



**NSAI**  
Standards

Irish Standard  
I.S. EN 15512:2020&LC:2020

# Steel static storage systems - Adjustable pallet racking systems - Principles for structural design

**I.S. EN 15512:2020&LC:2020**

*Incorporating amendments/corrigenda/National Annexes issued since publication:*

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

*This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):*

*NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.*

*This document is based on:*

*Published:*

*This document was published under the authority of the NSAI and comes into effect on:*

2021-01-27

ICS number:

53.080

NOTE: If blank see CEN/CENELEC cover page

NSAI  
1 Swift Square,  
Northwood, Santry  
Dublin 9

T +353 1 807 3800  
F +353 1 807 3838  
E standards@nsai.ie  
W NSAI.ie

Sales:  
T +353 1 857 6730  
F +353 1 857 6729  
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

## National Foreword

I.S. EN 15512:2020&LC:2020 is the adopted Irish version of the European Document EN 15512:2020, Steel static storage systems - Adjustable pallet racking systems - Principles for structural design

This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

For relationships with other publications refer to the NSAI web store.

**Compliance with this document does not of itself confer immunity from legal obligations.**

*In line with international standards practice the decimal point is shown as a comma (,) throughout this document.*

This page is intentionally left blank

## Correction Notice

**Reference:** EN 15512:2020

**Title:** Steel static storage systems - Adjustable pallet racking systems - Principles for structural design

**Work Item:** 00344013

Brussels, 2020-12-16

**please include the following minor editorial correction(s) in the document related to:**

the following language version(s) :

- English
- French
- German

for the following procedure :

- PQ/UQ
- Enquiry
- 2nd Enquiry
- Parallel Enquiry
- 2<sup>nd</sup> Parallel Enquiry
- Formal Vote
- 2<sup>nd</sup> Formal Vote
- Parallel Formal Vote
- 2<sup>nd</sup> Parallel Formal Vote
- UAP
- TC Approval
- 2<sup>nd</sup> TC Approval
- Publication
- Parallel Publication

---

It has been brought to our attention that this document, issued on 2020-11-25, requires modification.

Several editorial changes have been made in E.4.3.

Please find enclosed the updated English version.

We apologise for any inconvenience this may cause.

*This page is intentionally left BLANK.*

EUROPEAN STANDARD

**EN 15512**

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2020

ICS 53.080

Supersedes EN 15512:2009

English Version

## Steel static storage systems - Adjustable pallet racking systems - Principles for structural design

Systèmes de stockage en acier - Systèmes de rayonnages à palettes réglables - Principes applicables au calcul des structures

Ortsfeste Regalsysteme aus Stahl - Verstellbare Palettenregale - Grundlagen der statischen Bemessung

This European Standard was approved by CEN on 8 June 2020.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 16 December 2020.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## Contents

Page

|  |    |
|--|----|
| European foreword.....   | 10 |
| 0 Introduction .....   | 11 |
| 0.1 Racking .....  | 11 |
| 0.2 Requirement for EN Standards for racking in addition to the Eurocodes..... | 11 |
| 0.3 Liaison .....  | 11 |
| 0.4 Racking and Work Equipment regulations.....                                | 11 |
| 0.5 Additional information specific to EN 15512.....                           | 11 |
| 1 Scope .....  | 13 |
| 2 Normative references .....   | 13 |
| 3 Terms and definitions .....  | 14 |
| 4 Symbols.....   | 19 |
| 5 Assumptions and conventions.....   | 22 |
| 5.1 General.....   | 22 |
| 5.2 Verticality.....   | 22 |
| 5.3 Conventions for member axis.....   | 22 |
| 6 Basis of design .....  | 22 |
| 6.1 Requirements .....   | 22 |
| 6.1.1 Basic requirements .....   | 22 |
| 6.1.2 Design working life.....   | 22 |
| 6.1.3 Requirements for pallet racking .....                                    | 23 |
| 6.2 Principles of limit state design.....                                      | 23 |
| 6.2.1 General.....   | 23 |
| 6.2.2 Ultimate limit state.....  | 23 |
| 6.2.3 Serviceability limit state.....  | 23 |
| 6.3 Actions.....   | 23 |
| 6.3.1 General.....   | 23 |
| 6.3.2 Permanent actions.....   | 23 |
| 6.3.3 Variable actions .....   | 24 |
| 6.3.4 Accidental actions .....   | 31 |
| 6.4 Combination of actions .....   | 32 |
| 6.4.1 General.....   | 32 |
| 6.4.2 Ultimate limit state.....  | 32 |
| 6.4.3 Serviceability limit states.....   | 33 |
| 6.5 Partial factors .....  | 33 |
| 6.5.1 Load factors.....  | 33 |
| 6.5.2 Material factors.....  | 34 |
| 7 Materials.....   | 35 |
| 7.1 Steel.....   | 35 |
| 7.1.1 General.....   | 35 |
| 7.1.2 Material properties .....  | 35 |
| 7.1.3 Steels with no guaranteed mechanical properties.....                     | 36 |
| 7.1.4 Untested steels .....  | 36 |
| 7.1.5 Average yield strength of sections.....                                  | 36 |



|        |   |    |
|--------|---|----|
| 7.1.6  | Special selection of production material .....              | 36 |
| 7.1.7  | Fracture toughness .....                                    | 37 |
| 7.1.8  | Dimensional tolerances.....                                 | 37 |
| 7.2    | Floor materials .....                                       | 38 |
| 7.2.1  | Concrete floors .....                                       | 38 |
| 7.2.2  | Bituminous floors.....                                      | 38 |
| 7.2.3  | Other floor materials.....                                  | 38 |
| 8      | Durability .....  | 38 |
| 9      | Structural analysis .....                                   | 39 |
| 9.1    | Structural modelling for analysis .....                     | 39 |
| 9.1.1  | Structural modelling for analysis and basic assumption..... | 39 |
| 9.1.2  | Joint modelling .....                                       | 39 |
| 9.1.3  | Ground-structure interaction .....                          | 42 |
| 9.1.4  | Racks braced against the building structure .....           | 45 |
| 9.2    | Global analysis.....  | 45 |
| 9.2.1  | Effects of deformed geometry of the structure .....         | 45 |
| 9.2.2  | Method of analysis.....                                     | 46 |
| 9.2.3  | Structural stability of frames .....                        | 47 |
| 9.3    | Imperfections.....  | 53 |
| 9.3.1  | General .....   | 53 |
| 9.3.2  | Global imperfections .....                                  | 53 |
| 9.3.3  | Local bracing imperfections .....                           | 55 |
| 9.3.4  | Member imperfections .....                                  | 56 |
| 10     | Ultimate limit states .....                                 | 57 |
| 10.1   | Resistance of cross-sections and members.....               | 57 |
| 10.1.1 | General .....   | 57 |
| 10.1.2 | Section properties .....                                    | 57 |
| 10.1.3 | Compression members.....                                    | 58 |
| 10.1.4 | Bending members .....                                       | 60 |
| 10.1.5 | Tension members.....  | 60 |
| 10.2   | Design of beams .....                                       | 62 |
| 10.2.1 | General .....   | 62 |
| 10.2.2 | Effects of interaction between unit load and beam.....      | 62 |
| 10.2.3 | Correction for looseness .....                              | 63 |
| 10.2.4 | Plastic design resistance .....                             | 63 |
| 10.2.5 | Buckling length of beams in braced pallet racks .....       | 63 |
| 10.2.6 | Beams subject to bending and torsion.....                   | 64 |
| 10.2.7 | Beams affected by distortion.....                           | 65 |
| 10.3   | Design of uprights.....                                     | 65 |
| 10.3.1 | General .....   | 65 |
| 10.3.2 | Buckling curves .....                                       | 65 |
| 10.3.3 | Flexural buckling length .....                              | 66 |
| 10.3.4 | Torsional buckling length.....                              | 69 |
| 10.4   | Design of frame bracing .....                               | 71 |
| 10.4.1 | General .....   | 71 |
| 10.4.2 | Robustness .....  | 71 |
| 10.4.3 | Buckling length of frame bracing.....                       | 72 |
| 10.5   | Design of run spacers .....                                 | 73 |
| 11     | Serviceability limit states .....                           | 74 |
| 11.1   | General .....   | 74 |
| 11.2   | Beams.....  | 74 |

EN 15512:2020 (E)

|                     |   |    |
|---------------------|---|----|
| 11.3                | Beams in walkways or rack supported floors .....                                  | 74 |
| 12                  | Design of joints.....   | 74 |
| 12.1                | General.....  | 74 |
| 12.2                | Design of beam end connectors .....   | 74 |
| 12.2.1              | Design resistance of moment and shear .....                                       | 74 |
| 12.2.2              | Combination of moment and shear .....   | 74 |
| 12.2.3              | Reversed moment .....   | 74 |
| 12.3                | Design of beam connector locks .....  | 75 |
| 12.4                | Design of splices .....   | 75 |
| 12.5                | Design of base plates.....  | 75 |
| 12.5.1              | General.....  | 75 |
| 12.5.2              | Compression .....   | 76 |
| 12.5.3              | Tension .....   | 77 |
| 12.6                | Design of anchorages .....  | 77 |
| 12.6.1              | General.....  | 77 |
| 12.6.2              | Robustness .....  | 77 |
| 13                  | Design assisted by testing .....  | 77 |
| 13.1                | General.....  | 77 |
| 13.2                | Requirements for tests.....   | 78 |
| 13.2.1              | Equipment .....   | 78 |
| 13.2.2              | Support conditions .....  | 78 |
| 13.2.3              | Application of the load .....   | 78 |
| 13.2.4              | Increments of the test load .....   | 79 |
| 13.2.5              | Test materials.....   | 79 |
| 13.2.6              | Assembly of test specimens.....   | 79 |
| 13.2.7              | Test reports .....  | 79 |
| 13.3                | Interpretation of test results .....  | 80 |
| 13.3.1              | Definition of failure load .....  | 80 |
| 13.3.2              | Adjustment of test results .....  | 80 |
| 13.3.3              | Derivation of characteristic values.....  | 82 |
| 13.3.4              | Characteristic values for a family of tests .....                                 | 83 |
| 13.3.5              | Interpolation between test results .....  | 84 |
| 14                  | Marking and labelling – Identification of performance of rack installations ..... | 84 |
| Annex A (normative) | Testing.....  | 85 |
| A.1                 | Materials tests .....   | 85 |
| A.1.1               | Tensile test .....  | 85 |
| A.1.1.1             | General.....  | 85 |
| A.1.1.2             | Tensile test from beam end connector.....   | 85 |
| A.1.2               | Bend tests.....   | 85 |
| A.2                 | Tests on components .....   | 86 |
| A.2.1               | Stub column compression test .....  | 86 |
| A.2.1.1             | Purpose of the test .....   | 86 |
| A.2.1.2             | Test arrangement and method.....  | 86 |
| A.2.1.3             | Corrections to the observations.....  | 87 |
| A.2.1.4             | Derivation of the results.....  | 88 |

|              |  |            |
|--------------|--|------------|
| <b>A.2.2</b> | <b>Compression tests on uprights – Checks for the effects of distortional buckling</b> | <b>88</b>  |
| A.2.2.1      | Purpose of the test  | 88         |
| A.2.2.2      | Test arrangement and method  | 89         |
| A.2.2.3      | Corrections to the observations  | 89         |
| A.2.2.4      | Derivation of the test results   | 89         |
| <b>A.2.3</b> | <b>Compression tests on uprights – Determination of buckling curves</b>                | <b>91</b>  |
| A.2.3.1      | Purpose of the test  | 91         |
| A.2.3.2      | Test arrangement   | 91         |
| A.2.3.3      | Test method  | 93         |
| A.2.3.4      | Corrections to the observations  | 93         |
| A.2.3.5      | Derivation of the column curve   | 93         |
| <b>A.2.4</b> | <b>Frame shear stiffness tests</b>   | <b>95</b>  |
| A.2.4.1      | Purpose of the tests   | 95         |
| A.2.4.2      | Method A, loading the frame in the longitudinal direction                              | 95         |
| A.2.4.2.1    | Test arrangement   | 95         |
| A.2.4.2.2    | Test method  | 97         |
| A.2.4.2.3    | Corrections to the observations  | 97         |
| A.2.4.2.4    | Derivation of results  | 97         |
| A.2.4.3      | Alternative method B using a cross-aisle reversible shear load on a frame              | 98         |
| A.2.4.3.1    | General  | 98         |
| A.2.4.3.2    | Test arrangement   | 98         |
| A.2.4.3.3    | Test method  | 100        |
| A.2.4.3.4    | Corrections to the observations  | 100        |
| A.2.4.3.5    | Derivation of results  | 100        |
| <b>A.2.5</b> | <b>Bending tests on upright sections</b>   | <b>101</b> |
| A.2.5.1      | Purpose of the test  | 101        |
| A.2.5.2      | Test arrangement   | 101        |
| A.2.5.3      | Test method  | 103        |
| A.2.5.4      | Corrections to the observations  | 103        |
| A.2.5.5      | Derivation of results  | 103        |
| <b>A.2.6</b> | <b>Bending tests on beams</b>  | <b>103</b> |
| A.2.6.1      | Purpose of the test  | 103        |
| A.2.6.2      | Test arrangement   | 103        |
| A.2.6.3      | Test method  | 105        |
| A.2.6.4      | Corrections to the observations  | 105        |
| A.2.6.5      | Derivation of the results  | 105        |

EN 15512:2020 (E)

|                  |   |            |
|------------------|---|------------|
| <b>A.3</b>       | <b>Tests on connections</b> .....   | <b>106</b> |
| <b>A.3.1</b>     | <b>Bending tests on beam end connectors</b> .....                             | <b>106</b> |
| <b>A.3.1.1</b>   | <b>Purpose of the test</b> .....  | <b>106</b> |
| <b>A.3.1.2</b>   | <b>Test arrangements</b> .....  | <b>106</b> |
| <b>A.3.1.3</b>   | <b>Test procedure</b> .....   | <b>108</b> |
| <b>A.3.1.4</b>   | <b>Corrections to the observations</b> .....                                  | <b>108</b> |
| <b>A.3.1.5</b>   | <b>Derivation of the results and procedure to define curves</b> .....         | <b>109</b> |
| <b>A.3.1.5.1</b> | <b>Procedure 1:</b> .....   | <b>109</b> |
| <b>A.3.1.5.2</b> | <b>Procedure 2:</b> .....   | <b>109</b> |
| <b>A.3.1.5.3</b> | <b>General</b> .....  | <b>109</b> |
| <b>A.3.1.5.4</b> | <b>Procedure to derive a bi-linear curve</b> .....                            | <b>110</b> |
| <b>A.3.1.5.5</b> | <b>Procedure to derive a multilinear curve</b> .....                          | <b>110</b> |
| <b>A.3.2</b>     | <b>Looseness tests on beam end connectors</b> .....                           | <b>112</b> |
| <b>A.3.2.1</b>   | <b>Purpose of the test</b> .....  | <b>112</b> |
| <b>A.3.2.2</b>   | <b>Alternative 'A' Test arrangement using a double acting jack</b> .....      | <b>112</b> |
| <b>A.3.2.2.1</b> | <b>General</b> .....  | <b>112</b> |
| <b>A.3.2.2.2</b> | <b>Test Method</b> .....  | <b>112</b> |
| <b>A.3.2.2.3</b> | <b>Corrections to the observations</b> .....                                  | <b>113</b> |
| <b>A.3.2.2.4</b> | <b>Derivation of results</b> .....  | <b>113</b> |
| <b>A.3.2.3</b>   | <b>Alternative 'B' using two cantilever beams and a central upright</b> ..... | <b>113</b> |
| <b>A.3.2.3.1</b> | <b>Test arrangement</b> .....   | <b>113</b> |
| <b>A.3.2.3.2</b> | <b>Test Method</b> .....  | <b>115</b> |
| <b>A.3.2.3.3</b> | <b>Corrections to the observations</b> .....                                  | <b>115</b> |
| <b>A.3.2.3.4</b> | <b>Derivation of results</b> .....  | <b>115</b> |
| <b>A.3.3</b>     | <b>Shear tests on beam end connectors and connector locks</b> .....           | <b>115</b> |
| <b>A.3.3.1</b>   | <b>Purpose of the test</b> .....  | <b>115</b> |
| <b>A.3.3.2</b>   | <b>Test arrangement</b> .....   | <b>115</b> |
| <b>A.3.3.3</b>   | <b>Test method</b> .....  | <b>117</b> |
| <b>A.3.3.4</b>   | <b>Corrections to the observations</b> .....                                  | <b>117</b> |
| <b>A.3.3.5</b>   | <b>Derivation of results</b> .....  | <b>117</b> |
| <b>A.3.4</b>     | <b>Moment-shear interaction test of beam end connectors</b> .....             | <b>117</b> |
| <b>A.3.4.1</b>   | <b>Purpose of the test</b> .....  | <b>117</b> |
| <b>A.3.4.2</b>   | <b>Test arrangement</b> .....   | <b>117</b> |
| <b>A.3.4.3</b>   | <b>Test procedure</b> .....   | <b>117</b> |
| <b>A.3.4.4</b>   | <b>Corrections to the observations</b> .....                                  | <b>117</b> |
| <b>A.3.4.5</b>   | <b>Derivation of the bending and shear resistance</b> .....                   | <b>117</b> |

|  |     |
|--|-----|
| A.3.4.6 Derivation of the moment-shear interaction curve .....                           | 118 |
| A.3.4.7 Generalized moment-shear relationship .....                                      | 118 |
| A.3.5 Floor connections test.....  | 118 |
| A.3.5.1 Purpose of the test.....   | 118 |
| A.3.5.2 Reuse of concrete blocks.....  | 119 |
| A.3.5.3 Alternative 'A' using two lengths of upright with a central concrete block.....  | 119 |
| A.3.5.3.1 Test arrangement.....  | 119 |
| A.3.5.3.2 Test method.....   | 121 |
| A.3.5.4 Alternative 'B' using a single length of upright with an end concrete block..... | 122 |
| A.3.5.4.1 Test arrangement.....  | 122 |
| A.3.5.4.2 Test Method.....   | 124 |
| A.3.5.5 Corrections to the observations .....  | 124 |
| A.3.5.6 Derivation of the Results.....   | 124 |
| A.3.6 Upright splices test.....  | 125 |
| A.3.6.1 Purpose of the test.....   | 125 |
| A.3.6.2 Test arrangement .....   | 125 |
| A.3.6.3 Test method.....   | 126 |
| A.3.6.4 Corrections to observations .....  | 126 |
| A.3.6.5 Derivation of results.....   | 126 |
| Annex B (informative) Approximate method.....  | 127 |
| B.1 General .....  | 127 |
| B.2 Approximate down-aisle stability analysis – Amplified sway method.....               | 127 |
| B.2.1 General .....  | 127 |
| B.2.2 Amplification factor.....  | 129 |
| B.2.3 Linear elastic analysis.....   | 129 |
| B.2.4 Elastic critical value.....  | 129 |
| B.3 Approximate down-aisle analysis of a regular storage rack .....                      | 129 |
| B.3.1 Approximate equation for regular construction.....                                 | 129 |
| B.3.2 Additional bending moments due to pattern loading .....                            | 132 |
| B.3.3 Design Moments.....  | 132 |
| B.3.4 Design loads in outer columns.....   | 134 |
| B.4 Approximate cross-aisle stability analysis.....                                      | 134 |
| B.4.1 General .....  | 134 |
| B.4.2 Global buckling of upright frames.....   | 134 |
| B.4.3 Shear stiffness of upright frame .....   | 135 |
| B.4.4 Amplification factor $\beta$ .....   | 135 |

EN 15512:2020 (E)

|  |  |            |
|--|--|------------|
| <b>B.5</b>   | <b>Approximate design for symmetrically loaded beams</b> .....                         | <b>139</b> |
| <b>B.5.1</b>   | <b>Mid-span bending moment</b> .....   | <b>139</b> |
| <b>B.5.2</b>   | <b>Deflection</b> .....  | <b>140</b> |
| <b>B.5.3</b>   | <b>Shear force</b> .....   | <b>140</b> |
| <b>B.5.4</b>   | <b>Beam end connector</b> .....  | <b>141</b> |
| <b>B.5.5</b>   | <b>Equivalent beam loads</b> .....   | <b>141</b> |
| <b>Annex C (informative) Correction of beam moments and deflection due to looseness</b> .....                              |  | <b>143</b> |
| <b>Annex D (informative) Frame looseness</b> .....   |  | <b>145</b> |
| <b>D.1</b>   | <b>General</b> .....   | <b>145</b> |
| <b>D.2</b>   | <b>Frame bracing types</b> .....   | <b>145</b> |
| <b>D.3</b>   | <b>Looseness</b> .....   | <b>146</b> |
| <b>Annex E (normative) Resistance of compression member according to EN 1993-1-1 and -3</b> ....                           |  | <b>148</b> |
| <b>E.1</b>   | <b>Cross-sectional verification</b> .....  | <b>148</b> |
| <b>E.2</b>   | <b>Design strength with respect to flexural buckling</b> .....                         | <b>148</b> |
| <b>E.2.1</b>   | <b>General</b> .....   | <b>148</b> |
| <b>E.2.2</b>   | <b>Buckling curves</b> .....   | <b>149</b> |
| <b>E.3</b>   | <b>Design strength with respect to torsional and torsional-flexural buckling</b> ..... | <b>150</b> |
| <b>E.4</b>   | <b>Combined bending and axial loading</b> .....  | <b>152</b> |
| <b>E.4.1</b>   | <b>General</b> .....   | <b>152</b> |
| <b>E.4.2</b>   | <b>Bending and axial compression – resistance of cross-section</b> .....               | <b>152</b> |
| <b>E.4.3</b>   | <b>Bending and axial compression – buckling resistance of member</b> .....             | <b>153</b> |
| <b>E.4.4</b>   | <b>Bending and tension</b> .....   | <b>156</b> |
| <b>Annex F (informative) Guidance to the determination of the critical length for the distortional buckling test</b> ..... |  | <b>157</b> |
| <b>F.1</b>   | <b>Introduction</b> .....  | <b>157</b> |
| <b>F.2</b>   | <b>Length in relation to the end conditions in the test set-up</b> .....               | <b>157</b> |
| <b>F.3</b>   | <b>Method for the determination of the critical distortional buckling length</b> ..... | <b>158</b> |
| <b>F.3.1</b>   | <b>Step 1</b> .....  | <b>158</b> |
| <b>F.3.2</b>   | <b>Step 2</b> .....  | <b>158</b> |
| <b>F.3.3</b>   | <b>Step 3</b> .....  | <b>160</b> |
| <b>F.3.4</b>   | <b>Step 4</b> .....  | <b>160</b> |
| <b>F.3.5</b>   | <b>Step 5</b> .....  | <b>160</b> |
| <b>F.3.6</b>   | <b>Step 6</b> .....  | <b>161</b> |
| <b>Annex G (informative) Equivalent section properties</b> .....   |  | <b>162</b> |
| <b>Annex H (informative) Guidance to modelling spine bracing in braced pallet racking</b> .....                            |  | <b>165</b> |
| <b>Annex I (informative) Cold-reduced steel</b> .....  |  | <b>173</b> |
| <b>Annex J (informative) Systems with random storage</b> .....   |  | <b>174</b> |

|  |            |
|--|------------|
| <b>Annex K (informative) Position inaccuracies</b> .....                                 | <b>175</b> |
| <b>Annex L (informative) Beam stability – comprising interlocking ‘C’ sections</b> ..... | <b>176</b> |
| <b>L.1 General</b> .....   | <b>176</b> |
| <b>L.2 Approximate limit values</b> .....  | <b>176</b> |
| <b>Annex M (informative) Factory production control (FPC)</b> .....                      | <b>178</b> |
| <b>M.1 General</b> .....   | <b>178</b> |
| <b>M.2 Frequency of tests</b> .....  | <b>178</b> |
| <b>M.3 Bending tests on beam end connectors</b> .....                                    | <b>178</b> |
| <b>M.4 Bend tests</b> .....  | <b>178</b> |
| <b>Annex N (informative) A-deviations</b> .....  | <b>179</b> |
| <b>N.1 Dutch national legislative deviations</b> .....                                   | <b>179</b> |
| <b>N.2 Italian national legislative deviations</b> .....                                 | <b>179</b> |
| <b>Annex O (informative) Bituminous floors</b> .....                                     | <b>181</b> |
| <b>Annex P (informative) Typical loading pattern for a regular rack layout</b> .....     | <b>182</b> |
| <b>Bibliography</b> .....  | <b>184</b> |

## **EN 15512:2020 (E)**

### **European foreword**

This document (EN 15512:2020) has been prepared by Technical Committee CEN/TC 344 “Steel static storage systems”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2021, and conflicting national standards shall be withdrawn at the latest by May 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15512:2009.

Compared to EN 15512:2009, the overall document structure has been updated to be more similar to the Eurocode, several clauses were updated to current state of Standards and FEM recommendations, alternative options for testing setups were included. A probabilistic reliability study was carried out to verify reduced load factors were according to Eurocode principles resulting in minor adjustments on the material factors.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



## 0 Introduction

### 0.1 Racking

Racking systems are load bearing structures for the storage of goods in warehouses. The goods to be stored are generally on pallets or in box-containers.

Racking is constructed from steel components including upright frames and beams. Special beam to column (upright) connections and bracing systems are utilized, in order to achieve a three dimensional steel 'sway' or 'braced' structure with "aisles" to enable order pickers, industrial trucks or stacker cranes to reach the storage positions. Although components are standardized, they are only standard to each manufacturer. These components differ from traditional column and beam structures in the following regard:

- 1) continuous perforated uprights;
- 2) hook-in connections;
- 3) structural components for racking generally consist of cold-formed thin gauge members.

### 0.2 Requirement for EN Standards for racking in addition to the Eurocodes

Because of the differences in shape of structural components, detailing and connection types additional technical information to the Eurocodes are required, in order to have reliable state of the art guidance for the practicing designer involved in designing racking.

The scope of CEN/TC 344 is to establish European Standards providing guidance for the specification, design, methods of installation, accuracy of build and guidance for the user on the safe use of steel static storage systems.

This, together with the need for common design rules was the reason that FEM Racking and Shelving has taken the initiative for CEN/TC 344. CEN/TC 344 is in the course of preparation of a number of European Standards for specific types of racking and shelving.

### 0.3 Liaison

CEN/TC 344 "Steel Storage Systems" liaise with CEN/TC 250 "Structural Eurocodes", CEN/TC 135 "Execution of steel structures and aluminium structures" and CEN/TC 149 "Power-operated warehouse equipment".

### 0.4 Racking and Work Equipment regulations

Although racking is a load bearing structure, national regulatory requirements may require that racking be considered as 'work equipment' and therefore may be subject to the European Directive 89/391/EEC. This document is not a standalone document and is intended to be used in conjunction with EN 15620, EN 15629 and EN 15635.

### 0.5 Additional information specific to EN 15512

EN 15512 is intended to be used with EN 1990, Basis of Structural Design, EN 1991, Actions on structures, and the EN 1993 series for the Design of steel structures.

EN 15512 is intended for use by:

- designers and structural engineers;
- relevant authorities.

## **EN 15512:2020 (E)**

Numerical values for partial factors and other reliability parameters are basic values that provide an acceptable level of reliability assuming an appropriate level of workmanship and quality management.

## 1 Scope

This document specifies the structural design requirements applicable to all types of adjustable beam pallet rack systems fabricated from steel members intended for the storage of unit loads and subject to predominantly static loads. Both un-braced and braced systems are included.

This document gives guidelines for the design of clad rack buildings where requirements are not covered in the EN 1993 series. The requirements of this document also apply to ancillary structures, where rack components are employed as the main structural members.

This document does not cover other generic types of storage structures. Specifically, this document does not apply to mobile storage systems, drive-in, drive-through, pallet live storage, push back, shuttle systems, systems where two or more cranes operates one above another in the same aisle and cantilever racks or static steel shelving systems.

For the specific design of adjustable pallet racking for use in seismic areas, this document is to be used in combination with EN 16681.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1090-4, *Execution of steel structures and aluminium structures — Part 4: Technical requirements for cold-formed structural steel elements and cold-formed structures for roof, ceiling, floor and wall applications*

EN 1990, Eurocode — Basis of structural design

EN 1991-1-1:2002, Eurocode 1: Actions on structures — Part 1-1: General actions — Densities, self-weight, imposed loads for buildings

EN 1992-4, *Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete*

EN 1993-1-1:2005, Eurocode 3: Design of steel structures — Part 1-1: General rules and rules for buildings

EN 1993-1-3:2006, Eurocode 3: Design of steel structures — Part 1-3: General rules — Supplementary rules for cold-formed members and sheeting

EN 1993-1-8:2005, Eurocode 3: Design of steel structures — Part 1-8: Design of joints

EN 15620, Steel static storage systems — Adjustable pallet racking — Tolerances, deformations and clearances

EN 15629, *Steel static storage systems — Specification of storage equipment*

EN 15635, *Steel static storage systems — Application and maintenance of storage equipment*

EN 16681, *Steel static storage systems — Adjustable pallet racking systems — Principles for seismic design*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1)*

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

- 
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
  - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-