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NEW ZEALAND ELECTRICAL CODE OF PRACTICE

for

ELECTRICAL INSTALLATIONS

OF MINERAL INSULATED CABLES AND EQUIPMENT

Issued by the Office of
The Chief Electrical Inspector,
Energy and Resources Division, Ministry of Commerce

THE ELECTRICITY ACT 1992

APPROVAL OF ELECTRICAL CODE OF PRACTICE

FOR

ELECTRICAL INSTALLATIONS OF MINERAL INSULATED

CABLES AND EQUIPMENT

Pursuant to Section 36 of the Electricity Act 1992 ("the Act")

On the 1st day of February 1993, the Secretary of Commerce issued the Electrical Code of Practice for Electrical Installations of Mineral Insulated Cables and Equipment ("the Code")

On the 4th day of February 1993, pursuant to Section 38 of the Act the Secretary published in the Gazette a notice of intention to apply to me for approval of the code, and there has been consultations with such persons (or their representatives) as will be affected by the Code and they have had the opportunity to consider possible effects and comment on those effects.

I have considered the comments concerning those effects and where necessary amendments were made to the Code.

Therefore Pursuant to Section 38 of the Act, I, John Luxton, Minister of Energy, have this day approved the Code as attached to this approval, which Code shall come into force on the 1st day of April 1993.

Dated this 18th day of March 1993.

John Luxton
Minister of Energy.

COMMITTEE REPRESENTATION

This Code of Practice was prepared by the Ministry of Commerce, Chief Electrical Inspector's Office with reference to the following organisations:

Electrical Contractors' Association of NZ Inc.
Electrical Supply Engineers' Association of NZ Inc.
New Zealand Electrical Institute
Electrical Inspectors' Association
Institution of Professional Engineers of New Zealand

REVIEW

This Code of Practice will be revised as occasions arise. Suggestions for improvement of this Code are welcome. They should be sent to the Chief Electrical Inspector's Office, Ministry of Commerce, P O Box 1473, WELLINGTON.

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INTRODUCTION

Mineral Insulated cables have been used for wiring in electrical installations for many years but until recently its use had been declining due to the initial higher cost of materials and installation compared with other cables.

Renewed interest is now being shown in the use of MI cables for two main reasons:

1 MI cables are able to withstand very high temperatures, including fire, without significant damage and this factor is required in many installations, eg, for essential services. MI cables do not burn to produce smoke or toxic fumes.

2 MI cables have the ability to be used in an Earthed Sheath Return (ESR) wiring system, i.e. where the cable sheath is used as a combined earth/neutral conductor. An ESR system can have comparable cost advantage to that of a normal wiring system using PVC or XLPE insulated cables.

This Code of Practice has been written to clarify the requirements for MI cable installations, and to introduce the specific aspects relating to the use of ESR systems.

ELECTRICAL INSTALLATIONS OF MINERAL INSULATED CABLES AND FITTINGS

SECTION 1

SCOPE, APPLICATION, REFERENCED DOCUMENTS, INTERPRETATIONS, GLOSSARY AND NUMBERING

1.1 SCOPE

This Code of Practice outlines the electrical safety requirements for the installation of Mineral Insulated (MI), Copper Sheathed cables with copper conductors (MICC); MIMS) and fittings.

1.2 APPLICATION

This Code applies to the installation of MI cables and associated fittings.

1.3 REFERENCE DOCUMENTS

AS 3008	Electrical Installations Selection of Cables
AS 3187	Mineral-Insulated Metal-Sheathed Cables

1.4 INTERPRETATIONS

1.4.1 Earth Sheath Return (ESR) - means a wiring system using the copper sheath of MI cable as a combined neutral and earth (CNE) return conductor.

1.4.2 Serving means one or more extruded layers applied to the exterior of the copper sheathed cable.

1.5 GLOSSARY OF ABBREVIATIONS USED IN THIS CODE

CNE	Combined neutral and earth
d.c.	Direct current
ESR	Earth sheathed return
Hz	Hertz
kV	Kilovolts
m	Metres
MI	Mineral insulated
MICC	Mineral insulated copper conductors
MIMS	Mineral insulated, metal sheathed
mm	Millimetres
p.f.	Power factor
PVC	Poly-vinyl chloride
V/A	Volt-ampere

1.6 NUMBERING SYSTEM OF THIS CODE

1.6.1 Sections are numbered from 1 to 5.

1.6.2 Subsections are numbered by one full stop between two numbers. (eg: 1.6)

1.6.3 Clauses are numbered by two full stops between three numbers. (eg:4.18.3)

1.6.4 Subclauses are numbered by three full stops between four numbers. (eg:3.2.1.1)

1.6.5 Paragraphs contain numbering punctuated by one or more full stops together with a parenthesised letter.

1.6.6 Subparagraphs are represented by a lower case roman numerals enclosed on parenthesis following paragraphs.

SECTION 2

SELECTION AND INSTALLATION

2.1 GENERAL

2.1.1 MIMS cable installations shall comprise manufacturers proprietary fittings installed in accordance with manufacturers instructions and following completion shall be tested and inspected prior to livening.

2.1.2 Unserved MI cable shall not be installed in:

(a) Damp situations; or

(b) Hazardous areas; or

(c) An unenclosed space within a boiler or the like wherein a person may work and where earth metal is extensively exposed.

2.1.3 When used for wiring in hazardous areas MI cables shall be used with the correct fittings certified for the area classification involved.

2.1.3.1 Light grade MI cable shall not be used in a hazardous area without additional mechanical protection.

2.2 COMPLIANCE WITH STANDARDS

MI cables and associated fittings used in an installation shall comply with the requirements of an official standard.

2.3 CLASS OF CABLE

2.3.1 The voltage rating of cable used in an installation shall not be less than the maximum steady rms voltage likely to be applied.

2.3.2 1/1 kv class MI cables may be used for service mains provided that they are protected on the supply side by means of suitably rated fuses or circuit breakers.

2.3.3 0.6/0.6 kV class MI cables are permitted for final subcircuits only.

2.4 CURRENT RATING AND VOLTAGE DROP

2.4.1 The maximum current in any cable shall not exceed that approved for its use.

Approved current ratings for cables are as per Table 1, Page 10.

2.4.2 In any installation containing MI cables the voltage drop from the terminals of the main switch on the main switch board to any point in the installation shall not exceed 2.5 percent of the standard voltage at the main switchboard when the conductors are carrying their maximum current under normal conditions of service.

Provided that this requirement need not apply during motor starting, solenoids closing, and other similar applications where high instantaneous currents may be experienced.

2.4.2.1 Voltage drop on MI cable circuits shall be calculated in accordance with Table 2, Page 11.

2.5 SUPPORT OF CABLES

2.5.1 Cables shall be adequately supported by means of suitable clips, saddles, cable trays or other similar means.

2.5.2 The maximum distances between supports for MI cables shall not be greater than those specified in Table 3, Page 12.

2.5.3 Bare MI cable shall not be installed on dissimilar metal supports in locations where an electrolyte solution could be present.

2.5.4 The supports or fixings shall be suitable for use at the highest temperature attained by the cable according to the circumstances of its use.

2.6 BURIED CABLES

Cables installed underground, either directly buried or in ducts, shall be of the served type.

2.7 PROTECTION AGAINST MECHANICAL DAMAGE

2.7.1 MI Cables are not regarded as being inherently mechanically protected. Extra protection shall be provided for cables installed underground at a lesser depth than 0.6 m and above ground in exposed locations to a height of 2 metres.

2.8 PROTECTION AGAINST CORROSION

2.8.1 Cables shall not be installed in environments hostile to copper unless the cables are suitably protected against corrosion.

2.8.2 When buried in concrete or plaster the metal sheathing of MI cables shall be served.

2.8.3 Cables used in damp situations where corrosion is likely to occur shall be protected by suitable serving or other suitable enclosure.

2.9 PROTECTION AGAINST VIBRATION

2.9.1 In situations where MI cables are subject to vibration precautions shall be taken to ensure that mechanical damage does not occur to the sheath or conductor.

2.9.2 At termination points of fittings the effects of vibration may be overcome by the introduction of a loop in the cable before the termination point. The size of the loop shall be in accordance with manufacturers recommendations.

2.9.3 In cases of severe vibration or movement, the cable shall be terminated in a suitable junction box and a flexible cable run to the fittings.

2.10 JOINTS AND TERMINATIONS

All joints and terminations shall be made with securely attached fittings of a type which:

(a) Affords effective insulation and continuity of conductors,

(b) Prevents the entry of moisture into the mineral insulation of the cable.

2.11 BENDING AND STRAIGHTENING

2.11.1 The minimum bending radius of any MI cable shall not be less than : -

(a) Six times the overall cable diameter for cables with conductors up to 240 mm^2,

(b) Twelve times the overall cable diameter for cables with conductors of larger than 240 mm^2.

2.11.2 Straightening and rebending of MI cables shall be avoided wherever possible.

2.12 SURGE PROTECTION

2.12.1 Cables shall be protected against voltage surges and transients.

2.12.2 Surge diverters installed in areas prone to lightening shall be located at the termination nearest to the aerial line.

2.13 IDENTIFICATION OF CONDUCTORS

2.13.1 Cables shall be identified at terminations and junctions by the use of appropriately coloured sleeving or other suitable methods.

2.13.2 Identification shall be mechanically secure and of a permanent nature taking into account the temperature rating of the cable.

2.14 SINGLE CORE MI CABLES

2.14.1 The passing of single core MI cables through ferrous materials shall be avoided or where this is not possible, the manufacturers instructions for the limitation of eddy currents should be followed.

2.14.2 Single core cables shall be run in one of the permitted configurations outlined in Table 4, Page 13.

2.14.2.1 Cables run in trefoil configuration shall maintain this formation throughout their length except for a distance not exceeding 2 metres at each end to facilitate the termination of the cables.

2.14.2.2 Cables run in other than trefoil formation shall be placed as close as practicable to each other (touching if possible).

2.14.2.3 Bare cables run as in 2.14.2.1 shall have their sheaths bonded at each end and at intervals not exceeding 30 metres along the cable run.

2.14.3 The bonding conductor shall have a conductivity of not less than that of the cable sheath.

2.14.4 Served cable need only be bonded at each end of the cable run.

2.15 USE OF EARTH CONTINUITY CONDUCTORS

Internal conductors of multi-core MI cables shall not be used as earth continuity conductors.

2.16 TESTING

2.16.1 Cables shall be tested prior to livening and the insulation resistance between the conductors and between the conductors and cable sheath shall not be less than 200 Megohm when measured by applying 500 volt dc.

2.16.2 All surge diverters shall be reconnected following completion of the tests of 2.16.1.

SECTION 3

EARTH SHEATH RETURN (ESR) SYSTEMS

3.1 GENERAL

3.1.1 Only copper sheathed MI cables with copper conductors shall be used for an ESR system.

3.1.2 The ESR system of wiring shall be used only in installations where the Multiple Earthed Neutral (MEN) system of earthing is used.

3.1.3 The ESR system of wiring shall only be employed on a three phase 400 volt wiring system.

3.1.4 The ESR system shall not be used in corrosive situations.

3.1.5 No switch shall operate in the neutral conductor of an ESR system.

3.2 ORIGIN OF ESR SYSTEM

3.2.1 An ESR system shall originate from the main switchboard for an installation.

3.2.2 Where the ESR system terminates and a separate neutral and earth is run to further fittings or switchboards the neutral and earth shall not be combined again to form as ESR system.

3.2.3 An ESR system shall terminate in a switchboard.

3.2.4 Where a switchboard is served by two supplies, (e.g., standby generator supply and normal supply) and an ESR system is to be used, both supplies shall be ESR.

3.3 MARKING

Every switchboard in which an ESR circuit originates, passes through or terminates shall be suitably labelled to indicate that a particular circuit is using the ESR system.

3.4 SUITABILITY OF EQUIPMENT

3.4.1 Only fittings suitable for an ESR system shall be used.

3.4.2 Cables impregnated with silicone oil or other additives designed to reduce the rate of moisture absorption shall not be used for ESR systems.

3.5 MINIMUM SIZE OF CONDUCTOR AND SHEATH

3.5.1 The minimum size of conductor used with any ESR system of wiring shall be 2.5 mm^2.

3.5.2 The sheath material of any cable used in an ESR wiring system shall have a conductivity not less than 85% of that of the associated active conductor.

3.6 BONDING

3.6.1 At every joint in the sheathing and at the terminations, the continuity of the earth/neutral sheathing conductor shall be maintained by means of two bonding conductors.

3.6.2 Connection of bonding conductors shall be made only by glands or other fittings specifically suited to the ESR system.

3.6.3 Neutral and earthing interconnecting bar/conductor bonding links for enclosed switchboards shall be sized to the requirements of Table 5, page 14.

TABLE 1

CURRENT-CARRYING CAPACITIES OF MINERAL-INSULATED COPPER-SHEATH CABLES WITH COPPER CONDUCTORS

1	2	3	4	5	6	7
Conductor Size	Nominal diameter of conductor	Current-carrying capacity, Amps				
mm2	mm	Single Core Cable	Two-Core Cable	Three-Core Cable	Four-Core Cable	Seven Core Cable
0.6/0.6 kV Cable						
1	1.13	20	20	15	15	10
1.5	1.38	30	25	20	20	15
2.5	1.78	40	30	-	-	-
4	2.25	50	40			
1/1 kV Cables						
1.5	1.38	-	25	20	20	15
2.5	1.78	45	35	35	30	20
4	2.25	60	45	45	40	-
6	2.76	70	60	60	50	-
10	3.57	95	80	80	65	-
16	4.51	125	105	105	90	-
25	5.64	160	140	140	120	-
35	6.68	200	-	-	-	-
50	7.98	250	-	-	-	-
70	9.44	300	-	-	-	-
95	11.00	370	-	-	-	-
120	12.36	425	-	-	-	-
150	13.82	500	-	-	-	-
185	15.35	590	-	-	-	-
240	17.48	650	-	-	-	-
300	19.54	850	-	-	-	-
400	22.57	1000	-	-	-	-

1.1 The current-carrying capacities given in this table are based on an operating temperature of 90°C for the external surface of the bare copper sheath. The current-carrying capacities of V-105 PVC - served cables are 1.1 times the values given above.

1.2 The current-carrying capacities given in this table do not apply to polyethylene-served cables used for heating purposes, such as trace heating, tank heating or floor warming.

1.3 To determine the three-phase voltage drop, refer to the appropriate value in table 2. To determine the single phase voltage drop, multiply the three phase value by 1.155.

1.4 The current-carrying capacities apply to single circuits. For grouped cable circuits refer to clauses 3.5.2 of AS 3008.

TABLE 2

THREE-PHASE VOLTAGE DROP AT 50 HZ OF SINGLE-CORE AND MULTICORE MINERAL-INSULATED METAL-SHEATHED (MI) CABLES LAID IN TREFOIL

Conductor	THREE PHASE DROP AT 50 Hz, m V/A.metre							
SIZE	CONDUCTOR TEMPERATURE, °C							
	45		60		75		90	
mm	**Max 0.8 p.f**		**Max 0.8 p.f**		**Max 0.8 p.f**		**Max 0.8 p.f**	
0.5/0.6 kV Cables								
1	32.8		34.6		36.3		38.1	
1.5	21.9		23.0		24.2		25.4	
2.5	13.1		13.8		14.5		15.2	
4	8.20		8.64		9.08		9.52	
1/1 kV Cables								
1.5	21.9		23.0		24.2		25.4	
2.5	13.1		13.8		14.5		15.2	
4	8.20		8.64		9.08		9.52	
6	5.46		5.77		6.05		6.34	
10	3.30		3.47		3.65		3.83	
16	2.06		2.17		2.28		2.39	
25	1.32		1.39		1.46		1.53	
35	0.949		0.999		1.05		1.10	
50	0.672		0.706		0.741		0.775	
70	0.491		0.515		0.539		0.563	
95	0.375		0.393		0.410		0.427	
120	0.307		0.320		0.333		0.346	
150	0.260		0.270		0.280		0.290	
185	0.228	0.232	0.236	0.239	0.243	0.248	0.251	0.255
240	0.195	0.194	0.201	0.200	0.206	0.206	0.211	0.211
300	0.178	0.173	0.181	0.178	0.185	0.182	0.189	0.187
400	0.163	0.154	0.166	0.157	0.168	0.161	0.170	0.164

TABLE 3

CABLE FIXING DISTANCES

CABLE DIAMETER	HORIZONTAL (mm)	VERTICAL (mm)
Up to 9 mm	600	800
9 mm to 15 mm	900	1200
15 mm to 20 mm	1500	2000
over 20 mm	2000	2500

TABLE 4

CONFIGURATION FOR SINGLE CORE MI CABLES

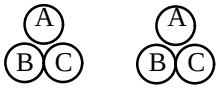
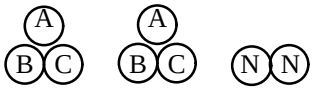
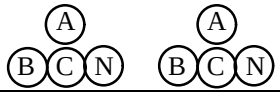
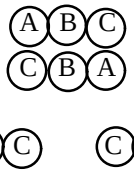
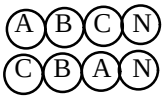
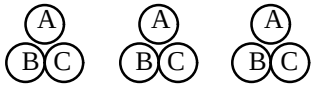
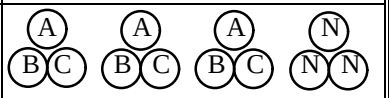
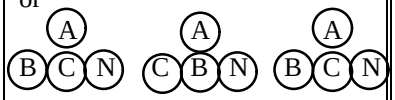
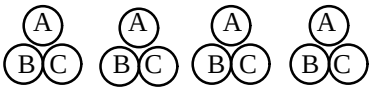
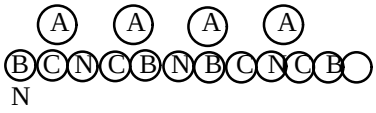
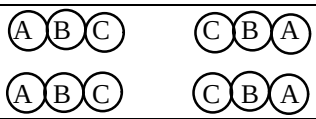
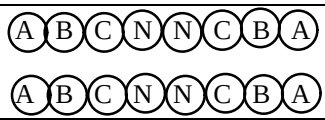
INSTALLATION DESCRIPTION	THREE PHASE THREE CABLES	THREE PHASE FOUR CABLES
Single circuit Trefoil formation		
Single circuit Flat formation		
Two cables in parallel per phase Flat formation		 or 
Two cables in parallel per phase Trefoil formation	 or 	 or 
Three cables in parallel per phase Trefoil formation		 or 
Three cables in parallel per phase	Not Permitted	Not Permitted
Four or more cables in parallel per phase Trefoil formation		 N
Four or more cables in parallel per phase Flat information		

TABLE 5

SWITCHBOARD NEUTRAL & EARTHING INTERCONNECTING BAR/CONDUCTOR CHART (ESR SYSTEM ONLY)

Cable size conductor area mm^2	Size of copper bar to interconnect the three sheaths together mm	Size of copper bar to connect the bonded sheaths to a neutral link mm	Additional bonding over straight through joints Note- Only required on ESR system mm	Size of earthing conductor to interconnect gland plate to earth link mm^2
6	*9.5 x 0.9	*9.5 x 0.9	*12.5 x 1.2	4
10	*12.5 x 1.2	*12.5 x 1.2	*16 x 1.4	6
16	*16 x 1.4	*16 x 1.4	*16 x 1.4	6
25	12.5 x 4	12.5 x 4	12.5 x 4	10
35	16 x 4	16 x 4	12.5 x 2.5	16
50	20 x 4	20 x 4	12.5 x 2.5	25
70	25 x 4	25 x 4	12.5 x 2.5	35
95	25 x 4	25 x 4	12.5 x 4	50
120	40 x 2.5	40 x 2.5	12.5 x 4	70
150	31.5 x 4	31.5 x 4	16 x 4	70
185	40 x 4	40 x 4	16 x 4	70
240	40 x 4	40 x 4	20 x 4	70
300	50 x 4	50 x 4	20 x 4	70
400	40 x 6.3	40 x 6.3	16 x 6.3	70

* PYROTENAX COPPER STRIP CAN BE USED