Validation aid for the use of ROBA®-linearstop E brakes as a safety-related part in accordance with DIN EN ISO 13849-2

This document provides machine manufacturers with important information with respect to validating the installed ROBA®-linearstop E brake in accordance with DIN EN ISO 13849-2.

Validity

This validation aid applies exclusively to the named types in standard design, as well as approved special designs. Special designs deviate from the standard and can be identified by the suffix "S" in the type name.

Use the 7-digit *mayr*® article number to ask *mayr*® power transmission whether this validation aid is approved for your special design.

This validation aid applies exclusively to the following types:

Construction size	Type
All	3820._ _ _ _ _

Safety Parameters

The following safety parameters are required for calculating the performance level:

- ❑ $B10_d$ - Medium number of cycles until 10 % of the components have failed dangerously

Construction size	$B10_d$ switching cycles
LBE 10	1,000,000
LBE 15	1000000
LBE 20	2,000,000
LBE 40	2000000
LBE 60	2000000
LBE 80	2000000

The $B10_d$ value states the medium number of cycles until 10% of the brakes have failed dangerously. The $B10_d$ value for the ROBA®-linearstop E refers to the mechanical switching procedure, i.e. the movement of the collet and the application of the spring force.
Attention: It does not include the braking force or the wear on the collet.

The $B10_d$ value is a statistical value that does not indicate any guaranteed lifetime or failure-free period. The brake provides no single error reliability. One error, and the resulting loss of braking force, is possible.

- ❑ T_M – service life – period covering the equipment's prescribed useful life

  T_M = 20 years

  To ensure that the brake is functioning correctly over its period of application, it is necessary to install it correctly and carry out regular inspections and maintenance. These activities concern the collet, the brake mounting and the piston rod. Refer to the original operating instructions for specific information on installation, inspections and maintenance tasks.

Category according to DIN EN ISO 13849-1

Determining the required category according to DIN EN ISO 13849-1 depends on the specific application and is therefore the responsibility of the user.

The ROBA®-linearstop E safety brake has been designed in such a way that it meets the requirements of category 1 according to DIN EN ISO 13849-1. The brake has been manufactured and verified using principles that demonstrate its suitability and reliability for applications related to safety. The decision to approve the brake as "proven" depends on the application. A pre-requisite for accepting the brake as a tried and tested component is that the brake is dimensioned and used in accordance with the original operating instructions. The relevant fundamental and established safety principles, according to DIN EN ISO 13849-2 for mechanical systems, are applicable to the electromagnetic ROBA®-linearstop® safety brakes, see annex.

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Tried and tested springs and screw connections are also used.

mayr® power transmission has plenty of experience dealing with numerous types of brakes that have been designed and manufactured according to the same principles and used successfully in a wide range of applications over many years. Different and more challenging conditions (additional requirements) require an agreement with the manufacturer in accordance with VDE 0580.

Dimensioning

To ensure safe and reliable braking and correct operation of ROBA®-linearstop E safety brake, the following is required: adequate dimensioning in accordance with the original operating instructions, intended use, compliance with application limits and technical fringe parameters as outlined in the original operating instructions.

For this, the static holding force, the dynamic braking force, the path feed speed, the friction work per braking action, the switching frequency and the braking time are to be determined so that the required load torque can be held reliably, and the required braking distance can be reliably maintained.

Refer to the original operating instructions for specific information on brake dimensioning.
mayr® power transmission, your reliable partner, is happy to assist you in selecting the correct brake dimensioning.

Test / Diagnostic

The efficacy and function of the brake is to be inspected due to the overall risk assessment to be carried out and the resulting measures for risk minimisation depending on the application case through suitable tests at appropriate time intervals.

The brake safety is generated through the braking force. Some errors, e.g. braking force too low due to friction value-reducing substances on the piston rod, can only be detected by performing a cyclical brake test. Errors relating to the braking force cannot be detected by the switching condition monitoring signal.

Refer to the original operating instructions for recommendations on how to perform a brake test.

The switching condition monitoring signal is a feedback signal of the actuator (output unit, output) ROBA®-stop safety brake as a test and monitoring measure, related to the brake component as part of the safety channel, and is used to estimate the diagnostic coverage DC in accordance with Annex E DIN EN ISO 13849-1 of the brake.

This helps detect any brake faults affecting the release of the collet and/or the electical actuation of the brake.

We recommend assuming a DC value of 60 % for the actuator due to switching condition monitoring including an additional plausibility check - e.g. through safe brake control. For higher DC values, we recommend taking further measures, e.g. a cyclical brake test. The DC values specified by the control unit manufacturers can then be applied. MTTF values are available for applications in category 2 according to DIN EN ISO 13849-1.

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Annex

Basic safety principles of mechanical systems

Basic safety principle	Explanations
Application of suitable materials and appropriate manufacturing methods	Use of tried and tested materials and manufacturing methods
Proper dimensioning and design	Design and dimensioning according to established internal specifications
Suitable selection, combination, arrangement, assembly and installation of components / system	Use of tried and tested components and design
Application of energy-separation principle	The reliable condition is achieved through separation of the energy source, and thus accords with the required safety aspects, for example during power failure or EMERGENCY STOP. When in de-energized condition, the springs press against a cone. This compresses the collet and clamps or brakes the piston rod. By applying the coil nominal voltage to the coil, the cone is pulled or pressed against the housing against the spring force. The collet becomes free and the brake is released. The piston rod can move freely.
Suitable mounting	Dimensioning of screw connection according to established internal specifications
Limiting production and/or transmission of force and similar parameters	Braking force tolerance see 2.6 Dimensioning of other machine elements and 5.2 Technical data, in the original operational instructions
Limiting range of environmental parameters	Ambient conditions are defined in the original operating instructions.
Limitation of speed and similar parameters	Technical data according to original operating instructions • Maximum permitted path feed speed • Maximum load mass • Permitted Switching Work $Q_{r\ zul.}$ per Braking • Permitted Friction Work $Q_{r\ ges.}$ up to wear end The permitted values are documented in the original operating instructions under 5.4 friction works.
Suitable reaction time	Switching time according to the original operating instructions • Response delay on connection t_{11} • Separation time (release) t_2
Protected against unexpected start-up	An unexpected start-up, i.e. brake is opened, is only possible by energizing the brake. Machine manufacturers/operators must take measures to reliably prevent this from occurring. Disassembling the brake results in a loss of braking force.
Simplification	Generation of the holding force according to simple principle
Separation	Use of brake only for safety-related functions under the responsibility of the machine manufacturer
Suitable lubrication	Lubrication not required - dry running or lifetime-lubricated sealing surfaces
Suitable protection against penetration of liquids and dust	Protection of brakes, see original operating instructions Protection of brakes, see original operating instructions If there are special ambient conditions, additional measures can be taken after consultation (e.g. sealing air).

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Tried and tested safety principles

Tried and tested safety principle	Explanations
Application of carefully selected materials and manufacturing methods	Use of long established materials and manufacturing methods
Use of oriented failure mode components	The most common failure behavior of brakes is described in the “Malfunctions” section of the original operating instructions.
Overdimensioning/safety factor	Dimensioning according to established internal specifications Dimensioning appropriate for the application is important!
Secured position	Movement of the mechanism by springs
Increased OFF force	Not relevant. Energy-separation principle, fail-safe principle
Careful selection, combination, arrangement, assembly and installation of components/systems for respective application	Use of tried and tested components and design The specifications contained in the “Installation” and “Initial operation” section of the original operating instructions apply to the installation of brakes by the machine manufacturer.
Careful selection of the mounting method for the respective application	Dimensioning of screw connection according to established internal specifications Installation according to original operating instructions, see above.
Positive mechanically created effect	Functional principle safety brake
Proliferation of parts	Use of multiple springs to generate force
Application of tried and tested springs	Use of tried and tested springs, design and dimensioning in accordance with internal specifications The dimensioning of the springs in the dynamic strength range avoids a loss of spring force over the brake’s service lifetime of at min. 2 million load cycles.
Reduced range of force and similar parameters	Holding force tolerance, see original operating instructions
Reduced range of speed and similar parameters	Technical data according to original operating instructions • Maximum permitted path feed speed • Maximum load mass • Permitted Switching Work $Q_{r\ zul.}$ per Braking • Permitted Friction Work $Q_{r\ ges.}$ up to wear end The permitted values are documented in the original operating instructions.
Reduced range of environmental parameters	Ambient conditions are defined in the original operating instructions.

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Tried and tested safety principle	Explanations
Reduced range of response time, hysteresis limitation	Information in original operating instructions, cyclical brake test Certain conditions can result in a loss of braking force during operation, e.g. • aging of friction lining • wear • friction value-reducing materials in the brake • Mounting to motor and machine That is why regular maintenance work / inspections must be carried out in accordance with the specifications in the original operating instructions. The brake must be checked for effectiveness and function. This must be carried out on the basis of the overall risk assessment to be conducted and the resulting measures for risk minimization, depending on the application case, through suitable tests at appropriate time intervals (brake test, safe brake management, safe brake and holding system, etc.).

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ROBA®-linearstop E safety brakes are components according to VDE0580:2011-11. We are not referring to a harmonized standard in terms of European directives, but rather all references to standards are in relation to EN/IEC and ISO standards. VDE0580:2011-11 must be regarded as state of the art.

Basic safety principles of electrical systems : ROBA®-linearstop E

Basic safety principle	Explanations
Application of suitable materials and manufacturing methods	Long established component according to VDE 0580, CSA-approved Data according to product drawing, original operating instructions, catalog
Correct dimensioning and design	Long established component according to VDE 0580, CSA-approved Data according to product drawing, original operating instructions, catalog
Suitable selection, combination, arrangement, assembly and installation of the components/system	Not applicable
Correct protective conductor connection	Where specified or labeled on plug connector or cable, see VDE0580, section 4.6 (see IEC 60204-1, 9.4.3.1)
Insulation monitoring	Not applicable
Application of energy-separation principle	Fail-safe principle of ROBA®-stop safety brakes via safe separation of energy supply
Suppression of voltage peaks	See VDE 0580, section 4.7 Included when using mayr (fast acting) rectifiers according to specifications
Reduction in response times	Choose suitable wiring in accordance with original operating instructions
Compatibility	Long established component according to VDE 0580, CSA-approved Data according to product drawing, original operating instructions, catalog
Resistance to environmental demands	Long established component according to VDE 0580, CSA-approved Data according to product drawing, original operating instructions, catalog
Secure mounting of the input devices	Not applicable
Protected against unexpected start-up	Safe separation of energy supply, unexpected start-up not possible as no energy storage available
Control circuit protection	Safety devices in the electrical equipment according to the original operating instructions
Consecutive switching for electric circuits with series connections of redundant signals	Not applicable

Tried and tested safety principles	Explanations
Mechanically connected contacts	Part of the machine manufacturer's electrical equipment, in accordance with the risk analysis, in compliance with the original operating instructions

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Tried and tested safety principles	Explanations
Preventing faults in cables	Separation of energy and sensor systems, short circuits or earth short-circuits do not cause the brake to release
Distances between electrical conductors	Use of suitable plugs and terminals
Energy limitation	Not applicable
Limitation of electrical parameters	Limitation of current and voltage via machine manufacturer's electrical equipment in compliance with the technical data according to the original operational instructions
Preventing undefined states	Quiescent current/fail-safe principle of ROBA®-stop safety brakes via safe separation of energy supply by machine manufacturer
Positive actuation mode	Not applicable
Adjusting states in the event of failures	Quiescent current/fail-safe principle of ROBA®-stop safety brakes via safe separation of energy supply by machine manufacturer
Fail-over	Quiescent current/fail-safe principle of ROBA®-stop safety brakes via safe separation of energy supply by machine manufacturer Interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state
Over-dimensioning	Thermal class of the coil at least one level higher than the operating temperature during standard use
Reduction in possible faults	Observation of the plausibility of switching times, switching states, feedback signals and movements of the axis
Balance between complexity/simplification	Not applicable

Tried and tested components	Explanations
Switch (direct-opening)	Not applicable
EMERGENCY STOP device	Not applicable
Fuse	Part of the machine manufacturer's electrical equipment, in compliance with the original operating instructions
Circuit breaker	Part of the machine manufacturer's electrical equipment, in compliance with the original operating instructions
Differential circuit-breaker/RCD	Not applicable
Main contactor	Not applicable
Actuation and protective switching device	Not applicable
Auxiliary contactor (e.g. relay)	Not applicable
Transformer	Not applicable
Cable	In accordance with technical specifications or machine manufacturer requirements
Plug and socket	In accordance with technical specifications or machine manufacturer requirements
Temperature switch	Not applicable
Pressure switch	Not applicable
electromagnetic valve	Not applicable

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Fault and fault exclusions for lines/cables	Explanations
Short-circuit between any two conductors	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state, taking into account machine manufacturer specifications and IEC60204-1 requirements
Short-circuit between any conductor and an exposed conducting part or earth or protective conductor connection	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state, taking into account machine manufacturer specifications and IEC60204-1 requirements
Interruption of conductor	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state, taking into account machine manufacturer specifications and IEC60204-1 requirements

Fault and fault exclusions for clamping units	Explanations
Short-circuit between neighboring terminals	Internal terminals comply with normative specifications or those of the machine manufacturer, in accordance with the specified protection class

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Fault and fault exclusions for multipolar plug connectors	Explanations
Short-circuit between any two neighboring connector pins	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state, taking into account machine manufacturer specifications and IEC60204-1 requirements
Mixed-up or incorrectly inserted pin if there is no mechanical method to prevent this	No, ISO 13849-2 specifications Plug according to machine manufacturer specifications
Short-circuit between any conductor (see comment) and earth or a conducting part or the protective conductor	No, ISO 13849-2 specifications Plug according to machine manufacturer specifications
Interruption of individual connector pins	No, ISO 13849-2 specifications Plug according to machine manufacturer specifications

Fault and fault exclusions for inductivities	Explanations
Interruption	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state
Short-circuit	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state
Random change in value 0.5 LN < L < LN + difference, whereby LN is the nominal value of inductivity	YES, interruption, short-circuit, earth fault, together with the prescribed fuses, always result in a de-energized state = braked safe state; necessary diagnosis (switching condition monitoring can detect faults)

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