



**SLOVENSKI STANDARD
SIST EN 528:1999**

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Rail dependent storage and retrieval equipment - Safety

Regalbediengeräte - Sicherheit

Transtockeurs - Sécurité

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ICS:

53.080 Ù |æã } æ] | ^ { æ Storage equipment

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EUROPEAN STANDARD

EN 528

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 1996

ICS 53.080

Descriptors: safety of machines, storage equipment, rails, accident prevention, hazards, definitions, performance evaluation, control devices, brakes, operating stations, verification, maintenance, marking

English version

Rail dependent storage and retrieval equipment - Safety

Transtockeurs - Sécurité

Regalbediengeräte - Sicherheit

This European Standard was approved by CEN on 1996-07-21. 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 Central Secretariat or to any CEN member.

The European Standards exist 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 Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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↳ Bibliography - 6 technical

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 149 "Rail-dependent storage and retrieval equipment - Safety", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by February 1997, and conflicting national standards shall be withdrawn at the latest by February 1997.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex Z, which is an integral part of this standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

0 Introduction

This standard has been prepared to be a harmonized standard to provide one means of conforming with the essential safety requirements of the Machinery Directive and associated EFTA Regulations.

The extent to which hazards are covered is indicated in the scope of this standard. In addition, machinery shall comply as appropriate with EN 292 for hazards which are not covered by this standard.

1 Scope

This standard applies to all types of machines, restricted to the rails on which they travel within and outside of aisles, which embody lifting means and may embody lateral handling facilities, for the storage and retrieval of unit loads and/or long goods such as bar materials and/or for order picking or similar duties. Also included is the transfer equipment used to change between aisles. Control of machines may range from manual to fully automatic.

This standard does not apply to machines derived from cranes (e.g. overhead travelling cranes), industrial trucks with free ranging capability or robots.

Reference in this standard to racking, buildings and systems only applies where it is necessary to assess the hazards and risks at their interfaces with storage and retrieval machines.

This standard covers specific hazards which could occur during erection, commissioning, testing, operation, maintenance and dismantling of machines and equipment.

This standard applies to machines and equipment which are manufactured after the date of issue.

Illustrations of examples of machines and transfer equipment to which this standard applies are shown in Annex A.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 292-1	Safety of machinery - Basic concepts, general principles of design; Basic terminology, methodology
EN 292-2	Safety of machinery - Basic concepts, general principles of design; Technical principles and specifications
EN 294	Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs.
EN 349	Safety of machinery - Minimum distances to avoid crushing of parts of the human body
EN 418	Safety of machinery - Emergency stop equipment - functional aspects - Principles of design
prEN 614-1	Safety of machinery - Ergonomic design principles Part 1: Terminology and general principles
prEN 811	Safety of machinery - Safety distances to prevent danger zones being reached by the lower limbs
prEN 894-1	Safety of machinery - Ergonomic requirements for the design of displays and control actuators Part 1: Human interactions with displays and control actuators
prEN 894-2	Safety of machinery - Ergonomic requirements for the design of displays and control actuators Part 2: Displays
prEN 953	Safety of machinery - General requirements for the design and construction of guards (fixed, movable)
prEN 954-1	Safety of machinery - Safety related parts of control systems Part 1: General principles for design
prEN 982	Technical requirements for fluid power systems and components; hydraulics
prEN 50100-1	Safety of machinery - Electro-sensitive protective devices Part 1: Specification for general requirements
EN 60204-1	Safety of machinery - Electrical equipment of industrial machinery - General requirements
EN 60947-5-1	Low-voltage switchgear and controlgear Part 5-1: Control circuit devices and switching elements; Electromechanical control circuit devices

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 emergency control position: Protected position from which the machine may be controlled during an emergency or a maintenance operation.

3.2 driving position: Position on or off the machine from which the movements of the machine may be controlled.

3.3 load handling device: Part of the machine for carrying the specified loads.

3.4 operator's work area: Area on or off the machine where order picking, stock taking or similar work is carried out.

3.5 operator's position: Position, on or off the machine, comprising the driving position and the operator's work area.

3.6 deterring/impeding device: Any physical obstacle which, without totally preventing access to a danger zone, reduces the probability of access to this zone by offering an obstruction to free access.

3.7 rated load: Maximum load which the machine has been designed to carry, excluding the mass of operator (s) and any part of the machine.

3.8 test load: Rated load and additional load (e.g. person) multiplied by 1,25

3.9 rated speed: Maximum speed of the machine for which it has been designed and for which normal operation is guaranteed by the vendor.

3.10 safety gear: Mechanical device for stopping and maintaining stationary the lifting carriage in case of overspeeding in the downward direction.

3.11 specified load: Load with specified characteristics (mass, dimensions, pallet or container, packaging, etc.) which the machine has been designed to carry.

3.12 transfer device: Device used for transferring a storage and retrieval machine from one aisle to another. This is not integral with the storage and retrieval machine.

3.13 maintenance position: Position on or off the machine for safe maintenance and repair.

3.14 key: Device which can be mechanical, electrical, magnetic or similar with unique characteristics.

3.15 maximum working pressure: Maximum pressure corresponding to the setting of the pressure relief valve.

3.16 operating pressure: The pressure at which the system is designed to work.

3.17 satellite vehicle: An individual vehicle connected to the lifting carriage of the machine and used for transferring loads into or out of the rack structure.

3.18 load transfer area: An area where loads are transferred into or out of the machine operating area.

3.19 work station: A place where persons carry out their duties.

3.20 traffic area: An area which personnel use for travel from one place to another.

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4 List of hazards

The following hazards are applicable in the situations described and could involve significant risks to persons if not reduced or eliminated. The corresponding requirements are designed to limit the risk or reduce the hazard in each situation.

Hazards	Corresponding requirements
4.1 Mechanical hazards	
4.1.1 Crushing from collapse of racking due to contact with the machine	5.3.6.6 Unintentional lowering 5.5.2 End stops 5.5.3 Limitation of forces 5.5.5 Load handling interlocks 5.9.1 Safety clearances 7.4 Load handling devices
4.1.2 Shearing of a person on board between moving machine and racking	6.2.2/7.1 Protection of operator's position 5.8.1 Protection of maintenance position
4.1.3 Cutting due to broken glass	6.1.2.3/6.1.2.10 Safety glass 6.1.4.2 Protected lighting
4.1.4 Entanglement	Not applicable
4.1.5 Drawing-in or trapping of a person in a maintenance position when machine operated by a driver	5.8.4 Communication
4.1.6 Impact from: a) fall of objects from operator's position b) collision between machine and persons	6.1.2.3 Operator's platform floor 5.8.5 Protection from operating machines 5.9.2 Limited access 5.9.3 Load entry/exit protection 5.9.5 Escape 10.3.5 Operator check of aisle 10.3.6 No unauthorised person in aisles 10.3.7 Permit to work system 10.4.1.9 No danger from second machine
4.1.7 Stabbing or puncture	Not applicable
4.1.8 Abrasion	Not applicable
4.1.9 High pressure fluid ejection	Not applicable
4.1.10 Ejection of parts	Not applicable
4.1.11 Loss of stability	5.4.5/5.7.4 Stability 5.5.1 Load stability
4.1.12 Slip, trip or fall on operator's platform	5.9.2.2c) Access door interlock 6.1.2.3 Horizontal slip-resistant floor
4.1.13 Rollover	Not applicable
4.1.14 Contact with wheels	Not applicable
4.1.15 Handling of machine	5. Lifting points 8.1 Erection and dismantling
4.1.16 Falling objects	5.3.7.2 No separation of lifting carriage 5.3.8.2 No rack and pinion disengagement 6.1.2.8 Overhead protection
4.1.17 Fall of person from elevated operator position	6.1.1.3 Prevention of falls from access means 6.1.2.3 Floor design 6.1.2.4 Guard rails 6.1.2.7 Operator's position door opening 10.3.14 Driver leave with machine in position 10.3.19 No person on load handling device
4.1.18 Defective stopping	5.4.1.1b) Emergency braking system
4.1.19 Movement of tools	Not applicable
4.1.20 Uncontrolled movements	Not applicable
4.1.21 Break up of parts	Not applicable
4.1.22 Moving transmission parts	Not applicable
4.1.23 Failure of towing devices	Not applicable

4.1.24 Load falls	5.3.2 Limitation of lifting and lowering movement 5.3.6.7 Auxiliary hoist valve 5.5.1 Load stability 5.5.6 Auxiliary handling equipment 5.5.7 Load position monitoring 5.9.4 Load movement over persons 5.9.6 No unintentional load movement 5.9.7 Protection from falling loads 7.3.3 Leadscrew drives (safety nut) 10.3.9 No overloading 10.3.10 Load remains on load handling device 10.3.11 No projection of goods into aisle 10.3.17 No handling of faulty loads
4.1.25 Collisions	Not applicable
4.1.26 Tipping of machine	5.3.3 Overload protection 5.4.2 Speed reducing system 5.4.4.4 Anti-derailment device 5.4.5 Stability safety factor 5.5.5 Load handling interlocks 5.7.1 Machine position on transfer device 5.7.2 Transfer device movement 5.7.3 Machine interlocking before transfer 5.7.4 Stability of transfer device 6.3.1 Overload protection
4.1.27 Lifting of persons resulting in: a) plummeting of operator's position b) falling from operator's position	5.3.4 Safety gear 5.3.6 Hydraulic lowering control valve 5.3.7 Leadscrew drives (safety nut) 5.3.8 Rack and pinion drives 5.8.1 Protection of maintenance position 6.1.2 Operator's position design 10.3.3 Correct numbers of persons on machine
4.1.28 Derailment of machine	5.4.4 Anti-derailment device
4.1.29 Insufficient strength of parts	5 Compliance with EN standards
4.1.30 Inadequate design of pulleys and drums	5.3.5.4/5.3.5.5/5.3.5.8 Pulley and drum design requirements
4.1.31 Inadequate selection of chains and ropes	5.3.5.1/5.3.5.2/5.3.5.3/5.3.5.6/5.3.5.7/5.3.5.9 Rope and chain selection criteria
4.1.32 Lowering by friction brake	5.3.1 Hoist unit brake
4.2 Electrical hazards	
4.2.1 Electrical contact with live conductors	5 Compliance with EN standards 5.6.1 Main isolator 5.6.2 Maintenance area isolator 5.6.3 Prevention of unintended connection 5.9.2.2e) Protection of movable panels
4.2.2 Electrostatic phenomena	Not applicable
4.2.3 Thermal radiation	Not applicable
4.2.4 External influences	Not applicable
4.2.5 Lightning	Not applicable
4.3 Thermal hazards	
4.3.1 Burns and scalds	Not applicable
4.3.2 Hot or cold working environment.	5 Specified thermal conditions
4.3.3 Inadequate cab heating/ventilation	Not applicable
4.3.4 Fire at the operator's position	6.1.2.9 Furnishings difficult to ignite

4.4	Noise	
4.4.1	Hearing loss	5 Protection from hearing loss
4.4.2	Interference with communication	5.8.4 Means of communication
4.5	Vibration	Not applicable
4.6	Radiation	Not applicable
4.7	Materials and substances	5 Specified working environment
4.8	Neglecting ergonomic principles	
4.8.1	Unhealthy postures or efforts	6.1.2.1 Ergonomic principles
4.8.2	Inadequate consideration of anatomy	6.1.2.1 Ergonomic principles
4.8.3	No personal protection equipment	8.1.3 Provision of personal protection equipment
4.8.4	Inadequate lighting	6.1.2.2 Operator view of his area 6.1.4.3 Emergency lighting for evacuation
4.8.5	Mental overload or underload	Not applicable
4.8.6	Human error resulting in: a) unauthorised persons on machines b) dangerous change to automatic control	5.2.1 Equipment switch 10.2.4 Warning signs 5.2.2 Mode switch 5.2.3 Key dependence 5.6.1 Lockable main isolator 10.4.1.5 Switch off and lock main isolator 10.4.1.6 Avoid hazards when switching on power
4.8.7	Lack of visibility	6.1.2.2 Operator view of his area
4.8.8	Inadequate seating	Not applicable
4.8.9	Inadequate signs/signals/warnings	6.1.3 Operator's warning device
4.8.10	Control devices	5.2.4 Control switch position 5.2.5 Control switch identification 5.8.2 Emergency controls
4.8.11	Means of access	5.8.1 Maintenance position 6.1.1.1 Access to operator's position
4.8.12	Travel speed	Not applicable
4.8.13	Use in dark places	6.1.4.1 Adequate lighting for work area
4.8.14	Battery disconnection means	Not applicable
4.8.15	Towing devices	Not applicable
4.9	Hazard combinations	
4.9.1	Absence of a driver's cab	Not applicable
4.9.2	Insufficient evacuation means	6.1.1.2 Safe emergency egress 10.3.15 Immediate evacuation in emergency
4.9.3	Insufficient instructions	8.1.1 Correct assembly information 8.2.1 Correct commissioning information 8.2.2 Instruction manual for commissioning 10.3 Conditions for the safe operation of equipment
4.9.4	Unauthorised use	5.2.1 Prevention of unauthorised operation 10.4.1.10 Machine recovery procedure 8.1.2 Trained personnel for erection etc. 8.2.3 Trained personnel for commissioning 10.3.2 Suitable and reliable drivers only 10.3.12 Removal of key for manually controlled machines 10.3.13 Only one key for automatic machines

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4.10 Functional disorders	
4.10.1 Failure of energy supply	5.4.1.1b) Automatic braking with power failure
4.10.2 Unexpected ejection of fluids	5.3.6.1/5.3.6.2 Pipe and hose pressures 5.3.6.4 Pressure relief valve
4.10.3 Malfunction of control system	5 Compliance with EN standards
4.10.4 Fitting errors	Not applicable
4.10.5 Unexpected loss of machine stability	5.4.4.4 10 mm drop if wheel fails
4.11 Missing or incorrectly positioned safety related means	
4.11.1 All kinds of guard	Not applicable
4.11.2 Safety related devices	5.9.2.4 Sensing devices 5.9.3 Load entry and exit 8.2.4 Check safety devices before commissioning 10.3.4 Daily check on function of brakes, etc. 10.3.8 Safety devices to remain operational 10.4.2.5 Examination of safety components
4.11.3 Starting and stopping devices	5.4.1 Braking system 5.4.2 Speed reducing system 5.4.3 Limitation of travel 5.7.3 Stop machine from leaving aisle
4.11.4 Safety signs and signals	10.2.1 Identification plate 10.2.2 Carrying capacity 10.2.4 Warning signs
4.11.5 Information and warning devices	10.2.3 Operating instructions
4.11.6 Energy supply disconnection devices	5.6.1 Main isolator 5.6.2 Maintenance area isolator
4.11.7 Emergency devices	5.2.6/7.2.2 Emergency stopping device 5.4.1 Emergency braking system 10.4.1.10 Machine recovery procedure
4.11.8 Feeding/removal of workpieces	Not applicable
4.11.9 Equipment for safe adjustment and maintenance	5.6.2 Maintenance area isolator 5.8.1 Maintenance position 5.8.2 Emergency control position 5.8.4 Communication means 8.1.3 Correct tools etc. for assembly
4.11.10 Equipment for evacuating gases	Not applicable

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5 Safety requirements for all types of equipment

Storage and retrieval equipment and their accessories shall be suitable for use in the specified working environment, e.g. thermal conditions, dust and fumes, fire and explosion.

Storage and retrieval equipment shall be of good construction, sound materials and adequate strength in accordance with the requirements of this standard.

Controls and other electrical components shall be in accordance with EN 418, prEN 954-1, and EN 60204-1.

Storage and retrieval equipment and their accessories shall be designed to be erected in such a manner that persons are not endangered.

Machines and sub-assemblies shall be provided with lifting points where necessary.

The subjects of noise and vibration generated by the machine are not dealt with in this standard. However the relevant standards shall be taken into account.

5.1 Operator's position

Storage and retrieval machines with one or more on-board operators shall have an operator's position. This may be mounted on the lifting carriage, move independently of the lifting carriage, or may be mounted in a fixed position on the machine.

In the case of fully automatically controlled machines a driving position may be dispensed with, but a safe emergency control position shall be provided for each machine.

5.2 Control equipment

5.2.1 Prevention of unauthorised operation (equipment switch)

A key operated switch shall be fitted to the control panel of each machine to prevent unauthorized operation. With the key switch in the "off" position all movements of the machine shall be prevented (see 5.2.3). It shall only be possible to remove the key from this switch in the "off" position.

In the case of manual machines this key allows the operator to take control of the machine. In the case of automatic machines this key in conjunction with the key in 5.2.2 allows operation of the machine for commissioning, fault finding or any other work where the machine needs to be operated by manual control.

5.2.2 Changing mode of operation (mode switch)

To prevent danger due to change from manual to automatic control, or vice versa, one or more key operated mode switches, or alternative means providing the same level of safety, shall be provided for each automated machine (see 6.2.1 and 7.2.1).

It shall only be possible to remove the key from the mode switch on the machine in the "automatic" position and from the mode switch at a control position outside the machine operating area in the "manual" or "off" position.

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5.2.3 Key dependence

For manual machines the door key (see 5.9.2.2.b)) shall be the same key as specified in 5.2.1, or permanently attached to it. For automatic machines the door key shall be the same key as specified in 5.2.2, or permanently attached to it.

Each key shall be unique to a machine and the access door associated with a machine operating area.