

Australian/New Zealand Standard™

**Electrical protection devices for mines
and quarries**



AS/NZS 2081:2011

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-023, Electrical Equipment in Mines and Quarries. It was approved on behalf of the Council of Standards Australia on 23 September 2011 and on behalf of the Council of Standards New Zealand on 23 September 2011. This Standard was published on 4 November 2011.

The following are represented on Committee EL-023:

Australian Chamber of Commerce and Industry
Australian Coal Association
Australian Industry Group
Consult Australia
Department of Employment, Economic Development and Innovation
Department of Mines & Petroleum (WA)
Department of Trade and Investment, Regional Infrastructure and Services NSW
Electrical Apparatus Service Association
Mining Electrical and Mining Mechanical Engineering Society
National Association of Testing Authorities Australia
Queensland Department of Environment and Resource Management
Solid Energy New Zealand
The Aviation and Marine Engineers Association
University of Newcastle
WorkCover New South Wales

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 Standards may also be withdrawn.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 joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.saiglobal.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

Australian/New Zealand Standard™

Electrical protection devices for mines and quarries

Originally in Australia as AS C318—1958.
Previous editions, and first New Zealand editions, in part as AS/NZS 2081,
part 1 to 5 (2002).
Jointly revised, amalgamated and redesignated as AS/NZS 2081:2011.

COPYRIGHT

© Standards Australia Limited/Standards New Zealand

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, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, Private Bag 2439, Wellington 6140.

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-023, Electrical Equipment in Mines and Quarries, to supersede Parts 1 to 5 of AS/NZS 2081 (2002), *Electrical equipment for coal and shale mines—Electrical protection devices*.

This Standard specifies the performance requirements for protection devices intended for use with electrical supply networks utilizing earth fault current limitation techniques (IT networks). These protection devices include the following:

- (a) Earth fault current limiting devices.
- (b) Earth continuity protection devices.
- (c) Earth fault protection devices.
- (d) Earth fault lockout protection devices.
- (e) NER integrity protection devices.
- (f) Frozen contact protection devices.

Prospective touch voltage versus operating time characteristics are referenced to facilitate the key objectives of this Standard.

This edition of the Standard differs from the previous edition in the following significant ways:

- (a) All parts have been combined into a single document.
- (b) Clarification of the Scope to indicate that the Standard is applicable to both above and below ground mines and quarries.
- (c) The addition of NER integrity protection devices.
- (d) The addition of frozen contact protection devices.
- (e) The inclusion of references to specific prospective touch voltage versus operating time characteristics that form the basis of the protection strategies implemented by the equipment covered by this Standard.
- (f) The addition of prescribed levels of immunity to conducted common mode signals and electromagnetic interference for protection devices containing active circuits.
- (g) The addition of requirements for vibration, shock and bump immunity.
- (h) Clarification of requirements for conformal coatings in lieu of environmental testing.
- (i) The revision of typical system electrical diagrams showing the application of the various protection systems detailed in this Standard.
- (j) The inclusion of partial discharge and impulse testing.

The term 'informative' has been used in this Standard to define the application of the appendix to which it applies. An 'informative' appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
FOREWORD.....	6
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	7
1.2 OBJECTIVE.....	7
1.3 RELATIONSHIP TO REGULATIONS.....	7
1.4 REFERENCED DOCUMENTS.....	7
1.5 DEFINITIONS.....	9
1.6 MANUFACTURERS' DOCUMENTS.....	12
1.7 CATEGORIES OF TESTS.....	12
SECTION 2 DESIGN AND CONSTRUCTION—GENERAL REQUIREMENTS	
2.1 MOUNTING.....	13
2.2 CONNECTIONS.....	13
2.3 PROTECTION AGAINST FAILURE.....	13
2.4 EQUIPMENT FOR USE IN HAZARDOUS AREAS.....	13
2.5 SERVICE CONDITIONS.....	14
2.6 IMMUNITY TO INTERFERENCE.....	14
2.7 VIBRATION, SHOCK AND BUMP IMMUNITY.....	15
2.8 IP RATING.....	15
2.9 PRINTED CIRCUIT BOARD SURFACE PROTECTION.....	15
2.10 RELAY CONTACTS.....	15
2.11 FAULT INDICATION.....	15
2.12 ADJUSTMENT OF RELAY PARAMETERS.....	15
2.13 MARKING.....	16
2.14 CONTROL POWER SUPPLY VOLTAGE VARIATION.....	16
2.15 WITHSTAND RATINGS OF POWER CIRCUIT INTERFACES.....	16
SECTION 3 SOFTWARE CONTROLLED DEVICES	
3.1 GENERAL.....	18
3.2 SECURITY AGAINST ALTERATIONS TO MANUFACTURER'S SOFTWARE..	18
SECTION 4 EARLY FAULT CURRENT LIMITING DEVICES	
4.1 GENERAL.....	19
4.2 COMPLIANCE WITH STANDARDS.....	19
4.3 MANUFACTURING TOLERANCE.....	19
4.4 RATINGS.....	19
4.5 WITHSTAND VOLTAGES.....	20
4.6 SPECIFIC REQUIREMENTS FOR RESISTOR DEVICES.....	20
4.7 MARKING.....	21

SECTION 5 EARTH CONTINUITY PROTECTION DEVICES

5.1	GENERAL.....	23
5.2	OPERATING VALUE.....	23
5.3	OPERATING TIME	24
5.4	REMOTE START FACILITY.....	24
5.5	LATCH/RESET FACILITY	24
5.6	PILOT CIRCUIT VOLTAGE WITHSTAND.....	24
5.7	INDICATION.....	24
5.8	MARKING	24

SECTION 6 EARTH FAULT PROTECTION DEVICES

6.1	GENERAL.....	25
6.2	OPERATING VALUES	25
6.3	OPERATING TIME	25
6.4	CURRENT SENSING TRANSDUCER FAULTS.....	26
6.5	LATCH/RESET FACILITY	26
6.6	WITHSTAND VOLTAGES	26
6.7	INDICATION.....	26
6.8	MARKING.....	26
6.9	PROTECTION AGAINST TEMPERATURE RISE ASSOCIATED WITH EARTH FAULT CURRENT	27

SECTION 7 EARTH FAULT LOCKOUT PROTECTION DEVICES

7.1	GENERAL.....	28
7.2	OPERATING VALUES	28
7.3	SEQUENCE OF TESTS PRIOR TO ENERGIZING CIRCUIT.....	28
7.4	LATCH/RESET FACILITY	28
7.5	WITHSTAND VOLTAGES	28
7.6	INDICATION.....	29
7.7	MARKING	29

SECTION 8 RENEWABLE ENERGY INTEGRITY PROTECTION DEVICES

8.1	GENERAL.....	30
8.2	OPERATING VALUES	30
8.3	OPERATING TIME	30
8.4	LATCH/RESET FACILITY	30
8.5	WITHSTAND VOLTAGES	31
8.6	INDICATION.....	31
8.7	MARKING.....	31
8.8	EFFECT OF OWNER IMPEDANCE VALUE.....	31

SECTION 9 FROZEN CONTACT PROTECTION DEVICES

9.1	GENERAL.....	32
9.2	OPERATING VALUES	32
9.3	OPERATING TIME	32
9.4	LATCH/RESET FACILITY	33
9.5	WITHSTAND VOLTAGES	33
9.6	INDICATION.....	33
9.7	MARKING	33

SECTION 10 TYPE TESTS

10.1	GENERAL	34
10.2	LIST AND ORDER OF TESTS.....	34
10.3	COMMON TESTS	36
10.4	EARTH FAULT CURRENT LIMITING DEVICES	37
10.5	EARTH CONTINUITY PROTECTION DEVICES	38
10.6	EARTH FAULT PROTECTION DEVICES.....	40
10.7	EARTH FAULT LOCKOUT PROTECTION DEVICES	42
10.8	NER INTEGRITY PROTECTION DEVICES.....	43
10.9	FROZEN CONTACT PROTECTION DEVICES.....	45

SECTION 11 ROUTINE TESTS

11.1	ROUTINE TESTS	46
11.2	NEUTRAL EARTHING RESISTORS	47

APPENDICES

A	PRINCIPLES OF EARTH FAULT LIMITED PROTECTION SYSTEMS	50
B	TOUCH VOLTAGE VERSUS OPERATING TIME CHARACTERISTICS.....	55
C	INFORMATION ON THE INSTALLATION AND USE OF EARTH FAULT CURRENT LIMITATION DEVICES	57
D	INFORMATION ON THE INSTALLATION AND USE OF EARTH CONTINUITY PROTECTION SYSTEMS	59
E	INFORMATION ON THE INSTALLATION AND USE OF EARTH FAULT PROTECTION SYSTEMS	61
F	INFORMATION ON THE INSTALLATION AND USE OF EARTH FAULT LOCKOUT PROTECTION SYSTEMS.....	64
G	INFORMATION ON THE INSTALLATION AND USE OF NER INTEGRITY PROTECTION SYSTEMS	65
H	INFORMATION ON THE INSTALLATION AND USE OF FROZEN CONTACT PROTECTION SYSTEMS	66
I	INFORMATION ON LIGHTNING IMPULSE AND PARTIAL DISCHARGE WAVEFORMS.....	67

FOREWORD

The interrelationship of the techniques described in this Standard strives to create the lowest risk working environment possible in surface mines, underground mines and quarries, where electrically powered equipment is often mobile and supplied by trailing or reeling cables.

These techniques are as follows:

- (a) The use of earth fault current limiting devices to minimize the risk of touch and step potential reaching a level which would cause harm to personnel.
- (b) The continuous checking that the equipment is earthed, by monitoring the earth resistance in the supply cable to the equipment.
- (c) The measurement of leakage and fault currents to earth, and the initiation of disconnection of that circuit when the value of leakage or fault current exceeds a preset value.
- (d) The testing of a circuit prior to energizing, to ensure that the phase-to-earth insulation value of each and every phase conductor is above a preset value before the circuit can be energized.
- (e) The monitoring of the earth fault current-limiting device, and the associated connections between the supply neutral and earth, to ensure the integrity of the earth fault current limitation system.
- (f) The initiation of the disconnection of the power supply upstream of the interrupting device in the event that either the interrupting device fails to open when signalled to do so, or a voltage is detected on any phase of the load side of the interrupting device after it has received a signal to open.

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Electrical protection devices for mines and quarries

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out the design, performance, manufacturing, and testing requirements for electrical protection devices for use in surface and underground mines and quarries, where IT supply networks are utilized, and provides information on the general principles of—

- (a) earth fault current limitation;
- (b) earth continuity protection;
- (c) earth fault protection;
- (d) earth fault lockout protection;
- (e) NER integrity protection; and
- (f) frozen contact protection.

NOTES:

- 1 Whereas this Standard is based upon 50 Hz supply systems, it is envisaged that the equipment described may also be installed in systems with higher, lower or variable frequencies, or in d.c. supplied systems.

The effect of current upon the human body in 50 Hz supplied installations needs to be considered as detailed in AS/NZS 3000.

AS/NZS 60479, Parts 1 and 2 should be referenced for consideration of the effects of current at other supply frequencies upon the human body.

- 2 Refer to Appendix A for general information on the principles of electrical protection relevant to this Standard.

1.2 OBJECTIVE

The key objectives of this Standard are to set the performance criteria of protection devices to facilitate:

- (a) The maintenance of touch and step voltage levels against time within acceptable limits.
NOTE: Guidance information relating to touch voltage versus clearance times is contained in Appendix B.
- (b) The minimization of risks associated with electrical arcing i.e. arc blast, arc flash, etc.
- (c) Reliable performance under predetermined operating conditions.

1.3 RELATIONSHIP TO REGULATIONS

The requirements of this Standard may be read in conjunction with, but do not take precedence over, regulations of a regulatory authority that may apply in a specific area.