SLOVENSKI STANDARD
SIST EN 15512:2009

01-maj-2009

Stabilni jekleni sistemi za skladiģ enje - Sistemi za nastavljive regale za palete - Naļ ela dimenzioniranja

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

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

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

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53.080	Skladiģ na oprema	Storage equipment

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

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

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 15512:2009) 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of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

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Introduction

0.1 Racking

Racking systems are load bearing structures for the storage and retrieval 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, beams and decking. Special beam to column (upright) connections and bracing systems are utilised, 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 standardised 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 and shelving in addition to the Eurocodes

Because of the differences in shape of structural components, detailing and connection type's 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 harmonised design rules was the reason that the European Racking Federation ERF / 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 and particular applications which exist as European Standards (EN) and working group activities (WG) as follows:

EN 15512: Steel static storage systems - Adjustable pallet racking systems - Principles for structural design.

EN 15620: Steel static storage systems - Adjustable pallet racking - Tolerances, deformations and clearances.

EN 15629: Steel static storage systems - The specification of storage equipment.

EN 15635: Steel static storage systems - The application and maintenance of storage equipment

WG 3c: Terms and Definitions.

WG 4:Technical Principles for the Design of Adjustable Drive-in and Drive-through Racking Systems.

WG 5a:Technical principles for the Design of Pallet Racking Systems in Seismic Regions.

WG 5b:Technical Principles for the Design of Drive-in and Drive-through Racking Systems in Seismic Regions.

WG 6:Technical Principles for the Design of Shelving Systems.

WG 7:Technical Principles for the Design of Cantilever Racking Systems.

WG 8:Technical Principles for the Design of Mobile Racking Systems.

WG 9: Principles of Health and Safety during the installation of Racking Systems.

The intention is for these EN-Series “Racking and Shelving” to be published sequentially over a period of ten years.

In drafting these documents, liaisons with other CEN/TC's will occur as appropriate.

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 Shelving 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 stand alone document and is intended to be used in conjunction with EN15620, 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 EN 1993 for the Design of steel structures.

EN 1993-1 is the first of six parts of EN 1993 – Design of Steel Structures. It gives generic design rules intended to be used with the other parts EN 1993-2 to EN 1993-6. It also gives supplementary rules applicable only to buildings.

EN 1993-1 comprises eleven subparts EN 1993-1-1 to EN 1993-1-11, each addressing specific steel components, limit states or materials.

EN15512 may also be used for design cases not covered by the Eurocodes (other structures, other actions, other materials) serving as a reference document for other CEN TC´s concerning structural matters.

EN 15512 is intended for use by

committees drafting design related product, testing and execution standards,

designers and structural engineers,

relevant authorities.

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.

As part of the design process, reference to EN 15629 and EN 15635 shall be required to ensure that both specifier and designer are aware of the interface constraints in each other’s responsibility and to allow an effective design to be produced.

1 Scope

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

This European Standard does not cover other generic types of storage structures. Specifically, this European Standard does not apply to mobile storage systems, drive-in, drive-through and cantilever racks or static steel shelving systems, nor does this European Standard establish specific design rules for the assessment of racking in seismic areas.

2 Normative references

The following referenced documents are indispensable for the application 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 528, *Rail dependent storage and retrieval equipment - Safety*

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 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 10002-1, Metallic materials - *Tensile testing – Part1: Method of test at ambient temperature*

EN 10143, *Continuously hot-dipped coated steel sheet and strip - Tolerances on dimensions and shape*

EN 10162, *Cold rolled steel sections - Technical delivery conditions - Dimensional and cross-sectional tolerances*

EN 10326, *Continuous hot-dip coated strip and sheet of structural steels -Technical delivery conditions*

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

EN 15629, *Steel static storage systems - The specification of storage equipment*

EN 15635, *Steel static storage systems - The application and maintenance of storage equipment*

prEN 15878, *Steel static storage systems - Terms and definitions*

EN ISO 7438, *Metallic materials - Bend test (ISO 7438:2005)*

EN ISO 9001, *Quality management systems - Requirements (ISO 9001:2000)*

ETAG No 001, *Guideline for European Technical Approval of Metal Anchors for Use in Concrete*

3 Terms and definitions

For the purposes of this document, the following terms and definitions given in prEN 15878 apply.

3.1
accidental action
action, usually of short duration but of significant magnitude, that is unlikely to occur on a given structure during the design working life

3.2
basic material
flat steel sheets or coiled strip, possibly cold reduced from which the rack components are pressed or rolled

3.3
batch of steel
quantity of steel, all to the same specification, produced by one supplier at one time

3.4
beam
horizontal member linking adjacent frames and lying in the horizontal direction parallel to the operating aisle

3.5
beam end connector
connector, welded to or otherwise formed as an integral part of the beams, which has hooks or other devices which engage in holes or slots in the upright

3.6
compartment load
load which can be loaded into one compartment of a rack or shelving structure from one side

3.7
double entry rack
run of racking accessible from two adjacent operating aisles connected by run spacers

3.8
global analysis
determination of a consistent set of internal forces, moments and displacements that represent the entire three dimensional load bearing rack structure, which are in equilibrium with a particular set of actions on the structure

3.9
perforated member
member with multiple holes regularly spaced along its length

3.10
placement load
load caused by deposit and picking operations of a unit load into and out of the system, reflecting good practice

3.11
single entry rack
run of racking accessible from a single operating aisle

3.12
spine bracing
sway bracing in the vertical plane parallel to the main aisle of the rack, linking adjacent frames

3.13
spring-back
tendency of a cold-formed section to undergo spontaneous cross-sectional distortion when it is cut from a longer length

3.14
stiffened element
stiffened element of a cross-section is a part of the cross-section which is connected to the remainder of the section along both longitudinal edges

3.15
sway
horizontal displacement of structure in addition to any initial out of plumb

3.16
unit load
individual stored item that can be placed or retrieved in one operation

3.17
un-stiffened element
an un-stiffened element of a cross-section is a part of the cross-section which is connected to the remainder of the section along one longitudinal edge only

3.18
upright frame
two (often perforated) upright sections linked together by a system of bracing members

NOTE Typical examples are shown in Figure 1.

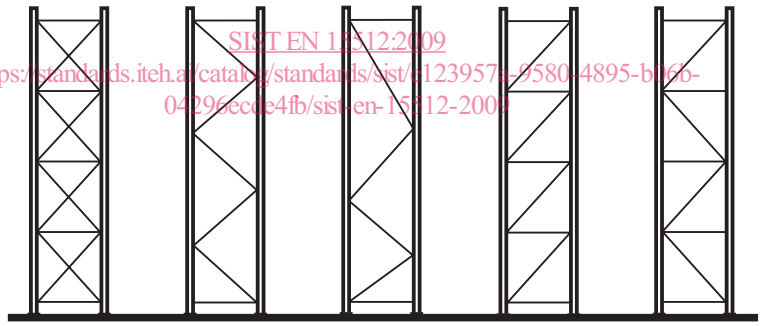

Figure 1 — Typical forms of upright frames

4 Symbols

For the purpose of this document a number of the following symbols may be used together with standard subscripts which are given later.

Additional symbols and subscripts are defined where they first occur.

A symbol and subscript may have several meanings in this document.

In general primary symbols are not defined with all the standard subscripts with which they may be used.

A accidental action

A cross sectional area

A_{eff} effective cross sectional area

A_g gross cross sectional area

A_{ph} accidental horizontal placement force

A_{pv} accidental vertical placement force

b width of upright

b_p notional plane width of element

E modulus of elasticity

e effective bearing width of base plate

e eccentricities

f_{ck} characteristic cylinder strength of concrete

f_t observed yield strength in test specimen

f_u ultimate strength

f_y yield strength

f_{ya} average yield strength

f_{yb} basic yield strength ($=f_y$)

G shear modulus

G_k characteristic value of permanent loads (dead loads)

h storey height

I second moment of area

I_T St Venant torsion constant

I_w warping constant

i radius of gyration

i_0 polar radius of gyration

K effective length factor

k_b stiffness of beam to column connector

k_s coefficient related to number of tests

L span

l length

ℓ effective length or buckling length

M bending moment

N axial load

n number of tests

n_c number of uprights in the down aisle direction in a run of bays

n_s number of beam levels

Q variable load

Q_f concentrated load on floor

Q_h maximum specified lateral load per crane

Q_{ph} horizontal placement load

Q_{pv} vertical placement load

Q_u weight of unit load

q distributed load

R_m mean value of adjusted test results

R_n corrected failure load

R_t observed failure load

s_n standard deviation of the normalised test results

t thickness of material

t_c core thickness of material exclusive of coatings

t_t observed core thickness in test specimen

V shear force

V vertical load

V_{cr} elastic critical value of vertical load

W section modulus

W total load on a beam

α coefficient of linear thermal expansion