

# SICON – The Bolted Connector with Stepless Shear Bolts for Low-, Medium- and High-Voltage Cables

PFISTERER Kontaktsysteme GmbH presents a completely new type of bolted connector for low-, medium- and high-voltage cable joints. The patented stepless SICON shear bolt allows the joint to be used with a wide range of cross-sections independent from the cable type.



The SICON product programme: cable lugs, connectors and tap connectors

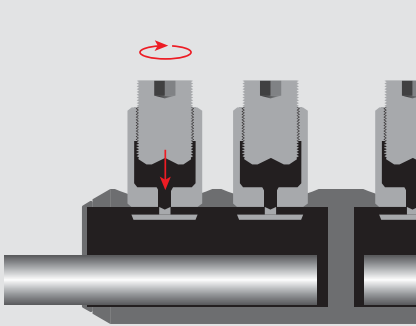
For the past several years clamps, connectors and cable lugs using screw technology have been developing rapidly. For good reasons: bolted connectors offer technological and practical advantages which compression connectors do not provide, for example a large cross-section range and ease of handling. This clamp technology is perfectly suited to the new multi-range cable joints. Fitting only requires a simple tool – literally in the twinkling of an eye. In contrast to what is usually required in the area of compression connector technology, neither expensive special tools nor special connecting sleeves assigned to every cross-section and every cable type are necessary. This makes storage considerably easier and ensures quick availability when remedying malfunctions. The higher individual price of a bolted connector versus a compression connector is to a large degree balanced out by the fact that no special tools are required and storage and logistics costs are reduced.

Until now the best available innovation in the area of screw technology has been the multi-stage breakaway bolt. When the preset torque is reached the bolt breaks away, which is supposed to guarantee the ideal contact force and prevent the bolt from protruding above the connecting body. The structural strength of the multi-stage bolt – the integrated pre-determined breaking points – is at the same time its critical weakness. Each breakaway point disrupts the load-bearing thread, and the maximum clamping force cannot be made available.

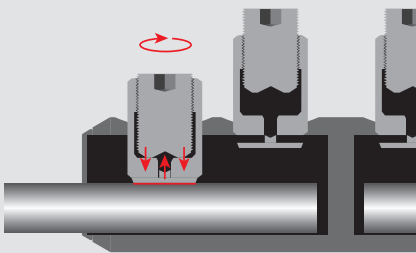
Protrusion of the clamp bolts must be prevented as this could damage the covering joint. To date multi-stage breakaway bolts have been used in an attempt to counteract the problem of the smallest possible protrusion of the clamp bolt above the connecting body which, with the multitude of conductor diameters and

## Advantages

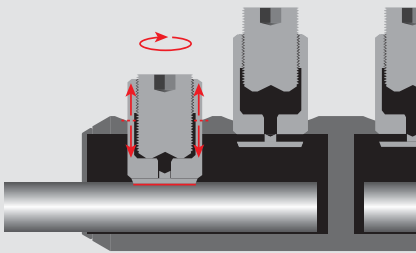
- Friction disc for uniform friction and increased contact force
- Up to 30% increased contact force compared with conventional type terminals on aluminium conductors
- Nothing protrudes
- Full utilisation of the thread loading for any size of conductor
- No special tool needed
- Smooth breakage of the shear bolt simplifies tightening process
- The remains of the bolt stay on the tool and can be disposed safely
- Suitable for fine-stranded Class 5 cables



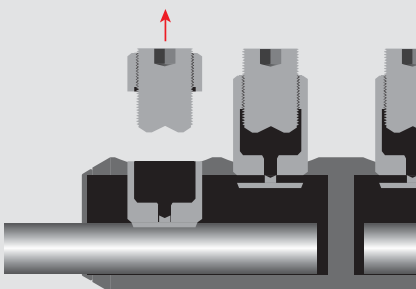
- 1** A standard hexagon key is used to screw a threaded stud into the hole in the stepless thrust bolt. The force closure is not interrupted by any steps or notches in the bolt.



- 2** As the SICON bolt is screwed in, the friction disc at the base of the bolt breaks away. The bolt now turns on this plate; unlike with conventional bolts, no tip friction occurs on the conductor. The bolt's torque generates the contact pressure almost independently of the conductor material. This way, significantly higher contact pressures are achieved with aluminium conductors and even fine stranded conductors are not damaged.



- 3** The SICON bolt continues to turn until the shear torque is reached. The thrust bolt is tensioned as it is screwed in and, on reaching the shear torque, it stretches axially and breaks off. Compared with conventional shear bolts, the bolt breaks very smoothly, almost without a shock.



- 4** The SICON bolt always breaks even with the surface of the clamp body. This ensures that the minimum possible protrusion is achieved every time irrespective of the size of the conductor to be connected.

materials, no manufacturer has succeeded doing satisfactorily. Even with standardised conductors there is a multitude of possible pairings; for example, in accordance with DIN VDE 0276-603 there are mathematically 98 variations for the commonly-used 50 mm<sup>2</sup> – 240 mm<sup>2</sup> connector when all of the cross-section levels, conductor shapes and conductor materials are taken into account. However, a step bolt only has 3 steps. The result: either the bolt breaks away too low, and the thread bearing capacity is not used to its full extent, or it breaks away too high, and the protruding remainder must be filed off. Furthermore, conventional multi-stage breakaway bolts do not provide for the different material-dependant torque requirements for aluminium and copper conductors. Due to all of these disadvantages compression connectors are still being used in many areas.

### “Smart” breakaway point

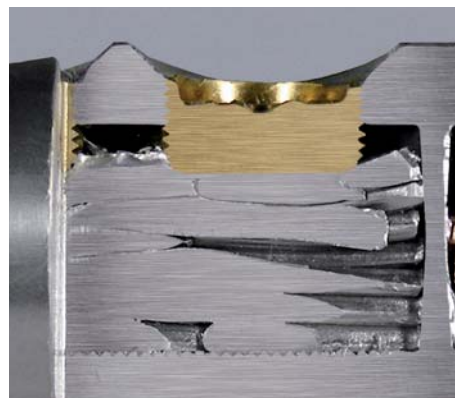
None of these disadvantages arise with the new SICON screw technology as it is based on a completely different principle from the multi-stage breakaway bolt. Although the continuously adjustable clamp bolt covers large line ranges, it is still supposed to generate an optimum level of contact force and leave behind a smooth and even fracture surface after breaking away. PFISTERER solves the problem with a two-part bolt design: a threaded stud that is screwed into the actual thrust bolt causes the screw body to overstretch, and when the break-

away torque is reached the thrust bolt is stretched axially and broken off. Because the area inside the connector cannot break, it is always the weakest point outside of the connector that breaks. The SICON bolt is designed such that this point is always located directly above the connecting body. In this way the smallest possible protrusion is attained, independent of the conductor that is to be connected.

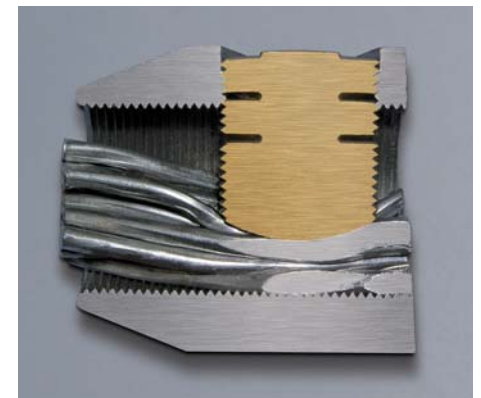
### Risk of injury minimised

When developing the new technology special attention was focused on safe assembly. The bolt does not break with a shock like conventional breakaway bolts, it is instead slowly stretched to its limit. This considerably reduces the risk of injury during assembly. The bolt head that has broken off remains seated on the pin wrench and does not roll away unchecked. Loose metal parts of this sort could become a serious safety problem in electrical installations.

The new bolted joints come in many variants with different cross-sections for low-voltage and medium-voltage lines and are used for conductor cross-sections of 10 to 630 mm<sup>2</sup>. A commercially available Allen wrench, such as can be found in any toolbox, is all that is needed for assembly. Suitably powerful cordless impact wrench can also be used. For high-voltage joints, there are special versions for conductors with cross-sections of up to 2,500 mm<sup>2</sup>.



SICON stepless shear bolts utilise the full thread loading



Conventional shear bolts cannot utilise the full thread loading



SICON connectors are available for low- and medium-voltage cables from 10 to 630 mm<sup>2</sup> and for high-voltage cables up to 2500 mm<sup>2</sup>

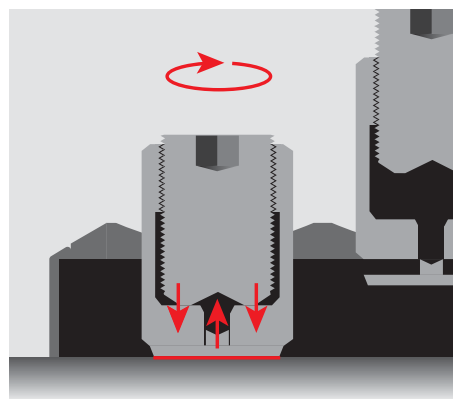
### Technical features

- Large clamping range: 10 – 95 mm<sup>2</sup>; 25 – 150 mm<sup>2</sup>; 50 – 240 mm<sup>2</sup>; 95 – 300 mm<sup>2</sup>; 185 – 400 mm<sup>2</sup>; 300 – 630 mm<sup>2</sup> (others on request)
- Conductor channels with transverse grooves and protection against conductor oxidation
- Blind hole designed as pressure-resistant oil barrier for oil cable
- Contact technology type-tested electrically and mechanically to IEC 61238-1
- Compact design: rounded edges and flat transitions, suitable for slide-on and shrink joints
- Suitable for aluminium- and copper conductors
- Centric cable guide with different centring sleeves

### Optimum contact force for all conductor materials

Different conductor materials have different requirements with regard to the break-away torque. When the bolt is tightened, a part of the applied torque is converted to frictional force between the conductor and the bolt head, and the remainder provides the contact force on the conductor. Aluminium conductors create a high degree of head friction, and the residual

contact force is relatively small. There is the risk that the necessary contact force is not attained during long-term use due to setting procedures. In contrast, copper conductors create a low degree of head friction, and the residual contact force is relatively large. This contact force creates an equally large counteracting force on



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Conventional multi-stage shear-off bolt (left) and new SICON bolt (right)

the thread. There is the risk that the screw thread is broken.

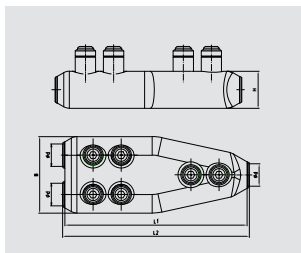
For this reason the breakaway torque for conventional bolts is always a compromise between the optimum torques for aluminium conductors and copper conductors. With the SICON bolt, on the other hand, the contact force is independent of the conductor. On the lower end of the bolt there is a friction disc which is connected to the bolt by means of a thin link. When the bolt is screwed in the link breaks, and the friction disc and screw can now move opposite to one another. When screwed in further, the bolt turns on the friction disc which remains stationary on the conductor. The contact force that is created as a result of the applied torque is therefore independent of the conductor material.

In this way, and by using the full thread length, with aluminium conductors the SICON bolt achieves a 30% higher contact force than conventional step bolts. The new bolt design offers an additional advantage: the individual wires of flexible stranded conductors are not able to be damaged as a result of the bolt friction. The friction disc is moulded such that it is connected to the bolt and can still move together with it.

### Globally active family-owned enterprise

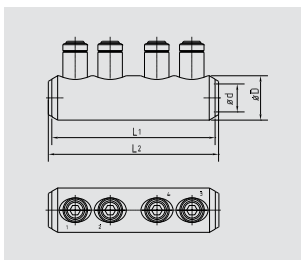
PFISTERER is a leading supplier to the companies providing power for private and public use and to their sub-contractors. The company has been family-owned ever since its establishment in 1921 in Stuttgart. PFISTERER develops, produces and supplies components and systems for connecting, joining, branching and switching electrical energy networks. Under the guidance of PFISTERER Holding AG in Winterbach (Germany) the 15 companies in the PFISTERER Group with around 1200 employees generated a turnover of approximately € 250 million.

Tap connectors



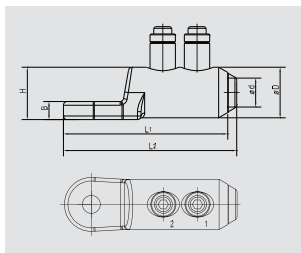
No. (Al + Cu)	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mm <sup>2</sup>	mounting hole	across flats	No. of bolts	L1 mm	DØ mm	dØ mm
332 447 010	50 – 240	50 – 185	50 – 185	50 – 150	50 – 240	–	SW 6	6	162	68/33	20

Connectors with oil stop



332 601 010	10 – 95	10 – 95	50 – 95	35 – 70	10 – 95	–	SW 5	2	65	24	13
332 607 010	25 – 150	25 – 150	35 – 120	35 – 120	25 – 150	–	SW 5	2	68	28	16,3
332 593 010	25 – 150	25 – 150	35 – 120	35 – 120	25 – 150	–	SW 5	4	102	28	16,3
332 592 010	50 – 240	50 – 185	50 – 185	50 – 150	50 – 240	–	SW 6	4	126	33	20
332 614 010	50 – 240	50 – 240	50 – 240	50 – 240	50 – 240	–	SW 6	4	126	35	21
332 602 010	95 – 400	95 – 300	95 – 240	95 – 240	95 – 300	–	SW 8	4	140	38	24
332 617 010	185 – 500	185 – 400	185 – 240	185 – 240	185 – 400	–	SW 8	6	170	42	26
332 603 010	300 – 800	300 – 630	–	300 – 400	300 – 630	–	SW 8	6	230	52	33,3

Bolted cable lugs



332 604 010	10 – 95	10 – 95	50 – 95	35 – 70	10 – 95	13	SW 5	1	70	24	13
332 599 010	25 – 150	25 – 150	35 – 120	35 – 120	25 – 150	13	SW 5	2	91	28	16,3
332 595 010	50 – 240	50 – 185	50 – 185	50 – 150	50 – 240	13	SW 6	2	115	33	20
332 595 011	50 – 240	50 – 185	50 – 185	50 – 150	50 – 240	16,5	SW 6	2	115	33	20
332 605 010	95 – 400	95 – 300	95 – 240	95 – 240	95 – 300	13	SW 8	2	120	38	24
332 605 011	95 – 400	95 – 300	95 – 240	95 – 240	95 – 300	16,5	SW 8	2	120	38	24
332 625 010	185 – 500	185 – 400	185 – 240	185 – 240	185 – 400	13	SW 8	3	138	42	26
332 625 011	185 – 500	185 – 400	185 – 240	185 – 240	185 – 400	16,5	SW 8	3	138	42	26
332 606 010	300 – 800	300 – 630	–	300 – 400	300 – 630	16,5	SW 8	3	180	52	33,3

Axial bolted cable lugs on request.

Any type of customized connectors with SICON technology on request.

Accessories



305 917 011	Cordless impact wrench for trouble-free assembly of bolted connectors and terminal lugs, comes with replacement battery, charger, tool set (Allen nut SW 5, SW 6, SW 8, load-carrying nut SW 8, SW 10, SW 13, SW 16, SW 19)
305 917 106	Replacement hex socket for the cordless impact wrench 1/2", SW 6 bit length 9 mm
305 917 107	Replacement hex socket for the cordless impact wrench 1/2", SW 6 bit length 19 mm
305 917 108	Replacement hex socket for the cordless impact wrench 1/2", SW 5 bit length 7.5 mm
305 917 109	Replacement hex socket for the cordless impact wrench 1/2", SW 8 bit length 15 mm



331 901 900	Holding arm for bolted connectors with diameters of 14 – 35 mm
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Subject to change as required by technical progress.