

Latch key safety limit switches

Technical data

Safety
limit switches

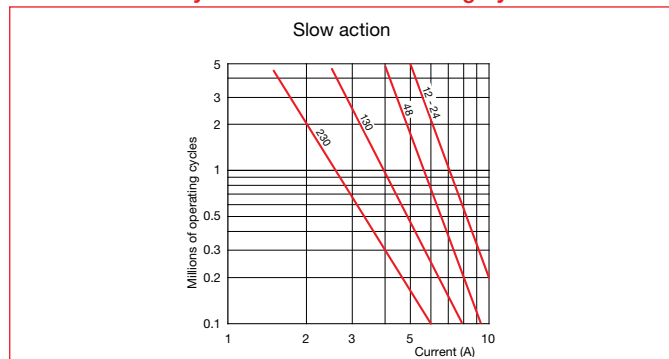
General Data

Standards	IEC 60947-1, IEC 60947-5-1, EN 60947-1, EN 60947-5-1, UL 508, and CSA C22-2 No. 14	
Certifications - Approvals	UL and CSA	
Air temperature near the device	°C	-25 ... +70
– during operation	°C	-30 ... +80
– for storage		
Climatic withstand	According to IEC 68-2-3 and salty mist according to IEC 68-2-11	
Mounting positions	All positions are authorised	
Shock withstand (according to IEC 68-2-27 and EN 60068-2-27) (1/2 sinusoidal shock for 11 ms) no change in contact position	g	Limit switch with small latch (key): 10 g Limit switch with rotative axis or lever: 40 g
Resistance to vibrations	g	5 g (10 ... 500 Hz) no change in position of contacts > 100 µs
Protection against electrical shocks (acc. to IEC 536)	Class II	
Degree of protection (according to IEC 529 and EN 60529)	UL Type 4 & IP65	
Minimum actuation speed	m/s	Slow action contacts 0.060 / Snap action contacts 0.001

Electrical Data

Rated insulation voltage U_i – according to IEC 60947-1 and EN 60947-1 – according to UL 508, CSA C22-2 No. 14	V	690 (degree of pollution 3) A600, Q600
Rated impulse withstand voltage U_{imp} (according to IEC 60947-1 and EN 60947-1)	kV	6
Conventional free air thermal current I_{th} (according to IEC 60947-5-1 and EN 60947-5-1) ($0 \leq 40^\circ\text{C}$)	A	10
Short-circuit protection - gG type fuses	A	10
Rated operational current I_e / AC-15 – acc. to IEC 60947-5-1	24 V - 50/60 Hz 130 V - 50/60 Hz 230 V - 50/60 Hz 240 V - 50/60 Hz 400 V - 50/60 Hz	A A A A A 10 5.5 3.1 3 1.8
– according to UL 508, CSA C22 No.14		A600
I_e / DC-13 – acc. to IEC 60947-5-1	24 V - d.c. 110 V - d.c. 250 V - d.c.	A A A 2.8 0.6 0.27
– according to UL 508, CSA C22 No.14	Q600	
Positivity	Contacts with positive opening operation as per IEC 60947-5-1 chapter 3 and EN 60947-5-1	
Resistance between contacts	mΩ	25
Mechanical durability	Millions of operations	> 1 million of operating cycles
Max. switching frequency	Cycles/h	600
Electrical durability (according to IEC 60947-5-1 appendice C)	Utilization categories AC-15 and DC-13 (see curves and values below)	
– Max. switching frequency	Cycles/h	3600
– Load factor		0.5

Electrical durability for AC-15 utilization category



Electrical durability for DC-13 utilization category

Slow action	
Power breaking for a durability of 5 million operating cycles	
Voltage	24 V
	12 W
Voltage	48 V
	9 W
Voltage	110 V
	6 W

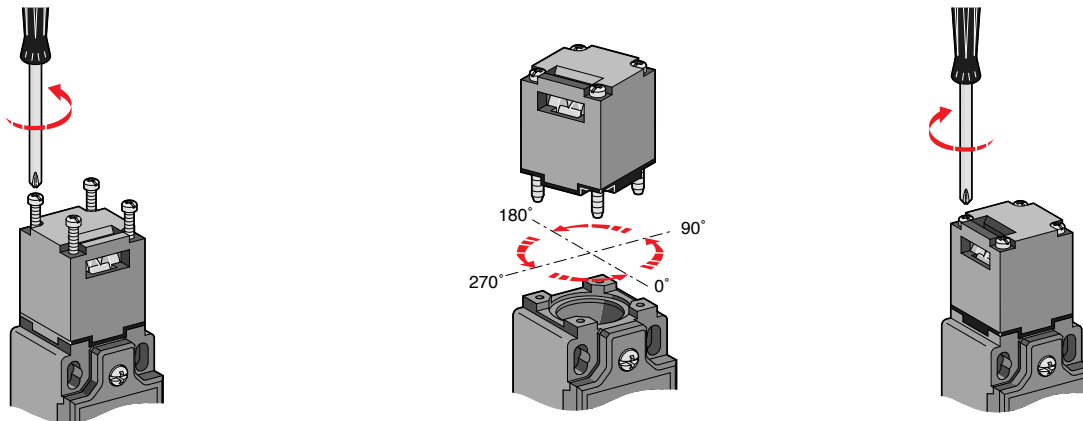
Latch key safety limit switches

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Implementation

Limit switches with small latch (key) LS30P80...-S, LS31P80...-S and LS35P80...-S

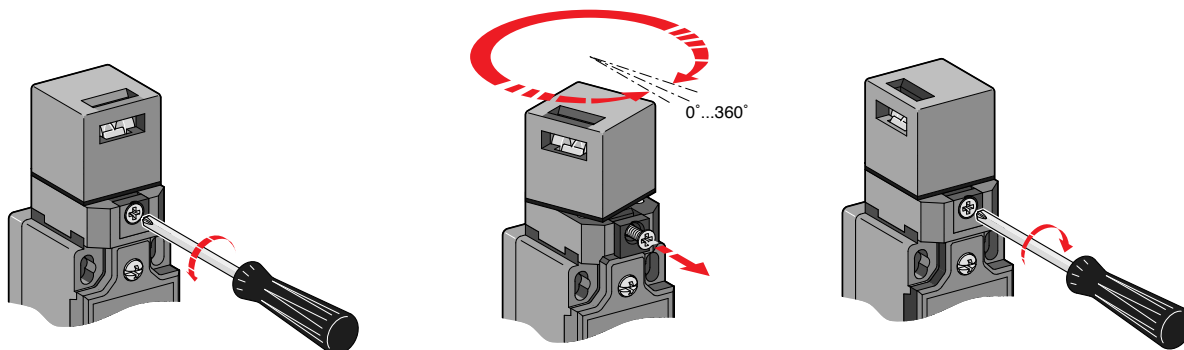
- Head adjustment every 90°.



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Limit switches with small latch (key) LS30P81...-S, LS31P81...-S and LS35P81...-S

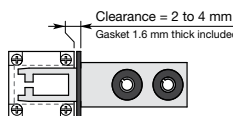
- Pivoting head continuous between 0° to 360°.



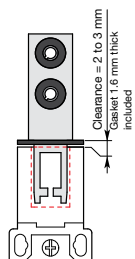
Adjusting the small latches (keys)

Clearances to be respected on installation

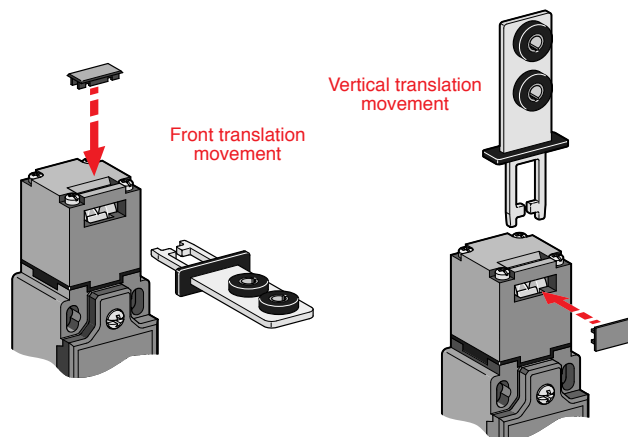
Front transition movement



Vertical translation movement



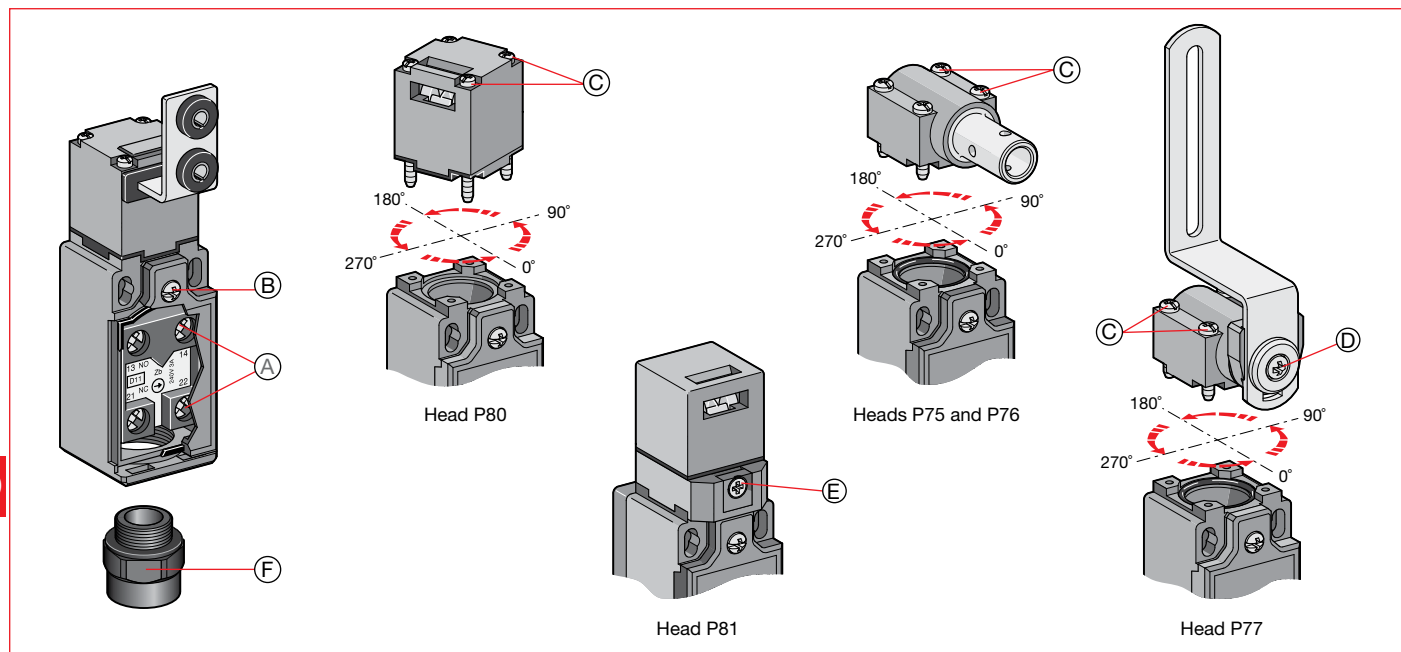
Blanking off the window not used (NEMA 4x protection)



Rotative axis safety limit switches

Technical data

Tightening torques



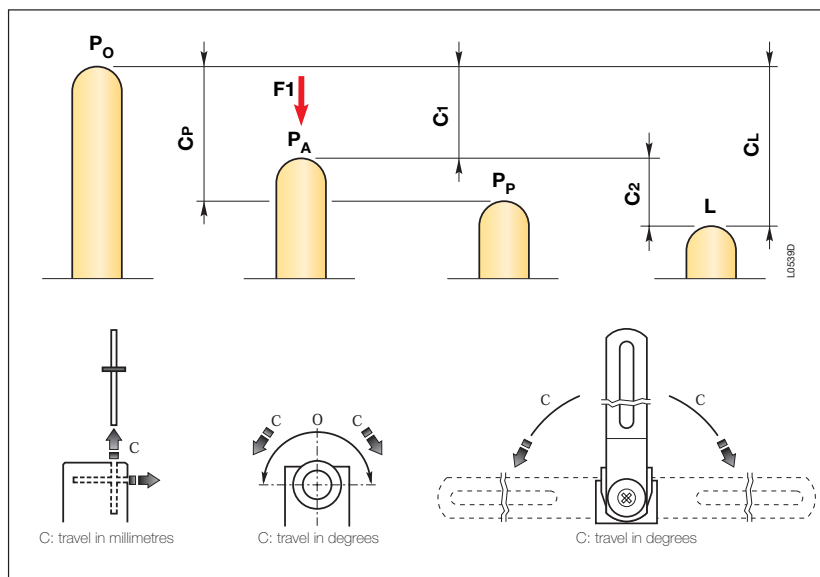
	A		B		C		D		E		F	
	Contact block connecting terminals		Closing the cover		Assembling the operating head		Assembling the flush mounting right angle lever		Adjusting the pivoting head		Cable inlet by 1/2" NPT adaptor	
Screws	M3.5 ± pozidriv 2		ø3 ± pozidriv 1		ø3 ± pozidriv 1		M3.5 pozidriv 2		M3 Philips No. 1		–	
Tightening torque	Recommended	Max.	Recommended	Max.	Recommended	Max.	Recommended	Max.	Recommended	Max.	Recommended	Max.
	N.m / lb.in	N.m	N.m / lb.in	N.m	N.m / lb.in	N.m	N.m / lb.in	N.m	N.m / lb.in	N.m	N.m / lb.in	N.m
Limit switches												
LS35P80...-S	0.8 / 7	0.9	0.5 / 4.3	0.8	0.5 / 4.3	0.8	–	–	–	–	17 / 150	18
LS35P81...-S	0.8 / 7	0.9	0.5 / 4.3	0.8	–	–	–	–	0.3 / 2.63	0.5	17 / 150	18
LS35P75...-S	0.8 / 7	0.9	0.5 / 4.3	0.8	0.5 / 4.3	0.8	–	–	–	–	17 / 150	18
LS35P76...-S	0.8 / 7	0.9	0.5 / 4.3	0.8	0.5 / 4.3	0.8	–	–	–	–	17 / 150	18
LS35P77...-S	0.8 / 7	0.9	0.5 / 4.3	0.8	0.5 / 4.3	0.8	0.5 / 4.3	0.8	–	–	17 / 150	18

Connecting data of contact blocks

Connecting terminals	M3.5 (+,-) pozidriv 2 screw with cable clamp	
Connecting capacity	1 or 2 x mm ² / AWG	0.5 mm ² / AWG 20 to 2.5 mm ² / AWG 14
Terminal marking	According to EN 50013	

Safety Limit Switches

Travel and Operating diagrams



P₀ Free position:
position of the switch actuator when no external force is exerted on it.

P_A Operating position:
position of the switch actuator, under the effect of force **F₁**, when the contacts leave their initial free position.

P_P Positive opening position:
position of the switch actuator from which positive opening is ensured.

L Max. travel position:
maximum acceptable travel position of the switch actuator under the effect of a force **F₁**.

C₁ Pre-travel (average travel):
distance between the free position **P₀** and the operating position **P_A**.

C_P Positive opening travel:
minimum travel of the switch actuator, from the free position, to ensure positive opening operation of the normally closed contact (N.C.).

C₂ Over-travel (average travel):
distance between the operating position **P_A** and the max. travel position **L**.

C_L Max. travel (maximum travel):
distance between the free position **P₀** and the max. travel position **L**.

Note: C₁₋₁ = pre-travel of contact 21-22,
C₁₋₂ = pre-travel of contact 13-14.

Examples:

LS35P80L02-S
Simultaneous slow action contacts

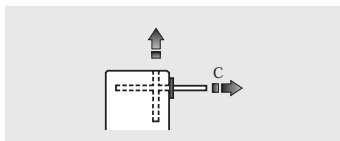
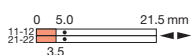


Diagram
in millimetres / key travel



LS35P76D11-S
non-overlapping slow action contacts

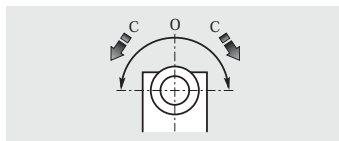
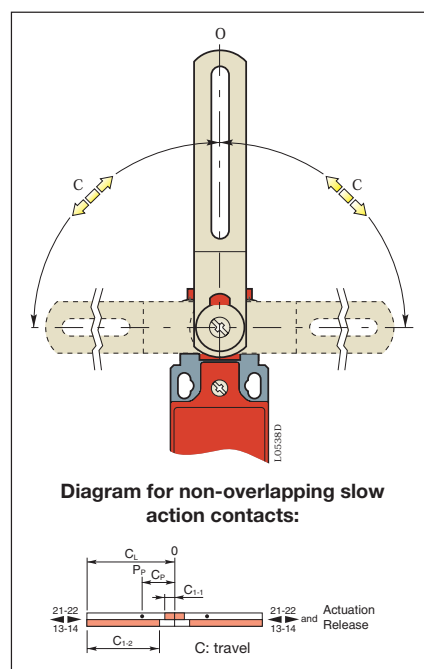
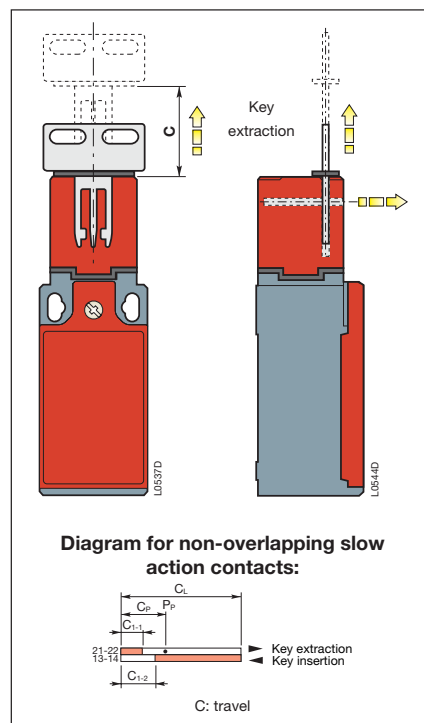
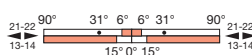


Diagram
in degrees / lever rotation



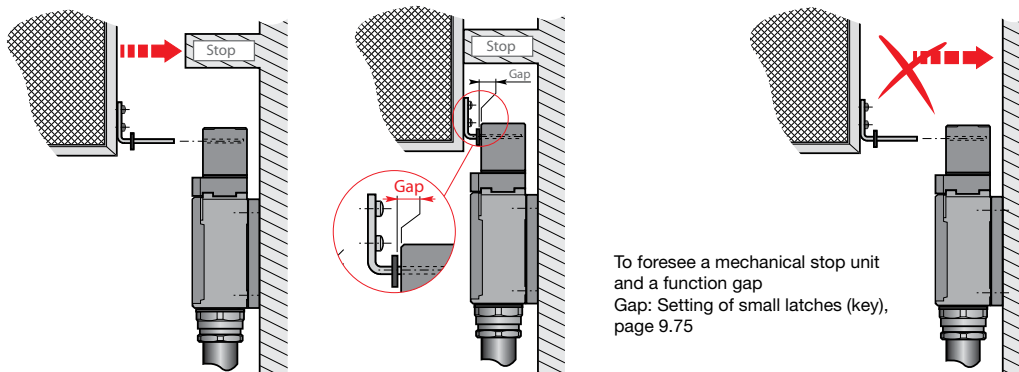
Contacts position

21-22 Contact closed
21-22 Contact open
Contacts identification (example)

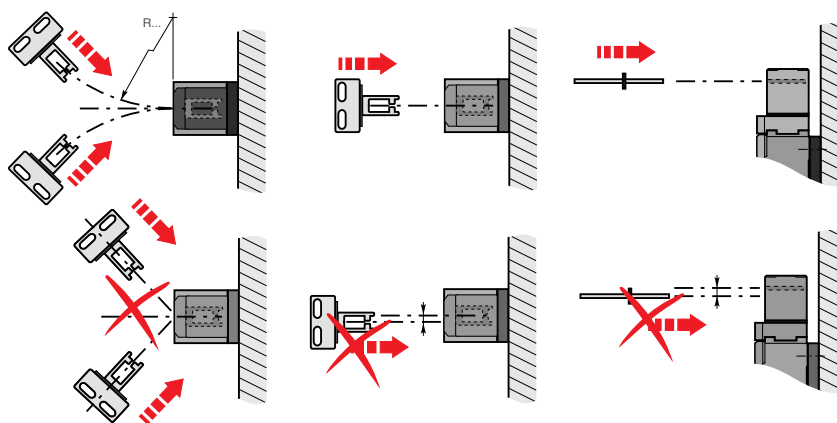
Rotative axis safety limit switches

Technical data

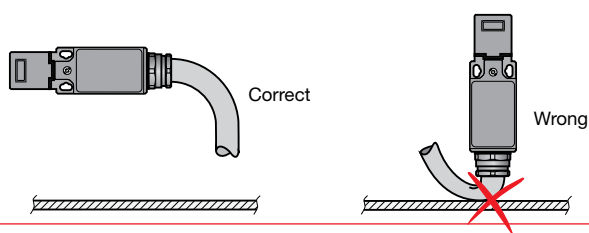
Utilization cautions



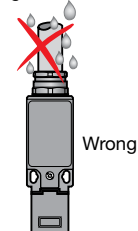
The small latch (key) shall be presented in the axis of the control head.



Curve of connecting cable



Cable gland orientation



Safety limit switches

Technical data

Specifications, directives, standards & EC conformity

Definitions

The ABB limit switches listed in this catalogue are developed and manufactured according to the rules set out in IEC international publications and EN European standards. In most countries, the devices are not subject to further obligation for approval. In some countries, however, the law stipulates obligation for approval.

Specifications

• International Specifications

The International Electrotechnical Commission, IEC, which is part of the International Standards Organization, ISO, publishes IEC publications which act as a basis for the world market.

• European Specifications

The European Committee for Electrotechnical Standardization (CENELEC), grouping 18 European countries, publishes EN standards for low voltage industrial apparatus. These European standards vary very little from IEC international standards and use a similar numbering system. The same is true of national standards. Contradicting national standards are withdrawn.

• Harmonized European Specifications

The European Committees for Standardization (CEN and CENELEC), grouping 18 European countries, publish EN standards relating to safety of machinery.

• Specifications in Canada and the USA

These are equivalent, but differ markedly from IEC, UTE, VDE and BS specifications.


UL Underwriters Laboratories (USA)

CSA Canadian Standards Association (Canada)

Remark concerning the label issued by the UL (USA). Two levels of acceptance between devices must be distinguished:

"Recognized"

Authorized to be included in equipment, if the equipment in question has been entirely mounted and wired by qualified personnel. They are not valid for use as "General purpose products" as their possibilities are limited.

They bear the mark: 

"Listed"

Authorized to be included in equipment and for separate sale as "General purpose products" components in the USA.

They bear the mark: 

European directives

The guarantee of free movement of goods within the European Community assumes elimination of any regulatory differences between the member states. European Directives set up common rules that are included in the legislation of each state while contradictory regulations are cancelled.

There are three main directives:

- **Low Voltage Directive 73/23/EEC**, amended by Directive 93/68/EEC concerning electrical equipment from 50 to 1000 V a.c. and from 75 to 1500 VDC. This specifies that compliance with the requirements that it sets out is acquired once the equipment conforms to the standards harmonized at European level: EN 60947-1 and EN 60947-5-1 for limit switches.

- **Machines Directives - 89/392/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC** - defining main safety and health requirements concerning design and manufacture of the machines and other equipment including safety components in European Union countries.

- **Electromagnetic Compatibility Directive 89/336/EEC**, amended by Directive 92/31/EEC and Directive 93/68/EEC concerning all electrical devices likely to create electromagnetic disturbances.

Signification of CE marking:

CE marking must not be confused with a quality label.

CE marking placed on a product is proof of conformity with the European Directives concerning the product.

CE marking is part of an administrative procedure and guarantees free movement of the product within the European Community.

Standards

• International standards

IEC 60947-1	Low-voltage switchgear and controlgear – Part 1: General Rules (NFC 63-001).
IEC 60947-5-1	Low-voltage switchgear and controlgear – Part 5: Control circuit devices and switching elements – Section 1: Electromechanical control circuit devices (NFC 63-146) – Chapter 3: Special requirements for control switches with positive opening operation.
IEC 60204-1	Electrical equipment of industrial machines – Part 1: General requirements (≈ NFC 79-130).
IEC 60204-2	Electrical equipment of industrial machines – Part 2: Item designation and examples of drawings, diagrams, tables and instructions (Appendices D and E of Publications IEC 60204-1).

• European Standards

EN 50005	Low-voltage switchgear and controlgear for industrial use – Terminal marking and distinctive number: General rules (NFC 63-030).
EN 50013	Low-voltage switchgear and controlgear for industrial use – Terminal marking and distinctive number for particular control switches (NFC 63-033).
EN 50041	Low-voltage switchgear and controlgear for industrial use – Control switches – Position switches 42.5 x 80 – Dimensions and characteristics.
EN 50047	Low-voltage switchgear and controlgear for industrial use – Control switches – Position switches 30 x 55 – Dimensions and characteristics.
EN 60947-1	Low-voltage switchgear and controlgear for industrial use – Part 1: General rules (NFC 63-001).
EN 60947-5-1	Low-voltage switchgear and controlgear for industrial use – Part 5: Control circuit devices and switching elements – Section 1: Electromechanical control circuit devices (NFC 63-146) – Chapter 3: Special requirements for control switches with positive opening operation.

• Harmonized European Standards

These standards are common to all European Union and EFTA (European Free Trade Association) countries. They were prepared (prEN project) and written (EN final text) by the European standardization committees CEN or CENELEC.

Harmonized European standards were drawn up to allow definition of the rules and technical means to be used to satisfy the main safety requirements on machines and thus guarantee conformity with the Machines Directive.

Compliance with a harmonized European standard is presumption of conformity with the relevant Directive.

European standards relating to machine safety are divided into groups (A, B and C types).

Type A standards: basic standards: setting out design principles and the general aspects valid for all machine types.

EN 292-1 Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology.

EN 292-2 and Safety of machinery – Basic concepts, general principles for design – Part 2: Technical principles and specifications.

EN 292-2/A1 Safety of machinery – Principles for risk assessment.

EN 1050 Type B standards: group standards:

B1: dealing with specific safety aspects.

EN 60204-1 Safety of machinery – Electrical equipment of machines – Part 1: General requirements.

EN 954-1 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design.

B2: dealing with components and devices determining safety.

EN 1088 Safety of machinery – Interlocking devices associated with guards – Principles for design and selection.

Type C standards: specific standards or standards per machine family giving detailed safety specifications applicable to a machine or to a group of machines.

EN 81-1 Safety rules for the construction and installations of lifts – Part 1: Electric lifts.

Content of the "EC" Declaration of Conformity for Safety Components

The "EC" Declaration of Conformity is intended to certify that the safety component complies with the main safety and health requirements of Machines Directive 89/392/EEC.

It must contain the following information:

- the name and address of the manufacturer or his representative established in the European Community,
- the description of the safety component (brand, type, serial number, etc.),
- the safety function performed by the safety component if this is not obvious from the description,
- when needed, the name and address of the notified organization and the number of the type "CE" certificate,
- when needed, the name and address of the notified organization to which the file has been sent as per article 8, paragraph 2, point c), first hyphen,
- when needed, the name and address of the notified organization who performed the check referred to in article 8, paragraph 2, point c), second hyphen,
- when needed, the reference to the harmonized standards,
- when needed, the national technical standards and specifications used,
- identification of the signatory authorized to hire the manufacturer or his representative established in the European Community.

Safety limit switches

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Control system categories as per EN 954-1

Safety
limit switches

The main aim of all machine designers is to guarantee that the faults on safety-related control system parts or external disturbances cannot result in a dangerous situation or a dangerous event on the machine.

The summarizing table below determines the category of the safety-related control system parts.

Categories	Summary of control system requirements	Control system behavior	Main principle for ensuring safety
B	The parts of the safety-related control system and / or its devices must be designed, manufactured, selected, mounted and combined according to proper procedures so as to withstand expected influences.	If a fault occurs, it may lead to possible loss of the safety function.	By selection of components conforming to relevant standards.
1	The requirements formulated in category B are combined with use of tried and tested safety components and principles.	– Occurrence of a fault may lead to possible loss of the safety function, but this is less probable than in category B.	By choice and use of safety components and principles.
2	The requirements formulated in category B and use of tried and tested safety principles apply. The safety function(s) must be tested regularly by the machine control system. Test frequency must be adapted to the machine and to its application.	– Occurrence of a fault may lead to possible loss of the safety function between the periodic test intervals. – Loss of the safety function is detected at each test.	By improvement of safety circuit structure.
3	The requirements formulated in category B and use of tried and tested safety principles apply. The control system must be designed so that: a) a single fault in the control does not lead to loss of the safety function and... (see paragraph b). b) if this is reasonably feasible, the single fault must be detected by appropriate technical means.	– When a single fault occurs, the safety function is always guaranteed. – Some faults will be detected, but not all. – Accumulation of undetected faults may lead to loss of the safety function.	By improvement of safety circuit structure.
4	The requirements formulated in category B and use of tried and tested safety principles must be applied. The control system must be designed so that: a) a single fault in the control does not lead to loss of the safety function and... (see paragraph b). b) if possible the single fault must be detected as soon as or before the next tripping of the safety function or... (see paragraph c). c) if this was not possible, an accumulation of faults must not lead to loss of the safety function.	– When faults occur, the safety function is always guaranteed. – The faults will be detected in time to prevent loss of the safety function.	By improvement of safety circuit structure.

Important: The safety categories apply to the entire control system and not to the individually considered safety components.

Safety limit switches

Technical data

Risk assessment & determination of control system categories

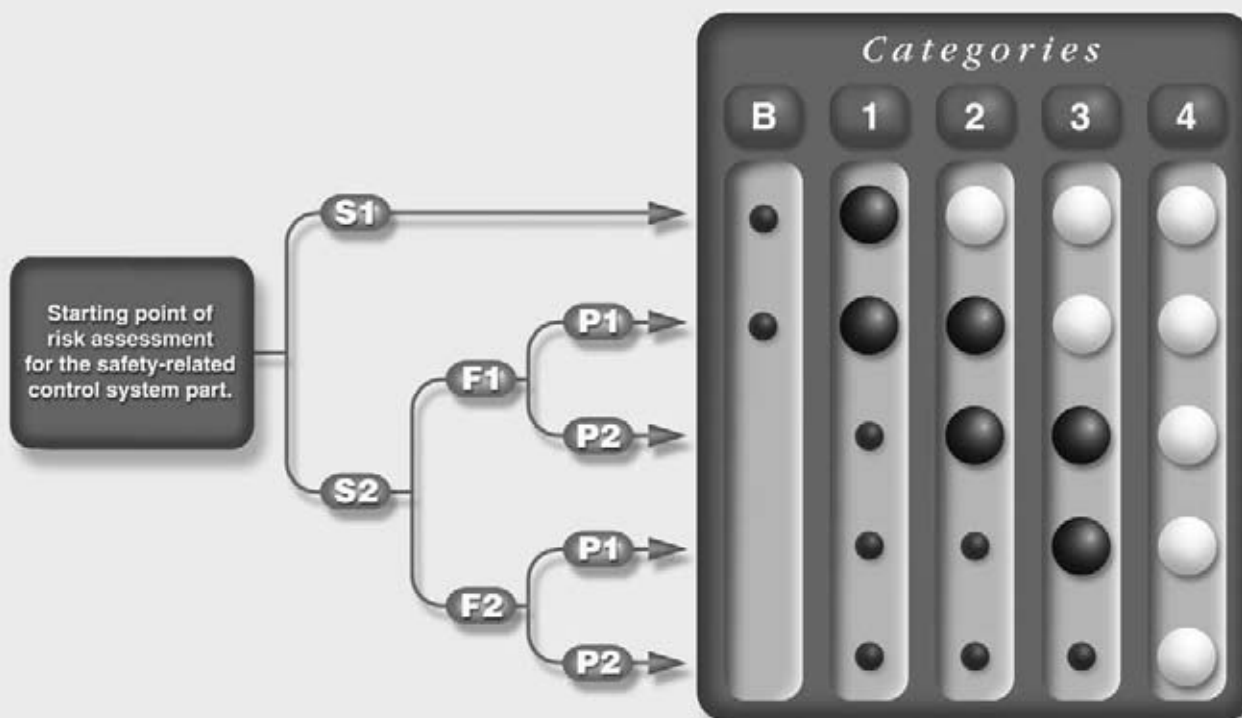
Classification of a machine into categories to EN 954-1

Pursuant to the Machinery Directive 89/392/EEC, every machine must comply with the relevant Directives and standards. Measures must be taken to keep the risk to persons below a tolerable extent.

In the first step, the project planner performs a risk evaluation to EN 1050 "Risk Assessment". This must take into consideration the machine's ambient conditions for instance. Any overall risk must then be assessed. This risk assessment must be conducted in such a form as to allow documentation of the procedure and the result

achieved. The risk, dangers and possible technical measures to reduce risks and dangers must be stipulated in this risk assessment. After stipulating the extent on the risk, the category on the basis of which the safety circuits are to be designed is determined with the aid of EN 954-1 "Safety-Related Components of Controls".

This determined category defines the technical requirements applicable to the design of the safety equipment. There are five categories (B, 1, 2, 3 and 4) whereby B (standing for basic category) defines the lowest risk and, thus, also the minimum requirements applicable to the controller.



S Gravity of injury

- S1** Minor injury (normally reversible)
- S2** Major injury (normally irreversible), including death

F Frequency and / or length of exposure to the dangerous phenomenon

- F1** Rare to fairly frequent and / or short exposure time
- F2** Frequent to continuous and / or long exposure time

P Possibility to avoid the dangerous phenomenon

- P1** Possible under certain conditions
- P2** Rarely possible

Category selection

B, 1 to 4 Categories for the safety-related control system parts



Preferential categories for the reference points



Measures that can be oversized for the risk concerned



Categories that may require additional measures