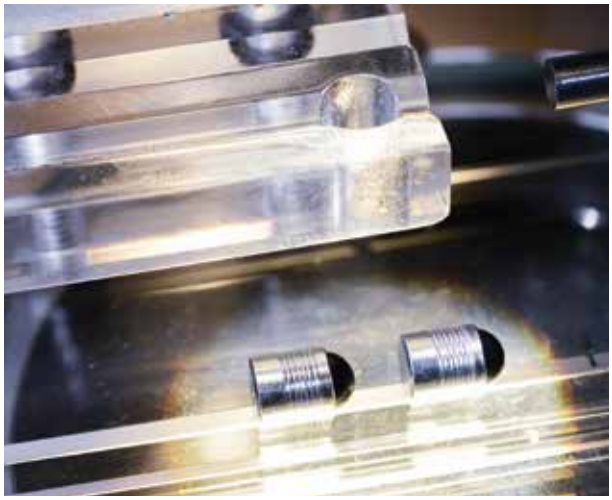
CHAPTER CONTENTS

TECHNICAL INFORMATION

KOENIG EXPANDER® **KOENIG** CHECK VALVE® **KOENIG** RESTRICTOR®

Our technical information section contains reference details related to performance, installation and materials. SFC KOENIG engineers are available to assist you at any time, and can advise on questions and concerns about your individual application. We also offer custom engineered solutions to meet your individual needs.

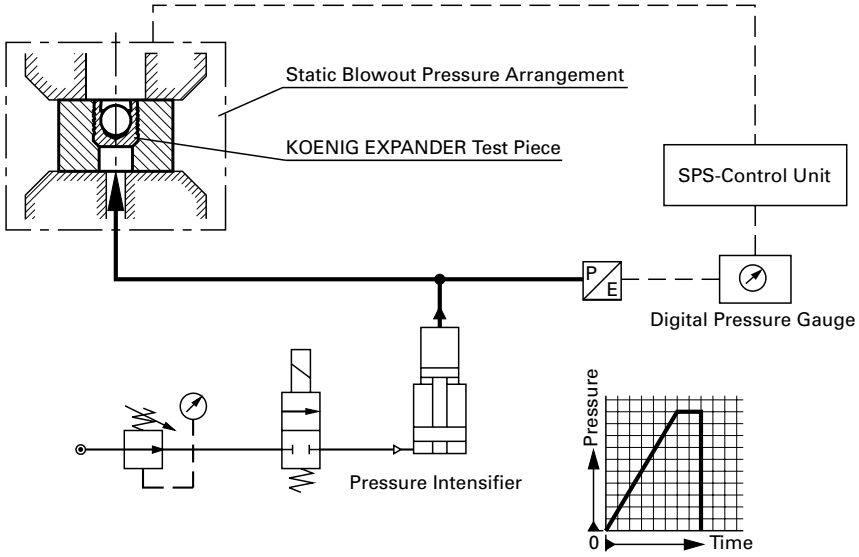


KOENIG EXPANDER® TEST PRESSURE

TEST PRESSURE Ⓐ

The KOENIG EXPANDER® is statically loaded up to burst pressure. This test is performed at SFC KOENIG for functional testing during the production process.

Samples from each production batch are subjected to this functional test.

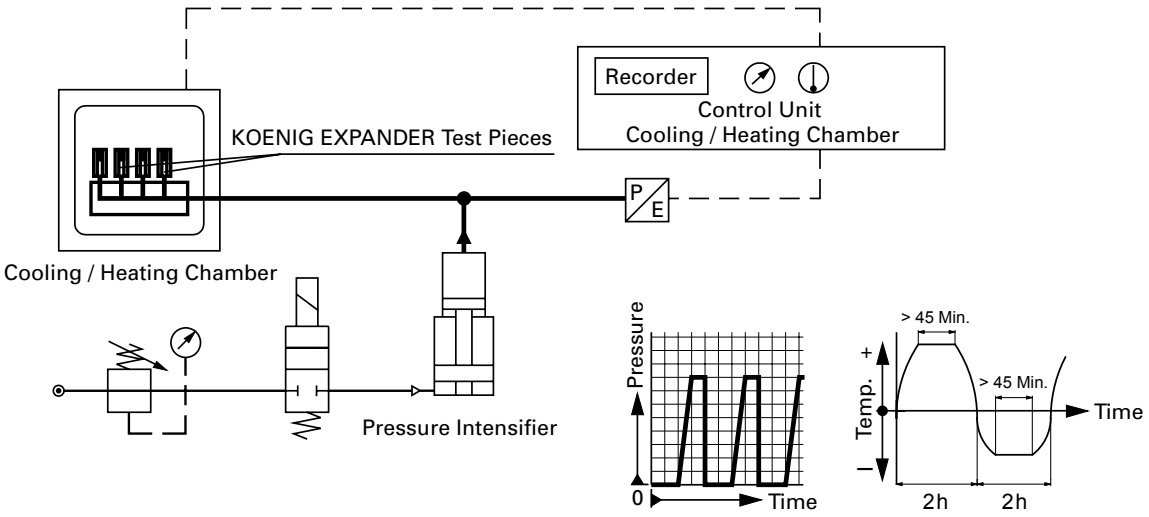


TEST PRESSURE, TEST Ⓑ

The KOENIG EXPANDER® is subjected to a pressure cycling test under varying environmental conditions. The test determines the levels of pressure that can be absorbed by the part by applying intermittent pressure loads and temperature fluctuations to confirm the sealing plug is not squeezed out.

CONDITIONS

- Temperature: > 45 min. at +100°C (Series LK partially at +150°C) / > 45 min. at -40°C
- Pressure: Intermittent, 24 sec. 0 bar / 36 sec. proof pressure (10,000 cycles)
- Duration: 168 hrs (long-term test)
- Bore: Tolerance, roundness and roughness in accordance with standard sheets, plain surface, edge and wall distance according to standard sheet



BASE MATERIALS / INSTALLATION REQUIREMENTS

Operating pressures listed can be achieved for the following base materials:

	Base Material of the Installation	Tensile Strength Rm [N/mm²]	Elongation A5 [%]	Yield Strength Rp0.2 [N/mm²]	Hardness HB
❶	High Strength Steel ETG-100 / 44SMn28 AISI 1144	960 - 1000	6	min. 865	320 avg.
❷	Case Hardened Steel C15Pb / 1.0403 AISI 10L15	430 - 730	10	min. 280	200 avg.
❸	Ductile Cast Iron EN 1563: GJS-600-3 ASTM A536: 80-60-03	min. 600	3	min. 370	200 - 290
❹	Ductile Cast Iron (Dura-Bar®) EN 1563: GJS-450-10 ASTM A536: 65-45-12	450 avg.	12	310 avg.	131 - 217
❺	Gray Cast Iron EN 1561: GJL-250 ASTM A48: N0.35	350 avg.	0.3	165 - 228	160 - 250
❻	Aluminum-Alloy AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	min. 450	8	min. 310	120 avg.
❼	Aluminum-Alloy AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	min. 310	8	min. 260	105 avg.
❽	Cast Aluminum-Alloy G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356	min. 230	2	min. 190	min. 75

**SFC KOENIG's North American Engineering Department utilizes 2024-T4/T6 as a test base material.*

- Equally high working pressures can also be achieved with base materials with similar mechanical properties. However, compliance must be met for the appropriate installation conditions.
- Applications in high-strength aluminum alloys, magnesium alloys, nonferrous metals and plastics require special consideration and can be developed upon request.
- Applications in base materials with high hardness and hardened materials, require special consideration and can be developed upon request.
- **Applications in surface coated materials (zinc plated, anodized ...) require special consideration and can be developed upon request.**
- For factors affecting pressure performance please see:
  – Anchoring Principle
  – Surface Finish: Requirements
  – Design Guidelines

SAFETY MARGIN

The safety margin includes uncontrollable factors. Dynamic loads at nominal pressure, with 10^6 load cycles and a frequency of 3 – 4 Hz have shown that the subsequently measured bursting pressures, are reduced according to TestⒶ by 20 % as well as TestⒷ.

PRESSURE PERFORMANCE

Series MB / CV

Series MB 600 mm	Base Material of the Installation						
	① ETG-100 / 44SMn28 AISI 1144	② C15Pb / 1.0403 ~ SAE 1015 (10L15)	③ EN 1563: GJS-600-3 ASTM A536: 80-60-03	⑤ EN 1561: GJL-250 ASTM A48: NO.35	⑥ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	⑦ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	⑧ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 3 – 10	1400 bar / 20300 psi 450 bar / 6500 psi					1200 bar / 17400 psi	380 bar / 5500 psi
Ø 12 – 14	1000 bar / 14500 psi 350 bar / 5100 psi					900 bar / 13000 psi	280 bar / 4100 psi
Hole Tolerance	0 / +0.1 mm						
Hole Roughness	R_z 10 – 30 µm				Anchorage in Base Metal		

Series MB 600 Inch	Base Material of the Installation						
	① ETG-100 / 44SMn28 AISI 1144	② C15Pb / 1.0403 ~ SAE 1015 (10L15)	③ EN 1563: GJS-600-3 ASTM A536: 80-60-03	⑤ EN 1561: GJL-250 ASTM A48: NO.35	⑥ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	⑦ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	⑧ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 0.093 – 0.281	1400 bar / 20300 psi 450 bar / 6500 psi					1200 bar / 17400 psi	380 bar / 5500 psi
Hole Tolerance	Ø 0.093 0 / +0.002 Inch from Ø 0.125 0 / +0.004 Inch						
Hole Roughness	R_z 10 – 30 µm				Anchorage in Base Metal		

Series MB 700 mm	Base Material of the Installation						
	① ETG-100 / 44SMn28 AISI 1144	② C15Pb / 1.0403 ~ SAE 1015 (10L15)	③ EN 1563: GJS-600-3 ASTM A536: 80-60-03	⑤ EN 1561: GJL-250 ASTM A48: NO.35	⑥ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	⑦ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	⑧ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 3 – 10	1400 bar / 20300 psi 450 bar / 6500 psi					1200 bar / 17400 psi	380 bar / 5500 psi
Ø 12 – 22	1150 bar / 16700 psi 350 bar / 5100 psi					900 bar / 13000 psi	280 bar / 4100 psi
Hole Tolerance	0 / +0.1 mm						
Hole Roughness	R_z 10 – 30 µm				Anchorage in Base Metal		

Series MB 850 mm	Base Material of the Installation						
	① ETG-100 / 44SMn28 AISI 1144	② C15Pb / 1.0403 ~ SAE 1015 (10L15)	③ EN 1563: GJS-600-3 ASTM A536: 80-60-03	⑤ EN 1561: GJL-250 ASTM A48: NO.35	⑥ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	⑦ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	⑧ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 3 – 10	1100 bar / 16000 psi 350 bar / 5100 psi					1000 bar / 14500 psi	320 bar / 4600 psi
Ø 12 – 22	900 bar / 13000 psi 280 bar / 4100 psi					800 bar / 11600 psi	250 bar / 3600 psi
Hole Tolerance	0 / +0.1 mm						
Hole Roughness	R_z 10 – 30 µm				R_z 10 – 30 µm	Anchorage in Base Metal	

Series CV 173 mm	Base Material of the Installation				
	① ETG-100 / 44SMn28 AISI 1144	③ EN 1563: GJS-600-3 ASTM A536: 80-60-03	④ EN 1563: GJS-450-10 ASTM A536: 65-45-12	⑥ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	⑧ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 3 – 10				650 bar / 9400 psi 210 bar / 3000 psi	
Ø 12				300 bar / 4300 psi 100 bar / 1500 psi	
Hole Tolerance	0 / +0.1 mm				
Hole Roughness	R_z 10 – 30 µm			Anchorage in Base Material	

Series CV 588 mm	Base Material of the Installation				
	① ETG-100 / 44SMn28 AISI 1144	③ EN 1563: GJS-600-3 ASTM A536: 80-60-03	④ EN 1563: GJS-450-10 ASTM A536: 65-45-12	⑥ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	⑧ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 4 – 9	1000 bar / 14500 psi 350 bar / 5000 psi				
Ø 10	860 bar / 12500 psi 280 bar / 4000 psi				
Hole Tolerance	0 / +0.1 mm				
Hole Roughness	R_z 10 – 30 µm			Anchorage in Base Material	

Proof Pressure Test Ⓑ Max. Allowable Working Pressure = Nominal Pressure *SFC KOENIG's North American Engineering Department utilizes 2024-T4/T6 as a test base material.

See Anchorage Principle related to the base materials on page 70.

PRESSURE PERFORMANCE

Series SK / SKC / LK / RE

Series SK / SKC mm	Base Material of the Installation						
	❶ ETG-100 / 44SMn28 AISI 1144	❷ C15Pb / 1.0403 ~ SAE 1015 (10L15)	❸ EN 1563: GJS-600-3 ASTM A536: 80-60-03	❺ EN 1561: GJL-250 ASTM A48: NO.35	❻ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	❼ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	❽ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 4 – 10	1600 bar / 23200 psi 500 bar / 7200 psi					1400 bar / 20300 psi	450 bar / 6500 psi
Ø 12	1600 bar / 23200 psi 400 bar / 5800 psi						
Hole Tolerance	0 /+0.12 mm						
Hole Roughness	R_z 10 – 30 µm				Anchorage in Base Metal		

If SK plugs are used to keep channels separated, allowable working pressure on the insertion side is reduced by 50%.

Series LK 600 mm	Base Material of the Installation						
	❶ ETG-100 / 44SMn28 AISI 1144	❷ C15Pb / 1.0403 ~ SAE 1015 (10L15)	❸ EN 1563: GJS-600-3 ASTM A536: 80-60-03	❺ EN 1561: GJL-250 ASTM A48: NO.35	❻ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	❼ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	❽ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 4 – 10	180 bar / 2600 psi 60 bar / 850 psi						
Hole Tolerance	0 / +0.12 mm						
Hole Roughness	R_z 10 – 30 µm					Anchorage in Base Metal	

❶❷❸❺ Temperature range for proof pressure test Ⓑ: – 40 °C to + 150 °C ❻❼❽ Temperature range for proof pressure test Ⓑ: – 40 °C to + 100 °C

Series LK 950 mm	Base Material of the Installation						
	❶ ETG-100 / 44SMn28 AISI 1144	❷ C15Pb / 1.0403 ~ SAE 1015 (10L15)	❸ EN 1563: GJS-600-3 ASTM A536: 80-60-03	❺ EN 1561: GJL-250 ASTM A48: NO.35	❻ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	❼ AlMgSiPb / EN AW-6012-T6 AA: 6012-T6	❽ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 4 – 20	180 bar / 2600 psi 60 bar / 850 psi						
Hole Tolerance	+0.05 / +0.15	0 / +0.12 mm					
Hole Roughness	R_z 10 – 30 µm					R_z 10 – 30 µm	Anchorage in Base Metal

❶❷❸❺ Temperature range for proof pressure test Ⓑ: – 40 °C to + 150 °C ❻❼❽ Temperature range for proof pressure test Ⓑ: – 40 °C to + 100 °C

KOENIG EXPANDER® sealing plugs series LK are not suitable for pressure load applied on the insertion side of the plug. For special release contact SFC KOENIG.

Series RE mm	Base Material of the Installation			
	❶ ETG-100 / 44SMn28 AISI 1144	❹ EN 1563: GJS-450-10 ASTM A536: 65-45-12	❻ AlCu4Mg1 / EN AW-2024-T3 AA: 2024 T4/T6*	❽ G-AlSi7Mg / EN-AC-42100 ASTM/UNS: A356
Ø 4	120 bar / 1740 psi			100 bar / 1450 psi
Ø 5	180 bar / 2610 psi			150 bar / 2175 psi
Ø 6	210 bar / 3045 psi			150 bar / 2175 psi
Ø 7–8	210 bar / 3045 psi			180 bar / 2610 psi
Ø 9–10	Please Contact Us for Details			

Proof Pressure Test Ⓑ Max. Allowable Working Pressure = Nominal Pressure *SFC KOENIG's North American Engineering Department utilizes 2024-T4/T6 as a test base material.

Base Material Harder than Expander: To achieve the allowable working pressure, anchorage to the bore roughness of the base material is required. **Roughness R_z = 10 – 30 µm.**

Base Material Softer than Expander: Anchorage to the bore of the base material occurs automatically due to the serrations on the sleeve of the KOENIG EXPANDER®.

Transition Zone: To achieve the allowable working pressure, anchorage to the bore roughness of the base material is required. **Roughness R_z = 10 to 30 µm.**

See Anchorage Principle related to the base materials on page 70.

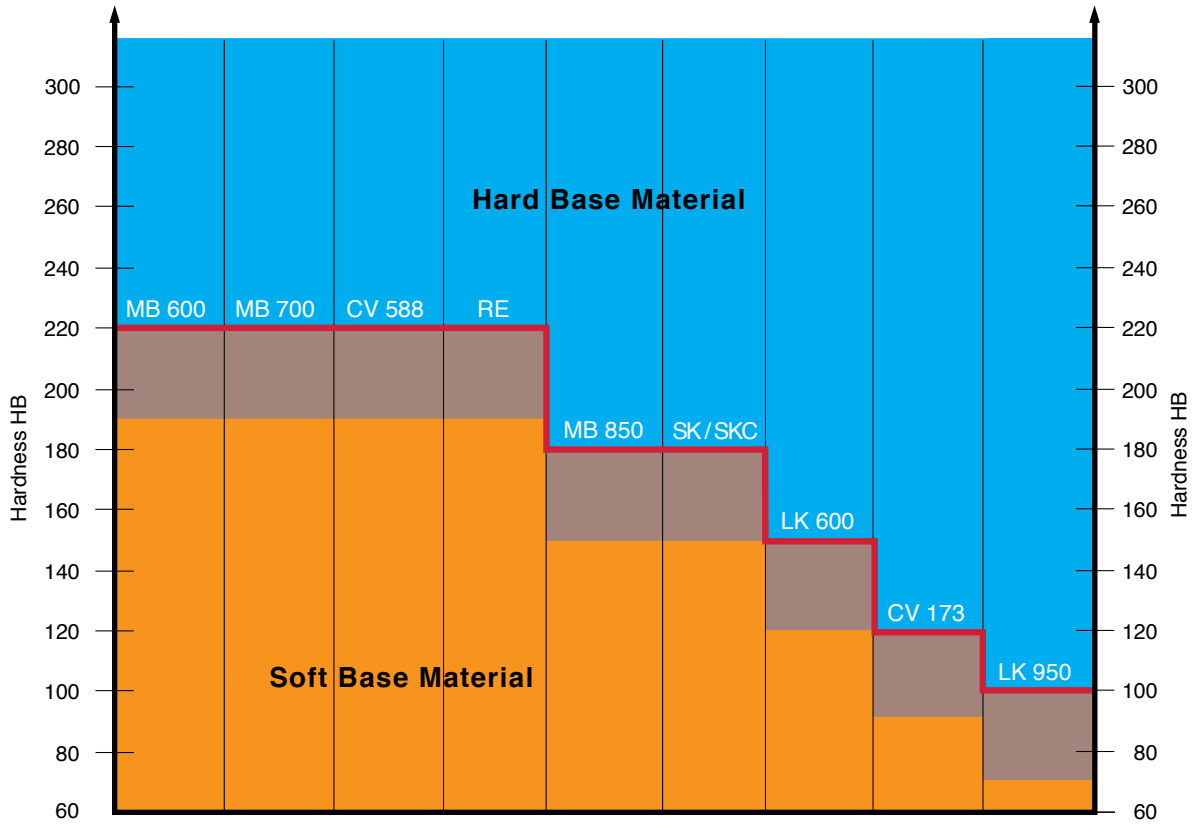
ANCHORAGE PRINCIPLE

The required bore roughness is directly related to the hardness and the mechanical characteristics of the base material. Depending on the combination of sealing plug and base material, anchorage takes place either by the groove profile of the expander sleeve biting into the base material or on anchorage to the surface roughness of the bore.

Note:
When selecting a KOENIG EXPANDER® the bore roughness must always be adjusted according to the hardness of the base material.

Anchorage between sleeve and base material is achieved when the sleeve is a minimum of HB = 30 greater than the base material. If the hardness difference is less, hole roughness of 10 to 30 µm is needed to achieve indicated working pressures.

Anchorage Principle Related to the Base Material



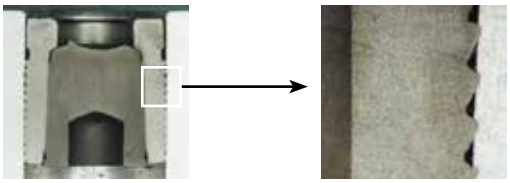
KOENIG EXPANDER®

Base Material Harder than Expander: To achieve the allowable working pressure, anchorage to the bore roughness of the base material is required.
Roughness R_z = 10 – 30 µm.

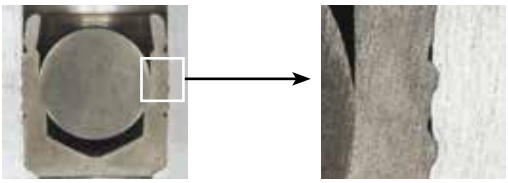
Base Material Softer than Expander: Anchorage to the bore of the base material occurs automatically due to the serrations on the sleeve of the KOENIG EXPANDER®.

Transition Zone: To achieve the allowable working pressure, anchorage to the bore roughness of the base material is required.
Roughness R_z = 10 to 30 µm.

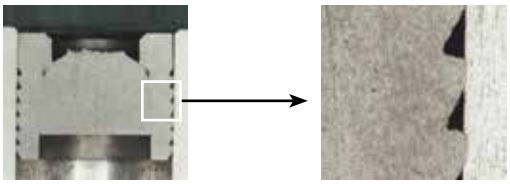
ANCHORAGE PRINCIPLE



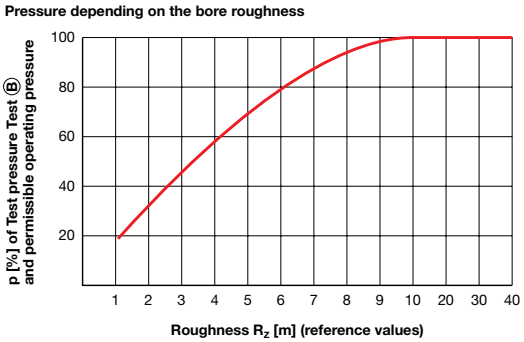
Anchorage due to plug sleeve serrations
KOENIG EXPANDER® **Series SK / SKC**
In aluminum-alloy HB = 90



Anchorage due to plug sleeve serrations
KOENIG EXPANDER® **Series MB 850**
In aluminum-alloy HB = 90

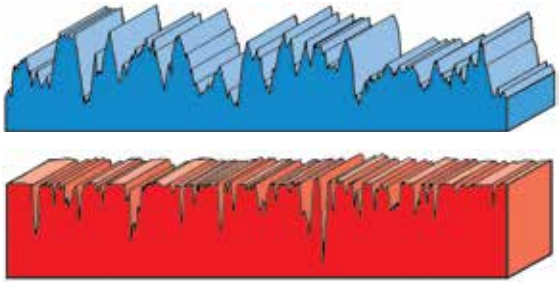


Sufficient anchorage due to plug sleeve serrations
KOENIG EXPANDER® **Series LK 950**
In aluminum-alloy HB = 90



BORE ROUGHNESS REQUIREMENTS

When installing KOENIG EXPANDER® plugs in hard base material positive anchoring is not possible. To attain suitable working pressures and anchorage, it is necessary to have a bore roughness of R_z = 10–30 µm. At a roughness greater than R_z = 30 µm leakage might occur.



ROUGHNESS PROFILE

Required Roughness Profile

The ideal bore roughness for anchorage is attained by drilling with a twist drill or a core drill.

Undesirable Roughness Profile

By reaming, a one-sided, smooth roughness profile is created. This is not desirable.

INSTALLATION INSTRUCTIONS FOR SERIES MB / CV

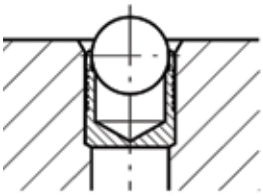


Fig. 1

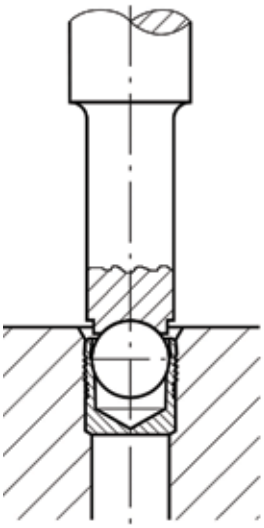


Fig. 2

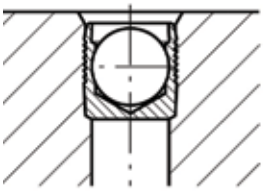


Fig. 3

DRILLED HOLE

- The drilled hole must be within the tolerances shown on the preceding dimensional sheets.
- The counterbored hole (d_2) must be properly sized for the through hole (d_3) according to the dimensional sheets.
- Holes must be round within 0.05 mm.
- With hard materials the bore roughness should be from R_z = 10–30 µm for best results.
- Longitudinal rifles and spiral grooves should be avoided. These influence the sealing effectiveness.
- The bore must be free of oil, grease and chips.

SETTING PROCEDURE

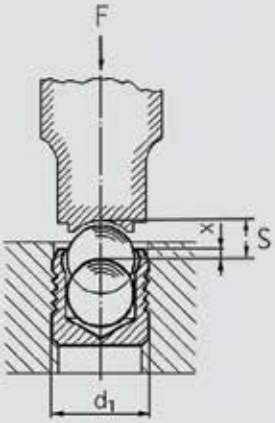
- With the ball facing out the KOENIG EXPANDER® is inserted in the counterbored hole. The top sleeve should not be above the surface of the base material (Fig. 1).
- With only a slight or no counterbore, the base of the sleeve must be adequately supported during installation.
- The ball can now be pressed in until the top of the ball is below the edge of the sleeve (Fig. 2 and 3). Corresponding approximate values for stroke S as well as the dimensions X are from the table below.

Note:

- Use the proper size setting tool for the KOENIG EXPANDER® according to the data sheet.
- Spray cleaning with air drying is the only way to clean/degrease plugs before installation. Do not dip and vacuum dry the plugs.

PRESS

Small quantities or single parts can be installed with a hammer and a setting tool. Installation can also be done with an arbor press. It is preferred to limit stroke travel when using a press because insertion force is difficult to control. KOENIG EXPANDER® plugs are also ideal for automated installation because they are problem free.



INSTALLATION CHART

Series MB 600 / MB 700 / MB 850														
d1 (mm)		3	4	5	6	7	8	9	10	12	14	16	18	20	22
S (mm)	Stroke (approx. values)	1.2	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.5	6.35	7.0	8.0	9.0	10.0
X (mm) ±0.2	Position of Top of Ball Relative to Top of Sleeve	0.4	0.2	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.6	0.6	0.8	0.8

Series MB 600 Inch-Version								
d1 (inch)		0.093	0.125	0.156	0.187	0.218	0.250	0.281
S (in)	Stroke (approx. values)	0.031	0.047	0.059	0.079	0.094	0.109	0.118
X (in) 0/-0.012	Position of Top of Ball Relative to Top of Sleeve	Flush to 0.012 Below the Sleeve						

INSTALLATION INSTRUCTIONS FOR SERIES MB / CV

PLUG REMOVAL

With KOENIG EXPANDER® MB / CV Series removal of the plug is possible. The plug can be drilled out with a carbide tipped drill or with a high speed steel drill.

Plug Removal Drill Bit Recommendation		
MB 600-030 to 140	Ball HB ~250	High Speed Steel Drill
MB 600-093 A	Ball HRC ~55	Carbide Tipped Drill
MB 600-125 A to 281 A	Ball HB ~250	High Speed Steel Drill
MB 700-030 to 220	Ball HRC ~45	Carbide Tipped Drill
MB 850-030 to 220	Ball HRC ~45	Carbide Tipped Drill
CV 173/CV 588 (all sizes)	Ball HRC ~250	High Speed Steel Drill

PROCEDURE:

- For KOENIG EXPANDER® smaller than 6mm or .250 inches in diameter:
  Drill out, in one process, to the **next larger diameter** according to the data sheet.
- For KOENIG EXPANDER® models larger than 6mm or .250 inches in diameter:
  Drill out in several steps with last step to the **next larger diameter** according to the data sheet.
- Clear chips, remnants of the sleeve, and oil and grease from the bore.
- Inspect bore to confirm that it meets all requirements.
- Install a new KOENIG EXPANDER®.

Note:

After plug removal always use the next larger size plug.

Series CV 173 / 588										
d1 (mm)		3	4	5	6	7	8	9	10	12
S (mm)	Stroke (approx. values)	1.0	1.4	1.9	2.3	2.8	3.4	3.7	4.2	5.1
X (mm) ±0.1	Position of Top of Ball Relative to Top of Sleeve	0.02 Below the Sleeve								

Series CV 173 / 588 Inch-Version											
d1 (inch)		0.156	0.187	0.218	0.250	0.281	0.312	0.343	0.375	0.406	0.437
S (in)	Stroke (approx. values)	0.053	0.066	0.078	0.094	0.110	0.129	0.140	0.153	0.162	0.166
X (in) ±0.004	Position of Top of Ball Relative to Top of Sleeve	0.008	0.010 Below the Sleeve								

Series CV 173 / 588 Inch Short										
d1 (Inch)		0.125	0.156	0.187	0.218	0.250	0.281	0.312	0.343	0.406
S (in)	Stroke (approx. values)	0.042	0.040	0.066	0.063	0.083	0.091	0.107	0.118	0.143
X (in) ±0.004	Position of Top of Ball Relative to Top of Sleeve	0.007	0.000	0.010	0.000					-0.010

INSTALLATION INSTRUCTIONS FOR SERIES SK / SKC

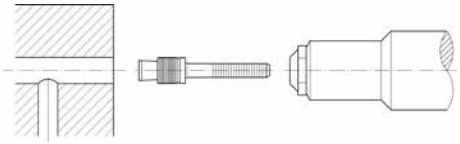


Fig. 1

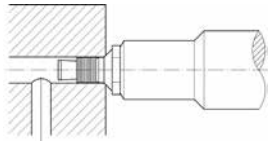


Fig. 2

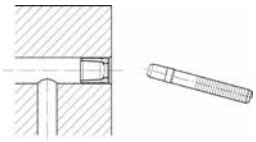


Fig. 3

DRILLED HOLE

- The drilled hole must be within the tolerances shown on the preceding data sheets.
- Holes must be round within 0.05 mm.
- With hard materials the bore roughness should be from R_z = 10–30 µm for best results.
- Longitudinal rifles and spiral grooves should be avoided. These influence the sealing effectiveness.
- The bore must be free of oil, grease and chips.

SETTING PROCEDURE

- Insert the plug in the tool, making sure that the sleeve is against the nosepiece (Fig. 1).
- After inserting the plug into the hole (ensuring the tool is flush to the work surface) activate the tool to expand the plug. The mandrel will break apart when the proper tension has been reached (Fig. 2 and 3).

Note:

- The assembly of KOENIG EXPANDER® plugs should only be done in a **clean working area**.
- The sleeve and mandrel of the **plug should not be cleaned, lubricated or have sealant (compound) applied**.

TOOLS

For trouble free installation of KOENIG EXPANDER® plugs use the tools and appropriate components according to the data sheet.

PLUG REMOVAL

With KOENIG EXPANDER® SK / SKC Series plug removal is possible.

PROCEDURE:

- Drive the mandrel from the sleeve with a punch.
- Drill out the sleeve and remove the mandrel.
- Bore the hole to the **next larger Expander diameter** per the data sheet.
- Clear chips, remnants of the sleeve, and oil and grease from the bore.
- Inspect bore to confirm that it meets all requirements.
- Install a new KOENIG EXPANDER®.

Note:

After plug removal always install the next larger size plug.

INSTALLATION INSTRUCTIONS FOR SERIES LK

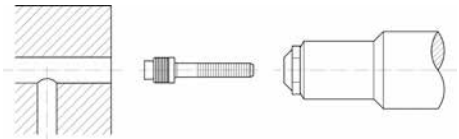


Fig. 1

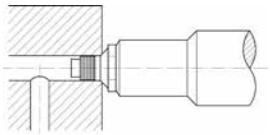


Fig. 2

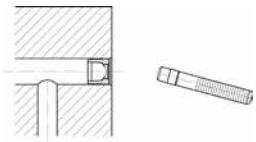


Fig. 3

DRILLED HOLE

1. The drilled hole must be within the tolerance shown on the dimensional sheets.
   In base materials with high hardness or hardened materials:
   - < 280HB the bore tolerance should be 0 / + 0.12
   - ≥ 280HB the bore tolerance should be +0.05 / + 0.15
2. Holes must be round within 0.05 mm.
3. With hard materials the bore roughness should be from R_z = 10–30 µm for best results.
4. Longitudinal rifles and spiral grooves should be avoided. These influence the sealing effectiveness.
5. The bore must be free of oil, grease and chips.

SETTING PROCEDURE

- Insert the plug in the tool, ensuring that the sleeve is against the nosepiece (Fig. 1).
- After inserting the plug into the hole activate the tool to expand the plug.
- The mandrel will break apart when the proper tension has been reached (Fig. 2 and 3).

Note:

- The assembly of KOENIG EXPANDER® plugs should only be done in a **clean working area**.
- The sleeve and mandrel of **the plug should not be cleaned, lubricated or have sealant (compound) applied**.

TOOLS

For trouble free installation of KOENIG EXPANDER® plugs use the tools and appropriate components according to the data sheet.

PLUG REMOVAL

With KOENIG EXPANDER® plugs LK Series plug removal is possible.

PROCEDURE:

- Drive the mandrel from the sleeve with a punch.
- Drill out the sleeve and remove the mandrel.
- Bore the hole to the **next larger Expander diameter** per the data sheet.
- Clear chips, remnants of the sleeve and oil and grease from the bore.
- Inspect bore to confirm that it meets all requirements.
- Install a new KOENIG EXPANDER®.

Note:

After plug removal always install the next larger size plug.