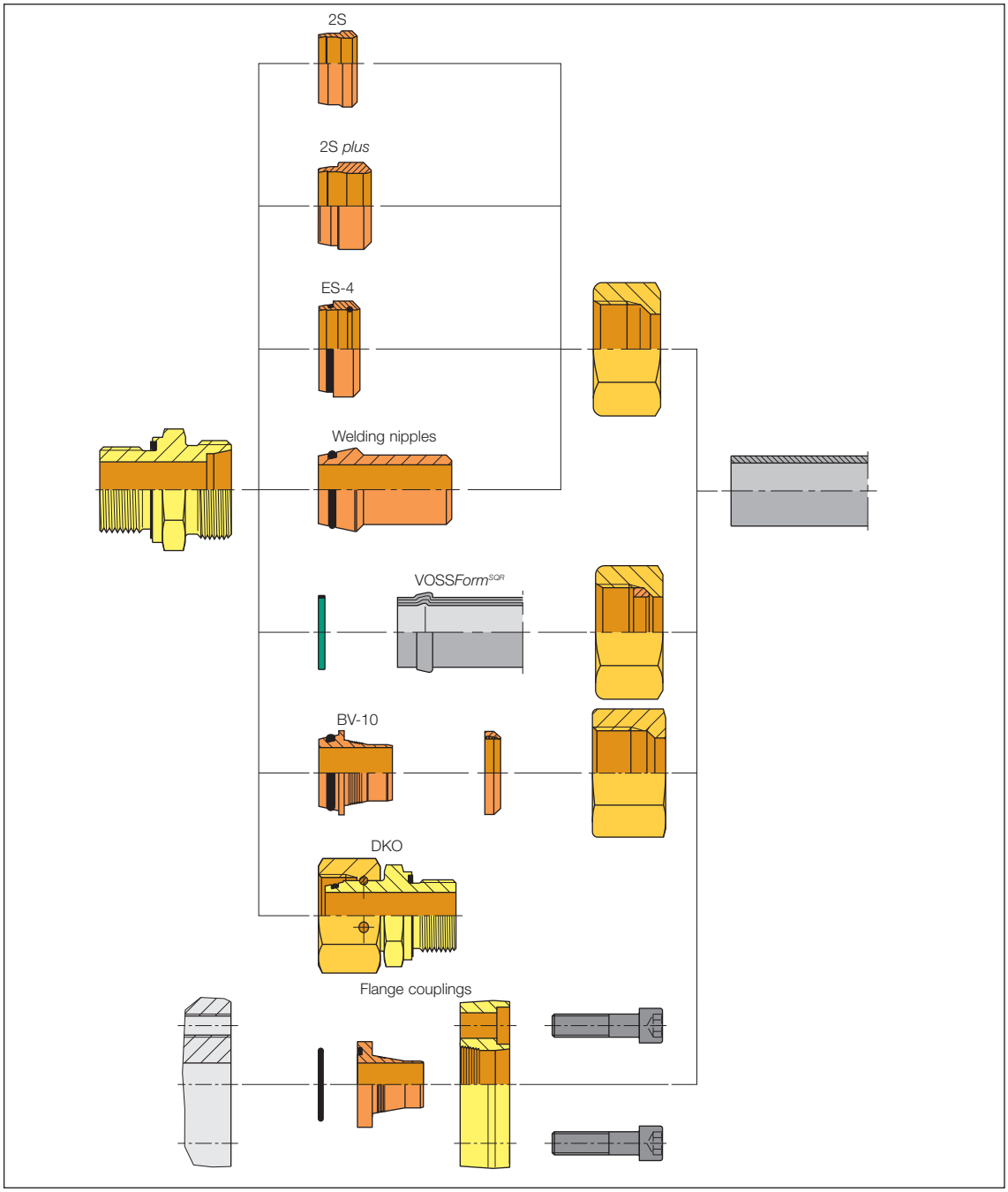
Overlook of 24° Tube Couplings

VOSS

Contents Page

Contents Page

The right connections for every application



The Complete Range of VOSS Couplings

2S cutting rings	2S *plus* cutting rings	ES-4 cutting rings	2SVA cutting rings	ES-4VA cutting rings	Union nuts
					
P. 48	P. 49	P. 50	P. 48	P. 50	P. 51

Male Stud Couplings

metric/imperial, tapered	metric/imperial, parallel, seal-edge	metric/imperial, parallel, PEFLEX	UN/UNF, O-ring
			
P. 60	P. 65	P. 72	P. 79
metric, parallel, ISO 6149, O-ring	Elbow, metric/imperial, tapered	L, metric/imperial, tapered	T, metric/imperial, tapered
			
P. 82	P. 84	P. 88	P. 90

Connecting Couplings

Straight	Reducing Couplings	Elbow
		
P. 94	P. 96	P. 99
T	T-Reduction	Cross
		
P. 101	P. 103	P. 108

Adjustable Stud Couplings with tube socket

Elbow	T	L	Stud Standpipe Adapters, metric/imperial, parallel, seal-edge
			
P. 132	P. 132	P. 132	P. 134
Stud Standpipe Adapters, metric/imperial, parallel, PEFLEX	Stud Standpipe Adapters, NPT	Stud Standpipe Adapters, UN/UNF, O-ring	
			
P. 136	P. 138	P. 139	

24° Taper Couplings

Straight, DKO	Elbow, DKO	45°, DKO
		
P. 142	P. 151	P. 151
T, DKO	L, DKO	Stud Standpipe Adapters, DKO, metric/imperial, parallel, PEFLEX
		
P. 151	P. 151	P. 153
	Reducing Couplings, DKO	Gauge Couplings, DKO
		
	P. 156	P. 160

Adjustable Couplings with lock nut

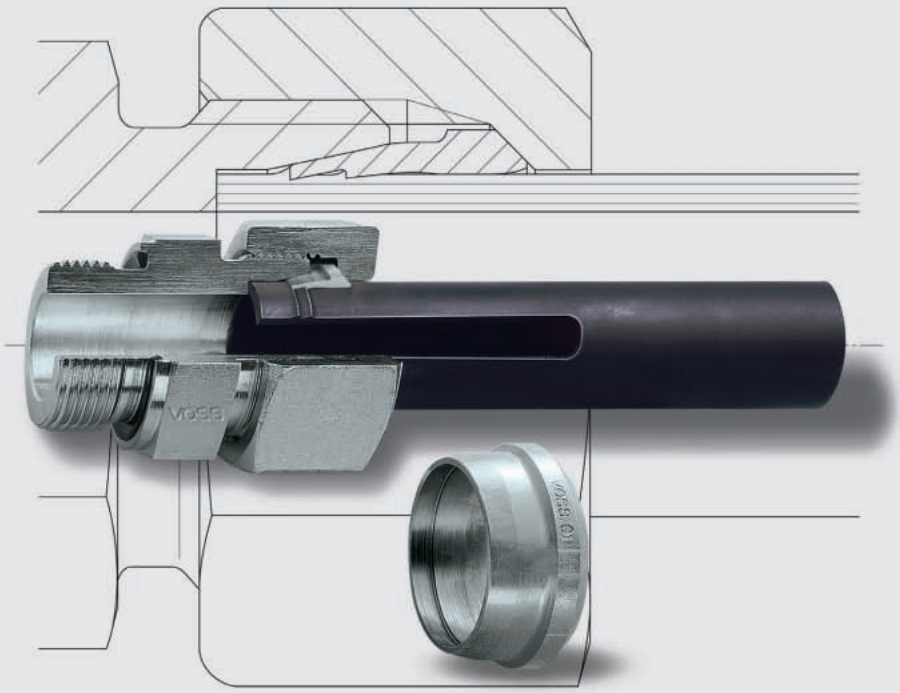
Elbow, metric/imperial, parallel	Elbow, metric, parallel, ISO 6149, O-ring	45°, metric, parallel, ISO 6149, O-ring
		
P. 162	P. 166	P. 167
L, metric, parallel, ISO 6149, O-ring	T, metric, parallel, ISO 6149, O-ring	
		
P. 168	P. 169	

Female Stud and Gauge Couplings

Straight Female Stud Couplings, metric/imperial	Gauge Couplings, standard couplings	Gauge Couplings, male version
P. 176	P. 179	P. 180

2S Cutting Ring Couplings

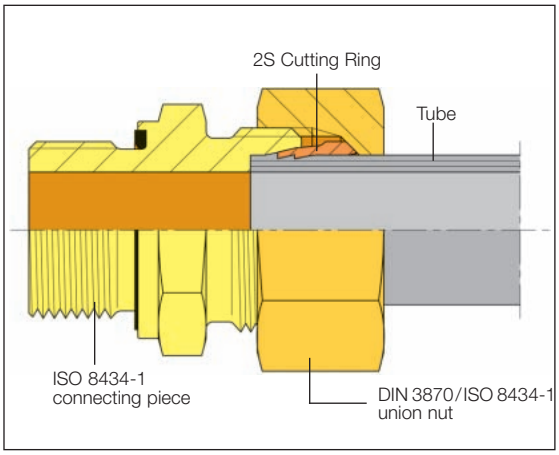
The proven, reliable solution



Experience plus ideas

Product Information
2S Cutting-Ring Tube Couplings

VOSS 2S cutting ring tube couplings comply with the latest standards with regard to design and dimensions. (DIN 2353 or ISO 8434-1)
They are designed for use with metric tubes. All dimensions, such as spanner size across flats, through borehole and the connection dimensions are also metrically dimensioned.
VOSS 2S cutting ring tube couplings are characterised by their high functional stability and practice-oriented installation behaviour. The spring effect typical of the 2S cutting ring permanently holds the pre-tensioning forces for the connection.



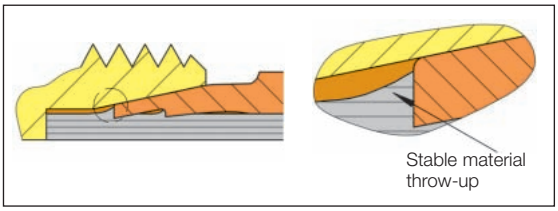
Other advantages from the use of VOSS 2S cutting-ring tube couplings are the broad range of types, the worldwide availability and their wide range of potential uses in the hydraulic and pneumatic sectors.

Function description

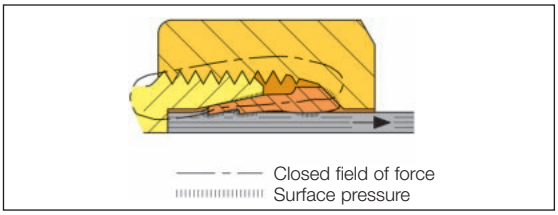
As integrated connection components, tube couplings are to permanently fulfil the function of “holding and sealing”. On the screw-in side, a broad range of standardised male threads and assigned sealing options, as well as the corresponding hole patterns for flange connections are available.

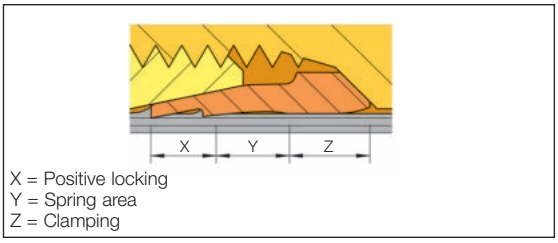
With tube connections even the smallest detail is also important. For example, the details of the current VOSS 2S cutting ring were created during many years of practice in accompanying development steps. Its special characteristics are:

- Optimum incision of both cutting edges. The 2S cutting ring produces the material throw-up decisive for the tube hold with its first cutting edge. The second cutting edge optimises the overall function and ensures additional reliability with a uniform distribution of force over the entire taper.



- Extreme freedom from leaks due to the pre-tensioning forces applied during final assembly. Using state-of-the-art calculation methods, it was possible to match the assembly forces and the surface pressures required for sealing to each other in a function-oriented manner.





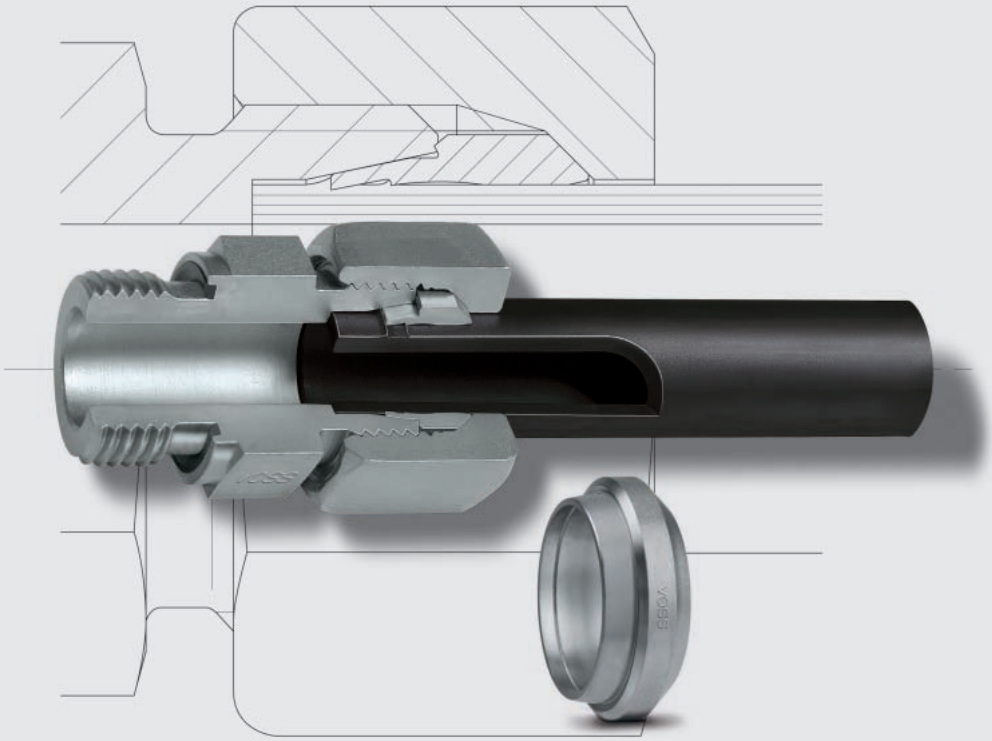
- Elastic behaviour due to the spring effect typical for VOSS cutting rings. This is achieved through the interaction of geometry and material qualities at the end of assembly. The elastic pre-tensioning compensates all settling phenomenon of the materials under dynamic loads.

General Note

In order for the VOSS 2S cutting ring couplings to fulfil their function, it is extremely important that the installation instructions and the note in the technical remarks are followed exactly. Incorrect handling will lead to risks with regard to safety and leaking of the connection.

2S *plus* Cutting Ring Couplings

That certain plus in reliability



Experience plus ideas

Product Information
2S *plus* Cutting Ring Couplings

„2S *plus*“ is the new, metallically sealing cutting ring in which the proven standard has been consistently further developed.

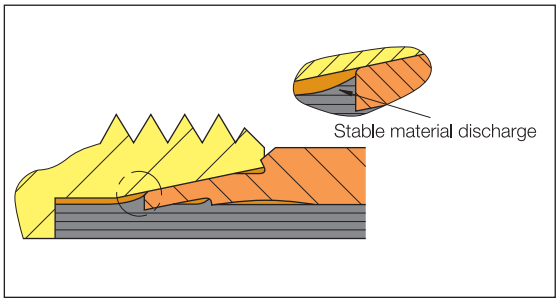
As worldwide system partner in hydraulic coupling technology, VOSS Fluid constantly ensures the highest process reliability of your products. Here not only the proper advice on the choice of product and the quality of the VOSS products is important, but also the correctly performed installation by the end-user.

Our experience has shown that this is where the greatest optimisation potential exists.

Incorrectly performed installation automatically means leaks in the hydraulic system that are not always immediately noticed. The lasting leak-tightness of your products is therefore extremely limited by incorrect installation. The new “2S *plus*” stands for the highest safety thanks to the dual cutting technology proven millions of times over, paired with the best installation properties and high load-bearing strength. It raises the standard in hydraulic connection technology to a new level.

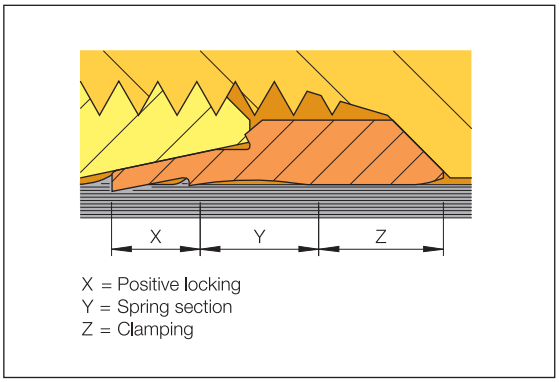
Reliable dual cutting technology

The feed movement that occurs when the union nut is tightened causes the first strong cutting edge to cut into the tube, piling up material in front of the cutting edge. This massive material accumulation ensures firm seating of the cutting ring. The trailing second cutting edge determines the cutting depth of the first cutting edge, and also prevents any further subsequent cutting into the tube material.



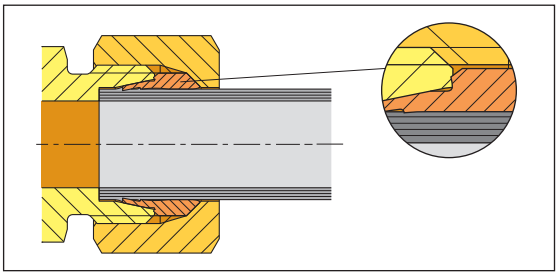
Furthermore, the second cutting edge ensures a uniform force distribution over the whole conical surface, as an additional counter-force is created by the tube in the area of the cutting point. Together the two cutting edges provide maximum security against the cutting ring being twisted off the tube.

Thanks to the special contour of the “2S *plus*” cutting ring, the preloading forces occurring at the end of the assembly are lastingly maintained. This “spring effect” in the middle section of the cutting ring compensates settling effects of the connection under dynamic loads. The “2S *plus*” is thus ideally suited for use also under elevated vibrational and reversed bending loads.

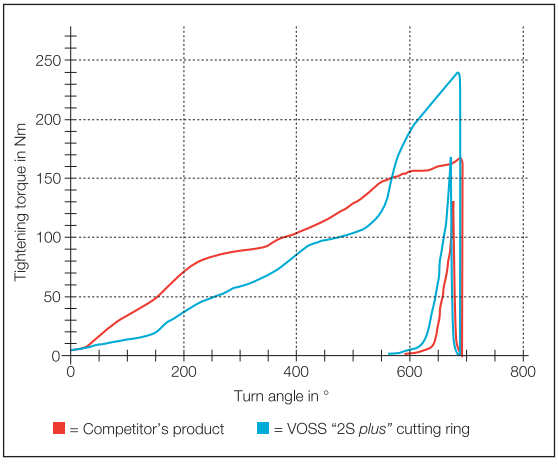


Process reliability also for assembly

The new block stop significantly increases the reliability of the assembly. The over-assembly responsible for the occurrence of many leaks is successfully prevented by the special contour of the “2S *plus*” cutting ring. If any over-assembly starts to occur, the tightening torque increases significantly and gives the user a direct feedback.



Research result of direct comparisons between the “2S *plus*” cutting ring and products from the competitor showed a significantly sharper force increases for the “2S *plus*” when over-assembly was simulated – an unmistakable signal effect for the user that reliably prevents incorrect assembly.



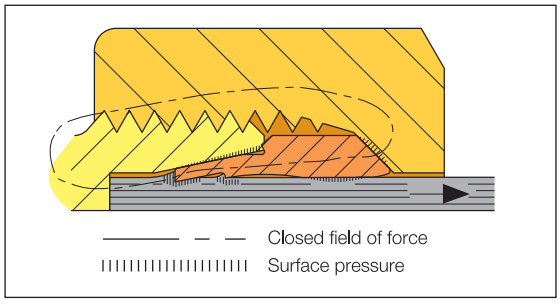
Repeat installations also present no problems. The union nut is simply tightened with the same force as for the original assembly. The assembly procedure for the “2S *plus*” is identical with that for the “2S” cutting ring, offering the experienced end-user an additional benefit.

Maximum load-bearing capability

The stable geometry in the area of the block stop provides additional protection for the “2S *plus*” cutting ring against deformation, and ensure a closed force flow loop in the whole system.

Apart from the matching high surface pressures of the metallic sealing surfaces, this offers an additional benefit:

The “2S *plus*” cutting ring can be used even with the most extreme system pressures, up to 500 bar in the light “L” Series and up to 800 bar in the heavy “S” Series – and that with four-fold safety!

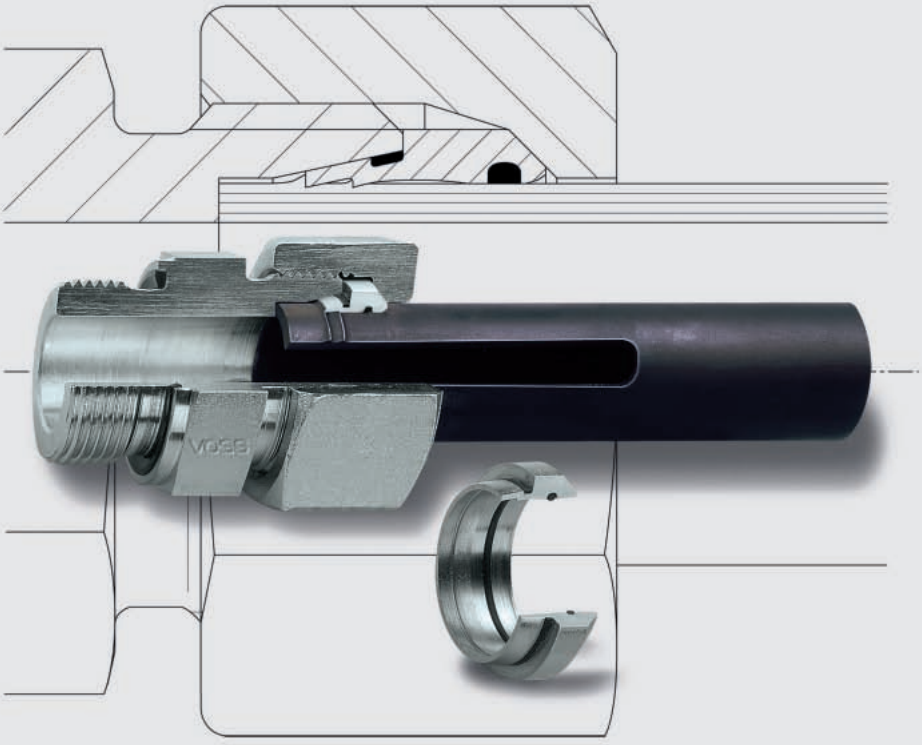


Flexible in application

Selective influencing of the material properties during production makes the “2S *plus*” cutting ring suitable for use not only with metric steel tubes, but also for applications with tubes of stainless steel.

ES-4 Cutting Ring Couplings

The soft seal connection
with 4-fold benefits

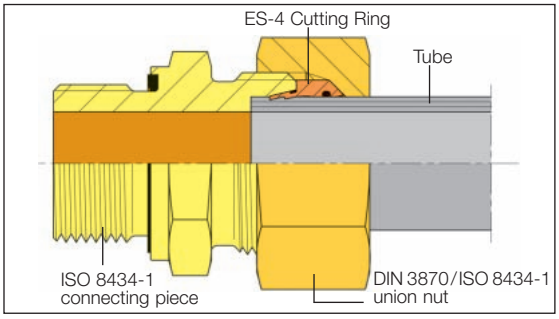


Experience plus ideas

Product Information
ES-4 Tube Couplings

VOSS ES-4: The soft seal couplings in accordance with DIN / ISO with 4-fold benefits:

1. **The basis is the proven VOSS 2S cutting ring.**
2. **Additional precision sealing with soft sealing elements of FPM / FKM in the secondary area.**
3. **Reliable freedom from leaks with gap-free chambering of the soft seals.**
4. **Guided assembly up to the tightening limit**.



With “ES-4”, VOSS engineers have developed a soft seal coupling that not only offers an additional potential for reliability, but is also considerably more economical.

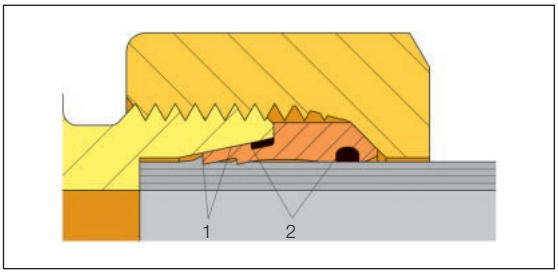
The ES-4 coupling covers the application range on the tube connection side between the proven 2S cutting ring coupling for standard applications and the 10° flared coupling for heavy loading.

Avoid leaks

The special moulded seal in the groove on the cutting ring taper and the additional O-ring between the cutting ring and the tube eliminate leaks resulting from slackening of the metallic sealing, e.g. due to creep characteristics. The diagram shows the reliable functioning of the VOSS ES-4 couplings under dynamic and static loads.

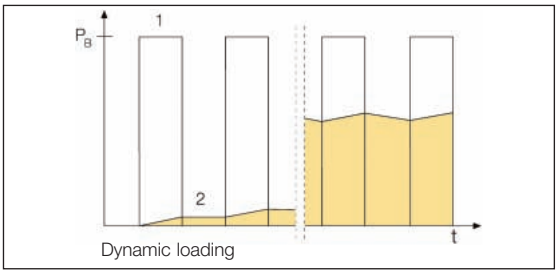
Dynamic loading

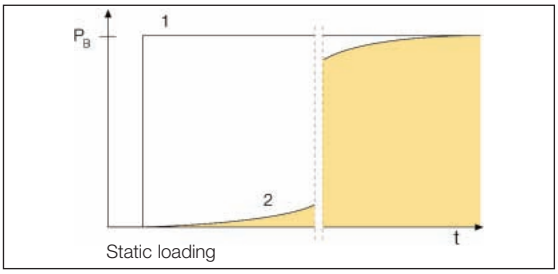
If the medium succeeds in overcoming the metallic sealing zone (No. 1) under alternating pressure loads, it is caught by the soft seals (No. 2) located behind the zone. The arrangement of the elastomer seals in the secondary area behind the metallic sealing zone results in the alternating pressure load only reaching the soft seal in a highly vaporised state. This quasi-static load on a lower level compared to the operating pressure ensures an excellent long-term stability of the elastomers.



Static loading

With static pressure loading and an assumed leak in the metallic sealing zone, the full operating pressure nevertheless builds up in front of the soft seal following a major time delay. In this case the completely gap-free chambering of the soft seal elements ensures reliable sealing in the secondary zone.





VOSS 2S ring as the basis

The basis for the soft seal coupling is the proven VOSS tube connection in accordance with DIN 2353 / ISO 8434-1.
In the process, the 2S cutting ring is supplemented with soft seals fitted on the secondary side.

The reliable functional properties of the 2S cutting ring are completely preserved:

- In the final assembly state, the attacking moment of flexion is counteracted with sufficient resistance by the broad support and by the closed power flux.
- In addition, the first, strong cutting edge and the additional second cutting edge provide for a stable hold in the case of sudden pressure increases, i.e. for tear-out protection.

Additional precision seal with clear chambering

The precision seals prevent the familiar sweating effects of purely metallic seals:

- The special moulded seal of the ES-4 cutting ring, which is captively integrated in a groove on the cutting ring taper, seals off the possible leakage path between the cutting ring and the connecting piece.
- An additional O-ring prevents possible leakage between the cutting ring and the tube.

As a result, both soft seals lie in the secondary area behind the proven metallic seal. With this arrangement, dynamic and static loads are intercepted in the primary zones, i.e. at the metallic sealing points, and only reach the soft seals in virtually static form.

Another advantage is that the soft seals are chambered in stable, gap-free installation spaces after the cutting rings are fitted. This prevents the extrusion of the soft seal, even at full system pressure.

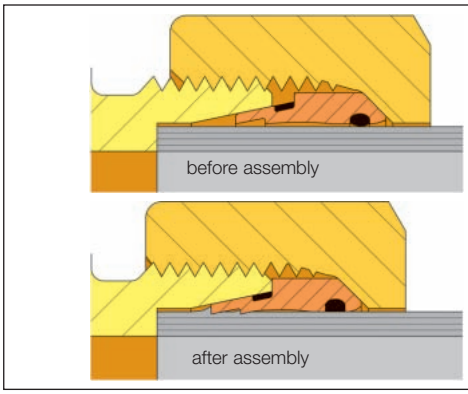
Safety through block installation

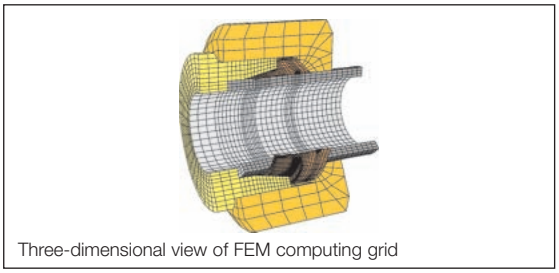
The stable, gap-free chambering of the fine seal is achieved with the block installation of the ES-4 cutting ring. To be specific, this is achieved with a stronger pressing of the moulded seal onto the coupling taper, and with the gap-free, radial contact of the cutting ring on the outside tube diameter in the area of the O-ring seal. For this purpose, the cutting ring geometry is designed so that the maximum possible elasticity results despite the block effect.

Block installation also ensures an incision limitation, which counteracts tube constriction with thin-walled tubes.

This makes over-tightening of the connection considerably more difficult.

For block installation the same assembly forces apply as for 2S cutting rings. The checking of the correct cutting ring incision required by the standard can also be carried out unchanged. The fitter can continue to use the same working methods and tools.





Three-dimensional view of FEM computing grid

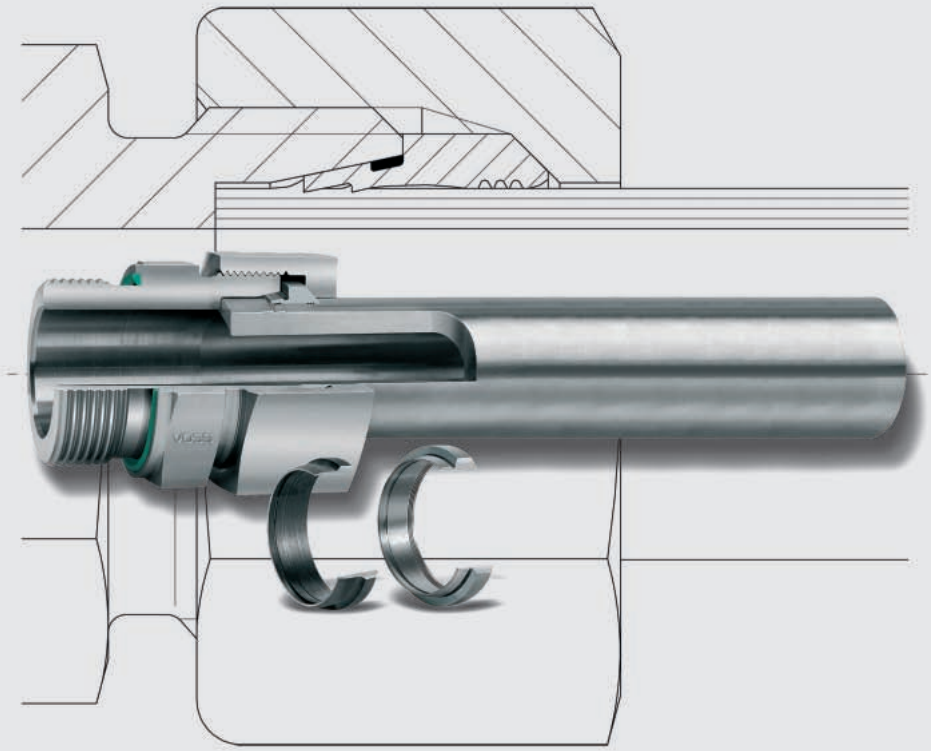
The economic advantages:

ES-4 couplings not only offer a high degree of security against leaks, but also additional economic benefits:

- Cost and time-intensive corrections are no longer required. Production failures are avoided.
- Dry connections help improve the image of the final product. The final customer achieves a competitive advantage over its competitors.
- With the introduction of the ES-4 couplings, VOSS offers a uniform soft seal system. The user can considerably reduce the number of suppliers and minimise the number of orders required.
- Because ES-4 couplings consist of DIN/ISO connecting pieces and DIN/ISO nuts, the user does not need to establish and maintain a stock of special parts.
- As the user does not need to change either its assembly habits or its tools, additional costs for training and tools are eliminated.

Conclusion: In view of the advantages offered by the ES-4 couplings with regard to the greatest possible protection against leaks, they represent an interesting economical alternative in a cost-benefit comparison.

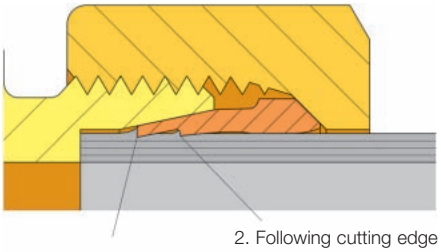
2SVA / ES-4VA Cutting Ring Couplings



Experience plus ideas

VOSS offers both

Standard 2S cutting ring
2SVA



2SVA 2-cutting-edge ring and ES-4VA stainless-steel soft-sealing cutting ring

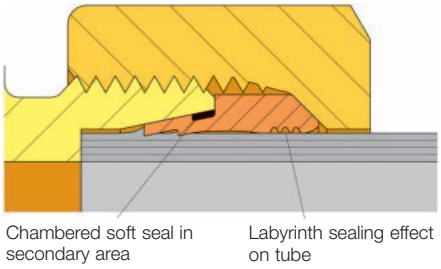
The standard cutting ring with the 2 cutting edges for reliable connection of your piping.

The first cutting edge produces a stable material throw-up that ensures the secure holding of the tube.

The following second cutting edge provides additional safety with higher vibration and reversed bending loads. The later incision keeps the assembly forces in balance.

The elastic behaviour of the ring maintains the pre-tension of the assembly forces and prevents leaks due to settling effects or critical pressure peaks.

ES-4VA cutting ring for
maximum safety



The ES-4VA soft-sealing cutting ring for maximum safety against leaks in the maximum-precision range.

Especially for applications with highly sensitive liquids, 100-percent precision sealing is imperative for the protection of the environment and economical process design.

The four familiar advantagesof the ES-4 cutting ring for steel also come to bear for the ES-4VA cutting ring.

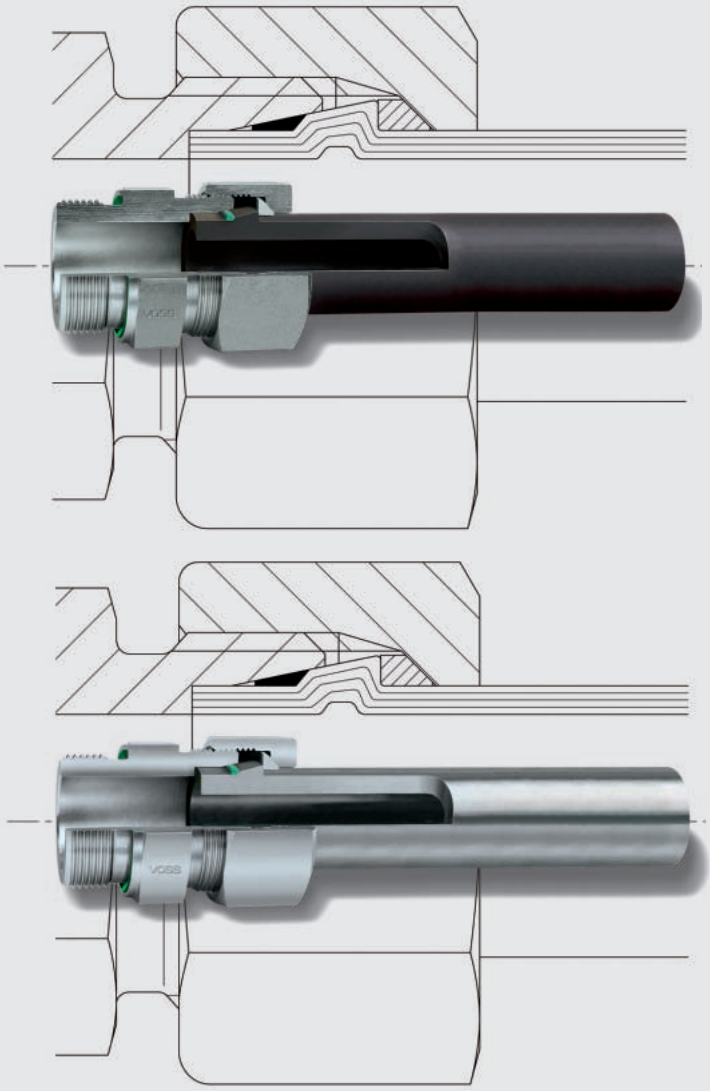
1. The basis is the proven VOSS 2S cutting ring.
2. Additional precision sealing in the secondary area – soft seal of FPM / FKM between the cutting ring and the connecting piece, labyrinth sealing effect between the cutting ring and the tube.
3. Chambering of the soft seal against flushing out under pressure-change loads, for the maximum life of the elastomer.
4. Sure assembly with a mechanical stop; over or under-tightening are virtually eliminated.

Both cutting rings can be fitted using VOSS standard pre-assembly devices. Please request the corresponding installation instructions from us.

VOSS also offers stainless-steel couplings for the VOSS*Form*^{SQR} system.

VOSS*Form*^{SQR} / VOSS*Form*^{SQR}VA Tube Couplings

- Safety
- Quality
- Profitability



Experience plus ideas

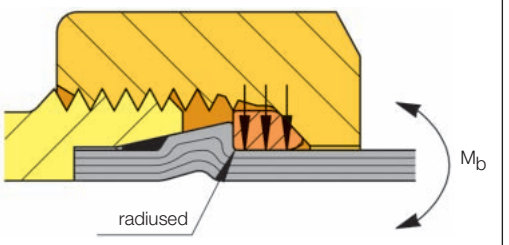
Product Information – VOSS*Form*^{SQR} Tube Couplings

The main requirements for hydraulic connections can be summarised in three words:

- Safety, as the most important aspect.
- Quality, without which permanent freedom from leaks is not possible.
- Profitability, only an economical coupling can prevail on the market.

The tube coupling system VOSS*Form*^{SQR} fulfills these requirements by its innovative design based on the successful VOSS construction principles.

In the VOSS*Form*100 forming machine a contour is shaped at the end of a commercially obtainable hydraulic tube. When a soft seal and the special SQR nut are added, a simple, high-quality connection results.



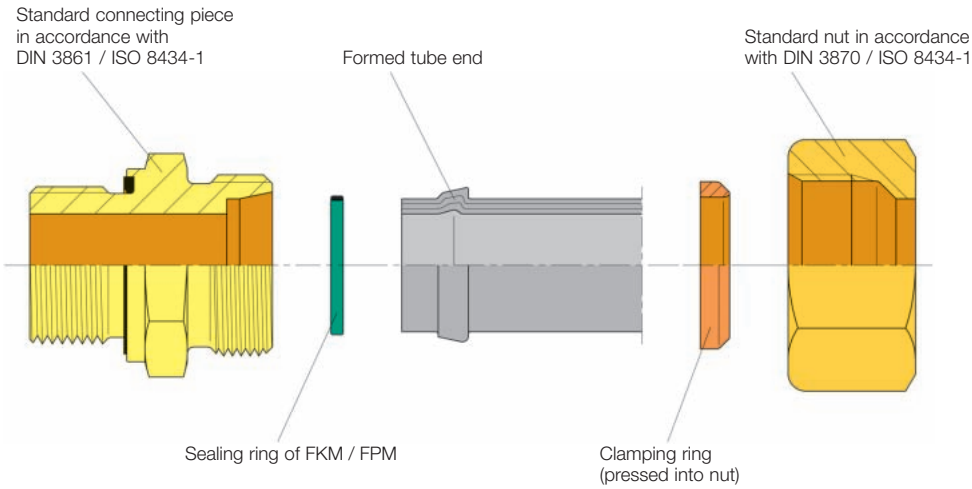
Absorption of dynamic loads
by integrated clamping ring

Maximum loadability and safety

The critical area is the transition from the formed contour to the tube. Here the forming process can result in material embrittlement. With the VOSS*Form*^{SQR} system this weak point is effectively relieved. On the one hand, the radiused transition minimises the notch effect. On the other hand, the SQR nut with the integrated clamping ring clamps in the tube radially on the circumference, absorbing the dynamic loads before the critical area and increases the pressure loading capacity and resistance to breakage.

Assembly safety with sure stop

Safe assemblies mean safe connections. With the VOSS*Form*^{SQR} System the face of the tube end strikes against the bottom of the standard DIN/ISO connecting piece during assembly. When the nut is tightened, the end of assembly becomes clear from a noticeable increase in force. Under and over-tightening can be virtually eliminated. In addition, the assembly path is reduced, and with it the mounting time. The formed-on contour is deeply inserted into the 24° taper, ensuring stable seating.



VOSS*Form*^{SQR} Design

Process-capable tube forming

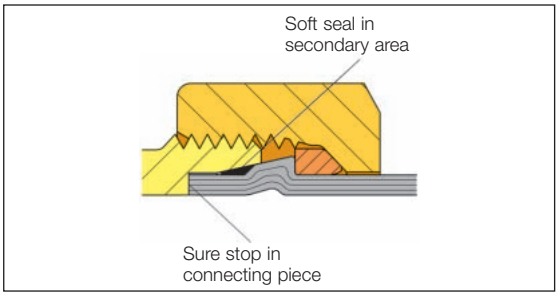
Forming using the forming machine VOSS*Form*100 is quite easy. The simple pushing in of the tube end against the stop and the monitored forming allows no errors to occur. The inner mandrel on the forming head prevents constriction of the tube in the formed area. The inside tube diameter is completely retained, preventing pressure losses due to inward arching.

Cycle times from 12 to 15 seconds particularly decrease the assembly times in series production.

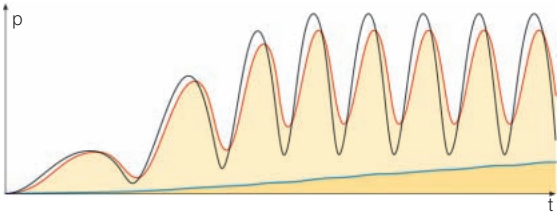
Freedom from leaks with soft seal

A soft seal offers considerable advantages over a purely metallic seal. Leaks due to the components settling under mechanical loading are compensated. This effectively prevents connection sweating. A completely leak-tight connection even in the precision area is more economical, protects the environment and emphasises the quality of the connection, and therefore also of the entire product.

The concept of locating the soft seal in the secondary area – as with the ES-4 cutting ring – minimises both static and dynamic loading of the seal. The metallic primary throttle on the face of the tube dampens the load during pressure change loading. With static loading there is a major time delay in charging with pressure. This type of arrangement ensures the long-term stability of the elastomer.



VOSS soft seal in secondary area



- Dynamic pressure curve in the tube
- Ordinary connection system with soft seal in primary area
- VOSS System with soft seal in secondary area

Economy

Avoiding leaks, minimising the assembly time and eliminating maintenance effort and expense is an excellent basis for economy. Low material costs and simple parts handling also make VOSS*Form*^{SQR} tube couplings an especially advantageous solution for series production.

Complete product range

The condition for the successful use of connection systems is a broad range of products. The VOSS*Form*^{SQR} system is based on standardised components. As a result, the entire VOSS DIN/ISO programme is completely available for the VOSS*Form*^{SQR} system.

VOSS*Form*^{SQR} VA

The forming system VOSS*Form*^{SQR} VA is available to you for applications of stainless steel. All individual components here are made of stainless steel.

The product characteristics and advantages can be considered as identical, the same as with the VOSS*Form*^{SQR} for steel applications.

High performance paired with simple production of the connection makes VOSS*Form*^{SQR} a universal connection in series production.

Forming machine VOSS*Form*100

The forming machine VOSS*Form*100 ensures time-saving, process-capable production of VOSS tube profiles. The monitored process in conjunction with optimum tube guidance makes defective forming as a result of incorrect operation virtually impossible.

Simple tool changes considerably contribute to reducing processing times. The clamping jaws and forming head can be replaced without tools. The clear marking of both tools prevents assembly errors due to incorrect combinations of tools and tube dimensions.

The forming process

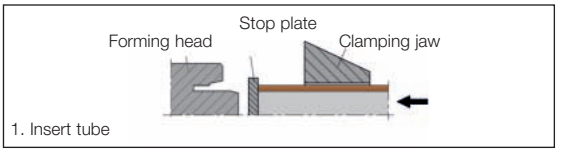
Forming begins by pushing the tube against the stop plate in the forming machine. Pressing the Start button triggers the process (1.).

The clamping jaws close and clamp the tube in place. The stop plate swivels out of the forming area (2.).

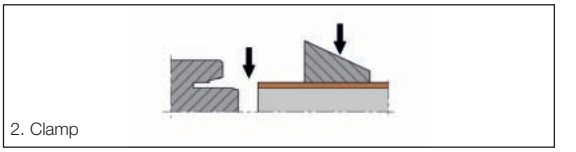
The forming head moves forward and forms the VOSS*Form*^{SQR} contour plastically on the tube (3.).

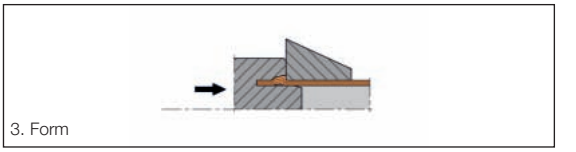
The forming head moves back and the clamping jaws open (4.).

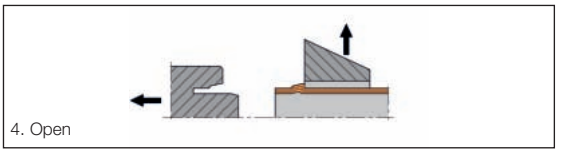
Removal of the tube is monitored. By doing this, the machine can automatically drive to the basic position again and the next tube forming sequence can be made without manual resetting (5.).

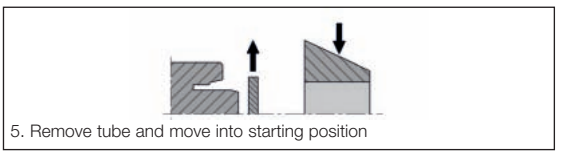


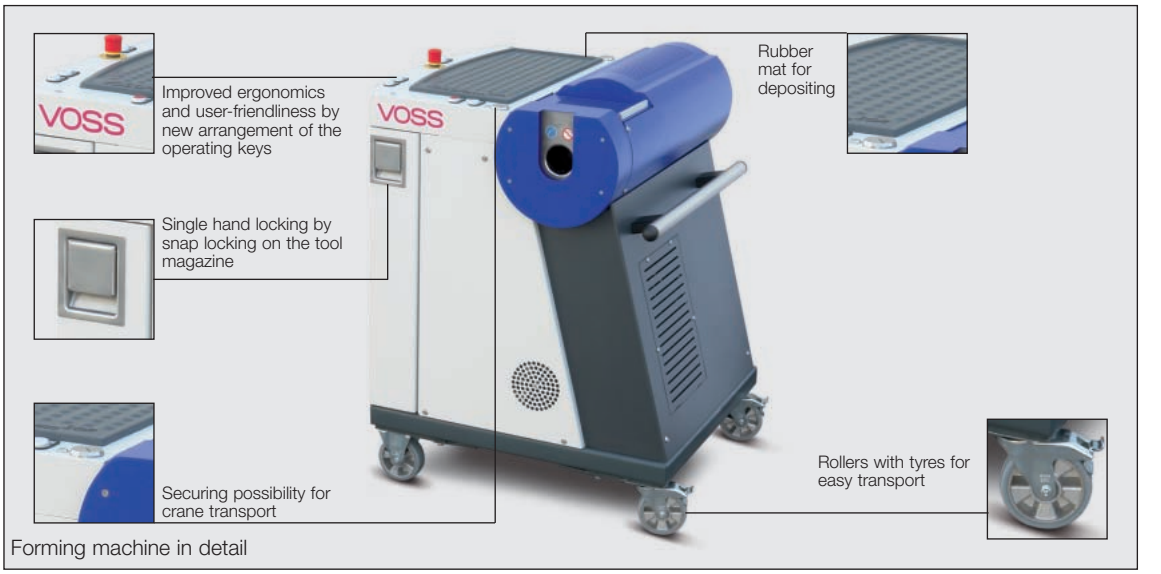
1. Insert tube


2. Clamp


3. Form


4. Open

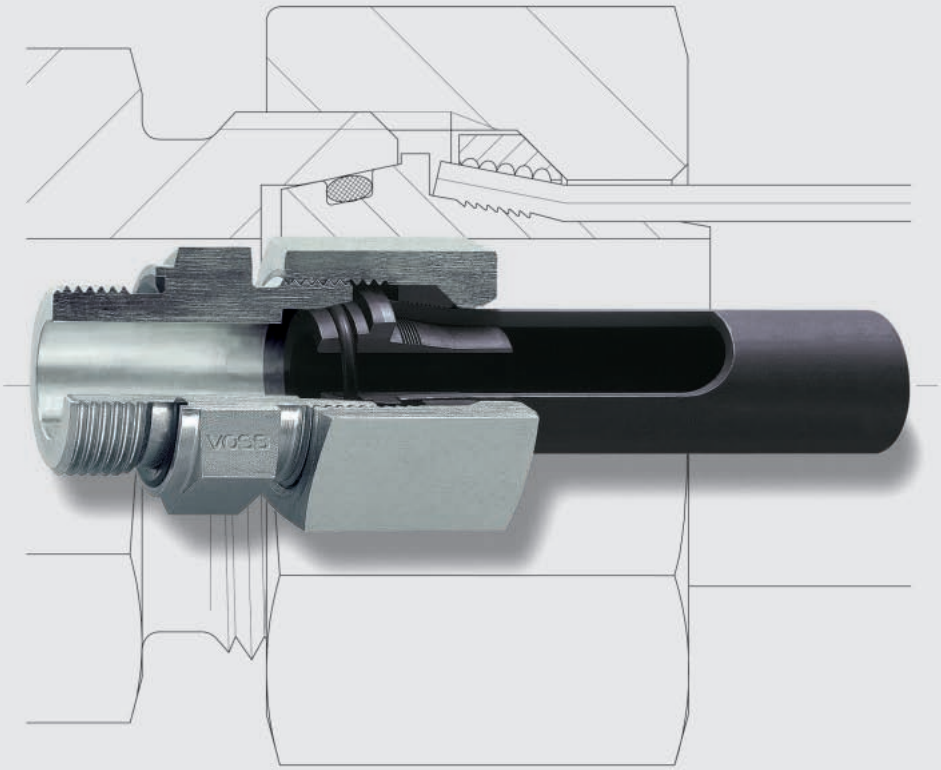

5. Remove tube and move into starting position



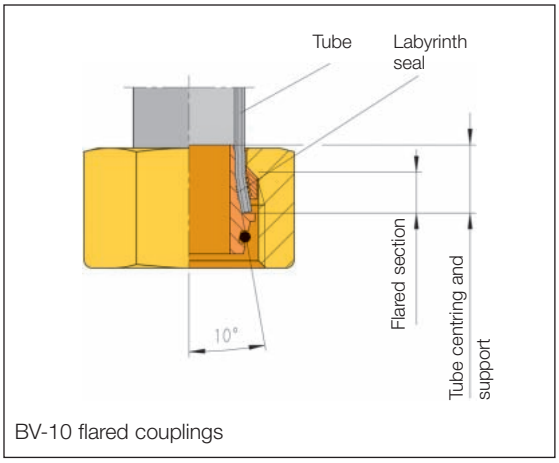
Forming machine in detail

BV-10 Flared Couplings

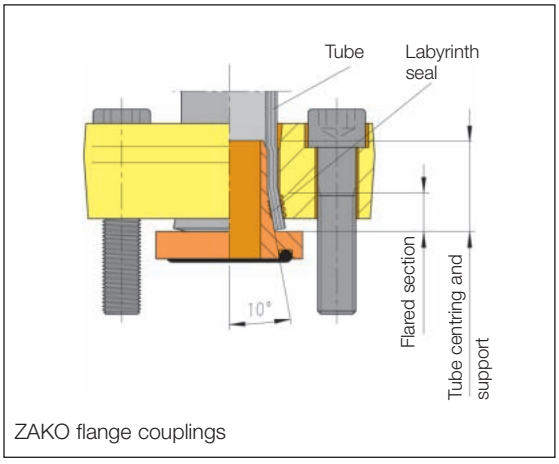
For extreme loads



Experience plus ideas



BV-10 flared couplings



ZAKO flange couplings

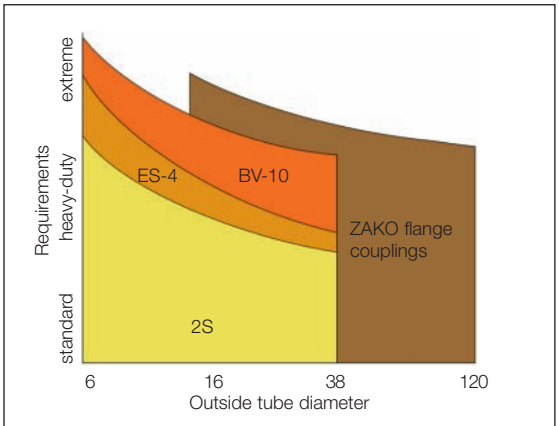


Diagram of applications

Product Information on 10° Flared Coupling System

The VOSS 10° flared coupling system complements the proven VOSS cutting ring programme for heavy-duty applications (see diagram of applications). BV-10 flared couplings are the ideal solution for applications that exceed the capacity of cutting ring couplings. VOSS BV-10 flared couplings have excellent properties regarding reversed bending stress, sudden pressure increases, peak pressures, vibrations and temperature fluctuations.

At the tube end, these systems include a flared angle of 10°, and therefore differ from standard systems.

The connection end toward the unit – either directly or via a connecting piece – is designed to fit the standard or standardised connection ends. The combination of a flared cone and clamping ring or a ZAKO ring and flange respectively provide excellent hold, and with it maximum operational safety at high loads.

Both the BV-10 coupling and the ZAKO flange system are based on 10° flared couplings.

BV-10 Flared Couplings

A complete coupling program in a light and heavy-duty series is available to the user. The BV-10 flared coupling is based on the use of DIN/ISO coupling pieces with 24° cones, allowing for easy replacement with cutting ring and weld nipple systems.

As shown in Fig. 1, in BV-10 flared couplings the tube clamp in conjunction with the 10° flared cone provides the necessary initial tension for the secure connection to the tube. The sealing effect on the connecting piece is ensured by the proven DKO stud of the flared cone by means of a metal seal and completely chambered soft packing.

On the tube connection side, the coupling is fully sealed thanks to optimised surface pressure at the flared section and the labyrinth seal effect of the small teeth on the cone surface. The clamping ring presses a large area of the tube end against the flared cone, ensuring especially high holding forces. As a result, the system remains leaktight even when exposed to vibrations or reverse bending stress.

The rated pressures for VOSS BV-10 flared couplings correspond to those of 24° taper couplings or 24° cutting ring couplings.

Advantages of the 10° flared system

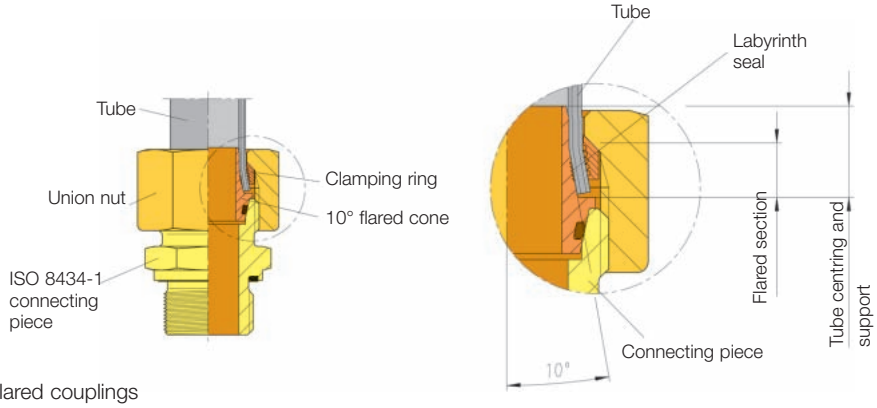
Hydraulic engineers appreciate the following characteristics of BV-10 tube couplings:

- Particularly suitable for extreme loading.
- Notching and incision-free tube holding with the 10° flared cone principle.
- Suitable for use with standard coupling bores and connecting pieces.
- Easy assembly, even with thick-walled tubes.
- Elimination of assembly errors, as the flared cone ring must be pre-assembled in an assembly aid.
- Suitable for stainless-steel tubes with tolerances according to DIN 2391-C.
- Complete coupling programme in the L and S series.

Note on safety:

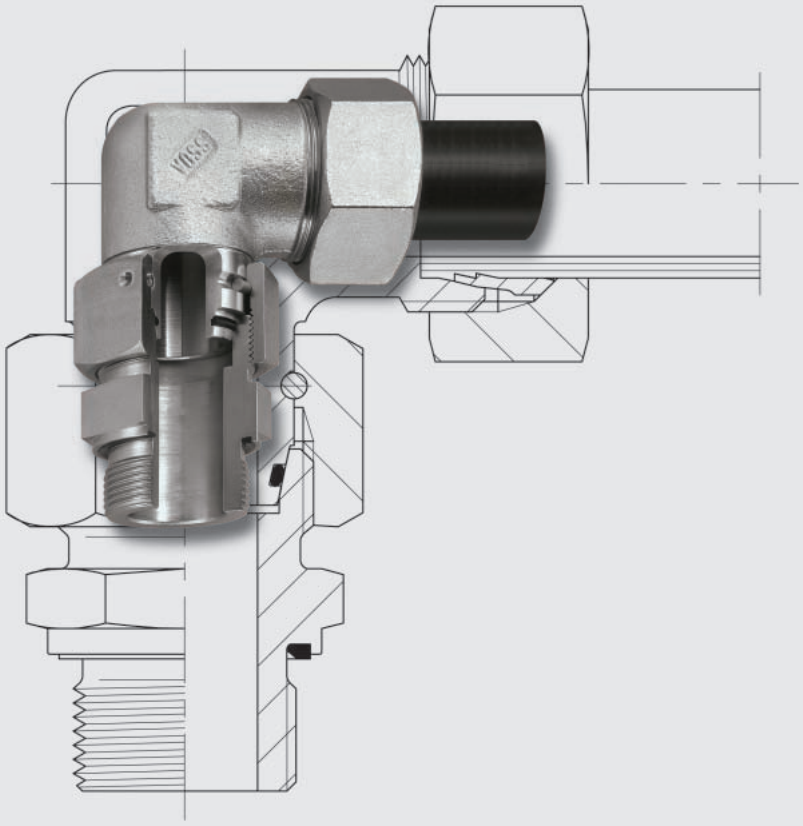
A wide range of different operating conditions often cause loads on tube connections with unforeseeable parameters. To ensure safe operation, please observe the following:

- In addition to the outer diameter of the tube, also take the wall thickness into account.
- VOSS 10° flared couplings may only be pre-assembled with the specially designed VOSS pre-assembly devices.
- Always observe the assembly instructions of the device used!

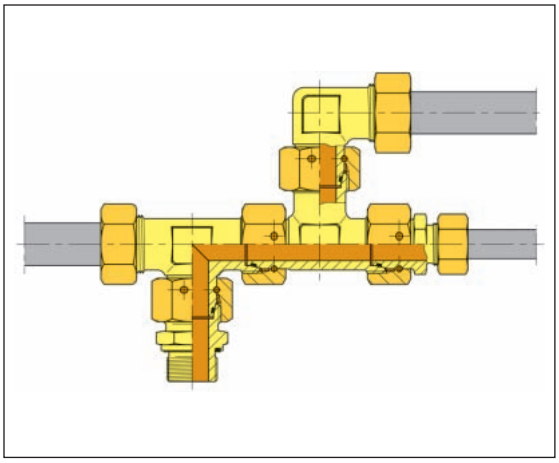


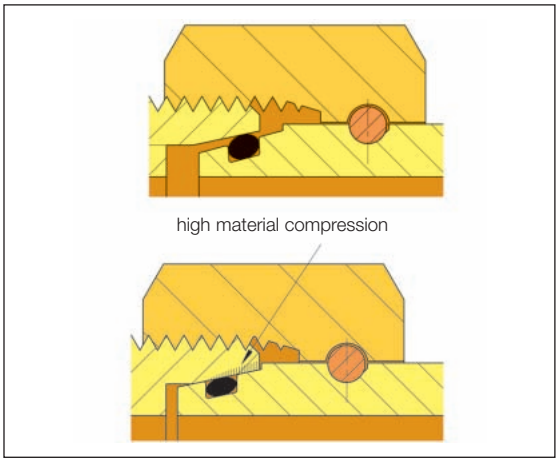
BV-10 flared couplings

24° taper couplings / Welding couplings



Experience plus ideas





Product information 24° taper couplings

The 24° taper coupling is a logical further development of the adjustable coupling with a tube socket and pre-assembled cutting ring. A particularly reliable and permanently stable coupling connection is achieved with the taper mounted on the coupling body.

The holding function is assumed by a special union nut by means of a wire pin located in a groove. Following final assembly the interlocked union nut ensures a coupling resistant to tearing out.

Sealing is provided by the embedded O-ring. This results in an ideal precision seal.

With a broad range of different designs, all common combinations of couplings with adjustable directions can be produced. The connection dimensions comply exactly with the standards DIN 2353/ISO 8434-1. This results in an interchangeability with the traditional adjustable spigot version.

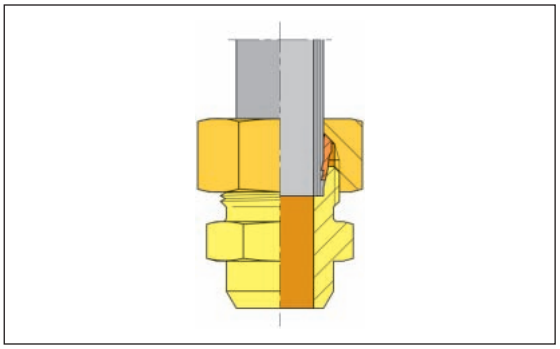
Special features:

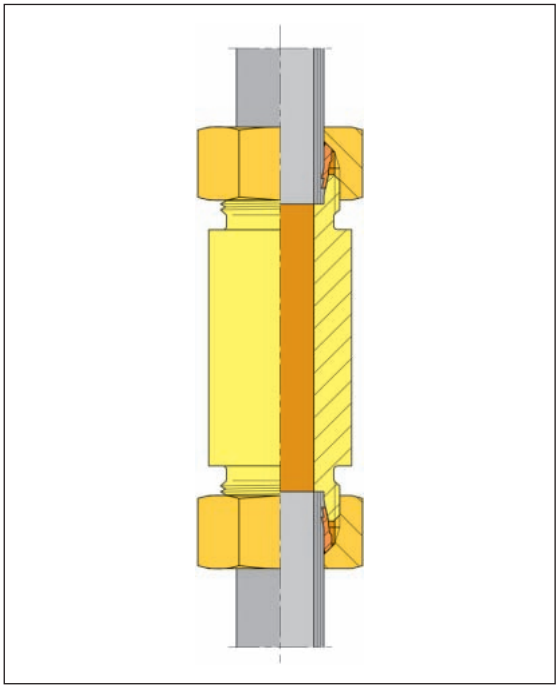
- The VOSS taper coupling provides an improvement with regard to freedom from leaks and precision sealing by means of the precisely chambered O-ring seal.
- It provides reliable operation and long-term freedom from leaks even under extreme operating conditions, such as sudden pressure increases, reversed bending loads and vibrations.
- The VOSS taper coupling can be easily and reliably assembled. Optimal final functioning is produced with a short tightening distance and a practice-oriented final tightening force.
- Repeat assemblies can be carried out frequently and without difficulty.

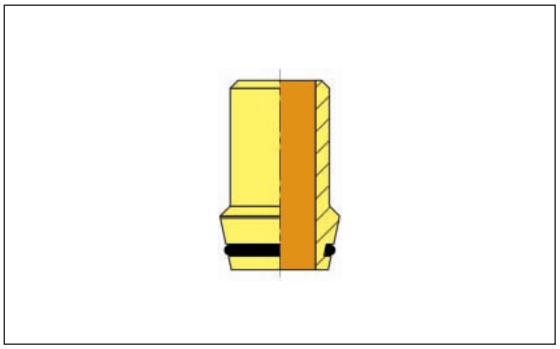
General information

In order for the taper couplings to fulfil their function, it is extremely important that the installation instructions and the notes in the technical remarks are followed exactly.

On the tube connection side the assembly instructions of the respective function rings must be observed.







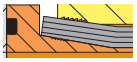
Product information on welding couplings

VOSS welding couplings and weld nipples are in addition to the product range of the common cutting ring, pipe forming and flared coupling systems.

Due to their limited usability, the high costs, the pre-treatment of the tube, the welding process, qualification of the specialised welding personnel, post-treatment and checking involved, welding couplings are increasingly becoming a special niche solution.

Weld-on and weld-in bulkhead couplings are designed with the cutting ring systems 2S and ES-4, as well as the BV-10 flared coupling as in accordance with the catalogue.

VOSS weld nipples with a 24° taper and O-ring can be combined with all tube couplings according to DIN 2353 / ISO 8434-1 and their coupling pieces.

Requirements / System features	2S	2S *plus*	ES-4	VOSS*Form*^{SQR}	BV-10	ZAKO
						
Standard	DIN EN ISO 8434-1	DIN EN ISO 8434-1	DIN EN ISO 8434-1	DIN EN ISO 8434-1	DIN EN ISO 8434-1	
Type of seal	Metallic	Metallic	Metallic + soft sealing	Metallic + soft sealing	Metallic + soft sealing	Metallic + soft sealing
Material	Steel/ stainless steel	Steel	Steel/ stainless steel	Steel/ stainless steel	Steel	Steel
Series Tube-OD	L/S 6-42	L/S 6-42	L/S 6-42	L/S 6-42	L/S 6-42	 16-120
Pressure resistance - Static/dynamic compressive loadability - Absorption of external forces	○	●	●	●●	●●	●●
Temperature resistance	●	●	●	●	●	●
Corrosion resistance	●●	●●	●●	●●	●●	●●
Media resistance	●	●	●	●	●	●
Ease of assembly - Preassembly and final assembly - Sources of error, testing possibilities	○	●●	●●	●●	●	●
On-site assembly - Without special tools - Possible repair solutions	●	●	●	○	●	○
Maintenance - Settling behaviour under continuous load - Permanent fine sealing	○	●	●●	●●	●●	●●
Flow behaviour - Cross-section reduction, dead spaces - Pressure loss, noise	○	○	○	○	○	○
System reliability - Tearing out, tube fracture - Reliability of assembly	○	●	●	●●	●●	●●

●● Outstanding ● Very good ○ Good ○ Average