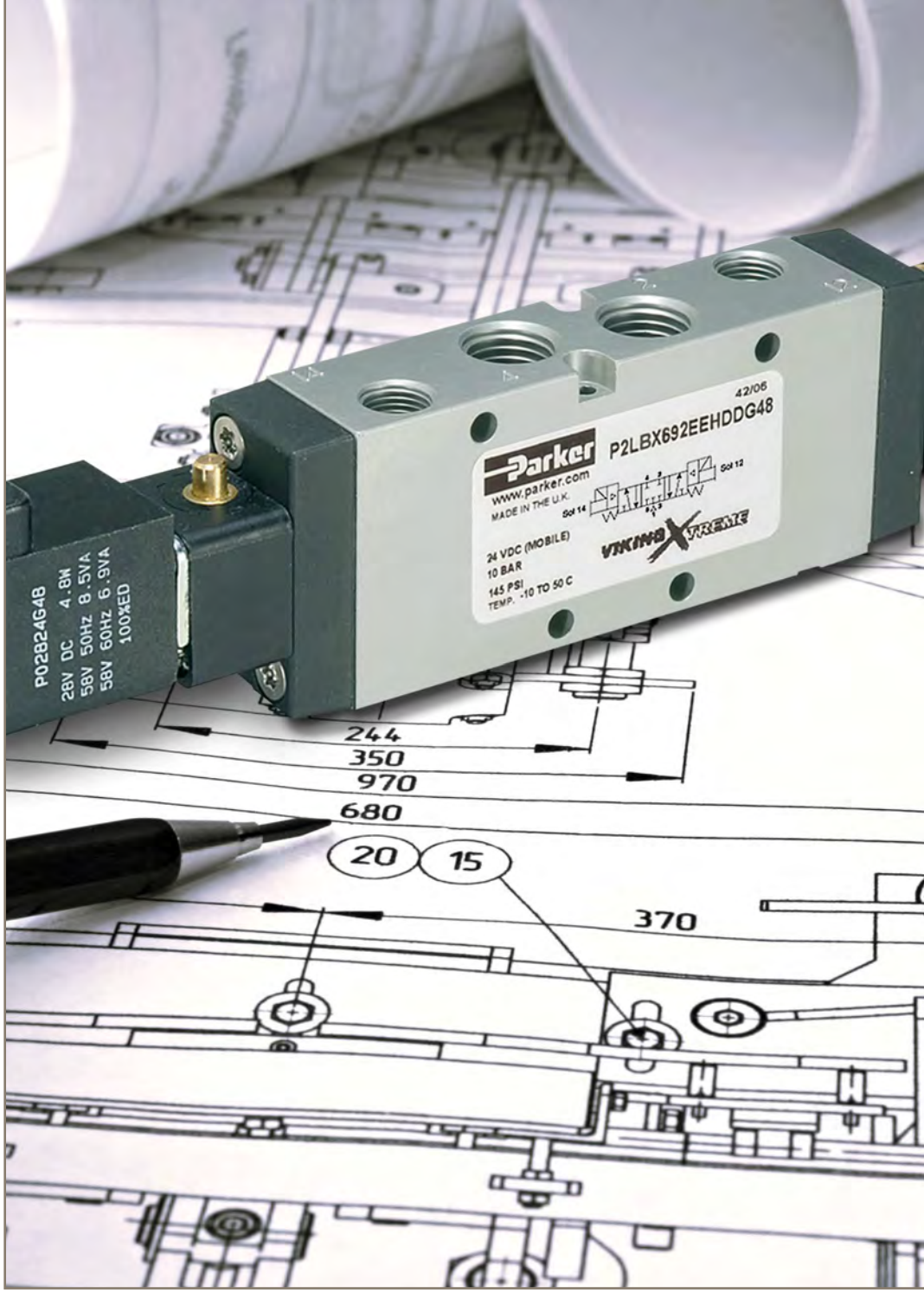


Machine Safety Solutions

Bulletin 0600-B99

Parker

ENGINEERING YOUR SUCCESS.

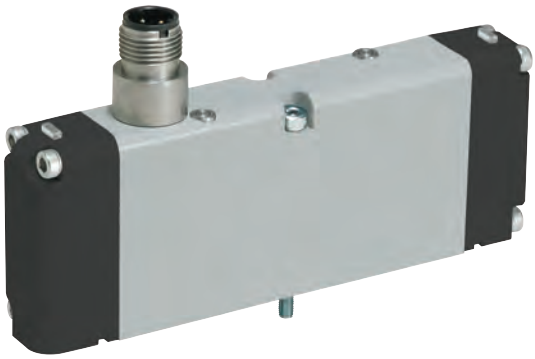
Machine Safety Solutions

Standard Products in Safety Applications

Safety-relevant controls can be realized using standard components. This places the product selection, verification of reliability, testing, and liability on the system designer.

Products Rated for use in a Safety Related Control System (SRP/CS)

Where possible the machine designer may choose to use a component that is “Suitable for use in a Safety Related Control System” (SRP/CS) instead of a standard product. In the case of pneumatics, this would be a component that is well-tried and tested and would offer a published B10 or $B10_D$ value (life cycle value measured in switching cycles). This data can be used to calculate the probability of failure based on the components chosen within the safety circuit. It saves time and money in testing and provides some level of assurance of the components' reliability although, it has not been third-party validated. The B10 value saves a significant amount of work and liability for the system designer.



Safety Components

Safety-rated components offer an advantage. Manufacturers are required to use well-tried and tested components in the product design and must undergo rigorous testing along with third-party testing to validate the conformity of the product. This results in a published endurance life and the necessary documentation. The few extra dollars for safety-rated componentry saves considerable time and expense for the machine designer and supports component selection and testing requirements.

Parker offers a selection of products that are either suitable for use as an SRP/CS or have been safety-certified to make life easier.

Regardless of the products used, validation of the control system and testing are still a critical (and often over-looked) function of the system designer. To achieve functional safety, the systematic suitability of components must be considered in addition to the use of a suitable architecture (category), the realization of required fault detection (PL, performance level), and the consideration of failure rates/probabilities (Diagnostic Coverage) for the safety level deemed necessary by the risk assessment.

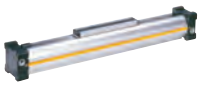
Safety Control Output Devices				
Series	Image	Actuation	$B10_D$ (In Millions of Switching Cycles)	Compliance / Function
Safety Valve		Pneumatic & Electrical	2.50×10^7	Up to Cat 4 Ple, Safe exhaust
Safety Valve (Threaded Exhaust)		Pneumatic & Electrical	2.50×10^7	Up to Cat 4 Ple, Safe exhaust
LV/EZ Lockout		Pneumatic & Manual	Not Required	Safe exhaust
Two Hand Control		Pneumatic	3.00×10^6	Two hand control (THC)
PXM Pilot Exhaust Module		Electrical	Consult Factory	Safe exhaust

$B10_D$ endurance life values are derived based on the testing standards from EN ISO 19973 standard.
Additional $B10_D$ Valves can be based on the EN ISO 13849 standard for component reliability.
Consult factory for specific endurance life values by part number.

Network Communication Components				
Series	Image	Actuation	$MTTF_D$ (Endurance Life in Years)	Compliance / Function
PCH Portal		Electrical & Pneumatic	290 Years	Ethernet portal with IO-Link master capability
H ISO Manifold		Electrical & Pneumatic	Consult Factory	ISO 15407 & ISO 5599
P2H IO-Link		Electrical & Pneumatic	Consult Factory	IO-Link Class A and B. Safe power option
P2H Ethernet		Electrical & Pneumatic	492 Years	Safe power option
P2M IO-Link		Electrical & Pneumatic	Consult Factory	IO-Link Class A and B. Safe power option
P2M Ethernet		Electrical & Pneumatic	Consult Factory	Safe power option

$B10_D$ endurance life values are derived based on the testing standards from EN ISO 19973 standard.
Additional $B10_D$ Valves can be based on the EN ISO 13849 standard for component reliability.
Reliability of electrical components is derived from SN29500
Consult factory for specific endurance life values by part number.

When designing safety circuits complex elements are generally excluded since they do not offer easy answers about suitability or the required life expectancy. It is also good engineering practice to design redundancy (or sub-systems) using different components and varying product designs to eliminate faults that may occur for a common reason in a given environment.

Actuator & Locking Devices				
Series	Image	Actuation	$B10_D$ (In Millions of Switching Cycles)	Compliance / Function
4MA		Pneumatic	Consult Factory	NFPA
4MAP Rod Lock		Pneumatic	2 Million Engagement Cycles (Static Braking) 2.00×10^6	Up to Cat 4 Ple
P1F Cylinder		Pneumatic	Consult Factory	ISO 15552
P1F Rod Lock		Pneumatic	Consult Factory	ISO 15552
OSP Cylinder		Pneumatic	Consult Factory	Rodless actuator
OSP Brakes		Pneumatic	Consult Factory	Safe stopping and Bblocking (SSB)
P1P Cylinder		Pneumatic	Consult Factory	ISO 21287
P1D Cylinder		Pneumatic	Consult Factory	ISO 6431, VDMA 24562
P1D Rod Lock		Pneumatic	Consult Factory	
SR Cylinder		Pneumatic	Consult Factory	

$B10_D$ endurance life values are derived based on the testing standards from EN ISO 19973 standard.
Additional $B10_D$ Valves can be based on the EN ISO 13849 standard for component reliability.
Consult factory for specific endurance life values by part number.

Air Preparation and Control				
Series	Image	Actuation	$B10_D$ (In Millions of Switching Cycles)	Compliance / Function
Safety Valve		Pneumatic & Electrical	2.50×10^7	Up to Cat 4 Ple, Safe energization (SEZ)
Filter Regulator		Pneumatic & Electrical	2.00×10^7	Safe limited torque (SLT)
Regulator		Pneumatic & Manual	2.00×10^7	Safe equilibrium of torque (SET)
Soft Start/ Dump Valve		Pneumatic	2.00×10^7	Safe energization (SEZ)
On / Off Ball Valve		Electrical	2.50×10^5	Safe de-energization (SDE)
On/Off Ball Valve		Electrical	Consult Factory	EN31000-6-X:2001

$B10_D$ endurance life values are derived based on the testing standards from EN ISO 19973 standard.
Additional $B10_D$ Valves can be based on the EN ISO 13849 standard for component reliability.
Consult factory for specific endurance life values by part number.

Valve Products (Inline and Subbase)				
Series	Image	Actuation	$B10_D$ (In Millions of Switching Cycles)	Compliance / Function
HB Valve		Pneumatic & Electrical	1.40×10^8	Prevention of unexpected start-up (PUS)
HA Valve		Pneumatic & Electrical	1.43×10^8	Prevention of unexpected start-up (PUS)
HA Valve (with Spool Sensing)		Pneumatic & Electrical	Consult Factory	Prevention of unexpected start-up (PUS)
H1 Valve		Pneumatic & Electrical	3.10×10^7	Prevention of unexpected start-up (PUS)
H2 Valve		Pneumatic & Electrical	1.40×10^8	Prevention of unexpected start-up (PUS)
H3 Valve		Pneumatic & Electrical	5.37×10^7	Prevention of unexpected start-up (PUS)
Moduflex		Pneumatic & Electrical	1.00×10^8	Prevention of unexpected start-up (PUS)
Viking Lite		Pneumatic & Electrical	4.00×10^7	Prevention of unexpected start-up (PUS)
Viking Extreme		Pneumatic & Electrical	1.00×10^8	Prevention of unexpected start-up (PUS)
PXM Pilot Exhaust Module		Pneumatic & Electrical	MOP=1.00×10^{10} EOP=$1.00 \times 1 \times 10^8$	Safe Pilot Control
N Series		Pneumatic & Electrical	Consult Factory	

$B10_D$ endurance life values are derived based on the testing standards from EN ISO 19973 standard.
Additional $B10_D$ Valves can be based on the EN ISO 13849 standard for component reliability.
Consult factory for specific endurance life values by part number.

Air Preparation and Control				
Series	Image	Actuation	$B10_D$ (In Millions of Switching Cycles)	Compliance / Function
CPS Sensor		Electrical	1.24×10^8	
SCPSD Pressure Sensor		Electrical	1.00×10^8	
PPS1 Pressure Switch		Electrical	1.00×10^6	
MPS-33 Pressure Sensor		Electrical	Consult Factory	
MPS-34 Pressure Sensor		Electrical	Consult Factory	
Pneumatic Fuses		Pneumatic	N/A	TUV Approval: 01-02-0145 & ISO 4414

Additional $B10_D$ Valves can be based on the EN ISO 13849 standard for component reliability.
Consult factory for specific endurance life values by part number

The Machinery Directives' goal is to protect people and the environment from accidents caused from all types of machinery. Based on the standard EN 13849 [safety of machines; safety-related parts of control systems] these standards build the procedure to assess safety-related control systems.

Required Performance Level (PLr) based on a risk assessment are now commonly used to determine the safety level required for the controls system, for the application of machinery.

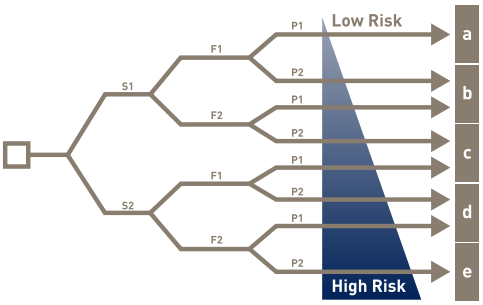
Performance Level (PL) based on the original B, 1,2,3,4 safety categories, diagnostic capabilities, Mean time to dangerous failure (MTTFD), and common cause failure (CCF), define safety levels of a given safety function. This ensures that safety is not just focused on component reliability, but instead introduces common sense safety principles such as redundancy, diversity, and fail-safe behavior of safety related control parts.

The new EN 13849 standards of the Machinery Directive dictates the machine is safe when the Performance Level of the safety control circuit is equal to or greater than the Required Performance Level of the application. When determining the required performance level, the greater the risk, the higher the requirements of the control system.

$$PLr \leqq PL$$

Determining PLr According to EN 13849-1

The level of each hazardous situation is classified in five Performance levels from a to e. With PL a the control functions contribution to risk reduction is low, while at PL e it is high. The risk graph above can be used as a guideline to determine the required performance level PLr for safety function.



Risk Parameters

(S) Severity of injury

- S1 Slight (normally reversible injury)
- S2 Serious (normally irreversible injury, or death)

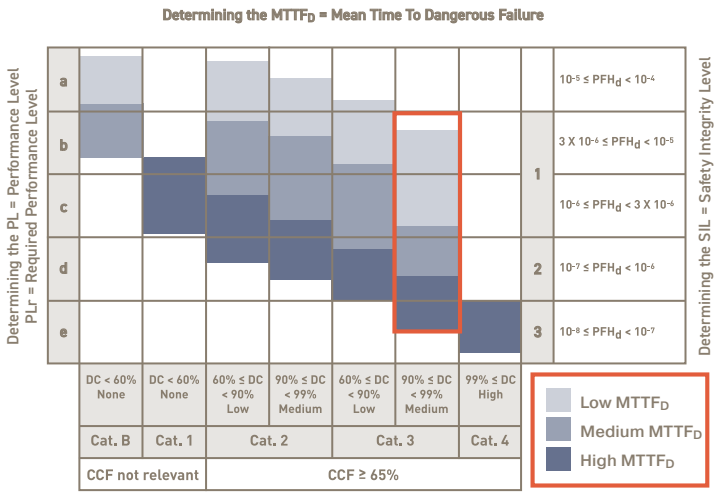
(F) Frequency and / or duration of exposure to hazard

- F1 Seldom to less often and / or brief
- F2 Frequent to continuous and / or long

(P) Possibility of avoiding the hazard

- P1 Possibility of avoiding the hazard
- P2 Scarcely ever possible

Determining PL According to EN 13849-1



Categories Defined by EN 13849-1

Category	Summary
Category B	When a fault occurs it can lead to the loss of the safety function.
Category 1	Same that Category B, but loss of the safety function is less likely thanks to a good $MTTF_D$ of each channel.
Category 2	System behavior allow that the occurrence of a fault can lead to the loss of the safety function between the checks; the loss of the safety function is detected by the check.
Category 3	A single fault in any of safety related parts does not lead to the loss of the safety function. Whenever reasonably possible the single fault shall be detected at or before the next demand upon the safety function. (Means redundancy)
Category 4	Same as Category 3, but if detection of single fault is not possible on or before the next demand upon the safety, an accumulation of these undetected faults shall not lead to the loss of the safety function. (Means redundancy & check)

RG Group
650 North State Street, York, PA 17403
www.rg-group.com