Engineering Standards

Guarding, Access & Egress

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THE ENGINEERING EXCHANGE

CONTENT

- Accident Statistics
- Objectives
- Guarding Standards
- Examples of Bad Guards
- Examples of Good Guards
- Guard Audit - Summary
- Access & Egress Audit Purpose
- Access Standards
- Check Lists
- Access & Egress Audit - Summary

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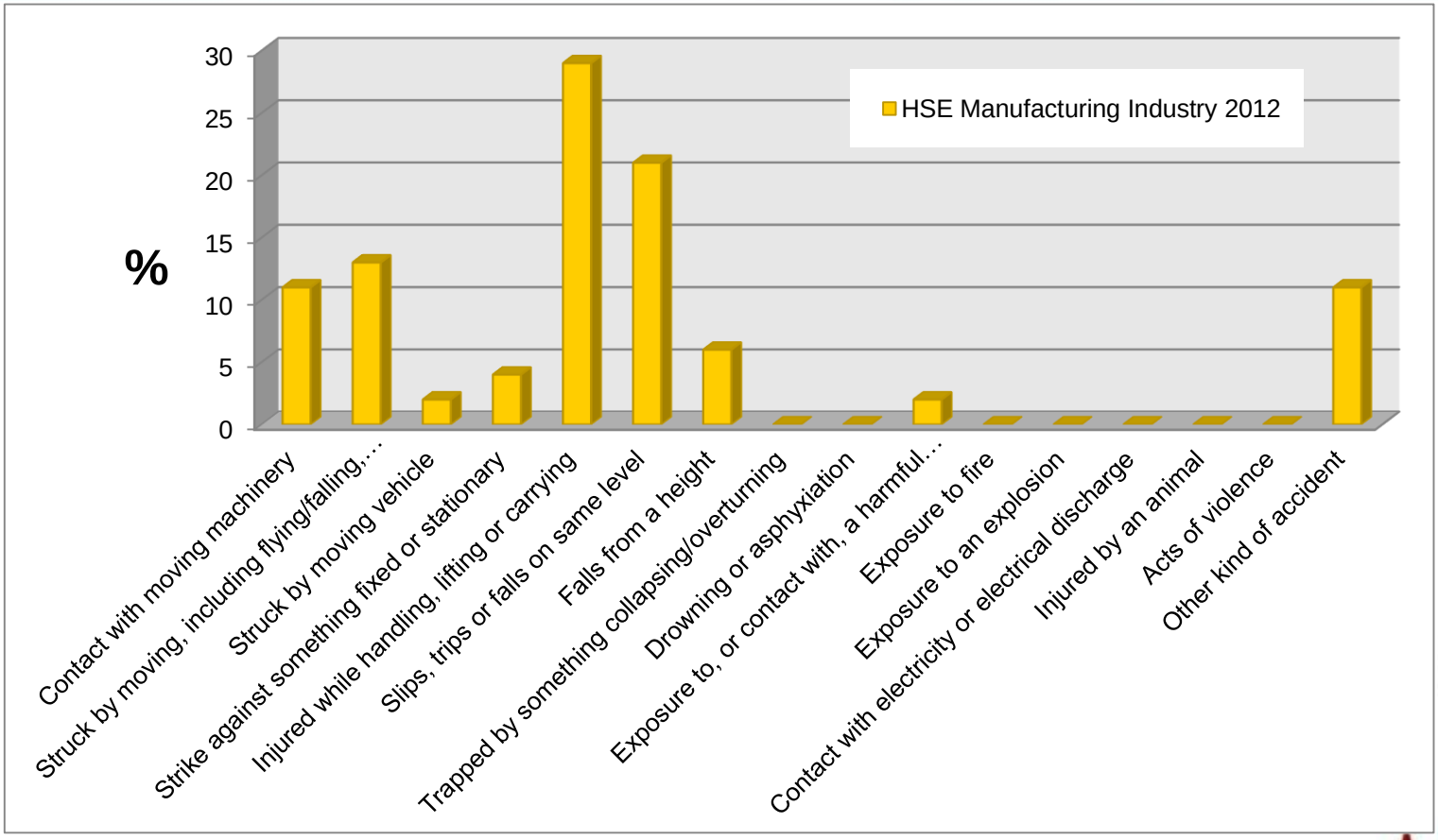
ACCIDENT TYPES; MANUFACTURING



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OBJECTIVES

- Eliminate/Reduce Accidents and Near Misses
- Identify Hazards via FLEM & FLM Auditing
    - Non compliant Guarding
    - Non compliant Access & Egress
- Replace/correct non compliant guards
- Replace/correct non compliant stairs, ladders & platforms

- New guards should be designed to reduce down-time
    - Improve Maintenance Access
    - Improve Cleaning Access
    - Remove non-conforming and non-essential guarding

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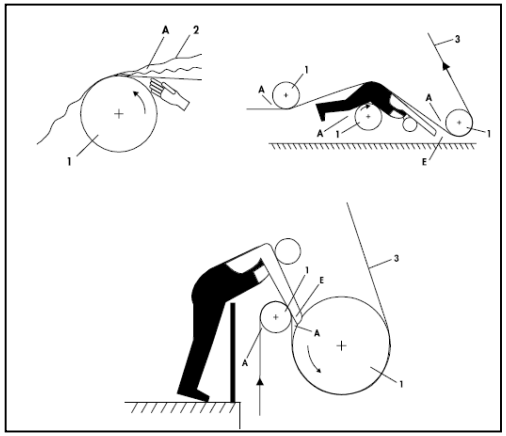
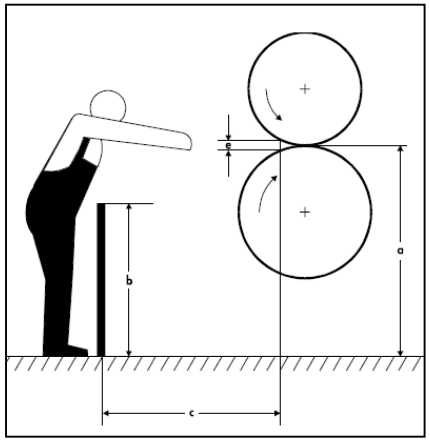
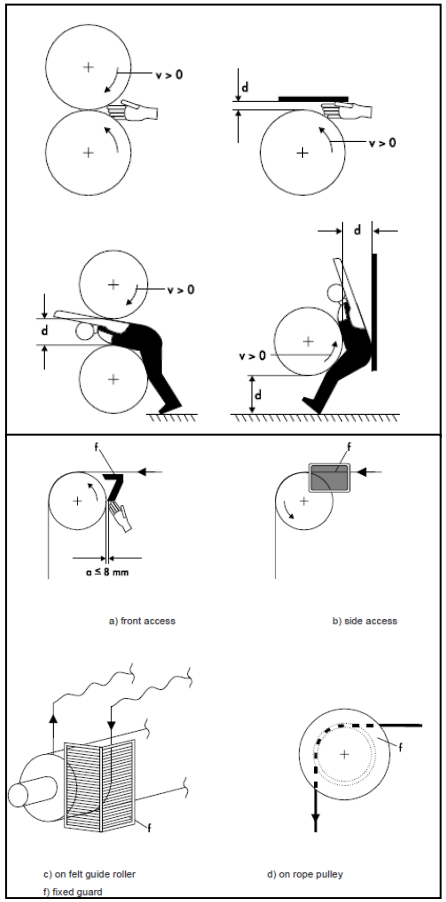
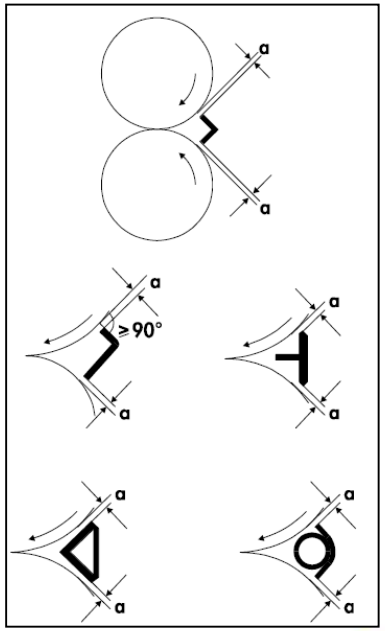
GUARDING STANDARDS









Safety of Machinery – Paper Making

BS EN 1034-1:200

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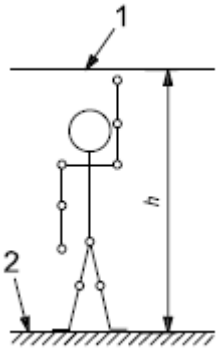
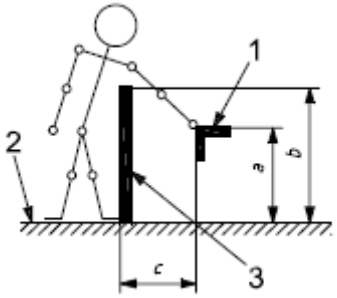
GUARDING STANDARDS





Height of hazard zone [c] *a*	Height of protective structure [a, b] *b*									
	1 000	1 200	1 400	1 600	1 800	2 000	2 200	2 400	2 500	2 700
	Horizontal safety distance to hazard zone, *c*									
2 700	0	0	0	0	0	0	0	0	0	0
2 600	900	800	700	600	600	500	400	300	100	0
2 400	1 100	1 000	900	800	700	600	400	300	100	0
2 200	1 300	1 200	1 000	900	800	600	400	300	0	0
2 000	1 400	1 300	1 100	900	800	600	400	0	0	0
1 800	1 500	1 400	1 100	900	800	600	0	0	0	0
1 600	1 500	1 400	1 100	900	800	500	0	0	0	0
1 400	1 500	1 400	1 100	900	800	0	0	0	0	0
1 200	1 500	1 400	1 100	900	700	0	0	0	0	0
1 000	1 500	1 400	1 000	800	0	0	0	0	0	0
800	1 500	1 300	900	600	0	0	0	0	0	0
600	1 400	1 300	800	0	0	0	0	0	0	0
400	1 400	1 200	400	0	0	0	0	0	0	0
200	1 200	900	0	0	0	0	0	0	0	0
0	1 100	500	0	0	0	0	0	0	0	0

[a] Protective structures less than 1 000 mm in height are not included because they do not sufficiently restrict movement of the body.

[b] Protective structures lower than 1 400 mm should not be used without additional safety measures.

[c] For hazard zones above 2 700 mm, refer to 4.2.1.

Safety of Machinery – Safety Distances - BS EN ISO 13857:2008

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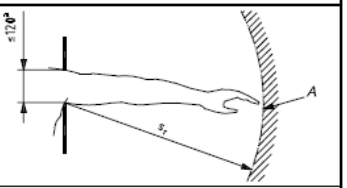
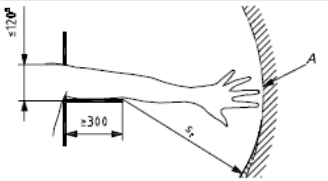
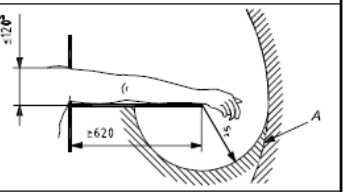
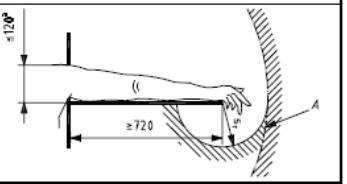
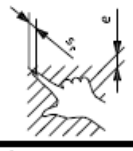
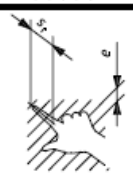
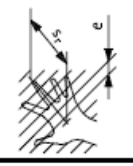
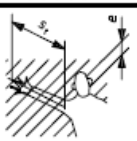
GUARDING STANDARDS

Limitation of movement	Safety distance, s_r	Illustration
Limitation of movement only at shoulder and armpit	⩾ 850	
Arm supported up to elbow	⩾ 550	
Arm supported up to wrist	⩾ 230	
Arm and hand supported up to knuckle joint	⩾ 130	

A range of movement of arm

s_r radial safety distance

[a] This is either the diameter of a round opening, or the side of a square opening, or the width of a slot opening.

Part of body	Illustration	Opening	Safety distance, s_r		
			Slot	Square	Round
Fingertip		$e \leqslant 4$	⩾ 2	⩾ 2	⩾ 2
		$4 < e \leqslant 6$	⩾ 10	⩾ 5	⩾ 5
Finger up to knuckle joint		$6 < e \leqslant 8$	⩾ 20	⩾ 15	⩾ 5
		$8 < e \leqslant 10$	⩾ 80	⩾ 25	⩾ 20
Hand		$10 < e \leqslant 12$	⩾ 100	⩾ 80	⩾ 80
		$12 < e \leqslant 20$	⩾ 120	⩾ 120	⩾ 120
		$20 < e \leqslant 30$	⩾ 850 [a]	⩾ 120	⩾ 120
Arm up to junction with shoulder		$30 < e \leqslant 40$	⩾ 850	⩾ 200	⩾ 120
		$40 < e \leqslant 120$	⩾ 850	⩾ 850	⩾ 850

The bold lines within the table delineate that part of the body restricted by the opening size.

[a] If the length of the slot opening is ⩽ 65 mm, the thumb will act as a stop and the safety distance can be reduced to 200 mm.

Safety of Machinery – Safety Distances - BS EN ISO 13857:2008

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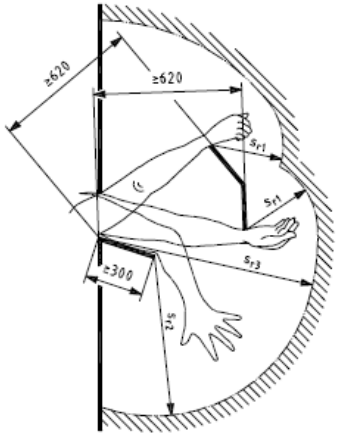
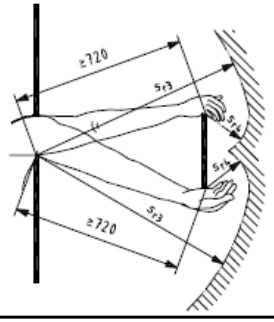
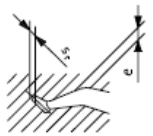
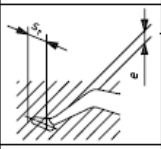
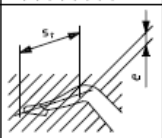
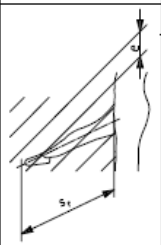
GUARDING STANDARDS

Limitation of movement	Safety distance, s_r	Illustration
Limitation of movement at shoulder and armpit: two separate protective structures — one permits movement from the wrist, the other movement from the elbow.	$s_{r1} \geqslant 230$ $s_{r2} \geqslant 550$ $s_{r3} \geqslant 850$	
Limitation of movement at shoulder and armpit: one separate protective structure, which permits movement from the fingers up to the knuckle joint.	$s_{r3} \geqslant 850$ $s_{r4} \geqslant 130$	
s_r radial safety distance		

Part of lower limb	Illustration	Opening	Safety distance, s_r	
			Slot	Square or round
Toe tip		$e \leqslant 5$	0	0
		$5 < e \leqslant 15$	$\geqslant 10$	0
Toe		$15 < e \leqslant 35$	$\geqslant 80$ [a]	$\geqslant 25$
Foot		$35 < e \leqslant 60$	$\geqslant 180$	$\geqslant 80$
		$60 < e \leqslant 80$	$\geqslant 650$ [b]	$\geqslant 180$
Leg (toe tip to knee)		$80 < e \leqslant 95$	$\geqslant 1\,100$ [c]	$\geqslant 650$ [b]
Leg (toe tip to crotch)		$95 < e \leqslant 180$	$\geqslant 1\,100$ [c]	$\geqslant 1\,100$ [c]
		$180 < e \leqslant 240$	Not admissible	$\geqslant 1\,100$ [c]

[a] If the length of the slot opening is $\leqslant 75$ mm, the distance can be reduced to $\geqslant 50$ mm.

[b] The value corresponds to leg (toe tip to knee).

[c] The value corresponds to leg (toe tip to crotch).

NOTE Slot openings with $e > 180$ mm and square or round openings with $e > 240$ mm will allow access for the whole body (see also Clause 1, final paragraph).

Safety of Machinery – Safety Distances - BS EN ISO 13857:2008

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ACCESS & EGRESS AUDIT PURPOSE

This review applies to:

- All stationary and mobile machinery where fixed means of access are necessary.
- All stairs, step ladders and guard-rails which are a part of a machine.
- Platforms attached to machinery.
- Stairs, step ladders and guard-rails to that part of the building where the machine is installed, providing that the main function of that part of the building is for a means of access to the machine.
- Stairs, step ladders and guard-rails specific to the machine which are not permanently fixed to the machine and which may be removed or moved to the side for some operations of the machine (e.g. felt change)
- Small sets of steps, that are fixed in place and are primarily low level (height) for use to gain access over low level obstacles, are called ‘fixed steps” in this Enabler
- Long term scaffolding access – in place for more than 1 year

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STANDARDS

The listed standards below were used to develop the checklists for the different types of stairs and ladders.

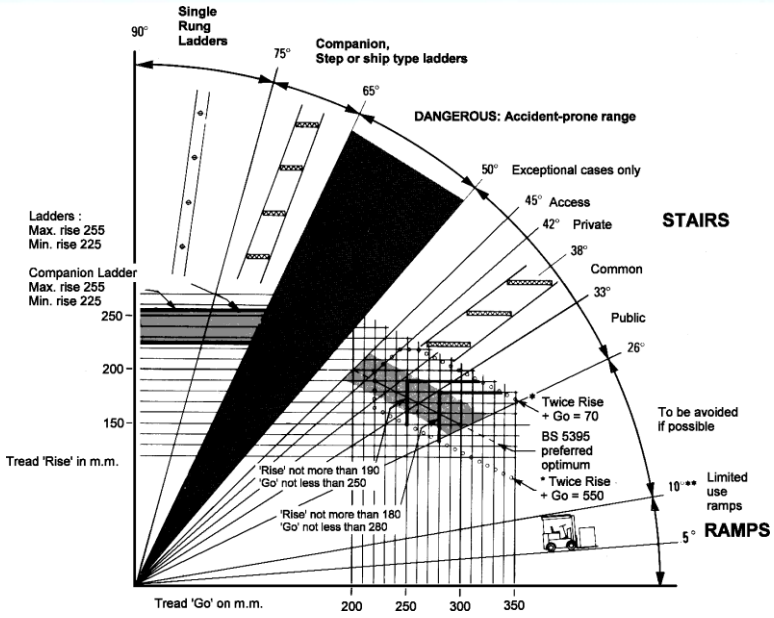
For machines which are covered by the scope of a type C standard and which have been designed and built according to the provisions of that standard, the provisions of that type C standard take precedence over the provisions of a type B standard.

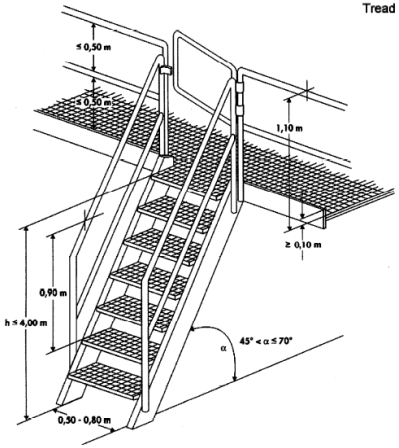
ISO 14122-1-4 (Type B standard)

EN 1034-1 (Type C standard)

EN 1010-1 (Type C standard)

BS 5395-1:2000 Reference Document





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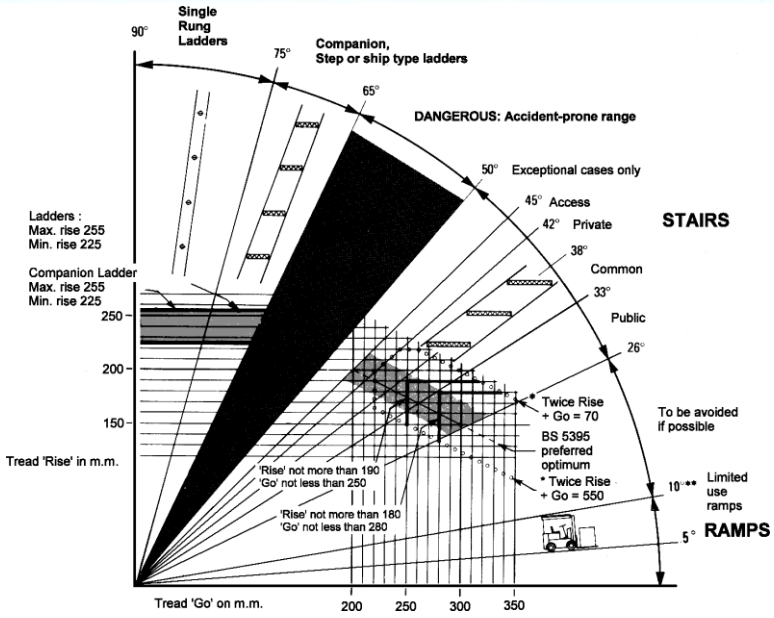

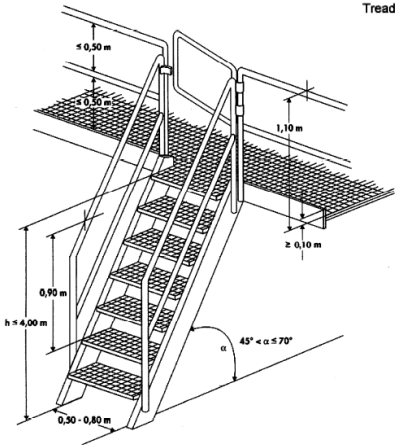

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RISK ASSESSMENT WITH CHECKLISTS

Right beside each checklist you will find a table of columns which can be used to document the results of the check. The risk level will be calculated automatically.

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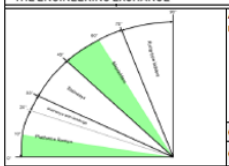
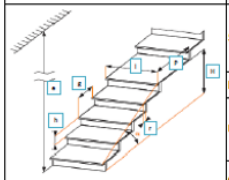
Checklist Stairways
Enabler Stairs and Ladders

Formula:
Date:



A staircase should always be built in this range if practicable because it is a safer means of access than any ladder but space constraints often present a problem.

		Check	Severity -Level
Gradient min	30°		
Gradient max	45°	O	2



Slip, trip	For example by using textured plates (flooring class R10)	O	2
	Accumulation of substances (dirt, oil, grease, dust) must be prevented.	O	2
	Tripping points max. 4mm high	O	2
Floor openings	Floor openings are restricted to a size where a ball of 35mm diameter cannot fall through.	O	2
H Height of stairs	Hmax = 3m (several flights)	O	10
	Hmax = 4m (one flight)	O	10
	Hmax > 4m platform required	O	10
g tread	600 ≤ g+2h ≤ 660, the highest step must be level with the platform (g) ___mm (2xh) ___mm =	O	5
h pitch	Pitch h must be constant, lower step reduced by a max. 15 %	O	10
l stairways width	Occasionally use 500mm	O	5
	Single person 600mm	O	5
	several persons: 1000mm	O	5
r underout	r ≥ 10mm	O	5
e clear height	e ≥ 2300mm	O	5
p length of platform	p ≥ 800mm	O	5

Railings:			
Railings	A railingshall be fitted whenever the height to climb exceeds 3 steps	O	10
v vertical height	>900mm	O	10
	At least one intermediate rail or vertical rails.	O	10
c clearance	Between toeboard and intermedia rail, between intermediate rail and handrail <=500mm.	O	5
H Handrail	Diameter between 25mm to 50mm	O	2
	Minimum gap between obstacle and handrail =100mm	O	2
	Stairs must have at least one handrail. For stairs with a width of >= 1200mm handrails are required on both sides.	O	5
	Gaps in handrail >75mm and <120mm, no sharp edges and positive fitting	O	2

Frequency of access: 2 - Less than once per week 4 - more than once per week 8 - Once per day 10 - More than once per day 20 - almost every hour

Nr.	01	02	03	04	05	06	07	08	09	10
Area/Identification										
height										
# steps										
gradient										
date:										
Checked by										
date:										
	0	0	0	0	0	0	0	0	0	0

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RISK ASSESSMENT WITH CHECKLISTS

The checklists is a number of direct questions, if the access/egress complies with the question then put a “0” in the column, if the access/egress does not comply with question then put the corresponding number in the column e.g. “10”

if the question is not applicable the put “n.a.”

H height	The ladder shall be fitted with a fall protection device when a) height of the ladder flight is more than 3000 mm; b) height of the ladder is 3000 mm or less, but at the departure area there is the risk of falling an additional distance. NOTE: Risk of falling is considered to exist when the distance from the centre of the ladder to the unprotected side of a platform (or similar) is less than 3000 mm.	✓	10
	H_{max}= 10000mm single flight H_{max}=6.000 multiple flight (each)	✗	10
Self closing door	Mandatory if falling height > 2000mm, handrail and intermediate rail	○	10

Fulfilled

Not fulfilled

Not applicable

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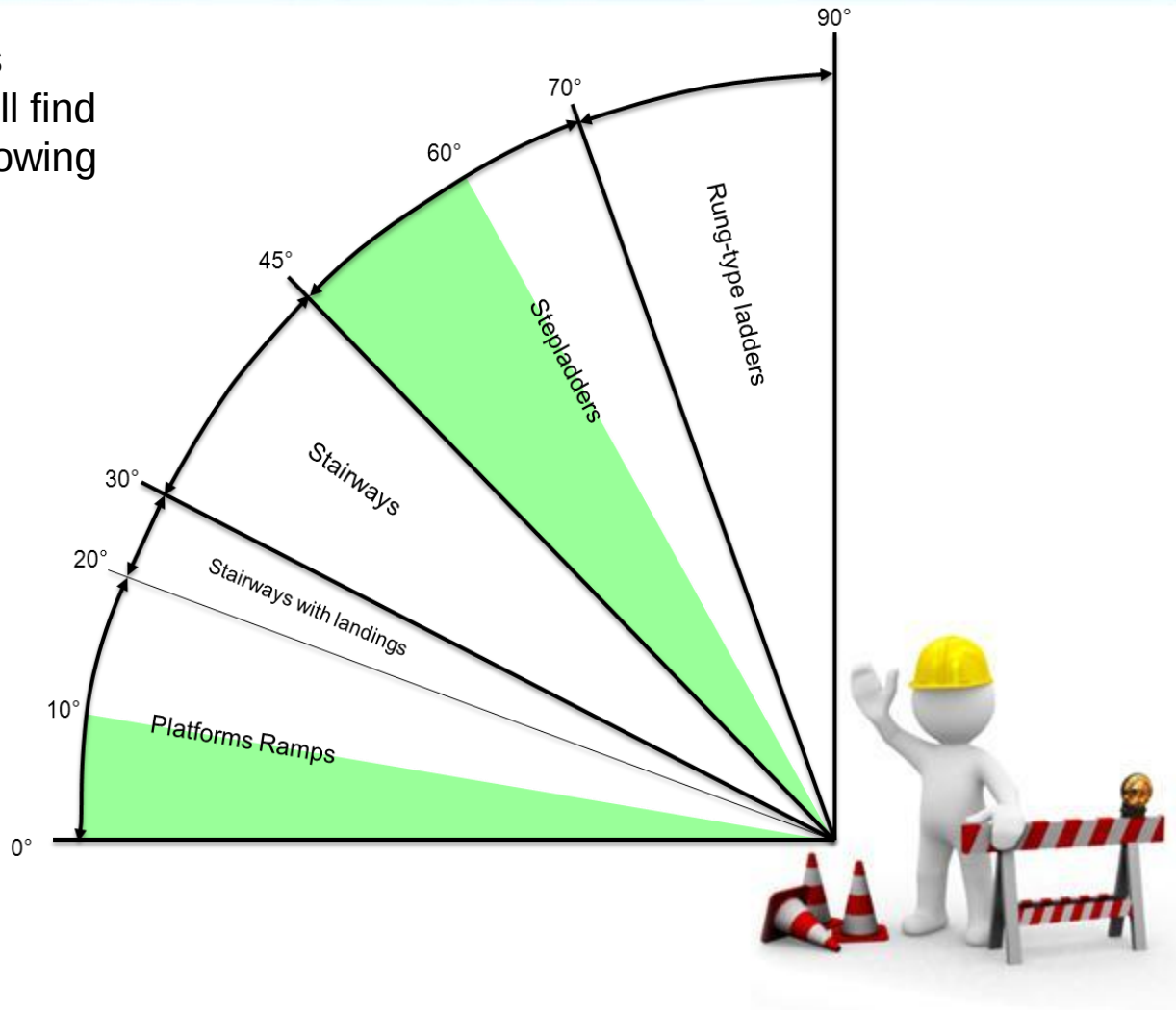
DESIGN REGARDING THE GRADIENT

To analyses all means of access systematically and completely will find examples of checklist for the following types of access:

- Fixed steps
- Platforms/Ramps
- Stairs/Stairways
- Stepladder
- Rung-type ladders
  - with safety cage
  - with fall arrester



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PRACTICAL TIPS

Use an inclinometer or prepare a transparent board like this (e.g. a clipboard) to measure the gradient of a stair or a stepladder directly.

A tape measure or a folding ruler is required.

Examples of non-slip flooring

R10

R11

R12

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RISK ASSESSMENTS WITH CHECKLISTS

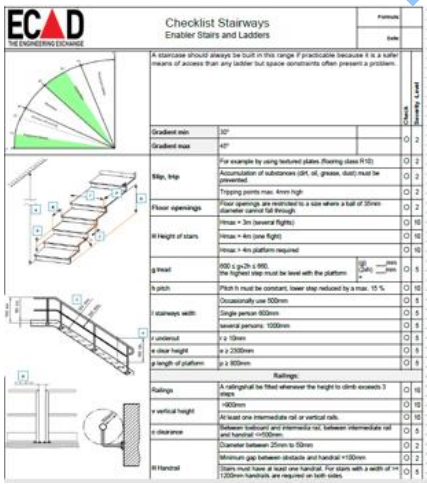
Severity level

$$Risk\ Level = \sum Severity\ level$$

$$* frequency\ of\ acccess$$

The severity level range is from 2-10.

Please notice that this value is only a hint of the severity and cannot substitute the expert knowledge of the safety specialists.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Checklist Stairways
Enabler Stairs and Ladders

With frequency of access:

2 Less than once per week

4 More than once per week

6 Once per day

10 More than once per day

20 Almost every hour

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ACTION PLANNING

After evaluating the risk level helps to prioritize further counter measures.
Use **ERIC PD** as a principle to control the risks:

Eliminate get rid of the hazard; e.g. redesign, relocation of equipment…
Reduce the level of risk by reducing the nature of the hazard; e.g. automation…
Isolate the hazard from people, for example by guarding e.g. ladder guard…
Control exposure to the hazard; e.g. control who has access…

PPE issue personnel protective equipment, e.g. using fall arrester
Discipline and Culture, e.g. climbing down backwards where the gradient is more than 60°.

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