

Australian Standard<sup>®</sup>

**Steel storage racking**



This Australian Standard® was prepared by Committee BD-062, Steel Storage Racking. It was approved on behalf of the Council of Standards Australia on 30 January 2012. This Standard was published on 29 February 2012.

---

The following are represented on Committee BD-062:

- Australian Industry Group
  - Australian Steel Institute
  - Consult Australia
  - Engineers Australia
  - Griffith University
  - The University of Sydney
  - WorkSafe Victoria
- 

This Standard was issued in draft form for comment as DR AS 4084.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

---

#### **Keeping Standards up-to-date**

Australian Standards® are living documents that 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Standards may also be withdrawn.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 that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting [www.standards.org.au](http://www.standards.org.au)

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at [mail@standards.org.au](mailto:mail@standards.org.au), or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

---

Australian Standard<sup>®</sup>

## Steel storage racking

Originated as AS 4084—1993.  
Second edition 2012.

### **COPYRIGHT**

© Standards Australia Limited

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.

Published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 1 74342 043 0

## PREFACE

This Standard was prepared by the Standards Australia Committee BD-062, Steel Storage Racking, to supersede AS 4084—1993, *Steel storage racking*.

The objective of this Standard is to provide designers of steel storage racking with specifications for hot-rolled and cold-formed steel structural members used for action carrying purposes.

The design provisions of the Standard are based on the limit states method and are intended to supplement AS 4100 and AS/NZS 4600.

This edition incorporates the following major changes to the previous edition:

- (a) The Standard is in limit states format.
- (b) The Standard provides for internal actions to be determined by linear, geometric nonlinear, and material and geometric nonlinear analyses.
- (c) The Standard contains a comprehensive range of tests for determining the stiffness and strength of rack components and subassemblies.

Reference has been made to the European Racking Code (EN 15512) and the American Rack Manufacturers Institute Specification (RMI).

The term 'normative' is used in this Standard to define the application of the appendix to which it applies. A normative appendix is an integral part of a Standard.

## CONTENTS

	<i>Page</i>
<b>SECTION 1 SCOPE AND GENERAL</b>	
1.1 SCOPE.....	5
1.2 NORMATIVE REFERENCES .....	5
1.3 DEFINITIONS.....	6
1.4 NOTATION.....	15
1.5 USE OF ALTERNATIVE MATERIALS OR METHODS .....	22
1.6 GENERAL REQUIREMENTS FOR RACKING INSTALLATIONS .....	22
1.7 TOLERANCES AND CLEARANCES .....	22
<b>SECTION 2 ACTIONS</b>	
2.1 GENERAL.....	26
2.2 PERMANENT ACTIONS .....	26
2.3 VARIABLE ACTIONS .....	26
2.4 ACCIDENTAL ACTIONS .....	31
2.5 WIND ACTIONS .....	32
2.6 SEISMIC ACTIONS.....	33
2.7 ACTION COMBINATIONS .....	33
<b>SECTION 3 STRUCTURAL ANALYSIS</b>	
3.1 GENERAL.....	38
3.2 DESIGN CRITERIA.....	38
3.3 GLOBAL STRUCTURAL ANALYSIS .....	39
<b>SECTION 4 DESIGN PROCEDURES</b>	
4.1 GENERAL.....	52
4.2 DESIGN CRITERIA.....	52
<b>SECTION 5 DESIGN OF COLD-FORMED STEEL UPRIGHTS AND PALLET BEAMS</b>	
5.1 GENERAL.....	58
5.2 UPRIGHTS.....	58
5.3 PALLET BEAM .....	59
<b>SECTION 6 CONNECTIONS AND BASE PLATES</b>	
6.1 GENERAL.....	60
6.2 PALLET BEAM CONNECTIONS.....	60
6.3 BASE PLATES AND ANCHORAGE.....	60
6.4 DESIGN OF BASE PLATE ANCHORAGE .....	63
6.5 DESIGN OF FRAME SPACERS .....	64
6.6 UPRIGHT SPLICES.....	64
<b>SECTION 7 TEST METHODS</b>	
7.1 INTRODUCTION .....	66
7.2 EVALUATION OF TESTS FOR DETERMINING STRUCTURAL PERFORMANCE .....	67
7.3 TESTS ON UPRIGHTS.....	71
7.4 PALLET BEAM TESTS.....	77
7.5 PALLET BEAM TO UPRIGHT CONNECTION TESTS.....	80
7.6 UPRIGHT FRAME TEST .....	86
7.7 TESTS FOR SHEAR STIFFNESS OF UPRIGHT FRAMES .....	88

7.8	TESTS ON UPRIGHT SPLICES.....	91
7.9	TESTS ON FLOOR CONNECTIONS.....	93
7.10	CHARPY TYPE IMPACT TESTS .....	96
SECTION 8 OPERATION AND MAINTENANCE OF ADJUSTABLE PALLET RACKING		
8.1	GENERAL.....	99
8.2	INSPECTIONS.....	100
8.3	DAMAGE DUE TO IMPACT.....	100
8.4	OUT-OF-PLUMB OF RACKING .....	102
8.5	DAMAGE CLASSIFICATION AND RISK MANAGEMENT .....	102
BIBLIOGRAPHY.....		114
APPENDICES		
A	AMPLIFIED SWAY METHOD FOR DOWN-AISLE STABILITY ANALYSIS ...	103
B	SIMPLIFIED EQUATIONS FOR THE DESIGN OF A REGULAR STORAGE RACK IN THE DOWN-AISLE DIRECTION .....	105
C	SIMPLIFIED METHOD FOR CROSS-AISLE STABILITY ANALYSIS.....	110

# STANDARDS AUSTRALIA

## Australian Standard Steel storage racking

### SECTION 1 SCOPE AND GENERAL

#### 1.1 SCOPE

This Standard sets out minimum requirements for the design, fabrication and erection tolerances, test methods, operation and maintenance of steel storage racking in the limit states method.

This Standard applies to adjustable static pallet racking made of cold-formed or hot-rolled steel structural members. It covers racking installed within a building, outside a building, and racking that forms part of the frame of the building.

The Standard does not cover drive-in and drive-through racking, cantilever racking, mobile racking or racking made of materials other than steel.

NOTE: Guidance for the design of drive-in and drive-through racking is available in FEM 10.2.07, and in FEM 10.2.09 for cantilever racking.

#### 1.2 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents for informative purposes are listed in the Bibliography.

##### AS

- 1170 Structural design actions
- 1170.4 Part 4: Earthquake actions in Australia
- 1391 Metallic materials—Tensile testing at ambient temperature
- 1657 Fixed platforms, walkways, stairways and ladders—Design, construction and installation
- 4100 Steel structures

##### AS/NZS

- 1170 Structural design actions
- 1170.0 Part 0: General principles
- 1170.1 Part 1: Permanent, imposed and other actions
- 1170.2 Part 2: Wind actions

- 4600 Cold-formed steel structures

##### FEM The European Federation of Materials Handling

- 9.831 Calculation Principles for Storage and Retrieval Machines. Tolerances, Deformations and Clearances in the High-bay Warehouse
- 9.832 Basis of Calculations for Storage and Retrieval Machines, Tolerances, Deformations and Clearances in Automatic Small Parts Warehouses (not Silo Design)