Technical Information TI-A10
Safety Catchers

- ☑ high holding force by self-intensifying clamping
- ☑ hydraulic or pneumatic actuation
- ☑ officially certified by DGUV as restraint device for presses, injection moulding machines, rubber and plastics machines

For further information on technical data and optional accessories, please see:

- ***"Technical Data Sheet TI-A11"*** (hydraulic pressure versions: series KR, K)
- ***"Technical Data Sheet TI-A12"*** (pneumatic pressure versions: series KRP)
- ***"Technical Data Sheet TI-A13"*** (hydraulic tensile versions: series KR/T, K/TA)
- ***"Technical Data Sheet TI-A14"*** (pneumatic tensile versions: series KRP/T)
- ***"Technical Data Sheet TI-A20"*** (spring bases for pressure versions)
- ***"Technical Data Sheet TI-A21"*** (spring bases for tensile versions)
- ***"Technical Data Sheet TI-A30"*** (flanges for Safety Catchers and spring bases)

For information on the DGUV approval and EC type-examination certificate, please see:

- ***"EC Type-examination Certificate TI-A40"***

A detailed description of control, mounting and performance test of the SITEMA Safety Catchers can be found in:

- ***"Operating Manual BA-A11"*** *(hydraulic versions)*
- ***"Operating Manual BA-A12"*** *(pneumatic versions)*

Contents

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 e.g. be a leakage or breakdown 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-intensifying clamping ensures an extremely high safety level.

Safety Catchers serve as mechanical restraint devices for static loads. For this static holding, the Safety Catcher 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-A40"*, internet download: www.sitema.com.

2 Function

SITEMA Safety Catchers release by applying hydraulic or pneumatic pressure and clamp at pressure loss. The kinetic energy of the falling mass is then used to generate the holding force.

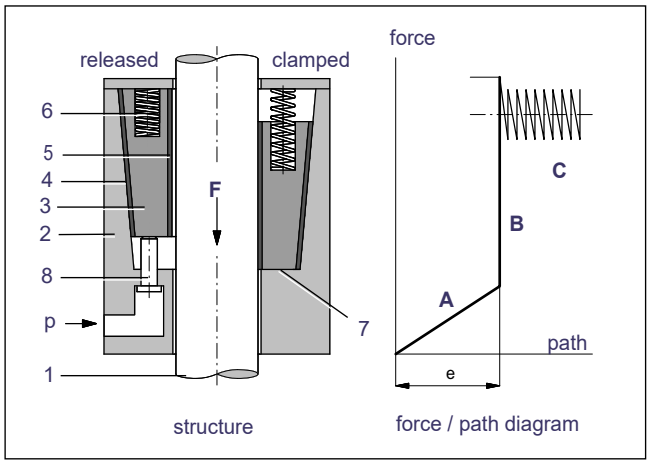


Fig. 1: Design principle

The piston or clamping rod (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 rod can move freely. The springs (6) are compressed in this position.

2.1 Secure the load

The Safety Catcher secures the load as soon as pressure is released from the plungers (8), *Fig. 1*. Then the action of the springs (6), *Fig. 1* causes the clamping jaws (3), *Fig. 1* to clamp the rod (1), *Fig. 1* firmly, whereby an initial friction contact between rod and clamping sleeve is achieved (contact condition).
At this point, the Safety Catcher secures the load but has not yet taken the load.

2.2 Take the load

The holding force, however, is not built up until the rod has been moved by the load. Due to the self-intensifying static friction at the rod, the clamping systems contracts:
The clamping jaws (3), *Fig. 1* are drawn into the clamping position at their stops (7), *Fig. 1* after having moved the distance "**e**", *Fig. 1* (approx. 5 to 15 mm, depending on design). This movement is illustrated as phase **A** in the force/path diagram, *Fig. 1*.

If the load is increased further (phase **B,** *Fig. 1*), the rod remains in its clamped position, independent of the load, until the static holding force **F***, *Fig. 1* is reached. As soon as this limit is exceeded, the Safety Catcher (phase **C,** *Fig. 1*) generates a mean dynamic braking force **F** (holding force), *Fig. 1* and thus dissipates the kinetic energy of the falling mass.

2.3 Release the clamping

To release the clamping after securing the load, it is sufficient to apply the operating pressure to pressure port L.

To release the clamping after taking up the load the rod must additionally be moved back in opposite direction to the load direction (travelling back the tapering distance "**e**") with a force corresponding the load. Thus providing the safety advantage that the clamping can generally only be released as far as the hoist drive is intact and controlled. An excess force (e.g. for breaking loose) is normally not required.

Applying pressure to the annular piston at the same time moves the clamping system in the raised (e. g. released) position.

3 Design types

Depending on size and pressure fluid, there are different series of SITEMA Safety Catchers.

They are all identical as far as function and application are concerned.

Series K

To release the clamping, this series has a number of small plungers to lift the clamping jaws, which are pressurized simultaneously by a common, annular groove.

Series KR

In this series releasing is ensured by a compact annular piston instead of the individual plungers used in series K. For reasons of design and cost, this solution is preferred to series K if used on rod diameters of less than 80 mm.

Series KRP

The KRP-series is the pneumatic option within the family of Safety Catchers.

Due to the self-intensifying friction, the KRP series attains the same holding forces as the KR series regardless of the acting spring force or actuator force.

That's why the outer dimensions are equal to the ones of hydraulic KR series.

4 Control

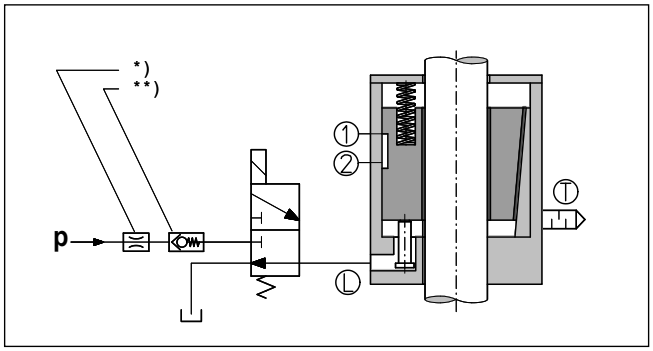


Fig. 2: Schematic circuit diagram

* In case impact noises due to excess pressure are audible when pressurizing the Safety Catcher, 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.

WARNING!
Risk due to slowed discharge of pressure medium!
Slowed discharge of the pressure medium may cause a dangerous situation. The clamping then only locks with a time delay.

- Do not integrate any components which impair discharge of the fluid from pressure port L.
- Route all connection lines without any kinks.
- If there is any danger of kinking, take appropriate precautions (protective tube, thicker hose, etc.).

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

- short line distances
- fast valve response times
- appropriate control
- large valve and line cross-sections (esp. when actuated hydraulically)
- installation of a dump valve at L (when actuated pneumatically)

4.1 Pressure fluids

To keep the clamping permanently open, Safety Catchers mostly are hydraulically actuated. For smaller units, also pneumatic versions are available.

Hydraulic actuation:

Hydraulic oil (HLP) in accordance with DIN 51524-2:2017 must be used as pressure fluid. Please consult SITEMA before using any other fluids.

Pneumatic actuation:

The compressed air must be dried and filtered. SITEMA recommends compressed air according to ISO 8573-1:2010 [7:4:4].

4.2 Actuation with a 3/2-way valve

In most applications an actuation as suggested in *Fig. 2* is used. During every operational cycle, the 3/2-way valve is actuated electrically and releases the Safety Catcher.

In all other operational conditions, as well as in cases of power failure, pressure line breakage, emergency stop, etc. the Safety Catcher becomes effective, secures the rod and/or stops the load. If necessary the valve can also be switched by another safety signal, e.g. speeding, contouring error, etc.

4.3 Monitoring by proximity switches

Proximity switch 1 “load secured” signals the secure state and is used to authorize entrance to the danger zone.

Proximity switch 2 “clamping released” is used to activate the movement of the drive in the load direction.

Cross-checking the signals 1 and 2 is essential for unambiguous state display. The signals must not occur simultaneously. Brief overlap times during switching are admissible. Also the correct processing of the signals in the machine controller must be checked.

4.4 Proposal for a logical integration of the Safety Catcher into the machine control system

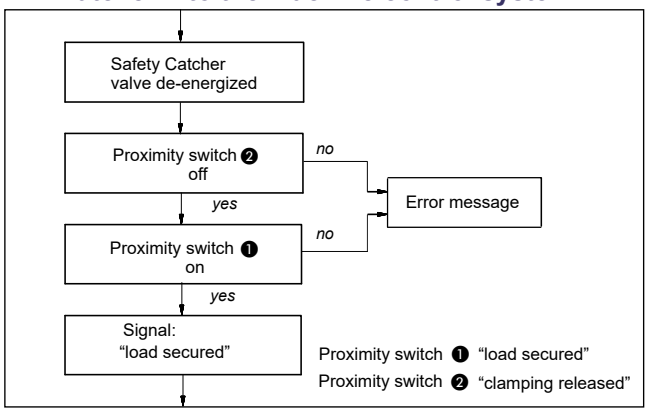


Fig. 3: Secure load

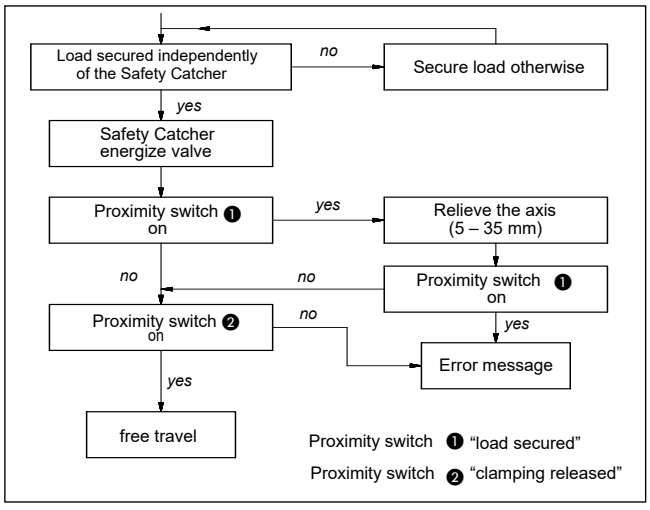


Fig. 4: Release clamping

Control and function monitoring are the responsibility of the machinery manufacturer.

5 Choosing the right type

The admissible load M is stated for all types in the *“Technical Data Sheets TI-A11 to TI-A14”*. Normally (for vertical movement), the condition as below is to be fulfilled.

$$M \geq \frac{\text{moving weight}}{\text{number of Safety Catchers}}$$

The holding (braking) force for dry or hydraulic-oil wetted rods is not less than 2 x M, but will not exceed 3.5 x M (see also *Chapter 6 “Design and attachment of the rod”*).

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-A40”.

6 Design and attachment of the rod

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

- ISO tolerance field f7 or h6
- surface roughness: Rz = 1 to 4 µm (Ra 0.15 – 0.25 µm)
- protection from corrosion: hard chrome plating: 800 – 1100 HV
- basic material: yield strength min. 580 N/mm²
- lead-in chamfer, rounded:
  ø 18 mm up to ø 80 mm: min. 4 x 30 °
  ø over 80 mm up to ø 180 mm: min. 5 x 30 °
  ø over 180 mm up to ø 380 mm: min. 7 x 30 °

The rod must not be lubricated with grease.

Often, the following standard rods fulfill the above mentioned requirements and can then be used:

- standard piston rods, ISO tolerance field f7

The actual holding force of the Safety Catcher is higher than the **admissible load (M)** indicated in the data sheets and drawings but will not be higher than 3.5 times this value. Therefore, all **fixation elements** carrying the load (rod, its attachment, etc.) have to be dimensioned for at least **3.5 x M**. This maximum force can occur at emergency braking and also if, in case of control errors, the full driving force is exerted against the Safety Catcher.

In case of overload, the rod will slip. This does normally not cause any damage to the rod or the Safety Catcher.

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

7 Service life

When estimating service life, a distinction is made between the following categories of stress:

1. Stress when securing the load

When securing a stationary load (see *Chapter 2.2.1 "Secure the load"*), the occurring material stresses are negligible and can be withstood millions of times over.

2. Stress when taking the load

When taking up the load (see *Chapter 2.2.2 "Take the load",* for example in the event of leakage or a line break*),* the Safety Catcher may reach the maximum holding force. The design forces and material stresses then occur. The rod does not slip when this happens.

3. Stress when the rod slips through the closed clamping

Occasional slippage of the rod when the clamp is closed has practically no influence on service life.

To ensure longer service life, the following operating modes should be avoided:

- frequent dynamic braking
- incorrect operation of the (press) cylinder with the clamp engaged
- driving the rod against the load direction without applying pressure simultaneously

Based on the results of fatigue tests, it can be assumed that under usual operating conditions (type of use 1 and occasionally type of use 2), the holding force will not drop below the nominal value after several years in use. Even after lots of clamping cycles, no relevant changes in the diameter or surface quality will be observed on the clamping rod either.

Additionally, you can take the following measures to extend service life:

- Make sure the rod is not subjected to any transverse forces.
- Do not use excessively rough rod surfaces.
- Protect the interior of the housing against penetration of corrosive media and dirt.
- Clamp the rod preferably only once the load has come to a complete standstill.

8 DGUV Test certification

SITEMA Safety Catchers have been certified by DGUV Test for installation in the following machines (for clamping from a standstill):

- hydraulic presses (according to EN 693)
- mechanical presses (according to EN 692)
- injection molding machines (according to EN 201)
- rubber and plastics machines (according to EN 289)
- hydraulic press brakes (according to EN 12622)

You can find the **DGUV Test Certificate** (EC type-examination certificate) and further information in *"EC Type-examination Certificate TI-A40"*.

9 Required risk assessment

It must be ensured that the dimensions and arrangement of a Safety Catcher used in safety-relevant applications meet the requirements of the risk evaluation EN ISO 12100:2010 and also comply with any further standards and regulations applicable for the intended use. The Safety Catcher 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 Operating conditions

The immediate environment of the Safety Catcher in its standard version must be dry and clean. Environmental contamination such as grease, dirt, grinding dust, chips may require special protective measures. Liquids such as coolants, conservation agents and other liquids or chemicals inside the housing may reduce the holding force. It is particularly important not to apply any grease on the rod surface.

- The machine manufacturer must take appropriate measures to ensure that contamination cannot enter the interior of the housing.
- In case of doubt, please contact SITEMA.

The permitted surface temperature is 0°C to 60°C.

11 Regular performance tests

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

Please check the operating manuals for further details: *"Operating Manual BA-A11" for* hydraulic standard versions and *"Operating Manual BA-A12"* for pneumatic standard versions.

12 Maintenance

The maintenance is limited to the regular performance tests.

Should the Safety Catchers cease to comply with the required characteristics, the safety for working with the machine or system may no longer be given. In this case the Safety Catchers must be immediately and professionally repaired by SITEMA.

The Safety Catchers are safety components. Any repair or refurbishing must be carried out by SITEMA. SITEMA cannot take any responsibility for repairs by another party.

13 Attachment

Overview of attachment options for PRESSURE and TENSILE versions

Safety Catchers can be integrated into the machine as **stationary** units or as **mobile** units moving with the load to be secured.

When choosing the right series, consider the **load** that acts on the rod and the Safety Catcher.

In the case of **PRESSURE versions**, the load presses the Safety Catcher onto the machine frame. The load is transferred via the mounting surface of the Safety Catcher into the machine frame. PRESSURE versions are: **series KR, KRP** and **K**.

In the case of **TENSILE versions** the load pulls the Safety Catcher away from the machine frame. The tensile load is transferred via the attachment bolts into the machine frame.
TENSILE versions are: **series KR/T, KRP/T, K/T** and **K/TA** (T = tension).

Stationary Safety Catcher

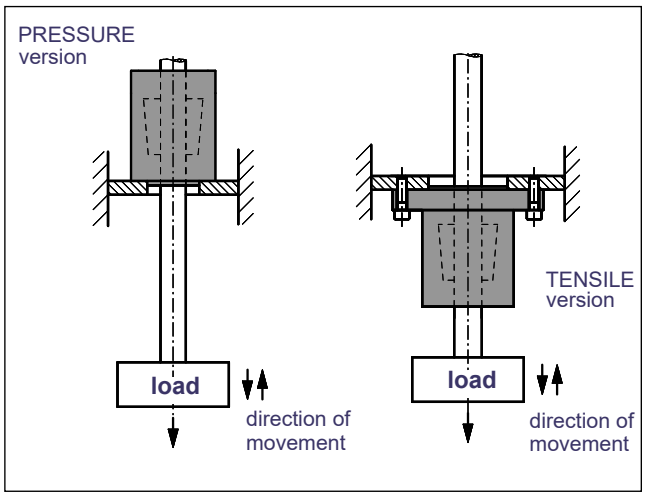


*Fig. 5: Attachment options for **stationary** Safety Catcher*

If the Safety Catcher is installed stationary, the load (e. g. the slide) is usually mobile.

*To avoid side load on the rod, install either the Safety Catcher or the rod with a **floating** attachment. For a floating attachment of the Safety Catcher, use a **mounting flange**.*

For further information on the different attachment options, please read
Chapter 13.1 “Attachment options for PRESSURE versions” and
Chapter 13.2 “Attachment options for TENSILE versions”.

Mobile Safety Catcher

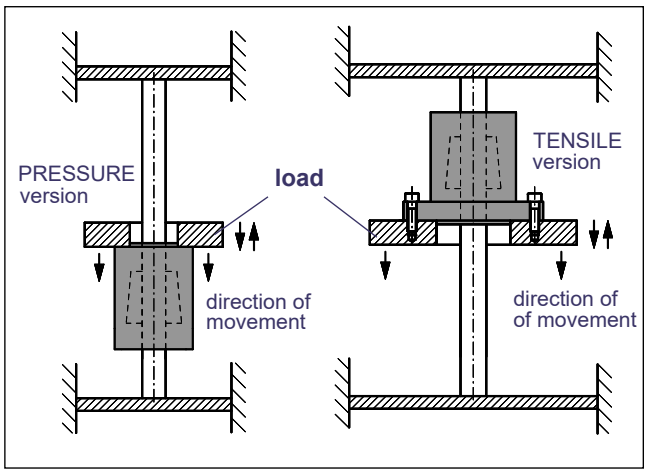


*Fig. 6: Attachment options for **mobile** Safety Catcher*

If the Safety Catcher is mobile and moves with the load (e. g. the slide), the rod is usually stationary.

*To avoid side load on the rod, install either the Safety Catcher or the rod with a **floating** attachment. For a floating attachment of the Safety Catcher, use a **mounting flange**.*

For further information on the different attachment options, please read
Chapter 13.1 “Attachment options for PRESSURE versions” and
Chapter 13.2 “Attachment options for TENSILE versions”.

The pictures only show technical principles of the attachment for SITEMA Safety Catchers. They are not intended as actual design drafts.

13.1 Attachment options for PRESSURE versions

There are various ways to attach the Safety Catchers series KR, KRP and K.

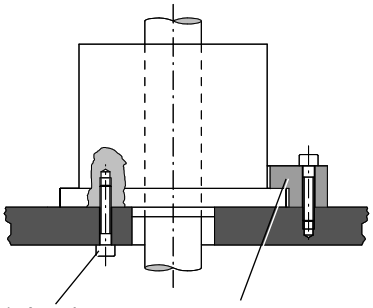
In any case, it must be ensured that no side load can be induced due to tolerances in dimensions or angular alignment relative to other guiding means. If the Safety Catcher is directly mounted to a cylinder head, it usually is properly centered to the rod. In all other setups either the rod or the body of the Safety Catcher must not be rigidly fixed but mounted floating with enough radial clearance. Four 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”.

Suitable mounting flanges can be found in *“Technical Data Sheet TI-A30”*.

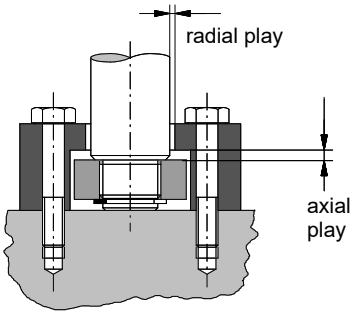
Stationary Safety Catcher

r

Stationary Safety Catcher **fixed** to the machine frame



- rod floating on slide

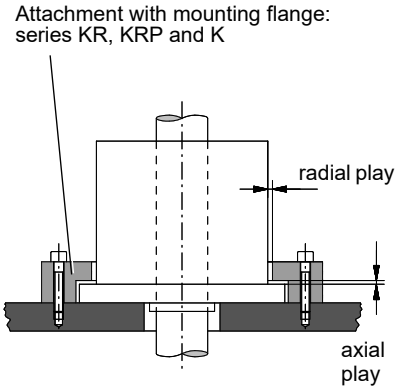


If the Safety Catcher is firmly bolted to the machine frame, the retaining rod must have sufficient play at its attachment, so that the lateral or tilting movements of the slide will not create lateral forces to the rod.

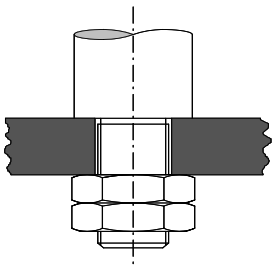
Fig. 7: Attachment option 1

Stationary Safety Catcher

Stationary Safety Catcher with **floating** attachment to the machine frame



- rod fixed to slide



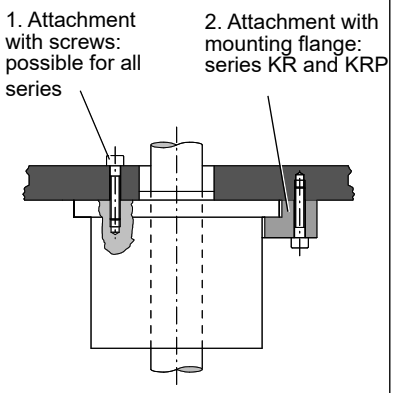
The mounting flange as shown above is one of the common solutions for a mounting with radial play. Alternatively a spring base is recommended, which on top provides additional advantages as described in *“Technical Data Sheet TI-A20”*.

Both mounting options ensure that the Safety Catcher can move freely to compensate for lateral movements of the traveling rod.

Fig. 8: Attachment option 2

Mobile Safety Catcher

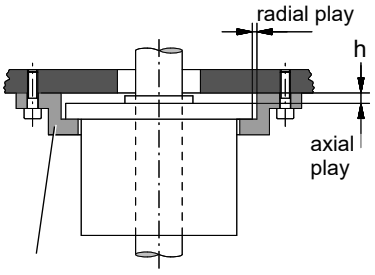
Mobile Safety Catcher **fixed to slide - rod floating** on the machine frame



If the mobile Safety Catcher is firmly fixed to the slide, the stationary rod must have a floating attachment, similar to option 1 (*Fig. 7*).

Fig. 9: Attachment option 3

Mobile Safety Catcher with **floating** attachment to the **slide - rod fixed** to the machine frame



Attachment with mounting flange: series KR and KRP

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

Fig. 10: Attachment option 4

13.2 Attachment options for TENSILE versions

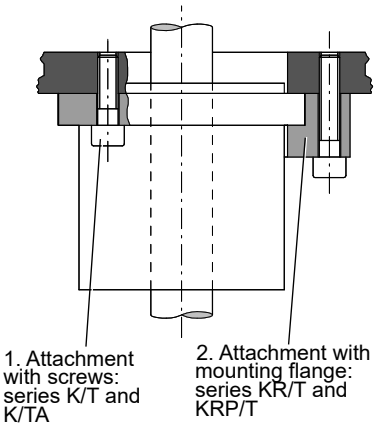
There are various ways to attach the Safety Catchers series KR/T, KRP/T and K/T, K/TA.

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 head, 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 play. Three 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”.

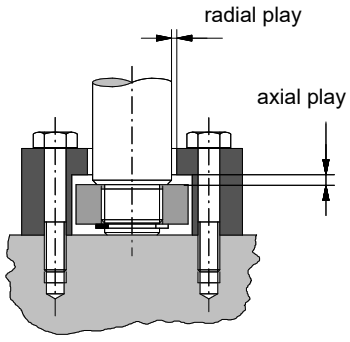
Suitable attachment flanges can be found in *“Technical Data Sheet TI-A30”*.

Stationary Safety Catcher

Stationary Safety Catcher **fixed** to the machine frame



- rod floating on slide

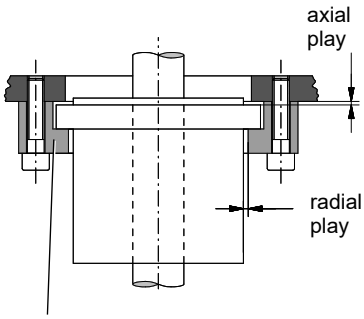


If the Safety Catcher is firmly bolted to the machine frame, the retaining rod must have sufficient play at its attachment, so that the lateral or tilting movements of the slide will not create lateral forces to the rod.

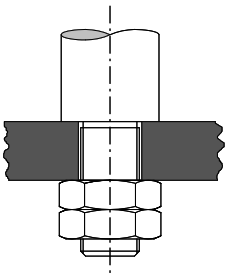
Fig. 11: Attachment option 1

Stationary Safety Catcher

Stationary Safety Catcher with **floating** attachment to the machine frame



- rod fixed to slide



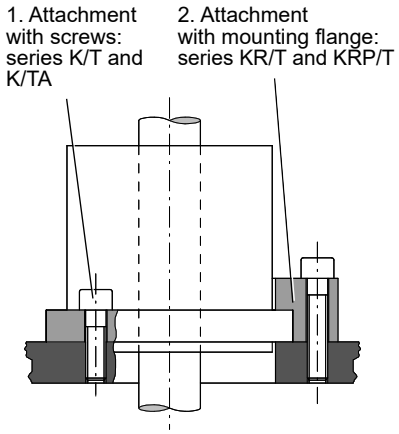
The mounting with a flange as shown above is one of the common solutions for a mounting with radial play. Alternatively a spring base can be recommended, which on top is providing other advantages.

Both mounting versions make sure that the Safety Catcher can move freely in order to compensate for lateral movements of the traveling rod.

Fig. 12: Attachment option 2

Mobile Safety Catcher

Mobile Safety Catcher **fixed to slide - rod floating** on the machine frame



If the mobile Safety Catcher is firmly fixed to the slide, the stationary rod must have a floating attachment, similar to option 5 (*Fig. 11*).

Fig. 13: Attachment option 3