

# Wind energy

Blade, tower and foundation connection solutions  
for Owners, Managers and Designers



**SCHAAF** – Product quality and  
cooperation just as you like!

## Leading joining technology by SCHAAF

SCHAAF is an international group of enterprises with home-base in Germany that has specialised in the development and production of joining technologies since 1954. The globally active company thrives on its innovative system solutions and convinces with excellent quality. SCHAAF supplies bolt tensioning devices, hydraulic nuts, hydraulic high-pressure generators and accessories to more than 60 countries worldwide every year.

### VISION

The Vision statement is focused on tomorrow and what we would like to become. It sets our company the direction where to go.

**We develop world leading technology in the field of joining technique and thereby inspire our customers. Together we hereby create a future in which material will be saved, resources will be sustained and life will be easier.**

### MISSION

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### **Joining Technology for wind energy**

SCHAAF offers specially adapted products and assembly accessories with up to 4,000 bar hydraulic high-pressure technology for wind energy (onshore and offshore), such as rotor blade bolting, tower segment connections, various connections in the drive train, foundation fixings and nacelle bearings. The system solutions are designed according to all standard classification company requirements as well as highest operational safety and operating economy. The accessories such as high-pressure pumps, hydraulic hoses and the connection couplings as well as the assembly documentation solutions are precisely matched to the functions and are thus a 100 % system solution.



## Innovative solutions for the wind energy

Rotor blade bolting, tower segment connections, various connections in the drive train, foundation fixings and nacelle bearings with up to 4000 bar hydraulic high-pressure technology



### Blade connections

Bolt Tensioners (SSV), special solutions and accessories for permanent blade connections.

Bolt Tensioner

TTG Nuts

TTG Bolts

OBLM

MDS

Hydraulic Nuts



### Nacelle connection

Bolt tensioners (SSV) and customised solutions for the safe assembly of fuselage bearings.

Bolt Tensioner

TTG Nuts

TTG Bolts



### Drive train

Optimum connections for flanges, couplings, gearboxes and generators.

GripCon

ExpaTen

ExpaTen QL

ExpaBolt

Bolt Tensioner



### SCHAFF TTG-Technology

- TTG is a special, patented process for manufacturing threads in nuts or on bolts
- TTG can demonstrably save up to 40% of material.
- Threads with TTG revolutionize the connection possibilities and save money.
- Nut and bolt flanks have a 100 % contact at the pretensioning force and the load distributes equally on the complete thread area

#### Tower connection

Optimal and time-saving tower connections, manual or partially automated.

Bolt Tensioner

TTG Nuts

TTG Bolts

OBLM

FSTS

#### Foundation

Bolt Tensioners (SSV) and assembly accessories with monitoring and documentation systems.

Bolt Tensioner

TTG Nuts

TTG Bolts

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FSTS

## Tooling

### Bolt Tensioning techniques up to 4000 bar

**SSV**

#### **Bolt Tensioner** Axial Bolt tensioning using a removable tool

Torsion-free generation of axial tensioning force – Economical use of bolt material capacity from size M8 to S1000 and bigger.



#### **Hydraulic Nuts** Axial Bolt tensioning using a hydraulic nut that stays on the bolt-connection.

Torsion-free generation of axial-tensioning force. Quicker tightening and loosening of your connection for regular maintenance – compared to Bolt Tensioner.

**HM**

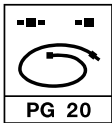
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#### **Multiple Stud Nut** Axial bolt tensioning using torque (MSN)

Simple option to achieve torsion-free axial tensioning force with increased mounting effort. The MSN replaces the standard nut in a bolted connection.







## FSTS

### SCHAFF solution for a Tower Flange Stud Tensioning System

#### Documentation – Efficiency – Quality

The design of the tools is aiming for simplicity to have reduced cost and intuitiveness for the operator. There are for instance no additional motor used to operate the tools. Instead the use of a standard cordless screw-driver system is foreseen. This can be adopted using a universal fixation system matching with a large variety of tools. Visual signals show if the tensioner is handled within its limits (especially correct bolt protrusion and maximum piston stroke) to increase worker safety. Also the handwagon is not using any motors. For tangential movement on the flange handforce is sufficient. The integrated tool lifting mechanism supports the operator with a system of 2 or more gas-springs to reduce the required handforce for lifting during operation.



#### Advantages

- Optimized Tool design: All parts are designed for min. 100.000 LC. Service interval is 10.000 LC/12 months and preventing collision with obstacles (tower wall, cable tray, ladder, weld seams) for a long life-time and simple handling for the operator.
- Suitable for marine and offshore environment: robust against outer influences up to IP67
- Increased lifetime of the bolt connection: TTG increases the possible residual force of a bolt connection and OBLM is used for real time load monitoring
- Full documentation including bolt elongation, residual force and flange gap evaluation for every bolt connection to achieve maximum security

## SCHAFF TTG-Technology

### Bolts and nuts of the future

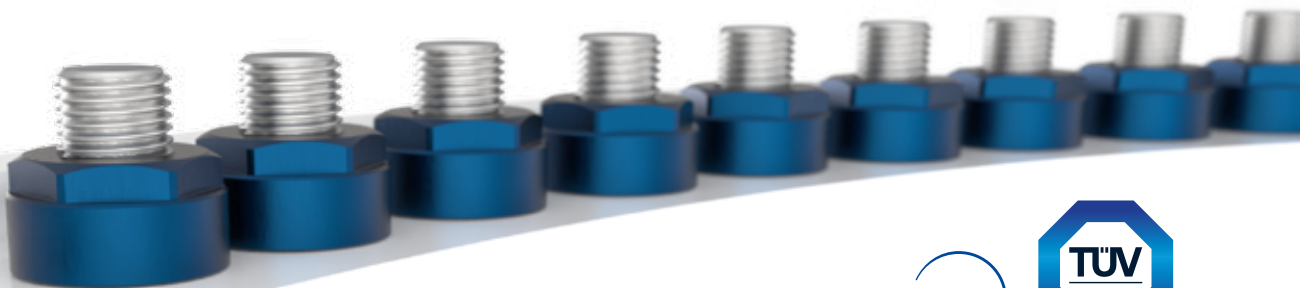
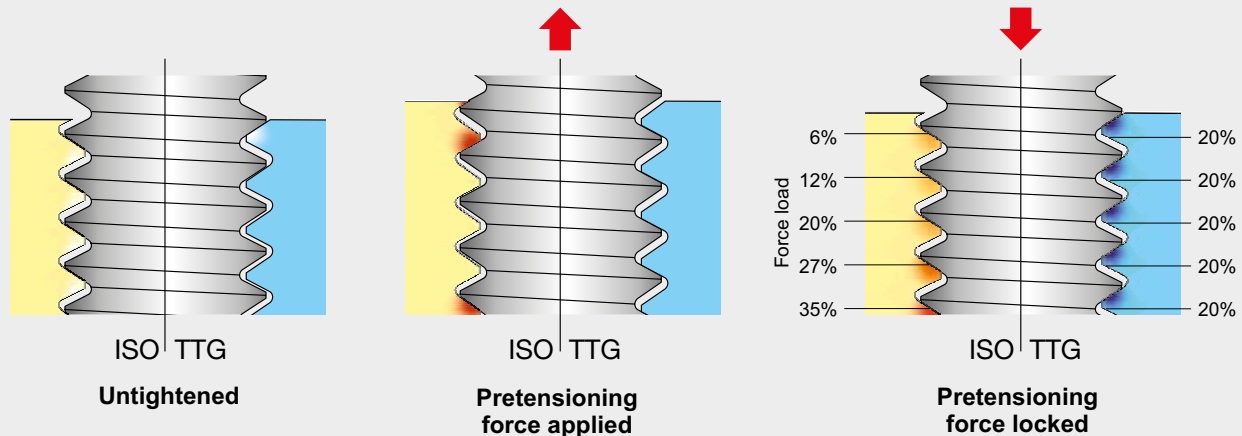
The TTG patented by SCHAFF has been studied extensively in several test procedures by the Fraunhofer-Gesellschaft as part of its technology research and has been awarded internationally valid certificates.



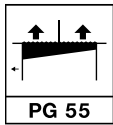
## TTG

### Targeted equal force in the thread area

TTG, a patented manufacturing process for creating threads in nuts or on bolts ensures optimum fitting accuracy in the thread when tightened. This innovative method not only enhances durability but also enables bolts with TTG to withstand significantly higher loads. Consequently, the connection diameter can be reduced, leading to substantial material savings. Threads featuring TTG revolutionize connection possibilities and offer cost-saving benefits.





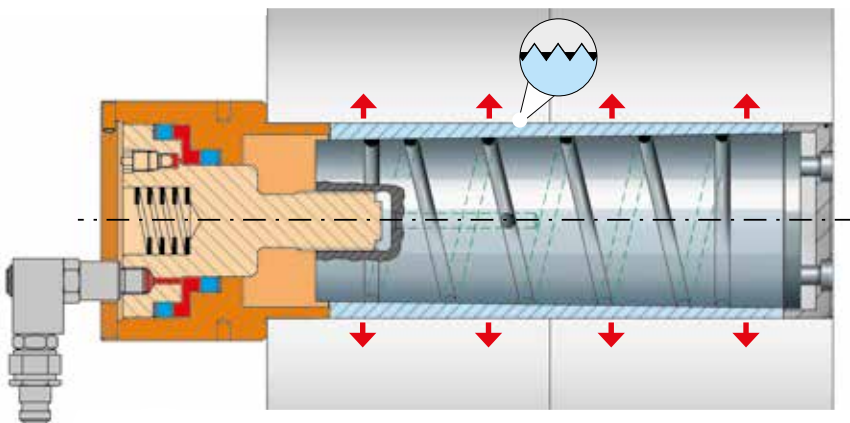


## GripCon

**Form fit component connection which takes up highest axial and radial loads**

### Cost reducing – Powerful – Unique

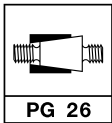
SCHAFF GripCon takes all of the leading design principles and advantages of ExpaTen and raises hydraulic coupling bolt design and performance to a new level. Designed for weight, cost and space saving applications, GripCon offers maximum product safety, reliability and total performance for all power bolt connections. The patented SCHAFF design technology offers a complete lifetime guarantee even after multiple installations and removals.



### Advantages

Due to expansion and interlocking of the sleeve into the bore surfaces, the following advantages are given compared to normal bolt connections:

- 100 % form fit and frictional connection anytime after mounting, no slipping of flanges
- No nuts for flange connections, thus significant cost reduction
- An approximate 50 % weight reduction
- Lower manufacture investment for significantly less connection elements
- No more thread cutting in stud holes necessary
- No protruding threads or nuts – better design and higher efficiency of rotation machines
- No conventional bolt connection elements
- Significant mounting time reduction because of less connection elements
- Significant less mounting and dismounting space needed
- Simple and quick installation and removal of GripCon even after years of use
- Reusability after removal again and again – no spare parts necessary

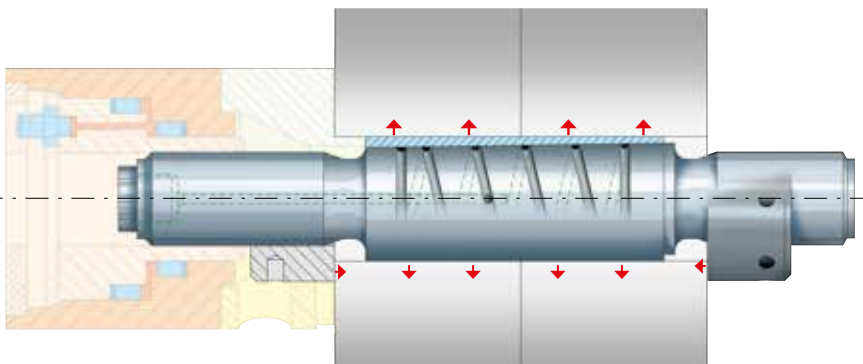


## ExpaTen

**100% positive locking in the flange bores plus frictional connection between flanges with guaranteed dismounting and remounting**

### ExpaTen – Safety and cost reduction

Due to patented technology within the ExpaTen design, the radial expansion and axial pretensioning achieved, guarantees a 100% form and friction fit. High torque values can then be transferred via the coupling whilst remaining completely free from backlash. ExpaTen Bolts have revolutionised the removable flange connection of drive shafts, as a result of high pressure hydraulic technology, improving safety and giving recognised time and cost reductions. ExpaTen installation and removal is guaranteed and can be done within 10 – 15 minutes per bolt. ExpaTen is certified by well-known buyers.

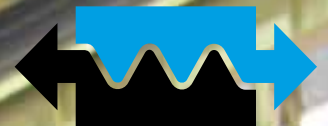


### Advantages

Expansion and pretensioning result in the following advantages compared to conventional bolts:

- 100% positive locking and frictional connection all the time after mounting, no slipping between the flanges
- Simple and quick installation and removal of ExpaTen even after years of use – nearly unlimited times
- Reusable after removal, again and again – no sparebolts required
- Torsionally and flexurally rigid connection even with sudden changes in the rotational speed, torque, or direction of rotation
- No jammed or oversized bolts any longer
- High torque transmission, completely free from backlash
- Reduction of flange dimensions possible due to fewer number of bolts
- Maximum torque and shear force transmission in minimum space
- Tolerance for mounting is 0.05 to 0.2 % of the bore diameter
- Simple machine ring of the flange holes is sufficient



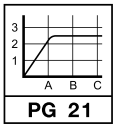


### ExpaTen QL

Quick form and force fit connections with detachable axial tensioning system (Quick Locking)

- Quick radial and axial tensioning for components, which cope with torque / shear force, axial force and / or bending load
- 100 % form fit and friction fit
- Simple and quick installation and removal of ExpaTen QL even after years of use – nearly unlimited times
- Reusable after removal, again and again – no sparebolts required





## OBLM

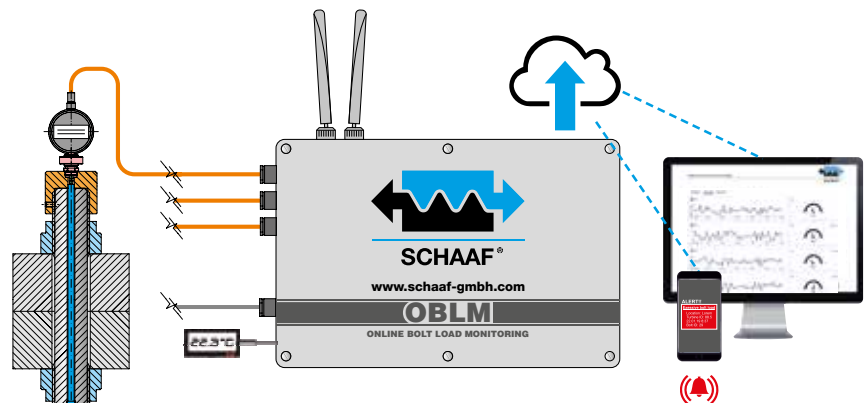
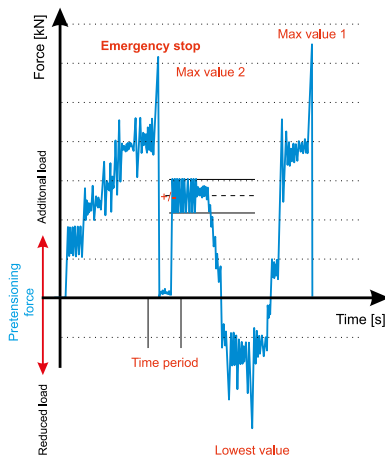
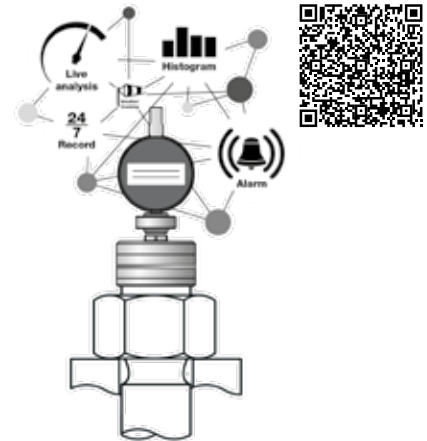
### Online Bolt Load Monitoring

#### Real-time analysis – Plug and play – Real life experience

OBLM – Accurate long-term bolt load monitoring and safety failure warnings.

#### Scope of service

- Data collection up to 16 sensors
- Real-time transmission of data, via LAN and GSM (worldwide)
- Storage of measured data in the event of communication failure
- Live data, platform independent
- Sampling of measured data 1x/second (adjustable). The analysis occurs before transmission to the cloud
- Transmission of data 1x/minute, with the following values being transmitted: maximum, average and minimum
- Defined threshold values that transmit automated messages upon exceedance



#### The smart IoT solution

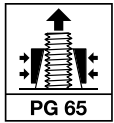
Too many times the question of “how a system is affected under real conditions” has been asked. The condition of objects can often insufficiently be determined. Online Bolt Load Monitoring (OBLM) is a comprehensive solution to measuring real time status changes of systems under full operational load.

Monitoring technology, transmission technology, hardware, software, sensor technology, cloud, measured data analysis – OBLM combines all these components into an optimally compatible IoT solution.

The OBLM system not only has the task to transmit data in real time, but additionally supports complex data analysis and evaluation. The newly gained insights help save resources and determine unwanted conditions prematurely.

The OBLM allows for unprecedented, real time analysis of the tension of bolt connections during the operation of machines. Thanks to perennial experience, SCHAAF has the technology, that allows the monitoring and analysis of occurring tension in the bolt, even during full operational load. With sophisticated analysis tools and the highly precise measuring sensors, the slightest changes in bolt-length are recorded and the resulting bolt-tension is calculated. This allows to learn and understand your machine in all different operation modes (start-up, normal/exceptional operation, standby/idle time, heating/cooling down).





## ShrinkNut

### The maintenance free bolt connection with TTG

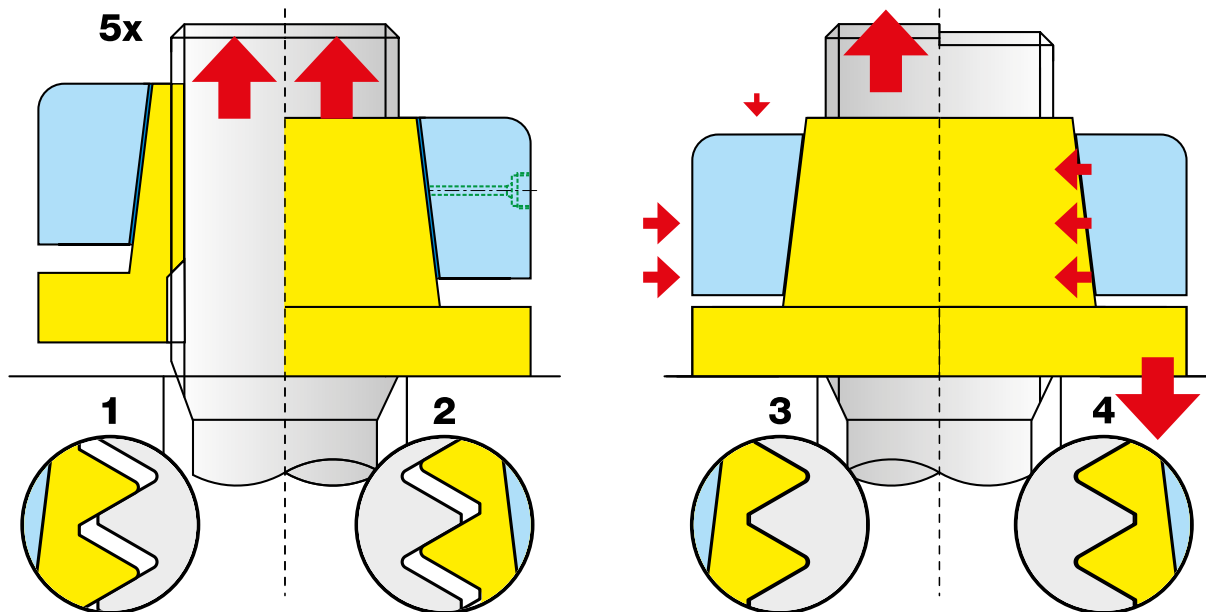
The standard version of the SCHAFF ShrinkNuts comprises the following components:

- High-strength quenched and tempered steel for maximum strength and axial load capacity
- Friction value maximised pressure ring
- QR-code marking for various documentation techniques
- All thread types, thread pitches and norms
- Surfaces according to different requirements
- Modern CAD and FEA-analyses
- Customer specific solutions



#### Alternative shrinking of the nut during pretensioning with integrated tool

(1) Before the final pretensioning of the ShrinkNut connection the bolt should preferably be pretensioned 5 times with the maximum force to compensate material relaxations over time. (2) For the final pretensioning apply the calculated pretensioning force and turn the ShrinkNut against the counterpart. (3) In this condition the inner part of the ShrinkNut is shrunk onto the thread by pushing the outer sleeve onto the inner tapered sleeve. (4) Afterwards the pretension force can be released leaving the bolt connection perfectly pretensioned in a maintenance free condition.

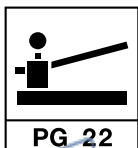


#### Advantages

- No loosening of the connection – even with steady vibration influences
- Higher and torsion free pretensioning of bolts
- Decreased rupture risk due to perfect load distribution over the whole nut height
- 100% thread contact due to optimised TTG
- Maintenance free connection
- Dimensions similar to standard hexagonal nuts
- Standard bolts, thread sizes and thread pitches of any kind can be used

## Product Extensions

### Pumps and High-Pressure Units, Accessories



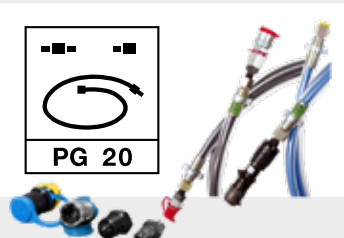
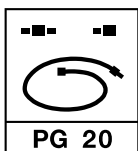
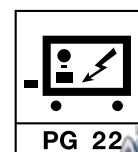
#### Hand Lever Pumps up to 4000 bar hydraulic pressure

All Hand Lever Pumps are of an extremely rugged design. All high-pressure valves are manufactured with hardened valve seats. This ensures exceptional long service life and ruggedness with regard to contaminants in the hydraulic circuit. All pumps are therefore perfectly suited for rough conditions at construction sites.



#### High-pressure Units up to 4000 bar

Electrohydraulic High-pressure Units that are coordinated best with our high pressure tools.

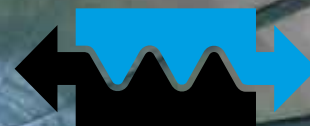


#### Accessories Nipples, Adapters, Hoses, Gauges

We design and manufacture hydraulic high pressure accessories to special requirements such as special adaptors which are tailored exactly to your application. Please, tell us your requirements; we will be pleased to submit a quick quotation without obligation for you.







### Joining Technology for wind energy

- For all products such as GripCon, ShrinkNut, ExpaTen, FSTS, SCHAFF offers the Mounting Documentation System (MDS), which documents the pre-tensioning forces, hydraulic clamping pressures, clamping paths and all other quality parameters.
- All bolted connections can be equipped with SCHAFF's patented thread production process TTG and thus increase the service life by up to 13 times. TTG can demonstrably save up to 40% of material.
- All SCHAFF tools offer maximum service life with internal safety functions that protect the operator and the plant. Operational safety and operational economy are in harmony.



## SCHAAF References

A small selection of our products supply references



### GE Renewable Energy

Haliade DB-A 13MW

TTG Bolts and nuts M64, M56, M48  
Reusable packing solutions

### VESTAS Offshore Wind

V236 15 MW

GripCon Connection Elements  
GripCon 83 mm



### CSSC Haizhuang Wind Power

HZ 6.2 MW

Bolt Tensioner M64, M56, M45, M39  
Handwagon M64, M56, M45, M39  
Standalone Pump 2500 bar  
TTG nut M64, M56, M45, M39

### CSSC Haizhuang Wind Power

5,95 MW Floating Turbine Prototype

Bolt Tensioner M72, M64, M39  
Handwagon M72, M64, M39  
Hydraulic Pump  
OBLM



### SEWIND

4MW

Bolt Tensioner M36  
MMDS  
Hydraulic Pump  
TTG nut M36  
TTG cylindrical nut M36



### **VESTAS**

V136-3.6MW

Bolt Robot M56, M36  
TTG nut M36, M 56  
Stud bolt

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HZ 5MW

Bolt Tensioner M64, M56, M45  
Handwagon M64, M56, M45  
TTG nut M56, M45, M39  
Standalone Pump unit 2500 bar



### **VESTAS Offshore Wind**

V164 / V174 8-9.5 MW

ExpaTen QL Connection Elements  
ExpaTen QL Ø100 mm

### **CSSC Haizhuang Wind Power**

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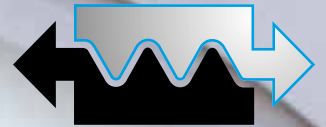


### **Mingyang**

11MW

MSN M110, MSN M90  
Stud bolt M110 and M90





### Service by SCHAFF

- Worldwide mounting, demounting, maintenance, installation, repairs and support
- Quality, reliability and precision
- More than 50 years experience with hydraulic high-pressure tools
- Instructions and trainings for safely and highly efficient operation
- SCHAFF service staff have completed both the „Management Awareness Training“ and the „Specialist Training“ and receive ongoing training by APQP4Wind.

APQP 4 Wind



## SCHAAF worldwide

### International production and installation

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#### SCHAAF Germany

What originally started with a modest production facility and just three office rooms has evolved into an impressive manufacturing of over 20,000 m<sup>2</sup> over the past forty years. Our highly modern machinery, in-house testing facilities and an efficient dispatch centre form the backbone of our manufacturing processes. In addition, our in-house joinery and high volume production capabilities give us the flexibility and versatility needed to meet the demands of the future.



#### SCHAAF China

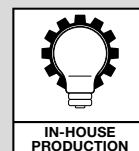
After the successful expansion of the sales network in the Near East, SCHAAF (Taicang) Co. Ltd was founded in 2007. Under strict quality requirements according to German standards, SCHAAF products have been produced especially for the Chinese market since 2011 on around 700 m<sup>2</sup>. This reduces the costs because there are no transports from Germany and the express delivery capability in Asia is increased.

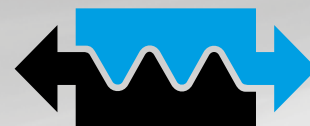


#### FASTEC Switzerland

The SCHAAF Group has included FASTEC AG, based in Altdorf, since 2010. The production facility is equipped with the precision of state-of-the-art machines that is well known in Switzerland. FASTEC specialises primarily on the SCHAAF TTG-Technology, which is a patented process for manufacturing threads in nuts or on bolts with 100% flank contact over the complete area.

## Excerpt of the certificates:





**SCHAAF GmbH & Co. KG**

Bruesseler Allee 22  
41812 Erkelenz - Germany

Telephone: +49 - 24 31 - 9 77 70-0

Fax: +49 - 24 31 - 9 77 70-77

E-Mail: [info@schaaf-gmbh.com](mailto:info@schaaf-gmbh.com)

Internet: [www.schaaf-gmbh.com](http://www.schaaf-gmbh.com)



Several customer awards confirm again and again, that SCHAAF comes to mind due to innovative developments and dozens of patents worldwide regarding optimised processes and quality the addition "Leading joining technology" is right.

**Follow us!**



[www.schaaf-gmbh.com](http://www.schaaf-gmbh.com)



SCHAAF develops and produces world leading technology in the field of joining technique in all sectors of the industry.

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Axial Bolt tensioning using a hydraulic nut that stays on the bolt-connection.

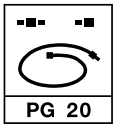
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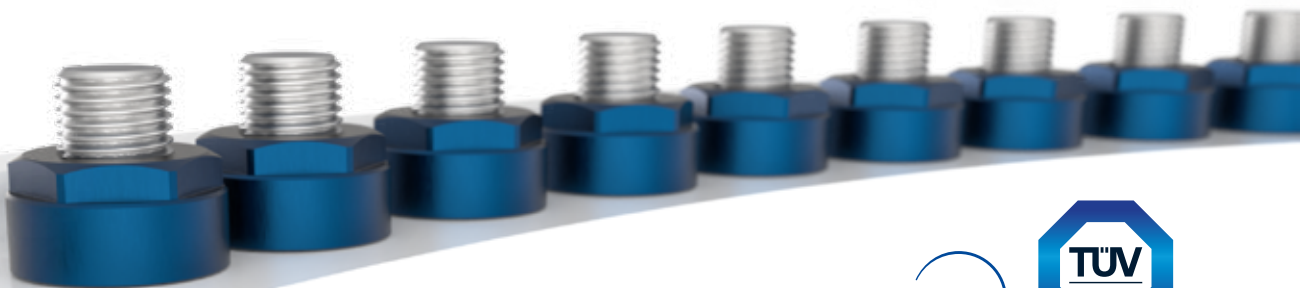
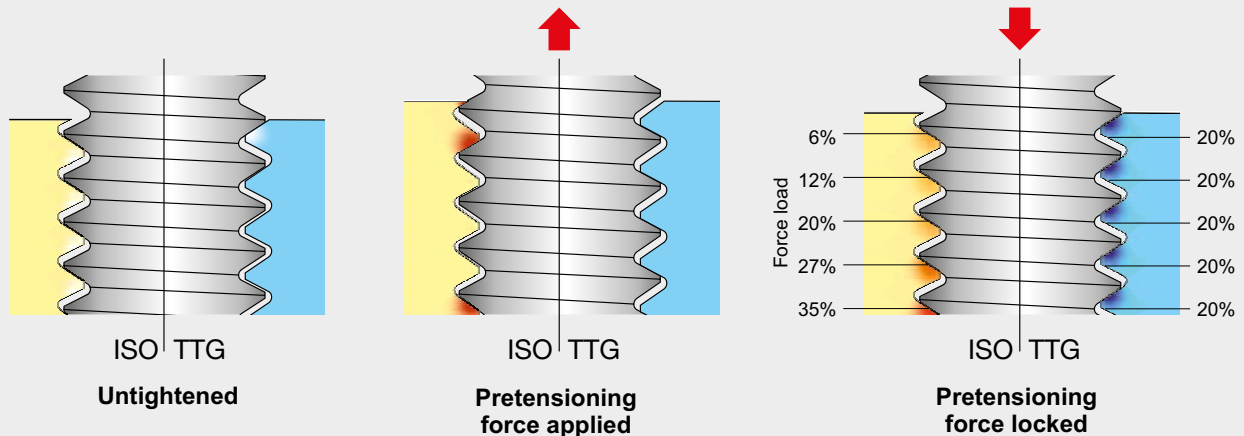
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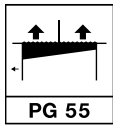


## TTG

### Targeted equal force in the thread area

TTG, a patented manufacturing process for creating threads in nuts or on bolts ensures optimum fitting accuracy in the thread when tightened. This innovative method not only enhances durability but also enables bolts with TTG to withstand significantly higher loads. Consequently, the connection diameter can be reduced, leading to substantial material savings. Threads featuring TTG revolutionize connection possibilities and offer cost-saving benefits.



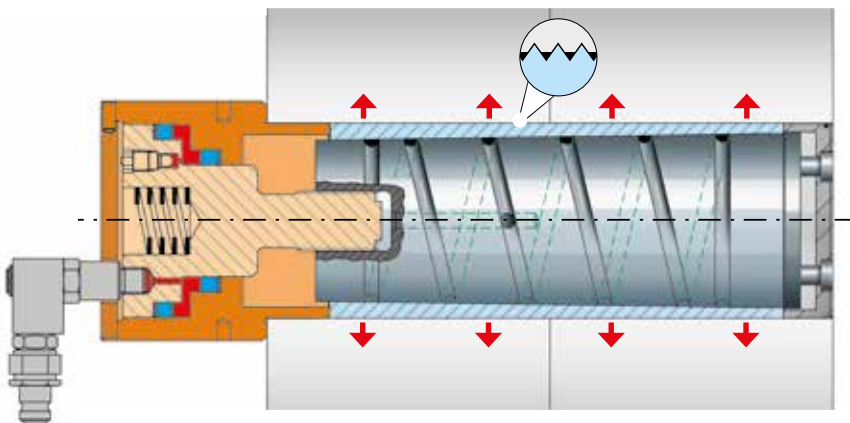


## GripCon

**Form fit component connection which takes up highest axial and radial loads**

### Cost reducing – Powerful – Unique

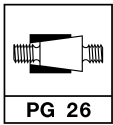
SCHAFF GripCon takes all of the leading design principles and advantages of ExpaTen and raises hydraulic coupling bolt design and performance to a new level. Designed for weight, cost and space saving applications, GripCon offers maximum product safety, reliability and total performance for all power bolt connections. The patented SCHAFF design technology offers a complete lifetime guarantee even after multiple installations and removals.



### Advantages

Due to expansion and interlocking of the sleeve into the bore surfaces, the following advantages are given compared to normal bolt connections:

- 100 % form fit and frictional connection anytime after mounting, no slipping of flanges
- No nuts for flange connections, thus significant cost reduction
- An approximate 50 % weight reduction
- Lower manufacture investment for significantly less connection elements
- No more thread cutting in stud holes necessary
- No protruding threads or nuts – better design and higher efficiency of rotation machines
- No conventional bolt connection elements
- Significant mounting time reduction because of less connection elements
- Significant less mounting and dismounting space needed
- Simple and quick installation and removal of GripCon even after years of use
- Reusability after removal again and again – no spare parts necessary

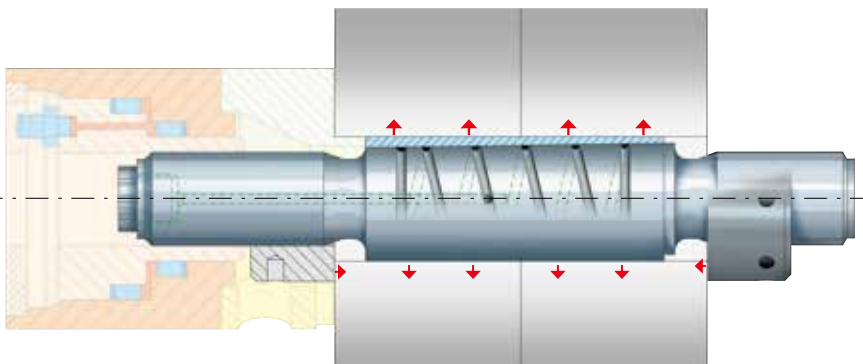


## ExpaTen

**100% positive locking in the flange bores plus frictional connection between flanges with guaranteed dismounting and remounting**

### ExpaTen – Safety and cost reduction

Due to patented technology within the ExpaTen design, the radial expansion and axial pretensioning achieved, guarantees a 100% form and friction fit. High torque values can then be transferred via the coupling whilst remaining completely free from backlash. ExpaTen Bolts have revolutionised the removable flange connection of drive shafts, as a result of high pressure hydraulic technology, improving safety and giving recognised time and cost reductions. ExpaTen installation and removal is guaranteed and can be done within 10 – 15 minutes per bolt. ExpaTen is certified by well-known buyers.

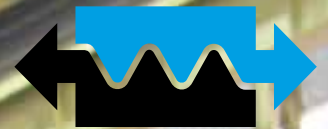


### Advantages

Expansion and pretensioning result in the following advantages compared to conventional bolts:

- 100% positive locking and frictional connection all the time after mounting, no slipping between the flanges
- Simple and quick installation and removal of ExpaTen even after years of use – nearly unlimited times
- Reusable after removal, again and again – no sparebolts required
- Torsionally and flexurally rigid connection even with sudden changes in the rotational speed, torque, or direction of rotation
- Torsionally and flexurally rigid connection even with sudden changes in the rotational speed, the torque, direction of rotation or direction of load
- No jammed or oversized bolts any longer
- High torque transmission, completely free from backlash
- Reduction of flange dimensions possible due to fewer number of bolts
- Maximum torque and shear force transmission in minimum space
- Tolerance for mounting is 0.05 to 0.2 % of the bore diameter
- Simple machine ring of the flange holes is sufficient





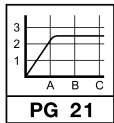
**SCHAFF®**

### **ExpaTen QL**

**Quick form and force fit connections with detachable axial tensioning system (Quick Locking)**

- Quick radial and axial tensioning for components, which cope with torque / shear force, axial force and / or bending load
- 100 % form fit and friction fit
- Simple and quick installation and removal of ExpaTen QL even after years of use – nearly unlimited times
- Reusable after removal, again and again – no sparebolts required





# OBLM

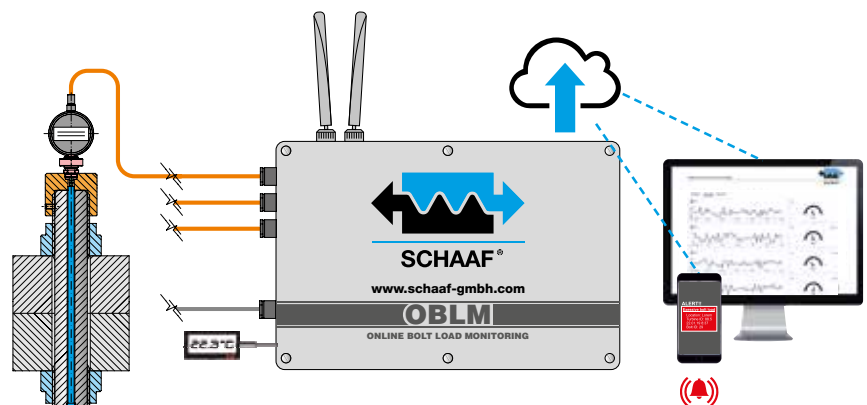
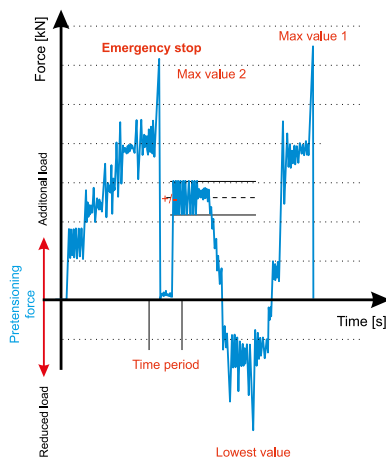
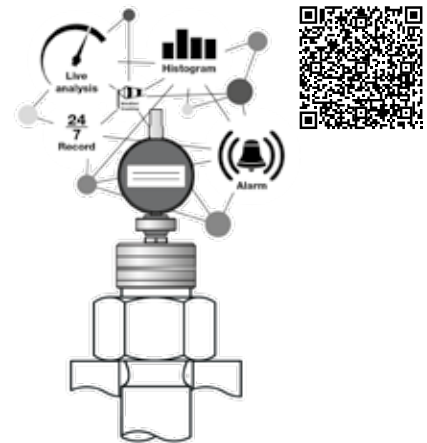
## Online Bolt Load Monitoring

### Real-time analysis – Plug and play – Real life experience

OBLM – Accurate long-term bolt load monitoring and safety failure warnings.

#### Scope of service

- Data collection up to 16 sensors
- Real-time transmission of data, via LAN and GSM (worldwide)
- Storage of measured data in the event of communication failure
- Live data, platform independent
- Sampling of measured data 1x/second (adjustable). The analysis occurs before transmission to the cloud
- Transmission of data 1x/minute, with the following values being transmitted: maximum, average and minimum
- Defined threshold values that transmit automated messages upon exceedance



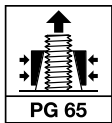
### The smart IoT solution

Too many times the question of “how a system is affected under real conditions” has been asked. The condition of objects can often insufficiently be determined. Online Bolt Load Monitoring (OBLM) is a comprehensive solution to measuring real time status changes of systems under full operational load.

Monitoring technology, transmission technology, hardware, software, sensor technology, cloud, measured data analysis – OBLM combines all these components into an optimally compatible IoT solution.

The OBLM system not only has the task to transmit data in real time, but additionally supports complex data analysis and evaluation. The newly gained insights help save resources and determine unwanted conditions prematurely.

The OBLM allows for unprecedented, real time analysis of the tension of bolt connections during the operation of machines. Thanks to perennial experience, SCHAAF has the technology, that allows the monitoring and analysis of occurring tension in the bolt, even during full operational load. With sophisticated analysis tools and the highly precise measuring sensors, the slightest changes in bolt-length are recorded and the resulting bolt-tension is calculated. This allows to learn and understand your machine in all different operation modes (start-up, normal/exceptional operation, standby/idle time, heating/cooling down).



## ShrinkNut

### The maintenance free bolt connection with TTG

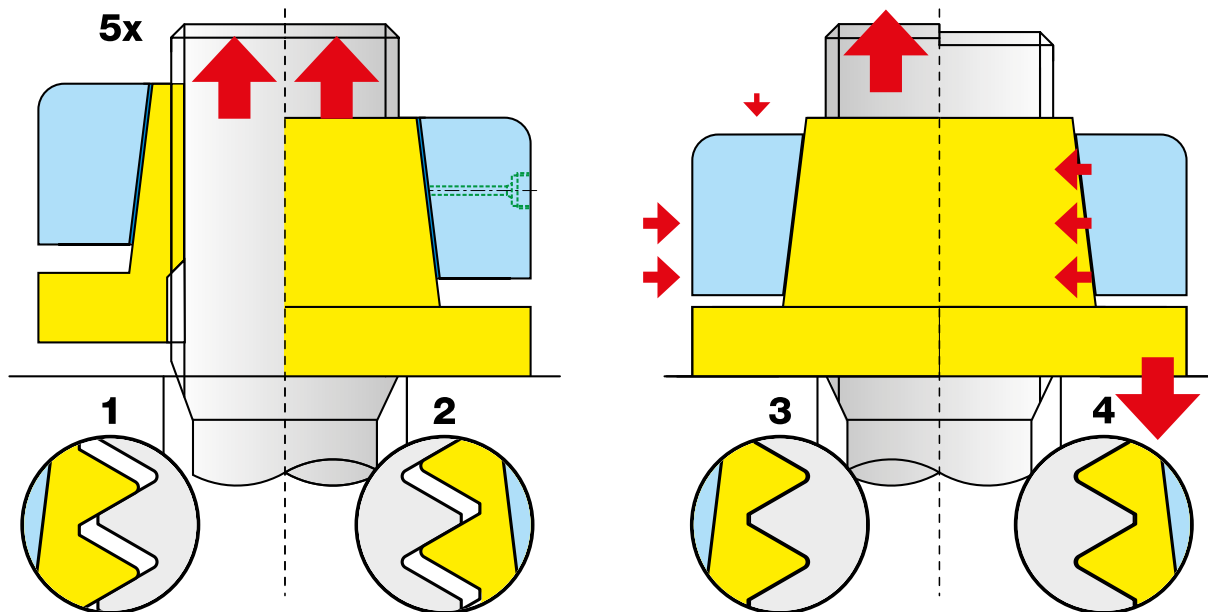
The standard version of the SCHAAF ShrinkNuts comprises the following components:

- High-strength quenched and tempered steel for maximum strength and axial load capacity
- Friction value maximised pressure ring
- QR-code marking for various documentation techniques
- All thread types, thread pitches and norms
- Surfaces according to different requirements
- Modern CAD and FEA-analyses
- Customer specific solutions



#### Alternative shrinking of the nut during pretensioning with integrated tool

(1) Before the final pretensioning of the ShrinkNut connection the bolt should preferably be pretensioned 5 times with the maximum force to compensate material relaxations over time. (2) For the final pretensioning apply the calculated pretensioning force and turn the ShrinkNut against the counterpart. (3) In this condition the inner part of the ShrinkNut is shrunk onto the thread by pushing the outer sleeve onto the inner tapered sleeve. (4) Afterwards the pretension force can be released leaving the bolt connection perfectly pretensioned in a maintenance free condition.



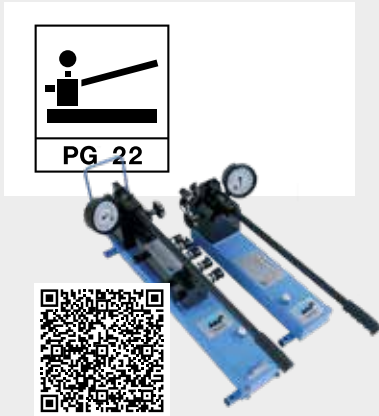
#### Advantages

- No loosening of the connection – even with steady vibration influences
- Higher and torsion free pretensioning of bolts
- Decreased rupture risk due to perfect load distribution over the whole nut height
- 100% thread contact due to optimised TTG
- Maintenance free connection
- Dimensions similar to standard hexagonal nuts
- Standard bolts, thread sizes and thread pitches of any kind can be used



## Product Extensions

### Pumps and High-Pressure Units, Accessories



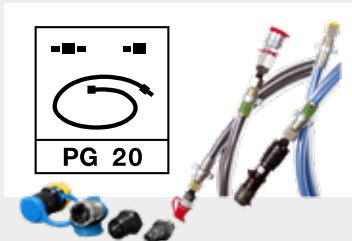
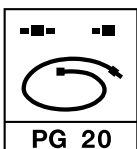
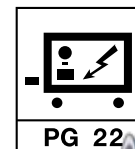
#### Hand Lever Pumps up to 4000 bar hydraulic pressure

All Hand Lever Pumps are of an extremely rugged design. All high-pressure valves are manufactured with hardened valve seats. This ensures exceptional long service life and ruggedness with regard to contaminants in the hydraulic circuit. All pumps are therefore perfectly suited for rough conditions at construction sites.



#### High-pressure Units up to 4000 bar

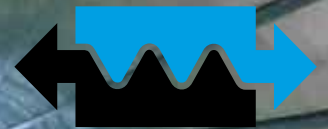
Electrohydraulic High-pressure Units that are coordinated best with our high pressure tools.



#### Accessories Nipples, Adapters, Hoses, Gauges

We design and manufacture hydraulic high pressure accessories to special requirements such as special adaptors which are tailored exactly to your application. Please, tell us your requirements; we will be pleased to submit a quick quotation without obligation for you.





**SCHAAF®**

## Joining Technology for wind energy

- For all products such as GripCon, ShrinkNut, ExpaTen, FSTS, SCHAAF offers the Mounting Documentation System (MDS), which documents the pre-tensioning forces, hydraulic clamping pressures, clamping paths and all other quality parameters.
- All bolted connections can be equipped with SCHAAF's patented thread production process TTG and thus increase the service life by up to 13 times. TTG can demonstrably save up to 40% of material.
- All SCHAAF tools offer maximum service life with internal safety functions that protect the operator and the plant. Operational safety and operational economy are in harmony.



## SCHAAF References

A small selection of our products supply references



### GE Renewable Energy

Haliade DB-A 13MW

TTG Bolts and nuts M64, M56, M48  
Reusable packing solutions

### VESTAS Offshore Wind

V236 15 MW

GripCon Connection Elements  
GripCon 83 mm



### CSSC Haizhuang Wind Power

HZ 6.2 MW

Bolt Tensioner M64, M56, M45, M39  
Handwagon M64, M56, M45, M39  
Standalone Pump 2500 bar  
TTG nut M64, M56, M45, M39

### CSSC Haizhuang Wind Power

5,95 MW Floating Turbine Prototype

Bolt Tensioner M72, M64, M39  
Handwagon M72, M64, M39  
Hydraulic Pump  
OBLM



### SEWIND

4MW

Bolt Tensioner M36  
MMDS  
Hydraulic Pump  
TTG nut M36  
TTG cylindrical nut M36





## VESTAS

V136-3.6MW

Bolt Robot M56, M36  
TTG nut M36, M 56  
Stud bolt

## CSSC Haizhuang Wind Power

HZ 5MW

Bolt Tensioner M64, M56, M45  
Handwagon M64, M56, M45  
TTG nut M56, M45, M39  
Standalone Pump unit 2500 bar



## VESTAS Offshore Wind

V164 / V174 8-9.5 MW

ExpaTen QL Connection Elements  
ExpaTen QL Ø100 mm

## CSSC Haizhuang Wind Power

HZ 5MW

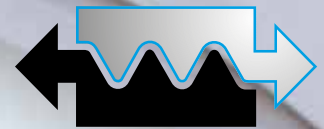
Bolt Tensioner M64, M56, M48, M36  
Handwagon M64, M56, M48  
Standalone Pump unit 2500 bar  
TTG Nut M56, M48, M39



## Mingyang

11MW

MSN M110, MSN M90  
Stud bolt M110 and M90



### Service by SCHAFF

- Worldwide mounting, demounting, maintenance, installation, repairs and support
- Quality, reliability and precision
- More than 50 years experience with hydraulic high-pressure tools
- Instructions and trainings for safely and highly efficient operation
- SCHAFF service staff have completed both the „Management Awareness Training“ and the „Specialist Training“ and receive ongoing training by APQP4Wind.

APQP 4 Wind



## SCHAAF worldwide

### International production and installation

SCHAAF is an international group of enterprises with home-base in Germany that has specialised in the development and production of joining technologies since 1954. The globally active company thrives on its innovative system solutions and convinces with excellent quality. SCHAAF supplies bolt tensioning devices, hydraulic nuts, hydraulic high-pressure generators and accessories to more than 60 countries worldwide every year.



#### SCHAAF Germany

What originally started with a modest production facility and just three office rooms has evolved into an impressive manufacturing of over 20,000 m<sup>2</sup> over the past forty years. Our highly modern machinery, in-house testing facilities and an efficient dispatch centre form the backbone of our manufacturing processes. In addition, our in-house joinery and high volume production capabilities give us the flexibility and versatility needed to meet the demands of the future.



#### SCHAAF China

After the successful expansion of the sales network in the Near East, SCHAAF (Taicang) Co. Ltd was founded in 2007. Under strict quality requirements according to German standards, SCHAAF products have been produced especially for the Chinese market since 2011 on around 700 m<sup>2</sup>. This reduces the costs because there are no transports from Germany and the express delivery capability in Asia is increased.



#### FASTEC Switzerland

The SCHAAF Group has included FASTEC AG, based in Altdorf, since 2010. The production facility is equipped with the precision of state-of-the-art machines that is well known in Switzerland. FASTEC specialises primarily on the SCHAAF TTG-Technology, which is a patented process for manufacturing threads in nuts or on bolts with 100% flank contact over the complete area.

## Excerpt of the certificates:





**SCHAAF GmbH & Co. KG**

Bruesseler Allee 22  
41812 Erkelenz - Germany

Telephone: +49 - 24 31 - 9 77 70-0  
Fax: +49 - 24 31 - 9 77 70-77

E-Mail: [info@schaaf-gmbh.com](mailto:info@schaaf-gmbh.com)  
Internet: [www.schaaf-gmbh.com](http://www.schaaf-gmbh.com)



Several customer awards confirm again and again, that SCHAAF comes to mind due to innovative developments and dozens of patents worldwide regarding optimised processes and quality the addition “Leading joining technology” is right.

**Follow us!**



[www.schaaf-gmbh.com](http://www.schaaf-gmbh.com)

SCHAAF develops and produces world leading technology in the field of joining technique in all sectors of the industry.



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