

Australian Standard™

**Degrees of protection provided by
enclosures (IP Code)**



This Australian Standard was prepared by Committee EL-026, Protective Enclosures and Environmental Testing for Electrical/Electronic Equipment. It was approved on behalf of the Council of Standards Australia on 14 November 2003 and published on 27 January 2004.

The following are represented on Committee EL-026:

Australian Chamber of Commerce and Industry
Australian Electrical and Electronic Manufacturer's Association
Electrical Compliance Testing Association
Electrical Regulatory Authorities Council
Electricity Supply Association of Australia
Testing Interests (Australia)

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about Standards can be found by visiting the Standards Australia web site at www.standards.com.au and looking up the relevant Standard in the on-line catalogue.

Alternatively, the printed Catalogue provides information current at 1 January each year, and the monthly magazine, *The Global Standard*, has a full listing of revisions and amendments published each month.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at mail@standards.com.au, or write to the Chief Executive, Standards Australia International Ltd, GPO Box 5420, Sydney, NSW 2001.

This Standard was issued in draft form for comment as DR 03332.

Australian Standard™

Degrees of protection provided by enclosures (IP Code)

Originated as AS C302—1965.
Previous edition AS 1939—1990.
Revised and redesignated as AS 60529—2004.

COPYRIGHT

© Standards Australia International

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia International Ltd
GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 5647 6

 **Documents**
Document Sharing Hub

PREFACE

This Standard was prepared by the Standards Australia Committee EL-026, Protective Enclosures and Environmental Testing for Electrical/Electronic Equipment, to supersede AS 1939—1990 on publication.

The objective of this Standard is to give definitions for degrees of protection provided by enclosures of electrical equipment, with regard to protection of persons against access to hazardous parts inside the enclosure and protection of the equipment inside the enclosure against ingress of solid foreign objects and harmful effects due to the ingress of water. It also provides tests to verify that the enclosure meets the requirements of this Standard.

This Standard has been reproduced from IEC 60529 Ed 2.1:2001, *Degrees of protection provided by enclosures (IP Code)*.

Variations to IEC 60529 Ed 2.1:2001 are indicated at the appropriate places throughout this standard. Strikethrough (**example**) identifies IEC text, tables and figures which, for the purposes of this Australian Standard, are deleted. Where text, tables or figures are added, each is set in its proper place and identified by shading (**example**).

Minor errors in the IEC text have been corrected and other editorial changes have been made as indicated below:

- (a) Clause 5.2, 3rd paragraph, 3rd line—Full stop removed after the word ‘opening’.
- (b) Table 3, heading of first column—Changed to read ‘Second characteristic numeral’.
- (c) Table 5, 2nd column in rows for first characteristic numerals 5 and 6—The ‘0’ after the ‘mm’ changed to Ø for diameter.
- (d) Informative note added to Clause 14.2.4(a) advising that the hand held test device may be used as allowed in 14.2.3(a).
- (e) Text under Figure 5—Third line changed to read ‘2 inner circles of 12 holes ...’.
- (f) Title for Figure 5—For consistency with all other figure titles, changed to read ‘Hand-held test device to verify ...’.

The above changes have been submitted to IEC TC 70 for consideration.

As this Standard is reproduced from an International Standard, the following applies:

- (i) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (ii) In the source text ‘this international standard’ should read ‘this Australian Standard’.
- (iii) A full point should be substituted for a comma when referring to a decimal marker.
- (iv) Any French text on figures should be ignored.

The terms ‘normative’ and ‘informative’ are used to define the application of the annex to which they apply. A normative annex is an integral part of a standard, whereas an informative annex is only for information and guidance.

CONTENTS

	<i>Page</i>
Introduction.....	v
1 Scope and object.....	1
2 Normative references	2
3 Definitions	2
4 Designations	4
4.1 Arrangement of the IP Code	4
4.2 Elements of the IP Code and their meanings	5
4.3 Examples for the use of letters in the IP Code	5
5 Degrees of protection against access to hazardous parts and against solid foreign objects indicated by the first characteristic numeral.....	6
5.1 Protection against access to hazardous parts.....	6
5.2 Protection against solid foreign objects	7
6 Degrees of protection against ingress of water indicated by the second characteristic numeral	8
7 Degrees of protection against access to hazardous parts indicated by the additional letter.....	10
8 Supplementary letters.....	10
9 Examples of designations with the IP Code	11
9.1 IP Code not using optional letters:.....	11
9.2 IP Code using optional letters:.....	12
10 Marking	12
11 General requirements for tests	12
11.1 Atmospheric conditions for water or dust tests.....	12
11.2 Test samples.....	13
11.3 Application of test requirements and interpretation of test results	13
11.4 Combination of test conditions for the first characteristic numeral.....	13
11.5 Empty enclosures.....	14
12 Tests for protection against access to hazardous parts indicated by the first characteristic numeral	14
12.1 Access probes.....	14
12.2 Test conditions.....	14
12.3 Acceptance conditions.....	16
13 Tests for protection against solid foreign objects indicated by the first characteristic numeral	17
13.1 Test means	17
13.2 Test conditions for first characteristic numerals 1, 2, 3, 4	17
13.3 Acceptance conditions for first characteristic numerals 1, 2, 3, 4	17
13.4 Dust test for first characteristic numerals 5 and 6	17
13.5 Special conditions for first characteristic numeral 5	18
13.6 Special conditions for first characteristic numeral 6	19
14 Tests for protection against water indicated by the second characteristic numeral.....	19
14.1 Test means	19
14.2 Test conditions.....	20
14.3 Acceptance conditions.....	23

15 Tests for protection against access to hazardous parts indicated by the additional letter.....	24
15.1 Access probes.....	24
15.2 Test conditions.....	24
15.3 Acceptance conditions.....	24
Annex A (informative) Examples of IP coding for the verification of protection of low-voltage equipment against access to hazardous parts	32
Annex B (informative) Summary of responsibilities of relevant technical committees.....	38
Bibliography	40
Figure 1 – Jointed test finger	26
Figure 2 – Test device to verify protection against dust (dust chamber)	27
Figure 3 – Test device to verify protection against vertically falling water drops (drip box).....	28
Figure 4 – Test device to verify protection against spraying and splashing water; second characteristic numerals 3 and 4 (oscillating tube)	29
Figure 5 – Hand-held test device to verify protection against spraying and splashing water; second characteristic numerals 3 and 4 (spray nozzle)	30
Figure 6 – Test device to verify protection against water jets (hose nozzle)	31
Table 1 – Degrees of protection against access to hazardous parts indicated by the first characteristic numeral	7
Table 2 – Degrees of protection against solid foreign objects indicated by the first characteristic numeral	8
Table 3 – Degrees of protection against water indicated by the second characteristic numeral	9
Table 4 – Degrees of protection against access to hazardous parts indicated by the additional letter.....	10
Table 5 – Test conditions for degrees of protection indicated by the first characteristic numeral	14
Table 6 – Access probes for the tests for protection of persons against access to hazardous parts.....	15
Table 7 – Test means for the tests for protection against solid foreign objects	17
Table 8 – Test means and main test conditions for the tests for protection against water	20
Table 9 – Total water flow rate q_v under IPX3 and IPX4 test conditions – Mean flow rate per hole $q_{vI} = 0,07$ l/min	22

INTRODUCTION

This standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. Whilst this system is suitable for use with most types of electrical equipment, it should not be assumed that all the listed degrees of protection are applicable to a particular type of equipment. The manufacturer of the equipment should be consulted to determine the degrees of protection available and the parts of equipment to which the stated degree of protection applies.

The adoption of this classification system, wherever possible, Will promote uniformity in methods of describing the protection provided by the enclosure and in the tests to prove the various degrees of protection. It should also reduce the number of types of test devices necessary to test a wide range. of products.

This second edition of IEC 60529 takes account of experiences with the first edition, and clarifies the requirements. It provides for an optional extension of the IP Code by an additional letter A, B, C, or D if the actual protection of persons against access to hazardous parts is higher than that indicated by the first characteristic numeral.

In general, enclosures with an IP coding to the first edition would be eligible for the same code according to this edition.

NOTES

STANDARDS AUSTRALIA

Australian Standard

Degrees of protection provided by enclosures (IP Code)

Any table, figure or text of the international standard that is struck through is not part of this standard. Any Australian table, figure or text that is added is part of this standard and is identified by shading.

1 Scope and object

This standard applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72,5 kV.

The object of this standard is to give:

- a) *Definitions* for degrees of protection provided by enclosures of electrical equipment as regards:
 - 1) protection of persons against access to hazardous parts inside the enclosure;
 - 2) protection of the equipment inside the enclosure against ingress of solid foreign objects;
 - 3) protection of the equipment inside the enclosure against harmful effects due to the ingress of water.
- b) *Designations* for these degrees of protection.
- c) *Requirements* for each designation.
- d) *Tests* to be performed to verify that the enclosure meets the requirements of this standard.

It will remain the responsibility of individual technical committees to decide on the extent and manner in which, the classification is used in their standards and to define "enclosure" as it applies to their equipment. However, it is recommended that for a given classification the tests do not differ from those specified in this standard. If necessary, complementary requirements may be included in the relevant product standard. A guide for the details to be specified in relevant product standards is given in annex B.

For a particular type of equipment, a technical committee may specify different requirements provided that at least the same level of safety is ensured.

This standard deals only with enclosures that are in all other respects suitable for their intended use as specified in the relevant product standard and which from the point of view of materials and workmanship ensure that the claimed degrees of protection are maintained under the normal conditions of use.

This standard is also applicable to empty enclosures provided that the general test requirements are met and that the selected degree of protection is suitable for the type of equipment to be protected.

Measures to protect both the enclosure and the equipment inside the enclosure against external influences or conditions such as

- mechanical impacts
- corrosion
- corrosive solvents (for example, cutting liquids)

- fungus
- vermin
- solar radiation
- icing
- moisture (for example, produced by condensation)
- explosive atmospheres

and the protection against contact with hazardous moving parts external to the enclosure (such as fans), are matters for the relevant product standard to be protected.

Barriers external to the enclosure and not attached to it and obstacles which have been provided solely for the safety of personnel are not considered as a part of the enclosure and are not dealt with in this standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter and identified by shading. Any Australian or Australian/New Zealand Standard that is identical to the International Standard it replaces is identified as such.

IEC 60050-195:1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

~~IEC 60050(826):1982, *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations of buildings*~~

AS 1852.826—1983, *International Electrotechnical Vocabulary—Electrical installations of buildings* (identical to IEC 60050(826):1982)

~~IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*~~

AS 60068.1—2003, *Environmental testing—General and guidance* (identical to IEC 60068-1:1988)

~~IEC 60068-2-68:1994, *Environmental testing – Part 2: Tests – Test L: Dust and sand*~~

AS 60068.2.68—2003, *Environmental testing – Part 2: Tests – Test L: Dust and sand* (identical to IEC 60068-2-68:1994)

IEC 60071-2:1996, *Insulation co-ordination – Part 2: Application guide*

3 Definitions

For the purpose of this standard, the following definitions apply:

3.1 enclosure

a part providing protection of equipment against certain external influences and, in any direction, protection against direct contact [IEV 826-03-12]*.

NOTE - This definition taken from the existing International Electrotechnical Vocabulary (IEV) needs the following explanations under the scope of this standard:

- 1) Enclosures provide protection of persons or livestock against access to hazardous parts.
- 2) Barriers, shapes of openings or any other means – whether attached to the enclosure or formed by the enclosed equipment – suitable to prevent or limit the penetration of the specified test probes are considered as a part of the enclosure, except when they can be removed without the use of a key or tool.

3.2 direct contact

contact of persons or livestock with live parts [IEV 826-03-05]

NOTE This IEV definition is given for information. In this standard “direct contact” is replaced by “access to hazardous parts”.

3.3 degree of protection

the extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and/or against ingress of water and verified by standardized test methods

3.4 IP Code

a coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection

3.5 hazardous part

a part that is hazardous to approach or touch

3.5.1 hazardous live part

a live part which, under certain conditions of external influences, can give an electric shock (see IEC 60050-195, 195-06-05)

3.5.2 hazardous mechanical part

a moving part, other than a smooth rotating shaft, that is hazardous to touch

3.6 protection provided by an enclosure against access to hazardous parts

the protection of persons against

- contact with hazardous low-voltage live parts
- contact with hazardous mechanical parts
- approach to hazardous high-voltage live parts below adequate clearance inside an enclosure

NOTE - This protection may be provided

- by means of the enclosure itself,
- by means of barriers as part of the enclosure or distances inside the enclosure.

* IEC 60050(826).

3.7**adequate clearance for protection against access to hazardous parts**

a distance to prevent contact or approach of an access probe to a hazardous part

3.8**access probe**

a test probe simulating in a conventional manner a part of a person or a tool, or the like, held by a person to verify adequate clearance from hazardous parts

3.9**object probe**

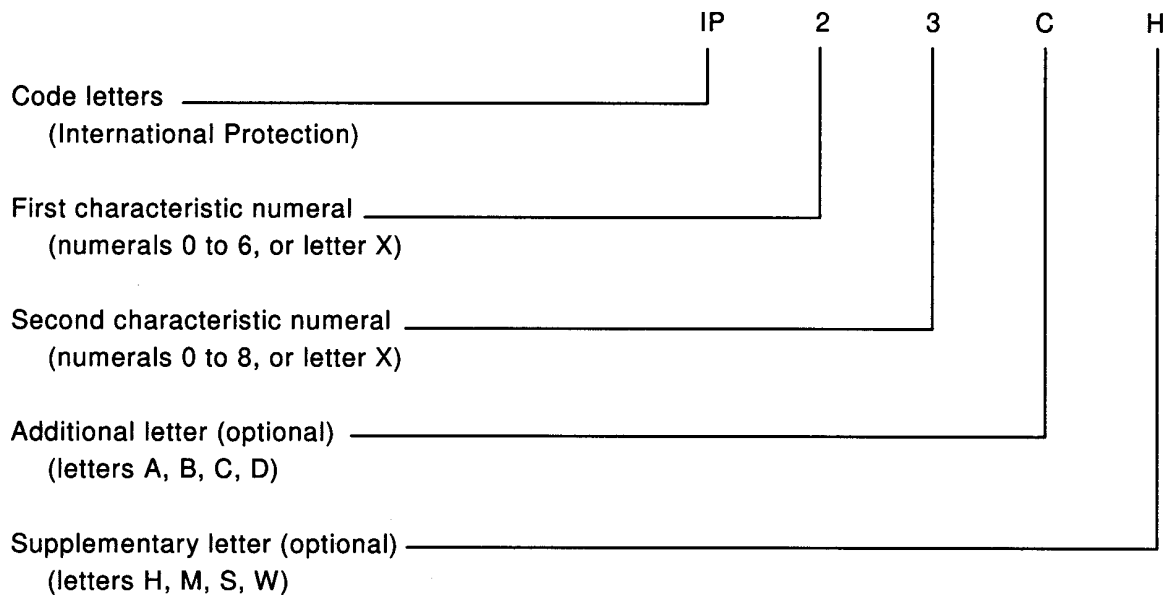
a test probe simulating a solid foreign object to verify the possibility of ingress into an enclosure

3.10**opening**

a gap or aperture in an enclosure which exists or may be formed by the application of a test probe at the specified force

4 Designations

The degree of protection provided by an enclosure is indicated by the IP Code in the following way:

4.1 Arrangement of the IP Code

Where a characteristic numeral is not required to be specified, it shall be replaced by the letter "X" ("XX" if both numerals are omitted).

Additional letters and/or supplementary letters may be omitted without replacement.

Where more than one supplementary letter is used, the alphabetic sequence shall apply.

If an enclosure provides different degrees of protection for different intended mounting arrangements, the relevant degrees of protection shall be indicated by the manufacturer in the instructions related to the respective mounting arrangements.

Details for the marking of an enclosure are given in clause 10.

4.2 Elements of the IP Code and their meanings

A brief description of the IP Code elements is given in the following chart. Full details are specified in the clauses indicated in the last column.

Element	Numerals or letters	Meaning for the protection of equipment	Meaning for the protection of persons	Ref.
Code letters	IP	–	–	–
First characteristic numeral	0 1 2 3 4 5 6	Against ingress of solid foreign objects (non-protected) ≥ 50 mm diameter ≥ 12,5 mm diameter ≥ 2,5 mm diameter ≥ 1,0 mm diameter dust-protected dust-tight	Against access to hazardous parts with (non-protected) back of hand finger tool wire wire wire	Cl. 5
Second characteristic numeral	0 1 2 3 4 5 6 7 8	Against ingress of water with harmful effects (non-protected) vertically dripping dripping (15° tilted) spraying splashing jetting powerful jetting temporary immersion continuous immersion	–	Cl. 6
Additional letter (optional)	A B C D	–	Against access to hazardous parts with: back of hand finger tool wire	Cl. 7
Supplementary letter (optional)	H M S W	Supplementary information specific to: High voltage apparatus Motion during water test Stationary during water test Weather conditions	–	Cl. 8

4.3 Examples for the use of letters in the IP Code

The following examples are to explain the use and arrangement of letters in the IP Code.

For more comprehensive examples see clause 9.

- IP44 – no letters, no options;
- IPX5 – omitting first characteristic numeral;
- IP2X – omitting second characteristic numeral;
- IP20C – using additional letter;
- IPXXC – omitting both characteristic numerals, using additional letter;
- IPX1C – omitting first characteristic numeral, using additional letter;
- IP3XD – omitting second characteristic numeral, using additional letter;
- IP23S – using supplementary letter;

- IP21CM – using additional letter and supplementary letter;
- IPX5/IPX7 – giving two different degrees of protection by an enclosure against both water jets and temporary immersion for “versatile” application.

5 Degrees of protection against access to hazardous parts and against solid foreign objects indicated by the first characteristic numeral

The designation with a first characteristic numeral implies that conditions stated in both 5.1 and 5.2 are met.

The first characteristic numeral indicates that:

- the enclosure provides protection of persons against access to hazardous parts by preventing or limiting the ingress of a part of the human body or an object held by a person;

and simultaneously

- the enclosure provides protection of equipment against the ingress of solid foreign objects.

An enclosure shall only be designated with a stated degree of protection indicated by the first characteristic numeral if it also complies with all lower degrees of protection.

However, the tests establishing compliance with any one of the lower degrees of protection need not necessarily be carried out provided that these tests would obviously be met if applied.

5.1 Protection against access to hazardous parts

Table 1 gives brief descriptions and definitions for the degrees of protection against access to hazardous parts.

Degrees of protection listed in this table shall be specified only by the first characteristic numeral and not by reference to the brief description or definition.

To comply with the conditions of the first characteristic numeral, adequate clearance shall be kept between the access probe and hazardous parts.

The tests are specified in clause 12.

Table 1 – Degrees of protection against access to hazardous parts indicated by the first characteristic numeral

First characteristic numeral	Degree of protection		Test conditions, see
	Brief description	Definition	
0	Non-protected	–	–
1	Protected against access to hazardous parts with the back of a hand	The access probe, sphere of 50 mm Ø, shall have adequate clearance from hazardous parts	12.2
2	Protected against access to hazardous parts with a finger	The jointed test finger of 12 mm Ø, 80 mm length, shall have adequate clearance from hazardous parts	12.2
3	Protected against access to hazardous parts with a tool	The access probe of 2,5 mm Ø shall not penetrate	12.2
4	Protected against access to hazardous parts with a wire	The access probe of 1,0 mm Ø shall not penetrate	12.2
5	Protected against access to hazardous parts with a wire	The access probe of 1,0 mm Ø shall not penetrate	12.2
6	Protected against access to hazardous parts with a wire	The access probe of 1,0 mm Ø shall not penetrate	12.2
NOTE In the case of the first characteristic numerals 3, 4, 5 and 6, protection against access to hazardous parts is satisfied if adequate clearance is kept. The adequate clearance should be specified by the relevant product committee in accordance with 12.3. Due to the simultaneous requirement specified in table 2, the definition "shall not penetrate" is given in table 1.			

5.2 Protection against solid foreign objects

Table 2 gives brief descriptions and the definitions for the degrees of protection against the penetration of solid foreign objects including dust.

Degrees of protection listed in this table shall only be specified by the first characteristic numeral and not by reference to the brief description or definition.

The protection against the ingress of solid foreign objects implies that the object probes up to numeral 2 in table 2 shall not fully penetrate the enclosure. This means that the full diameter of the sphere shall not pass through an opening in the enclosure. Object probes for numerals 3 and 4 shall not penetrate the enclosure at all.

Dust-protected enclosures to numeral 5 allow a limited quantity of dust to penetrate under certain conditions.

Dust-tight enclosures to numeral 6 do not allow any dust to penetrate.

NOTE Enclosures assigned a first characteristic numeral of 1 to 4 generally exclude both regularly and irregularly shaped solid foreign objects provided that three mutually perpendicular dimensions of the object exceed the appropriate figure in column 3 of table 2.

The tests are specified in clause 13.

Table 2 – Degrees of protection against solid foreign objects indicated by the first characteristic numeral

First characteristic numeral	Degree of protection		Test conditions, see
	Brief description	Definition	
0	Non-protected	–	–
1	Protected against solid foreign objects of 50 mm Ø and greater	The object probe, sphere of 50 mm Ø, shall not fully penetrate ¹⁾	13.2
2	Protected against solid foreign objects of 12,5 mm Ø and greater	The object probe, sphere of 12,5 mm Ø, shall not fully penetrate ¹⁾	13.2
3	Protected against solid foreign objects of 2,5 mm Ø and greater	The object probe, sphere of 2,5 mm Ø, shall not penetrate at all ¹⁾	13.2
4	Protected against solid foreign objects of 1,0 mm Ø and greater	The object probe of 1,0 mm Ø, shall not penetrate at all ¹⁾	13.2
5	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety	13.4 13.5
6	Dust-tight	No ingress of dust	13.4 and 13.6
¹⁾ The full diameter of the object probe shall not pass through an opening of the enclosure.			

6 Degrees of protection against ingress of water indicated by the second characteristic numeral

The second characteristic numeral indicates the degree of protection provided by enclosures with respect to harmful effects on the equipment due to the ingress of water.

The tests for the second characteristic numeral are carried out with fresh water. The actual protection may not be satisfactory if cleaning operations with high pressure and/or solvents are used.

Table 3 gives brief descriptions and definitions of the protection for the degrees represented by the second characteristic numeral.

Degrees of protection listed in this table shall be specified only by the second characteristic numeral and not by reference to the brief description or definition.

The tests are specified in clause 14.

Up to and including second characteristic numeral 6, the designation implies compliance also with the requirements for all lower characteristic numerals. However, the tests establishing compliance with any one of the lower degrees of protection need not necessarily be carried out provided that these tests obviously would be met if applied.

An enclosure designated with second characteristic numeral 7 or 8 only is considered unsuitable for exposure to water jets (designated by second characteristic numeral 5 or 6) and need not comply with requirements for numeral 5 or 6 unless it is dual coded as follows: