English translation of German original

TI-A10-EN-03/2011

Technical Information TI-A10

Safety Catchers

- ☑ High holding force by self-intensifying clamping
- ☑ Hydraulic respectively pneumatic actuation
- ☑ Approved for use in presses and lifting gear (DIN EN 693)

Contents

A detailed description of the control, assembly and operational test of the SITEMA Safety Catchers can be found in the *„Operating Manuals BA-A11 to BA-A14“ .*

1 Purpose

Safety Catchers are used where protection of personnel and accident prevention must be achieved in connection with raised loads or tools in case of failure of load-bearing machine parts. This may be a leakage or breakdown, for example, of a hydraulic or pneumatic pressure system. Safety Catchers catch falling masses infinitely variable at any position of the stroke, in a mechanically secure and absolutely reliable manner. The design principle of the self-reinforcing clamping ensures an extremely high safety level.

2 Function

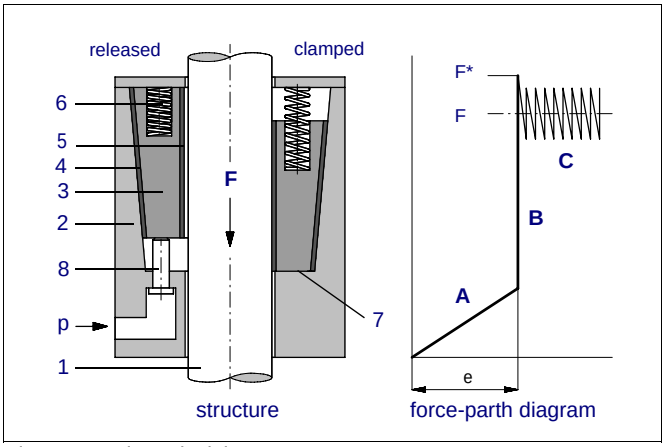


Fig. 1: Design principle

The piston shaft (1) is surrounded by the housing (2) in which several wedged clamping jaws (3), each with one slide lining (4) and one brake lining (5), are assembled. When pressure (p) is applied to the plungers (8), the clamping jaws are held in a raised position so that the shaft can move freely. The springs (6) are compressed in this position.

The Safety Catcher becomes effective as soon as pressure is released from the plungers (8). The action of the springs causes the clamping jaws (3) to then clamp the shaft (1) firmly, thus securing the load.

The clamping force, however, is not built up until the shaft has been moved by the load. Due to the self-intensifying static friction at the shaft, the clamping jaws (3) are drawn into the clamping position at their stops (7) after having moved the distance "e" (approx. 5 to 15 mm, depending on the design). This movement is illustrated as phase **A** in the force-path diagram.

If the load is increased further (phase **B**), the shaft remains in its position, independent of the load, until the static holding force F* is reached. As soon as this limit is exceeded, the clamping device (phase **C**) generates a mean dynamic braking force F -- the holding force -- and thus dissipates the kinetic energy of the falling mass.

The clamping is released by an upward movement of the shaft through path "e", by applying pressure corresponding to the load being lifted. Thus the release operation is only possible if the pressure system is intact. Excess pressure (e.g. for breaking loose) is normally not required.

3 Design types

Depending on size there are different types of SITEMA Safety Catchers. K-, KR- and KRP-type Safety Catchers are identical as far as function and application are concerned.

Type K

This type has a number of small plungers to lift the clamping jaws. They are pressurised simultaneously by a common, annular groove.

Type KR

In this case the lifting function is ensured by an annular piston instead of the individual plungers used in type K. For reasons of design and cost, this solution is preferred to type K if used on shaft diameters of less than approximately 80 mm.

Type KRP

The KRP-type is the pneumatic option within the familiy of Safety Catchers. Although the forces of pneumatic actuators are a lot less than of comparable hydraulic ones, the KRP-types and KR-types of same rod size have same outer dimensions and same holding capacity. This is why - thanks to the self-intensifying friction - the holding force does not depend on the acting spring force or actuator force.

4 Control

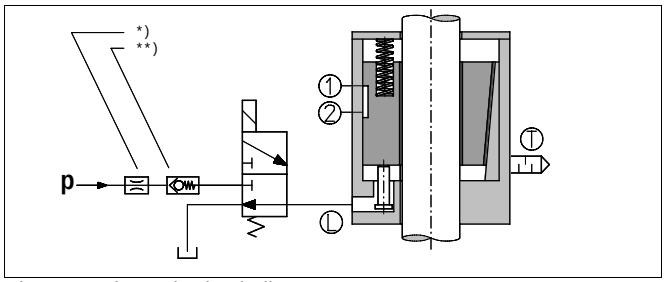


Fig. 2: Schematic circuit diagramm

* If impact noises are audible when pressuring the Safety Catcher due to excess pressure, they can be suppressed by means of a flow control valve in the p-line.

** If the pressure (p) is not suficiently 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 may the hydraulic flow between connection L and the tank be impaired by any additional components.

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

- Short piping distances
- large valve and pipe cross-sections
- fast valve response times

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

Pressure fluids

SITEMA Safety Catchers mostly are hydraulically actuated. Up to rod diameter 100 m also pneumatic versions are available.

Hydraulic actuation:

Hydraulic oil (HLP) in accordance with DIN 51524-2 must be used as pressure medium. Please consult us before using any other media.

Pneumatic actuation:

The compressed air must be dried and filtered.

Actuation with a 3/2-way valve

In most applications the actuation suggested in fig.2 is used. During every operational cycle, the 3/2-way valve is actuated electrically and releases the clamping device.

In all other operational conditions, as well as in cases of power failure, emergency stop, etc. the clamping device 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 required e.g. in hydraulic lifts, the valve can also be controlled by a speed governor. In this case the safety catcher acts as a safety gear (braking mechanism).

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.

5 Choosing the right size

The admissible load M is stated for all types in the *„Technical Data Sheets TI-A11 to TI-A14“*. During usual conditions (vertical movement), the criteria as below is to be maintained..

$$M \geq \frac{\textit{Moving weight}}{\textit{Number of safety catchers}}$$

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 bra king and also if, in case of control errors , the fuill driving force is exerted against the Safety Catcher. However, circumstances of this kind should remain accidental exceptions, as otherwise possible damage could occur to the Safety Catcher.

6 Rod requirements

The Safety Catcher will operate correctly only if the rod has the correct surface:

- ISO tolerance field f7 or h6
- Surface roughness: Rz = 1 to 4 µm or Ra= 0,1 bis 0,4 µm.
- Hardchrome plated surface recommended
- Lead-in chamfer 3x20°, rounded.

As the maximum load can be as high as 3,5 times the nominal force M (for M see data sheets or dimensional drawing), care must be taken to ensure that the strength of the rod material is adequate. In the case of compression-loaded rods, sufficient buckling resistance must be assured.

In practice, suitable and commercially available rods are:

Piston rods with,

Rod diameter toleranz: ISO f7
Basic material: 42CrMo4V
Hard chrome plating: 800-1100 HV min. 13 µm deep
Surface finish: RA 0,15 - 0,25

7 Service life

When discussing the service life of SITEMA Safety Catchers, a distinction must be made between two different types of use. In he normal case of securing a stationary load (e.g. the slide etc.), the clamping jaws (3) will only cover a very small distance, until the radial play is eliminated and an equilibrium between the spring forces and the forces generated on the slide and brake linings is achieved. The stress caused by this operations is extremely low and can certainly be cycled millions of times. For this reason, securing of a stationary slide, for example at each stroke of the press, will certainly not cause any wear or fatigue of safety-relevant parts, even after years of service. The radial forces and material stresses for which the unit is initially designed will occur only if unoperational lowering of the shaft occurs in clamped "load secured" condition, due to leakage, pipe break etc. In this case the clamping jaws are drawn into the clamping position after moving the full distance "e". Lowering through such a distance as a result of leakage is very rare, however, and only occurs when the machine is stopped for an extended period of time. Pipe breaks are even less frequent. Such events will certainly not occur more than several times a day or a few hundred times per year.

Based on the results of fatigue tests it can be guaranteed that for several years in normal use, the holding force will not drop below the nominal value, and that even after lots of clamping cycles, no relevant changes in the diameter or surface quality will be observed on the clamping shaft. The service life of SITEMA Safety Catchers will therefore not be less than the usual service life of production machinery.

There will be no relevant reduction of service life even in the occasional case of slippage when catching the load or due to overloads resulting from incorrect operation of the press cylinder with the clamp engaged, or the lifting of load without applying pressure simultaneously. However, abnormal situations like this should be avoided.

On the other hand it should be mentioned, that from our experience certain undesired operational conditions could diminish the service life considerably.

Most of all following operating conditions must be avoided:

- Radial forces or side loads due to misalignmet
- Finish of the rod too rough
- Penetration of corrosive substances into the housing (including humid compressed air)
- Lowering of the load in "load secured" position with every stroke due to control.

8 Acceptance by Safety Authories

SITEMA Safety Catchers have been tested and approved as safety devices for a number of different applications by

- TÜV Technischer Überwachungsverein
- Berufsgenossenschaften (Workers Insurance)
- Lloyd's Register of Shipping

Particularly SITEMA Safety Catchers are certified with respect to the European Standard DIN EN 693 (Machine tools - Safety - Hydraulic presses) and DIN EN 692 (- Mechanical presses) as mechanical restraint device to prevent gravity fall.

A copy of respective certification and additional information can be found in *„Technical Information TI-A40“*

9 Required risk assessment

It must be ensured that the dimensions and arrangement of SITEMA - Safety Brakes in safety-relevant applications meet the requirements of the risk evaluation DIN EN ISO 14121-1 and also comply with any further standards and regulations applying to the intended use. This is the duty of the system manufacturer and the user.

10 Operating conditions

The Safety Catcher 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.

11 Overall documentation and CE label

The Safety Catcher is designed as a component to be integrated into a machine or system and as such can never be CE-certified itself. The seller of the machine or system must provide information on the Safety Catcher with the overall documentation and if applicable ensure that the machine or system is CE-certified.

12 Regular functional checks

The Safety Catcher 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 respective operating manual for further details. For standard versions *„Operating Manuals BA-A11 to BA-A14“* are valid.

13 Maintenance

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

Should the Safety Catchers 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 Catchers 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.

14 How to attach

There are various ways to attach the Safety Catchers type K and KR/KRP.

In any case it must be ensured, that no side load can be induced due to tolerances in dimensions or angular alignment relative to other guiding means.

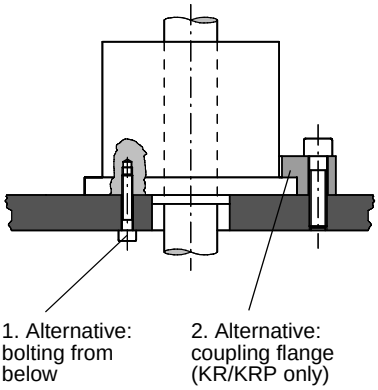
If the Safety Catcher is directly mounted to a cylinder end cap, it usually is properly centered to the rod. In all other setups either the rod or the body of the catcher must not be rigidly fixed but mounted floating with enough radial clearance.

The 4 basic options are illustrated below, using hydraulic presses as an example of application.

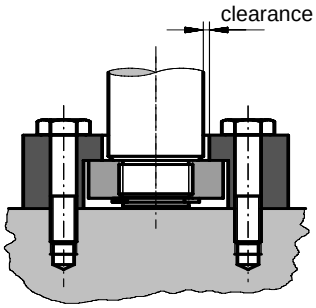
They can be applied in other cases as well if the expression slide is replaced by the more general term load carrying device.

Suitable attachment flanges are offered in *„Technical Data Sheet TI- A30“*.

1. Safety Catcher fixed to machine frame -

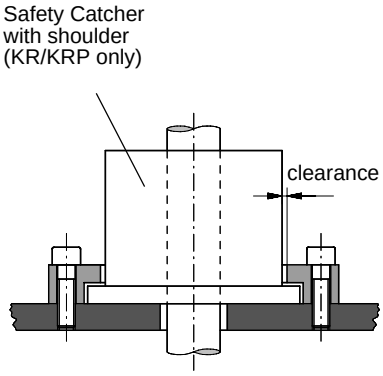


- rod floating on slide

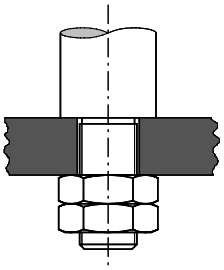


If the clamping device is firmly boled to the machine frame, the retaining rod must have sufficient clearance at its attachment, so that the transverse or tilting movements of the slide will not create transverse forces to the rod.

2. Safety Catcher floating on machine frame -



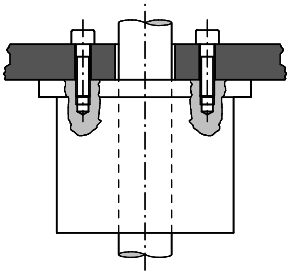
- rod fixed to slide



The collar flange as shown above is one of the common solutions for a mounting with radial play. Alternatively a spring-base can be recommended, which on top is providing other advantages as descibed in "Technical Information TI-A20".

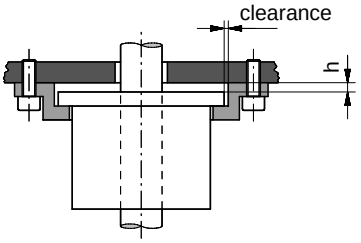
Both mounting versions make sure that the safety catcher can move freely in order to compensate for transverse movements of the travelling rod.

3. Safety Catcher fixed to slide - rod floating on machine frame



If the moving Safety Catcher is firmly mounted on the slide, the stationary rod must be loosely attached, similar to the option 1.

4. Safety Catcher floating on slide - rod fixed to machine frame



This is another application using a coupling flange. In addition an axial clearance of h = approx. 5 to 10 mm is used, so that this design will perform the function of the spring-base as well.