Validation aid for the use of ROBA®-linearstop safety 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 safety brakes 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.

The validation aid applies to the following types:

ROBA®-linearstop pneumatic	
Construction size	Types
All	381._ _ _. _

ROBA®-linearstop hydraulic	
Construction size	Types
All	380._ _ _. _

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

ROBA®-linearstop pneumatic	
Construction size	$B10_d$ switching cycles
LBP 20	2,000,000
LBP 30	2,000,000
LBP 40	2,000,000
LBP 60	2,000,000
LBP 70	2,000,000
LBP 80	2,000,000

ROBA®-linearstop hydraulic	
Construction size	$B10_d$ switching cycles
LBH 10	1,000,000
LBH 20	1,000,000
LBH 30	1,000,000
LBH 40	1,000,000

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 refers to the mechanical switching procedure, i.e. the movement of the pistions and the collet, a well as 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, regular inspections or maintenance tasks are necessary. These activities concern the collet, the brake mounting and the piston rod. Refer to the original operating instructions for specific information on inspections, maintenance tasks and wear tests.

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

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

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 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, are applicable to the ROBA®- linearstop safety brakes
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 holding and braking and correct operation of ROBA®- linearstop safety brakes, 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-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®- linearstop 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 actuation (pressurization) 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. by the brake control or a pressure sensor. 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.

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

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 depressurized condition, the springs press against a cone. This compresses the collet and clamps or brakes the piston rod. When operating pressure is applied, the cone is pushed 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	For holding force tolerance and dimensioning of other machine elements, see original operating 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.
suitable reaction time	Switching time according to the original operating instructions, • Switching time of the brake t_{50} • Separation time (release) t_2
Protected against unexpected start-up	An unexpected start-up, i.e. brake is opened, is only possible by pressurizing the brake. Machine manufacturers/operators must take measures to reliably prevent this from occurring. Disassembling the brake results in a loss of holding 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 / machine operator
Suitable lubrication	Lubrication not required - dry running or lifetime-lubricated sealing surfaces Compressed air quality or hydraulic oil see original operating instructions
suitable protection against penetration of liquids and dust	Protection of brakes, see original operating instructions If there are special ambient conditions, additional measures can be taken after consultation (e.g. sealing air).

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

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

Tried and tested safety principles of mechanical systems

Tried and tested safety principle	Explanations
Application of carefully selected materials and manufacturing methods	Use of tried and tested 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	If several springs are used to generate force, the holding force will not be completely lost if one spring breaks.
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 prevents a loss of spring force over the brake’s service lifetime of 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.

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

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 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.).

Basic safety principles of pneumatic systems

Basic safety principle	Explanations
Application of suitable materials and manufacturing methods	Use of tried and tested materials and manufacturing methods
Correct 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 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.
Application of energy-separation principle	Fail-safe principle of ROBA®- linearstop brakes via safe separation of energy supply
Suitable mounting	Dimensioning of screw connection according to established internal specifications
Pressure limitation	Specification of the maximum operating pressure in the original operational instructions. The machine manufacturer and operator are responsible for the use of suitable pressure limiters.
Limitation/reduction of speed	Throttles or hose length and diameter influence the switching time of the brake. Specifications according to original operating instructions
Sufficient measures to prevent the fluid from becoming contaminated	Specifications according to original operating instructions
Suitable switching time range	Specification of the switching times in the original operational instructions
Resistance to ambient conditions	Use of tried and tested components and design Ambient conditions as specified in the original operational instructions.
Protected against unexpected start-up	An unexpected start-up, i.e. brake is opened, is only possible by pressurizing the brake. Machine manufacturers/operators must take measures to reliably prevent this from occurring.
Simplification	Generation of the holding force according to simple principle

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

suitable temperature range	As specified in the original operational instructions
Separation	Use of brake only for safety-related functions under the responsibility of the machine manufacturer / machine operator

Tried and tested safety principles of pneumatic systems

Tried and tested safety principles	Explanations
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
Valve closing due to the load pressure	Selection of valves by machine manufacturer / machine operator
mechanically created effect	Energy-separation principle, fail-safe principle
Proliferation of parts	If several springs are used to generate force, the holding force will not be completely lost if one spring breaks.
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 prevents a loss of spring force over the brake's service lifetime of 2 million load cycles.
Limitation/reduction of the speed using resistance to achieve a defined volume flow rate	Not desired Switching times should be as low as possible. Wiring according to the original operating instructions; machine operator checks the braking distance
Limitation/reduction of force	Holding force tolerance, see original operating instructions
Suitable range for the operating conditions	Operating conditions according to the original operational instructions
Suitable prevention of contamination of the fluid	Compressed air quality according to original operating instructions
Sufficiently large positive overlap in gate valves	Not relevant
Hysteresis limitation	Use of tried and tested construction and dimensioning according to internal specifications. Hysteresis due to friction; spring force is known and taken into account.

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

Basic safety principles of hydraulic systems

Basic safety principles	Explanations
Application of suitable materials and manufacturing methods	Use of tried and tested materials and manufacturing methods
correct 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 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.
Application of energy-separation principle	Fail-safe principle of ROBA®- linearstop brakes via safe separation of energy supply
suitable mounting	Dimensioning of screw connection according to established internal specifications
Pressure limitation	Specification of the maximum operating pressure in the original operational instructions. The machine manufacturer and operator are responsible for the use of suitable pressure limiters.
Limitation/reduction of speed	Throttles or hose length and diameter influence the switching time of the brake. Specifications according to original operating instructions
Sufficient measures to prevent the fluid from becoming contaminated	Specifications according to original operating instructions
Suitable switching time range	Specification of the switching times in the original operational instructions
Resistance to ambient conditions	Use of tried and tested components and design Ambient conditions as specified in the original operational instructions.
Simplification	Generation of the holding force according to simple principle
suitable temperature range	Specifications according to original operating instructions
Separation	Use of brake only for safety-related functions under the responsibility of the machine manufacturer / machine operator

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com

Tried and tested safety principles of hydraulic systems

Tried and tested safety principles	Explanations
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
Valve closing due to the load pressure	Selection of valves by machine manufacturer / machine operator
mechanically created effect	Energy-separation principle, fail-safe principle
Proliferation of parts	If several springs are used to generate force, the holding force will not be completely lost if one spring breaks.
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 prevents a loss of spring force over the brake's service lifetime of 2 million load cycles.
Limitation/reduction of the speed using resistance against a fixed volume flow	Not desired Switching times should be as low as possible. Wiring according to the original operating instructions; machine operator checks the braking distance
Limitation/reduction of force	Holding force tolerance, see original operating instructions
Suitable range for the operating conditions	Operating conditions according to the original operational instructions
Monitoring of the fluid condition	Hydraulic oil according to original operating instructions
Sufficiently large positive overlap in spool valves	Not relevant
Hysteresis limitation	Use of tried and tested construction and dimensioning according to internal specifications. Hysteresis due to friction; spring force is known and taken into account

Chr. Mayr GmbH + Co. KG
Eichenstraße 1, D-87665 Mauerstetten
Phone: +49 8341 804-0, Fax: +49 8341 804-421
www.mayr.com, E-Mail: public.mayr@mayr.com