Expertise in Safety

English translation of German original

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Technical Information TI-B10

Safety Brakes type KSP

☑ High holding force by self-intensifying clamping

☑ Pneumatic actuation

☑ Secure against overloading

Contents

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

1 Purpose

The KSP Safety Brake 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

   Static holding of a weight against gravity on a round rod and securing load to prevent it falling in one direction. The size of the KSP Safety Brake must be selected in such a way that the static forces do not exceed the admissible load (nominal load M) of the KSP Safety Brake as given in the *„Technical Data Sheet TI-B11“*

2. Emergency brakes

   Emergency brakes for 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.

The KSP Safety Brake is typically used as a **clamping mechanism** or **emergency brake** in the following applications:

- Vertical drives of loaders
- Vertical or diagonal machine tool axes

2 Function

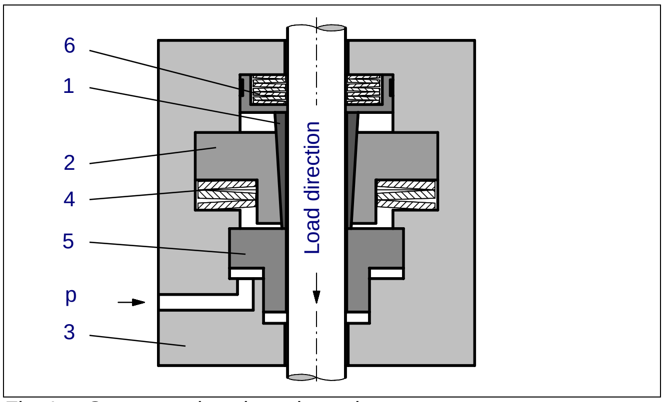

Fig. 1: Structure, clamping released

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 shaft can move freely in both directions.

Static holding of the load

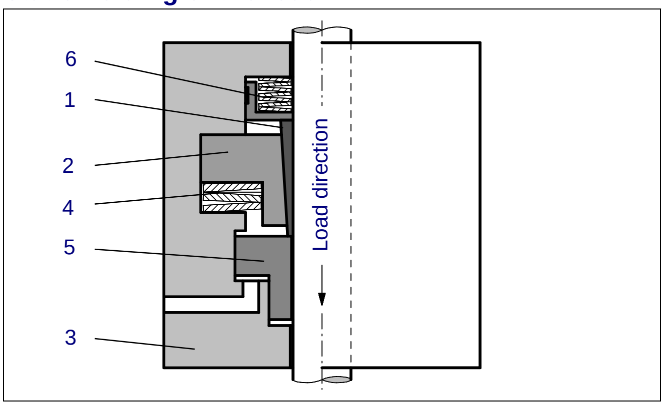

Fig. 2: Clamped, maximum load equals nominal load

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 (see *Fig. 1*).

Dynamic braking of a falling mass

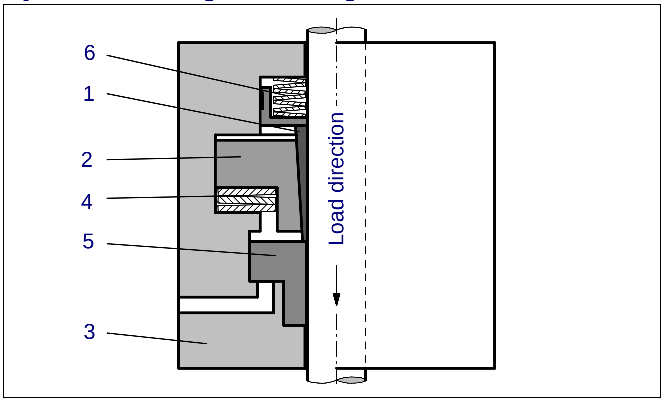

Fig. 3: Clamped and overloaded, i.e. dynamic braking force substantially larger than nominal load

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 2.5xg. 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.

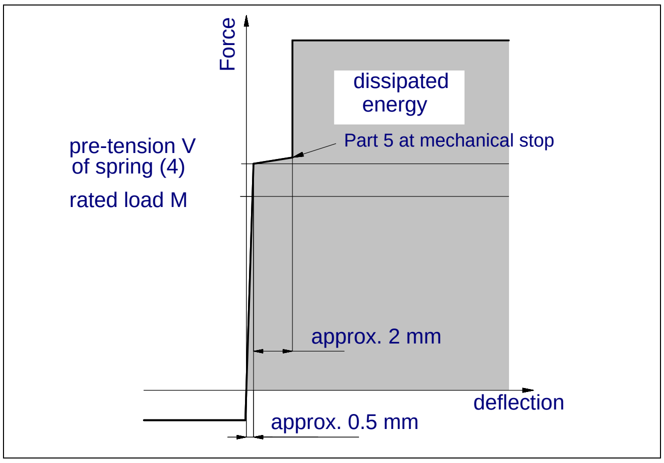

Fig. 4: Force-deflection diagram

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 KSP Safety Brake 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".

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 friction force then achieves approx. 15-20% of M, which effect can principally be used for an emergency-stop in upward movement. In normal conditions, the safety brake should always be released during upward movement.

Downward movement

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

3 Control

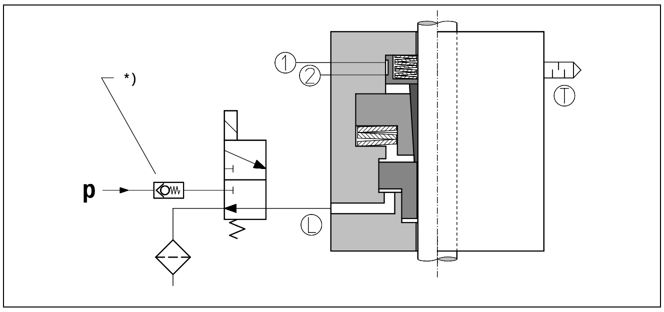

Fig. 5: Schematic diagramm of pneumatic circuit

* If the pressure (p) is not suficiently constant (e.g. pressure drop at the beginning of lowering movements) we recommend a check valve in the p connection of the valve.

Under no circumstances may the outflow of the medium from connection L be hindered 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.)**

Pressure medium

The compressed air must be dried and filtered.

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 KSP Safety Brake.

In all other operational conditions, as well as in cases of power failure, emergency stop, etc. the Safety Brake becomes effective, secures the shaft 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 KSP Safety Brake operates as a generic emergency brake.

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 '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.

4 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 shafts 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 fuill driving force is exerted against the KSP Safety Brake. However circumstances of this kind should remain accidental exceptions, as otherwise possible damage could occur to the KSP Safety Brake.

5 Rod requirements

The KSP Safety Brake is designed for operation on smooth round rods.

Fig. 6: Rod end with lead-in chamfer

Rod design requirements:

- The rod end is fitted with a lead-in chamfer (min. 3×20°, rounded) as a mounting aid.
- The rod surface is hardened (at least HRC 56), burnished and within ISO tolerance f7 or h6 and a surface finish Rz= 1 to 4 µm or R_a 0.15 - 0.25 µm
- The material has a yield strength sufficient to withstand the maximum posible load (up to 3.5 x M, see *§ "Dynamic braking of a falling mass"*). In the case of compression-loaded rods buckling resistance must be assured.

Most recommended are:

Piston rods, hard chrome-plated (ISO-tolerance f7 or h6)
basic material: yield strength min 580 N/mm²
induction-hardened HRC 56 - 64 / min. 1 mm deep
hard chrome plating: 800-1100 HV min 13 µm thickness
surface finish: R_a 0.15 - 0.25 µm

6 Operating conditions

The KSP Safety Brake is designed to operate in usual clean and dry shop atmosphere. In case of other environments at least the port T for breathing purposes is to be connected to a clen and dry volume (tank).

Should heavy soiling conditions (grinding dust, chips, other liquids, etc.) exist, please contact SITEMA.

Grease on the rod may reduce the holding force. The permissible surface temperature is 0 - 60°C.

7 Required risk assessment

If SITEMA - Safety Brakes are used in safety-relevant applications the following has to be carefully attended:

It must be ensured that the size, the dimensions and arrangement of SITEMA - Safety meet the requirements of the risk evaluation EN ISO 14121-1 for the complete machine and also comply with any further standards and regulations applying to the intended use. This is generally the duty of the system manufacturer/user.

8 Overall documentation and CE mark

The KSP Safety Brake is designed as a component for integration into a machine or system. The seller of the machine or system must provide information on the KSP Safety Brake with the overall documentation and - if applicable - ensure that the machine or system carries the CE mark.

9 Regular functional checks

The KSP Safety Brake 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 *„Operating Manual BA-B10“* for further details.

10 Maintenance

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

Should the KSP Safety Brake 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 KSP Safety Brake must be removed immediately and professionally repaired by SITEMA.

Any repair or refurbishing must be carried out by SITEMA. SITEMA cannot take any responsibility for repairs by another party.