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Fédération Européenne de la Manutention (Section IX)

1 Introductory remarks and objectives

This guideline is intended to lay down the essential framework and environmental conditions for the selection and design of drives for storage and retrieval machines and to give clarity and explicitness for customers, system planners, those responsible for systems and manufacturers of storage and retrieval machines. Compliance with the EC Machinery Directive and harmonised standards also requires clear arrangements between the partners in the system.

The checklist in chapter 6 is intended to serve as an information sheet for the customer, a technical description for the system planner and as a design basis for the manufacturer of storage and retrieval machines.

2 Scope

This guideline applies to rail-guided, electrically driven storage and retrieval machines and also to transfer devices for storage and retrieval machines.

3 Definitions and abbreviations

Drive: unit consisting of motor, power dividers, control part, gearbox, mechanical brake, analogue position feedback transmitter for speed and, if applicable, positional control

EMC: EC Directive "Electromagnetic compatibility" 89/336/ECC as amended by Directives 92/31/ECC and 93/68/ECC

General overhaul: A general overhaul is understood to be the measures taken by the manufacturer for the testing and/or replacement of parts when the calculated useful life has been reached in order to gain a further "safe working period" (S.W.P.) (also see FEM 9.755).

Load handling attachments (LHA): Serves to pick up the load make-up accessory (e.g. pallet) with load or the load directly.

Mains regeneration: Process of feeding electrical energy back into the supply network through the driven working machine in certain operation conditions, for example lowering a load or braking. This is possible on certain drive motors with additional current converters and controllers if applicable.

Positional control: A device for the position-dependant control of the speed of one or more drives in order to control the movement of it/ them to a target which is specified by positional co-ordinates as a nominal value whereby the target is arrived at with a specifiable repeatable accuracy of the position.

4 Design criteria and limiting conditions

The interaction between drive and control technology and the mechanics of the storage and retrieval machine (statics/dynamics/vibration) decisively determines the dynamic behaviour and thus the performance of the storage and retrieval machine. The behaviour (stability) of the load on the load make-up accessory and/or load handling attachment during acceleration and deceleration in operation fundamentally influences the required travelling characteristics of storage and retrieval machines.

According to the demands placed on drives, motors are used which are either step-controlled, continuously controlled or positionally controlled.

Different demands are placed on the design and the travelling characteristics respectively of automatic storage and retrieval machines, manual storage and retrieval machines for order-picking and of transfer units. The incorrect selection at the planning stage of design data to be specified, e. g. operating classification or hoisting class, can result in impracticable limitations and/or increases in price.

The following criteria are essential in the selection of drives for storage/ retrieval machines:

- Masses to be moved
- Tractive resistance
- Service life
- Cycle time

- Positioning accuracy
- Starting and braking characteristics
- Running smoothness, vibrational characteristics

- Mains power supply
- Energy consumption, efficiency, mains regeneration
- Electromagnetic compatibility
- Type of protection

- Commissioning, operational reliability, maintenance

Additionally, the following environmental conditions, in which present-day storage and retrieval machines can operate, are to be considered:

- Surroundings which are extremely dirty and dusty
- Refrigeration plants
- Clean room systems
- Explosion-proof areas
- Chemical stores
- Noise-sensitive environments

5 Project planning data

After the material flow concept has been drawn up, the basic project planning data - length, height, required throughput, ambient conditions, etc. - for the selection or design of the drives for the storage and retrieval machines which was established in the process, are to be based on the checklist for project planning data. The selection and design is carried out by those responsible for the system, normally the manufacturer of the storage and retrieval machine, on the basis of the basic planning data and taking into consideration the possible effects of these influencing factors on the drive concept.

6 Checklist Project Planning Data

Project Planning Data	Definition (Standards and guidelines used as a basis)	Possible effects
1) Required performance of the S/R machine Rated load Double or single cycles Reliability, Availability	FEM 9.851 or according to specially agreed rack-compartment coordinates; FEM 9.221, FEM 9.222	Type of LHA, Speeds, Accelerations, Positioning methods
2) Dimensions of the warehouse Length, Height, Racking-steelwork with details of the racking compartments		Speeds, Accelerations, Positioning methods
3) Tolerances and clearances	FEM 9.831	Positioning methods, Manufacturing accuracy and manufacturing costs of the individual components, Space utilization factor
4) Frequency distribution of the loads (number of cycles with maximum load/ number of cycles with minimum load respectively)	FEM 9.512	Service life
5) Sizes, dimensions and composition of the load and the load-make-up accessory (Danger of slipping and tipping-over)	FEM 9.831 UIC 435-2 UIC 435-3 Details from the manufacturer in the case of plastic boxes	Acceleration and deceleration operations
6) Total service life Number of operating hours/ day Number of operating days/ year	FEM 9.512	Drive design, Maintenance intervals, General overhaul

6 Checklist Project Planning Data

7) Environmental conditions, e.g.		
7.1) Mains power supply	EN 60204-1, Section 4	
7.2) Environmental conditions Temperature, Air humidity, Height of installation (Air pressure)	EN 60721-1 EN 60721-3-0 EN 60721-3-3 EN 60721-3-3/A2	Class of insulation Air conditioning Fan power
7.3) Surroundings which are extremely dirty and dusty	EN 60034-5	Type of protection
7.4) Refrigeration plants		Design of drive/ Moisture (materials)
7.5) Clean room systems	EN ISO/DIS 14644-1	Class of insulation, Sealing of bearings, Wear on moving parts, Sealing of gearboxes, Air circulation
7.6) Explosion proof areas	EN 50014-50020 EN 50028 EN 50039 EN 60079-10 EN 1127-1	Type of protection against explosion
7.7) Chemical stores		Mounting locations Type of motor protection
7.8) Noise-sensitive environment	EN 60034-9	Design of motor/ gearbox Travel wheel-/ rail system
8) Special regulations	Works-standards, special contractual arrangements standards from outside Europe (e.g. „UL“ in USA, „JEC“ in Japan)	Influencing of the manu- facturing standards

International Standards quoted

EN 1127-1 (1997)

Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology

EN 60204-1 (1993)

Safety of Machinery – Electrical equipment of machines; Part 1: General requirements

EN 50014 (1994)

Electrical apparatus for potentially explosive atmospheres; General requirements

EN 50015 (1995)

Electrical apparatus for potentially explosive atmospheres; Oil-immersion apparatus "o"

EN 50016 (1996)

Electrical apparatus for potentially explosive atmospheres; Pressurised apparatus "p"

EN 50017 (1995)

Electrical apparatus for potentially explosive atmospheres; Powder filling "q"

EN 50018 (1995)

Electrical apparatus for potentially explosive atmospheres; Flameproof enclosure "d"

EN 50019 (1996)

Electrical apparatus for potentially explosive atmospheres; Increased safety "e"

EN 50020 (1996)

Electrical apparatus for potentially explosive atmospheres; Intrinsic safety "i"

EN 50028 (1980)

Electrical apparatus for potentially explosive atmospheres – Encapsulation "m"

EN 50039 (1982)

Electrical apparatus for potentially explosive atmospheres – Intrinsically safe electrical systems "i"

EN 60034-5 (1988)

Rotating electrical machines, Part 5: Classification of degrees of protection provided by enclosures for rotating machinery

EN 60034-9 (1998)

Rotating electrical machines, Part 9: Noise limits

EN 60079-10 (1996)

Electrical apparatus for explosive gas atmospheres; Part 10. Classification of hazardous areas

EN 60721-1 (1997)

Classification of environmental conditions – Part 1: Environmental parameters and their severities

EN 60271-3-0 (1994)

Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities - Introduction

EN 60721-3-3 (1995)

Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations

EN 60721-3-3/A2 (1997)

Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations

EN ISO/DIS 14644-1 (1998)

Clean rooms and associated controlled environments, Part 1: Classification of airborne particulate cleanliness for clean rooms and clean zones

FEM-Documents quoted

FEM 9.221 (10.1981)

Performance data of Storage/Retrieval machines; Reliability, Availability

FEM 9.222 (06.1989)

Standards on the acceptance and availability of installations with Storage/Retrieval machines and other machinery

FEM 9.512 (07.1997)

Calculation principles for Storage/Retrieval machines; Mechanisms

FEM 9.755 (06.1993)

Measures for achieving safe working periods for motorized serial hoist units (S.W.P.)

FEM 9.831 (02.1995)

Calculation principles for Storage/Retrieval machines; Tolerances, deformations and clearances in the high-bay warehouse

FEM 9.851 (08.1978)

Performance data of Storage/Retrieval machines; Cycle times

International Documents quoted

UIC 435-2

Standard of quality for a European flat pallet made of wood with 4 openings and measuring 800 x 1200 mm

UIC 435-3

Standard of quality for a European box pallet "y" made of steel with 4 openings and measuring 800 x 1200 mm

obtainable at:

UIC – Union Internationale des Chemins de Fer
14 rue Jean Rey, F – 75015 Paris
Tel: 33 (0) 1 44 49 21 85
Fax: 33 (0) 1 44 49 20 29

Sekretariat: Sekretariat der FEM Sektion IX
Secretariat: c/o VDMA
Secrétariat: Fachgemeinschaft Fördertechnik
Postfach 71 08 64
D-60498 Frankfurt

Zu beziehen durch das oben angegebene Sekretariat oder durch die folgenden Nationalkomitees der FEM
Available from the above secretariat or from the following committees of the FEM
En vente auprès du secrétariat ou des comités nationaux suivants de la FEM

Belgique

Comité National Belge de la FEM
Fabrimétal
Rue des Drapiers 21
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Deutschland

Deutsches Nationalkomitee der FEM
VDMA
Fachgemeinschaft Fördertechnik
Postfach 71 08 64
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España

Comité Nacional Español de la FEM
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Finnish National Committee of FEM
Federation of Finnish Metal and
Engineering Industries
Eteläranta 10
SF-00131 Helsinki

France

Comité National Français de la FEM
c/o Syndicat des industries de matériels
de manutention (SIMMA)
39/41 rue Louis Blanc - F-92400 Courbevoie
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Great Britain

British National Committee of FEM
AMHSA Automated Handling
Systems Association Ltd.
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GB HOOK, Hampshire, RG27 0BQ

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Lote 13
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