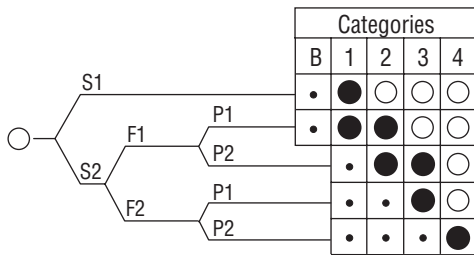


Risk: A combination of the probability of occurrence of harm and the severity of that harm

Probability vs. Severity Matrix (based on ANSI B11.TR3)					Risk Reduction Decision Matrix (based on ANSI/RIA R15.06-1999)				
Probability of Occurrence	Severity of Harm				Severity of Injury	Exposure	Avoidance	Safeguard Performance	Circuit Performance
	Minor	Moderate	Serious	Catastrophic					
Remote	—	—	Low	Low	Serious injury (more than first aid)	Frequent	Not Likely	Eliminate or substitute hazard through design	Control Reliable
Unlikely	—	Low	Medium	Medium		Infrequent	Likely		
Likely	Low	Medium	High	High	Slight injury (first aid)	Frequent	Not Likely	Safeguard the hazard with safety devices	Single Channel with Monitoring
Very Likely	Medium	High	High	High		Infrequent	Likely		
								Barriers, clearance, procedures and equipment Awareness	Simple

Implementing the Categories (based on ISO 13849-1/EN 954-1)



- S** = Severity of injury
 S1: Slight injury
 S2: Serious injury, including death
- F** = Frequency and/or duration of exposure to the hazard
 F1: Seldom short exposure time
 F2: Frequent long exposure time
- P** = Possibility of avoiding the hazard
 P1: Possible under specific conditions
 P2: Nearly impossible

- Selection of Categories B, 1 to 4**
- Preferred categories for the risk
 - Possible categories (may require additional measures)
 - Measures may be over-dimensioned for risk

	Basic	Single	Single with Monitoring	Dual with Monitoring
Generic	Stop Command →	Safety Stop Command →	Safety Stop Command Monitoring Signal ↔	Redundant Safety Stop Commands Monitoring Signal ↔
Fault	Possible loss of safety function	Greater reliability, but possible loss of safety function	Fault detected at each test	Safety function is ensured with a single fault. An accumulation of faults is not possible or detected.
Risk	Very Low Minor bump or bruise with no lost time	Low Minor first aid, infrequent exposure, or high likelihood of avoiding the hazard	Mid Range Injuries that are slight or normally reversible, requiring normal healing or only first aid.	High or Very High Normally reserved for hand-fed applications where injuries could be severe to irreversible
ANSI / B11	—	—	—	Control Reliable ANSI B11.19 (Clause 6.1 and Annex C) Not directly comparable to the requirements of ISO 13849-1 and exceeds a Category 2
ANSI / RIA	Simple	Single Channel	Single Channel with Monitoring	Control Reliable ANSI/RIA R15.06 (Clause 4.5) Control reliability for robots typically exceeds a Cat 3 but is not necessarily intended to be a Cat 4
ISO / EN	Category B ISO 13849-1/EN 954-1	Category 1 ISO 13849-1/EN 954-1	Category 2 ISO 13849-1/EN 954-1	Category 3 & 4 ISO 13849-1/EN 954-1