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Using proximity switches having a safety function for the purpose of guard gate monitoring

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Starting position

In the past, position monitoring of guards on machines and installations was implemented by using mechanically operated position switches for safety tasks which were designed especially for personal protection functions. As an alternative to these mechanical switches, "proximity switches having a safety function" were developed which avoid the disadvantages regarding wear, pollution and an increased mechanical effort regarding installation. Design and construction of the control of these switches, in conjunction with a respective evaluation device are the reason why independent test and certification bodies will confirm, for some versions, a certain fault detection quality in accordance with EN 954-1 or EN ISO 13849-1, respectively, of the switch with its evaluation unit. However, this cannot be assumed generally valid for a guard gate monitoring application as it is necessary to consider the properties of the whole system, and the fault detection capabilities of the respective application.

However, in order to achieve the same safety as has been achieved so far, the question is "What are the conditions and prerequisites" under which how many "proximity switches having a safety function" are to be used in order to achieve the required safety level. One can anticipate already now that those promotionally effective statements purporting that it is generally possible to use only one "proximity switch having a safety function" to monitor a guard gate for which a risk assessment requires a control system of category 3 or category 4 of EN 954-1, or Performance Level (PL) d or e in acc. with EN ISO 13849-1, respectively, must be considered precarious from the safety point of view, if there are no further conditions to fulfil.

Proximity switches shall only fulfil safety functions if they are used together with an evaluation logic which has been developed for this purpose.

Clause 10.1.4 of EN 60204-1 „Electrical equipment of machines“ stipulates that position sensors (e.g. position switches, proximity switches) used in circuits with safety-related control functions shall have direct opening action (in acc. with IEC 60947-5-1), or shall provide a similar reliability.

*However, it is also possible to achieve a safety similar to that of position switches having direct opening action by reading e.g. **two proximity switches**, which, separately, fail to fulfil the requirements, via an evaluation device using means of redundancy or diversity.*

If a fault to be assumed presupposes failure of one switch, the so-called single-fault consideration presupposes that the other proximity switch continues to fulfil its safety function, the fault is detected via the evaluation device and a new start of the machine is prevented.

Source: DKE Publication 26: Explanations on DIN EN 60204-1, 4th edition

Hence follows: It is possible to replace **one** position switch having direct opening action with two "standard" proximity switches, if an appropriate evaluation and plausibility check of the proximity switches is carried out upon actuation of the protective device.

Thus, in order to avoid a redundant use of proximity switches, proximity switches having a safety function have been developed which provide the required "similar reliability" on their own. As a rule, proof is given by a voluntary type test performed by an independent test and certification body. The respective test certificates prove that the tested combination "switch and electrical/electronic evaluation device" fulfils the requirements of category 4 of EN 954-1. However, by no means one can deviate from this fact that, in control applications, one single "proximity switch having a safety function" is capable of covering the required protective level without any additional conditions.

Promotionally effective statements, such as:

- *With only one switch, you will be able to achieve a safety level of up to category 4 of EN 954-1.*
- *However, one single safety switch is already sufficient for applications up to category 4.*
- *In conjunction with evaluation devices, the safety switches will offer you a safe, complete solution including test body approval in conformity with EN 60947-5-3 for applications up to category 4 of EN 954-1.*

are misleading and incomplete, as it is always necessary to consider the specific installation when fitting the switch to a protective device. At least the following, additional conditions shall be observed in order to allow the use of only one proximity switch of category 4 or PL e, respectively, to monitor a guard gate for which a risk assessment requires control level category 4 of EN 954-1 or PL e of EN ISO 13849-1, respectively:

Additional conditions:

Defeat prevented

- *Safety switch und actuator shall be fitted in such a way that defeat by simple means is prevented (see EN 1088). e.g. by:*

- covered installation,
- using single-serving screws to fix counterparts and switches (further alternatives, e.g. glueing, riveting, welding)

Effective fault detection

The correct functioning shall be monitored upon each actuation of the protective function (i.e. opening the guard). E.g.:

- *Power operated guard gate: When the gate is triggered, the switching position shall change (expectation, with evaluation via machine control system)*
- *In the event of a fault occurring, the initiation of a further hazardous movement shall be prevented.*
- *Electrical faults in the wiring shall be detected.*

The proximity switches shall be connected to the evaluation device in accordance with the manufacturer's specifications.

The operating instructions for proximity switches having a safety function shall contain unambiguous safety information describing the above-mentioned conditions for installation and fault analysis.

Conclusion:

It is possible to replace mechanically operated position switches with "proximity switches having a safety function", if these switches possess an identical safety. Only if additional conditions are observed, it is possible to use one single "proximity switch with safety function" to safeguard protective devices requiring a control level category 3 or 4 of EN 954-1, and not all machine or installation constellations will allow this.

International Section Machine- and System safety

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IVSS was founded in 1927, with the registered office being in Geneva. Today, it works worldwide in 156 countries in 367 member institutions coming from all branches of Social Security.

The **Special Committee for Prevention** is the gremium of IVSS for handling job-related risks. It has eleven international sections as members.

Section Machine and System Safety was founded in 1975 in order to deal with related issues on an international level.

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