

Australian Standard™

Cathodic protection of metals

Part 2: Compact buried structures

This Australian Standard was prepared by Committee MT-014, Corrosion of Metals. It was approved on behalf of the Council of Standards Australia on 6 May 2003 and published on 27 June 2003.

The following are represented on Committee MT-014:

Australian Gas Association
AUSTROADS
Australasian Corrosion Association
Australian Aluminium Council
Australian Chamber of Commerce and Industry
Australian Electrolysis Committee
Australian Institute of Steel Construction
Australian Paint Approval Scheme
Bureau of Steel Manufacturers of Australia
Department of Defence (Australia)
Division of Building, Construction and Engineering, CSIRO
Galvanizers Association of Australia
Ministry of Economic Development (New Zealand)
New Zealand Abrasive Blasting Association
United Water International
Water Services Association of Australia

Additional interests participating in the preparation of this Standard:

Building Research Association of New Zealand
Corrosion engineers and consultants
Galvanic anode manufacturers
Telstra Corporation
Victorian Gas Industry

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 Standards may also be withdrawn.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.

Australian Standard™

Cathodic protection of metals

Part 2: Compact buried structures

Originated as AS 2832.2—1991.
Second edition 2003.

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 5320 5

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee MT-014, Corrosion of Metals, at the request of industry to supersede AS 2832.2—1991, *Guide to the cathodic protection of metals, Part 2: Compact buried structures*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

The objective of this Standard is to specify the technical requirements for the cathodic protection of compact buried structures.

This Standard is Part 2 of the AS and AS/NZS 2832 series of Standards, titled *Cathodic protection of metals*, currently comprising four parts. The other three parts are as follows:

AS or AS/NZS

2832 Cathodic protection of metals

2832.1 Part 1: Pipes and cables

2832.3 Part 3: Fixed immersed structures

2832.4 Part 4: Internal surfaces

To enable this Standard to be referred to in regulations, it now contains requirements for cathodic protection and differs from the other Standards in the AS 2832 series which give guidelines for cathodic protection.

There are no International Standards (ISO) on the cathodic protection of metals.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
FOREWORD	5
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	6
1.2 REFERENCED DOCUMENTS.....	6
1.3 DEFINITIONS.....	8
SECTION 2 COMPETENCE OF PERSONNEL	
SECTION 3 CRITERIA FOR CATHODIC PROTECTION	
3.1 SCOPE AND GENERAL	14
3.2 PROTECTION CRITERIA.....	14
3.3 OVERPROTECTION	16
SECTION 4 MEASURING TECHNIQUES AND EQUIPMENT	
4.1 GENERAL.....	17
4.2 POTENTIAL MEASUREMENT AND EQUIPMENT	17
SECTION 5 DESIGN OF STRUCTURES TO ACCOMMODATE CATHODIC PROTECTION	
5.1 SCOPE AND GENERAL	19
5.2 MATERIALS OF CONSTRUCTION.....	19
5.3 COATED AND UNCOATED STRUCTURES.....	19
5.4 ELECTRICAL HAZARDS AND DISTURBANCES	19
5.5 TEST POINTS.....	20
5.6 INSULATING JOINTS (ISOLATING JOINTS).....	21
5.7 ROAD AND RAIL CROSSINGS	22
5.8 ELECTRICAL ISOLATION	22
5.9 ELECTRICAL CONTINUITY	23
SECTION 6 DESIGN OF CATHODIC PROTECTION SYSTEMS	
6.1 SCOPE AND GENERAL	24
6.2 SAFETY HAZARDS.....	24
6.3 DESIGN REQUIREMENTS.....	25
6.4 DESIGN DATA.....	25
6.5 MATERIALS.....	26
6.6 TEST POINTS.....	27
6.7 REFERENCES	27
6.8 ELECTRICAL EARTHING	27
6.9 GRAPHICAL SYMBOLS	27
SECTION 7 INSTALLATION OF CATHODIC PROTECTION SYSTEMS	
7.1 SCOPE.....	28
7.2 APPROVAL TO INSTALL.....	28
7.3 INSTALLATION PRACTICE.....	28
7.4 INSPECTION REQUIREMENTS FOR MATERIALS AND EQUIPMENT	29
7.5 INSTALLATION OF GALVANIC ANODE SYSTEMS	30
7.6 INSTALLATION OF IMPRESSED CURRENT ANODE SYSTEMS	30
7.7 INSTALLATION OF INSULATED FLANGES, JOINTS AND COUPLINGS	31

SECTION 8 CONTROL OF INTERFERENCE WITH FOREIGN STRUCTURES	
8.1	SCOPE AND GENERAL 32
8.2	STATUTORY REGULATIONS..... 32
8.3	MINIMIZATION OF INTERFERENCE CURRENT 32
SECTION 9 COMMISSIONING OF CATHODIC PROTECTION SYSTEMS	
9.1	SCOPE AND GENERAL 36
9.2	PRE-ENERGIZATION TESTING 36
9.3	SYSTEM OPERATION AND ADJUSTMENT..... 36
9.4	POST-ENERGIZATION TESTS 37
9.5	RECORDS..... 37
9.6	OPERATION MANUALS..... 37
SECTION 10 OPERATION OF CATHODIC PROTECTION SYSTEMS	
10.1	SCOPE AND GENERAL 38
10.2	SYSTEM OPERATION CHECKS 38
10.3	STRUCTURE INSPECTIONS 38
10.4	CATHODIC PROTECTION POTENTIAL SURVEYS..... 39
10.5	SYSTEM RE-APPROVAL..... 39
10.6	RECORDS..... 39
SECTION 11 DOCUMENTATION OF CATHODIC PROTECTION SYSTEMS	
11.1	SYSTEM DESIGN DOCUMENTATION 41
11.2	COMMISSIONING DOCUMENTATION 41
APPENDICES	
A	GUIDANCE ON THE GENERAL USE OF CATHODIC PROTECTION 42
B	THE MEASUREMENT OF STRUCTURE POTENTIALS USING THE INSTANTANEOUS OFF-POTENTIAL METHOD 46
C	COUPONS AND RESISTANCE PROBES 48
D	CALIBRATION AND MAINTENANCE OF REFERENCE ELECTRODES..... 50
E	INFORMATION FOR THE DESIGN OF STRUCTURES TO ACCOMMODATE CATHODIC PROTECTION..... 52
F	COATINGS FOR USE WITH CATHODIC PROTECTION 53
G	ELECTRICAL HAZARDS—CATHODIC PROTECTION ON COMPACT BURIED STRUCTURES 56
H	INFORMATION FOR THE DESIGN OF CATHODIC PROTECTION SYSTEMS. 59
I	EXAMPLE OF CATHODIC PROTECTION SYSTEM DESIGN DOCUMENTATION FOR COMPACT BURIED STRUCTURES 67
J	GRAPHICAL SYMBOLS RELATING TO CATHODIC PROTECTION..... 68
K	CONTROL OF INTERFERENCE CURRENTS— LIST OF ELECTROLYSIS COMMITTEES/REGULATORY AUTHORITIES 69
L	STRUCTURE INSPECTIONS 70
M	COMPARISON OF STRUCTURE/ELECTROLYTE POTENTIALS OBTAINED WHEN MEASURED WITH VARIOUS REFERENCE ELECTRODES..... 71
N	CATHODIC PROTECTION OF STRUCTURES SUBJECT TO STRAY DIRECT TRACTION CURRENT 72

FOREWORD

Corrosion of a metal is an electrochemical reaction between it and its environment which results in wastage of the metal. Thus, corrosion is a combination of chemical effects with an associated flow of electrical energy (corrosion current).

In many practical situations, where it is impossible to change the nature of the environment, corrosion may be prevented by employing cathodic protection on a buried or submerged structure. This is achieved by applying an appropriate direct current flowing in opposition to the original corrosion current, thus preventing the natural tendency of the metal to react with its environment. In practice, the electrical potential of the metal at risk is used to judge whether adequate protection is being achieved.

To employ cathodic protection, a circuit is established by connecting a suitable source of direct current to the structure to be protected.

Two types of cathodic protection systems are available, as follows:

- (a) Galvanic anode systems, which employ metallic anodes that are consumed to provide the source of direct current for protection of the structure. The driving voltage for the protective current comes from the natural potential difference that exists between the structure and a second metal (the galvanic anode).
- (b) Impressed current systems, in which the driving voltage for the protective current between the structure and the anode is supplied by an external direct current power source.

Corrosion control for a structure should be considered at the conceptual design stage. Factors that affect the corrosion of metallic structures are listed in Paragraph A3 of Appendix A. The practices recommended in this Standard relate to steps that need to be taken following a decision to apply cathodic protection to a structure. These steps are as follows:

- (i) Designing the structure to be compatible with cathodic protection and including cathodic protection facilities during construction. For existing structures, determine the measures to be taken to apply cathodic protection effectively, and the facilities necessary for cathodic protection monitoring.
- (ii) For new structures, deciding whether to coat, and if so, deciding which particular coating system should be employed. The nature and condition of any coating on existing structures needs to be considered when determining the requirements for the cathodic protection system.
- (iii) Designing the cathodic protection system. If the structure is already installed, the design parameters may be measured and an optimum design provided. If the structure is not installed, a number of assumptions, especially in regard to interference, will be required for the estimation of design parameters.
- (iv) Installing the cathodic protection system.
- (v) Commissioning the cathodic protection system and achieving a balance of cathodic protection current to enable the entire structure to be protected with minimum current, and with as uniform a potential distribution as is practicable.
- (vi) Monitoring cathodic protection at regular intervals, adjusting the system as necessary, and maintaining complete records of its operation.

STANDARDS AUSTRALIA

Australian Standard
Cathodic protection of metals

Part 2: Compact buried structures

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the cathodic protection of external surfaces of compact buried structures, including tank farms, service station tanks, tower footings, steel pilings (in soil), short well casings, compressor and pump stations and associated pipe work.

The Standard specifically covers the following subjects which relate to cathodic protection:

- (a) Pertinent aspects of the design of structures requiring cathodic protection.
- (b) Coatings for use on buried structures.
- (c) Criteria for the cathodic protection of a structure.
- (d) Measuring techniques and equipment.
- (e) The design of cathodic protection systems.
- (f) The installation of cathodic protection systems.
- (g) The control of interference currents on foreign structures.
- (h) The cathodic protection of structures subject to stray direct current.
- (i) The operation and maintenance of cathodic protection systems.
- (j) Electrical hazards.

NOTES:

- 1 Guidance on the general use and design of cathodic protection systems and factors affecting the corrosion of buried metallic structures are given in Appendix A.
- 2 This Standard employs conventional (positive) current flow, for consistency with accepted practice, and uses the potential sign conventions specified in AS/NZS 1852 (all parts). In order to understand the various electrochemical reactions that occur at electrodes during cathodic protection, it should be recognized that electron flow occurs in the opposite direction to conventional current flow.
- 3 Voltage and current referred to in this Standard is direct voltage and direct current, unless otherwise stated.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1100 Technical drawing

1100.401 Part 401: Engineering survey and engineering survey design drawing