

Australian Standard[®]

Cathodic protection of metals

Part 2: Compact buried structures

This Australian Standard was prepared by Committee MT/14, Corrosion of Metals. It was approved on behalf of the Council of Standards Australia on 20 December 1990 and published on 13 May 1991.

The following interests are represented on Committee MT/14:

Aluminium Development Council
Australasian Corrosion Association
Australian Gas Association
Australian Institute of Steel Construction
Australian Zinc Development Association
Austroads
Bureau of Steel Manufacturers of Australia
Confederation of Australian Industry
Department of Defence
Electricity Supply Association of Australia
Engineering and Water Supply Department, South Australia
Railways of Australia Committee
States Electrolysis Committees
Telecom Australia
University of New South Wales

Additional interests participating in preparation of Standard:

Corrosion consultants
Department of Minerals and Energy, N.S.W.
Gas and Fuel Corporation of Victoria
Hunter Water Board
Petroleum refineries
State Electricity Commission of Victoria
Water Resources Commission, Queensland

Review of Australian Standards. To keep abreast of progress in industry, Australian Standards are subject to periodic review and are kept up to date by the issue of amendments or new editions as necessary. It is important therefore that Standards users ensure that they are in possession of the latest edition, and any amendments thereto.

Full details of all Australian Standards and related publications will be found in the Standards Australia Catalogue of Publications; this information is supplemented each month by the magazine 'The Australian Standard', which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.

Suggestions for improvements to Australian Standards, addressed to the head office of Standards Australia, are welcomed. Notification of any inaccuracy or ambiguity found in an Australian Standard should be made without delay in order that the matter may be investigated and appropriate action taken.

This Standard was issued in draft form for comment as DR 86024.

Australian Standard[®]

Cathodic protection of metals
Part 2: Compact buried structures

First published as AS 2832.2—1991.

Incorporating:
Amdt 1—1993
Amdt 2—1999

PUBLISHED BY STANDARDS AUSTRALIA
(STANDARDS ASSOCIATION OF AUSTRALIA)
1 THE CRESCENT, HOMEBUSH, NSW 2140

ISBN 0 7262 6754 6

PREFACE

This Standard was prepared by the Standards Australia Committee on the Corrosion of Metals under the direction of the Metals Standards Board, at the request of industry, to provide a Standard for the guidance of owners of underground structures which are to be cathodically protected. It is not intended to be a complete cathodic protection design manual and those requiring further information should refer to the other Standards mentioned, to text books on the subject or to appropriate corrosion prevention specialists.

During preparation of this Standard, account was taken of the regulations of the various State Authorities, which differ in their approach to cathodic protection.

This Standard forms one of a proposed series of Standards which cover the cathodic protection of metals. The first in the series is AS 2832.1, *Pipes, cables and ducts*.

Other Standards which are in the course of preparation and provide guidelines on cathodic protection cover compact immersed structures such as offshore platforms and jetties, internal surfaces of items such as water storage tanks, and the design of cathodic protection systems for boats.

© Copyright — STANDARDS AUSTRALIA

Users of Standards are reminded that copyright subsists in all Standards Australia publications and software. Except where the Copyright Act allows and except where provided for below no publications or software produced by Standards Australia may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from Standards Australia. Permission may be conditional on an appropriate royalty payment. Requests for permission and information on commercial software royalties should be directed to the head office of Standards Australia.

Standards Australia will permit up to 10 percent of the technical content pages of a Standard to be copied for use exclusively in-house by purchasers of the Standard without payment of a royalty or advice to Standards Australia.

Standards Australia will also permit the inclusion of its copyright material in computer software programs for no royalty payment provided such programs are used exclusively in-house by the creators of the programs.

Care should be taken to ensure that material used is from the current edition of the Standard and that it is updated whenever the Standard is amended or revised. The number and date of the Standard should therefore be clearly identified.

The use of material in print form or in computer software programs to be used commercially, with or without payment, or in commercial contracts is subject to the payment of a royalty. This policy may be varied by Standards Australia at any time.

CONTENTS

	<i>Page</i>
FOREWORD	5
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	6
1.2 REFERENCED DOCUMENTS	6
1.3 DEFINITIONS	6
SECTION 2 DESIGN OF STRUCTURES FOR CATHODIC PROTECTION	
2.1 GENERAL	8
2.2 STRUCTURE COATING	8
2.3 STRAY CURRENTS	8
2.4 TEST POINTS	8
2.5 INSULATING JOINTS	9
2.6 ROAD AND RAIL CROSSINGS	10
2.7 ELECTRICAL ISOLATION	10
2.8 EARTH POTENTIAL RISE CAUSED BY HIGH VOLTAGE POWER SYSTEM FAULTS	10
2.9 ELECTRICAL CONTINUITY	11
2.10 GRAPHICAL SYMBOLS	11
SECTION 3 COATINGS FOR USE WITH CATHODIC PROTECTION	
3.1 GENERAL	12
3.2 COATING PROPERTIES	12
3.3 COATING CHOICE	12
SECTION 4 CRITERIA FOR CATHODIC PROTECTION	
4.1 GENERAL	14
4.2 FERROUS STRUCTURES	14
4.3 COPPER/COPPER ALLOY STRUCTURES	14
4.4 LEAD STRUCTURES	14
4.5 MIXED METALLIC STRUCTURES	14
4.6 STRUCTURES SUBJECT TO STRAY DIRECT CURRENT	14
4.7 MEASUREMENT OF POTENTIAL	14
4.8 OVERPROTECTION	15
SECTION 5 DESIGN OF CATHODIC PROTECTION SYSTEMS	
5.1 GENERAL	16
5.2 SAFETY PRECAUTIONS	16
5.3 CHOICE OF SYSTEM—IMPRESSED CURRENT OR GALVANIC ANODES	16
5.4 CONTROL OF INTERFERENCE CURRENTS	17
5.5 CABLES	17
5.6 CHECK LIST FOR INITIAL SURVEYS	18
5.7 DETERMINATION OF CATHODIC PROTECTION CURRENT REQUIRE- MENTS	18
5.8 ANODE ARRANGEMENTS	19
5.9 ANODE MATERIALS, APPLICATIONS AND OPERATING CHARACTERISTICS	21
5.10 CALCULATION OF GALVANIC ANODE MASS	21
5.11 CALCULATION OF GALVANIC ANODE OUTPUT CURRENT	22
5.12 POWER SUPPLY FOR IMPRESSED CURRENT SYSTEMS	22
5.13 BACKFILL	23
5.14 PROVISION FOR STRAY CURRENTS	23
5.15 SYSTEM DESIGN DOCUMENTATION	23

SECTION 6 INSTALLATION OF CATHODIC PROTECTION SYSTEMS

6.1	GENERAL	25
6.2	MATERIALS AND EQUIPMENT ACCEPTANCE TESTS	25
6.3	INSTALLATION OF GALVANIC ANODE SYSTEMS	26
6.4	INSTALLATION OF IMPRESSED CURRENT ANODE SYSTEMS	26
6.5	INSTALLATION OF REFERENCE ELECTRODES	26
6.6	INSTALLATION OF INSULATING FLANGES, JOINTS AND COUPLINGS	27

SECTION 7 CONTROL OF INTERFERENCE CURRENTS FROM CATHODIC PROTECTION SYSTEMS TO MINIMIZE THEIR EFFECT ON FOREIGN STRUCTURES

7.1	GENERAL	28
7.2	REGULATORY REQUIREMENTS	28
7.3	MINIMIZATION OF INTERFERENCE CURRENT	28

SECTION 8 CATHODIC PROTECTION OF STRUCTURES SUBJECT TO STRAY DIRECT CURRENT

8.1	GENERAL	31
8.2	MINIMIZATION OF STRAY CURRENT EFFECTS	31

SECTION 9 OPERATION AND MAINTENANCE OF CATHODIC PROTECTION SYSTEMS

9.1	GENERAL	32
9.2	MEASURING TECHNIQUES	32
9.3	COMMISSIONING SURVEY	33
9.4	CATHODIC PROTECTION POTENTIAL SURVEY	33
9.5	EQUIPMENT MAINTENANCE CHECKS	33
9.6	STRUCTURE INSPECTIONS	33
9.7	RECORDS	33

APPENDICES

A	GUIDANCE ON THE GENERAL USE OF CATHODIC PROTECTION	35
B	LIST OF DEFINITIONS	38
C	CONTROL OF INTERFERENCE CURRENTS—LIST OF ELECTROLYSIS COMMITTEES	40

FOREWORD

Corrosion of a metal is an electrochemical reaction between the metal 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. This is achieved by applying an appropriate direct current flowing in opposition to the original corrosion current, thus stopping 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 its protection is being adequately 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 system are available:

- (a) Galvanic anode systems, which employ buried metallic anodes which sacrifice themselves to provide the source of direct current for protection of the structure.
- (b) Impressed current systems, which employ an external electrical power source of direct current for the protection of the structure.

Corrosion control for a structure should be considered at the conceptual design stage. Factors which affect the corrosion of buried or partially buried metallic structures are listed in Paragraph 3 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) Decide whether the structure should be coated. If the decision is to coat, then decide what particular coating system should be employed. If the structure is already installed, determination should then be made as to whether the nature and quality of the coating are compatible with cathodic protection.
- (ii) Design the structure to be compatible with cathodic protection and to include cathodic protection facilities during construction. If the structure is already installed, determine the measures to be taken to apply cathodic protection effectively, and the facilities necessary for cathodic protection monitoring.
- (iii) If necessary, design the cathodic protection system to include provisions for the mitigation of stray current effects. If the structure is already installed, the design parameters may be measured and an optimum design provided for the mitigation of stray current effects. If the structure is not installed, a number of assumptions will be required for the estimation of design parameters, and an adequate design for the mitigation of stray current effects may not be possible to achieve.

During the cathodic protection design stage, consideration should be given to the possibility that interference with foreign structures in the area may occur. In some circumstances this interference may only be resolved by field testing subsequent to installation.

- (iv) Install the cathodic protection system.

NOTE: Legislation in some States requires that a permit be obtained prior to the installation of a cathodic protection system.

- (v) Commission the cathodic protection system after achieving a balance of cathodic protection current, to enable the entire structure to be protected with minimum current, and with as uniform a potential over its surface as is practicable. Equipment installed for the mitigation of stray current effects should be balanced for optimum performance.

Carry out interference testing and satisfy all parties involved that any interference problems have been resolved, giving attention to regulatory requirements (if any) of the State in which the system is installed.

- (vi) Monitor cathodic protection at regular intervals, adjusting the conditions of operation as necessary, and maintain 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 provides guidelines 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 pipework.

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

- (a) The design of structures requiring cathodic protection.
- (b) Coatings for use on buried metal structures.
- (c) Criteria for choice of cathodic protection potential.
- (d) The design of cathodic protection systems.
- (e) The installation of cathodic protection systems.
- (f) The control of interference currents on foreign structures.
- (g) The cathodic protection of structures subject to stray direct current.
- (h) The operation and maintenance of cathodic protection systems.

NOTES:

- 1 A different approach is required to achieve satisfactory protection of grounded installations to that for installations buried below ground.
- 2 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.
- 3 This Standard employs positive current flow, and uses the potential sign conventions specified in AS 1852.

1.2 REFERENCED DOCUMENTS The following documents are referred to in this Standard:

AS	
1020	The control of undesirable static electricity
1076	Code of practice for selection, installation and maintenance of electrical apparatus and associated equipment for use in explosive atmospheres (other than mining applications)
1076.1	Part 1: Basic requirements
1100	Technical drawing
1100.401	Part 401: Engineering survey and engineering survey design drawing
1518	Extruded high density polyethylene protective coating for pipes
1627	Metal finishing—Preparation and pretreatment of surfaces
1627.4	Part 4: Abrasive blast cleaning
1627.7	Part 7: Hand tool cleaning of metal surfaces
1768	Lightning protection
1852	International electrotechnical vocabulary
2043	Coal-tar and synthetic (fast dry) primers for steel pipes
2044	Coal-tar enamel for steel pipes
2045	Materials associated with the coating and lining of steel pipes with coal-tar primer/enamel systems
2046	Code of practice for the coating and lining of steel pipes with coal-tar primer/enamel systems
2239	Galvanic (sacrificial) anodes for cathodic protection
2430	Classification of hazardous areas
2430.1	Part 1: Explosive gas atmospheres
2518	Fusion-bonded low-density polyethylene coating for pipes and fittings
3000	SAA Wiring Rules
3100	Approval and test specification—Definitions and general requirements for electrical materials and equipment