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Available in German (D), English (E) and French (F)

For references see end of document

1 Scope

These rules apply exclusively to S/R machines operated under automatic control and designed for handling unit loads. In high-bay warehouses, S/R machines are important for handling of goods.

Furtheron the extensions in chapter 6 are valid.

This document is intended as a uniform basis for calculating S/R machine cycle times and thus their handling rates, and for optimizing high-bay warehouses. The range of applications covers planning, the working-out of offers, constructions, and the handing-over of the installation to the user.

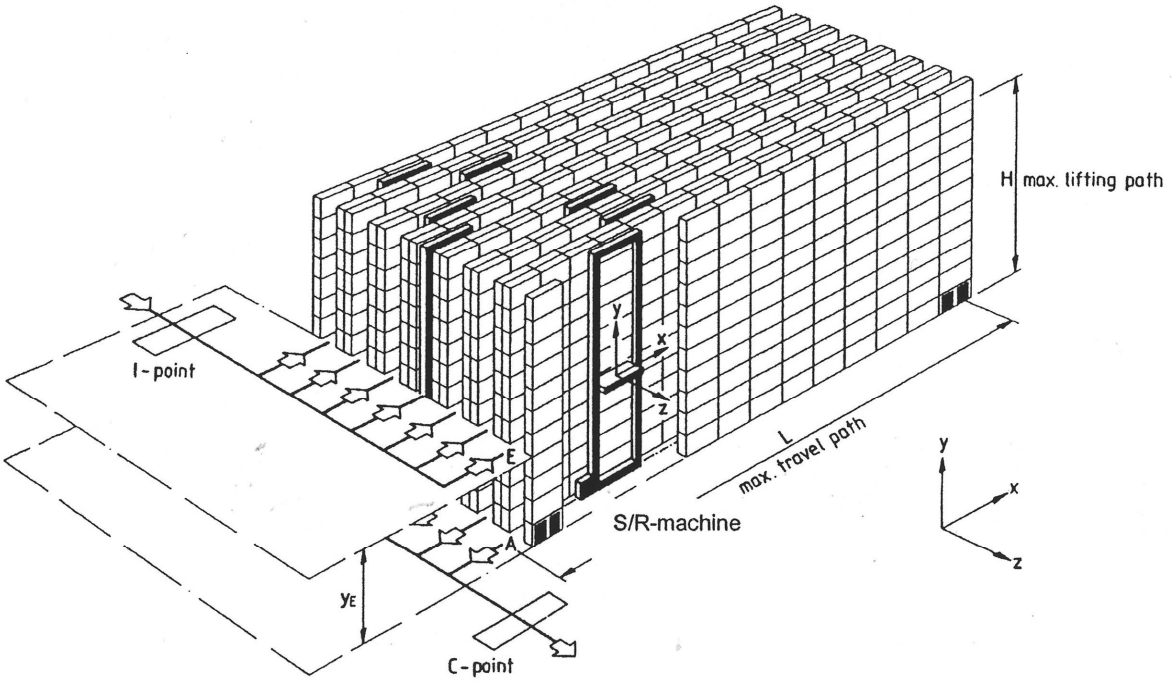


Figure 1

I-point: goods-in identification point
C-point: goods-out checking point

2 Definitions

2.1 Legend to section 4

E	Pick-up location for goods to be stored
A	Transfer location for goods retrieved
x_E; x_A / y_E; y_A	Coordinates of the pick-up and transfer locations
P1E;A / P2A;E	Theoretical reference point for storage or retrieval
x_1; x_2 / y_1; y_2	Coordinates of the reference points
PT(1;2)	Test points, corresponding to a storage location
H	Maximum lifting path
L	Maximum travel path
v_x	Maximum travel speed
v_y	Maximum lifting speed
a	Ratio (H/L) x (v_x/v_y) (velocity vector)
t	Time of movement between 2 points
t_1	Total time of a single cycle
t_2	Total time of a combined cycle
t_{01}	Sum total of single cycle times • Positioning • Location check • Switching and checking operations • Fork cycle
t_{02}	Sum total of combined cycle times • Positioning • Location check • Switching and checking operations • Fork cycle
t_{m1}	Mean single cycle time
t_{m2}	Mean combined cycle time

2.2 Rate of handling

The rate of handling indicates in a high-bay warehouse the number of unit loads handled into, and/or out of, storage per unit of time. In the warehouse area, it depends on

- the number of S/R machines
- the number of cycles per S/R machine, these cycles, in turn, depending on
    - the sequence of movements
    - the arrangement of transfer points
    - machine performance.

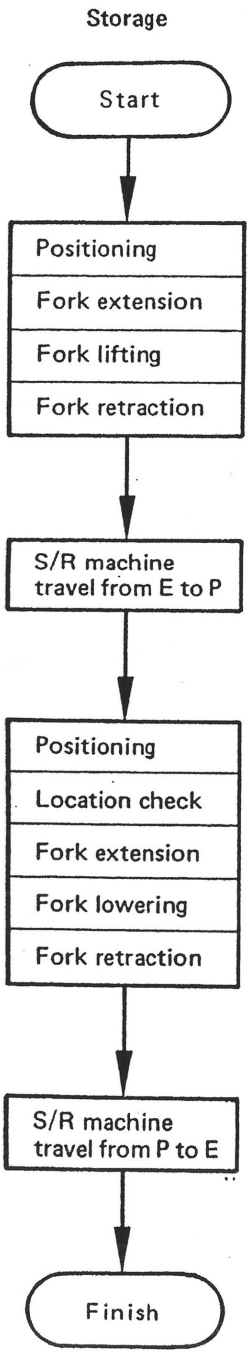
The “cycle time" is the duration of a sequence of movements.

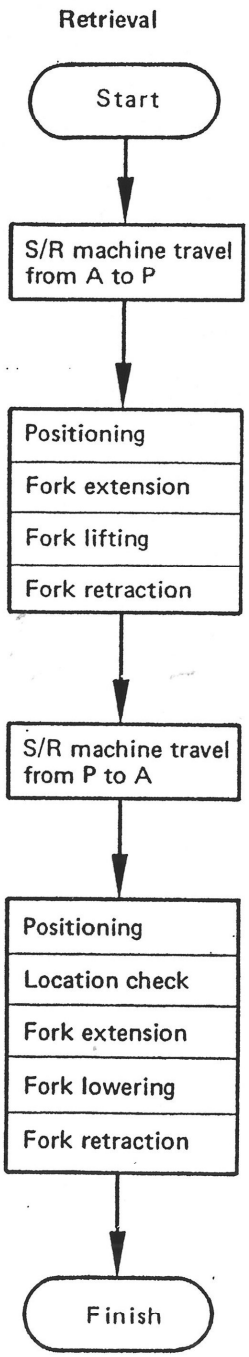
In a high-bay warehouse with transfer facility, the time required for aisle-to-aisle transfer of the S/R machine has to be considered in the calculation of cycle times.

2.3 S/R machine cycles, sequence diagrams

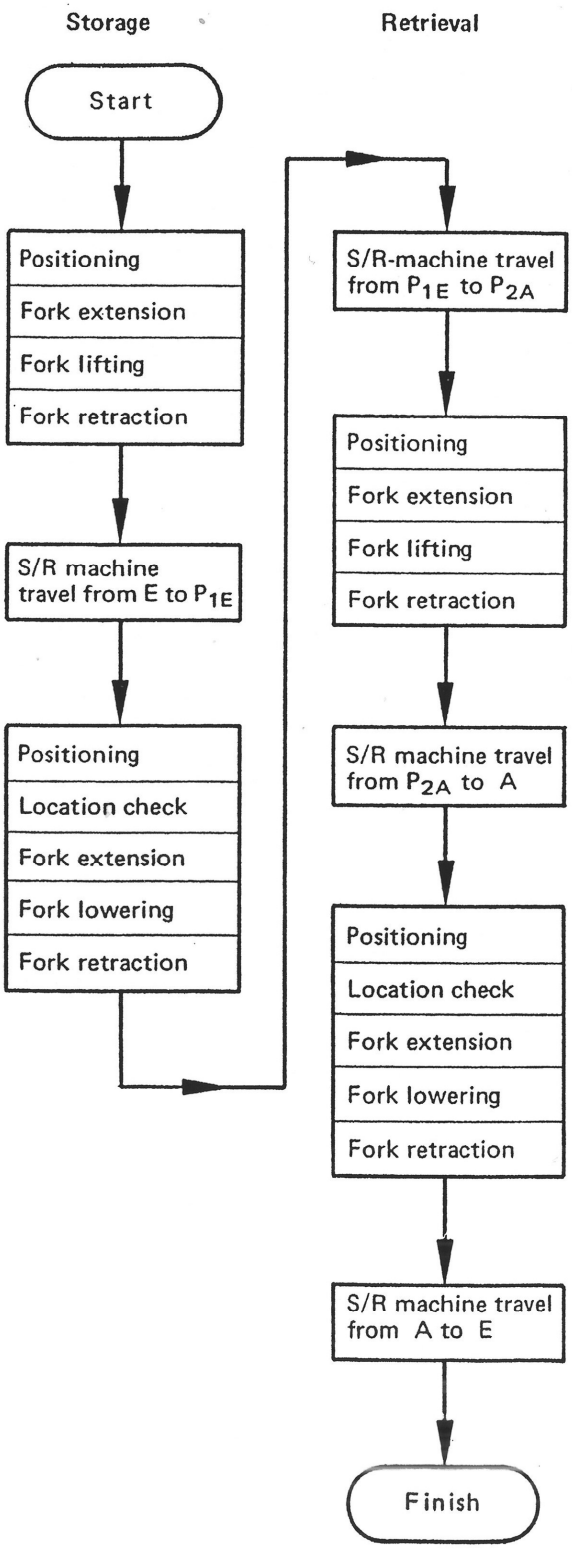
The following sequence diagrams are given for a better understanding of typical S/R machine cycles.

2.3.1 Single cycle





2.3.2 Combined cycle



2.3.3 Single cycle including aisle-to-aisle transfer (in z-direction)