

Australian Standard[®]

Loads on bulk solids containers

This Australian Standard was prepared by Committee BD/65, Loads on Bulk Solids Containers. It was approved on behalf of the Council of Standards Australia on 30 August 1996 and published on 5 October 1996.

The following interests are represented on Committee BD/65:

Bureau of Steel Manufacturers of Australia
CSIRO, Division of Building, Construction and Engineering
Institution of Engineers Australia
Swinburne University of Technology
University of Melbourne
University of Sydney
University of Wollongong

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which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.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.

Australian Standard[®]

Loads on bulk solids containers

PREFACE

This Standard was prepared by the Standards Australia Committee BD/65 on Loads on Bulk Solids Containers.

This Standard is based on *Guidelines for the assessment of loads on bulk solids containers* (first edition, 1986) prepared by a working party on bins and silos of the National Committee of Structural Engineering, The Institution of Engineers Australia.

The principal objective of the Standard is to provide users with nationally acceptable unified rules for the determination of loads for the design of containment structures, including bins, silos, bunkers, and dump hoppers, for the mass storage of granular bulk solids.

An amendment was approved by the Committee to take account of the 1993 publication of AS 1170.4, *Minimum design loads on structures (known as the SAA Loading Code)*, Part 4: *Earthquake loads*, and incorporate additional improvements to the clarity and intent of particular requirements, based on user comments. Other technical changes covered by the amendment are principally those initiated by comments from users of the Standard and relate to particular clauses in Sections 4, 6 and 7. The Committee recommended that, rather than issuing an amendment, a second edition of the Standard be published which incorporated the approved amendment.

Appropriate amendments to the relevant clauses in the Commentary on the Standard (AS 3774 Supplement 1) are issued concurrently with this second edition of AS 3774.

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.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

© 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>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	5
1.2 REFERENCED DOCUMENTS	5
1.3 DEFINITIONS	5
1.4 NOTATION	7
 SECTION 2 CLASSIFICATION AND GEOMETRIC PARAMETERS OF BULK STORAGE CONTAINERS	
2.1 CLASSIFICATION OF CONTAINERS	13
2.2 GEOMETRIC PARAMETERS OF CONTAINERS	20
2.3 CONTAINER CAPACITY	20
 SECTION 3 PROPERTIES OF BULK SOLIDS	
3.1 CLASSIFICATION	21
3.2 PROPERTIES FOR LOADING CALCULATION	21
3.3 OTHER PROPERTIES	21
3.4 REPRESENTATIVE VALUES	21
3.5 COMBINATION OF CHARACTERISTIC VALUES	22
 SECTION 4 LOAD CLASSIFICATION, LOAD COMBINATIONS, AND LOAD FACTORS	
4.1 GENERAL	24
4.2 LOAD COMBINATIONS	24
4.3 LOAD FACTORS	25
4.4 CONTAINERS SUBJECT TO REPEATED LOADING	26
4.5 CONSTRUCTION TOLERANCES	26
4.6 ALLOWANCE FOR WEAR AND CORROSION	26
 SECTION 5 DETERMINATION OF PERMANENT LOADS (GROUP A)	
5.1 SELF-WEIGHT OF THE STRUCTURE AND FIXED MECHANICAL PLANT AND EQUIPMENT (LOAD TYPE A.1)	27
5.2 LOADS FROM STRUCTURES SUPPORTED BY THE CONTAINER	27
 SECTION 6 DETERMINATION OF NORMAL SERVICE LOADS (GROUP B)	
6.1 RELEVANT PROPERTIES OF STORED BULK SOLID	28
6.2 INITIAL LOADS ON SYMMETRICALLY FILLED CONTAINER WALLS (LOAD TYPE B.2)	29
6.3 LOADS INDUCED BY FLOW DURING SYMMETRICAL DISCHARGE (LOAD TYPE B.3)	45
6.4 INITIAL LOADS ON ECCENTRICALLY FILLED CONTAINER WALLS (LOAD TYPE B.2)	50
6.5 FLOW LOADS ON ECCENTRICALLY DISCHARGED CONTAINER WALLS (LOAD TYPE B.3)	53
6.6 LOADS ASSOCIATED WITH GATES AND FEEDERS	56
6.7 LIVE LOADS ON PLATFORMS AND ROOFS (LOAD TYPE B.5)	58

6.8	LOADS DUE TO DIFFERENTIAL GAS PRESSURE (LOAD TYPE B.6) . .	58
6.9	FORCES FROM LATERAL RESTRAINTS (LOAD TYPE B.7)	59
6.10	LOADS ON INTERNAL STRUCTURAL ELEMENTS WITHIN THE STORED SOLID (LOAD TYPE B.8)	60
6.11	LOADS TRANSMITTED TO SUPPORTS	61
6.12	LOADS DUE TO BULK SOLIDS ON CONTAINER ROOFS	61
 SECTION 7 DETERMINATION OF ENVIRONMENTAL LOADS (GROUP C)		
7.1	WIND LOADS (LOAD TYPE C.1)	62
7.2	LOADS DUE TO DIFFERENTIAL SETTLEMENT OF FOUNDATIONS (LOAD TYPE C.2)	62
7.3	LOADS DUE TO DIFFERENTIAL TEMPERATURE (LOAD TYPE C.3) . .	63
7.4	SEISMIC LOADS (LOAD TYPE C.4)	65
7.5	LOADS DUE TO SWELLING OF STORED BULK SOLIDS (LOAD TYPE C.5)	68
 SECTION 8 DETERMINATION OF ACCIDENTAL LOADS (GROUP D)		
8.1	VEHICLE IMPACT LOADS (LOAD TYPE D.1)	70
8.2	PRESSURE CAUSED BY INTERNAL EXPLOSION (LOAD TYPE D.2) . .	70
8.3	FORCES DUE TO CONTAINED WATER (LOAD TYPE D.3)	70
 APPENDICES		
A	BULK SOLIDS CONTAINER SPECIFICATION DATA SHEETING	71
B	PROPERTIES OF BULK SOLIDS	72
C	TESTING TO DETERMINE PROPERTIES OF BULK SOLIDS	76
D	PRESSURE CAUSED BY INTERNAL EXPLOSION	81

Originated as AS 3774—1990.
Second edition 1996.

Incorporating:
Amdt 1—1998
Amdt 2—1998

STANDARDS AUSTRALIA

Australian Standard

Loads on bulk solids containers

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE This Standard specifies requirements for the determination of loads for the design of containment structures, including bins, silos, bunkers, and dump hoppers, for the mass storage of granular bulk solids.

This Standard does not apply to containers for the storage of silage or containers with parameters not complying with Section 2.

NOTE: A typical bulk solids container specification data sheet is shown in Appendix A.

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

AS

1170	Minimum design loads on structures (known as the SAA Loading Code)
1170.1	Part 1: Dead and live loads and load combinations
1170.2	Part 2: Wind loads
1170.4	Part 4: Earthquake loads
1250	The use of steel in structures (known as the SAA Steel Structures Code)
1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation

1.3 DEFINITIONS For the purpose of this Standard, the definitions below apply.

1.3.1 Angle of repose—the angle between the surface of a piled-up bulk solid and the horizontal plane.

1.3.2 Axisymmetric flow—a flow pattern formed during the discharge from a container of a bulk solid and characterized by particle trajectories that are symmetrical about the vertical axis of the container.

1.3.3 Bulk solids container—a generic name for all types of structures for containment of granular bulk solids, generally equipped with discharge outlets and capable of being emptied by gravity or by mechanical or pneumatic means.

1.3.4 Coefficient of wall friction—the ratio of the frictional traction to lateral wall pressure at any point on the container wall.

1.3.5 Coefficient of variation—the standard deviation expressed as a percentage of the mean value.

1.3.6 Cone—a conical hopper.

1.3.7 Cylinder—the vertical part of a circular container.

1.3.8 Dead zone—a zone of material that cannot be discharged by gravity.

1.3.9 Eccentric flow—a flow pattern in which the vertical centre-line of the flow channel does not coincide with the vertical centre-line of the container.