Technical Information TI-B10E
KSE electric Safety Brakes

☑ For small to medium loads
☑ One load direction
☑ With DGUV Test Certificate

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1 Purpose

Safety Brakes ensure personal protection and accident prevention if a suspension element supporting raised loads or tools should break – for example if the electrical supply is switched off or if a power failure occurs (normally closed).

KSE Safety Brakes secure suspended loads in one load direction using electric power alone. They also function in all-electric systems without pneumatics or hydraulics.

Safety Brakes take over falling loads continuously at any position of the stroke and in a mechanically secure and absolutely reliable manner. The operating principle of self-intensifying clamping ensures an extremely high safety level.

Safety Brakes are designed for static holding of loads and forces and for emergency braking of loads.

1.1 Static holding of loads

The Safety Brake serves as a mechanical restraint device for static loads.

1.2 Emergency braking of loads

The Safety Brake can be used for emergency braking of a load in load direction. The braking force in load direction is higher than the admissible load M, but it is limited to ensure that energy is absorbed in a defined manner.

Emergency braking is understood to mean a rarely occurring braking process that stops a machine movement in an exceptional circumstance.

2 Controller and high-level control system

Fig. 1: SiBox and KSE

The KSE Safety Brake is delivered along with a SiBox SB 20 as a safety controller. The SiBox and the clamping head are a fixed combination; the SiBox is specially parameterized for the associated clamping head and must not be operated with any other clamping head.

The SiBox is used to control the KSE Safety Brake.

The SiBox and the clamping head must be integrated into the customer's high-level control system.

- Information on connecting the SiBox to the KSE can be found in the operating manual supplied with the SiBox.
- Information on integrating the SiBox into the customer's high-level control system is provided in *Safety Manual SH-CSB20* from SITEMA.

3 Operating principle and operating states

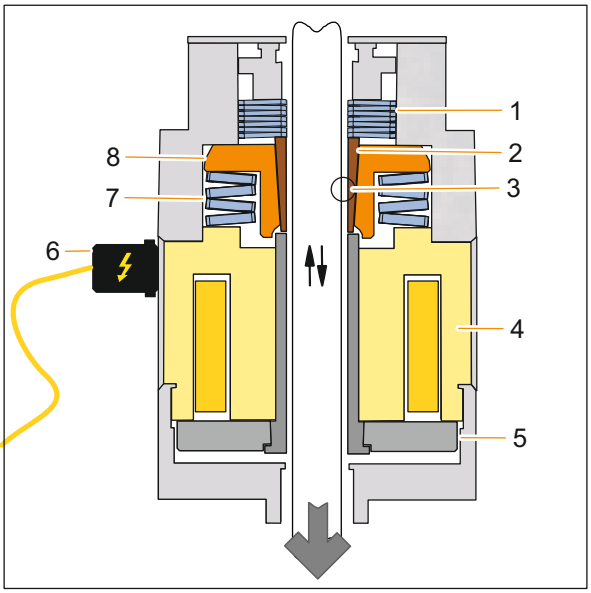

Fig. 2: KSE diagram: Clamping released

1	Tensioning springs
2	Clamping sleeve
3	Air gap
4	Solenoid with magnetic coil
5	Armature
6	Valve connector (connection to SiBox)
7	Overload springs
8	Clamping ring
	Load direction
	Directions of motion of rod

Visit our website www.sitema.com to see an animation of the operating principle.

The clamping system is within the housing. It consists of a clamping sleeve (2) with an outer cone and a clamping ring (8) with an inner cone. The clamping ring can slide within the housing. The overload springs (7) press the clamping ring against a stop.

Operating state "clamping released"

When a voltage is applied to the KSE (solenoid is activated), the clamping is released. The solenoid (4) attracts the armature (5). The clamping is therefore in the released position against the force of the tensioning springs (1). This results in a defined air gap (3) between the clamping sleeve and the rod. The rod can move freely in both directions.

To keep the armature in this position, current flows continuously from the SiBox (controller) to the clamping head.

The signal of proximity switch 2 is active: clamping released

Operating state "load secured"

When the current is switched off, the tensioning springs push the clamping sleeve into the cone of the clamping ring. The clamping sleeve makes contact with the clamping rod. This secures the load. The Safety Brake has not yet taken over the load.

The signal of proximity switch 2 becomes inactive; the signal of proximity switch 1 becomes active: load secured

To release the clamping, voltage must be reapplied to the KSE.

Operating state "load taken over"

When a force is now exerted on the rod in load direction, the clamping system tightens and so self-intensifies. The rod movement is minimal – less than 0.5 mm – as long as the force does not exceed the admissible load M.

The clamping ring remains in its original position because the preload of the overload springs slightly exceeds the admissible load M.

The signal of proximity switch 1 stays active: load secured

To release the clamping, the drive must move the rod in the opposite direction to load direction. A voltage must be applied to the KSE at the same time.

Emergency braking and overloads (special operating state)

If the load exceeds the preload of the overload springs, the whole assembly consisting of clamping sleeve, clamping ring and annular piston moves with the rod until it reaches the mechanical stop after approx. 2 mm. From this point on, the clamping force of the sleeve cannot increase, so the rod slips. This is how the unit brakes a moving load at a defined braking force in an emergency.

The force at which the rod starts to slip is at least twice the admissible load M. It is limited to 3.5 times the admissible load M. This limitation is important for the dimensions of the attachment elements of the unit and rod.

4 Complete system overview

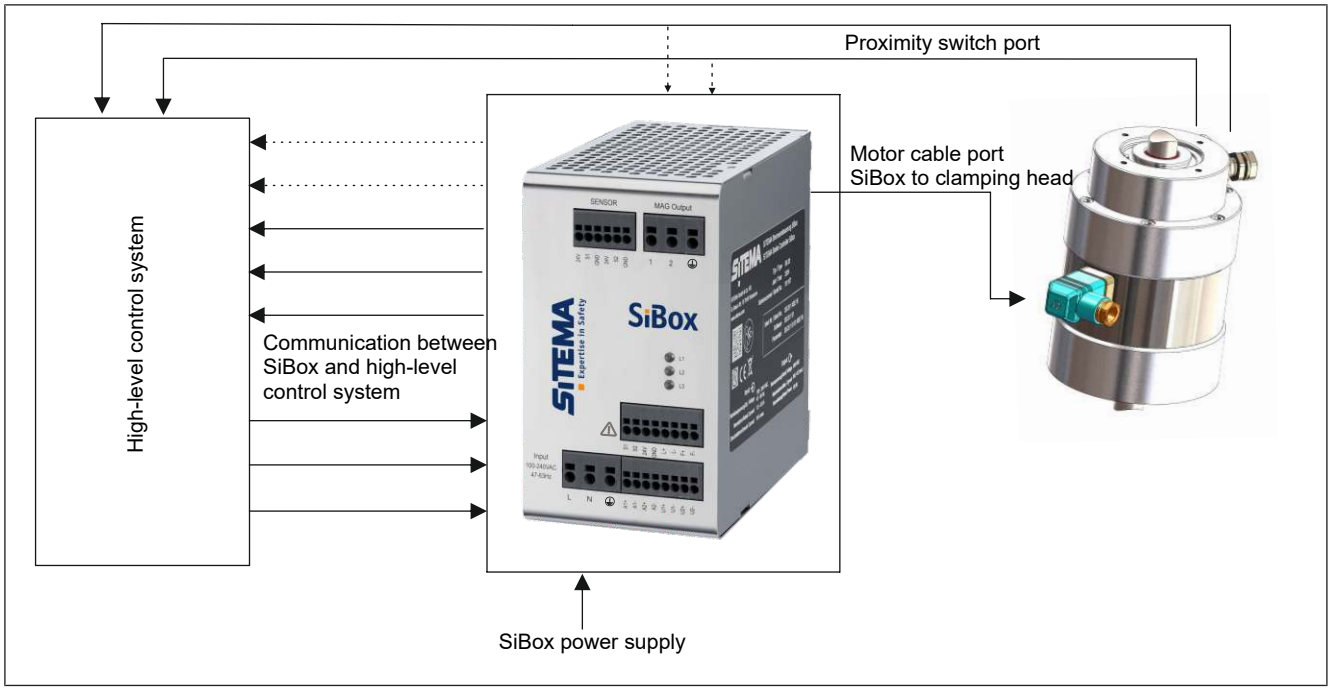

Fig. 3: Complete system overview

SITEMA delivers a system consisting of a clamping head and a SiBox controller; the SiBox is specifically parameterized for the particular clamping head. The clamping head and the SiBox must then be integrated into a high-level control system (safety PLC) by the customer. Exactly how this integration is done depends, among other things, on the desired performance level (in accordance with EN ISO 13849). Detailed information on this integration can be found in *Safety Manual SH-CSB20* supplied by SITEMA.

5 Operating conditions

Condition	Value
Permissible ambient temperatures	+10 to +50 °C (50 to 122 °F)

Table 1: Operating conditions

For other temperatures, please consult SITEMA.

The Safety Brake has been designed for use in dry and clean surroundings. Condensation water should be avoided. A heavily contaminated operating location requires special protective measures.

6 Choosing the right type

Technical Data Sheet TI-B12 specifies the admissible load M for all types. Normally (for vertical movement), the following condition must be met:

$$M \geq \frac{\textit{moving weight}}{\textit{number of Safety Brakes}}$$

The holding force of the KSE with a dry or hydraulic-oil wetted rod is at least 2 x M but will not exceed 3.5 x M.

7 Requirements of the clamping rod and fastening elements

The Safety Brake will function correctly only if the clamping rod is properly designed.

Requirement	Diameter	Value
ISO tolerance zone	all	f7 or h6
Induction hardened	all	min. HRC 56
Surface hardening depth	ø up to 30 mm	min. 1 mm
	ø over 30 mm	min. 1.5 mm
Surface roughness	all	Rz = 1 to 4 µm (Ra 0.15 to 0.3 µm)
Protection from corrosion	all	Hard chromium plating, for example: 20 ± 10 µm 800 - 1,000 HV
Lead-in chamfer rounded	ø 16 to 32 mm	min. 4 x 30°

Table 2: Clamping rod requirements

The rod must not be greased.

Manufacturers of cylinder piston rods or rods for linear ball bearings usually offer suitable clamping rods.

The actual holding force of the Safety Brake is higher than the admissible load (M) indicated on the data sheets and dimensional drawings. It does not exceed 3.5 times this value, however.

Accordingly, the fastening elements taking over the load (rod and its linkage, etc.) have to be dimensioned for at least 3.5 x M. This maximum force can occur during dynamic braking and also if, in case of control errors, the drive force is exerted against the closed Safety Brake.

The rod will slip in case of overload, which normally does damage the rod or the Safety Brake.

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

8 Fixed installation or radially floating installation

The Safety Brake can be installed radially floating or fixed. The type of installation depends on how the rod is installed.

Rod is installed fixed:

- Mount the Safety Brake radially floating.
  You can use the spring base for Safety Brakes for this purpose, see *TI-B20 Spring base for Safety Brakes*.

Rod is installed floating:

- Mount the Safety Brake securely with a direct screw connection.
  You can use the SITEMA rod attachment STB for this purpose, see *TI-STB10 SITEMA rod attachment*.

9 Unit stationary or travelling with the load

If the Safety Brake is integrated into the machine as a stationary component, the load (e.g. the slide of a press) is generally movable.

If the Safety Brake moves with the load, the rod is usually stationary.

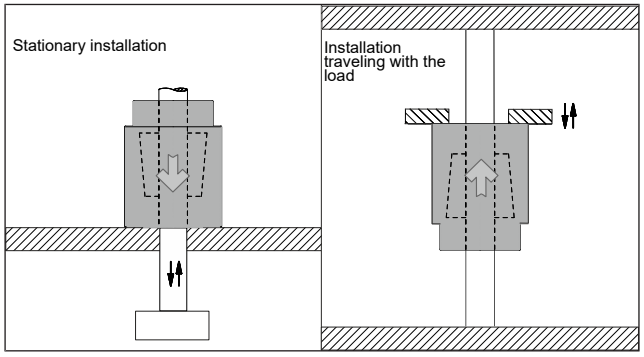

Fig. 4: Installation stationary or traveling with the load

⇅	Stationary installation: direction of movement of load and clamping rod
	Installation traveling with the load: direction of movement of load and Safety Brake
↓	Load direction

10 Status monitoring by proximity switches

Proximity switches monitor the operating state of the Safety Brake. These are not included in the scope of delivery and can be ordered separately from SITEMA. The proximity switches send the following signals to the machine control system:

Proximity switch	Signal	Purpose
1	Load secured	Enabling access to the danger zone.
2	Clamping released	Enabling drive movement in load direction.

To check the correct functioning of the proximity switches, the switching of the signals has to be tested. There is an error if both proximity switches indicate a signal or no signal at the same time (apart from short overlapping periods during switching).

The machine control system must process the signals from the proximity switches correctly.

You can find more information on proximity switches in the associated data sheet.

11 Regular performance tests

A performance test of the Safety Brake must be carried out at regular intervals. Regular checking is the only way to ensure that it will operate safely in the long run.

Please see the Operating manual for further details.

12 Service life

The frequency with which certain operating states occur plays an important role for the Safety Brake service life.

State	Stress
Securing the load	When securing a stationary load, the occurring material stresses are negligible and can be withstood millions of times over.
Taking up the load	When taking up the load, the Safety Brake may reach maximum holding force. Forces and material stresses in accordance with the design occur. The rod does not slip.
Emergency braking	The Safety Brake can withstand braking processes with a slipping rod from several hundred times to a few thousand times without damaging the clamping head or the rod. It is suitable for braking from speed ranges up to max. 1.5 m/s.

Table 3: Operating states and stress

For an extended service life, the following operating conditions should be avoided:

- Constant braking during movement
- Incorrect operation of the drive with the clamping closed

You can also take the following steps to extend the service life:

- Do not expose the rod to any transverse forces.
- Use a rod with a finish that is not too rough.
- Protect the interior of the housing against penetration of corrosive media and dirt.
- Do not clamp the rod until it has completely stopped. Ensure the correct sequencing of the operating states by appropriate actuation and control.

13 Maintenance

Maintenance is limited to a routine performance test. If the Safety Brake ceases to comply with the required characteristics, the machine or system may no longer be safe to work with. In this case the Safety Brake must be immediately and professionally repaired by SITEMA.

To ensure function as a safety-related component, any repair or refurbishing must be carried out by SITEMA. SITEMA will not take any responsibility for repairs carried out by another party.

14 Risk assessment

It must be ensured that the dimensions and arrangement of Safety Brakes used in safety-relevant applications meet the requirements of EN ISO 12100:2010 and also comply with any further standards and regulations applicable for the intended use. The Safety Brake alone principally cannot be a complete safety solution. It is however suitable to be part of such a solution. Furthermore, all attachments and connections have to be dimensioned correspondingly. This is the task of the machine manufacturer/operator.

15 Information on product safety

DGUV Test Certificate

The SITEMA Safety Brake KSE (the mechanical part) has been certified by DGUV Test (testing and certification body) for holding a load from standstill, for installation in the following machines:

- presses according to DIN EN 289
- mechanical "Group 1" presses according to DIN EN ISO 16092-1/-2
- hydraulic presses according to DIN EN ISO 16092-1/-3
- injection-molding machinery according to DIN EN ISO 20430

You will find the DGUV Test Certificate and further information in the *Technical Information TI-B40* (download from our website *www.sitema.com*).

Safety features and functions

Safety feature	Remarks
Safety features	Securing from standstill, emergency braking
Fail-Safe	Normally closed
Suitable for operator protection	yes
Proven component	yes*
Traceability	100 % with serial number
Final product check	Carried out for all units by SITEMA, documented
CE marking	According to conformity assessment procedure
Safety component	According to EU Machinery Directive 2006/42/EG and Regulation on machinery products 2023/1230
Safety features according to ISO 13849-1:2023	The control of the KSE Safety Brake by the SiBox SB 20 complies with the requirements of PL e category 4 Safety concept certified by TÜV Süd Rail.

Table 4: Safety features and functions

*) The product is a proven component for a safety-related application according to ISO 13849-1. The product fulfills the basic relevant and proven safety features according to ISO 13849-2.

16 Further information

For technical data on the various series and information on optional accessories, refer to these Technical Data Sheets:

- *Technical Data Sheet TI-B12*: Series KSE
- *Technical Data Sheet TI-B20*: Spring base for Safety Brakes
- *Operating Manual BA-B12*: detailed description of actuation, mounting and performance test

17 Accessories

We recommend the following accessories: All these parts are available from SITEMA:

Accessories	Description
SiBox SB-20	Standard SITEMA controller, pre-parameterized for the KSE
Proximity switch holder	Type NHT
Proximity switches	From SITEMA on request
Switch module (install in manual mode)	From SITEMA on request, suitable for the supplied combination of controller + clamping head
Spring base	From SITEMA on request. A spring base compensates for inaccuracies in alignment, ensures easier release of the SITEMA Safety Brake and extends its service life.
Rod attachment	For securely attaching the rod to the machine part; already designed for the maximum force of the clamping head, see *TI-STB10*