

INNOVATIVE BOLTED CONNECTOR FOR LV AND MV WITH STEPLESS SHEAR BOLTS



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ABSTRACT

Terminals, connectors and cable lugs using screw technology have been on the advance for years. And with good reason. Bolted connections offer technical and practical advantages that compression connections cannot provide. For instance, a large cross section, copper or and aluminium utilisation possible and no special tools as hydraulic pump and heads needed. This clamping technology perfectly complements the new multi range cable accessories.

Until now, the multi range shear bolt has been the state of the art in screw technology, but they don't have a clean break.

New from Pfisterer: An innovative connector with step less shear bolts.

KEYWORDS

- Step less shear bolt
- Large cross section range
- simple and faultless montage
- copper or and aluminium cable can be used
- non predefined cross section or cable diameter
- Full utilisation of the thread loading
- No special tools needed
- smooth breakage
- no edges protrudes.

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INTRODUCTION

Safe, reliable power transmission in low-voltage and medium-voltage power networks needs sophisticated solutions that cannot only withstand the harshest conditions but can also meet growing financial demands. Development and manufacture accordingly demand a great deal of experience and highly specialized know-how.

All around the world the first most used system to joint two end of cable is compression technique. The other possibility to make a joint between two cable is to used bolted connectors. We have packed all the knowledge we have accumulated in the last 85 years in this specific field of application and especially in this new development.

In the follow we want to give an overview about the difference between the compression technique (short) the usual bolted connector and the new stepless patented technology from Pfisterer.

COMPRESSION / BOLT



Compression connectors

Advantage

- Compact design
- Price
- Good contact properties
- Well known technology

Disadvantage

- One connector per cross section
- Material marriage must be respected
- Pressing tools are necessary

Bolted connectors




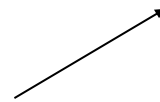
Advantage

- Wide cross section range
- One connector for Cu and / or Alu cable
- Easy mounting, no special tools needed
- Tested in accord with the IEC norms

Disadvantage

- Bigger design
- Price (apparently?)
- For a lot of customers a new technology

Utility market situation

Used technologies	Market Trend 2003; 2004; 2005; 2006
Compression 	
Bolted 	

BOLTED CONNECTORS ARE ADVANCING FAST

The market analysis has us confirm, that the screwed technology in the advance is, and more than ever is asked. This is, if we consider the advantages and disadvantages of both, to be understood.

A reason for our company to work again on this topic (Pfisterer was the first, for more than 30 years ago, which had realized a repair screwed connector).

The challenge by the development of a new bolted connector is not essentially the body from the connector, but the screw construction, in addition it is protected by many patents.

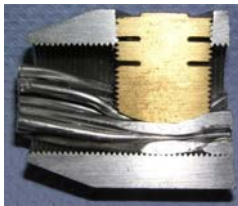
Our first task for the new development was to specify the requirement from the market related to the screw and naturally to do a Benchmarking of the existing solution.

REQUIREMENTS ON SHEAR BOLTS IN BOLTED CONNECTORS:

- wide cross section range
- high clamping forces
- defined breakaway moment
- minor projecting end of the screw
- clear and easy mounting process
- no special tools needed
- smooth breakaway
- cordless electric drill attractable as well

Previous different shear head bolts techniques on the market:

Multi-stage shear bolt or step technique



Multi stage shear bolts with several staged share points



Function:

One tool fitting acts to all share points, where as the weakest share point breaks. There are different breaking points; the weakest is on the ground of the screw.

Advantage:

Always the weakest breaking point activates near the outside surface of the connector. So it will be able to get always minor projecting end of the screw.

Disadvantage:

The breaking point torque grows to the end of the screw. That means the smallest conductor will be clamped with the greatest force. Additionally, each breaking point interrupts the load carrying thread and the breaking points are adjusted of one cable diameter.

Multi stage shear bolts with special tools



Function:

A special tool witch is required witch is plugged in the Screw. The Tool overlies on the body of the joint and set the range of the tool. For that only the breakpoint near the body that are between the Body and the tool can break.

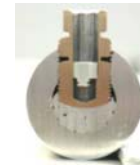
Advantage:

The breakaway-torque can be individual for each stage adjusted.

Disadvantage:

A special tool is required and must be enclosed. Additionally, each breaking point interrupts the load carrying thread and the breaking points are adjusted of one cable diameter.

Multi stage shear bolts with additional parts



Function:

At once there must a distancing-pin installed in the screw. This pin regulates the deepness of the tool.

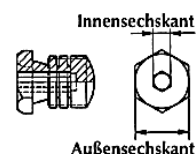
Advantage:

The share-point can be individual for each conductor. No special tool is needed.

Disadvantage:

Before mounting the connector, the worker has to prepare the screw in relation to the conductor. Additional built-in-parts are necessary. Additionally, each breaking point interrupts the load carrying thread and the breaking points are adjusted of one cable diameter.

Multi stage shear bolts with several tool fits



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Function:

Depending on the Tool different share-points are in use.

Advantage:

No additional tools required, individual torques can be built in by different share points.

Disadvantage:

Before mounting the connector the worker have to select the tools that must be used dependence to the conductor. Additionally, each breaking point interrupts the load carrying thread and the breaking points are adjusted of one cable diameter.

Summary

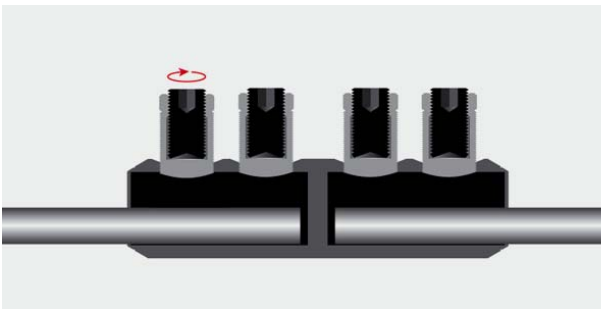
Step technique:

- special tools are often needed
- different breakaway moments for each step
- breakaway position very often inexact and reworking is necessary
- the steps are defining the cross section range
- suitable „tool elements“ for the different cross sections are necessary
- through the abrupt breakaway of the screw, the possibility risk of injuries is much higher

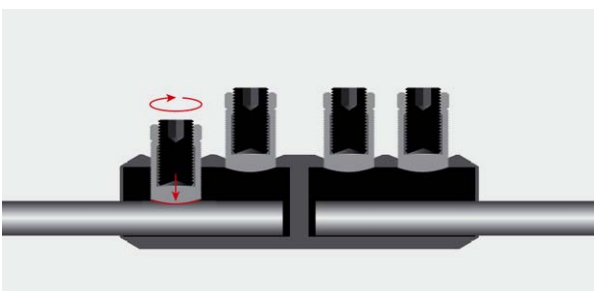
THE NEW PATENTED STEP LESS TECHNOLOGY FROM PFISTERER

The principle:

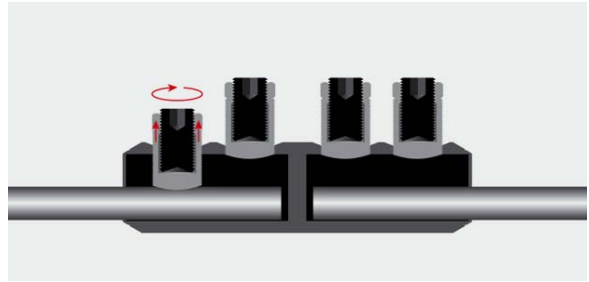
A threaded stud is screwed into the shear bolt.



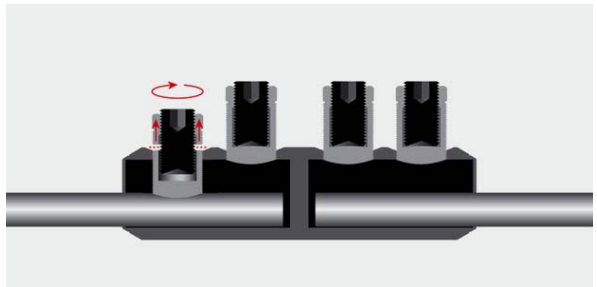
A further screw in of the threaded stud press the shear bolt on the cable



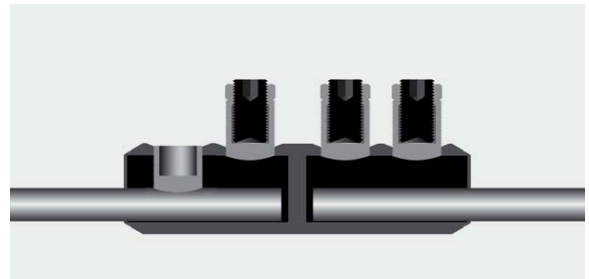
By reaching the contact force, the step less shear bolt blocked.



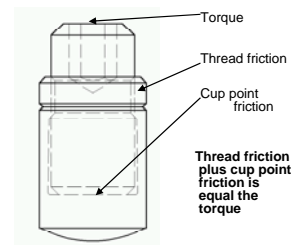
It becomes through the threaded stud tensioned and it stretches axially. On reaching the shear torque it breaks off



The break off takes place direct on the surface of the clamp body. No protrudes – no file down!



The function



A two part system

- One thread stud
- One "SICON" screw

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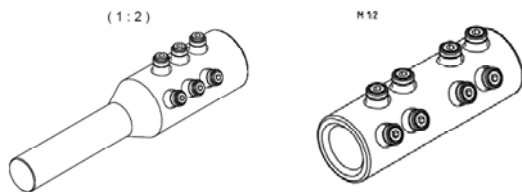
The tool act to the thread stud with is in the bore of the SICON screwed. The torque affects the tensile strength in the share area, that mean when the optimal contact force is reached, the SICON-screw blocked and stretched axially by continuing screwing the thread stud and breaks off when the shear torque is reached. The weakest point outside the body of the connector breaks because inside the connector there is no axial stress. The break off takes place directly on the surface of the body from the connector. No protrusion – no filing down.

Because there is no interrupt in the thread we have an optimum thread load for a great range of cross-sections, more than all others.

The actually standard range for LV and MV

- 10 mm² up to 95 mm²
- 25 mm² up to 150 mm²
- 50 mm² up to 240 mm²
- 95 mm² up to 300 mm²
- 300 mm² up to 630 mm²

The XXL range especially for HV



For bigger cross section or customer special version we can use the same technology.

The design from the connector depends from the application requirement.

Preview:



SICON screw with washer:

To optimizes and reduce the friction components between the SICON screw and the cable we have added a washer of the end of the screw (see pictures)

The result:

The friction to the cable will be minor, the break torque force is constants whatever for a cable material we have, the clamp force can be higher and we can use class 5 cable (copper flex-cable).

SUMMARY

The stepless technology offer many advantage and benefit for the user:

The security to have a good montage whatever the form and material of the cable the montage team will be found during the work is done.

The storage and maintenance of special tools like hydraulics pumps and heads is not necessary any more.

No rework after breaking the screw, no pollution of the work area with metal particles.

The risk of injuries is minimizing trough the smooth breakaway.

The dimensions from the connector are according to the main joint of the market.

The standard types are tested according to the IEC norms Trough the wide cross section range are the stock and logistic cost reduced.