



KRAL Pumps/Pump Stations

C, K, L, M, N, NB, W and pump stations

ATEX design



Observe safety instructions for persons with cardiac pacemaker, metallic implant or neurostimulator.



Observe the information and regulations for use in potentially explosive areas.

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1 About this document

1.1 General information

These instructions supplement the operating instructions of the pump/pump station. It is imperative that they be observed in the case of use in potentially explosive areas.

Like the operating instructions of the pump/pump station these supplementary instructions form part of the product and must be kept for future reference.

1.2 Associated documents

- Operating instructions of the pump/pump station
- Technical data and operating instructions of the optionally installed electrical heating system

1.3 Target groups

The instructions are intended for the following persons:

- Persons who work with the product
- Operator-owners who are responsible for the use of the product

Information on the required qualification of the personnel is provided separately at the beginning of the individual chapters in these instructions. The following table provides an overview.

Target group	Activity	Qualification
Transport personnel	Transportation, unloading	Transport personnel are qualified personnel who carry out the transportation of products properly due to their training, knowledge and experience and on the basis of the relevant provisions. Transport personnel recognize and avoid possible dangers and damage to property that are connected with this activity.
Mobile crane operators, crane operators, forklift operators	Unloading, positioning	Mobile crane operators, crane operators and forklift operators are qualified personnel who carry out work with cranes and forklifts properly due to their training, knowledge and experience and on the basis of the relevant provisions. Mobile crane operators, crane operators and forklift operators recognize and avoid possible dangers and damage to property that are connected with this activity.
Fitter	Mounting, connection	Fitters are qualified personnel who carry out the mounting work properly due to their training, knowledge and experience and on the basis of the relevant provisions. Fitters recognize and avoid possible dangers and damage to property that are connected with this activity.
Electrician	Electrical connection	Electricians are qualified personnel who carry out work on electrical equipment and installations properly due to their training, knowledge and experience and on the basis of the relevant provisions. Electricians recognize and avoid possible dangers and damage to property that are connected with this activity.
Trained personnel	Delegated task	Trained personnel were instructed by the operator-owner in the task delegated to them and the possible dangers arising through improper behaviour.

Tab. 1: Target groups

1 About this document








1.4 Symbols

1.4 Symbols








1.4.1 Danger levels

	Signal word	Danger level	Consequences of non-observance
	DANGER	Immediate threat of danger	Serious personal injury, death
	WARNING	Possible threat of danger	Serious personal injury, invalidity
	CAUTION	Potentially dangerous situation	Slight personal injury
	ATTENTION	Potentially dangerous situation	Material damage

1.4.2 Danger signs

	Meaning	Source and possible consequences of non-observance
	Electrical voltage	Electrical voltage causes serious physical injury or death.
	Magnetic field	Magnetic field can cause serious physical injury or death.
	Raised load	Falling objects can result in serious physical injury or death.
	Heavy load	Heavy loads can result in serious back problems.
	Risk of slipping	Discharging pumped liquid and oils on the foundation or tread surfaces can cause falls with serious physical injury or death.
	Flammable substances	Discharging pumped liquid and oils can be easily inflammable and can result in serious burns.
	Hot surface	Hot surfaces of the pump unit can cause burns.

1.4.3 Symbols in this document

	Meaning
	Warning personal injury
	Safety instruction
	Prohibition sign cardiac pacemaker
	Request for action
	Multi-step instructions for actions
	Action result
	Cross-reference

2 Safety

2.1 Proper use in potentially explosive areas

The ATEX Directive 2014/34/EU is applicable to equipment and protective systems for proper use in potentially explosive areas.

Equipment is by definition machines, devices, ... which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy and/or for the processing of material and which are capable of causing an explosion through their **own** potential ignition sources.

2.2 Potentially explosive atmosphere

A potentially explosive atmosphere is a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

Products are therefore only considered as being subject to the scope of the ATEX Directive if they are intended in whole or in part for use in potentially explosive areas.

2.3 Potential ignition sources

Potential ignition sources can be: electric sparks, arcs and thunderbolts, electrostatic discharges, electromagnetic waves, ionising radiation, hot surfaces, flames and hot gases, mechanically produced sparks, radiation in the optic region, chemical reactions, densification.

A further defining element of equipment in the sense of the ATEX Directive is the fact that they must have their own potential ignition sources.

Own ignition sources at non-electrical equipment such as screw pumps can be, for example, hot surfaces or sparks arising from friction.

Electrical heating system (optional)

Screw pumps can be equipped optionally with an electrical heating system. This can result in further restrictions regarding their use in potentially explosive areas.

Notice If an electrical heating system is used, additionally take into account the ATEX marking of the electrical heating system!

2.4 Limits for surface temperatures

The standard ISO 80079-36 defines the permissible limits for surface temperatures. In the process gases/vapours and dusts are differentiated.

At the gases and steams the devices are divided into temperature classes.

Temperature class	Max. surface temperature [°C]	Temperature range for mixtures [°C]	Typical gas (selection)
T1	450	> 450	I: Methane II A: Acetone, methane, methanol, propane II B: Town gas II C: Hydrogen
T2	300	> 300 – ≤ 450	II A: Ethyl alcohol, n-butane II B: Ethylene II C: Acetylene
T3	200	> 200 – ≤ 300	II A: Diesel, fuel oils II B: Hydrogen sulphide
T4	135	> 135 – ≤ 200	II A: Acetaldehyde, ethyl ether
T5	100	> 100 – ≤ 135	–
T6	85	> 85 – ≤ 100	II C: Sulphur hydrocarbon

Tab. 2: Limit temperatures for gases and vapours

In the case of dusts the maximum permissible surface temperature of the device is specified instead of the temperature class, since here a safety gap between the surface temperature and the ignition temperature has to be observed additionally.

2 Safety

2.5 Evaluation of pump units and pump stations

The permissible surface limit temperature results from the two determined values of the Process A and B of IEC 50281-2-1:

Limit temperature = MIN (Value A - 75 °C) and (Value B x 2/3)

Dust (selection)	IEC 50281-2-1 Process A [°C]	IEC 50281-2-1 Process B [°C]	Permissible max. surface limit temperature [°C]
Wood flour	300	400	225
Cellulose	370	500	295
Lignite	225	380	150
Soot	385	620	310
Sulphur	280	280	186
Aluminium	280	530	205

Tab. 3: Limit temperatures for dusts at Equipment group II

Dust	IEC 50281-2-1 Process A [°C]	IEC 50281-2-1 Process B [°C]	Permissible max. surface temperat- ure [°C]
On every surface that contains dust	–	–	150
When coal dust deposits are not to be expected, for example in the housing inside	–	–	450

Tab. 4: Limit temperatures for dusts at Equipment group I

2.5 Evaluation of pump units and pump stations

Combinations of motors and pumps into pump units as well as pump stations are to be considered a "group of individual devices". In accordance with Section 3.7.5 of the ATEX Directive the manufacturer of a group of individual devices can assume that the latter fulfils the Directive if a corresponding Declaration of Conformity exists. This applies in particular for couplings and motors that are "equipment" in the sense of the Directive. In addition for further components that are used, for example, in the station construction (flow indicators/dry running protection, pressure switches, etc.). For further information on this topic please refer to the corresponding documentation of these devices.

The manufacturer of a group of individual devices solely verifies whether further dangers arise through the final combination of the components. This is not the case at the pump units and pump stations manufactured by KRAL. In accordance with the Directive there is therefore no need for a further evaluation of conformity or for an overall identification of this group of individual devices.

2.6 Additional obligations of the operator-owner when used in potentially explosive areas

When the product is used in potentially explosive areas the operator-owner has to observe the following additional obligations from the ATEX directive (minimum regulations for improving the health protection and the safety of the employees that can be endangered through potentially explosive atmospheres).

This results in the following additional obligations for the operator-owner:

- Identify potentially explosive areas.
- Mark and identify all prohibitions clearly.
- Draw up explosion protection documents for each zone.
- Issue prohibitions of access for unauthorized persons.

2.7 Safety instructions

2.7.1 Additional safety instructions for use in potentially explosive areas



The following safety instructions must be observed strictly:

Potentially explosive areas are divided into zones in accordance with the frequency and duration of the occurrence of a potentially explosive atmosphere. The scope of measures to be taken in accordance with Directive 1999/92/EC results from this classification.

In the interior area of the pump the existence of an Ex-Zone depends on the properties of the pumped liquid.

- In the case of pumped liquids whose flash point lies **below** the maximum permissible ambient temperature, an Ex-Zone 0 in the interior of the pump is to be assumed at the presence of air in the piping or pump.
Only if the simultaneous transporting of the pumped liquid and air is excluded through appropriate measures in the system, does only Ex-Zone 2 exist in the interior of the pump (potentially explosive atmosphere only at malfunctions.)
- In the case of pumped liquids whose flash point lies **above** the maximum permissible ambient temperature, a potentially explosive atmosphere cannot arise in the interior of the pump even at the presence of air in the piping or pump. In this case the interior of the pump does not have an Ex-Zone.



⚠ DANGER

Risk of death through loss of the explosion protection.

The temperature in and at the pump may not exceed values that depend on the concrete application and the pumped liquid. The limit is the maximum permissible surface temperature minus 25 K, since further heating up continues briefly after switching off.

- ▶ Ensure that the temperature in and at the pump is monitored continuously.
- ▶ Use flow indicators/dry running protection so that, for example, immediate response to dry running is possible.
- ▶ Alternatively, use a temperature sensor to monitor the temperature directly in/at the pump.
- ▶ If the temperature limit is exceeded, the pump unit must be switched off immediately.



⚠ DANGER

Risk of death through loss of the explosion protection.

Heating elements must be stored, installed, operated and checked regularly in accordance with the operating instructions and technical data of the manufacturer. Otherwise explosion protection is not ensured.

- ▶ Heating elements are closed in the factory. Do not open the heating elements.
- ▶ Store heating elements protected against dust.
- ▶ Before commissioning the heating element check its insulation resistance.
- ▶ Check the heating element regularly after installing it.
- ▶ It is imperative that the instructions and technical data of the manufacturer of the heating element be observed.

The following sections list possible ignition sources in accordance with EN 1127-1.

2 Safety

2.7 Safety instructions

2.7.2 Ignition sources in normal operation

Ignition sources in normal operation	Causes and protective measures
Static electricity	Static charging of the can occur due to elastomers in the coupling. ▶ Ground the pump/pump unit carefully.
Electrical compensating currents	Through stray currents sparks can be ignited during the disconnection, connection or bypassing of the pump as an electrically conductive part of a system. ▶ Ground the pump/pump unit carefully.
Electromagnetic waves (10 ⁴ –3x10 ¹¹ Hz)	In the case of high-frequency electromagnetic waves the pump can act like a receiving antenna. ▶ Ensure that no danger of ignition through electromagnetic waves can occur in the area surrounding the pump.
Electromagnetic waves (3x10 ¹¹ –3x10 ¹⁵ Hz)	In this spectral range, for example sunlight, ignition can occur through absorption on solid surfaces such as the pump – in particular if focussing occurs. ▶ Ensure that no danger of ignition through electromagnetic waves can occur in the area surrounding the pump.
Hot surfaces	In normal operation the surface temperature of the pump lies only marginally above the temperature of the pumped liquid. Slightly higher temperatures arise in the interior of the pump through friction of the rotating parts, the shaft seal, the magnetic coupling (eddy current losses at the containment can). ▶ If a quench tank is used, check the filling level of the quench regularly every 2 weeks.

Tab. 5: Ignition sources in normal operation

The use of pumps with an EU Declaration of Conformity to Directive 2014/34/EU is permissible in Ex-Zone 2 and 22 ("safe in normal operation") without further protective measures.

Notice The maximum surface temperatures at the pump and its components to be expected during normal operation are determined by the temperature and viscosity of the pumped liquid, motor speed and differential pressure of the pump. Therefore "TX", which points the special surface temperatures, is to be specified instead of a temperature class in the ATEX marking. The liquid temperature is to be specified in the performance test record of the pump.

2.7.3 Ignition sources at foreseeable malfunctions

Ignition sources at foreseeable malfunctions	Causes and protective measures
Dry running of the pump	Possible causes: <input type="checkbox"/> Lack of pumped liquid, for example in the quench tank <input type="checkbox"/> Suction of air when there is a leak in the suction line <input type="checkbox"/> Closed shut-off device Dry running causes friction at the rotating parts with strong heating up. ▶ Use a flow indicator/dry running protection. If the flow indicator/dry running protection signals, the pump unit must be switched off immediately. ▶ Alternatively ensure direct temperature monitoring by means of a temperature sensor. If the maximum permitted temperature limit is exceeded, the pump unit must be switched off immediately.
Operation during blocked pressure line	Possible causes: <input type="checkbox"/> Closed shut-off valve in the pressure line The internal overflow valve opens and the complete delivery rate circulates in the pump. This results in strong heating up of the pump. ▶ Use a flow indicator/dry running protection. If the flow indicator/dry running protection signals, the pump unit must be switched off immediately. ▶ Alternatively ensure direct temperature monitoring by means of a temperature sensor. If the maximum permitted temperature limit is exceeded, the pump unit must be switched off immediately.

Ignition sources at foreseeable malfunctions	Causes and protective measures
Dry running of the mechanical seal	<p>Possible causes:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lack of venting during the commissioning <input type="checkbox"/> Formation of a gas bubble in the sealing chamber at gas-laden pumped liquid <p>Dry running causes friction at the rotating parts with strong heating up.</p> <ul style="list-style-type: none"> ▶ Prevent dry running of the mechanical seal, for example through a quench. Check the filling level of the quench regularly every 2 weeks. ▶ Alternatively, use a flow indicator/dry running protection and ensure that the pumped liquid is free of gas. Vent the sealing chamber during commissioning and subsequently regularly every 4 weeks.
Overheating of the pump at outer bearing	<p>Possible causes:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Lack of lubrication of the bearings <ul style="list-style-type: none"> ▶ Use lifetime lubricated bearings. ▶ Check the bearings regularly every 4 weeks for noises and vibration and replace immediately when conspicuities arise. ▶ Always replace bearings after 30,000 operating hours or in accordance with the order-specific documentation.
Overheating through surface damage	<p>Possible causes:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Abrasive substances in the pumped liquid <input type="checkbox"/> Temporary dry running <p>Surface damage causes friction at the rotating parts with strong heating up.</p> <ul style="list-style-type: none"> ▶ Monitor the temperature, for example by using a temperature sensor.
Overheating of the magnetic coupling	<p>Possible causes:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Reduction of loss of the heat-dissipating leak flow through soiling, caking, crystallizing pumped liquid <p>Through eddy current losses at the containment can and shear stress of the pumped liquid, heat that is dissipated through a correspondingly dimensioned leak flow arises.</p> <ul style="list-style-type: none"> ▶ Monitor the temperature of the containment can by means of a temperature sensor (limit temperature = Max. permissible surface temperature -25 K) ▶ If the temperature limit is exceeded, the pump unit must be switched off immediately. ▶ Check the temperature sensor regularly every 4 weeks, through brief disconnection of the sensor. If it functions correctly, the pump unit must be switched off immediately.

Tab. 6: Ignition sources at foreseeable malfunctions

The use of pumps with an EU Declaration of Conformity to Directive 2014/34/EU is also permissible in Ex-Zone 1 and 21 ("high safety") with the specified protective measures.

3 Identification

3.1 ATEX marking

3 Identification

3.1 ATEX marking

Screw pumps that are intended for proper use in potentially explosive areas have the ATEX marking in addition to the rating plate.

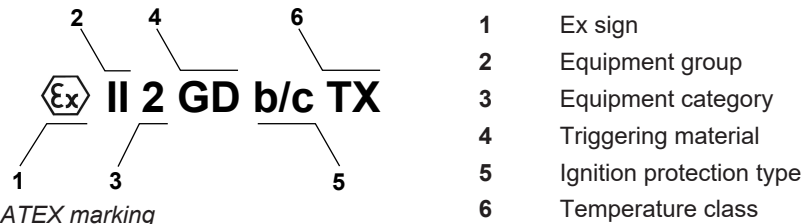


Fig. 1: ATEX marking

Item	Designation	Meaning
1	Ex sign	
2	Equipment group	I Equipment for use in underground mining, ...
		II Equipment in the remaining areas
3	Equipment category	For the occurrence of a potentially explosive atmosphere:
		1 Long-term, continually or frequently
		2 Occasionally
		3 Brief and rare
4	Triggering material	G Gases, vapours, mist
		D Dusts
5	Ignition protection type	b Ignition source monitoring
		c Constructional safety
6	Temperature class	TX Special surface temperature

Tab. 7: ATEX marking

Notice If an electrical heating system is used, additionally take into account the ATEX marking of the electrical heating system!

4 Transportation, storage

4.1 Storing heating elements

1. ➤ Ensure that dust deposits do not form on the heating element.
2. ➤ Store the heating element in the supplied air-tight plastic bag until it installed.

5 Installation, removal

5.1 Installing the electrical heating system

Personnel qualification:	<input type="checkbox"/> Electrician
Personal protective equipment:	<input type="checkbox"/> Work clothing
	<input type="checkbox"/> Protective gloves
	<input type="checkbox"/> Safety boots



DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

- ▶ Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.



DANGER

Risk of death through loss of the explosion protection.

Heating elements must be stored, installed, operated and checked regularly in accordance with the operating instructions and technical data of the manufacturer. Otherwise explosion protection is not ensured.

- ▶ Heating elements are closed in the factory. Do not open the heating elements.
- ▶ Store heating elements protected against dust.
- ▶ Before commissioning the heating element check its insulation resistance.
- ▶ Check the heating element regularly after installing it.
- ▶ It is imperative that the instructions and technical data of the manufacturer of the heating element be observed.

ATTENTION

Damage to the electrical heating system through leakage currents or flashovers at the emission point of the connecting cable.

- ▶ Protect the area of the connecting head against liquid and pasty liquids (lubricants, oil, plastics, etc.) as well as their vapours.

Notice For the case that the surface temperature of the heating element can lie above the ignition temperature of the potentially explosive atmosphere, the upper part of the casing of the heating element with the hole forms a spark-proof gap. This gap must be at least 30 mm long. The maximum width of the gap is specified in the drawing of the heating element.

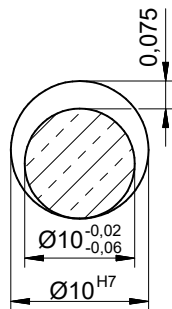


Fig. 2: Electrical heating system gap clearance

Requirement:

- ✓ Area of the connecting head protected against liquid and pasty liquids (lubricants, oil, plastics, etc.) as well as their vapours.
 - ✓ Supply lines protected against mechanical vibrations in the area of the emission from the heating element. Any vapours arising have to escape freely.
 - ✓ Heating element absolutely dry.
 - ✓ Gap clearance between the heating element and the hole lies within the tolerances as specified in the drawing.
1. ▶ Install the electrical heating system in accordance with the operating instructions of the pump and the regulations of the manufacturer of the heating element.
 2. ▶ Insert the heating element completely into the blind hole.
If the distance between the heating element and hole bottom > 2 mm, fill the space with temperature-resistant glass wool.
 3. ▶ Mount the heating element undetachably via the fastening device.
 4. ▶ Ensure that permanent and firm contact is ensured via the fastening device.

6 Connection

6.1 Connecting the electrical heating system



DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

- ▶ Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.



DANGER

Risk of death resulting from electric shock.

- ▶ Ensure that the electrical power supply is de-energized and is secured against being switched back on.
- ▶ Observe the operating instructions of the electrical components.



DANGER

Risk of injury through emitted pumped liquid.

The pump housing may burst through heat expansion of the pumped liquid.

- ▶ Open all the valves during the heating process.

1. ▶ Protect the heating element with a sufficiently dimensioned back-up fuse.
2. ▶ Connect the connecting cable of the heating element.

7 Operation

7.1 Commissioning

7.1.1 Checking the insulation resistance

▶ Before commissioning check the insulation resistance of the heating element in accordance with the following table.

Parameter	Unit	Value
Test basis		EN 60079-7, Section 6.8.3 a) and b) (VDE 0170-6)
Test voltage	[V]	500
Insulation resistance, required	[MΩ]	≥ 20

Tab. 8: Checking the insulation resistance

8 Maintenance

8.1 Additional required maintenance in case of use in potentially explosive areas

Component	Required maintenance	Cycle
Bearing at outer bearings	<input type="checkbox"/> Check for noises and vibration Caution: Replace the bearings immediately in the case of conspicuities!	4 weeks
Flow indicator	<input type="checkbox"/> Function test	4 weeks
Temperature sensor (surface/mechanical seal/containment can)	<input type="checkbox"/> Function test	4 weeks
Mechanical seal with quench	<input type="checkbox"/> Check the filling level of the quench	2 weeks
	<input type="checkbox"/> Vent the sealing chamber	4 weeks
Heating element	<input type="checkbox"/> Visual inspection for damage/soiling	Up to 2 years' operation: 6 months
	<input type="checkbox"/> Function test	As of 2 years' operation or 7000 operating hours: 3 months

Tab. 9: Additional required maintenance

Notice Test intervals have to be specified for the entire operating life in accordance with the applicable national laws on occupational safety laws. Tests and checks have to be carried out at least once a year.

8.2 Checking the heating element

Personnel qualification:	<input type="checkbox"/> Fitter
Personal protective equipment:	<input type="checkbox"/> Work clothing <input type="checkbox"/> Protective gloves <input type="checkbox"/> Safety boots <input type="checkbox"/> Face protection



! DANGER

Magnetic field.

Risk of death for persons with cardiac pacemaker, metallic implant or neurostimulator.

- ▶ Under no circumstances may persons with cardiac pacemakers, metallic implant or neurostimulator perform work on the pump/pump unit.

—▶ Check the insulation resistance of the heating element, see the following table.

-or-

Check the differential current of the heating element, see the following table.

⇒ If the limits specified in the standards are exceeded, replace the heating element.

Parameter	Unit	Value
Test basis		EN 60079-7, Section 6.8.3 a) and b) (VDE 0170-6)
Test voltage	[V]	500
Insulation resistance, required	[MΩ]	≥ 20

Tab. 10: Checking the insulation resistance

Parameter	Unit	Value
Test basis		DIN VDE 0701-0702
Connecting cable	[kW]	> 3.5
Min. current	[mA/kW (AC)]	1.0
Max. current	[mA (AC)]	3.5

Tab. 11: Checking the differential current

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