



# whitepaper

## Rail dependent storage and retrieval equipment

Using the Safety Speed Monitoring Interface SV MR0 in applications using stacker cranes and rail dependent retrieval and transfer equipment. These equipments are typically used in ASRS (Automatic Storage and Retrieval Systems) applications, vertical automated warehouses and warehouses with satellites. Request.

The accidents with storage and retrieval are infrequent, but when they occur the consequences can be very serious. The main dangers are:

- shearing and crushing,
- falling from a height in correspondence with the loading/ unloading points of the material and of the accesses,
- injury during the maintenance procedures.

## REQUEST

Monitor the movement speed of stacker cranes for collection and storage of material and transfer equipment between aisles in logistics systems ASRS (Automatic Storage and Retrieval Systems), vertical automated warehouses and warehouses with satellites.

The standard reference for this type of application is EN ISO 528 of February 2009 “Rail dependent storage and retrieval equipment Safety requirements”.

This standard is applicable to all types of machines which are restricted to rails for travelling within and outside the aisles. They also include lifting means and possibly lateral handling facilities, to store and retrieve unit loads and/or long goods eg. bar materials and/or order picking or similar duties.

The following images illustrate some examples of stacker cranes on rails, designed for automatic storage of materials. The stacker cranes move longitudinally inside the aisles between the shelves of the store where they enter, for prewash or to place the load.

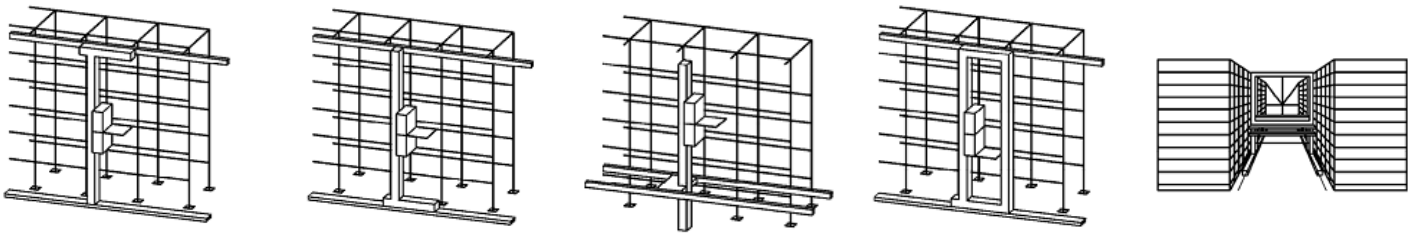


Fig. 1 - Examples of rail dependent storage and retrieval equipments

Transfer equipment means those devices used to transfer a stacker crane between the aisles of the warehouse. The following pictures show two examples.

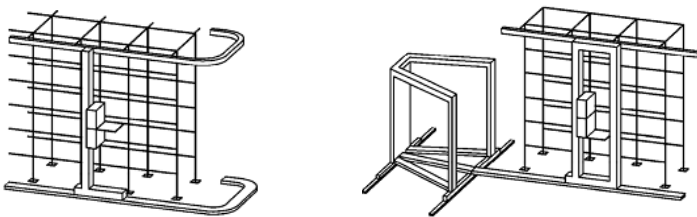


Fig. 3 - Examples of transfer equipments

## Safety requirements

Table C.1 summarizes the safety requirements of the UNI EN 528 and provides the performance level required for different safety functions.

Safety related parts	Clause EN 528	Performance level	Remarks
Anti-derailment device - Interlocking devices	5.5.4.2	d	Performance level d applies only when the derailing is not prevented by purely mechanical devices
Load handling devices - End stops	5.6.2	b	Performance level b applies only to the additional limiting devices
Load handling devices - Limitation of forces	5.6.3	b	Performance level b applies only to the other limiting devices
Load handling devices - Rotating devices - Breaking system	5.6.4	c	Performance level c applies only to the brake contactor
Load handling devices - Satellite vehicles - Position monitoring	5.6.8.2	b	Performance level b applies to all the different field devices. However, a higher safety level shall be reached by the interlocks, sequence control and plausibility checks within the control system (e.g. PLC).
Supply disconnecting (isolating) device a) main switch b) on-board switch	5.7.4.1	c	
Means of disconnection for maintenance areas - Maintenance area isolator	5.7.4.3	c	
Unintended connection	5.7.4.4	c	Performance level c applies to the electrical components
Unexpected start up, disconnection and unauthorised, inadvertent and/or mistaken connection	5.7.4.5	c	Performance level c applies to the electrical components
Suspension of safeguarding (see Note). Hold to run devices	5.7.6 a)	b	Performance level b applies to all the different field devices. However, a higher safety level shall be reached by the sequence control and plausibility checks within the control system (e.g. PLC).
Suspension of safeguarding Reduced speed	5.7.6 b)	d (b)	Performance level b applies only to all the different field devices
Suspension of safeguarding Emergency stop device	5.7.6 c)	c	
Suspension of safeguarding Limited space to escape	5.7.6 d)	d (c)	Performance level c applies to the three position enabling device. Performance level d applies to the control system



**NOTE:** The requirements of 9.2.4 of EN 60204-32:1998 will be applied for maintenance, fault clearance, inspection and setting:

- a) control devices for dangerous movements shall be hold-to-run devices;
- b) relevant movements shall be with reduced speed;
- c) emergency stop device shall be provided at the control station.
- d) if the nature of the work to be done does not give space enough to escape, the travel distance of the powered movement has to be limited or the enabling devices shall be a three-position type.

## Achievement

As an example, consider the following functional diagram of a plant.

1. **Emergency control station:** Protected place from which the machine can be controlled during an emergency or a maintenance operation.
2. **Control station:** Site on the machine, or outside, from which you can control the movements of the machine.
3. **Picking and handling area:** Part of the machine intended for the handling of specified loads.
4. **Transfer equipment**
5. **Operator's working area:** Site on the machine, or outside, where you can order the picking, pick/deposit or similar activities.
6. **Operator console:** Site on the machine, or outside, which includes the control station and operator's area.
7. **Deterrent device:** Any obstacle that, without totally preventing access to the danger zone, reduces the probability of free access.
8. **Maintenance working area:** Site on the machine, or outside, for maintenance and repair in a safe condition.
9. **Brake lifting group:** All lifting groups must be fitted with efficient brakes or other equivalent devices that are capable of stopping the movements of the lifting group with its own test load in a safe condition to its nominal speed and keep it in its stop position. The brakes must automatically take action when power supply is interrupted. The lift group must be designed so that the connection between the brake and the drum or the toothed wheel can not be interrupted. When there is a manual brake release lever, the brake must be operational when the lever is released.

The load handling device (stacker) picks up the material from the shelf and transports it to the transfer device.

This distributes the material between different operator's working areas. The sequence of operations is reversed in case of deposit of the material.

In a plant of this type the operating speed is normally managed directly by the PLC with the aid of encoders.

The safety functions related to the presence of an operator in the danger zone must be considered in the case of access within the system for maintenance or configuration.

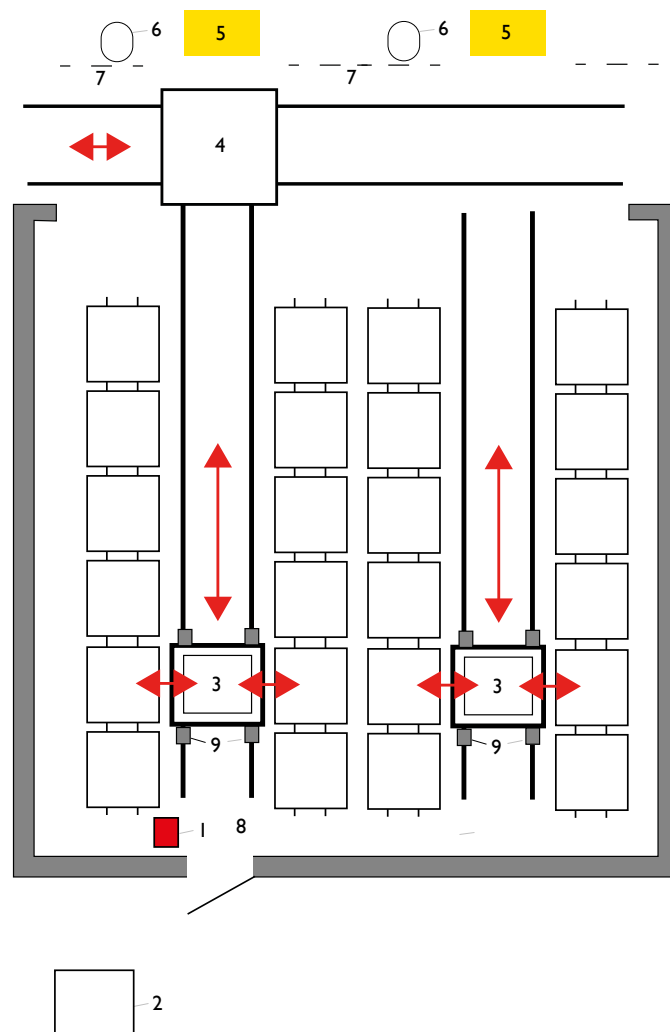
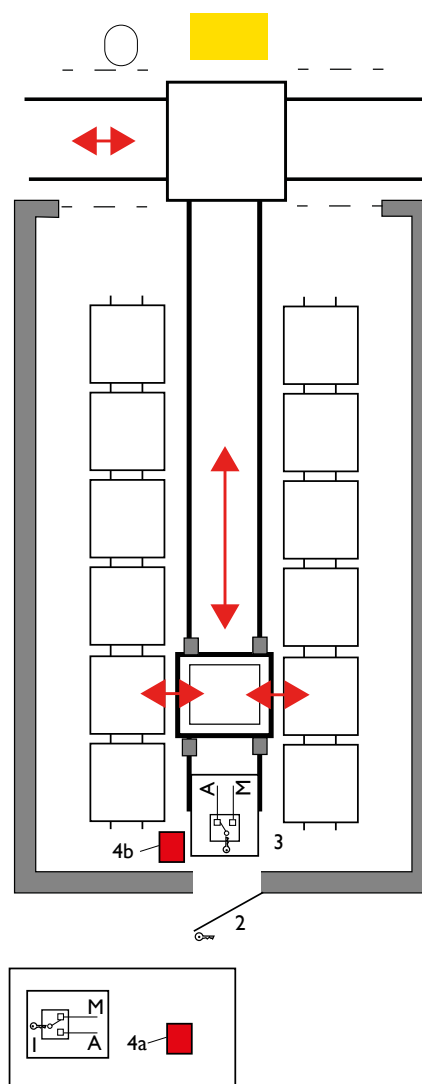


Fig. 4 - diagram of a plant

The operator access into the machine is regulated by procedures and specific controls, for example:

1. The machine operating mode must be switched from the automatic operating mode (A) to the manual mode (M) through an external key selector switch (1). The key can be removed only when the selector is in the manual position.
2. The door (2) can be opened only with the key removed from the selector switch. The door is monitored, so it is clear that the system is in manual operation.
3. In order to proceed with the operations requiring the presence of an operator, also the key selector switch inside the machine (3) must be brought in the manual position (M).
4. The plant can be activated through a "Start" button (4b) and eventually controlled by means of suitable devices such as the three-position type enabling switch.
5. In this phase the movement speed of the material handling devices must be monitored and must not exceed the safe speed. For this safety function the ideal solution is the safety speed monitoring interface SV MR0.
6. In order to reactivate the automatic operating mode, you need to move the internal key selector switch (3) in Automatic (A) position . The key can only be removed with the selector in automatic position.
7. The machine will start again in automatic operating mode (A) only when the door (2) is closed and the external selector is in automatic mode (A) position.
8. At this point the plant will be started with the outside "start" button (4a).



1. External key selector switch
2. door monitored
1. Internal key selector switch
2. a. extyernal Start button  
b. internal Start button

Fig. 5 - Example of accesses control procedure

With reference to section 5.7.6 of the ISO EN 528 standard is clear the need to monitor the movement speed of the stacker and stacker cranes during maintenance, trouble shooting, machine inspection and configuration.

The standard does not specify the speed considered safe. We will assume a speed of 2 m per minute as safe speed for the maintenance operations.

At this speed, we should be able to avoid:

- the problem of the projection of material from great heights
- slippage problems in case of emergency braking.

The use of the safety speed monitoring interface SV MR0 is an ideal solution for this type of control.

For the safe monitoring up to PL d of speed you can use an SV MR0 module and 2 proximity switches, that perform the dual channel.

$$SV MR0 + 2 proximity = Pl d$$



Following some pictures of the application



Fig. 6 - SADA cable warehouse in Fiorano (made by System Logistics. - 1000 place max 2500 kg.

SV MR0 module controls the maximum speed of the rail dependent storage.



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Code	WP AN11
Product	SV MRO
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Application	Rail dependent storage and retrieval equipment
Object	Using the Safety Speed Monitoring Interface SV MRO in applications using stacker cranes and rail dependent retrieval and transfer equipment. These equipments are typically used in ASRS (Automatic Storage and Retrieval Systems) applications, vertical automated warehouses and warehouses with satellites.