Technical Information TI-B10
Safety Brakes series KSP

- ☑ high holding forces by self-intensifying clamping
- ☑ pneumatic releasing
- ☑ secure against overloading
- ☑ with DGUV approval for intended use “static holding of loads and forces”

Contents

A detailed description of the control, assembly and operational test of the SITEMA Safety Brakes KSP can be found in the *“Operating Manual BA-B10”.*

1 Purpose

The Safety Brake KSP is designed and built to hold raised loads on a piston rod or on a separate clamping rod. The following purposes are possible and permitted:

1. Static holding of loads and forces

   Static holding of a weight against gravity on a round rod and securing load to prevent it from falling in one direction. The size of the Safety Brake KSP must be selected in such a way that the static forces do not exceed the admissible load (nominal load M) of the Safety Brake KSP as given in the *„Technical Data Sheet TI-B11“.*
   For this static holding, the Safety Brake KSP is certified according to the testing principle GS-HSM-02 of the DGUV (testing and certification body of the statutory accident insurance and prevention institution in Germany). For further information see *“EC type-examination certificate TI-B40“*, Internet download: www.sitema.com.

2. Emergency braking

   Emergency braking of a mass moving downwards in the specified direction. In this direction the brake force is high (higher than the nominal load) but limited to ensure well-defined energy dissipation.

The national and international regulations regarding safety as far as applicable to the particular case must be observed.

2 Function

2.1 Structure

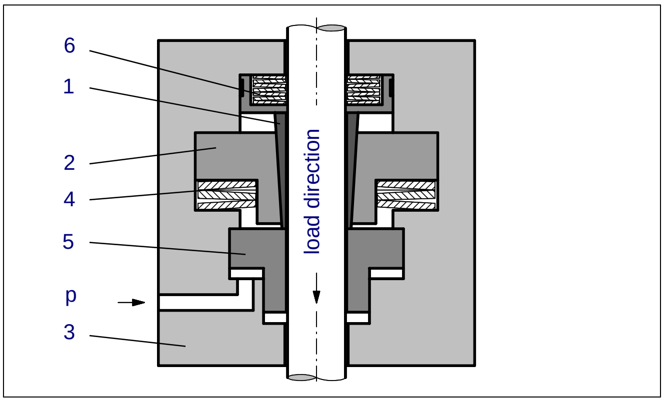

Fig. 1: Structure Safety Brake KSP; clamping released

As shown in *Fig. 1*, the clamping system consists of a conical clamping sleeve (1) with an outer cone moving within a clamping ring (2). This whole clamping system is movable inside the housing (3) against the force of the disc springs (4). In released condition, the annular piston (5) keeps the clamping sleeve pushed against the set of disc springs (6) by pneumatic pressure, so that the rod can move freely in both directions.

2.2 Static holding of the load

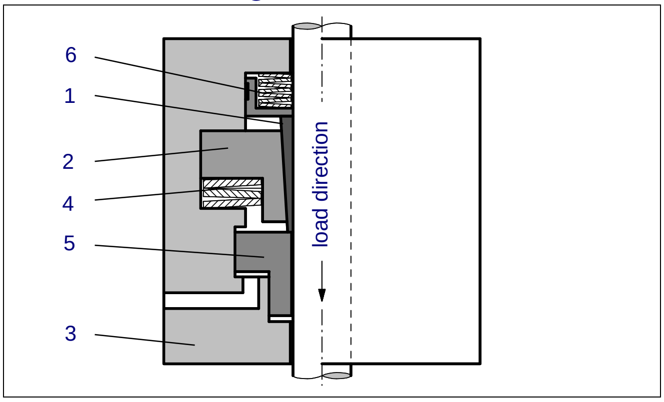

Fig. 2: Rod clamped, maximum load equals nominal load

At zero pressure the clamping sleeve (1) is pushed into the cone of the housing by a set of disc springs (6), whereby an initial friction contact between rod and clamping sleeve is achieved. If a load is now acting on the rod, the clamping process becomes self-intensifying.

Acting force does not exceed the nominal load M, the movement of the rod is very small, typically under 0.5 mm. The position of the clamping ring remains in its original position, because the spring force V (4) is somewhat larger than M.

2.3 Dynamic braking of a falling mass

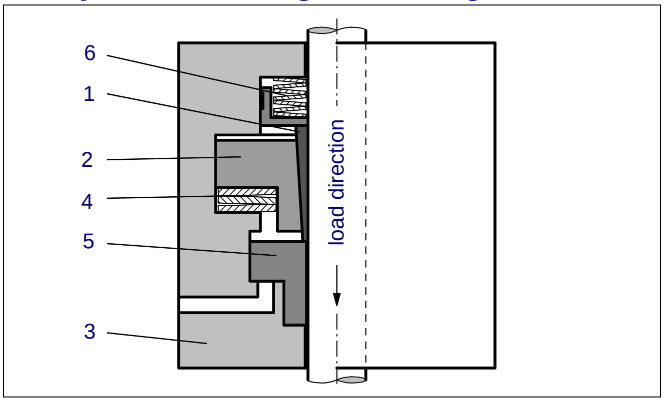

Fig. 3: Rod clamped, overload due to dynamic braking. The dynamic braking force is substantially larger than the nominal load.

If a moving mass has to be stopped, the kinetic energy has to be dissipated by friction.

For the clamping system, this means that the dynamic forces become much higher than the static forces. If the load exceeds the spring force V (4) *Fig. 4*, than the whole package (clamping ring (2) + clamping sleeve (1) + annular piston (5)) moves together with the rod until it gets to the mechanical stop after approx. 2 mm. The spring (4) then bounces slightly, without reaching the block storage area. The clamping force cannot increase after this point.

The slipping force for the rod is thus limited and predictable, lying between 2 and 3.5 times M. The resulting deceleration (if load is equivalent to M) is thus between g (gravity) and 2,5 x g. The shaded area under the force-deflection curve represents the dissipated energy.

After stopping, the spring (4) will again raise the mass by a small amount.

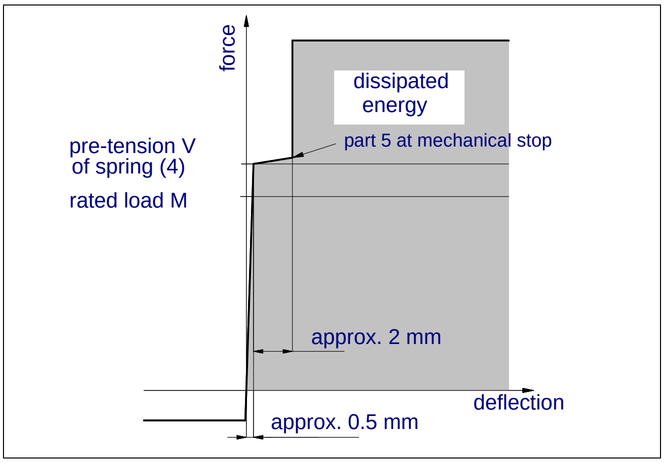

Fig. 4: Force-deflection diagram

2.4 Releasing the clamping

If the rod did not move after clamping and therefore no load is was transferred to the safety brake, the clamp may be opened by simply applying the operating pressure.

However, if the clamp is to be released while the Safety Brake KSP is holding a load, an upward movement of the rod is normally necessary additionally to the release pressure at port L. Thus providing the safety advantage that the clamp can generally only be released as far as the hoist drive is intact and controlled.

However this advantage does not necessarily apply to small loads with a simultaneously high release pressure (for details see minimal loads F6 in *"Technical Data Sheet TI-B11"*).

A standard proximity switch has to be used to indicate signal 2 "clamping released".

2.4.1 Upward movement

The release pressure should normally be enabled for all upward movement, as the rod can then move freely.

Upward movement while clamped (without release pressure) is possible. The holding force then achieves approx. 15 - 20% of M. In exceptional cases, this effect can be used for slowing down masses in upward movement. In normal conditions, the safety brake should always be released during upward movement.

2.4.2 Downward movement

Downward movements are only possible when and as long as signal 2 "clamping released" is activated, it is therefore imperative that this signal be processed accordingly in the control unit.

3 Pressure medium

The compressed air must be dried and filtered. SITEMA recommends compressed air class 5-4-5 according to ISO 8573-1.

4 Control

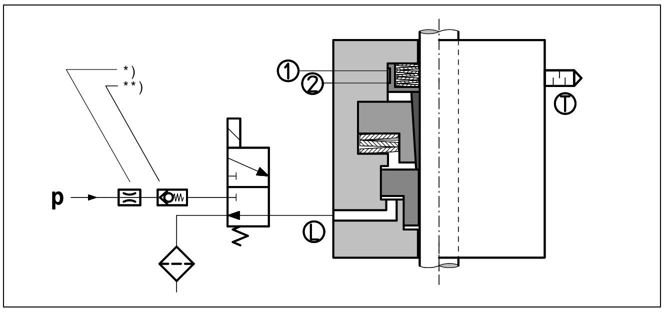

Fig. 5: Schematic diagramm of pneumatic circuit

* In case impact noises due to excess pressure are audible when pressurizing the Safety Brake KSP, these can be suppressed by means of a flow control valve in the p-line.

** In case the pressure is not sufficiently constant (e.g. pressure drop at the beginning of a downward stroke), we recommend a check valve in the p-connection of the valve.

Under no circumstances must the outgoing airflow from port L be impaired by any additional components.

⚠ **All connection lines must be laid out without kinks. If there is any danger of kinking, appropriate precautions must be taken (protective tube, thicker hose etc.).**

If a particular quick response time of the KSP Safety Brake is required, the following preconditions must be met:

- quick exhaust valve
- short line distances
- correspondingly large valve and line cross-sections
- appropriate control

4.1 Activation using 3/2-way valve

In most cases, the activation indicated in *Fig. 5* will be used.

During every operational cycle, the 3/2-way valve is actuated electrically and releases the Safety Brake KSP.

In all other operational conditions, as well as in cases of power failure, emergency stop, etc. the Safety Brake KSP becomes effective, secures the rod and/or stops the load. In case the pressure line should fail, the load is secured in the same way. If necessary the valve can also be switched by another safety signal, e.g. speeding, contouring error, etc. In these circumstances, the Safety Brake KSP operates as a generic emergency brake.

4.2 Proposal for the logic integration of the Safety Brake KSP in the machine control system

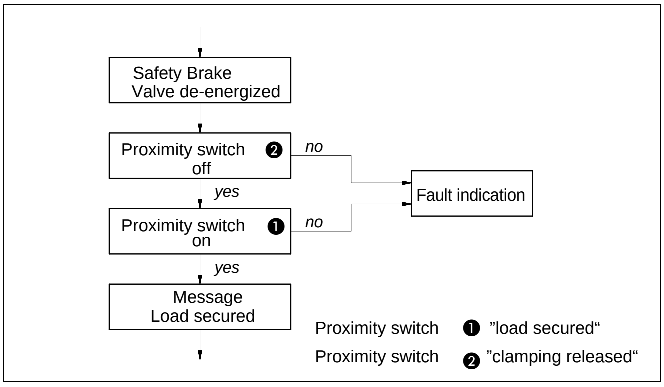

Fig. 6: *Secure load*

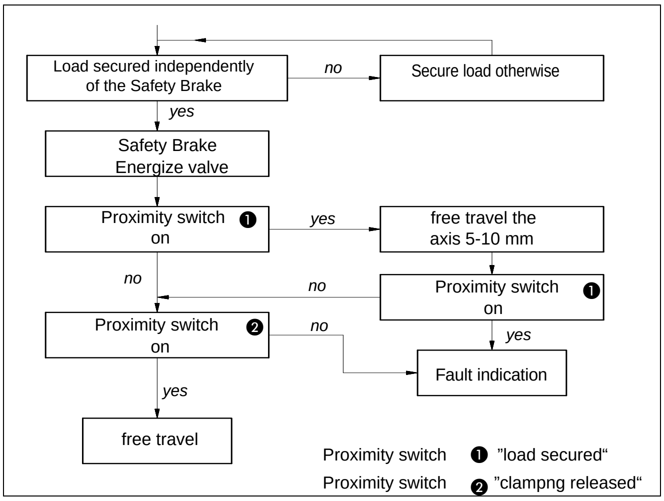

Fig. 7: *Release load*

5 Monitoring by proximity switches

The proximity switch 1 "load secured" signals the secure state and is used to authorise entrance to the danger area. Switch 2 "clamping released" is used to activate the downward movement of the drive.

For automatic detection of failures both signals are compared. In case both switches indicate the same state - apart from minor overlapping periods - there is a defect present.

6 Choosing the right size

The admissible load M is stated for all types in the *"Technical Data Sheet TI-B11"*. During normal conditions (vertical movement), the criteria load is to be maintained.

$$M \geq \frac{\text{moving weight}}{\text{number of safety brakes}}$$

The holding (braking) force for dry running or mineral-oil wetted rods is not less than 2 x M, but will not exceed 3.5 x M. The fixing elements which accept the load (e.g. linking the rod to the travelling tool etc.) must therefore be dimensioned for a 3,5 x M force. This maximum force can occur with emergency braking and also if, in case of control errors, the full driving force is exerted against the Safety Brake KSP. However circumstances of this kind should remain accidental exceptions, as otherwise possible damage could occur to the Safety Brake KSP.

When used in safety-related applications, please pay special attention to the information in the attachment to the DGUV certificate in *"EC type-examination certificate TI-B40"* (see in particular page 7).

7 Design and attachment of the rod

The Safety Brake KSP will operate correctly only if the rod has a suitable surface:

- ISO tolerance field f7 or h6
- surface roughness: Rz = 1 to 4 µm
- rod surface hardened (min. HRC 56)
- lead-in chamfer min. 3x20°, rounded

An additional hard chrome plating 20 +/- 10 µm, 800 – 1000 HV is recommended for protection from corrosion and a longer service life.

The following rod qualities are widely available and suitable:

1. piston rods, hard chrome plated (ISO tolerance f7)
   Basic material: yield strength min. 580 N/mm²
   Induction hardened HRC 56 - 64, min. depth 1 mm
   Hard chrome plating: 800-1100 HV, min. depth 13 µm
   Surface finish: Ra 0.15 - 0.25 µm

2. shafts for linear ball bearings (ISO tolerance h6)
   Induction hardened HRC > 60
   Surface finish: Ra 0.15 - 0.25 mm

The actual holding force of the Safety Brake KSP is higher than the admissible load indicated in the data sheets and drawings, but will not be higher than four times this value. Therefore, all fixation elements carrying the load (rod, its attachment, etc.) have to be dimensioned for 3,5 x M. Please note that at dynamic loads (e.g. when braking), the full holding force (3,5 x M) can occur.

Generally, the basic rod material has to have sufficient yield strength. In the case of compression-loaded rods, sufficient buckling resistance must be assured.

8 Operating conditions

SITEMA Safety Brakes KSP are designed to operate in normal clean and dry workshop atmosphere.

Heavy soiling conditions like grinding dust, chips, other liquids, etc. may require special protective measures. In such cases, please contact SITEMA.

The permissible surface temperature is 0 - 60°C.

9 Required risk assessment

It must be ensured that the dimensions and arrangement of a SITEMA Safety Brake KSP used in safety-relevant applications meet the requirements of the risk evaluation DIN EN ISO 12100:2011 and also comply with any further standards and regulations applicable for the intended use. The Safety Brake KSP alone principally cannot form a complete safety solution. It is however suitable to be part of such a solution. Furthermore, all attachments and fixations have to be dimensioned correspondingly. This is generally the duty of the system manufacturer and the user.

10 Regular functional checks

The Safety Brake KSP must be functionally checked at regular intervals. Regular checking is the only way to ensure that the unit will operate safely in the long run.

Please see the operation manual for further details.

11 Maintenance

The maintenance of SITEMA Safety Brakes KSP is limited to the prescribed regular functional check.

Should the Safety Brakes KSP cease to comply with the required characteristics, the aforementioned safety of working with the machine or system is no longer given. In this case the Safety Brakes KSP must be removed immediately and professionally repaired by SITEMA.

Safety Brakes KSP are safety devices. Any repair or refurbishing must be carried out by SITEMA.
SITEMA cannot take any responsibility for repairs by another party.