independent testing authority shall be accepted as final.

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* *See* list of related documents, p. 5.

9.3 The expenses attendant upon such independent tests shall be borne by the manufacturer when the material does not comply with the standard specification and by the purchaser when it does so comply.

10 Marking

10.1 Each tube shall be marked by the method shown hereunder appropriate to its nominal bore:

(a) Tubes up to and including 25 mm nominal bore shall be permanently marked along their length at intervals of not more than 0.6 m.

(b) Tubes of 50 mm nominal bore and above shall be marked at one end by a 25 mm wide band of waterproof adhesive tape.

(c) Tubes of 32 mm and 40 mm nominal bore shall be marked in accordance with either subclause "a" or subclause "b" above at the option of the manufacturer.

10.2 Where tubes are marked by means of waterproof adhesive tape, the following colour code shall be used:

	Colour of tape	Colour of legend
Tubes to table 1	Blue	Black
Tubes to table 2 - 65 mm n.b. and under	Blue	Black
Tubes to table 2 - over 65 mm n.b.	Black	White

10.3 All tubes shall be marked with the following information:

(a) The number of this standard, that is NZS 3501, and the appropriate table number ;

(b) The manufacturer's name or identification mark.

NOTE - Compliance with this standard may be claimed in two ways:

(1) The expression "NZS 3501" appearing on a product is a *claim* by the manufacturer that it complies with the requirements of this standard. This is the manufacturer's responsibility, and carries the usual obligations under the Sale of Goods Act 1908 and the Consumer Information Act 1969, as well as others under the Standards Act 1965.

(2) The Standard Certification Mark appearing on a product *certifies* compliance with the standard through a system of supervision, control, and testing which has been established by the manufacturer to the satisfaction of the Standards Council. In addition, periodical inspections are made at the manufacturer's works, and testing to the standard at agreed intervals is carried out by independent testing authorities. The Standard Certification Mark is registered as a certification trade mark under the Trade Marks Act 1953, and may be used *only* (a) in terms of a licence issued by the Standards Association of New Zealand and also (b) in conjunction with the licence number and the relevant New Zealand standard number.

Further particulars of the conditions of licensing may be obtained from the Director, Standards Association of New Zealand, Private Bag, Wellington.

THE STANDARD CERTIFICATION MARK

Specification for COPPER TUBES FOR WATER, GAS, AND SANITATION

AMENDMENT No. 1

September 1983

EXPLANATORY NOTE - This Amendment No. 1 makes provision for light gauge tubes of 10, 15, and 20 mm nominal bore for use with water and gas.

To ensure receiving the next amendment to NZS 3501:1976 please complete and return the amendment request form.

DECLARATION

Amendment No. 1 was declared on 23 September 1983 by the Standards Council to be an amendment to NZS 3501:1976 pursuant to the provisions of the Standards Act 1965.

RELATED DOCUMENTS

Delete the heading NEW ZEALAND STANDARD and the reference to NZS 914:1951.

Delete the heading BRITISH STANDARD and *substitute* the heading BRITISH STANDARDS and *add* the following under this new heading:

BS 1499:1949 Sampling non-ferrous metals 9.1

(Amendment No. 1, September 1983)

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1 Scope

Clause 1.2

In line 3 *delete* "table 1" and *substitute* "tables 1 and 3".

(Amendment No. 1, September 1983)

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4 Dimensions

Clause 4.1

In line 2 *delete* "table 1 or 2" and *substitute* "table 1, 2, or 3".

(Amendment No. 1, September 1983)

---

4 Dimensions

Clause 4.2

In lines 1 and 2 *delete* "table 1 or 2" and *substitute* "table 1, 2, or 3".

(Amendment No. 1, September 1983)

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5 Freedom from defects

Clause 5.2

In line 2 *delete* "table 1 or table 2" and *substitute* "table 1, 2, or 3".

In the NOTE after clause 5.2 *delete* from line 1 the words "in tables 1 and 2".

(Amendment No. 1, September 1983)

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9 Independent tests

Clause 9.1

In line 7 *delete* "NZS 914" and *substitute* "BS 1499".

(Amendment No. 1, September 1983)

NEW TABLE

Add a new table 3 as follows:

TABLE 3 LIGHT GAUGE COPPER TUBES FOR WATER AND GAS

Nominal bore*	Outside diameter		Thickness	Hydrostatic test pressure	Maximum working pressure
	Max.	Min.			
mm	mm	mm	mm	MPa	MPa
10 (3/8)	11.35	11.27	0.6	4.25	6.70
15 (1/2)	14.73	14.65	0.7	3.80	6.00
20 (3/4)	21.08	21.00	0.9	3.40	5.35

* The figures in parenthesis are the inch dimensions by which tubes of this diameter were previously designated.

(Amendment No. 1, September 1983)

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10 Marking

Clause 10.3

Delete the NOTE after clause 10.3 and *substitute* the following:

NOTE - Shown here is the Certification Mark of the Standards Association of New Zealand. This Mark may be used only by those manufacturers licensed by the Standards Association and must be accompanied by the number of the relevant New Zealand Standard and the number of the authorizing licence. The presence of this Mark on or in relation to a product is an assurance that the goods are manufactured under a system of supervision, control, and testing (including periodical inspection of the manufacturer's works by SANZ) designed to ensure compliance with the Standard.

APPROVED TO NEW ZEALAND STANDARD

NZS 3501

Licence No. .....

For further particulars, apply to the Director, Standards Association of New Zealand, Private Bag, Wellington.

(Amendment No. 1, September 1983)

Specification for
COPPER TUBES FOR WATER, GAS, AND SANITATION

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AMENDMENT No. 2

May 1987

EXPLANATORY NOTE - This amendment revises the marking requirements such that tubes of 32 and 40 mm nominal bore must be permanently marked at intervals along their length. An option for this type of marking is also introduced for larger diameter tubes.

DECLARATION

Amendment No. 2 was declared on 29 May 1987 by the Standards Council to be an amendment to NZS 3501:1976 pursuant to the provisions of section 23 of the Standards Act 1965.

(Amendment No. 2, May 1987)

10
MARKING

10.1 Delete items (a), (b) and (c) and **substitute:**

(a) Tubes up to and including 40 mm nominal bore shall be permanently marked along their length at intervals of not more than 0.5 m

(b) Tubes of 50 mm nominal bore and above shall be marked at the option of the supplier by either:

(i) A waterproof tape measuring 25 mm x 10 mm minimum dimensions placed at one end

or

(ii) Permanently marked along their length at intervals of not more than 0.5 m.

(Amendment No. 2, May 1987)

STANDARDS ASSOCIATION OF NEW ZEALAND
WELLINGTON TRADE CENTRE, 181-187 VICTORIA STREET
WELLINGTON 1

Pr AA

Specification for
COPPER TUBES FOR WATER, GAS, AND SANITATION

AMENDMENT No. 3

December 1987

EXPLANATORY NOTE - This amendment provides for tubes of 65 mm nominal bore and above to be supplied in the as drawn condition. Consequential amendments are made to the mechanical test requirements and the scope. Amendments arising from changes in reference documents have also been incorporated.

To ensure receiving the next amendment to NZS 3501:1976 please complete and return the amendment request form.

DECLARATION

Amendment No. 3 was declared on 18 December 1987 by the Standards Council to be an amendment to NZS 3501:1976 pursuant to the provisions of section 23 of the Standards Act 1965.

(Amendment No. 3, December 1987)

RELATED DOCUMENTS

Delete completely and **substitute:**

"BRITISH STANDARD

BS 18:1987 Method for tensile testing of metals (including aerospace materials)".

(Amendment No. 3, December 1987)

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1. SCOPE

Delete clauses 1.1, 1.2 and 1.3 and **substitute:**

1.1

This Standard applies to copper tubes of 10 mm to 300 mm nominal bore suitable for connection by compression fittings, by bronze or autogenous welding or by capillary fittings. Tubes are normally supplied in random straight lengths, those of 50 mm N.B. and under in the half-hard condition and those of 65 mm N.B. and above in the as-drawn condition. Tubes of 15 mm and 20 mm N.B. may also be supplied in coil form in the fully annealed condition. Tubes of 65 mm N.B. and above are not suitable for bending or expanding without local heating.

1.2

Maximum working pressures at temperatures up to 65 °C, calculated in accordance with the following formula are given in tables 1 and 3:

$$P = \frac{2Ft}{D-t}$$

where:

P = pressure (MPa)
F = stress (MPa)
t = thickness (mm)
D = outside diameter (mm)

The following values of stress *(F)* have been assumed:

annealed condition, F = 46 MPa
half-hard condition, F = 60 MPa
as drawn condition, F = 70 MPa "

(Amendment No. 3, December 1987)

Table 1

Delete and **substitute** the following:

COPPER TUBES FOR WATER AND GAS

Nominal bore*	Outside diameter		Thickness	Hydrostatic test pressure	Max. working pressure		
	Max.	Min.			Annealed coil	Half -hard	As drawn
mm	mm	mm	mm	MPa	MPa	MPa	MPa
10 (3/8)	11.35	11.27	0.91	6.45	-	10.50	-
15 (1/2)	14.73	14.65	1.02	5.55	6.85	8.95	-
20 (3/4)	21.08	21.00	1.02	3.90	4.70	6.10	-
25 (1)	27.43	27.35	1.02	2.95	-	4.65	-
32 ($1\frac{1}{4}$)	34.19	34.11	1.22	2.85	-	4.45	-
40 ($1\frac{1}{2}$)	40.54	40.46	1.22	2.40	-	3.70	-
50 (2)	53.24	53.16	1.22	1.85	-	2.80	-
65 ($2\frac{1}{2}$)	65.94	65.79	1.22	1.50	-	-	2.65
80 (3)	79.45	79.30	1.63	1.65	-	-	2.95
90 ($3\frac{1}{2}$)	92.56	92.41	1.83	1.60	-	-	2.80
100 (4)	105.66	105.51	2.03	1.55	-	-	2.75

* The figures in parenthesis are the inch dimensions by which the tubes were previously designated.

(Amendment No. 3, December 1987)

6
MECHANICAL TESTS

Delete clauses 6.1, 6.2 and 6.3 and **substitute:**

"6.1
Tensile test
When tested in accordance with the requirements of BS 18:Part 1 tubes shall have a minimum tensile strength appropriate to their condition of supply as follows:

Condition	Tensile strength
Annealed	200 MPa
Half-hard	250 MPa
As drawn	280 MPa

6.2
Drift test
When expanded over a taper drift having a 45° included angle (see fig. 1) the tubes shall show neither crack nor flaw when the diameter of the drifted end exceeds the original diameter by not less than 25 % for test pieces tested in the as supplied condition and 30 % for test pieces annealed prior to testing.

6.3
All tensile tests shall be carried out on tubes in the as supplied condition. Drift tests shall be carried out on test pieces in the as supplied condition for tubes of 50 mm N.B. or less but for tubes of 65 mm N.B. and above the test piece shall be annealed before testing."

(Amendment No. 3, December 1987)

9
INDEPENDENT TESTS

9.1
Delete the 2nd and 3rd sentences and **substitute:**

"The methods of sampling and analysis adopted for such independent tests shall be subject to agreement by the parties concerned".

(Amendment No. 3, December 1987)

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Please fill in the request for the next amendment to this New Zealand Standard and mail to the Standards Association of New Zealand, Private Bag, Wellington

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To confirm that the next amendment has been requested, enter details of despatch:

REQUEST FOR NEXT AMENDMENT

NZS 3501:1976
Amendment No. 4

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