

# Control Categories

## according to ISO 13849

The term “Category” is often used in safety standards to describe a specific function or level of reliability. **ISO 13849 Safety of machinery – Safety-related parts of control systems** uses the term category to designate the different wiring schemes available for a safety circuit. It is described as:

“Classification of the safety-related parts of a control system in respect of their resistance to faults and their subsequent behavior in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability”.

In other words, a category represents how a safety circuit is physically wired and how it detects and consequently reacts to faults. There are 5 categories ranging from least reliable, in terms of maintaining safety in the event of a fault, to the most reliable. This is represented as Category B, 1, 2, 3 and 4. To select the correct Category for your safety function designs, a risk assessment needs to be conducted to understand the hazards and risks which need to be guarded.

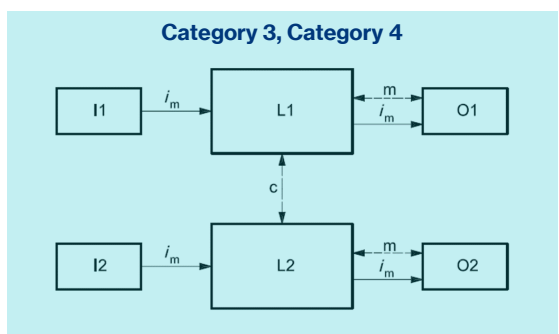
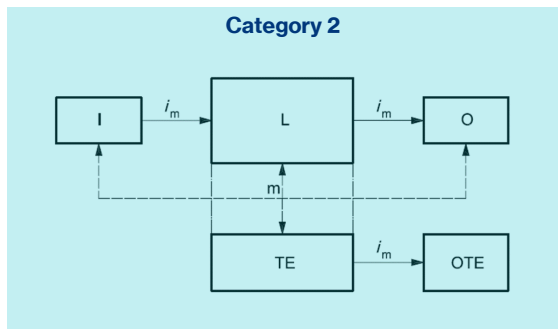
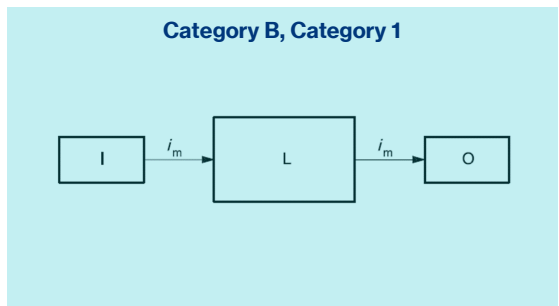
**Category B** is a minimum design for machine control systems. It is a single channel circuit without monitoring. One failure with the safety function may cause the system to not function as attended. For example, a welded contact on a single channel sensor may prevent a machine from stopping once the guard door is opened.

**Category 1** has the same physical structure of Cat. B of single channel without monitoring, but now the requirements call for well-tried principles and components. For example, a safety interlock featuring mechanically linked contacts. Using such components and principles decreases the chances of a failure, yet a single failure will still lead to the loss of the safety function.

**Category 2** now introduces a test function to the safety function which is using well-tried principles and components. This test function will check the integrity of the safety function at “suitable intervals” by the machine control systems. As this design is still a single channel, one failure in-between the test intervals may lead to the loss of the safety function.

**Category 3** now brings in the idea of a second, redundant channel. With this redundant channel (along with the well-tried principles and components), the monitoring is required to detect a single fault within the safety function and allow the safety function to bring the machine to a safe state. It must also prevent a reset of the function until the fault has been corrected. A Cat. 3 is described as being tolerant against a single fault.

**Category 4**, the highest reliable design achievable, builds off Cat. 3, with the requirement of being tolerant against fault accumulations. This is accomplished by the type of safety devices selected and how these devices are being monitored. For example, individual door safety reed sensors tied back to its own discreet input to a safety PLC (no series connections).



I: Input  
 O: Output  
 i<sub>m</sub>: Interconnecting means  
 TE: Test Equipment  
 L: Logic  
 C: Cross Monitoring  
 m: Monitoring  
 OTE: Output of Test Equipment