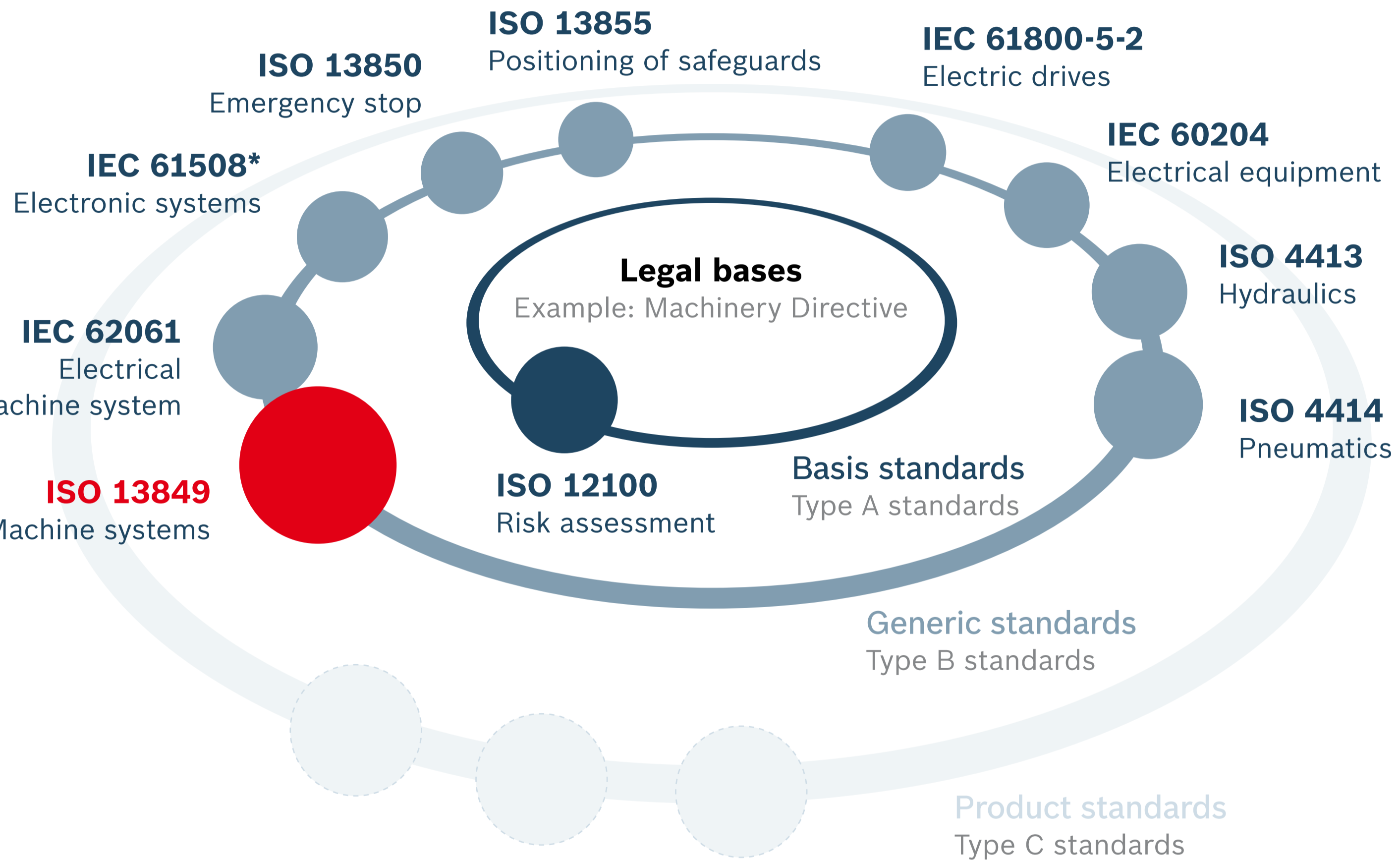
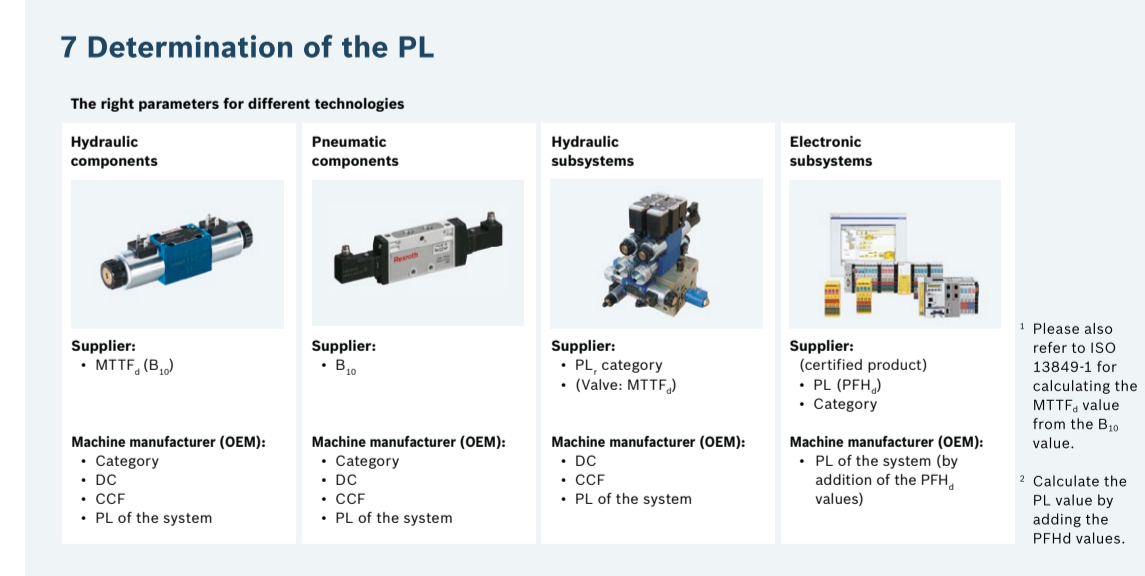
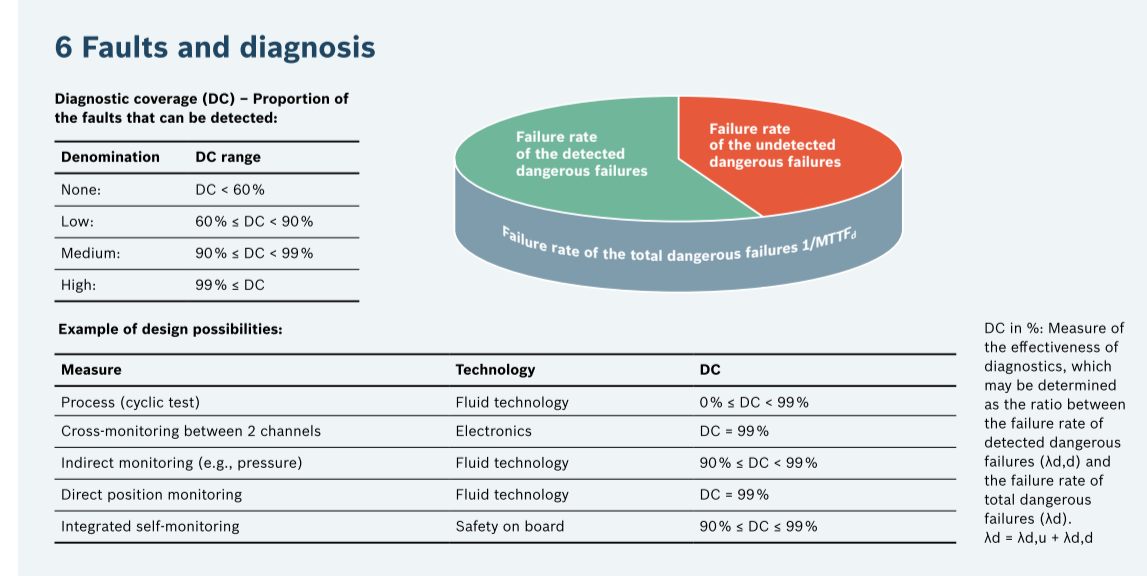
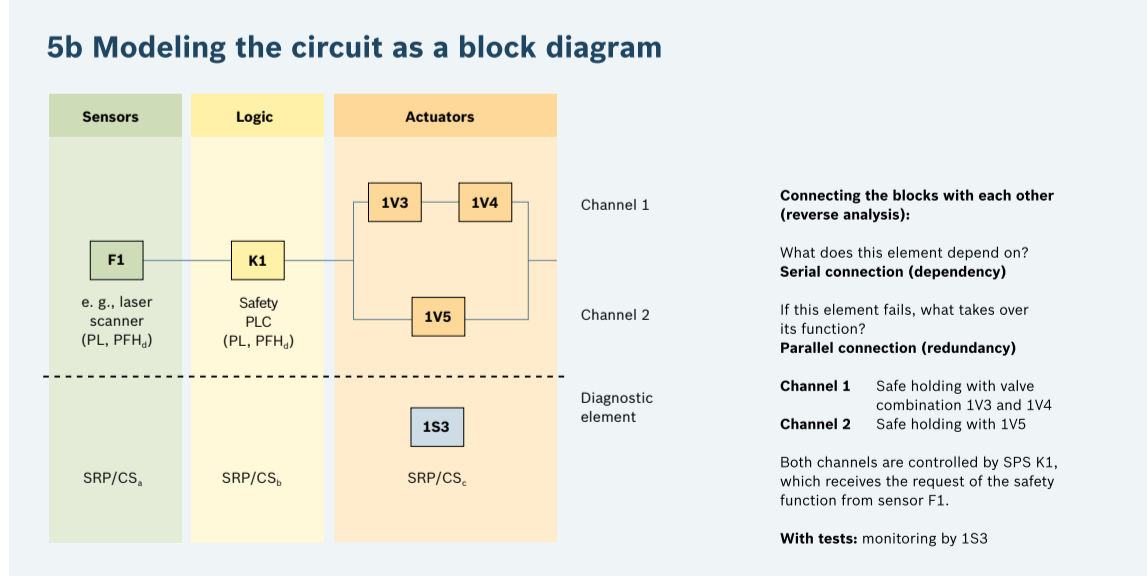
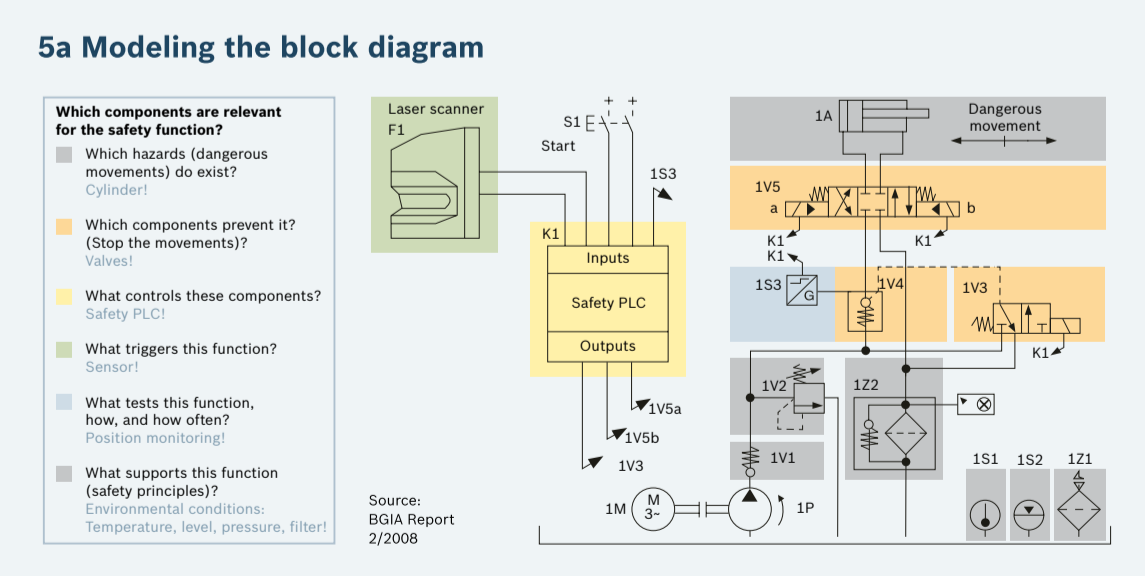
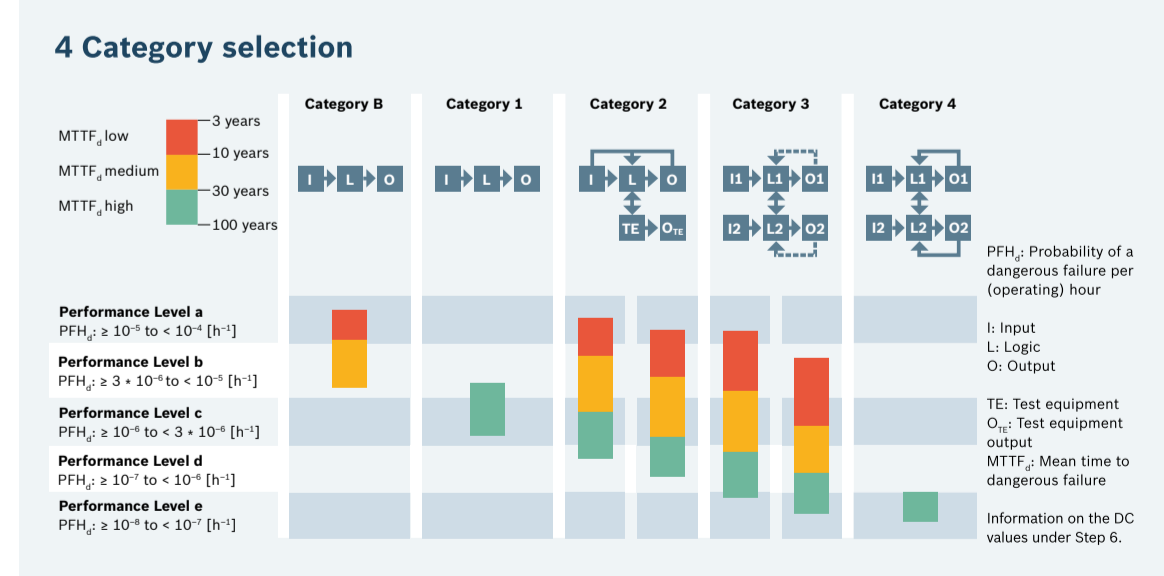
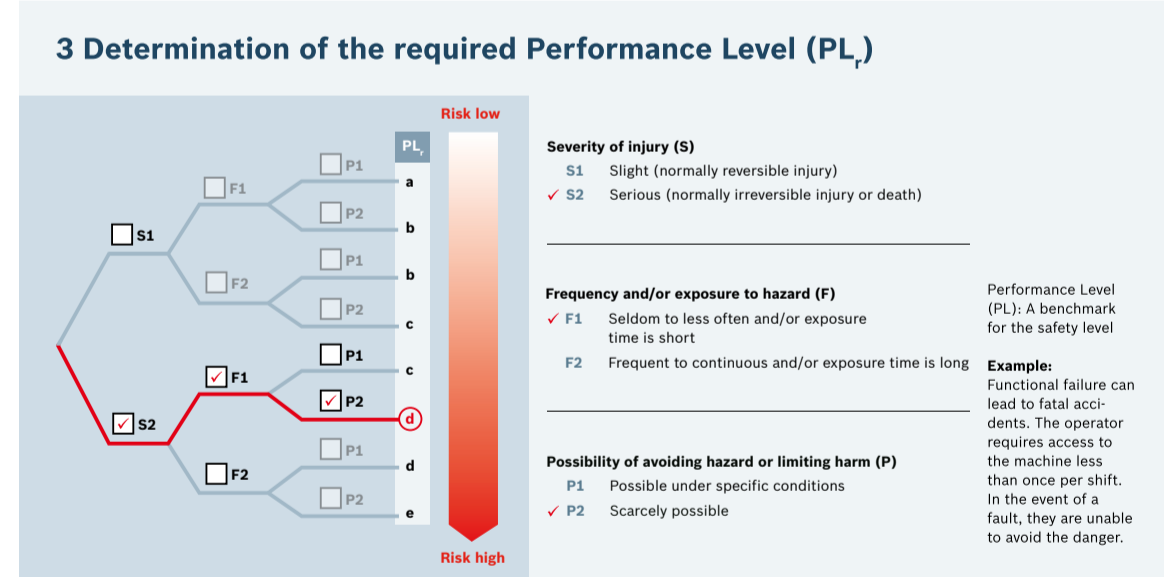
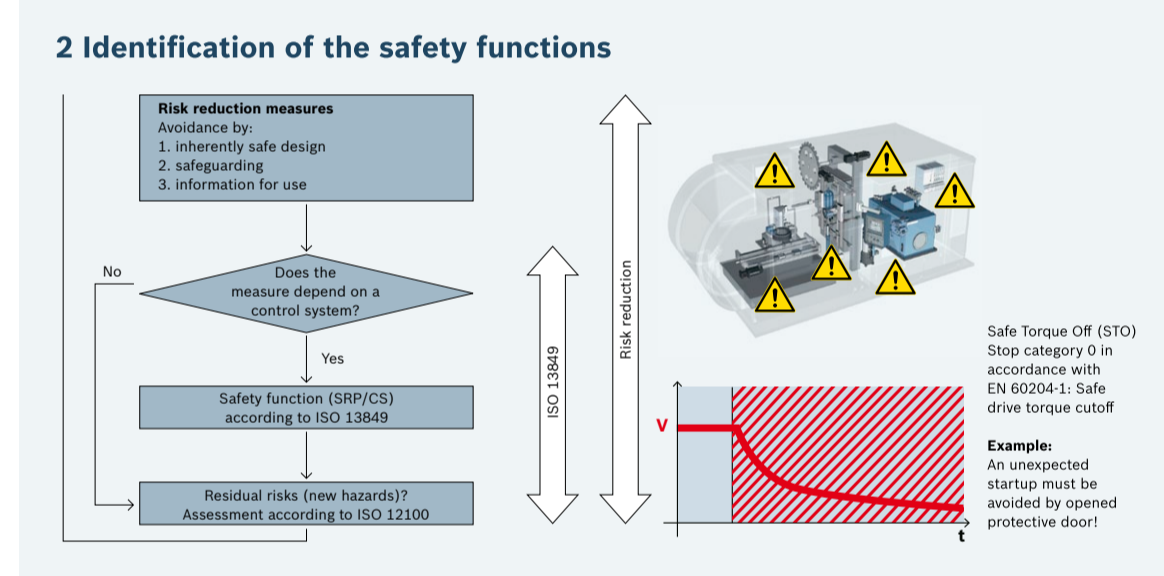
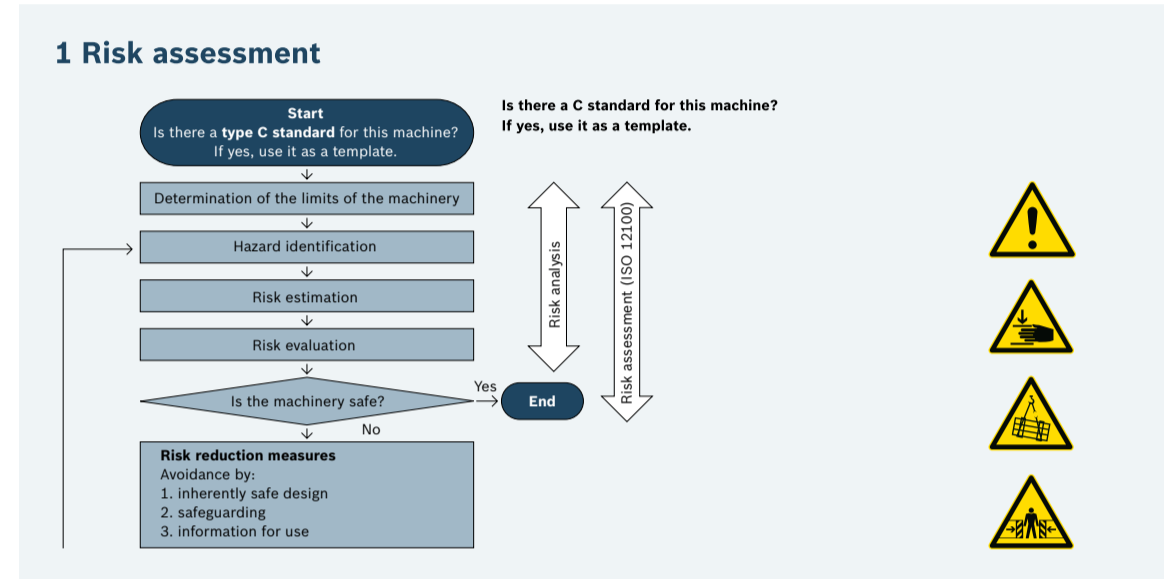


Machine Safety Increases Our Productivity: 10 Steps to Performance Level

Machine Safety



PL (Performance Level): Discrete level used to specify the ability of safety-related parts of control systems to perform a safety function under foreseeable conditions (ISO 13849)

PL (Required Performance Level): Required Performance Level (ISO 13849)

SIL (Safety Integrity Level): Safety Integrity Level (appropriated only for electronic control systems, see PL and IEC 62061)

MTTF (Mean Time To Failure): Statistic expected value of the mean time to failure (ISO 13849)

MTTF (Mean Time to Dangerous Failure): Statistic expected value of the mean time to dangerous failure (ISO 13849)

PFH (Probability of dangerous Failure per Hour): Probability of dangerous failure per hour (reference value for PL and SIL)

B_{10D}: Statistic expected value of the number of cycles until 10% of the components have exceeded specified limits (response time, leakage, switching pressure, ...) under defined conditions

B_{10F}: Statistic expected value of the number of cycles until 10% of the components fail dangerously

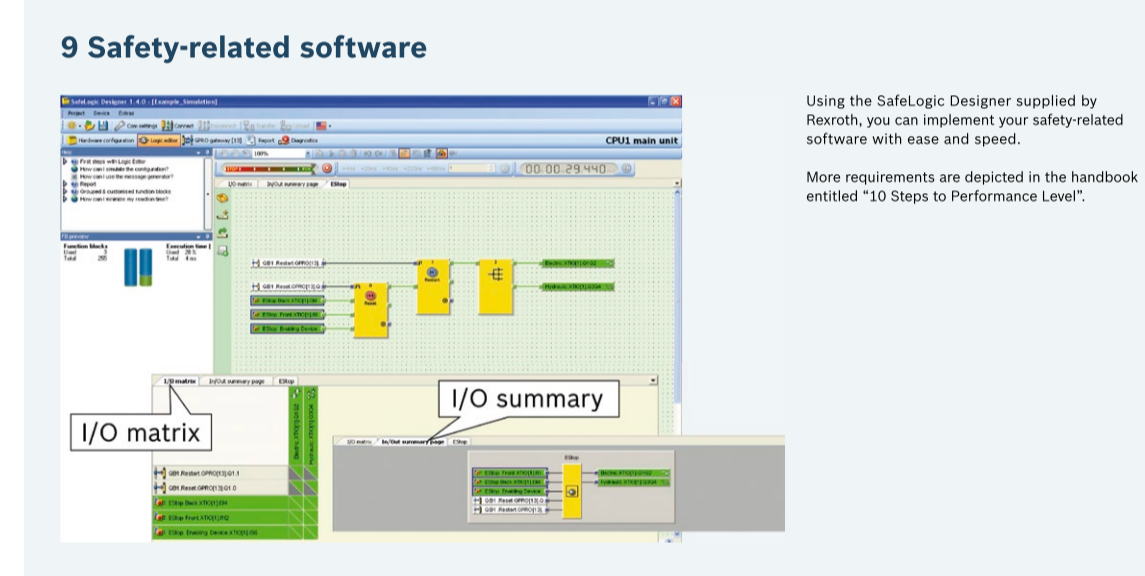
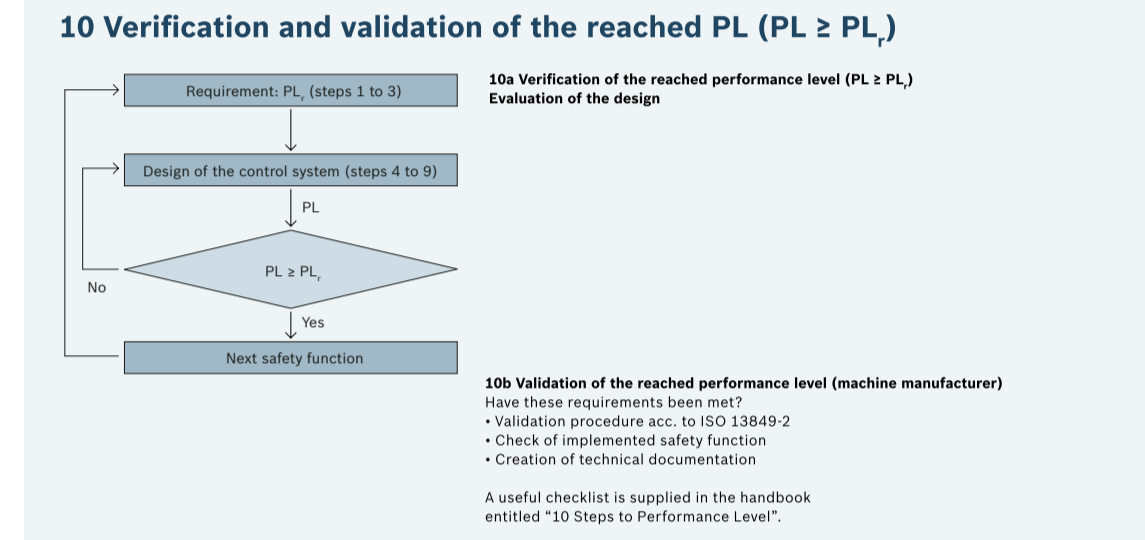
T_{10D}: Expected value of the mean time until 10% of the components fail dangerously (mean time to failure of a component)

T_{10F} (Mission Time): Service life

DC: Diagnostic Coverage

CCF: Common Cause Failure

SRP/CS: Safety-Related Parts of a Control System



8 Evaluation of the system robustness

Checklist of examples of measures against CCF
CCF: Common Cause Failure

Measure	Fluid technology	Electronics	Points	Ful-filled?
Separation between circuit paths	Separation in piping	Clearances and creep age distances on printed circuit boards	15	
Diversity	e.g., different valves	e.g., different processors	20	
Protection against over-voltage, over-pressure	Assembly acc. to ISO 4413 or ISO 4414 (e.g., pressure-vented valve)	Protection against over-voltage (e.g., contactors, power supply unit)	15	
Components used are well tried	To be examined by the machine manufacturer for each specific application		5	
FMEA in development	FMEA in the design of the system	FMEA in the design of the system	5	
Competency/training	Qualification measure	Qualification measure	5	
Protection against contaminants and EMC	Fluid quality	EMV test	25	
Other influences (incl. temperature, shock)	Fulfillment of ISO 4413 or ISO 4414 and product specification	Fulfillment of the environmental conditions acc. to product specifications	10	
CCF total	Total number of points (65 ± CCF ± 100)			

*IEC 61508 is not a harmonized standard according to the Machinery Directive, but serves as basis for other European harmonized standards.

Would you like additional information?
You will find in-depth information and the handbook for implementing functional safety here:
www.boschrexroth.com/machinesafety

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