Cleco®
Production Tools

Data sheet
P2388DB
2018-08

Performance Level System BTS

Basis BGIA Report 2/2008

Functional Safety of Machine Control Systems
– Application of DIN EN ISO 13849

Calculations

This is an sample calculation, which should serve the plant construction company as an initial estimate for its requirements/design solution. The plant construction company can only establish a precise calculation by taking into account the individual specifications and thus the hazards/risks of its machine.

Definitions of terms

d_{op} Average operating time in days (d) per year. This is a relative assumption and must be checked/adjusted by the plant construction company.

h_{op} Average operating time in hours (h) per day. This is a relative assumption and must be checked/adjusted by the plant construction company.

t_{cycl} Average time between the beginning of two consecutive cycles of the component in seconds (s) per cycle

B_{10} Service life parameter

n_{op} Average annual number of operations

$$n_{op} = \frac{d_{op} \times h_{op}}{t_{cycl}} \times 3600\frac{s}{h}$$

$MTTF_d$ Expectation value in years of the mean time to a hazardous failure

$$MTTF_d = \frac{B_{10d}}{0.1 \times n_{op}}$$

1 Components

The specified components/values correspond to the Cleco Production Tools standard design (CPM). If CPMs (Control Power Modules) are used according to customer specifications, e.g., with customer operating material specifications, material release lists or components with other values, then a different level of protection can be achieved.

1.1 Variant 1

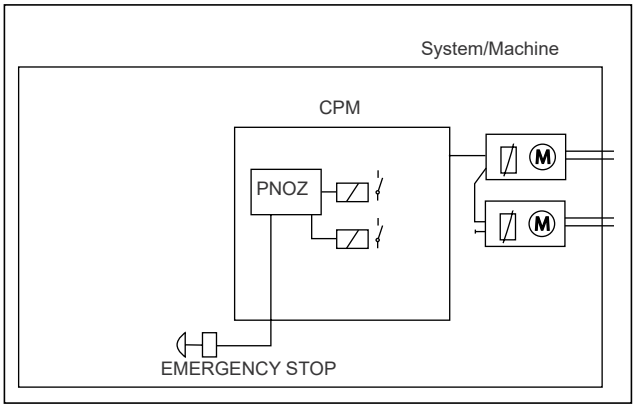

Fig. 1-1: EMERGENCY STOP button installed directly with CPM for protection circuit, e.g., handheld wheel nutrunner

1.1.1 Control systems

MPRO-400SG CPM3 Order No. S112925-SG-…
MPRO-400SG CPM6 Order No. S112929-SG-…
POWER MODUL; 3 KVA Order No. PDB-CPS3-FA-CE
POWER MODUL; 6 KVA Order No. PDB-CPS6-FA-CE

Operating days per year, not including Sat, Sun and holidays

$$d_{op} = 250\frac{d}{a}$$

Operating hours per year, double shift operation

$$h_{op} = 18\frac{h}{d}$$

Cycle time EMERGENCY STOP button
1× per shift, 8 h day
(28800 seconds = 8 h × 60 min × 60 sec)

$$t_{cycl} = 28800\frac{s}{cycle}$$

Operations per year

$$n_{op} = \frac{250\frac{d}{a} \times 18\frac{h}{a} \times 3600\frac{s}{h}}{28800\frac{s}{cycle}}$$

$$= 562.5\frac{cycle}{year}$$

1.1.2 Contactor

Siemens Order No. 3RT1025-3BB40

$$B_{10d} = 1369863$$

$$MTTF_d = \frac{1369863}{0.1 \times 562.5} = 2435.12\ (year)$$

→ Classification of $MTTF_d$ = high, see BGIA report 2/2008 Table 6.3
→ Performance Level PL = d, see BGIA report 2/2008 Figure 6.10

1.1.3 EMERGENCY STOP button

Siemens Order No. 3SB3400-OC

$$B_{10d} = 300000$$

$$MTTF_d = \frac{1369863}{0.1 \times 562.5} = 5300(years)$$

→ Classification of $MTTF_d$ = high, see BGIA report 2/2008 Table 6.3
→ Performance Level PL = d, see BGIA report 2/2008 Figure 6.10

1.1.4 EMERGENCY STOP relay

PNOZ X2 Pilz Order No. 777303
Cat. 4, PL = e

1.2 Variant 2

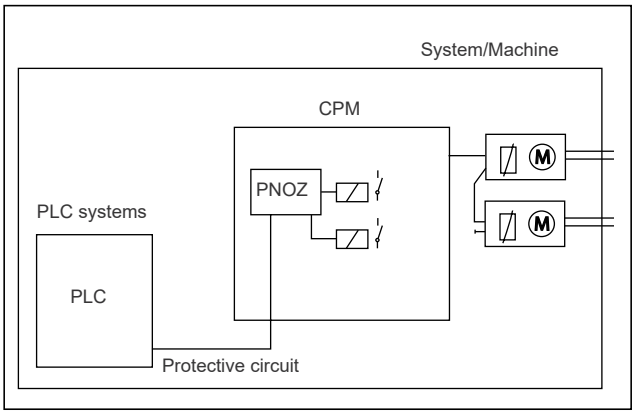

Fig. 1-2: Integration of the CPM into the station design.

Without the system design and the values to be used, no sample calculation is possible. Here, use the relevant values from the plant construction company, or use the correct calculation matrix.

2 Result

Number of subsystems = 3

Lowest PL = d

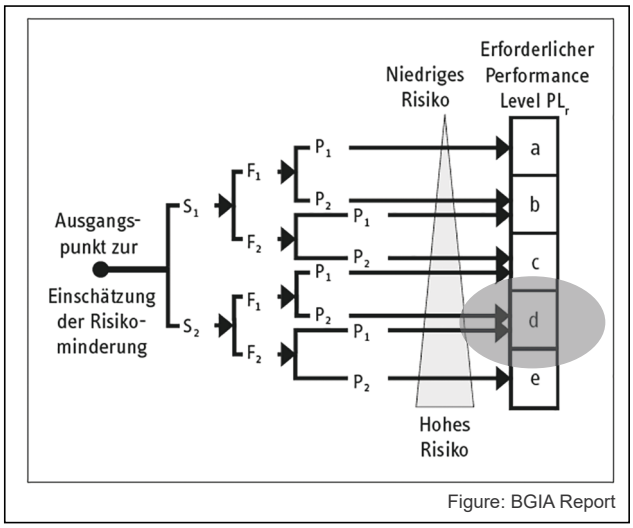

Fig. 2-1: Determination of the PL_r for each safety function

Total PL for the system = d

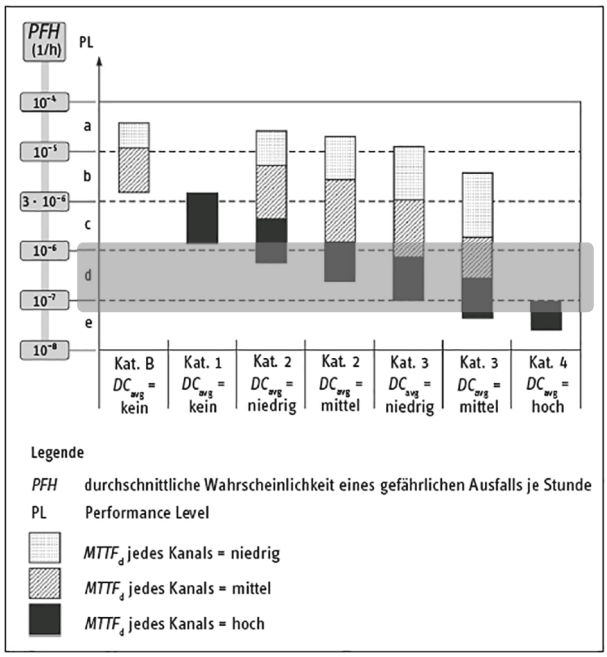

Fig. 2-2: Simplified PL determination from the category

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Apex Tool Group
2630 Superior Court
Auburn Hills, MI 48236
Phone: +1 (248) 393-5644
Fax: +1 (248) 391-6295

LEXINGTON, SOUTH CAROLINA
Apex Tool Group
670 Industrial Drive
Lexington, SC 29072
Phone: +1 (800) 845-5629
Phone: +1 (919) 387-0099
Fax: +1 (803) 358-7681

CANADA
Apex Tool Canada, Ltd.
7631 Bath Road
Mississauga, Ontario L4T 3T1
Canada
Phone: +1 (866) 691-6212
Fax: +1 (905) 673-4400

MEXICO
Apex Tool Group
Vialidad El Pueblito #103
Parque Industrial Querétaro
Querétaro, QRO 76220
Mexico
Phone: +52 (442) 211 3800
Fax: +52 (800) 685 5560

BRAZIL
Apex Tool Group
Av. Liberdade, 4055
Zona Industrial Iporanga
Sorocaba, São Paulo
CEP# 18087-170
Brazil
Phone: +55 15 3238 3870
Fax: +55 15 3238 3938

EUROPE | MIDDLE EAST | AFRICA

UK
Apex Tool Group GmbH
C/O Spline Gauges
Piccadilly, Tamworth
Staffordshire B78 2ER
United Kingdom
Phone: +44 1827 8727 71
Fax: +44 1827 8741 28

FRANCE
Apex Tool Group SAS
25 Avenue Maurice Chevalier - ZI
77330 Ozoir-La-Ferrière
France
Phone: +33 1 64 43 22 00
Fax: +33 1 64 43 17 17

GERMANY
Apex Tool Group GmbH
Industriestraße 1
73463 Westhausen
Germany
Phone: +49 (0) 73 63 81 0
Fax: +49 (0) 73 63 81 222

HUNGARY
Apex Tool Group
Hungária Kft.
Platánfa u. 2
9027 Györ
Hungary
Phone: +36 96 66 1383
Fax: +36 96 66 1135

ASIA PACIFIC

AUSTRALIA
Apex Tool Group
519 Nurigong Street, Albury
NSW 2640
Australia
Phone: +61 2 6058 0300

CHINA
Apex Power Tool Trading
(Shanghai) Co., Ltd.
2nd Floor, Area C
177 Bi Bo Road
Pu Dong New Area, Shanghai
China 201203 P.R.C.
Phone: +86 21 60880320
Fax: +86 21 60880298

INDIA
Apex Power Tool India
Private Limited
Gala No. 1, Plot No. 5
S. No. 234, 235 & 245
Indialand Global
Industrial Park
Taluka-Mulsi, Phase I
Hinjawadi, Pune 411057
Maharashtra, India
Phone: +91 020 66761111

JAPAN
Apex Tool Group Japan
Korin-Kaikan 5F,
3-6-23 Shibakoen, Minato-Ku,
Tokyo 105-0011, JAPAN
Phone: +81-3-6450-1840
Fax: +81-3-6450-1841

KOREA
Apex Tool Group Korea
#1503, Hibrand Living Bldg.,
215 Yangjae-dong,
Seocho-gu, Seoul 137-924,
Korea
Phone: +82-2-2155-0250
Fax: +82-2-2155-0252

Cleco®
Production Tools

Apex Tool Group GmbH
Industriestrasse 1
73463 Westhausen
Germany

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