KRAL Screw Pumps K Series.
The New Generation.

KRAL

The universal KRAL pump with innovative design for long service life, even in harsh operating conditions.

Operation, materials and accessories.

Delivery rates:	5 to 2.900 l / min.
Max. discharge pressure:	16 bar.
Temperature range:	-20 °C to 180 °C, magnetic coupling to 250 °C.
Casing:	EN-GJS-400.
Spindles:	Steel, nitration-hardened.
Accepted by:	ABS, BV, CCS, DNV, GL, LRS, MRS, NK, RINA.
ATEX:	Group II, Category 2 Ex II 2 GD b/c.
Heating:	Electric, media and steam heating.

Areas of application.

KRAL K Series are screw pumps for lubri-cating, non-abrasive and chemically inert fluids. They are used primarily in industrial applications, such as:

- Marine, as feed and circulation pumps for fuels and lubricants.
- Mechanical engineering as lubricant and coolant pumps for gears, engines, turbines and hydraulic systems.
- Oil burner technology as ring line and transfer pumps.
- Plastics processing, especially polyurethane applications.

How the K pump fits into the KRAL product program.

The KRAL K Series screw pump is designed for universal use. It is therefore the best-selling KRAL pump. With a delivery pressure of 16 bar, the K pumps capability lies between KRAL´s low-pressure and medium-pressure pumps. Even at a low delivery pressure, the K pump is often the pump of choice. This is due its safety standards and installation advantages. The casing of the K Series is made of nodular cast iron and is approved for use on-board ship. It has a sealed, lifetime-lubricated external bearing.

The K pump is designed for inline use. Various installation methods are possible for a flange mounting pump, a pedestal pump or a base pump.

Advantages of screw pumps.

Compared to other types of pumps, KRAL screw pumps offer high capacity without taking up much space. This applies in particular at high differential pressure. The pumps are self-priming, with low pulsation delivery and can be easily regulated. The single pumps, single stations and double stations are extremely compact. All K pumps have an internal safety valve.

Stop coupling damage.

With some fluids, residue forms which can cause the unit to fail.

A typical spot for residue to build up is at the mechanical seal. The residue damages the ball bearing, which runs hot, melts the elastomeric ring and damages the coupling.

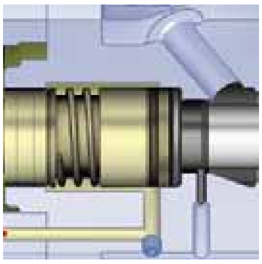
With the K Series, there is a weep hole next to the mechanical seal, to prevent the fluid from collecting and building up as residue.

Different types of seal.

As standard the K Series is equipped with a mechanical seal. The optional high-quality SiC mechanical seal can be used at temperatures up to 180 °C. A small leakage flow is required to lubricate the friction faces properly.

If the pump is going to be operated at temperatures up to 250 °C or requires hermetic sealing, then the correct choice is the KRAL magnetic coupling. The fluid cannot escape or react by coming into contact with other materials.

Rotary shaft lip seals can be used for clean pumped media up to 6 bar.



Safety backup for dry running.

The startup phase of a pump is critical.

If the pump is not properly filled with fluid and vented, it may take some time for the mechanical seal to be immersed in the fluid. If the seal runs dry, it will not take long to reach temperatures in excess of 200 °C. The O-rings and the seal faces will become damaged, resulting in leakage.

KRAL provides high-quality SiC mechanical seals with graphite, which acts as a dry lubricant. The chemically stable O-rings have a high fluorine content and are suitable for use at higher temperatures. These high-quality components offer additional safety.

Low-viscosity media.

Low-viscosity media can damage the pump due to insufficient lubrication. Abrasive media and solid matter can lead to wear and blockages.

When required, KRAL can provide the pump casing with a special surface treatment. This will improve the frictional properties of the spindles in the casing. The increased hardness provided reduces wear.

This will allow fluids with viscosities as low as 2 mm^2/s to be pumped. This also gives a greater safety margin should an unplanned increase in temperature reduce the viscosity.

Low-maintenance operation.

When operated correctly, The KRAL K Series pump is low-maintenance. The lifetime-lubricated external ball bearing is designed for a service life of 30.000 hours. There are two safeguards in place to protect the bearing:

- ☐ There is a weep hole just between the shaft seal and the bearing.
- ☐ The bearing is enclosed.

The ball bearing is not exposed to the fluid and therefore will not be damaged.

The mechanical seal is bathed by the fluid and is thus well lubricated and cooled. It is fitted in such a way that the frictional heat is guaranteed to be dissipated.

Advanced surface treatment.

The option is available to have a special surface treatment applied to the pump casing. This treatment reduces wear and improves the frictional properties when pumping low-viscosity fluids.

Standard mechanical seals.

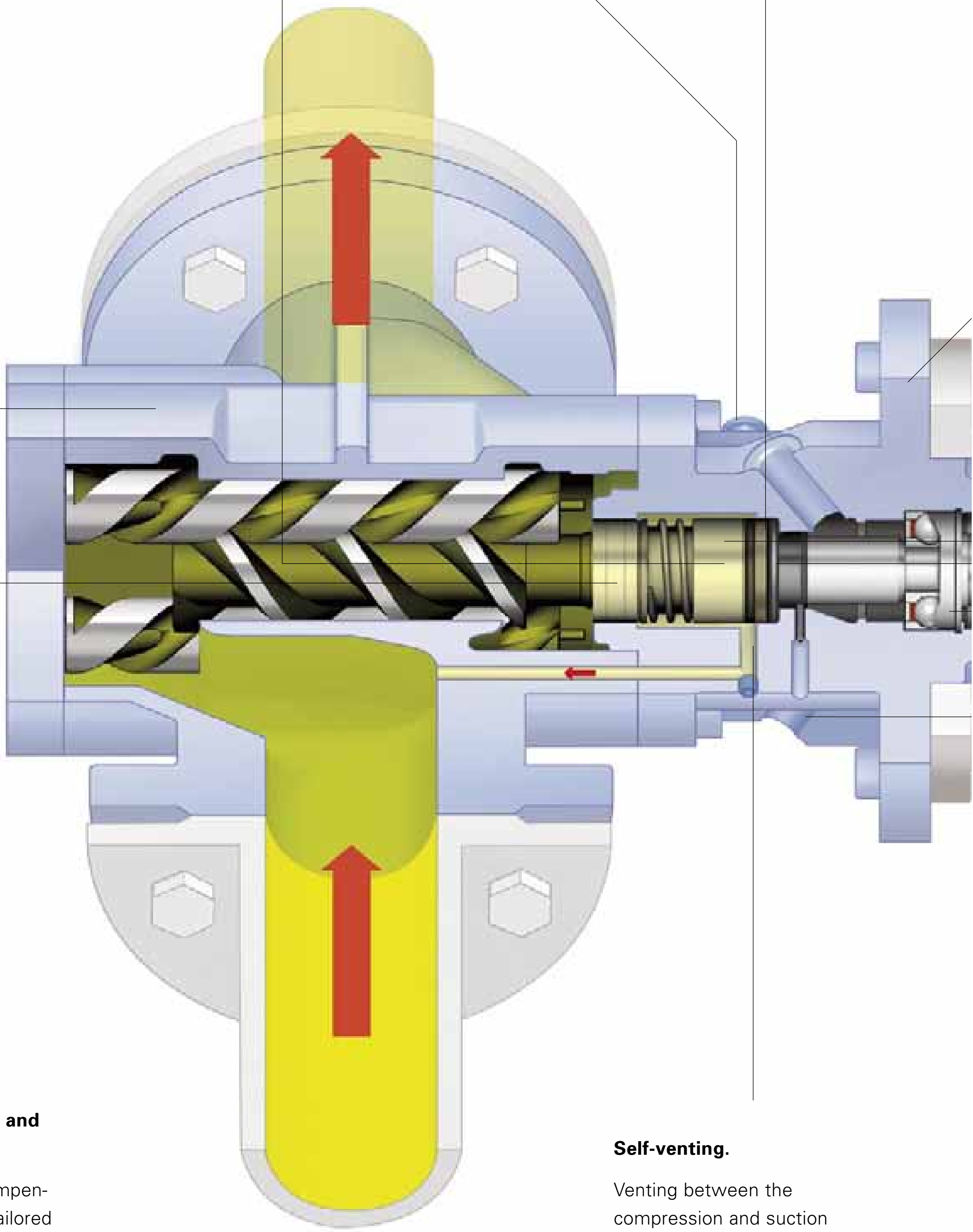
Depending on the operating requirements, there is a choice of mechanical seals in accordance with DIN 24960.

Venting the seal chamber.

The seal chamber has a separate vent hole. This allows the pump to be vented easily and correctly during startup.

State-of-the-art SiC quality.

The advanced SiC quality of the mechanical seal contains graphite as a dry lubricant. This reduces damaging friction when running dry.



Optimum cooling and lubrication.

The size of the compensating cylinder is tailored to the particular application, thus ensuring good cooling and lubrication of the sealing surfaces of the mechanical seal.

Self-venting.

Venting between the compression and suction sides starts directly at the mechanical seal. This ensures that even if the pump is mounted vertically, the air cushion will be displaced through the fluid into the vent line.

Optimized flange design.

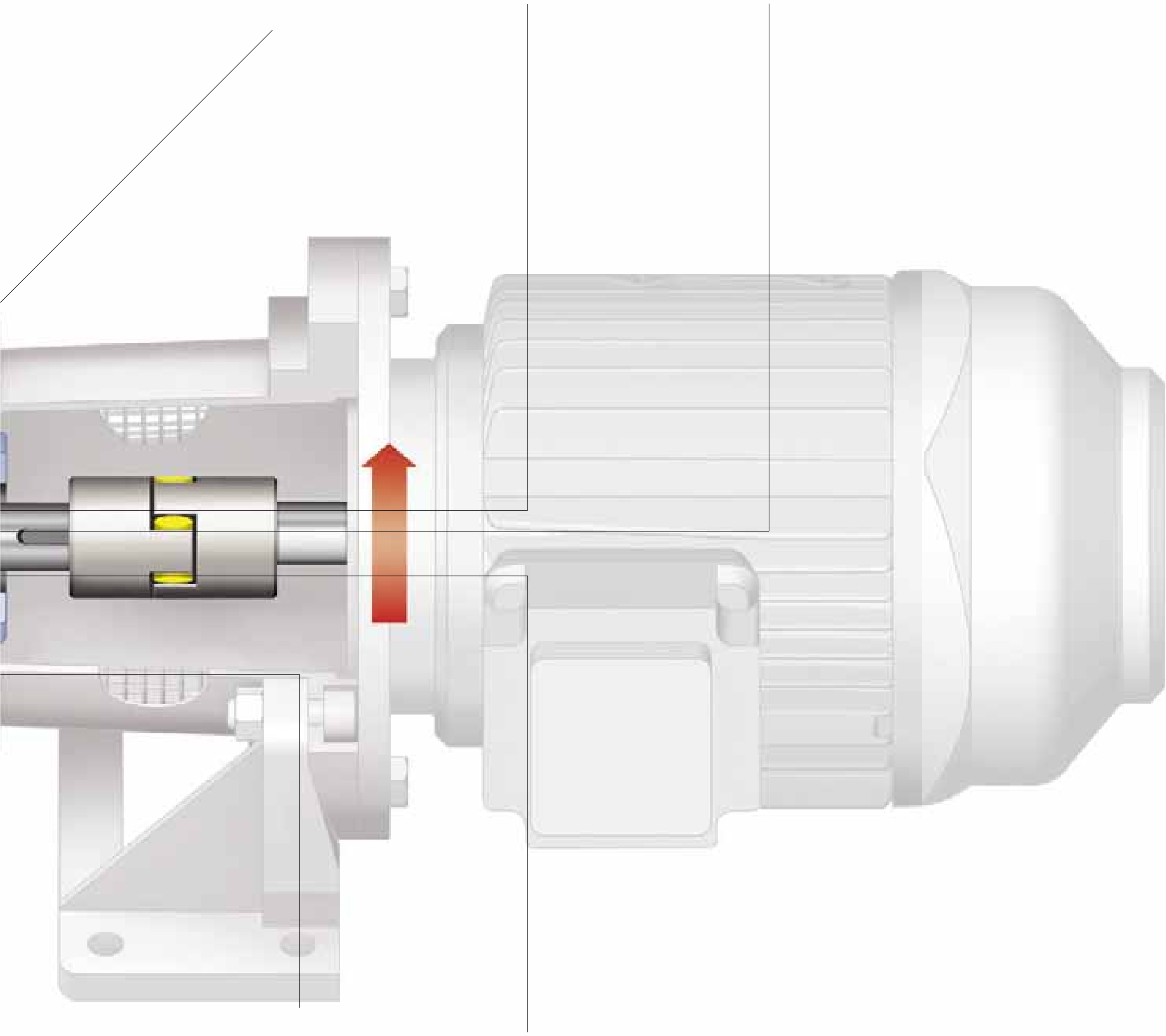
The flange is designed in accordance with ISO 3019. This means that the pump can be connected with normal, standard pump brackets. Thanks to this construction, minimal space is taken up by the magnetic coupling option.

Choice of shaft seals.

The standard fitting is a single mechanical seal in various material configurations. Available as options are a magnetic coupling, a rotary shaft lip seal or a mechanical seal with seal flushing.

Further improved O-rings.

The O-rings of the hard material mechanical seals have a high fluorine content. This material is chemically stable quality and can tolerate high temperatures without lasting deformation.



Residue does not collect.

Any leakage of the mechanical seal is drained through a weep hole immediately after the stationary seal face. Residue which could damage the ball bearing cannot collect unnoticed.

High-quality bearing.

In KRAL K Series pumps, lifetime-lubricated sealed standard bearings are used. This increases the service life and reduces maintenance costs.

Advantages.

Compared to other types of pump, KRAL screw pumps provide large flow rates in restricted spaces. KRAL pumps are quiet and deliver the fluid with low pulsation.

Short construction.

The K Series is known for its short construction. This compact pump is designed for delivery pressures up to 16 bar.

These questions help with pump selection.	Knowing this makes selection easier.	This is what you actually do.	Dimensioning example, tips and information.
With which value from the operating data should pump dimensioning start?	Start dimensioning the pump with the speed of the electric motor; this determines the delivery rate and thus the size. The theoretical delivery rate is relative to a speed of 1.450 min^{-1}. Factor F_n is the ratio of your standard speed to 1.450 min^{-1}.	Establish speed n for your application. Use the **Formula** to calculate factor F_n. The **Delivery rate** and **Performance** charts only apply to one size. Safeguard your pump dimensioning at KRAL.	**Example:** Feed pump in the booster module (marine application). 60 Hz. Speed 1.750 min^{-1}. Heavy fuel oil with 75 mm^2/s at 80 °C. Q = 50 l / min. Differential pressure 4 bar. **$F_{1.750}$ = 1.750 min^{-1}/ 1.450 min^{-1} = 1,2.**
Which size will achieve the required delivery rate?	The designation of the K pump includes the theoretical delivery rate Q_{th}, which is set at no-load operation (0 bar differential pressure) and 1.450 min^{-1}. If the speed of your application differs from 1.450 min^{-1}, you must calculate the theoretical delivery rate of the size for the speed of your application.	Calculate the theoretical delivery rate of size Q_{th} (n) using the formula.	**Example: Q_{th} (1.750) = 42,8 x 1,2 = 51,4 l / min.** An advantage of KRAL screw pumps is the linear correlation between the delivery rate and the speed. Regulating the speed is an excellent way to control the delivery rate.
How great is the difference between the application delivery rate and the theoretical delivery rate? **Is the selected size suitable for the application under load?**	The more the pressure needs to be increased and the lower the viscosity, the greater the difference between the actual delivery rate Q and Q_{th}.	With the viscosity ν [mm^2/s] and the pressure increase Δp [bar], you can find the delivery rate of the pump Q as a percentage value of Q_{th} in the **Delivery rate** chart.	**Example: Q / Q_{th} = 95 %. Q = 0,95 x 51,4 l / min = 48,8 l / min.** With size K 42, the delivery rate achieved by the application is rounded up to 50 l / min. Should the delivery rate be insufficient for your application, repeat the dimensioning with the next biggest size or increase the speed.

Formula.

$$F_n = n \,/\, 1.450\ \text{min}^{-1}$$

Example: $F_{1.750}$ = 1,2

Size.

$Q_{th}(n) = Q_{th}(1.450\ \text{min}^{-1}) \times F_n$
$P_{th}(n) = P_{th}(1.450\ \text{min}^{-1}) \times F_n$

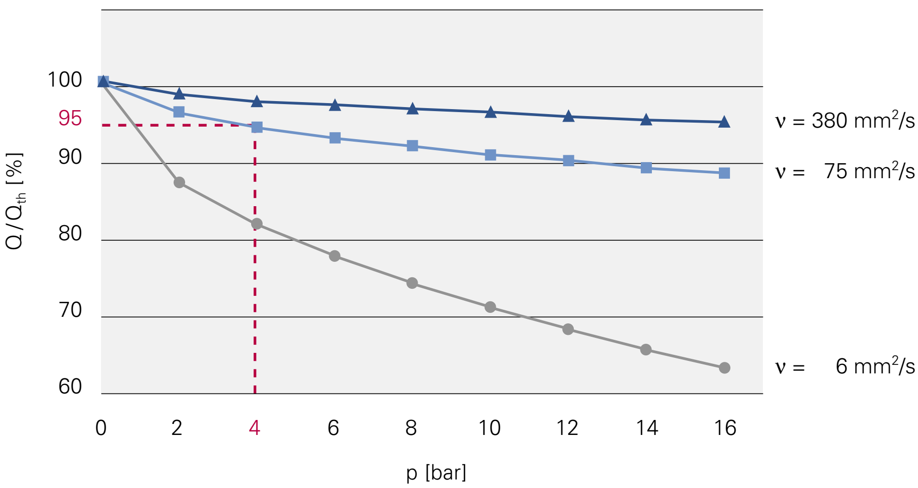
Q_{th} [l/min]	5,20	7,80	10,4	15,5	20,4	32,1	42,8	58,5	at 1.450 min^{-1}
P_{th} [kW]	0,14	0,21	0,28	0,41	0,54	0,86	1,14	1,56	at Δp = 16 bar
Size	K 5	K 7	K 10	K 15	K 20	K 32	K 42	K 55	

Q_{th} [l/min]	75,2	83,5	100	119	166	217	235	282	at 1.450 min^{-1}
P_{th} [kW]	2,01	2,23	2,68	3,17	4,42	5,79	6,26	7,52	at Δp = 16 bar
Size	K 74	K 85	K 105	K 118	K 160	K 210	K 235	K 275	

Q_{th} [l/min]	368	448	543	668	815	978	1.150	1.340	at 1.450 min^{-1}
P_{th} [kW]	9,81	11,9	14,5	17,8	21,7	26,1	30,7	35,7	at Δp = 16 bar
Size	K 370	K 450	K 550	K 660	K 851	K 951	K 1101	K 1301	

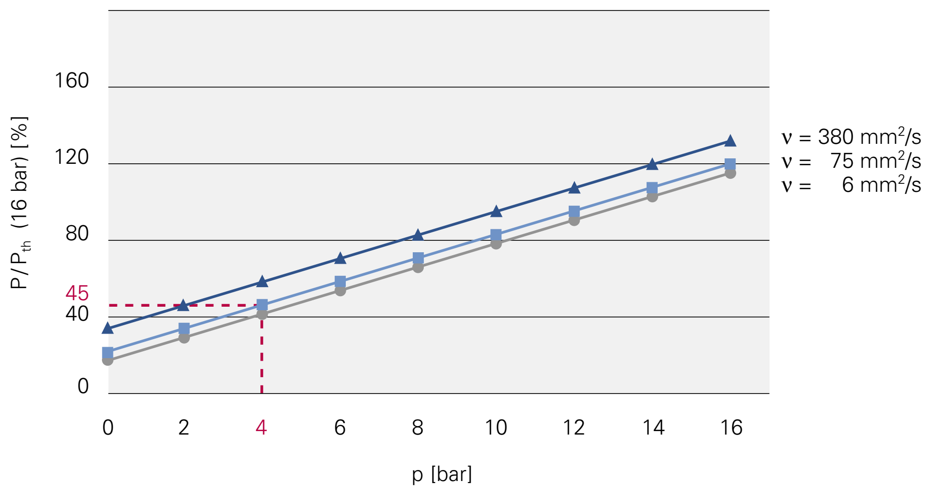
Q_{th} [l/min]	1.540	1.790	2.260	2.536	2.870	at 1.450 min^{-1}
P_{th} [kW]	41,1	47,7	60,3	67,6	76,5	at Δp = 16 bar
Size	K 1500	K 1700	K 2200	K 2500	K 2900	

Delivery rate.

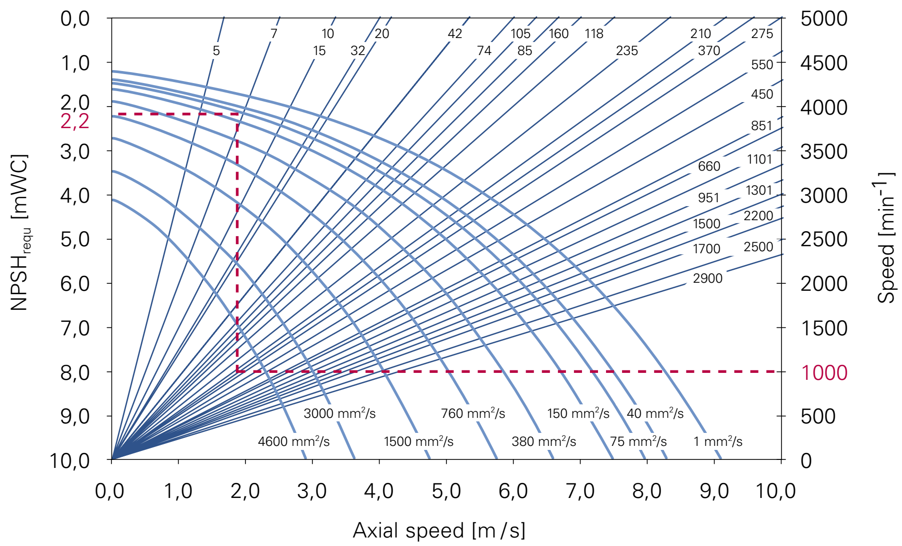


These questions help with pump selection.	Knowing this makes selection easier.	This is what you actually do.	Dimensioning example, tips and information.
How powerful must the electric motor be?	Knowing the power requirement of the pump makes it easier to choose the electric motor. The power requirement comprises the theoretical power P_{th} and the friction power. If the speed of your application differs from 1.450 m^{-1}, you must calculate the theoretical power of the size for the speed of your application.	With the viscosity ν [mm^2/s] and the pressure increase p [bar], you can find the power draw of the pump in the **Performance** chart. With P/P_{th} from the **Performance** chart and P_{th} from the **Size** table, you can calculate the motor power P.	**Example: P/P_{th} = 45 %. P_{th} (1.750) = 1,14 x 1,20 = 1,37 kW. P = 0,45 x 1,37 kW = 0,62 kW.** KRAL provides a motor one rating class higher: 0,75 kW, size 80. The **Performance** chart shows the linear correlation between the power and the pressure.
Which $NPSH_{requ}$ value does the pump need?	Cavitation starts earlier the greater the motor speed and the screw pitch. As the motor speed and the screw pitch increase, so the axial speed of the fluid increases. The fluid pressure decreases with the speed. Higher pressure is required at the pump inlet.	In the **$NPSH_{requ}$** chart, draw the point of intersection between the speed and the size. Drag a vertical line from the point of intersection to the viscosity. Take the $NPSH_{requ}$ value of the pump from the chart on the left.	Starting with speed 1.750 min^{-1}, horizontally left to size 42. From there, vertically upward to a viscosity of 75 mm^2/s. From there, continuing horizontally left to the $NPSH_{requ}$ scale, returns **$NPSH_{requ}$ = 2,2 mWC.**

Performance.

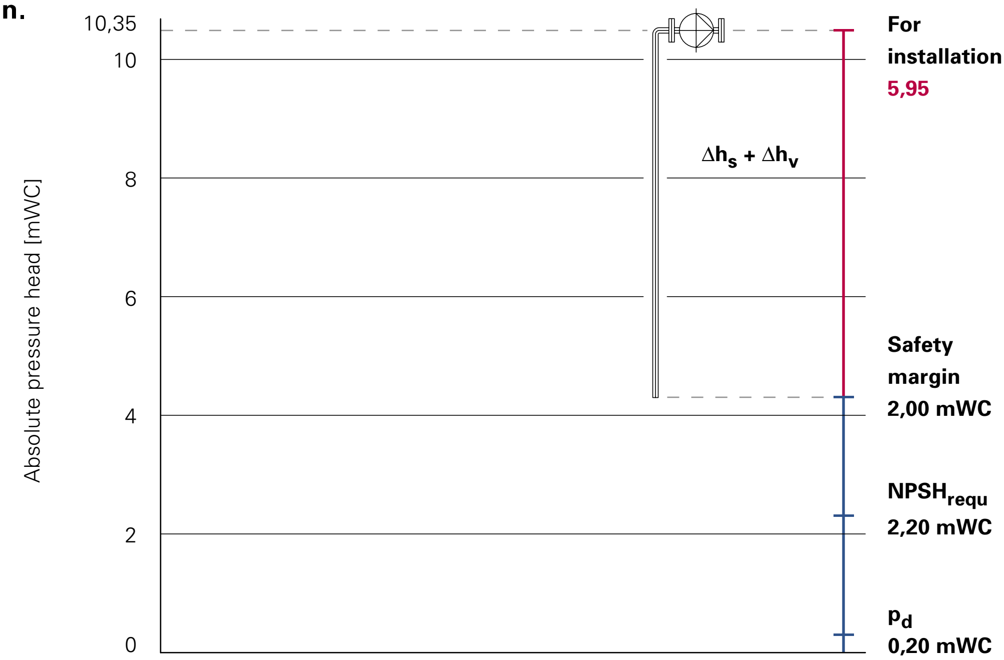


NPSH$_{requ}$.



These questions help with pump selection.	Knowing this makes selection easier.	This is what you actually do.	Dimensioning example, tips and information.
Which should be the suction pressure head for the pump?	The NPSH value (net positive suction head) indicates by how much the total pressure head at the pump inlet must exceed the vapor pressure head of the fluid, to ensure perfect functioning, without cavitation. In the installation, the available absolute pressure head is reduced by the suction head Δh_s and the pipe losses Δh_v.	Determine the absolute pressure head. At 1013 mbar ambient pressure, this is 10,35 mWC. Determine the vapor pressure head p_d. For water, at ambient pressure, p_d is about 0,20 mWC. In the **NPSH installation** chart, add the $NPSH_{requ}$ value from the **$NPSH_{requ}$** chart and the safety margin of 2,00 mWC specified by KRAL.	**Example:** Start at the bottom on the zero line with a vertical line of 0,20 mWC for p_d. Further on p_d add a vertical line of length 2,20 mWC for $NPSH_{requ}$ and 2,00 mWC for the safety margin. You will now be at 4,40 mWC. Around **6 mWC** remain for the installation. If you have too high a $NPSH_{requ}$ value for the pump and there is therefore not enough pressure head left in the installation, reduce the speed of the motor.

NPSH installation.



If required, you can get a DVD full of information and help for your work. Just ask your KRAL partner.

Design.

Starting with a prescribed Series, the KRAL selection program calculates the delivery rate of the pump and the power requirement for the electric motor.

The power requirement, the starting torque and the delivery rate are also displayed graphically. The design findings can be printed out together with the graphs.

The pump curve shows the variation of the working points.

Construction.

To help with construction, dimensioned drawings for all sizes of the K Series are available on the DVD in pdf format.

To make it easier for you, you can request a separate DVD with CAD drawings in *.dwg and *.dxf format. You can incorporate the drawings into your structural design.

Installation and operation.

The DVD includes Operating Instructions in pdf format.

Recommendation.

Do you want to keep your colleagues informed about your decision to use KRAL? The DVD includes a pump overview brochure. There is a separate product brochure for the K Series on the DVD as well.

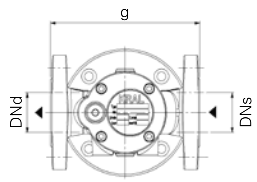
More detailed information on KRAL can be found in the corporate folder.

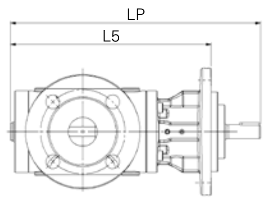
References and special applications are described in our magazine for our customers and business partners "KRAL INSIDE".

Technical Data, Dimensions and Weights

K technical data.	5-42	55-118	160-275	370-450	550-660	851-1301	1500-1700	2200-2900
Q_{th} (1.450 min^{-1}, 0 bar) l/min	5-43	59-119	166-282	368-448	543-668	815-1340	1540-1790	2260-2870
Max. discharge pressure bar	16	16	16	16	16	16	16	16
Temperature °C								
with NBR rotary lip seal	80	80	80	80	80	80	80	80
with FKM rotary lip seal	150	150	150	150	150	150	150	150
with standard mechanical seal	150	150	150	150	150	150	150	150
with SIC-SIC mechanical seal	180	180	180	180	180	180	180	180
with magnetic coupling	250	250	250	250	250	250	250	250
Viscosity mm²/s								
min.	2	2	2	2	2	2	2	2
max.	10000	10000	10000	10000	10000	10000	10000	10000
Speed min^{-1}								
50 Hz	2900	2900	2900	2900	1450	1450	1450	1450
60 Hz	3500	3500	3500	3500	1750	1750	1750	1750
Max. inlet pressure bar								
with rotary lip seal	6	6	6	6	6	6	6	6
with standard mechanical seal	6	6	6	6	6	6	6	6
with SIC-SIC mechanical seal	6	6	6	6	6	6	6	6
with magnetic coupling	16	16	16	16	16	16	16	16

Dimensions / Weights.	DNd	DNs	g	L5	LP	kg
K 5-20	25	25	150	201	251	7
K 32-42	32	32	169	244	297	11
K 55-118	50	50	220	290	349	18
K 160-275	80	80	250	364	418	33
K 370-450	100	100	270	396	453	43
K 550-660	100	125	360	561	628	78
K 851-1301	125	150	450	681	795	150
K 1500-1700	150	200	520	867	1000	310
K 2200-2900	150	200	585	977	1110	410

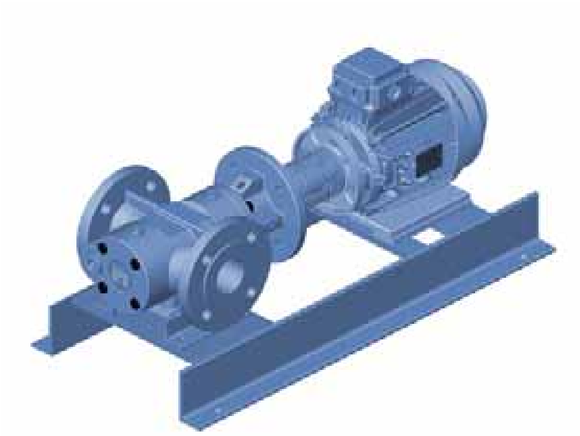




We will be happy to send you brochures on specialized applications for the KRAL K Series pumps on request, as well as product brochures for our other Series.

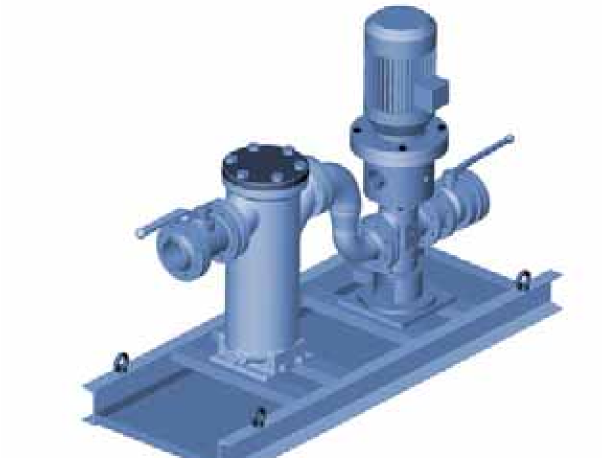
With so many different models of KRAL pumps available, there are numerous installation options.

KF flange pump.
The KF flange pump is the universal pump for horizontal installation. Other mounting positions are also possible.

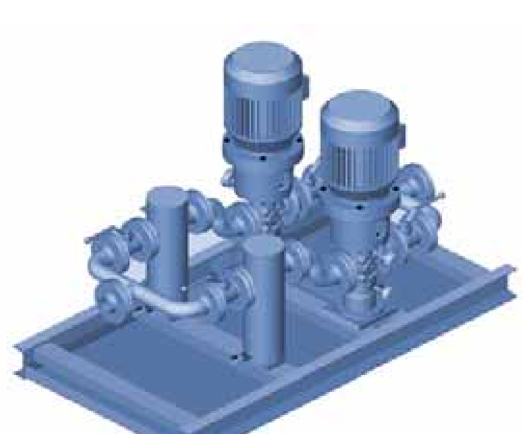


KH base pump.
We also deliver heavy pumps mounted on a base frame.

KV Pedestal pump.
The pedestal pump is the correct choice if there is minimal room at the installation location or if a large, heavy pump is required. Its compact design makes the KV ideally suited for station use.



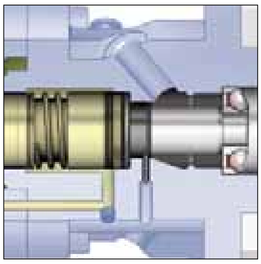
EKL / EKS single station.
In case of single and double stations, KRAL assumes system responsibility. They define the function and the pipeline connections.



DKL / DKS double station.
Double stations provide greater safety. The second pump is normally used as a back-up or capacity is split between the two pumps. Then, if one of the pumps is damaged, the system can still operate at half load.

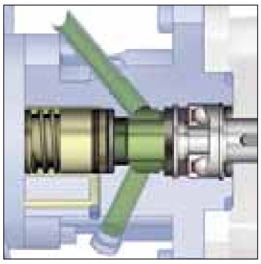
Seal design options to meet every demand.

Mechanical seals.



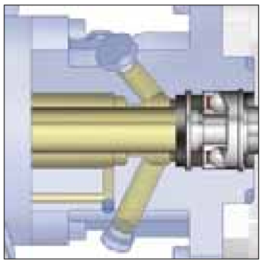
- ☐ Standard: DIN 24960, EAVGG; unidirectional, fluids without abrasive content, inlet pressure = 6 bar; T_{max} = 150 °C, viscosity < 500 mm²/s.
- ☐ Hard material, e.g. SiC, DIN 24960, JJXGF; unidirectional, fluids with abrasive content, inlet pressure = 6 bar; T_{max} = 180 °C, viscosity > 500 mm²/s.
- ☐ Boosted: DIN 24960, materials as requested, bi-directional, fluids with / without abrasive content, inlet pressure = 6 bar; T_{max} = 150 °C, viscosity < 500 mm²/s.
- ☐ Balanced: DIN 24960, materials as requested, bi-directional, fluids with / without abrasive content, inlet pressure = 16 bar; T_{max} = 150 °C.

Mechanical seal with flushing (quench).



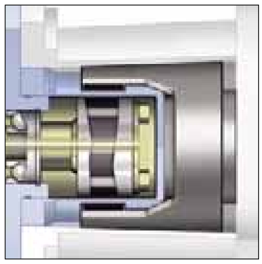
- ☐ DIN 24960, materials and version as requested, fluids with a tendency to harden / reaction when in contact with surrounding air, inlet pressure = 6 bar; T_{max} = 150 °C.

Rotary shaft lip seals.



- ☐ Standard: Domsel type AC, NBR, fluids without abrasive content, inlet pressure = 6 bar; T_{max} = 80 °C.
- ☐ High temperature: Domsel type AC, FKM, fluids without abrasive content, inlet pressure = 6 bar; T_{max} = 150 °C.

Magnetic coupling.



- ☐ Standard: containment can 1.4301, FKM secondary sealing, inlet pressure = 16 bar; T_{max} = 150 °C.
- ☐ High temperature: containment can 1.4301, FFKM secondary sealing on request, inlet pressure = 16 bar; T_{max} = 250 °C.

Practical examples.

Lubricating pump series.

Pump: KF 951.
Medium: Lubricating oil ISO VG320.
Delivery rate: 950 l/min.
Pressure: 10 bar.
Temperature: 40 °C.
Viscosity: 320 mm^2/s.
Seal: EAVGG mechanical seal.

A typical customer is a steel works manufacturer. In such an application KRAL pumps deliver the lubricating oil for the rolling-contact bearings of the mill trains.

Because of the harsh operating conditions, it is absolutely essential for the pumps to be robust. KRAL KF pumps have a cast-metal casing. The pump is very compact, as it is designed for inline use. This means that the installation does not take up excessive room in the mill train.

Engine room booster module and separator pumps on-board ship.

Pump: KF 74.
Medium: HFO, MDO.
Delivery rate: 20 to 74 l/min.
Pressure: 8 bar.
Temperature: 160 °C.
Viscosity: 2 to 1.000 mm^2/s.
Seal: Magnetic coupling.

In large-scale diesel engines the pressure and the viscosity are set in the booster module. Heavy fuel oils are pre-heated up to 160 °C. This temperature can damage the mechanical seals. When the fuel comes into contact with the atmosphere, residue may form which could destroy the ball bearing. As a result, the pumps could fail and the diesel engine would cut out. The ship would be unable to maneuver.

The magnetic coupling is hermetically sealed and can be operated at up to 250 °C.

Discharge and transfer pumps for PUR raw materials.

Pump: KF 20 to KF 550.
Medium: Polyol, isocyanate.
Delivery rate: 282 l/min.
Speed: 750 min^{-1}.
Pressure: 10 bar.
Temperature: Ambient.
Viscosity: Polyol to 5.000 mm^2/s, isocyanate to 1.500 mm^2/s.
Seal: Magnetic coupling.

A storage tank depot for polyols and isocyanate is used to supply the raw materials for polyurethane production plants.

Transfer pumps for isocyanate are equipped with magnetic couplings. They prevent the isocyanate from coming into contact with the atmosphere and combining with the water to form abrasive urea crystals. Deposits of these solids can cause mechanical seal leakage.

Joint projects.

Our business partners are particularly appreciative of the cooperative collaboration with the KRAL AG. From the best possible support to the successful conclusion of the project, friendly business relations are always the order of the day. We take the time to talk to our customers and collaborate closely with them on technical matters. You can rely on KRAL.

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