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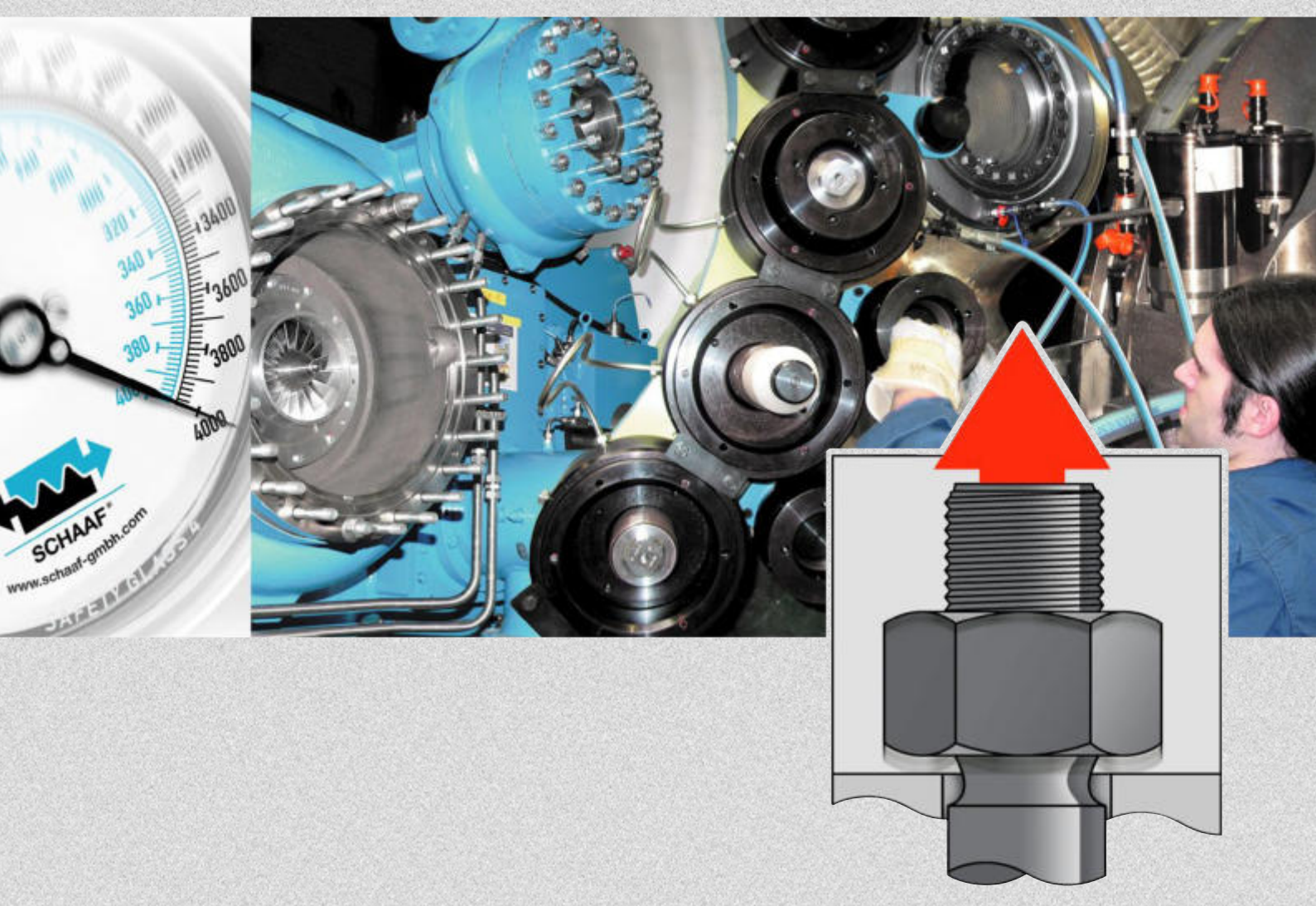
Bolt Tensioner

Axial Bolt Tensioning using High-Pressure Hydraulic



SSV and HM – Axial bolt tensioning without torquing!

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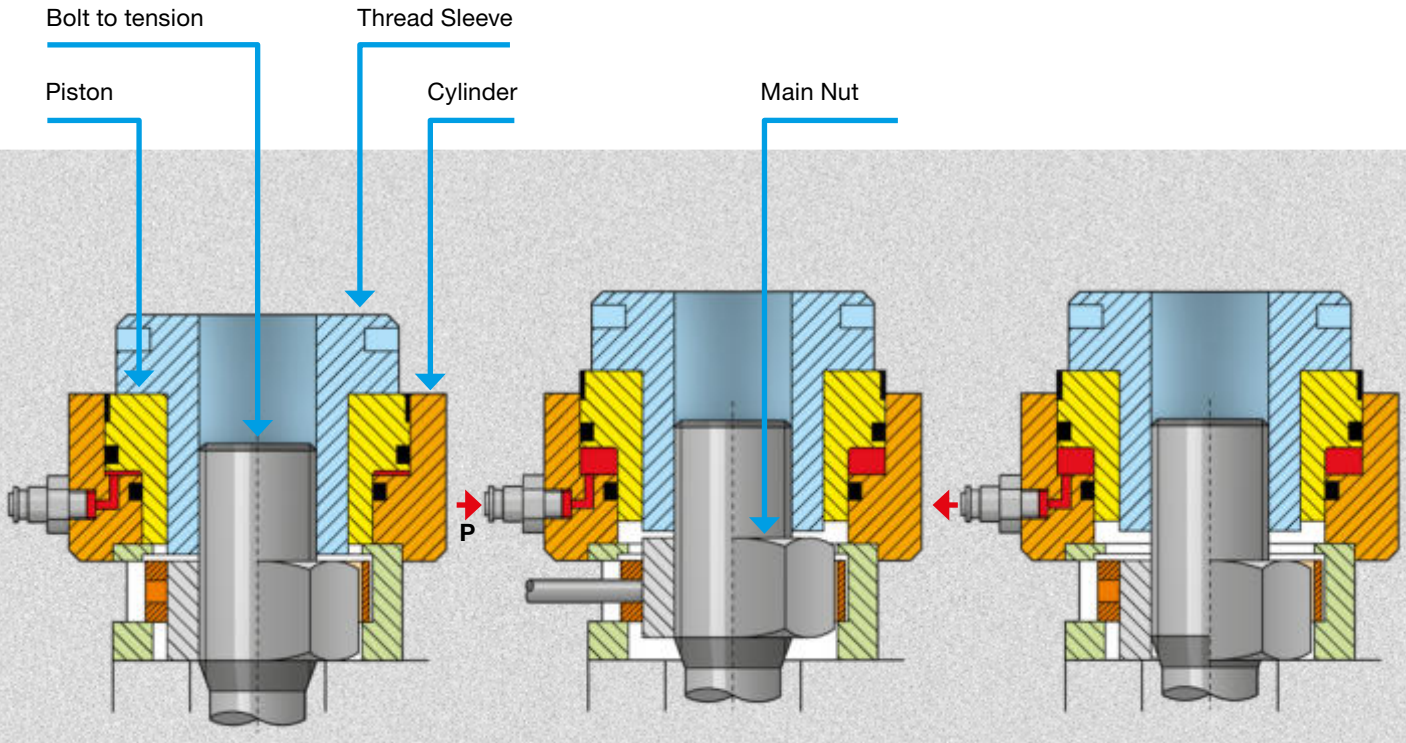
SSV

Function of a Bolt Tensioner (SSV) PG 3 in simplified representation



Bolt Tensioners can be removed from the bolt connection after pre-tensioning: in comparison, Hydraulic Nuts remain on the bolt or component connection.

Basic position

Place the SSV onto the bolt to be tensioned and screw the Thread Sleeve down to the Piston surface. A hydraulic high-pressure pump, through a flexible hose, feeds oil into the space between Cylinder and Piston. The hydraulic pressure increases.

Elongation and compression

As the hydraulic pressure increases, the resulting axial force elongates the Bolt and compresses the flanges. Thus, the Main nut lifts from the flange. On reaching the desired tension, pressurizing is stopped.

Positioning of the Main nut

The tensioning force is achieved and the Main nut can be turned down to contact the flange. When releasing the oil pressure, the desired tensioning force remains in the bolt connection. After removing the SSV, you may use the equipment for tensioning other bolts.

More information in animated operating instructions as well as further information and a complete product overview under **www.schaaf-gmbh.com**

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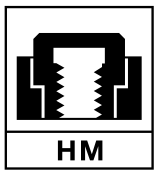
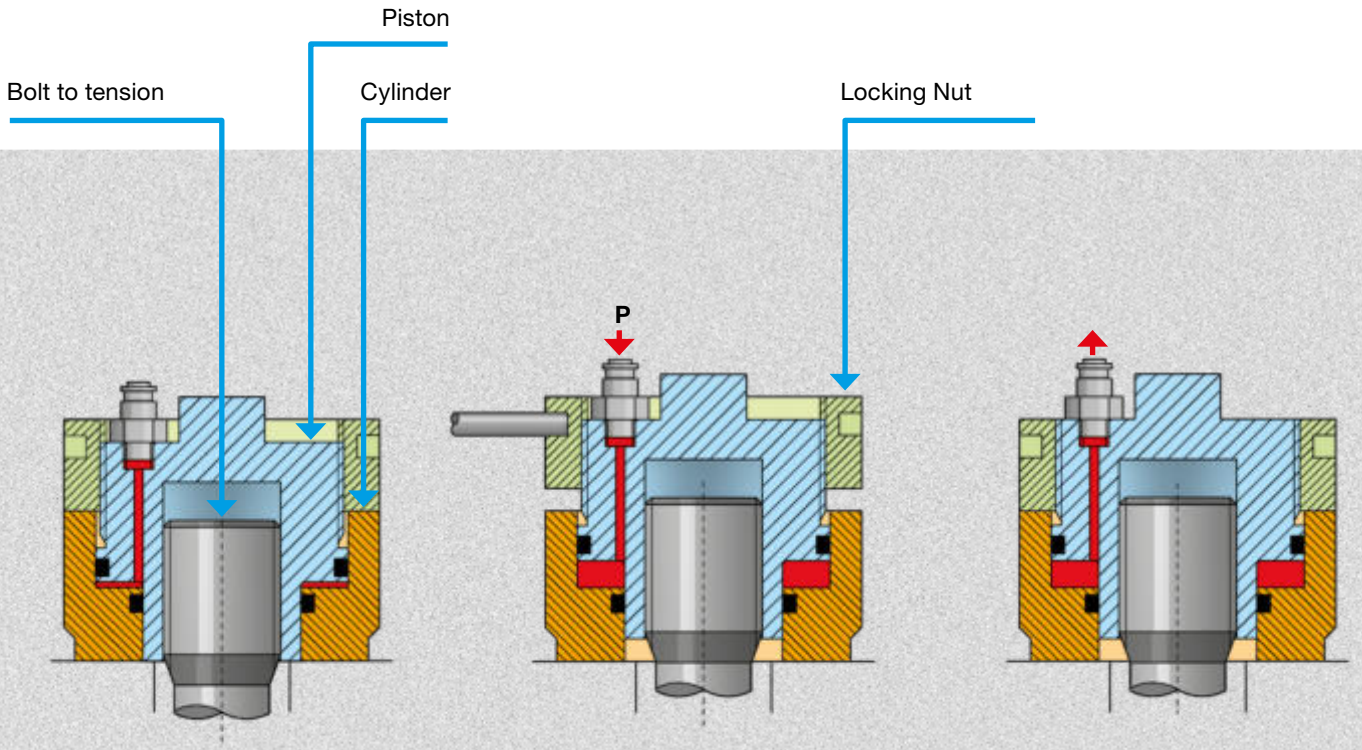


HM

Function of a Hydraulic Nut (HM) PG 12 in simplified representation



Hydraulic Nuts do not require a thread projection as Bolt Tensioners do and, therefore, can be used in older constructions to replace conventional torque wrenched bolt connections. For large bolt connections in particular, this eases work and increases the safety of the tension force. Compared with Bolt Tensioners, Hydraulic Nuts enable quicker changing times for connections that need tightening and loosening on a regular basis. This speeds up checking load forces.

Basic position

Screw the HM onto the bolt to be tensioned until it contacts the flange surface. A hydraulic high-pressure pump, through a flexible hose, feeds oil into the space between Cylinder and Piston. The hydraulic pressure increases.

Elongation and compression

As the hydraulic pressure increases, the resulting axial force elongates the Bolt and compresses the flanges. Thus, the Locking nut lifts from the Cylinder. On reaching the desired tension, pressurizing is stopped.

Positioning of the Locking nut

The tensioning force is achieved and the Locking nut can be turned down to contact the Cylinder. When releasing the oil pressure, the desired tensioning force stays in the bolt connection. The Hydraulic Nut remains on the bolt.

All **SSV, HM** and **MSN** threads can be equipped with Tensioned Thread Geometry (**TTG**). This enables a targeted equal force in the thread area for increase of longevity. Please see www.schaaf-gmbh.com/ttg/

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The advantages of generating pure axial pre-tension using pressures up to 4000 bar (SSV and HM)

Torsion-free generation of tension force – Economical use of bolt material capacity

A bolt is designed to hold two or more components together. Axial bolt elongation is the only force at work here. Torsion, which is generated, due to friction in the threads and in the support surface, by using torque wrenching methods, means only unnecessary weaking of the components. This requires stronger bolt connections. This disadvantage is no longer existing when using SCHAAF **SSV** and **HM** to generate the axial pre-tension.
This increases the economic utilisation factor. Axial tension force has been attained by using SCHAAF **SSV** and **HM** for bolts with a thread diameter from 8 mm to over 800 mm.

Maximum accuracy

Since the pre-tension is purely axial and only varies by -4% maximum, bolts can be tightened up to the yield strength of the material used. An integrated displacement transducer even allows tensioning beyond the elastic limit.

Increased safety

Due to the purely axial bolt tensioning force applied and as the safety factors given in bolt calculation instructions come down to a minimum, bolts can be higher tensioned for the same bolt thread cross section. The connection is more secure.

No-friction tensioning force application

Due to the purely axial bolt tensioning force applied, the main nut (SSV) or the locking nut (HM) can be threaded without effort or friction up to the flange. This completely eliminates the problem of chewing of the threads with a fine pitch or of bolt connections made of austenitic steel. For large bolt connections the calculated total torque is dependant, by more than 90% on the amount of friction. Estimated coefficients of friction for torque from $\mu = 0.08$ to $\mu = 0.35$ (a tensioning difference of around 400%) are now a thing of the past.

Fields of Application

- General mechanical engineering
- Metal industry
- Structural and civil engineering
- Refineries, chemical industry
- Powerplant technology
- Research technology
- Onshore / Offshore

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The advantages of generating pure axial pre-tension using pressures up to 4000 bar (SSV and HM)

Capability to start simultaneous tensioning at multiple points

„Crossover-tightening“ of several bolts at several points is no longer necessary, since SCHAAF **SSV** and **HM** offer the possibility of tightening all the bolt connections simultaneously with exactly the same tensioning force. This also applies when increasing the tensioning force.

Start of tensioning independently of tensioning path

As opposed to thermal screw starting procedures, SCHAAF **SSV** and **HM** make it possible to eliminate different gaps between individual components. Each bolt can be tensioned with exactly the same force and not over the same distance!

Quickest test capability at any time

SCHAAF **SSV** and **HM** make it possible to apply a residual tensioning force by means of test force stress application in order to determine if any settling of the screw may occur, and if so, to eliminate it.

Universal application

With a compact unit and the ability to interchange the component parts relating to the size of the bolt, SCHAAF **SSV** can also be used for other thread sizes.

Saving of time

SSV and **HM** will dramatically save time required for tensioning applications. This effect increases for higher tensioning forces, larger bolt thread diameters and also the installation of several SCHAAF **SSV** or **HM**. Time savings up to 99% are possible! It is no longer necessary to apply large torque by hand. There is a number of handling features available, designed to make work easier with SCHAAF **Bolt Tensioners** and **Hydraulic Nuts**, especially when it comes to large dimensions.

Special solutions:

In addition to a number of ***standardized*** Bolt Tensioners and Hydraulic Nuts, SCHAAF has already delivered ***thousands of customized*** axial Bolt Tensioners. The Design on Demand CAD system allows to realize customer solutions very quickly. Based on axial pre-tensioning technics, a number of patented, specialized solutions have been developed during the last years. Bolt Tensioners, Hydraulic Nuts and ExpaTen, as well as the A-Loc and EcoRolls, both developed especially for rolling mills, all represent a 100% system solution with SCHAAF’s accessories such as high-pressure hoses and high-pressure generators.

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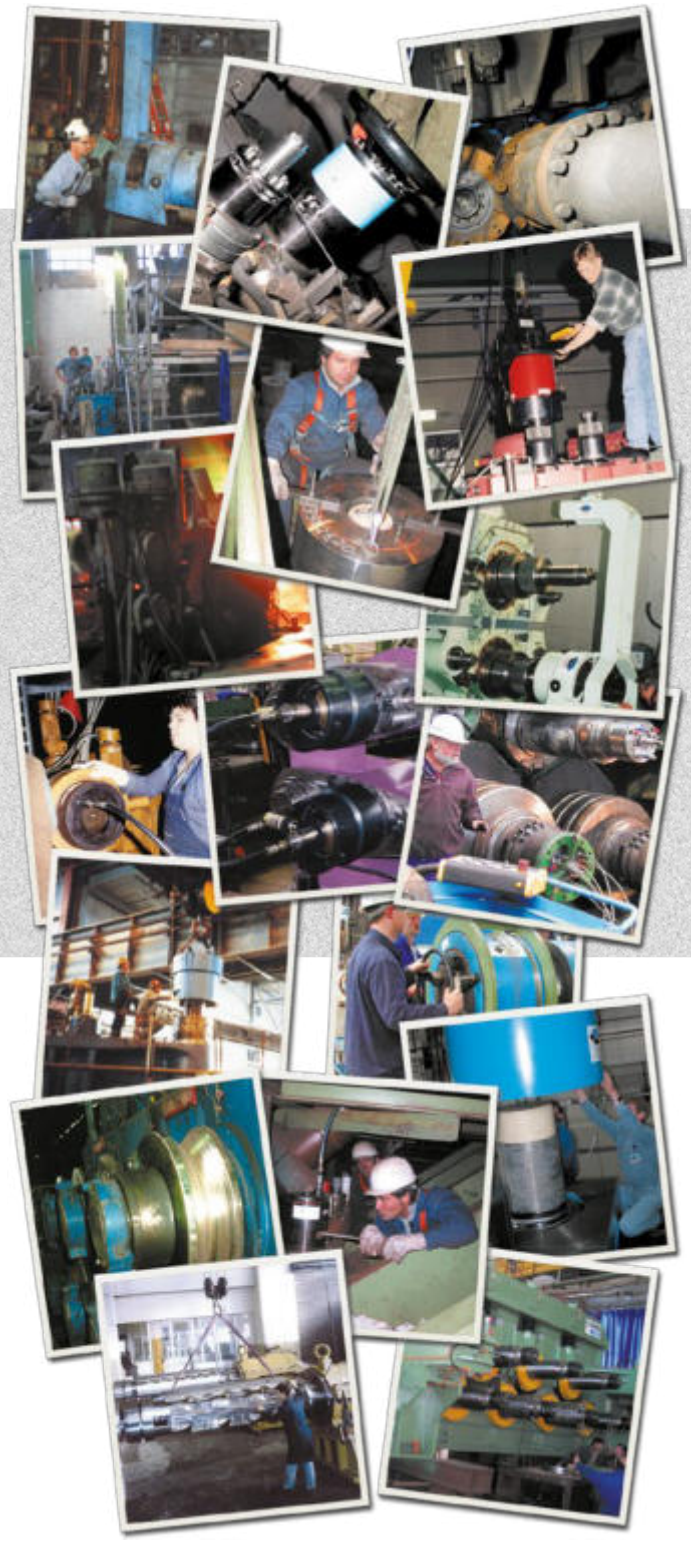
Examples of Applications

General mechanical engineering

Turbines, compressors, generators, presses, diesel engines, transformers, gear boxes, couplings, aerospace, aviation, extruders, pumps, roll tensioning and much more.

Metal industry

Heavy machines engineering, rolling mills, presses, finishing machines, shears and slitters, coilers and much more.



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Examples of Applications

Ship engine engineering, shipbuilding, Onshore / Offshore

Large 2- and 4-stroke engines, propellers, rudders, windlasses, pipeline construction, anchoring technology and much more.

Refineries, chemical industry

Plant construction, pipeline construction, apparatus / vessels, heat exchangers, turbines, compactors and much more.

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Examples of Applications

Powerplant technology

Nuclear power plants, coal power stations, wind energy plants, hydroelectric power plants, fusion plants, accelerator plants and much more.

Structural and civil engineering, mining, research technology

Material handling, spreaders, cranes, excavators, heading and cutting machines for tunnels, shredders, bridge building, steel building, grinding mills and much more.

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Equipment Variations
(SSV and HM)

- **Construction**
  · single stage, large outer diameter, small installation height
  · multi-stage, small outer diameter, large installation height
- **Material**
  · corrosion- and acid-resistant steel, aluminium alloys, various material combinations
- **Sealing materials**
  · for various temperature ranges from -80° C to +320° C, for various pressure ranges up to an operating pressure of 4000 bar
- **Pressure media**
  · HFC, grease (HM), oil of other viscosity classes, water, emulsions, others
- **Pressure control**
  · pressure indicator, pressure gauge, others
- **Stroke**
  · as required
- **Threads to match all screws to be pre-tensioned**
  · all thread types, all thread sizes, all standards, other force transfer elements such as e.g. bayonet
- **Turning elements for screwing main nut (SSV) or locking nut (HM)**
  · hexagon socket nut driver, hexagon socket with exterior gear and exterior drive (SSV), manual, using a ratchet and gear drive, face spanner bores (HM) motor driven
- **For HM, locking of the pre-tensioning force**
  · locking nut, shims, pressure accumulator with separate pressure release valve
- **Piston return stroke by**
  · wrench surface, elements for mechanical screw return, springs, hydraulic return stroke cylinder, hydraulic return stroke piston (hydraulic integrated)
- **Stroke limiting device**
  · mechanical stop (up to full operating power)
  · excess stroke valve (hydraulic limited stroke through pressure bleeding)
  · excess stroke valve (switches pressure generator oft)
- **Connector variations**
  · various thread sizes and types, axial connecting bore (front side), radial connecting bore (mantle side), sunk connecting bore, tangential connecting bore, screw-type connector, quick coupling nipple, rotary connection, rotary angled connection, input and output connector for series connections
- **Surface treatment**
  · gun metal finished, blackened, varnished, chemically nickel-plated, as per customer’s specifications

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SSV Product Groups

	Main Features	Advantages of PG	Conditions	Examples of Applications
 PG 1	· single-stage · tension nut · for recessed bolt threads	· SSV simple to place, thus short set-up times · short spindle path of nut due to recessed tension thread · easy handling because of low weight of tension nut when screwing on and off	· large thread overhang of bolt over main nut required · intensive bolt manufacturing process · maximum permissible pre-tensioning force is determined by tension thread geometry	· where a quick and easy handling is necessary · where remote handling is necessary · where austenitic screw materials are used · container construction · pipeline construction
 PG 2	· single-stage · tension nut · for continuous bolt threads	· SSV simple to place, thus short set-up times · cost-efficient continuous bolt thread · easy handling because of low weight of tension nut when screwing on and off	· large thread overhang of bolt over main nut required · large spindle path of main nut	· where bolts are tensioned to yield stress limit or for economic reasons where continuous thread is chosen · machine building · anchoring
 PG 3	· single-stage · flush nut · for continuous or recessed bolt threads	· can be used for other thread sizes, by replacing components which depend on thread size · short thread overhang of bolt · SSV is simple to place, thus short set-up times · easy handling because of low weight of flush nut	· larger outer diameter for same technical data as PG 1, 2, 4, 5, 6 and 7 · difficult handling for thread dimensions larger than 100 mm (4 inch), for overhead mounting	· when different screw sizes on a complete system have to be pretensioned using the same SSV · universally applicable
 PG 4	· single-stage · thread in piston · for continuous bolt threads	· cheapest SSV · short thread overhang of bolt · small outer diameter of SSV · low height of SSV	· use limited to one thread size · whole SSV must be screwed on · pressure connector rotates with SSV	· where bolts with one thread size should be tensioned at the lowest cost · transmission construction · press construction
 PG 5	· single-stage · thread in piston · for recessed bolt threads	· smaller outer diameter of SSV compared with PG 4, otherwise like PG 4	· use limited to one tension thread size · whole SSV must be screwed on · pressure connector rotates with SSV · maximum permissible pre-tensioning force is dependant on tension thread geometry	· where installation space is limited · pipeline construction · mining
 PG 6	· single- or multi-stage · lengthened bolt · for continuous or recessed bolt threads	· short thread overhang of bolt · maximum pre-tensioning force at smallest outer diameter · can be used for other thread sizes, by replacing components, which depend on thread size	· relatively large height · most expensive single SSV · longest mounting times compared with PG 1, 2, 3, 4, 5 and 7	· whenever generation of large pre-tensioning forces should be as close as possible to sealing boundaries · when the hydraulic head must protrude over extra high interfering lines and the screw should not be lengthened · turbine construction
 PG 7	· multi-stage · thread in top piston · for continuous or recessed bolt threads	· high pre-tensioning forces at small outer diameters · height smaller than PG 6 · larger cost-efficiency than PG 6 · lower disassembly height than PG 6 · lower weight than PG 6	· large thread overhang of bolt over main nut required · use limited to one tension thread size · pressure connector rotates with SSV on upper hydraulic head · maximum permissible pre-tensioning force is dependant on tension thread geometry	· whenever generation of large pre-tensioning forces should be as close as possible to sealing boundaries, or when a low installation height is imposed · turbine construction
 PG 8	· single- or multi-stage · cylinder and piston applied firmly attached, firmly screwed to or integrated into a ring, ringsegment or plate	· optimum method for generating the same pretensioning force on all screws simultaneously · shortest set-up times	· must be possible to apply as a ring or ringsegment to the object to be tensioned · handling aids required · most cost-intensive solution, due to one flange geometry	· whenever the generation of exactly the same pretensioning force in all screws is required simultaneously, or where the shortest possible assembly or disassembly times are required · container and vessel constructions · nuclear power plants

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HM Product Groups

	Main Features	Advantages of PG	Conditions	Examples of Applications
 PG 9	· single-stage · also used to generate axial displacement forces · pressure remains in HM after pre-tensioning · pressure medium: oil or grease · annular piston	· hydraulic pre-tensioning force application for short bolt threads · light construction type	· small stroke · risk of piston jamming if flange and screw axis are not at right angle · piston relatively loose in cylinder	· universally applicable · calibration equipment, machine saws, shears · general engineering · slide on bearings · mounting of conical sleeves
 PG 10	· single-stage · also used to generate axial displacement forces · mechanical locking · annular piston	· integrated mechanical locking · pre-tensioning force is maintained without pressure · otherwise, like PG 9	· larger outer diameter than PG 9 · otherwise, like PG 9	· rolling mill construction · shears, cutters · heavy engineering · general engineering
 PG 11	· single-stage · also used to generate axial displacement forces · pressure cylinder and nut part (traction and locking nut) are separate · mechanical locking · differential piston	· smaller outer diameter than PG 10 · for recessed bolt thread · larger stroke than PG 9 and 10 · high pre-tensioning force with small outer diameter · stable piston guidance · pre-tensioning force is maintained without pressure	· installation height larger than PG 9 and 10 · large thread overhang of bolt over flange required	· plant construction · mining · press construction · anchoring bolts
 PG 12	· single-stage · also used to generate axial displacement forces · mechanical locking · differential piston	· smaller geometric dimensions compared with PG 11 · short thread overhang · high pre-tensioning force at smallest outer diameter · stable piston guidance · pre-tensioning force is maintained without pressure	· installation height larger than PG 9 and 10	· wherever shortest possible assembly or disassembly times are required · mining · press construction
 PG 13	· single-stage · replaces flange · mechanical locking · cylinder and piston are firmly attached, firmly screwed to or integrated into a ring or plate · simultaneous pressurization of all HM	· optimum way of generating the same pre-tensioning force in all screws simultaneously · shortest set-up times	· most cost-intensive HM product group	· wherever precisely the same pre-tensioning forces must be generated in all screws simultaneously and where shortest possible assembly or disassembly times are required · pump construction · extruders · high-speed couplings in container, instrument and engineering
 PG 24	· cylinder and piston are firmly attached, firmly screwed to or integrated into a ring or plate · cylinder and piston are a self-contained system and can be removed from the ring · cylinders are connected through cross-bores	· extreme non-right angles can be compensated · cylinder and piston are one unit and are replaceable as a sparepart · stable single-piston guidance	· more expensive compared with PG 9 and 10	· wherever extreme non-right angles should be compensated during tensioning · heavy engineering · grinding wheel mounting · straight roll wheel mounting

The application areas for **Bolt Tensioners** and **Hydraulic Nuts** are unlimited. The great amount of user solutions have resulted in a great number of various designs. For this reason it is not always possible to classify all **Bolt Tensioners** and **Hydraulic Nuts** into a specific product group.

For example, the tensioning force can be transmitted by a thread or a bayonet.

Please contact us for your special application.

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Quality Assurance

All **Bolt Tensioning Tools** and **Hydraulic Nuts** are checked for material quality, dimensional accuracy, proper operation, and pressure resistance. They are subject to quality assurance measures during order execution and delivered with detailed documentation.

Services

SSV and **HM** are, of course, delivered packaged, ready for installation and operation.

SCHAAF **SSV** and **HM** are user-friendly, reliable and are manufactured in accordance with the highest level of technical know-how. Our highly-motivated staff will be pleased to train your personnel, in situ or at our works, in the general handling of high-pressure equipment.

Standard Features

SCHAAF **SSV** and **HM** are standardly designed with:

- components as per product group specification (cylinder, piston etc.)
- high-solidity, steel-surface treated
- hydraulic pressure as a function of pre-tensioning force
- sealing set for temperature range from -30° C to +100° C
- connection thread
- stroke based on thread size and screw geometry
- stroke indicator
- piston return stroke boring
- support sleeve with window for turning the main nut with a setting rod (SSV)
- support sleeve opening for main nut contact to flange control (SSV)

Accessories manufactured by SCHAAF

- Mounting aids such as centering pin and lifting devices, or as requested by the customer
- Turning devices
- High-pressure hydraulic hoses
- Couplings, nipples, adapters, distributor blocks up to 4000 bar
- High-pressure generators: manually operated, electric, or air-operated
- Different types of hydraulic oil

Certificates and Acceptance Tests

- Material test reports
- Specific test reports
- Certificates as per special customer requirements
- Acceptance test as per customer`s specifications

Hydraulic High-Pressure Technology

SCHAAF®

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TÜVRheinland® CERT ISO 9001 ID:0910070172

SCHAAF has been developing and manufacturing high-pressure hydraulic tools since 1954.