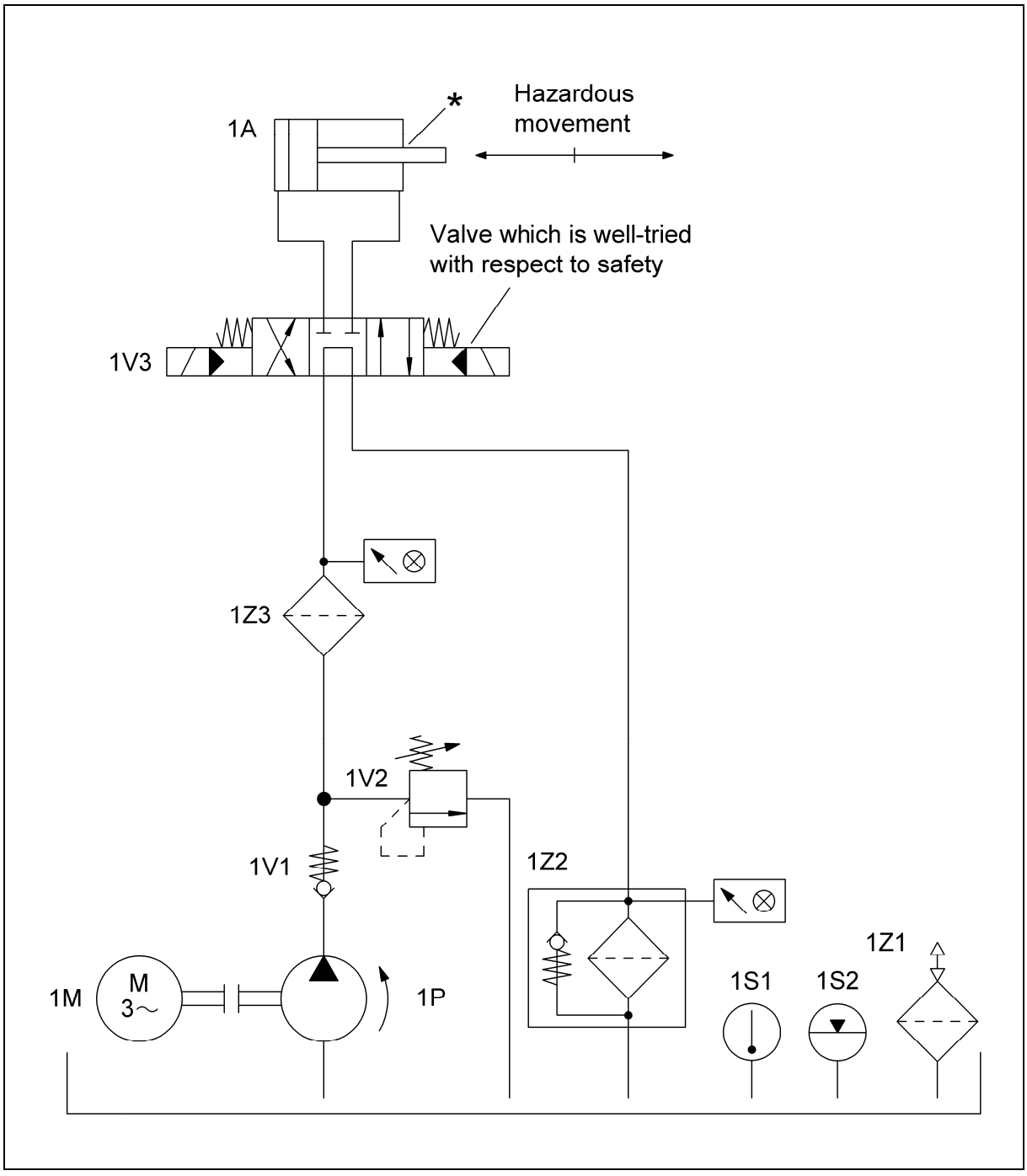
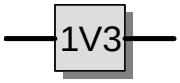
8.2.3 Hydraulic valve (subsystem) – Category 1 – PL c (for PL b safety functions) (Example 3)

Figure 8.7:
Hydraulic valve for the control of hazardous movements



Safety functions

- Safety-related stop function: stopping of the hazardous movement and prevention of unexpected start-up from the rest position



- Only the hydraulic part of the control is shown here in the form of a subsystem. Further safety-related control components (e.g. protective devices and electrical logic elements) must be added in the form of subsystems for completion of the safety function.

Functional description

- Hazardous movements are controlled by a directional control valve 1V3 with well-tried safety functionality.
- Failure of the directional control valve may result in loss of the safety function. The failure is dependent upon the reliability of the directional control valve.
- No measures for fault detection are implemented.

Design features

- Basic and well-tried safety principles are observed and the requirements of Category B are met.
- 1V3 is a directional control valve with closed centre position, sufficient overlap, spring centering and fatigue-resistant springs.
- The safety-oriented switching position is attained by removal of the control signal.
- Where necessary, the manufacturer/user must confirm that the directional control valve is a component with well-tried safety functionality.
- The following specific measures are implemented to increase the reliability of the directional control valve: a pressure filter 1Z3 upstream of the directional control valve and suitable measures on the cylinder to prevent dirt from being drawn in by the piston rod (e.g. effective wiper on the piston rod, see ∗ in Figure 8.6).

Calculation of the probability of failure

- $MTTF_d$: an $MTTF_d$ of 150 years is assumed for the directional control valve 1V3 [S]. This is also the $MTTF_d$ value per channel, which is capped to 100 years (“high”).
- DC_{avg} and measures against common cause failures are not relevant in Category 1.
- The hydraulic control corresponds to Category 1 with a high $MTTF_d$ (100 years). This results in an average probability of dangerous failure of 1.14×10^{-6} per hour. This corresponds to PL c. The addition of further safety-related control parts as subsystems for completion of the safety function generally results in a lower PL.

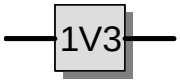


Figure 8.8:
Determining of the PL by means of SISTEMA