General technical notes

- Technical notes
- Seal types and threaded bores

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Technical notes

General safety notes

- The couplings, flanges, valves and other components listed in the catalogue are intended for fluid engineering applications only. They cover a range of operating conditions from normal to extreme.
- In order to ensure maximum performance and functional reliability of VOSS products, the respective assembly instructions, operating conditions and tube recommendations have to be adhered to. Failure to follow these instructions may impair the function and lead to loss of claims under guarantee.
- Coupling elements must not be tightened or loosened while the system is under pressure. Caution, this involves a potential risk to life and limb!
- Piping and tubing lines are to be designed and routed in such a way that they are not under tension in the unassembled state and that all connecting elements can be easily assembled.
- Always make sure that hydraulic components are clean and are handled in a clean environment. Contamination, dirt or damage can impair the function of individual components or of the entire hydraulic system.
- When using lubricants, observe the instructions and information given by the manufacturer.
- When using VOSS pre-assembly machines/devices and tools, always observe the operating instructions. Failure to observe these instructions may endanger life and limb and/or the environment.

Standardization

In terms of design and dimensions, VOSS cutting ring tube couplings, VOSS*Form*^{SQR} tube couplings, flared couplings and flanges all conform to the latest version of standard DIN 2353/ISO 8434-1/DIN 3861/SAE J 518 C.

Permitted pressures

The pressure ratings stated in the VOSS catalogue are as follows:

- The nominal pressure (PN) specifies the maximum operating pressure of the coupling. This is the maximum pressure that should be applied when operating the system or the system section under stationary conditions. During load tests, the bursting pressure of the specimen must be at least 4 times the nominal pressure.
- Permissible operating pressure (PB) as defined in DIN 2401 part 1. The operating pressure (“Betriebsüberdruck" - PB) data are stated for normal operating conditions (at 120° C, static load) for a safety factor of 2.5.

For the tube-end cutting-ring connections, VOSSFormSQR or flared connection, the safety factor is always four. Always observe the pressure information for the entire article. If tube couplings are subjected to greater loads – e. g. temperatures above +120 °C, strong pressure peaks etc. – the operating pressure must be reduced in order to retain the same safety level.

It is assumed that the tubing system is firmly installed and held by tube clamps/supports in order to achieve the required functional reliability. The recommended torque moments are to be used for articles with threaded stud connections. The specified pressure values always refer to VOSS coupling components. In the case of tubing, observe the pressure values stated by the respective tube manufacturer.

Permissible operating temperatures

Coupling and flange materials

For all steel coupling and flange parts listed in this catalogue, an operating temperature range of -40 °C to +120 °C is permissible (cf. DIN 3859 part -1). If the temperature limits are exceeded, the pressure has to be decreased accordingly.

Seal materials

Standard seals of NBR (e. g. Perbunan®)

- For couplings and flared cones:
  70 to 80 Shore A
- For ZAKO rings 90 Shore A
- Temperature range -35° C to +100° C

Seals of FKM/FPM e. g. Viton® upon request

- For screw couplings, flared cones and ZAKO rings
  75 - 85 Shore A
- Temperature range -25° C to +200° C
  The notes given in DIN 7716 (rubber products; requirements for storage, cleaning and maintenance) must be observed when using elastomer seals. w
- Dry storage at temperatures not exceeding + 25°C
- Protect against direct sunlight, ozone and strong artificial lighting

Materials

In the standard version, VOSS cutting rings, VOSS*Form*^{SQR}, flared couplings, valves and flanges are made of forged or drawn steel and, in exceptional cases, of cast steel, in accordance with the technical delivery conditions as specified in DIN 3859-1.

Surface protection

All VOSS tube connections are given a VOSS coat surface finish by default in order to protect them from corrosion. The only exceptions are articles whose function or normal market standard do not allow a VOSS coat finish (e. g. weld tube connection stubs).

VOSS coat corrosion prevention is based on a zinc-nickel base coat, a passivation layer and normally a top sealing coat.

The union nuts are also given a coating of lubricant/slip agent.

ZAKO flange connections have surfaces protected either by pickling and oiling or by a VOSS coat.

The parts intended for welding are shiny and oiled.

Upon request, versions made of other materials and with other surface finishes can be supplied.

Standards applied
Couplings

	National	International
Cutting ring couplings	DIN 2353	ISO 8434-1
Cutting rings	DIN 3861	ISO 8434-1
Conical seal couplings	–	ISO 8434-1
Flange	–	SAE J 518 C / ISO 6162-1

Standards applied
Threaded studs/Threaded holes

		Threaded stud ends National / International	Threaded hole National / International
Metric fine thread	Sealing by DIN 7603 seal ring (form A)	DIN 3852-1	DIN 3852-1 Form X
	Sealing by seal edge (form B)	DIN 3859-1/ ISO 9974-3	ISO 9974-1
	Sealing by taper thread (form C)	DIN 3852-1	DIN 3852-1 Form Z
	Sealing by PEFLEX ring (form E)	ISO 9974-2	ISO 9974-1
	Sealing by O-ring	ISO 6149-2 / ISO 6149-3	ISO 6149-1
Whitworth pipe thread / UN-UNF / NPT	Sealing by DIN 7603 seal ring (form A)	DIN 3852-2	DIN 3852-2 Form X
	Sealing by seal edge (form B)	ISO 1179-4	ISO 1179-1
	Sealing by taper thread (form C)	DIN 3852-2	DIN 3852-2 Form Z
	Sealing by taper thread (NPT)	ANSI/ASME B 1.20.1-1983	ANSI/ASME B 1.20.1-1983
	Sealing by PEFLEX ring (form E)	ISO 1179-2	ISO 1179-1
	Sealing by O-ring (UN-UNF)	ISO 11926-2/-3 / SAE J 514	ISO 11926-1 / SAE J 514

Pressure calculations for hydraulic tubes of steel and stainless steel

The pressures stated here are based on calculations carried out in accordance with DIN 2413. These calculations were carried out assuming the following boundary conditions for straight tubes and do not take into consideration any special conditions of a real hydraulic system. They are therefore only intended to assist in preliminary selection and do not release the user from his obligation to carry out own design calculations. The scope of application of the above standard shall also be observed.

Bursting pressures were calculated by a method similar to that described in ISO 10763. The assumed tensile strength values chosen in this case lead to deviations of not more than 15 % from real applications.

Pressure calculations as described in ISO 2413

Load case I – mainly static:

Design calculation pressure $p = \frac{20 \cdot K \cdot T \cdot C1}{S \cdot Da}$

Load case III – pulsating

Design calculation pressure $p = \frac{20 \cdot K \cdot T \cdot C1}{S \cdot (Da + T \cdot C1)}$

Da = outer diameter of tube [mm]
T = tube wall thickness [mm]
p = design calculation pressure [bar]
K = strength parameter [N/mm²]
S = safety factor
C1 = reduction factor for thinner tube walls

load case I – static			load case III – rising		
E235	E355	VA 1.4571	E235	E355	VA 1.4571
K = 235/225*	K = 355/345*	K = 245	K = 225	K = 230	K = 190
S = 1,5	S = 1,58	S = 1,5	S = 1,5	S = 1,5	S = 1,5
C1 = 0,9	C1 = 0,9	C1 = 0,9	C1 = 0,9	C1 = 0,9	C1 = 0,9

* For E235 and E355: a value of 10 N/mm² shall be subtracted for Da ≤ 30 and T ≤ 3mm.

Bursting pressure calculation based on ISO 10763

Calculation equation:

burst pressure $Pb = Rm \cdot \ln\left(\frac{Da}{Di}\right) \cdot 10$

Da = outer diameter of tube [mm]
Di = inner diameter of tube [mm]
Pb = bursting pressure [bar]
Rm = assumed tensile strength [N/mm²]

E235	E355	VA 1.4571
Rm = 388	Rm = 530	Rm = 468

Hydraulic tubes of E235 steel (formerly St37.4) or E355 steel (formerly St52.4) and stainless steel 1.4571: pressure calculations as described in DIN 2413

Tube dimensions			VOSS nominal pressure		Design calculation pressures in accordance with DIN 2413 [bar]						Bursting pressure [bar]		
Da [mm]	Di [mm]	T [mm]	L-series [bar]	S-series [bar]	Load case I (idle, up to +120°C)			Load case III (pulsating, up to +120°C)			calculated in accordance with ISO 10763		
					E235	E355	1.4571	E235	E355	1.4571	E235	E355	1.4571
6	4.5	0.75	500	800	338	491	368	303	310	256	1116	1525	1346
6	4	1	500	800	450	655	490	391	400	330	1573	2149	1898
6	3	1.5	500	800	675	983	735	551	563	465	2689	3674	3244
6*	2	2	500	800	900	1310	980	692	708	585	4263	5823	5142
6*	1.5	2.25	500	800	1013	1474	1103	757	774	639	5379	7347	6488
8	6	1	500	800	338	491	368	303	310	256	1116	1525	1346
8	5	1.5	500	800	506	737	551	433	443	366	1824	2491	2200
8	4	2	500	800	675	983	735	551	563	465	2689	3674	3244
8*	3	2.5	500	800	844	1228	919	659	673	556	3806	5198	4590
10	8	1	500	800	270	393	294	248	253	209	866	1183	1044
10	7	1.5	500	800	405	590	441	357	365	301	1384	1890	1669
10	6	2	500	800	540	786	588	458	468	386	1982	2707	2391
10	5	2.5	500	800	675	983	735	551	563	465	2689	3674	3244
10*	4	3	500	800	810	1179	882	638	652	539	3555	4856	4288
12	10	1	400	630	225	328	245	209	214	177	707	966	853
12	9	1.5	400	630	338	491	368	303	310	256	1116	1525	1346
12	8	2	400	630	450	655	490	391	400	330	1573	2149	1898
12	7	2.5	400	630	563	819	613	474	484	400	2091	2857	2523
12	6	3	400	630	675	983	735	551	563	465	2689	3674	3244
12*	5	3.5	400	630	823	1180	858	624	638	527	3397	4640	4097
12*	4	4	400	630	940	1348	980	692	708	585	4263	5823	5142
14	12	1		630	193	281	210	181	185	153	598	817	721
14	11	1.5		630	289	421	315	264	270	223	936	1278	1129
14	10	2		630	386	561	420	342	349	289	1306	1783	1575
14	9	2.5		630	482	702	525	415	425	351	1714	2342	2068
14	8	3		630	579	842	630	485	496	410	2171	2966	2619
14	7	3.5		630	705	1011	735	551	563	465	2689	3674	3244
15	13	1	400		180	262	196	170	174	143	555	758	670
15	12	1.5	400		270	393	294	248	253	209	866	1183	1044
15	11	2	400		360	524	392	321	329	271	1203	1644	1452
15	10	2.5	400		450	655	490	391	400	330	1573	2149	1898
15	9	3	400		540	786	588	458	468	386	1982	2707	2391
16	14	1		630	169	246	184	160	163	135	518	708	625
16	13	1.5		630	253	368	276	233	239	197	806	1100	972
16	12	2		630	338	491	368	303	310	256	1116	1525	1346
16	11	2.5		630	422	614	459	370	378	312	1454	1986	1754
16	10	3		630	506	737	551	433	443	366	1824	2491	2200
16	8	4		630	705	1011	735	551	563	465	2689	3674	3244
18	16	1	400		150	218	163	143	146	121	457	624	551
18	15	1.5	400		225	328	245	209	214	177	707	966	853
18	14	2	400		300	437	327	273	279	230	975	1332	1176
18	13	2.5	400		375	546	408	333	341	281	1263	1725	1523
18	12	3	400		450	655	490	391	400	330	1573	2149	1898
18	10	4	400		627	899	653	500	511	422	2281	3115	2751

VOSS

Tube dimensions			VOSS nominal pressure		Design calculation pressures in accordance with DIN 2413 [bar]						Bursting pressure [bar]		
					Load case I			Load case III					
Da [mm]	Di [mm]	T [mm]	L-series [bar]	S-series [bar]	(idle, up to +120°C)			(pulsating, up to +120°C)			calculated in accordance with ISO 10763		
20	17	1.5		420	203	295	221	190	194	160	631	861	761
20	16	2		420	270	393	294	248	253	209	866	1183	1044
20	15	2.5		420	338	491	368	303	310	256	1116	1525	1346
20	14	3		420	405	590	441	357	365	301	1384	1890	1669
20	13	3.5		420	494	708	515	408	417	345	1671	2283	2016
20	12	4		420	564	809	588	458	468	386	1982	2707	2391
20	10	5		420	705	1011	735	551	563	465	2689	3674	3244
22	20	1	250		123	179	134	118	121	100	370	505	446
22	19	1.5	250		184	268	200	173	177	146	569	777	686
22	18	2	250		245	357	267	227	232	192	779	1064	939
22	17	2.5	250		307	447	334	278	285	235	1000	1366	1207
22	16	3	250		368	536	401	328	335	277	1236	1688	1490
22	15	3.5	250		449	643	468	376	384	317	1486	2030	1792
22	14	4	250		513	735	535	422	431	356	1754	2396	2115
25	22	1.5		420	162	236	176	154	157	130	496	678	598
25	21	2		420	216	314	235	201	206	170	676	924	816
25	20	2.5		420	270	393	294	248	253	209	866	1183	1044
25	19	3		420	324	472	353	292	299	247	1065	1455	1284
25	18	3.5		420	395	566	412	336	343	283	1275	1741	1537
25	17	4		420	451	647	470	378	386	319	1496	2044	1805
25	16	4.5		420	508	728	529	418	428	353	1732	2365	2089
25	15	5		420	564	809	588	458	468	386	1982	2707	2391
28	25	1.5	250		145	211	158	138	141	117	440	601	530
28	24	2	250		193	281	210	181	185	153	598	817	721
28	23	2.5	250		241	351	263	223	228	188	763	1043	921
28	22	3	250		289	421	315	264	270	223	936	1278	1129
28	21	3.5	250		353	506	368	303	310	256	1116	1525	1346
28	20	4	250		403	578	420	342	349	289	1306	1783	1575
30	26	2		420	180	262	196	170	174	143	555	758	670
30	25	2.5		420	225	328	245	209	214	177	707	966	853
30	24	3		420	270	393	294	248	253	209	866	1183	1044
30	23	3.5		420	329	472	343	285	291	241	1031	1408	1243
30	22	4		420	376	539	392	321	329	271	1203	1644	1452
30	20	5		420	470	674	490	391	400	330	1573	2149	1898
30	18	6		420	564	809	588	458	468	386	1982	2707	2391
35	32	1.5	250		121	173	126	111	114	94	348	475	419
35	31	2	250		161	231	168	147	150	124	471	643	568
35	30	2.5	250		201	289	210	181	185	153	598	817	721
35	29	3	250		242	347	252	215	220	181	730	997	880
35	27	4	250		322	462	336	280	286	236	1007	1375	1215
35	25	5	250		403	578	420	342	349	289	1306	1783	1575
38	34	2		420	148	213	155	136	139	115	432	589	521
38	33	2.5		420	186	266	193	168	171	142	547	748	660
38	32	3		420	223	319	232	199	203	168	667	911	804
38	30	4		420	297	426	309	260	265	219	917	1253	1106
38	28	5		420	371	532	387	318	325	268	1185	1619	1429
38	26	6		420	445	639	464	373	382	315	1472	2011	1776
38	24	7		420	519	745	542	427	436	360	1783	2436	2151
38	22	8		420	594	851	619	478	488	404	2121	2897	2558
42	39	1.5	250		101	144	105	93	96	79	288	393	347
42	38	2	250		134	193	140	123	126	104	388	530	468
42	37	2.5	250		168	241	175	153	156	129	492	672	593
42	36	3	250		201	289	210	181	185	153	598	817	721
42	34	4	250		269	385	280	237	242	200	820	1120	989
42	32	5	250		336	481	350	290	297	245		1441	1273

* DIN 2413 no longer applies to these tubes (because od/id > 2.0)

Dimensions
The dimensions given in the catalogue have been adapted to currently valid standards. We reserve the right to make changes due to technical advances and developments.

Patents
We make reference here to our patents at home and abroad, as well as our registered designs, trade marks and intellectual property applications.

Approvals
For approvals, see Chapter 9.

Tightening torques for threads

The recommended tightening torques refer to steel threads with VOSS coat surface finish and a steel mating material with a breaking stress of 350 N/mm².

Steel threads with increased pressure level require a mating material with a breaking stress of ≥ 600 N/mm².

If other values for strength, modulus of elasticity and friction-surface combinations are used, the user must adapt the tightening torques empirically.

VOSS notes, operating instructions and assembly instructions are to be followed in order for the parts to fulfil their proper function.

The recommended tightening torques have to be adhered to if the pressure range is to be fully utilized and the appropriate safety level is to be maintained.

The tightening torques for the threads are given in the tables for the respective type of thread.

Recommended steel tubes

The following table contains recommendations for the tube connections listed in the catalogue.

The values in the table refer to DIN 2413 class III dynamic loads at up to 120° C and tube material 1.0255+N, without corrosion factor supplement.

There are a number of different German and international standards concerning calculation of the required dimensions of tubes under internal pressure.

We recommend standard DIN EN 13480-3, which explains the various load cases in great detail.

Specifications concerning permissible steel tubes:
Seamless, cold-drawn and normalized precision steel tubing as specified in DIN EN 10305-4, material E235+N, mat. no. 1.0308+N or E355, mat. no. 1.0580. The tubes must be ordered by specifying the outer diameter and the inner diameter.

Specifications concerning permissible stainless steel tubes:
Seamless cold-drawn and solution-annealed, scale-free stainless-steel tubes in CFA or CFD delivery condition of dimensions and tolerances in accordance with DIN EN 10305-1 and all other delivery conditions as specified in DIN EN 10216-5, material X6CrNiMoTi17-12-2, mat. no. 1.4571. The tubes must be ordered by specifying the outer diameter and the inner diameter.

To stabilize the connections, thin-walled steel tubes must be fitted with reinforcing internal sleeves.

Media resistance

VOSS cutting ring couplings, VOSS*Form*^{SQR} tube couplings, flared couplings and flanges are designed for use with normal commercially available hydraulic fluids at temperatures of up to +100° C and compressed air at temperatures up to +80° C.

If use with critical media such as low-flammability pressure fluids is intended, please consult our customer service department.

Orders

All articles described in this catalogue are delivered as depicted in the catalogue. Items are delivered in closed package units to facilitate warehousing and to protect them from dirt and damage.

Orders should be matched to the contents of the respective package units. The number of items in the individual package units are stated in the currently valid price list. If you require smaller quantities, i. e. less items than are contained in one package unit, we recommend that you purchase these from one of our dealers.

The general terms and conditions stated at www.voss.net apply to all business dealings.

Service for customers
Let our customer service department advise you. Simply contact our sales department or a member of our field service.

Coupling system pressure ratings

Nominal pressure (PN)

The nominal pressure specifies the maximum operating pressure of the coupling. This is the maximum envisaged pressure when the system or the system section is operated under stationary conditions. During load tests, the bursting pressure of the specimen must be at least 4 times the nominal pressure.

<table>
<tr><th>Series</th><th>2S
PN</th><th>2S plus
PN</th><th>ES-4
PN</th><th>BV-10
PN</th><th>VOSSForm^{SQR}
PN</th></tr>
<tr><td>L 6</td><td rowspan="6">315</td><td rowspan="2">500</td><td rowspan="2">500</td><td rowspan="2">500</td><td rowspan="2">500</td></tr>
<tr><td>L 8</td></tr>
<tr><td>L 10</td><td rowspan="3">400</td><td rowspan="3">400</td><td rowspan="3">400</td><td rowspan="3">400</td></tr>
<tr><td>L 12</td></tr>
<tr><td>L 15</td></tr>
<tr><td>L 18</td><td rowspan="4">160</td><td rowspan="4">250</td><td rowspan="4">250</td><td rowspan="4">250</td><td rowspan="4">250</td></tr>
<tr><td>L 22</td></tr>
<tr><td>L 28</td></tr>
<tr><td>L 35</td></tr>
<tr><td>L 42</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>S 6</td><td rowspan="4">630</td><td rowspan="2">800</td><td rowspan="2">800</td><td rowspan="2">800</td><td rowspan="2">800</td></tr>
<tr><td>S 8</td></tr>
<tr><td>S 10</td><td rowspan="3">630</td><td rowspan="3">630</td><td rowspan="3">630</td><td rowspan="3">630</td></tr>
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<tr><td>S 14</td><td rowspan="4">400</td><td rowspan="5">420</td><td rowspan="5">420</td><td rowspan="5">420</td><td rowspan="5">420</td></tr>
<tr><td>S 16</td></tr>
<tr><td>S 20</td></tr>
<tr><td>S 25</td></tr>
<tr><td>S 30</td><td rowspan="2">315</td></tr>
<tr><td>S 38</td></tr>
</table>

Additional information – Resistance to media, temperatures and pressure

Pressure reduction factors and temperatures

Pressure reduction factors within permitted operating temperatures in °C	Material			
	steel couplings	stainless-steel (1.4571) couplings	Seals of NBR (e. g. Perbunan®)	Seals of FPM/FKM (e. g. Viton®)
-60		0 %		
-50				
-40	0 %			
-35			0 %	
-25				0 %
+20				
+50		4 %		
+100		11 %		
+120		14 %		
+150	10 %			
+175	15 %	18 %		
+200	20 %			
+250	29 %	28 %		
+300				
+400		33 %		

permitted operating temperature
permitted ambient temperature for hydraulic applications
temperature not permitted

Seal durability with hydraulic fluids

	Temperature resistance of seals	
Pressure fluids	VOSS NBR	VOSS FPM/FKM
HL, HLP, HVLP	-35 °C up to +100 °C	-25 °C up to +200 °C [4]
HTG, HETG (rapeseed oils)	up to +80 °C [1]	up to +100 °C
HEPG (Polyalkylene glycols) [5]	up to +80 °C [2]	up to +120 °C
HEES (synthetic ester oils)	up to +80 °C [3]	up to +120 °C

[1] When rapeseed oil is used, even the lowest water content (0.5 %) can destroy the usability of the seals.
[2] Depending on the quality of the oil, the seals may swell excessively and their flexibility under cold conditions may be reduced.
[3] The wide range of HEES oils available means that the swelling rates differ considerably. General compatibility cannot be guaranteed in all cases.
[4] For steel coupling components, the temperature range is -40 °C to +120 °C. Observe the operating range of the hydraulic fluid e. g. the flash point of HVLP is +125 °C
[5] HEPG can only be used at up to +80 °C

Pressure reduction factors and temperatures

Permitted pressures

The pressure ratings stated in the VOSS catalog are as follows:

- The nominal pressure (PN) specifies the maximum operating pressure of the coupling. This is the maximum intended pressure when operating the system or the system section under stationary conditions. During load tests, the bursting pressure of the specimen must be at least 4 times the nominal pressure.

- Permissible operating pressure (PB) as defined in DIN 2401 part 1. The operating pressure ("Betriebsüberdruck" - PB) data are stated for normal operating conditions (at +120° C, static load) and a safety factor of 2.5.

At higher temperatures, the pressures must be reduced to below those stated in the catalog by a factor depending on the materials used. The intended operating temperature must be taken into consideration when selecting coupling and seal materials.

Caution!
When selecting tubes, please observe the pressure reduction factors stated by the tube manufacturers.

Calculation example:

Coupling:
VOSS*Form*^{SQR} tube OD S 10 = 800 bar nominal pressure

Temperature:
+150 °C

Material:
steel

Pressure reduction factor (see table):
10 %

Formula:
PN (coupling at +150° C)

$$= \frac{800 \text{ bar}}{100 \%} \times (100 \% - 10 \%) = 720 \text{ bar}$$

Overview of standard threads of VOSS 24° coupling components

Metric thread [M] **Imperial thread [G]**

		Male				Union nut	
Series	Tube-OD	Whitworth pipe thread	Width across flats	Metric fine thread	Width across flats	Metric fine thread	Width across flats
LL	4	G 1/8“	10	M 8 x 1	10	M 8 x 1	10
LL	5	G 1/8“	11	M 8 x 1	11	M 10 x 1	12
LL	6	G 1/8“	11	M 10 x 1	11	M 10 x 1	12
LL	8	G 1/8“	12	M 10 x 1	12	M 12 x 1	14
L	6	G 1/8“	14	M 10 x 1	14	M 12 x 1.5	14
L	8	G 1/4“	19	M 12 x 1.5	17	M 14 x 1.5	17
L	10	G 1/4“	19	M 14 x 1.5	19	M 16 x 1.5	19
L	12	G 3/8“	22	M 16 x 1.5	22	M 18 x 1.5	22
L	15	G 1/2“	27	M 18 x 1.5	24	M 22 x 1.5	27
L	18	G 1/2“	27	M 22 x 1.5	27	M 26 x 1.5	32
L	22	G 3/4“	32	M 26 x 1.5 (ISO 6149 = M 27 x 2)	32	M 30 x 2	36
L	28	G 1“	41	M 33 x 2	41	M 36 x 2	41
L	35	G 1 1/4“	50	M 42 x 2	50	M 45 x 2	50
L	42	G 1 1/2“	55	M 48 x 2	55	M 52 x 2	60
S	6	G 1/4“	19	M 12 x 1.5	17	M 14 x 1.5	17
S	8	G 1/4“	19	M 14 x 1.5	19	M 16 x 1.5	19
S	10	G 3/8“	22	M 16 x 1.5	22	M 18 x 1.5	22
S	12	G 3/8“	22	M 18 x 1.5	24	M 20 x 1.5	24
S	14 *	G 1/2“	27	M 20 x 1.5	27	M 22 x 1.5	27
S	16	G 1/2“	27	M 22 x 1.5	27	M 24 x 1.5	30
S	20	G 3/4“	32	M 27 x 1.5	32	M 30 x 2	36
S	25	G 1“	41	M 33 x 2	41	M 36 x 2	46
S	30	G 1 1/4“	50	M 42 x 2	50	M 42 x 2	50
S	36	G 1 1/2“	55	M 48 x 2	55	M 52 x 2	60

In addition to the standard dimensions as specified in ISO 8434-1, other male part thread sizes are available. Detailed dimension information is given on the respective pages of the catalogue.

* Tube size S14 is no longer covered by the applicable standards.

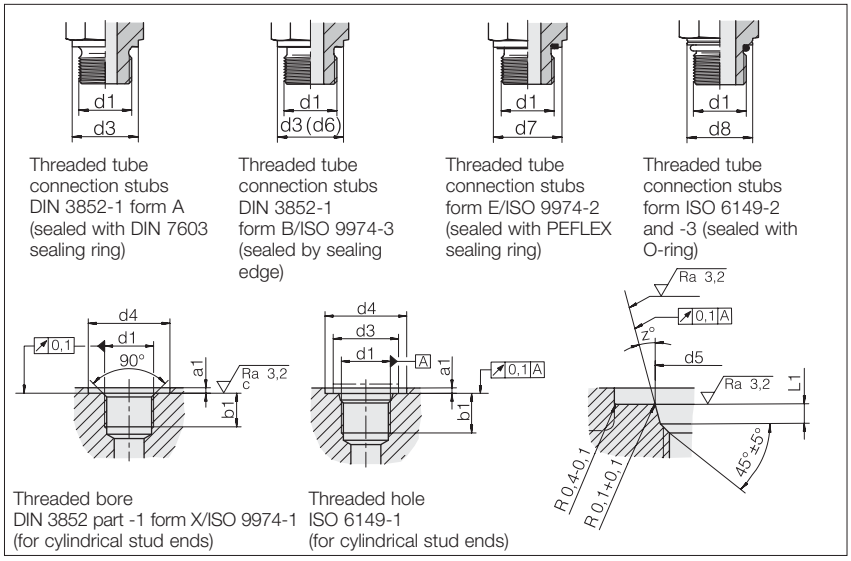
Seal types and threaded bores

for VOSS tube couplings

Male thread:
metric fine thread, cylindrical

Standard PEFLEX and O-ring seals are of NBR,
-35 °C to +100 °C

FPM/FKM seals for
-25 °C to +200 °C



Tube OD LL	L	S	d1	d3 (d6)	d4 +0.4	d4 (wide) +0.4	d4 min.	d5 +0.1	d7	d8 ±0.2	a1 max.	b1 min.	L1 +0.4	Z° ±1°
DIN 3852														
4	-	-	M 8 x 1	12			13				1	8		
6 / 8	6	-	M 10 x 1	14		20	15		13.9		1	8		
-	8	6	M 12 x 1.5	17		25	18		16.9		1.5	12		
-	10	8	M 14 x 1.5	19		25	20		18.9		1.5	12		
-	12	10	M 16 x 1.5	21		28	23		21.9		1.5	12		
-	15	12	M 18 x 1.5	23		30	25		23.9		2	12		
-	-	14	M 20 x 1.5	25		34	27		25.9		2	14		
-	18	16	M 22 x 1.5	27		34	28		26.9		2.5	14		
-	22	-	M 26 x 1.5	31		42	33		31.9		2.5	16		
-	-	20	M 27 x 2	32		42	33		31.9		2.5	16		
-	28	25	M 33 x 2	39		47	41		39.9		2.5	18		
-	35	30	M 42 x 2	49		56	51		49.9		2.5	20		
-	42	38	M 48 x 2	55		65	56		54.9		2.5	22		
ISO 6149														
-	6	-	M 10 x 1	14.5	16			11.1		13.8	1	10	1.6	12
-	8	6	M 12 x 1.5	17.5	19			13.8		16.8	1.5	11.5	2.4	15
-	10	8	M 14 x 1.5	19.5	21			15.8		18.8	1.5	11.5	2.4	15
-	12	10	M 16 x 1.5	22.5	24			17.8		21.8	1.5	13	2.4	15
-	15	12	M 18 x 1.5	24.5	26			19.8		23.8	2	14.5	2.4	15
-	18	16	M 22 x 1.5	27.5	29			23.8		26.8	2	15.5	2.4	15
-	22	20	M 27 x 2	32.5	34			29.4		31.8	2	19	3.1	15
-	28	25	M 33 x 2	41.5	43			35.4		40.8	2.5	19	3.1	15
-	35	30	M 42 x 2	50.5	52			44.4		49.8	2.5	19.5	3.1	15
-	42	38	M 48 x 2	55.5	57			50.4		54.8	2.5	22	3.1	15

[1] 0.1 ≤ M 22 x 1.5
0.2 ≥ M 26 x 1.5

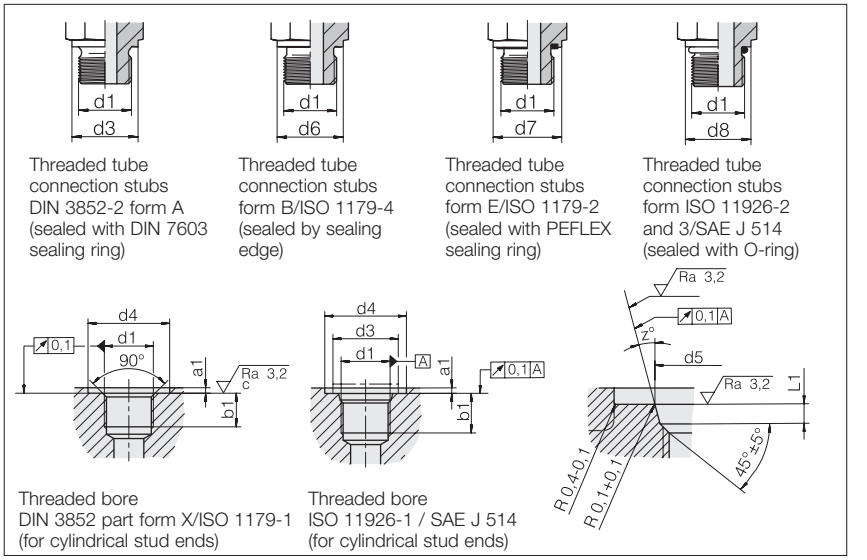
Seal types and threaded bores

for VOSS tube couplings

Male thread:
Whitworth pipe thread,
UN/UNF thread
cylindrical

Standard PEFLEX and O-ring seals are of NBR,
-35 °C to +100 °C

FPM/FKM seals for
-25 °C to +200 °C



Tube OD LL	L	S	d1 [2) 3)]	d3 (d6)	d4 +0.4	d4 (wide) +0.4	d4 min.	d5 +0.05	d7	d8 ±0.2	a1 max.	b1 min.	L1 +0.4	Z° ±1°
DIN 3852														
4 - 8	6	-	G 1/8 A	14		19	15		13.9		1	8		
-	8 / 10	6 / 8	G 1/4 A	18		25	20		18.9		1.5	12		
-	12	10 / 12	G 3/8 A	22		28	23		21.9		2	12		
-	15 / 18	14 / 16	G 1/2 A	26		34	28		26.9		2.5	14		
-	22	20	G 3/4 A	32		42	33		31.9		2.5	16		
-	28	25	G 1 A	39		47	41		39.9		2.5	18		
-	35	30	G 1 1/4 A	49		58	51		49.9		2.5	20		
-	42	38	G 1 1/2 A	55		65	56		54.9		2.5	22		
-			G 2 A	68		76	69				3	24		
ISO 11926														
-	8 / 10	8	7/16-20 UNF-2A	15	21			12.45		14.4	1.6	11.5	2.4	12
-	8	8	1/ 2-20 UNF-2A	16	23			14.05		16.2	1.6	11.5	2.4	12
-	12	10 / 14	9/16-18 UNF-2A	18	25			15.7		17.6	1.6	12.7	2.5	12
-	12 - 18	12 - 20	3/ 4-16 UNF-2A	23	30			20.65		22.3	2.4	14.3	2.5	15
-	12 - 22	16 - 20	7/ 8-14 UNF-2A	26	34			24		25.5	2.4	16.7	2.5	15
-	22 / 28	20 / 25	1 1/16-12 UN -2A	32	41			29.2		31.9	2.4	19	3.3	15
-	35		1 3/16-12 UN -2A	35	45			32.4		35	2.4	19	3.3	15
-	22 - 35	25 / 30	1 5/16-12 UN -2A	39	48.9			35.55		38.2	3.2	19	3.3	15
-	35 - 42	30 / 38	1 5/ 8-12 UN -2A	48	58			43.55		47.7	3.2	19	3.3	15
-	42	38	1 7/ 8-12 UN -2A	54	65			49.9		54	3.2	19	3.3	15

[1)] 0.1 ≤ G 1/2
0.2 ≥ G 3/4

[2)] "A" is not relevant for Whitworth pipe threads (internal/female thread).

[3)] Threaded bore UN-UNF-2B

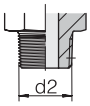
Seal types and threaded bores

for VOSS tube couplings

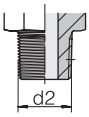
Male thread:
metric fine thread, conical

Whitworth pipe thread, conical

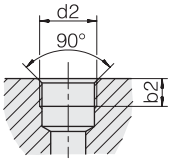
NPT thread



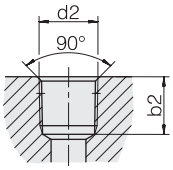
Threaded tube connection stubs
DIN 3852-1 and -2 form C
sealed by tapered thread



Threaded tube connection stubs NPT
ANSI/ASME B 1.20.1 – 1983
sealed by tapered thread



Threaded bore
DIN 3852-1 and -2 form Z [1]
(for tube connection stubs with tapered threads)



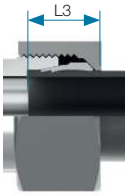
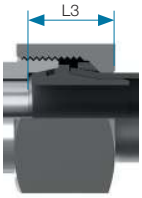
Threaded bore NPT
ANSI/ASME B 1.20.1 – 1983
for tapered threads

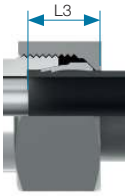
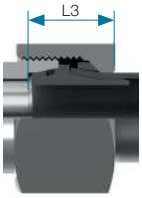
Series	Tube OD	d2	b2 min.	d2	b2 min.	d2	b2 min.
LL	4	M 8 x 1 keg	5.5	R 1/8	5.5	1/8 NPT	11.6
LL	6	M 10 x 1 keg	5.5	R 1/8	5.5	1/8 NPT	11.6
LL	8	M 10 x 1 keg	5.5	R 1/8	5.5	1/8 NPT	11.6
L	6	M 10 x 1 keg	5.5	R 1/8	5.5	1/8 NPT	11.6
L	8	M 12 x 1.5 keg	8.5	R 1/4	8.5	1/4 NPT	16.4
L	10	M 14 x 1.5 keg	8.5	R 1/4	8.5	1/4 NPT	16.4
L	12	M 16 x 1.5 keg	8.5	R 3/8	8.5	3/8 NPT	17.4
L	15	M 18 x 1.5 keg	8.5	R 1/2	10.5	1/2 NPT	22.6
L	18	M 22 x 1.5 keg	10.5	R 1/2	10.5	1/2 NPT	22.6
L	22	M 26 x 1.5 keg	10.5	R 3/4	13	3/4 NPT	23.1
L	28	M 33 x 2 keg	12	R 1	16	1 NPT	27.8
L	35	M 42 x 2 keg	13	R 1 1/4	17	1 1/4 NPT	28.3
L	42	M 48 x 2 keg	13	R 1 1/2	17	1 1/2 NPT	28.3
S	6	M 12 x 1.5 keg	8.5	R 1/4	8.5	1/4 NPT	16.4
S	8	M 14 x 1.5 keg	8.5	R 1/4	8.5	1/4 NPT	16.4
S	10	M 16 x 1.5 keg	8.5	R 3/8	8.5	3/8 NPT	17.4
S	12	M 18 x 1.5 keg	8.5	R 3/8	8.5	3/8 NPT	17.4
S	14	M 20 x 1.5 keg	10.5	R 1/2	10.5	1/2 NPT	22.6
S	16	M 22 x 1.5 keg	10.5	R 1/2	10.5	1/2 NPT	22.6
S	20	M 27 x 2 keg	12	R 3/4	13	3/4 NPT	23.1
S	25	M 33 x 2 keg	12	R 1	16	1 NPT	27.8
S	30	M 42 x 2 keg	13	R 1 1/4	17	1 1/4 NPT	28.3
S	38	M 48 x 2 keg	13	R 1 1/2	17	1 1/2 NPT	28.3

[1] Leak-tightness can only be achieved with liquid or elastic sealant.

Height of the completely assembled VOSS tube coupling

Dimension L3 describes the connection dimension of the tube connection used.

				
Series	**s [mm]**	**L3 approx. [mm] Cutting rings**	**L3 approx. [mm] VOSS*Form***	**L3 approx. [mm] BV-10**
L 6	1	15.0	15.5	18.0
	1.5		16.0	–
	2			
L 8	1	15.0	15.5	18.5
	1.5		16.0	–
	2			
	2.5			
L 10	1	15.0	15.5	18.5
	1.5		16.0	–
	2			
L 12	1	15.0	15.5	18.5
	1.5		16.0	–
	2			
L 15	1	15.0	17.5	–
	1.5			19.5
	2			
L 18	1.5	16.5	18.5	20.5
	2			–
	2.5			
	3			
L 22	1.5	16.5	20.0	20.5
	2			–
	2.5			
	3			
L 28	2	16.5	20.0	21.0
	2.5			–
	3			21.0
L 35	2	21.5	24.0	26.0
	2.5			–
	3		25.0	26.0
	4			–
L 42	2	23.0	24.5	–
	2.5			
	3		25.5	28.5
	4			–

				
Series	**s [mm]**	**L3 approx. [mm] Cutting rings**	**L3 approx. [mm] VOSS*Form***	**L3 approx. [mm] BV-10**
S 6	1	15.0	16.0	–
	1.5		16.5	
	2			
S 8	1	15.0	16.0	–
	1.5		16.5	19.0
	2			–
	2.5			
S 10	1.5	16.5	18.5	20.0
	2			–
	2.5			
S 12	1.5	16.5	18.5	19.5
	2			–
	2.5			19.5
	3			
S 14	1.5	18.0	20.0	–
	2		20.5	21.5
	2.5			–
	3			
S 16	1.5	18.5	21.0	–
	2			22.0
	2.5			
	3			
	4		21.5	–
S 20	2	21.5	25.0	25.0
	2.5			
	3			
	3.5			
	4			
S 25	2	24.0	28.0	–
	2.5			27.5
	3			
	3.5			
	4			
S 30	2	26.5	30.5	–
	2.5			
	3		31.5	33.0
	4			
	5			
	6		32.0	–
S 38	2.5	31.0	34.5	–
	3			
	4		35.5	38.5
	5			
	6			
	7		36.0	–

Additional lengths when designing tube assemblies

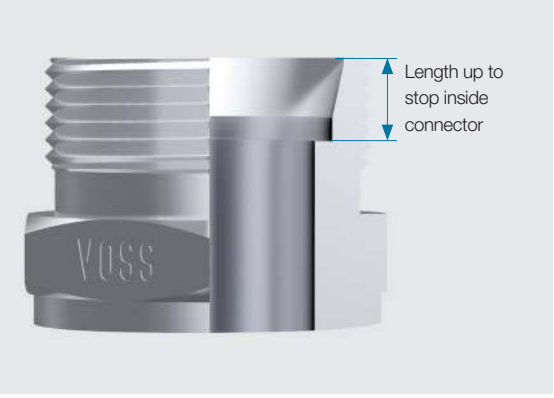
The following must be taken into consideration when calculating the length of tubing required for a given assembly length:

- minimum lengths of straight tube sections and of tube elbows*
- additional dimensions in the coupling connector
- additional tube sections (flaring, bend radii, elbow lengths, straight sections)

In addition, we recommend that in case of doubt some extra length be added when designing the ends of the tubes. This allows the tube length to be adjusted before commencing pre-assembly for the VOSS coupling system, if necessary.

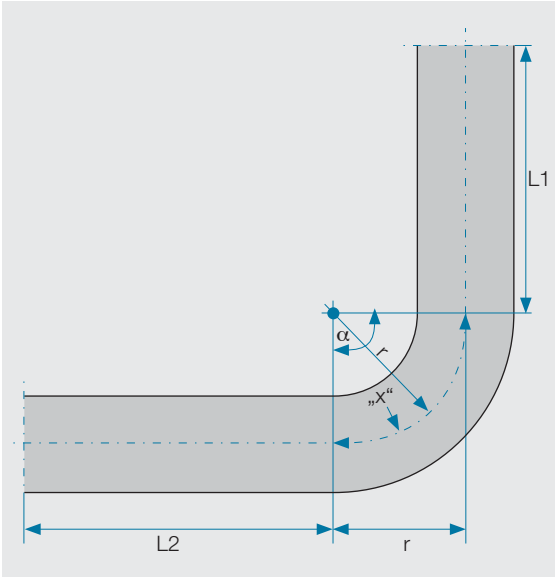
Dimension inside coupling connecting piece

tube OD	Length up to stop inside connector [mm]
L 6	7
L 8	7
L 10	7
L 12	7
L 15	7
L 18	7.5
L 22	7.5
L 28	7.5
L 35	10.5
L 42	11
S 6	7
S 8	7
S 10	7.5
S 12	7.5
S 14	8
S 16	8.5
S 20	10.5
S 25	12
S 30	13.5
S 38	16



* Depends on the coupling system and pre-assembly system used.

Calculating the equivalent straight tube length



L = total equivalent straight tube length
x = equivalent tube length of elbow
α = bend angle
r = radius

$$x = \frac{\alpha \cdot 2 \cdot r \cdot \pi}{360°}$$

$$L = L1 + L2 + x$$

Please note that the bend radius is determined by the bend template of the device.

VOSS cutting ring systems in applications using polyamide (PA) tubing

Tubing made of organic materials is becoming increasingly popular in industrial applications. These materials have a good resistance to oil, grease and fuels as well as to high and low temperatures. They are also weather-resistant and have good mechanical characteristics such as fracture and impact resistance.

Polyamide (PA) tubes possess most of these qualities. They are manufactured to extremely tight tolerances and can be easily installed using metal or plastic coupling elements.

All VOSS Fluid cutting ring systems are suitable for use with tubes made of polyamide (PA).

Polyamide (PA) tubing applications:

- Control, measuring and monitoring technology
- Laboratory equipment
- Food processing industry
- Medical technology and electrical engineering
- Automotive industry
- Plant and equipment construction
- Pneumatics

Polyamide tube material properties

- Low weight
- Corrosion and temperature resistant
- Impact resistance at both low and high temperature ranges
- Relatively high pressure resistance with low wall thicknesses
- Temperature range from -40° C up to +80° C, and even up to +100° C for short periods.

Product recommendation:

VOSS cutting pliers for plastic tubes
Plastic tubes must not be sawn apart as this leads to burrs, which endanger the leak-tightness of a coupling. VOSS Fluid recommends that the VOSS plastic tube cutting pliers be used to cut plastic tubing to length. This produces burr-free and orthogonally-cut tube ends. The surfaces of the cut do not need any additional processing.

Order designation: **TD-NTS**
Order-No.: **5994847200**

Assembly note:
Pre-assembly and final installation must always be carried out using tube support sleeve as described in the VOSS assembly instructions.

VOSS

Conceived and thought through

VOSS coat

Corrosion resistance in perfection

Pioneer in zinc-nickel applications since 2007 – and still a clear leader.

EC directive 2000/53/EC on end-of-life vehicles was amended in 2007, partially banning the use of hexavalent chromium in materials and vehicles components. For us, this meant that the era of yellow chromate corrosion protection coatings had come to an end. The technological characteristics of available alternatives – using zinc as a base coat with thick-film passivation – fell a great deal short of VOSS quality requirements, and were clearly a step in the wrong direction. This move was and still is unacceptable to VOSS, since we always strive to increase the benefits for customers in our products and solutions.

Our solution: VOSS zinc-nickel surface finishes. The relevant characteristics of these coatings even surpass those of yellow-chromate finishes. Users were especially delighted by their corrosion resistance – 10 times better than before. In 2007, this was a huge leap forward in the hydraulic coupling technology market.

The steel is given three coats to provide optimum corrosion protection: a zinc-nickel base coat, a passivation layer and a sealing coat. In 2009, we set up our own electroplating competence center in which we produce and enhance our surface finishes.

Features we provide as standard are options elsewhere.

Our surface finishes have set the benchmark for corrosion resistance in all market sectors and have been used in our entire product range all around the world since 2007, at high availability levels. For you, as a customer, this means maximum process reliability for your applications, homogeneous selection of parts, no danger of confusing items. Suitable for use in hydraulic presses, plant construction, agricultural and construction machinery, conveyor engineering as well as for injection-molding machines and machine tools.

After comparative testing in a salt-spray chamber for 720 hours

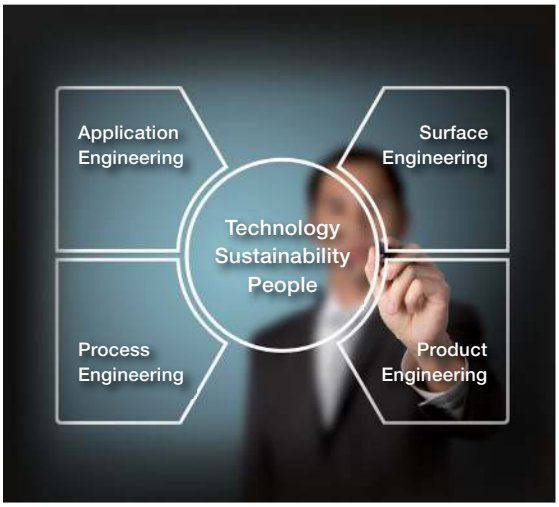
VOSS Zink-Nickel

Zinc + passivation + sealing coat

The trade mark for corrosion protection.

Our surface finish is much more than just a simple coating. This is why we have made it a trademark: VOSS coat. VOSS coat is synonymous with corrosion protection in perfection, focussing on technology, sustainability and human health and safety.

VOSS coat is the result of continuous improvement – for example of friction coefficients, layer thickness relationships and visual impression. These are the result of many years of experience in production processes and with customer applications furthered by our own research and development work. Only VOSS unites this comprehensive know-how under one roof – operating a proprietary VOSS coat competence center including an electroplating test line. In this way we make sure that our corrosion protection meets your strictest standards. To achieve a measurable technological lead for you.

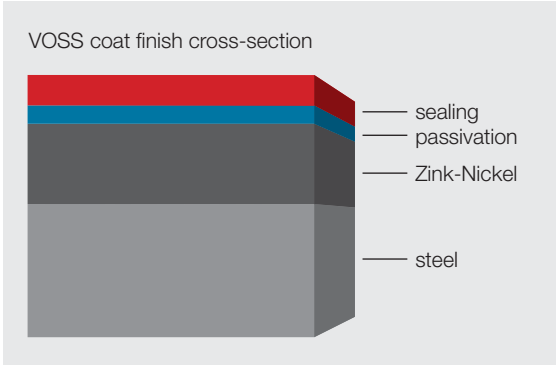


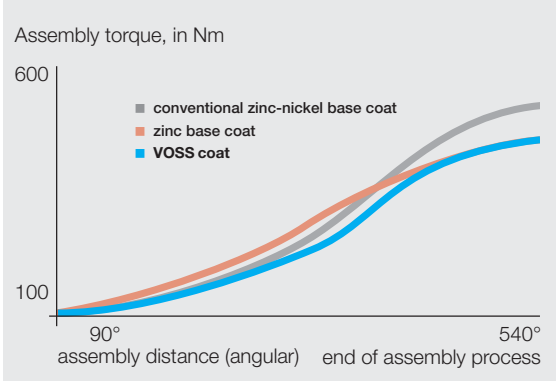
A technological lead, achieved by hard work

VOSS coat is the outcome of many years of in-house engineering that considers all the factors leading to in creased benefits for the customers. Not only have we achieved an extremely high level of corrosion protection but also user-friendly handling in practical applications.

- **1,000 hours corrosion resistance in productive applications following shipping, handling and assembly.**
  Tested using random samples in the assembled state taken from series production. In view of the microscopic lesions which can occur during assembly, this is the only way of obtaining a reliable estimate of the service life to be expected in the customer's applications. Under laboratory conditions, the service life of unassembled parts exceeds 2,000 hours. After this, red rust starts to develop, whereas white rust only appears in the form of a light grey film. In addition, samples for our own quality assurance tests are taken from all production lots.

- **Assembly testing of cutting ring coupling (size S30)**
  VOSS coat ensures optimum assembly torques.





- **Perfect assembly torques – not too high and not too low**
  How to avoid assemblies being too tight or too slack – thanks to our consistent quality – in all tube connections. Our own research, development and production have enabled us to continually improve the friction coefficient of VOSS coat to equal the best zinc surface finishes and have reached a value considerably lower than that of other zinc-nickel coatings.

- **Best possible process reliability thanks to a modern in-house electroplating plant with online sensors and analysis systems**
  This plant is designed exclusively for tube couplings – a unique feature. This is where we work to enhance our electroplating processes – in the electroplating test laboratory for chemical components, and in the engineering department for production procedures. In series of tests, the 12 program parameters are adjusted individually for each one of our 6,600 articles in order to optimize processes for all geometries and sizes. We have developed the racks and baskets used to move the articles through the plant ourselves and are continually improving these to achieve a degree of specialization impossible with outsourced processing. We conform without exception to the European Community Regulation on chemicals and their safe use (REACH), of course.

Individual plant control programs: a separate program for controlling 12 parameters is compiled for each of our 6,600 articles.

VOSS electroplating test laboratory: where VOSS coat is being permanently improved

Sustainability: only achievable from scratch if everything is under our control.

Since 2009, we have been operating the VOSS coat competence center, with a floor area of 5,000 m², at our headquarters. To provide the best possible working conditions, the facility has two storeys: on the ground floor, all goods are transported and the test batches are fed to the racks and drums for the electroplating plant, then a lift system conveys them to the second floor. The actual electroplating process is carried out there and no workers are required on this floor. We can control all process steps in the plant and optimize them to suit our requirements, sustainably and without compromises.

- **Energy-efficient production:**
  Alone the sophisticated energy optimization measures (e. g. heat recovery installations) installed when the facility was built bring annual energy savings of more than 490 MWh. This is the annual electric energy consumption of approximately 160 domestic dwellings

- **Emission reductions (air pollution, water and noise):**
  Extract air is drawn directly from the space above the baths and is cleaned by an air scrubber. This brings pollutant levels in the exhaust air down to values exceeding the lower limits by a factor of more than 250. The same principle applies to our responsible use of water: instead of using valuable drinking-quality water, we use process water. Waste water is cleaned and its pH value neutralized by sophisticated processes at our own treatment plant. And our electroplating plant fulfils the strictest noise emission regulations for mixed-utilization urban areas as well.

- **Reduction of potential environmental hazards:**
  We use environment-friendly materials.

- **Raw-material efficiency and recycling:**
  The online analysis process optimizes the useful life of baths to achieve low resource consumption. Metal residues are reprocessed and thus returned to the raw-material cycle.

Process chemistry – the essence of VOSS coat. Thanks to automated concentration correction in baths, process parameters remain within tight tolerances.

Our plant technology is specifically designed to prevent damage to threads.

The entire plant operation is controlled from the ground floor. All process steps and parameters are displayed and indicated in real time on control monitors.

All bath parameters are continuously monitored. Chemicals are added in a fully automatic process to maintain the correct concentration.

Process optimization has led to shorter product immersion times at our facility than in other electroplating plants. This means even less stress on the material.

After electroplating, each production lot is subjected to quality control inspection of both the thickness and the chemical composition of the coating. The results of the inspections are documented.

Our flexible plant controls allow customer-specific post-processing.

Extract air is drawn directly from the space above the baths and scrubbed before being exhausted. Heat energy is recovered and recycled.

The individual: at the focus of all our activities.

Technology improves products. Sustainability ensures efficiency and conservation of resources. But only by combining these two factors do we really benefit the human beings involved. VOSS coat benefits everyone, now and in the future – staff and our customers alike.

- **Productive working conditions for our staff:**
  Employees and chemicals are separated by construction measures. Since concentration-adjustment dosing of the process baths is fully automated and requires no manual work, contact to chemicals is avoided. Ergonomical workplaces, eliminating lifting movements, for example, prevent fatigue and the errors associated with this.

- **Process stability in the interest of our customers**
  Our good process stability, in conjunction with excellent component assembly characteristics, virtually eliminates faults which might occur due to excessively tight or slack assemblies. Coating processes specifically developed for our products ensure consistently high corrosion protection – at all times – for the entire product range.

- **Nickel release:**
  Our nickel release rate is more than 50 times lower than the limit values defined in EC regulation 1907/2006 for the release of nickel by objects coming into direct and prolonged contact with human skin.

VOSS coat

Corrosion resistance in perfection

VOSS coat: in a class of its own.

Corrosion protection is only as good as the weakest component. So it is best not to have any weakest component. VOSS coat sets the standard when it comes to improving corrosion protection in your entire system. Safety which improves your products and impresses your customers.

Reliability:

- 1,000 hours corrosion resistance under practical conditions.
- A technological leader among surfaces, thanks to many years of experience, research and development.
- Sustainable production in our own VOSS coat competence centre.
- 455 million couplings have been delivered since 2007.
- More than 30 % of all users in Germany choose VOSS coat.
- High availability and delivery readiness: lean, rapid supply chains.
- Image enhancement and a high resale value for your machinery and plant, thanks to uncompromisingly high-quality components.
- Enhanced customer satisfaction due to minimum risk of complaint.
- Application engineering: customer specifications can be realized by our own employees (e.g. in the case of prototypes).
- Assuring the future through our own research and cooperation with universities and other higher education institutions.

VOSS

VOSS couplings resistance to aggressive media

The VOSS coat surface finish is compatible with all normal hydraulic fluids. However, as VOSS Fluid products are used in a wide range of applications, they will also come into contact with other media such as newly-developed synthetic hydraulic fluids, fuels, cleansing agents, lubricants, gases or corrosive alkaline or acid liquids. If you are planning to use media which cannot be described as a hydraulic oil commonly used in mechanical engineering applications, we recommend that you examine their suitability prior to use. Please note that not only their stability when used with VOSS Fluid surface coatings has to be taken into consideration, but also their compatibility with elastomers and other hydraulic components as well. An overview is given in the following table, which is only meant to serve as a guide:

Medium	Coupling material		Seal material		
	Steel	Stainless steel 1.4571	NBR	FPM/FKM	EPDM
Acetone					
Ethanol (ethyl alcohol)					
Ether					
ASTM – oil No. 1					
ASTM – oil No. 2					
ASTM – oil No. 3					
ASTM – oil No. 4					
Brake fluid					
Gasolene (petrol)					
Benzene					
Steam					
Diesel fuel					
Compressed air (dry)					
Natural gas					
Petroleum oil					
Liquid propane (LPG)					
Transmission oil					
Glycol (ethylene glycol)					
Fuel oil					
Hydraulic fluids (petroleum-based) HL/HLP					
Hydraulic fluids (polyglycol-based) HEPG				*	
Hydraulic oils (bio-oil based) HEES			*		
Hydraulic fluids (synthet. ester) HEES			*		
Hydraulic fluids HFC					
Carbon dioxide					
Carbon monoxide					
Methane					
Methanol (methyl alcohol)					
Mineral oils					
Unprocessed natural gas		**			
Kerosene					
Crude petroleum oil					
Soap solution					
Shell Naturelle, HF-E-46					
Silicone oils					
Skydrol 500					
Skydrol 7000					
Turpentine					
Water					
Sea water					

resistant resistant under certain conditions not resistant

* resistance depends on temperature

** our gas requires reduction of material hardness when stainless steel is used

Please note that any material's resistance to aggressive media depends on the temperature of the media when used.

Materials of the soft seals (elastomers)

To ensure maximum leakage protection, different seal materials have to be used, depending on the respective application. The suitability of the elastomer to be selected depends essentially on the media being conveyed and on the temperature range.

The default elastomer material used by VOSS for 24° tube couplings, flange couplings and valves is NBR. All DKO screw couplings, VOSS*Form*^{SQR} and ES-4 products are supplied with elastomer seals of FPM/FKM (e. g. Viton®).

VOSS Fluid also offers other seal materials for the entire connector product range as options.

Seal material	Nitrile butadiene rubber	Hydrated NBR	Fluoroelastomer	Ethylene propylene diene-monomer rubber
Short designation (Examples: trademarks)	NBR (e. g. Perbunan®)	HNBR	FPM/FKM (e. g. Viton®)	EPDM
Temperature range	-35 °C up to +100 °C	-30 °C up to +140 °C	-25 °C up to +200 °C	-40 °C up to +150 °C
Low temperatures	++	+	+	++
Media resistance	good	good	very good	depends on conditions
Ozone resistance	limited	good	very good	very good

Please note that the effectiveness of elastomer seals will be affected by external influences, contact with media, friction and ageing.

Therefore the elastomers should be checked for the following kinds of damage when carrying out service or maintenance work, and should be replaced when necessary:

- cracking
- rough or otherwise changed surface
- deformation
- hardening or softening
- swelling
- reduced elasticity

The notes given in DIN 7716 (rubber products; requirements for storage, cleaning and maintenance) must be observed when using elastomer seals.

- Keep in dry storage at temperatures not exceeding + 25° C
- Protect against direct sunlight, ozone and strong artificial lighting

Viton® is a registered trademark of E. I. du Pont de Nemours and Company.
Perbunan® is a registered trademark of LANXESS Deutschland GmbH.

Ozone resistance of elastomer seals

Ozone is a gas occurring naturally in the atmosphere and which protects the environment against solar ultraviolet radiation. However, ozone is also a very strong oxidizing agent that attacks virtually all organic compounds. Elastomer seal materials, e. g. NBR, are particularly sensitive in this respect. Even a low atmospheric ozone concentration can impair product quality and service life considerably.

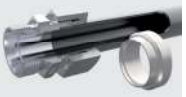
Ozone cracks the polymer chains of the seal material, thereby increasing the danger of this tearing, even at low strain values (less than 10 %). This risk may even be increased under certain temperatures and humidity conditions.

In our production and storage processes, VOSS Fluid always ensures optimum conditions for the seal materials used. For example, all seals are protected against heat exposure, direct sunlight and soiling. Long storage times are also avoided.

To prevent damage, you should observe the following notes on storing seal materials:

- Elastomers must be stored at a temperature between +5° C and +25° C.
- Deformation of the seals during storage should be avoided.
- Seal materials should be protected against direct contact with heat sources or lighting fixtures. Direct sunlight or strong artificial lighting with an ultraviolet component must also be avoided.
- Extremely damp and extremely dry conditions must be avoided. There must be no condensation, which means that the relative humidity of the storage spaces must be lower than 70 %.
- Packaging, particularly plastic bags, must be protected against UV radiation.
- Please note that ozone can also be emitted by other sources, which means that the storerooms may not contain any mercury-vapour lamps, high-voltage equipment and electric motors or other equipment which might cause arcing or electrostatic discharges. Exposure to combustion exhaust fumes and organic gases must also be avoided.
- While in storage, elastomer seals must not be allowed to come into contact with solvents, oil and grease.
- The service life of seals depends to a large extent on the type of elastomer used. Under ideal conditions, seals made of NBR and HNBR can be stored for up to 6 years and FPM/FKM seals for up to 10 years.
- Seals pre-assembled on the couplings must be inspected for damage and contamination before they are finally installed.

System comparison – requirements / system features

	2S	2S *plus*	ES-4	VOSS*Form*^{SQR}	BV-10
					

Technical comparison

General					
for tube couplings as specified in standard	DIN EN ISO 8434-1				
Series	L/S				
Tube OD	6 – 42				
Type of seal	metallic		metallic + soft sealing		
Pressure load capacity	up to 315 bar (series L)	up to 500 bar (series L)			
	up to 630 bar (series S)	up to 800 bar (series S)			
Features	2-cutting-edge cutting ring	2-cutting-edge cutting ring with additional stop	2-cutting-edge cutting ring with stop and additional soft seals	Tube forming solution with soft seals	10° flared coupling
Materials					
Material – version	Steel / stainless steel*	Steel	Steel / stainless steel*	Steel / stainless steel*	Steel
possible material pairing	Steel / stainless steel				Steel / stainless steel**
Soft seal material	–	–	FPM/FKM (black)	FPM/FKM (green)	NBR (standard)
					FPM/FKM (green)
Assembly instructions					
Machine-assisted pre-assembly	possible			required	
Pre-assembly device	Type 90 Basic II / Comfort			Type 100 / Type 100 Compact	Type 90 Basic II / Comfort
	Type 80 N3				Type 80 N3
Manual pre-assembly	possible			–	–
Specifications					
Installation spaces	Minimum length of straight tube sections H > 33 mm (L12) (see catalogue page 382; 392; 397)			Minimum length of straight tube sections (A1-L1) > 53 mm (L12) (see catalogue page 407)	Minimum length of straight tube sections (L1+L2) > 69.5 mm (L12) (see catalogue page 419)
	Machine-assisted pre-assembly only possible to a limited extent if the bend radii are small			Small bend radii are only possible to a limited extent because of pre-assembly device	Small bend radii are only possible to a limited extent because of pre-assembly device
Leak-tightness in relation to influencing factors / assembly	Many influencing factors, reliability depends on correct assembly			Hardly any influencing factors, very high safety factor (process reliability)	Some influencing factors, high safety factor

* Machine-assisted pre-assembly is recommended

** Recommendation: DurNi coated connection parts

	2S	2S *plus*	ES-4	VOSS*Form*^{SQR}	BV-10
					

Specifications					
Typical application sectors	Construction machinery, wind turbines, agricultural machinery	Pneumatic brakes, railway engineering	Agricultural machinery, cranes, mobile hydraulic systems	Elevators, presses	Injection-molding machines, mining vehicles
Can be used in safety areas.	No			Yes	
Fitter training requirements	Refresher training at 2-year intervals is recommended			low, single training course required	low, initial training course required, occasional refresher courses recommended
Pressure load capability	good	very good	very good	excellent	excellent
- static/dyn. pressure load capability					
- Transmission of external forces					
Resistance to tearing out of tubing	good	good	good	very good	very good
Long-term durability	good	good	very good	excellent	excellent
Influence of tube preparation	very great	very great	very great	little	great
Conclusion	**Cutting ring for normal applications**	**Cutting ring for normal applications, also suitable for high pressures**	**Cutting ring for all applications, high pressures and additional safety against leakage**	**Tube-forming solution for highest requirements and process stability**	**Flaring solutions for highest requirements, also ideally suited for repairs**

Preventing faults and correcting malfunctions

All VOSS Fluid products have been carefully designed, taking into account ease of assembly, user-friendliness and the product's ability to reliably fulfil the intended purpose.

In order to ensure these qualities while the products are in use, the careful choice of hydraulic coupling systems along with their correct assembly and installation are of tremendous importance.

Almost 85 % of all failures are due to assembly or installation faults, leading to impaired sealing functions or even complete failure of the coupling or connection.

Distribution of causes of assembly faults:

- approx. 55 % too slack assembly for tube OD 20–42 mm.
- approx. 40 % over-tightening for tube OD 6 – 18 mm.
- approx. 5 % other assembly/installation faults

Faulty hydraulic lines not only lead to immense re-working costs and image loss, they can also have serious consequences such as accidents, fire hazards and environmental damage.

On the following pages, you will find system-related notes which will help you identify potential faults causes and take preventive action.

You must on all accounts observe the notes in this catalogue as well as the assembly and operating instructions for VOSS tube connection systems, tools and pre-assembly devices.

In addition, we recommend regular user training and assembly auditing by our qualified staff.

VOSS 2S/2SVA cutting ring couplings

Problem: “leaks”

Characteristic	Preventive measures
Inadequate penetration of cutting ring / not enough tube material raised in front of first cutting edge.	Observe the specified tightening paths (number of turns) when manually pre-assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle ■ Use lubricants to reduce the assembly forces required Use pre-assembly devices and VOSS tools Observe the specified pre-assembly device parameter settings ■ Inspect and check the pre-assembly devices regularly Select tubes as specified in DIN EN 10305-4 Do not use rotary grinder or tube cutter Only de-burr tube edges internally and externally, do not sharpen them. Check de-burring tool regularly. Cut tubes at right angles. Ensure that the area where the tube was cut is free of contamination, metal chips and paint.
No visibly raised tube material in front of the first cutting edge / cutting ring is jammed on the tube.	The tube must be pushed firmly against the stop in the stud. ■ Ensure that the assembly is not subject to stress during installation Use pre-assembly devices and VOSS tools
Tube has been pressed away from under the cutting ring / the tube bulges	For thin-walled tubes, use suitable reinforcing supports. Avoid frequent re-tightening of the coupling after assembly.
Too much tube material has been raised	Observe the specified tightening paths when manually assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Use pre-assembly devices and VOSS tools Observe the specified pre-assembly device parameter settings ■ Inspect and check the pre-assembly devices regularly Select tubes as specified in DIN EN 10305-4 Avoid using extenders for small tubes and couplings.
Damaged threads / after being slackened, the nut cannot be unscrewed any further by hand.	Observe the specified tightening paths when manually assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Avoid using extenders for small tubes and couplings.

Characteristic	Preventive measures
The nut bulges / damage to the hex spanner surface	Observe the specified tightening paths when manually assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Avoid using extenders for small tubes and couplings.
Cutting ring is obviously too near to the tube end / stud connector has expanded	Inspect and check the pre-assembly devices regularly. ■ Use taper gauges. Do not re-use screw coupling parts more than once. Use pre-assembly dies, “high-strength material” version. Use VOSS test gauges to check cutting-ring positions.
Damage found on cutting ring after pre-assembly	Inspect and check the pre-assembly devices regularly. ■ Inspect internal cone surfaces for damage and/or contamination. Using suitable lubricants increases tool service life.
Cutting ring leaks repeatedly	Select the most suitable system for the respective application (depending on temperatures, pressure and type of load and stress) Use a soft sealing system (ES-4 / VOSS*Form*^{SQR} / BV-10). Avoid duplicate dimension notations; take expansion loops into consideration to allow stress-free installation. Use tube saddles or clamps. Provide specified minimum length of straight tube leading to elbow.
Cutting ring has penetrated unevenly	Provide specified minimum length of straight tube leading to elbow. Select tubes as specified in DIN EN 10305-4.
Slight oil film around the coupling	Only apply a small amount of lubricant to the components during assembly. Degrease the components after assembly.
Components bind at surfaces in contact with one another.	Use suitable stainless-steel assembly paste. Apply sufficient amount of lubricant to the contact surfaces. Only use hardened pre-assembly dies for manual pre-assembly work. Use pre-assembly devices and VOSS tools.

VOSS 2S/2SVA cutting ring couplings

Problem: “tube rupture”

Characteristic	Preventive measures
Tube breaks off directly behind union nut	Use tube saddles or clamps.
	Ensure that components are not subject to stresses in installed condition, avoid shear loads.
	Select the most suitable system for the respective application (depending on temperature, pressure and type of load)

Problem “tube pulled out of coupling”

Characteristic	Preventive measures
Cutting ring peels material off end of tube due to too shallow incision.	Before each final assembly, check the amount of tube material raised by the first cutting edge.
	Re-assemble and tighten up cutting-ring couplings which were inadequately tightened.
No visibly raised tube material in front of the first cutting edge / cutting ring is jammed on the tube.	Before each final assembly, check the amount of tube material raised by the first cutting edge.
Cutting ring has been placed on tube the wrong way around	Check that the cutting ring faces the correct direction.

VOSS 2S *plus* cutting ring couplings

Problem: “leaks”

Characteristic	Preventive measures
Inadequate penetration of cutting ring / not enough tube material raised in front of first cutting edge.	Observe the specified tightening paths (number of turns) when manually pre-assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the assembly forces required. Use pre-assembly devices and VOSS tools. Observe the specified pre-assembly device parameter settings ■ Inspect and check the pre-assembly devices regularly Select tubes as specified in DIN EN 10305-4. Do not use rotary grinder or tube cutter Only de-burr tube edges internally and externally, do not sharpen them. Check de-burring tool regularly. Cut tubes at right angles. Ensure that the area where the tube was cut is free of contamination, metal chips and paint.
No visibly raised tube material in front of the first cutting edge / cutting ring is jammed on the tube.	The tube must be pushed firmly against the stop in the stud. ■ Ensure that the assembly is not subject to stress during installation Use pre-assembly devices and VOSS tools.
Tube has been pressed away from under the cutting ring / the tube bulges	For thin-walled tubes, use suitable reinforcing supports.
Constriction behind the cutting ring / damaged thread / after being slackened, the nut cannot be unscrewed any further by hand / the nut bulges / damage to the hex spanner surfaces	Observe the specified tightening paths when manually assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Use pre-assembly devices and VOSS tools. Observe the specified pre-assembly device parameter settings ■ Inspect and check the pre-assembly devices regularly Select tubes as specified in DIN EN 10305-4. Avoid frequent re-tightening of the coupling after assembly. Avoid using extenders for small tubes and couplings.
Cutting ring is obviously too near the tube end / stud connector has expanded	Inspect and check the pre-assembly devices regularly. ■ Use taper gauges. Do not re-use screw coupling parts more than once. Use pre-assembly dies, “high-strength material” version. Use VOSS test gauges to check cutting-ring positions.

VOSS 2S *plus* cutting ring couplings

Problem: “leaks”

Characteristic	Preventive measures
Damage found on cutting ring after pre-assembly	Inspect and check the pre-assembly devices regularly. ■ Inspect internal cone surfaces for damage and/or contamination. Using suitable lubricants increases tool service life.
Cutting ring leaks repeatedly	Select the suitable system for the respective application (depending on temperature, pressure and type of load). Use a soft sealing system (ES-4 / VOSS*Form*^{SQR} / BV-10) Avoid duplicate dimension notations; take expansion loops into consideration to permit stress-free installation. Use tube saddles or clamps. Provide specified minimum length of straight tube leading to elbow.
Cutting ring has penetrated unevenly	Provide specified minimum length of straight tube leading to elbow. Select tubes as specified in DIN EN 10305-4.
Slight oil film around the coupling	Only apply a small amount of lubricant to the components during assembly. Degrease the components after assembly.
Components bind at surfaces in contact with one another.	Use suitable stainless-steel assembly paste. Apply sufficient lubricant to the contact surfaces. Only use hardened pre-assembly dies for manual pre-assembly work. Use pre-assembly devices and VOSS tools.

Problem: “tube rupture”

Characteristic	Preventive measures
Tube breaks off directly behind union nut	Use tube saddles or clamps.
	Ensure that components are not subject to stresses in installed condition, avoid shear loads.
	Select the most suitable system for the respective application (depending on temperature, pressure and type of load)
Tube breaks off directly behind the cutting ring	Stop tightening as soon as the cutting ring has reached the block.
	Avoid using extenders for small tubes and couplings.

Problem “tube pulled out of coupling”

Characteristic	Preventive measures
Cutting ring peels material off end of tube due to too shallow incision.	Before every final assembly, check the amount of tube material raised by the first cutting edge.
	Re-assemble and tighten up cutting-ring couplings which were inadequately tightened.
No visibly raised tube material in front of the first cutting edge / cutting ring is jammed on the tube.	Before every final assembly, check the amount of tube material raised by the first cutting edge.
Cutting ring has been placed on tube the wrong way around	Check that the cutting ring faces the correct direction.

VOSS ES-4/ES-4VA cutting ring couplings

Problem: “leaks”

Characteristic	Preventive measures
Inadequate penetration of cutting ring / not enough tube material raised in front of first cutting edge.	Observe the specified tightening paths (number of turns) when manually pre-assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Use pre-assembly devices and VOSS tools. Observe the specified pre-assembly device parameter settings ■ Inspect and check the pre-assembly devices regularly Select tubes as specified in DIN EN 10305-4. Do not use rotary grinder or tube cutter Only de-burr tube edges internally and externally, do not sharpen them. Check de-burring tool regularly. Cut tubes at right angles. Ensure that the area where the tube was cut is free of contamination, metal chips and paint.
No visibly raised tube material in front of the first cutting edge / cutting ring is jammed on the tube.	The tube must be pushed firmly against the stop in the stud. ■ Ensure that the assembly is not subject to stress during installation Use pre-assembly devices and VOSS tools.
Tube has been pressed away from under the cutting ring / the tube bulges	For thin-walled tubes, use suitable reinforcing supports. Avoid frequent re-tightening of the coupling after assembly.
Cutting ring is obviously too near to the tube end / stud connector has expanded	Inspect and check the pre-assembly devices regularly. ■ Use taper gauges. Do not re-use screw coupling parts repeatedly. Use pre-assembly dies, “high-strength material” version. Use VOSS test gauges to check cutting-ring positions.
Damage found on cutting ring after pre-assembly	Inspect and check the pre-assembly devices regularly. ■ Inspect internal cone surfaces for damage and/or contamination. Using suitable lubricants increases tool service life.
Sweating of liquid at tube end	In order to prevent the soft seal from being damaged, it is essential to apply a lubricant to the tube before installing the cutting ring during the pre-assembly process. Deburr the inner and outer edges of the tube end lightly. Check de-burring tool regularly.

Characteristic	Preventive measures
Sweating of liquid at stud connector end	To prevent damage to the soft seals, lubricant must be applied to all soft seals of the cutting- ring before assembling the coupling.
	Check soft seals for damage before assembling the coupling, replace seals if necessary.
Missing soft seals	Check that all components are in place before assembling the coupling.
	Replace soft seal.
Cutting ring leaks repeatedly	Select the most suitable system for the application (depending on temperatures, pressure and type of load and stress)
	Avoid duplicate dimension notations; take expansion loops into account to permit stress-free installation.
	Use tube saddles or clamps.
	Observe minimum lengths specified for straight tubes following elbows.
Cutting ring has penetrated unevenly	Provide specified minimum length of straight tube leading to elbow.
	Select tubes as specified in DIN EN 10305-4.
Very little or no material raised by the first cutting edge	Stainless-steel cutting rings must be used for stainless-steel tubes.
Components bind at surfaces in contact with one another.	Use suitable stainless-steel assembly paste.
	Apply sufficient amount of lubricant to the contact surfaces.
	Only use hardened pre-assembly dies for manual pre-assembly work.
	Use pre-assembly devices and VOSS tools.

VOSS ES-4/ES-4VA cutting ring couplings

Problem: “tube rupture”

Characteristic	Preventive measures
Tube breaks off directly behind union nut	Use tube saddles or clamps.
	Ensure that components are not subject to stresses in installed condition, avoid shear loads.
	Select the most suitable system for the application (depending on temperature, pressure and type of load)
Tube breaks off directly behind the cutting ring	Stop tightening as soon as the cutting ring has reached the block.
	Avoid using extenders for small tubes and couplings.

Problem “tube pulled out of coupling”

Characteristic	Preventive measures
Cutting ring peels material off end of tube due to too shallow incision.	Before every final assembly, check the amount of tube material raised by the first cutting edge.
	Re-assemble and tighten up cutting-ring couplings which were inadequately tightened.
No visibly raised tube material in front of the first cutting edge / cutting ring is jammed on the tube.	Before every final assembly, check the amount of tube material raised by the first cutting edge.
Cutting ring has been placed on tube the wrong way around	Check that the cutting ring faces in the correct direction.

VOSS*Form*^{SQR}/VOSS*Form*^{SQR}VA tube couplings

Problem: “leaks”

Characteristic	Preventive measures
Nut comes loose during operation	Observe the specified tightening paths (number of turns) when finally assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces and to reduce soft-seal wear. Observe specified tightening torque where this is the assembly criterion.
No clamping ring in the nut	Check that all components are in place before assembling the coupling. Install the soft seal.
Fehlender Klemmring in der Mutter	Check that all components are in place before assembling the coupling. Store DIN union nuts and SQR function nuts separately in order to prevent mistakes. Only use SQR function nuts.
VOSS*Form*^{SQR} contour is not created correctly	Check and inspect tools and machines regularly. Check the contour after every forming operation. Apply a thin film of lubricant only to the inner and outer tube surfaces, not to the end face, as oil on the end face can falsify the forming process results. Tube must be pushed against the stop plate during the forming process. Clean tools regularly.
Slight oil film around the coupling	Only apply a small amount of lubricant to the components during assembly. Degrease the components after assembly.
Material surface binds during tube forming / tool breakage	Only stainless-steel tools (marked VA for stainless-steel use) may be used for forming stainless-steel tubes. Use special fine-cutting oil (Feinschneideöl FOE).
Components bind at surfaces in contact with one another.	Use suitable stainless-steel assembly paste. Apply sufficient lubricant to the contact surfaces.
Couplings leak repeatedly	Select the most suitable system for the application (depending on temperature, pressure and type of load and stress)

Problem: “tube rupture”

Characteristic	Preventive measures
Tube breaks off directly behind union nut	Tube breaks off directly behind union nut Ensure that components are not subject to stresses in installed condition, avoid shear loads.

VOSS BV-10 flared couplings

Problem: “leaks”

Characteristic	Preventive measures
Flared cone has not been driven into the tube far enough / saw-toothed surface is not completely covered.	Check that the gap between the face end of the tube and the collar of the cone is correct (≥ 0.5 to max. 1 mm).
Nut comes loose during operation	Observe the specified tightening paths when manually assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the assembly forces required and to reduce soft-seal wear.
Tube has bulged in the front section	Check that the gap between the face end of the tube and the collar of the cone is correct (≥ 0.5 to max. 1 mm). The end face of the tube must not come into contact with the collar of the flared cone during the pre-assembly process.
Damaged thread / after being slackened, the nut cannot be unscrewed any further by hand / the nut bulges / damage to the hex spanner surfaces	Observe all specified tightening distances ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Select tubes as specified in DIN EN 10305-4. Avoid frequent re-tightening of the coupling after assembly. Avoid using extenders for small tubes and couplings.
Missing O-ring	Check that all components are in place before assembling the coupling. Install the soft seal.
Clamping ring missing	Check that all components are in place before assembling the coupling. Always install clamping ring before flaring the tube.
Slight oil film around the coupling	Only apply a small amount of lubricant to the components during assembly. Degrease the components after assembly.
Contact corrosion during operation	When using stainless-steel tubing, only use Dur-Ni-coated flared cones. Apply sufficient lubricant to the contact surfaces.
Components bind at surfaces in contact with one another.	Use suitable stainless-steel assembly paste. Apply sufficient lubricant to the contact surfaces.
Couplings leak repeatedly	Select the most suitable system for the application (depending on temperature, pressure and type of load and stress)

Problem: “tube rupture”

Characteristic	Preventive measures
Tube breaks off directly behind union nut	Use tube saddles or clamps.
	Ensure that components are not subject to stresses in installed condition, avoid shear loads.

VOSS ZAKO/ZAKO LP

Problem: “leaks”

Characteristic	Preventive measures
Flared cone has not been driven into the tube far enough / saw-toothed surface is not completely covered	Observe specified gap width between face end of tube and collar of ZAKO ring, see assembly instructions for dimensions.
ZAKO ring lifts off the connecting surface	Tighten all screws/bolts with the specified torques.
Tube has bulged in the front section	Observe specified gap width between face end of tube and collar of ZAKO ring, see assembly instructions for dimensions. The end face of the tube must not come into contact with the collar of the ZAKO ring during the pre-assembly process.
Screws/bolts are difficult to screw into the threaded flange	Lubricate the screw/bolt threads
Missing O-ring	Check that all components are in place before assembling the coupling. Install the soft seal.
Sealing surfaces are dirty	Keep sealing surfaces and soft seals clean.
Flange mounted crookedly on the tube	Ensure that the flange is at right angles to the connecting surface. ■ Tighten up diagonally opposing screw/bolt pairs crosswise.
Slight oil film around the coupling	Degrease the components after assembly.
Couplings leak repeatedly	Select the most suitable system for the application (depending on temperature, pressure and type of load and stress)

Problem: “tube rupture”

Characteristic	Preventive measures
Tube breaks off directly behind the flange	Tube breaks off directly behind union nut Ensure that components are not subject to stresses in installed condition, avoid shear loads.

VOSS taper seal couplings (DKO)

Problem: “leaks”

Characteristic	Preventive measures
Nut comes loose during operation	Observe the specified tightening paths (number of turns) when finally assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Observe specified tightening torque where this is the assembly criterion.
Damaged thread / after being slackened, the nut cannot be unscrewed any further by hand / the nut bulges / damage to the hex spanner surfaces / wire pin has come out of the groove	Observe the specified tightening paths (number of turns) when finally assembling the coupling. ■ Mark strokes on parts to allow visual control of the rotation angle. ■ Use lubricants to reduce the required assembly forces. Avoid using extenders for small tubes and couplings.
Missing O-ring	Check that all components are in place before assembling the coupling. Install the soft seal.
Slight oil film around the coupling	Only apply a small amount of lubricant to the components during assembly. Degrease the components after assembly.
Damaged O-ring	Align DKO coupling properly before tightening it by hand. Hold the connecting piece body with a spanner to counter tightening torque when finally tightening up the connection. Use lubricants to reduce the assembly forces required and to reduce soft-seal wear. Ensure that components are not subject to stresses in installed condition, avoid shear loads.
Couplings leak repeatedly	Select the most suitable system for the application depending on temperature, pressure and type of load and stress)

Problem: “tube rupture”

Characteristic	Preventive measures
DKO coupling cracks open radially along the groove for the wire pin	Install the connected tubes and hoses in such a way that no additional shear loads will act on the coupling. Ensure that the components are not subjected to stresses in the installed state.

VOSS 24° couplings

Problem: “leaks”

Characteristic	Preventive measures
Screwed connection pulls out of the threads	Observe all specified tightening torques ■ Use lubricants
Damaged thread / damage to the hex spanner surfaces	Observe all specified tightening torques ■ Use lubricants Avoid frequent re-tightening of the coupling after assembly. Avoid using extenders for small tubes and couplings.
Thread tears away	Observe all specified tightening torques Use a spanner to hold the coupling body when assembling the coupling.
Missing seal (PEFLEX or O-ring)	Check that all components are in place before assembling the coupling. Install the soft seal.
Threaded section cannot be screwed into the female part	Check whether the threads are imperial or metric (danger of confusion). ■ Use the VOSS thread gauge board to determine the thread type and size.
Leaks in the threads	Keep sealing surfaces and soft seals clean. Use the correct type of seal for every threaded hole. Avoid screwing conical male stud connectors into cylindrical threaded holes. ■ Use components with adjustable screw connections as an alternative.
Leakage at recesses	When re-assembling used components, especially male stud connectors with a sealing edge (form B), renew the recess every time. Use the correct type of seal for every threaded hole.
Damaged thread / hairline cracks in the male stud connector	Correct handling and transportation. Inspect and check coupling components before assembly. Check that the DKO cone has a stop to prevent over-tightening of the connection.
Slight oil film around the coupling	Only apply a small amount of lubricant to the components during assembly. Degrease the components after assembly.

Characteristic	Preventive measures
Components bind at surfaces in contact with one another.	Use suitable stainless-steel assembly paste.
	Apply sufficient lubricant to the contact surfaces.
Male stud connectors cannot be unscrewed manually after being initially slackened	Observe the tightening torques specified for the respective mating materials.
	Use suitable lubricants.
Metal chips in the threaded hole	Clean the threads.