

## Wilo Motor FKT 20.2, 27.1, 27.2: EMU FA, Rexa SUPRA, Rexa SOLID



**zh-CHS** 安装及操作说明

**en** Installation and operating instructions



|                                  |           |
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## 1 概述

### 1.1 关于本说明书

本说明书是产品的固定组成部分。遵守本说明书中列出的要求和操作步骤，是按规定使用及正确操作产品的前提条件：

- 在执行所有工作前或使用产品前请仔细阅读本说明书。
- 请妥善保管说明书，以备随时使用。
- 另外注意遵守产品上标注的所有产品相关参数和标识。

原版操作说明书以德语撰写。所有其它语种的说明书均为其翻译件。

### 1.2 版权

本说明书的版权归Wilo所有。所有内容禁止以任何形式：

- 翻版。
- 传播。
- 出于竞争目的非法使用。

Wilo保留更改所述数据的权利，恕不另行通知，对于技术性描述不准确和/或遗漏不承担任何责任。

### 1.3 保留更改权力

Wilo保留对产品以及单个部件进行技术变更的权利。说明书中使用的图片可能与实际设备存在偏差，仅用于举例介绍产品。

### 1.4 保修和免责声明

Wilo对于如下情况，不承担任何保修义务或责任：

- 由于运营者或委托方提供的数据存在缺陷或者错误，导致出现配置欠缺问题
- 不遵守本说明书的内容
- 未按规定使用
- 不按规范存放或运输
- 错误安装或拆卸
- 缺乏维护
- 无授权维修
- 安装基础有缺陷
- 化学、电气或电化学影响
- 磨损

## 2 安全

本章节主要介绍各生命阶段适用的基础提示信息。不遵守提示会导致下列危险：

- 电气、机械和细菌作用以及电磁场危害人身安全
- 有害物质泄漏会污染环境
- 物资损失
- 产品重要功能失灵

不遵守提示信息会导致丧失索赔权利。

此外也应遵守其他章节列出的各项指导说明和安全说明！

### 2.1 安全说明的标识

本安装及操作说明针对物资损失和人身安全问题列举了多项安全说明。其表现形式各有不同：

- 涉及到人身安全问题的安全说明以一个信号词作为开端，配套使用相应的符号并使用灰色作为背景色。



#### 危险

##### 危险类型和危险源！

危险产生的影响以及避免危险说明。

- 涉及到物资损失问题的安全说明也以一个信号词作为开端，但是没有符号。

#### 小心

##### 危险类型和危险源！

影响或信息。

#### 信号词

- 危险！
- 如不注意，会导致死亡或重伤！

- 警告！  
如不注意，可能导致人员受伤（重伤）！
- 小心！  
如不遵守，可能造成物资损失，甚至导致全损。
- 提示！  
操作产品时有用的注意事项

#### 文本说明

- ✓ 前提条件
- 1. 操作步骤/细目列举
  - ⇒ 提示/指导
- 结果

#### 图标

在本说明书中使用以下图标：



电击危险



细菌感染危险



强磁场危险



爆炸危险



爆炸气体导致危险



一般警告图标



切割受伤警告



高温表面警告



高压警告



悬挂物警告



个人防护装备：戴安全头盔



个人防护装备：穿劳保鞋



个人防护装备：戴防护手套



个人防护装备：佩戴口罩



个人防护装备：戴护目镜



禁止独自工作！必须两人在场。



实用注意事项

## 2.2 工作人员资格鉴定

工作人员必须：

- 了解当地现行的事故预防条例。
- 已阅读安装及操作说明书并且理解其中内容。

工作人员必须具备下列资质：

- 电气作业：电气作业必须由专业电工执行。
- 安装/拆卸工作：必须由专业人员执行，而且要求该人员接受过相关培训，了解工作中会用到的工具以及当前施工现场需要使用的固定材料。
- 保养工作：必须由熟悉所使用工作介质及其废弃处置的专业人员执行。此外工作人员还必须具有机械制造方面的基础知识。

### “专业电工”定义

所谓“专业电工”，是指接受过相关培训，具备所需知识和经验，能够发现并且规避电力危险的人员。

## 2.3 电气作业

- 电气作业由专业电工负责执行。
- 在对产品开始任何作业之前，都应先将其断电并采取措施防止重新接通。
- 通电时注意遵守当地相关法规。
- 注意遵守当地供电公司的相关规定。
- 将电气连接方式等知识告知相关人员。
- 告知相关人员如何关闭产品。
- 遵守本安装及操作说明以及铭牌上给出的技术参数。
- 将产品接地。
- 遵守电气开关设备连接规定。
- 如果使用启动控制器（比如软启动或变频器等），注意遵守电磁兼容性规定。如果需要，考虑采取专业措施（比如使用屏蔽电缆和滤波器等）。
- 更换损坏的接线电缆。请咨询客户服务部。

## 2.4 监控装置

安装方必须准备下列监控设备：

### 断路器

断路器的规格和开关属性取决于所连接产品的额定电流。注意遵守当地相关法规。

### 电机保护开关

对于不带插头的产品，安装方应该准备一个电机保护开关！最低要求是配备一个符合本地规定，具备温度补偿、差分触发和重启锁定功能的热敏继电器/电机保护开关。针对反应灵敏的电网，安装方还应准备其他保护装置（比如超压、欠压或缺相继电器等）。

### 漏电断路器 (RCD)

遵守当地供电公司的相关规定！建议使用漏电断路器。

如果人员可能接触到产品和导电液体，需要对电路连接采取安全措施，装备一个漏电断路器 (RCD)。

## 2.5 在危害健康的介质内使用

如果在危害健康的介质内使用产品，可能导致细菌感染危险！拆下之后，以及再次使用之前，应该彻底清洁产品并进行消毒。运营者必须注意以下几点：

- 进行产品清洁时，提供下列防护装备供工作人员使用：
  - 封闭式护目镜
  - 氧气面罩
  - 防护手套
- 告知所有工作人员，流体会导致危险，并普及正确的流体处理方法！

## 2.6 永磁电机

通过永磁转子驱动永磁电机。在使用永磁电机时请注意以下几点：



### → 磁铁和磁场

如果关闭电机外壳，磁铁和磁场不会产生危险。对于佩戴心脏起搏器的人同样不会构成特殊危险。在保养时可毫无顾忌地打开螺旋塞。绝对不能打开电机外壳！只有客户服务部可以在打开的电机上作业！

### → 发电机运行模式

如果在没有电能情况下驱动转子（比如在流体回流时），电机会产生感应电压。这时接线电缆会通电。另外在连接有水泵时，会向连接的变频器馈能。为避免因过电压损坏变频器和电机，设计了以下方案：

- 向供电网反馈传入的能量。
- 通过制动电阻导出传入的能量。

## 2.7 运输

### → 穿戴以下防护装备：

- 安全鞋
- 安全头盔（使用提升设备的情况下）

### → 运输产品时始终抓住把手。不得拉扯接线电缆！

### → 只使用合法且获得认证的提升装置。

### → 根据实际情况（天气、接合点、负载等）选择提升装置。

### → 始终把提升装置固定在接合点（把手或吊孔）上。

### → 使用期间必须保证提升设备稳定可靠。

### → 使用提升设备时，如果需要（比如视线受阻），安排另外一位工作人员负责协调。

### → 切勿在悬挂物下停留。悬挂物切勿从有人员停留的工作位置上方经过。

## 2.8 安装/拆卸工作

### → 穿戴以下防护装备：

- 安全鞋
- 安全手套，用以预防切割伤害
- 安全头盔（使用提升设备的情况下）

### → 遵从当地有关作业安全和事故防范措施的现行法律法规。

### → 将产品断电并采取安全措施防止意外接通。

### → 所有旋转零部件均须保持静止。

### → 在封闭的空间内需提供足够的通风条件。

### → 在集水坑和封闭空间内作业时，为安全起见，必须有第二个人在场。

### → 如果出现有毒气体或窒息气体汇集的情况，立刻采取对策！

### → 彻底清洁产品。如果在危害健康的流体内使用过产品，请消毒！

### → 进行所有焊接作业或使用电气装置工作时，确保不存在爆炸风险。

## 2.9 运行期间

### → 穿戴以下防护装备：

- 安全鞋
- 耳罩（遵循工作规程的相关通知）

### → 产品工作区域不是人员停留区。在产品运行期间，禁止任何人在工作区域内停留。

### → 通过单独的控制器根据流程接通和断开产品。在停电之后，可自动接通产品。

### → 一旦发生故障或者出现异常，操作人员必须立即报告主管。

### → 一旦出现危及人身安全的缺陷，操作人员必须立刻关闭设备：

- 安全和监控设备故障
- 外壳部件损坏
- 电气装置损坏

### → 切勿探入吸水口中。旋转的部件可能会对身体造成挤伤或割伤。

### → 如果电机在运行过程中浮出水面，而且采取干式地坑安装方式，这种情况下电机外壳温度可能超过 40 °C (104 °F)。

### → 打开入口侧和出口侧管路中的所有截止阀。

### → 通过干转保护确保不会低于最低水浸。

### → 在一般工作条件下，产品的噪声低于 85 dB(A)。但是实际发出的噪声受多种因素影响：

- 安装深度
- 安装
- 附件和管路固定件
- 工况点
- 潜水深度

### → 如果产品在有效的工作条件下运行，则运营者方面必须执行声压测量。声压超过 85 dB(A) 时，佩戴耳罩并标识工作区域！

## 2.10 维护工作

### → 穿戴以下防护装备：

- 封闭式护目镜
- 安全鞋
- 安全手套，用以预防切割伤害

- 始终在运行空间/安装地点以外执行维护工作。
- 只执行本安装及操作说明中列出的维护工作。
- 进行维护和维修时，只能使用生产商提供的原装部件。由于使用非原装部件而造成的任何损失，生产商概不承担任何责任。
- 一旦发生流体和工作介质泄露事故，立即收集泄漏物并按照当地现行法规进行废弃处理。
- 将工具保管在指定位置。
- 工作结束后，重新安装所有安全和监控设备，并检查其功能是否正确。

#### 更换工作介质

一旦发生损坏，电机内可能形成高达数巴的压力！打开螺旋塞时，这种压力会向外冲出。如果打开螺旋塞时不注意，它可能会高速弹出！请始终遵守以下指示，避免受伤：

- 遵守规定的工作步骤顺序。
- 缓慢转动螺旋塞，不要完全拧出。开始泄压之后（可听见空气鸣叫声或嘶嘶声），不要继续转动螺旋塞。  
警告！泄压时可能喷出高温工作介质，会导致烫伤！为了避免受伤，执行任何作业之前，都应先将电机冷却到环境温度！
- 待泄压完成之后，完全拧出螺旋塞。

### 2.11 工作介质

电机的密封室和冷却系统中注有白油或水与乙二醇混合物。定期维护时必须更换工作介质，之后按照本地相关法规进行废弃处置。

### 2.12 运营者的责任

- 为工作人员提供以其母语写成的安装及操作说明。
- 为工作人员提供必要的培训，确保其能胜任指派的工作。
- 提供必要的防护装备并保证工作人员佩戴防护装备。
- 使产品上安装的安全和提示标牌长期保持清晰可读状态。
- 使工作人员了解设备的功能原理。
- 杜绝电流导致危险。
- 为设备中的危险部件装备触摸防护装置（安装方提供）。
- 标记工作区并采取安全措施。
- 为工作人员指定工作范围，保证安全作业。

禁止儿童和 16 岁以下或身体、感官或精神上能力不足的人员处理该产品！18 岁以下人员必须由专业人员监督！

## 3 应用/使用

### 3.1 规定用途

潜水泵适用于泵送：

- 含有粪便的污水
- 污水（含少量沙子和砂砾）
- 工艺污水
- 干物质所占比例不超过 8 % 的流体

### 3.2 未按规定使用



#### 危险

##### 输送爆炸性流体会导致爆炸！

严禁输送纯粹形态下的易燃易爆流体（汽油、煤油等）。爆炸导致生命危险！水泵不是针对这类流体设计出的产品。



#### 危险

##### 危害健康的流体会导致危险！

如果在危害健康的流体中使用过水泵，则拆卸水泵后必须进行消毒处理，之后才能用于其他工作！有生命危险！遵守工作规程的相关规定！运营者必须保证工作人员已经收到并阅读工作规程！

潜水泵不得用于泵送以下流体：

- 饮用水
- 混杂硬物（比如石头、木头、金属等）的流体
- 含有大量磨蚀性物质（比如沙子、砂砾等）的流体。

符合规定的使用还包括遵守本说明的规定。任何超出规定范围的应用均视为不合规定。

4 产品说明

4.1 结构

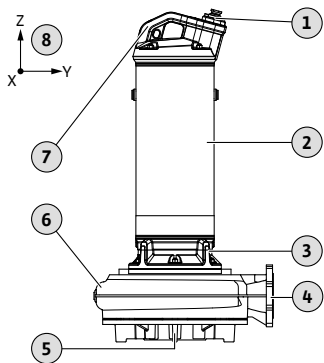


Fig. 1: 示意图

4.1.1 水力部件

污水潜水泵作为潜水式整机组，适用于湿井安装和干式地坑安装。

|   |                                   |
|---|-----------------------------------|
| 1 | 进线接线电缆                            |
| 2 | 带冷却罩的电机                           |
| 3 | 密封壳体/轴承箱体                         |
| 4 | 出水口                               |
| 5 | 吸水口                               |
| 6 | 水力部件外壳                            |
| 7 | 吊装孔/把手                            |
| 8 | 坐标系：Digital Data Interface中的振动传感器 |

离心式水力部件配备不同形式的叶轮、出口侧水平法兰接口以及泵体密封环和叶轮耐磨环。  
水力部件不是自吸式产品，即流体必须自动流入或者在一定的供给压力下流入。

叶轮形式

叶轮形式取决于叶轮规格，不是所有叶轮形状都适合所有水力部件。下文概述介绍各种叶轮形式：

- 涡流叶轮
- 单通道叶轮
- 双通道叶轮
- 三通道叶轮
- 四通道叶轮
- SOLID 叶轮，封闭或半开

泵体密封环和叶轮耐磨环（取决于水力部件）

吸水口和叶轮在泵送过程中大多承受负荷。如果装备通道叶轮，则叶轮和吸水口之间的间隙是保持恒定效率的重要因素。叶轮和吸水口之间的间隙越大，输出量的损耗就越高。这样会降低效率，发生堵塞的危险提高。为了确保水力部件能够长期高效运行，视装备的叶轮和水力部件而定，设备装有一个叶轮耐磨环和/或泵体密封环。

- 叶轮耐磨环  
叶轮耐磨环安装在通道叶轮上，保护叶轮的入流边。
- 泵体密封环  
泵体密封环安装在水力部件的吸水口中，保护通向离心室的入流边。

在磨损时，客户服务部可方便地更换两个部件。

4.1.2 电机

三相交流电规格的自冷却型异步或永磁电机。通过主动式冷却系统进行冷却。该电机都可以在浸入非浸入状态下，以及在干式地坑安装中连续运行。接线电缆有裸线端。

电机装备概述

|                        | 异步电动机    |          | 永磁电机          |
|------------------------|----------|----------|---------------|
|                        | FKT 20.2 | FKT 27.x | FKT 20.2...-P |
| 类型                     | 异步       | 异步       | 同步            |
| 最高效率等级（根据 IEC 60034）   | IE3      | IE3      | IE5           |
| 使用变频器运行                | o        | o        | ! (Wilo-EFC)  |
| Digital Data Interface | o        | –        | •             |
| 浸入运行模式                 | S1       | S1       | S1            |
| 非浸入运行模式                | S1       | S1       | S1            |

|                    | 异步电动机    |          | 永磁电机          |
|--------------------|----------|----------|---------------|
|                    | FKT 20.2 | FKT 27.x | FKT 20.2...-P |
| 干式地坑安装运行模式         | S1       | S1       | S1            |
| 上方滚动轴承：永久润滑的，维护需求低 | •        | •        | •             |
| 下方滚动轴承：永久润滑的，维护需求低 | •        | •        | •             |
| 纵向防水密封接线电缆         | •        | •        | •             |

! = 必要/前提条件，• = 标配，o = 可选，- = 不可用

#### 4.1.3 密封件

流体密封件和电机舱密封件类型不同：

- “G”型：两个单独的机械密封
- “K”型：两个机械密封装在一个不锈钢制成的整装密封盒中

根据电机结构尺寸，两种不同类型的冷却系统的规格为：

- FKT 20.2：密封室和冷却系统形成一套单腔系统。密封室和冷却系统填充有冷却液 P35。
- FKT 27.x：密封室和冷却系统形成一套双腔系统。这时密封室填充有医用白油，冷却系统填充有冷却液 P35。

如果密封件发生泄漏，液体会进入密封室或泄漏腔：

- 密封室接收流体侧密封件泄漏出的液体。
- 泄漏腔接收电机侧密封件泄漏出的液体。泄漏腔在出厂时是空的。

#### 4.1.4 冷却系统

电机拥有一套有单独冷却回路的主动式冷却系统。使用水与乙二醇混合物 P35 作为冷却液。通过叶轮循环冷却液。通过电机轴驱动叶轮。余热通过散热凸缘直接排放到流体中。冷却系统本身在低温状态下无压力。

#### 4.1.5 材料

标准规格使用下列材料：

- 水泵壳体：灰口铸铁
- 叶轮：灰口铸铁
- 电机外壳：灰口铸铁
- 电机侧密封件：
  - “G”= 碳/陶瓷或 SiC/SiC
  - “K”= SiC/SiC
- 流体侧密封件：SiC/SiC
- 静态密封件：FKM (ASTM D 1418) 或 NBR（丁腈橡胶）

所使用材料的精确参数体现在相应的配置中。

## 4.2 Digital Data Interface



### 注意

#### 注意 Digital Data Interface 的说明书！

阅读并遵守有关 Digital Data Interface 的单独说明书，以了解详细信息和高级设置。

Digital Data Interface 是一种集成在电机中的通讯模块，包括集成式网络服务器。通过用户图形界面，借助网络浏览器进行访问。通过用户界面可方便地配置、控制和监控水泵。为此可在水泵中安装不同的传感器。另外可通过外部控制的信号变送器将其他设备参数加载到控制装置中。Digital Data Interface 可根据系统模式：

- 监控水泵。
- 使用变频器控制水泵。
- 控制有最多 4 台水泵的完整设备。

## 4.3 监控设备

### 监控设备概述

|                        | 异步电动机    |          |          | 永磁电机          |
|------------------------|----------|----------|----------|---------------|
|                        | FKT 20.2 | FKT 20.2 | FKT 27.x | FKT 20.2...-P |
| <b>内部监控设备</b>          |          |          |          |               |
| Digital Data Interface | –        | •        | –        | •             |
| 端子室/电机舱：湿度             | –        | –        | •        | –             |

|            | 异步电动机    |                    |          | 永磁电机               |
|------------|----------|--------------------|----------|--------------------|
|            | FKT 20.2 | FKT 20.2           | FKT 27.x | FKT 20.2...-P      |
| 电机绕组：双金属   | •        | —                  | •        | —                  |
| 电机绕组：PTC   | o        | • (+ 1...3x Pt100) | o        | • (+ 1...3x Pt100) |
| 电机轴承：Pt100 | o        | o                  | o        | o                  |
| 密封室：电感式传感器 | —        | —                  | —        | —                  |
| 密封室：电容式传感器 | —        | •                  | —        | •                  |
| 泄漏腔：浮子开关   | •        | —                  | •        | —                  |
| 泄漏腔：电容式传感器 | —        | •                  | —        | •                  |
| 振动传感器      | —        | •                  | —        | •                  |
| 外部监控设备     |          |                    |          |                    |
| 密封室：电感式传感器 | o        | —                  | o        | —                  |

• = 标配, — = 不可用, o = 可选

所有现有的监控设备必须始终处于连接状态！

#### 4.3.1 无 Digital Data Interface 的电机

##### 端子室和电机舱监控

端子室和电机舱监控设备保护电机接口和电机绕组免于短路。湿度探测通过端子室和电机舱内的电极实现。

##### 电机绕组监控

电机过热保护可以保护电机绕组免于过热。标准安装带一个双金属片的温度限制装置。如果达到反应温度，必须使用重启锁定功能执行一次关闭操作。

温度探测装置可以选装一个 PTC 传感器。此外也可将电机过热保护装置用作温度调节装置。这样就可以探测两个温度。如果达到更低的反应温度，可以在电机冷却后执行一次自动重启。只有达到高反应温度时，才必须使用重启锁定功能执行一次关闭操作。

##### 密封室外部监控装置

密封室可以装备一个外部铅芯湿度电极。电极记录通过液体侧机械密封渗入介质的事件。之后就可以通过水泵控制器生成报警或者关闭水泵。

##### 泄漏腔监控

泄漏腔装有一个浮子开关。浮子开关记录通过电机侧机械密封渗入流体的事件。之后就可以通过水泵控制器生成报警或者关闭水泵。

##### 电机轴承监控

电机轴承热监控设备保护滚动轴承免于过热。使用 Pt100 传感器记录温度。

#### 4.3.2 有 Digital Data Interface 的电机



##### 注意

##### 注意 Digital Data Interface 的说明书！

阅读并遵守有关 Digital Data Interface 的单独说明书，以了解详细信息和高级设置。

通过 Digital Data Interface 分析所有现有的传感器。通过 Digital Data Interface 的图形操作界面显示当前值和设置极限参数。在超过极限参数时会发出警示或警报信息。为安全关闭水泵，电机绕组另外配备有 PTC 传感器。

#### 4.4 运行模式

##### 运行模式 S1：连续运行

水泵能在额定负荷下连续运行，而不会超过允许的温度。

##### 运行模式：非浸入运行

“非浸入运行”这种运行模式描述电机在水泵运行过程中浮出水面。这时水位可以降低至更低位置，直至达到水力部件上缘。非浸入运行时注意以下几点：

- 运行模式：连续运行 (S1)。
- 最高流体和环境温度：最高环境温度与依据铭牌的最高介质温度相匹配。

4.5 使用变频器运行  
4.5.1 异步电动机

允许使用变频器运行异步电动机。变频器必须至少有以下接口：

- 双金属和 PTC 传感器
- 湿度电极
- Pt100 传感器（如果有电机轴承监控！）

其他要求参考并注意遵守章节“在变频器上运行 [► 50]”！

如果电机配备有 Digital Data Interface，另外要确保具备以下前提条件：

- 网络：Ethernet 10BASE-T/100BASE-TX，基于 IP
- 协议支持：Modbus TCP/IP

详细的要求请参考 Digital Data Interface 的单独说明书！

4.5.2 永磁电机

在运行永磁电机时，确保具备以下前提条件：

- 有 PTC 传感器接口的变频器
- 网络：Ethernet 10BASE-T/100BASE-TX，基于 IP
- 协议支持：Modbus TCP/IP

详细的要求请参考 Digital Data Interface 的单独说明书！

永磁电机允许使用以下变频器运行：

- Wilo-EFC

其他变频器敬请垂询！

4.6 在易爆环境中运行

|             | 异步电动机    |          | 永磁电机          |
|-------------|----------|----------|---------------|
|             | FKT 20.2 | FKT 27.x | FKT 20.2...-P |
| 经 IEC-Ex 批准 | o        | –        | o             |
| 经 ATEX 批准   | o        | o        | o             |
| 经 FM 批准     | o        | o        | o             |
| 经 CSA-Ex 批准 | –        | –        | –             |

图例  
– = 不存在/不可能，o = 可选，• = 标配

在爆炸性气体中使用时，水泵铭牌上必须具有下列标识：

- 相应认证的防爆标识
- 防爆等级

关于防爆电缆的相关要求，参见本操作说明书的附录，并注意遵守要求！

**ATEX 认证**

水泵适合在潜在爆炸环境中运行：

- 设备组：II
- 类别：2，1 区和 2 区  
水泵不可在 0 区使用！

**FM 认证**

水泵适合在潜在爆炸环境中运行：

- 防护等级：Explosionproof
- 类别：Class I，Division 1  
注意：如果根据 Division 1 布线，则也允许在 Class I，Division 2 中安装。

4.7 铭牌

下面概述介绍铭牌上的缩写词和相关数据：

| 铭牌缩写词          | 含义    |
|----------------|-------|
| P-Typ          | 水泵类型  |
| M-Typ          | 电机类型  |
| S/N            | 序列号   |
| Art.-No.       | 商品号   |
| MFY            | 生产日期* |
| Q <sub>N</sub> | 工况点流量 |

| 铭牌缩写词          | 含义         |
|----------------|------------|
| $Q_{\max}$     | 最大流量       |
| $H_N$          | 工况点扬程      |
| $H_{\max}$     | 最大扬程       |
| $H_{\min}$     | 最小扬程       |
| $n$            | 转速         |
| $T$            | 流体最高温度     |
| IP             | 防护等级       |
| I              | 额定电流       |
| $I_{ST}$       | 启动电流       |
| $I_{SF}$       | 服务因数下的额定电流 |
| $P_1$          | 功耗         |
| $P_2$          | 额定功率       |
| U              | 额定电压       |
| $U_{EMF}$      | 感应电压       |
| f              | 频率         |
| $f_{op}$       | 最高工作频率     |
| $\cos \varphi$ | 电机效率       |
| SF             | 服务因数       |
| $OT_s$         | 运行模式：浸入式   |
| $OT_E$         | 运行模式：非浸入式  |
| AT             | 启动方式       |
| $IM_{org}$     | 叶轮直径：初始    |
| $IM_{korr}$    | 叶轮直径：修正后   |

\*生产日期书写格式符合 ISO 8601 标准：JJJJWww

- JJJJ = 年份
- W = 周缩写词
- ww = 日历周数据

4.8 型号代码

各个水力部件之间的型号代码不同。下面展示各个型号代码。

4.8.1 水力部件型号代码：EMU FA

| 示例：Wilo-EMU FA 15.52-245E |  |
|---------------------------|--|
| FA                        | 污水泵  |
| 15                        | x10 = 压力连接公称直径   |
| 52                        | 内部功率因数   |
| 245                       | 叶轮初始直径<br>(仅限标准型号，经过配置的水泵不适用)  |
| D                         | 叶轮形式：<br>W = 涡流叶轮<br>E = 单通道叶轮<br>Z = 双流道叶轮<br>D = 三通道叶轮<br>V = 四通道叶轮<br>T = 闭式双流道叶轮<br>G = 半开式单通道叶轮 |

4.8.2 水力部件型号代码：Rexa SUPRA

| 示例：Wilo-Rexa SUPRA-V10-736A |   |
|-----------------------------|---|
| SUPRA                       | 污水泵   |
| V                           | 叶轮形式：<br>V = 涡流叶轮<br>C = 单通道叶轮<br>M = 多通道叶轮 |



4.8.3 水力部件型号代码：Rexa SOLID

| 示例：Wilo-Rexa SUPRA-V10-736A |   |
|-----------------------------|---|
| 10                          | x10 = 压力连接公称直径  |
| 73                          | 内部功率因数  |
| 6                           | 特征曲线编号  |
| A                           | 材料规格：<br>A = 标准规格<br>B = 防腐 1<br>D = 防磨 1<br>X = 特殊规格 |

4.8.4 电机型号代码：FKT 电机

| 示例：Wilo-Rexa SOLID-Q10-768A |   |
|-----------------------------|---|
| SOLID                       | 污水泵配备 SOLID 叶轮  |
| Q                           | 叶轮形式：<br>T = 闭式叶轮<br>G = 半开式单通道叶轮<br>Q = 半开式双流道叶轮     |
| 10                          | x10 = 压力连接公称直径  |
| 76                          | 内部功率因数  |
| 8                           | 特征曲线编号  |
| A                           | 材料规格：<br>A = 标准规格<br>B = 防腐 1<br>D = 防磨 1<br>X = 特殊规格 |

| 示例：FKT 20.2M-4/32GX-P5 |   |
|------------------------|---|
| FKT                    | 配备有单独冷却回路的自冷却电动机  |
| 20                     | 规格  |
| 2                      | 版本  |
| M                      | 轴型号   |
| 4                      | 极数  |
| 32                     | 包装箱长度，单位 cm   |
| G                      | 密封件规格   |
| X                      | 具有防爆级   |
| P                      | 电机类型：<br>- 无 = 标准异步电动机<br>- E = 高效异步电动机<br>- P = 永磁电机                       |
| 5                      | IE 能效等级（依据 IEC 60034-30）：<br>无 = IE0 至 IE2<br>3 = IE3<br>4 = IE4<br>5 = IE5 |

4.9 供货范围

- 水泵带裸露电缆端部
- 根据客户需求提供相应长度的电缆
- 所安装的附件，例如外部铅芯湿度电极、水泵支脚等
- 安装及操作说明

4.10 附件

- 悬挂装置
- 水泵支脚
- 有 Ceram 涂层或使用特殊材料的特殊版本
- 外部铅芯湿度电极，用于密封室监控
- 液位控制装置
- 固定附件和链条
- 控制开关、继电器和插头



## 5 运输和存放

### 5.1 交货

收到货物之后，必须立刻检查货物有无缺陷（损坏、完整性）。如有缺陷，必须标注在运单上！此外还必须在到货当天，将损坏情况告知运输公司或者生产商。如果不在当天通知，就会丧失索赔权利。

### 5.2 运输



#### 警告

##### 在悬挂物下停留！

所有人严禁在悬挂物下停留！零部件掉落会导致（严重）受伤。悬挂物切勿从有人员停留的工作位置上方经过！



#### 警告

##### 不佩戴防护装备会导致头部和脚部受伤！

工作时存在（严重）受伤危险。穿戴以下防护装备：

- 安全鞋
- 如果使用提升设备，还必须佩戴安全头盔！



#### 注意

##### 请只使用技术方面毫无瑕疵的提升设备！

请只使用技术方面毫无瑕疵的提升设备提升和降低水泵。确保水泵在升降过程中不会卡住。切勿超过提升设备允许的最大承载能力！开始使用之前，先检查提升设备的功能是否正常！

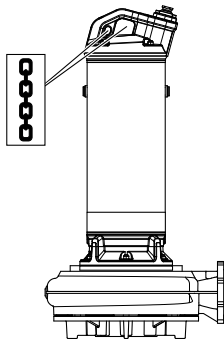


Fig. 2: 吊装孔

### 5.3 存放



#### 危险

##### 危害健康的流体会导致危险！

如果在危害健康的流体中使用过水泵，则拆卸水泵后必须进行消毒处理，之后才能用于其他工作！有生命危险！遵守工作规程的相关规定！运营者必须保证工作人员已经收到并阅读工作规程！



#### 警告

##### 叶轮和进水口的锋利边缘！

叶轮和进水口可能形成锋利的边缘。导致四肢被割伤的危险！必须佩戴防护手套，防止出现切割受伤的情况。

**小心****永磁电机：连接绞线可能通电！**

通过旋转转子，在连接绞线上可能存在电压。将连接绞线绝缘但不短接！

**小心****渗入湿气导致全损**

液体进入接线电缆会损坏电缆和水泵！切勿将接线电缆端部浸入液体中，存放时须将其牢牢封住。

新水泵到货后，可以存放一年。如果存放时间超过一年，请咨询客户服务部。

存放时注意下列事项：

- 将水泵直立（垂直）放置在坚固的基底上。防止水泵倾翻和移动！
- 存储温度范围是 -15 至 +60 °C（5 至 140 °F）。空气湿度最高 90 %，非冷凝。建议存储在无霜冻的环境中。环境温度：5 至 25 °C（41 至 77 °F），相对空气湿度：40 至 50 %。
- 切勿在执行焊接作业的室内存放水泵。因为焊接时形成的气体或辐射可能侵蚀弹性体零件和涂镀。
- 牢牢封闭住吸入接口和压力连接。
- 保护接线电缆，防止其弯折和损坏。注意弯曲半径！
- 每隔一段时间（隔 3-6 个月），将叶轮转动 180°。从而防止轴承无法转动，并更换机械密封的润滑膜。警告！叶轮和进水口的锋利边缘可能导致人员受伤！
- 弹性体零件和涂镀会自然脆化。如果存放时间超过 6 个月，必须咨询客户服务部。

结束存放时段之后，必须清洁水泵上的灰尘和油，并检查涂镀和损坏情况。如果涂镀受损，须在继续使用前将其修复。

## 6 安装及电气连接

### 6.1 工作人员资格鉴定

- 电气作业：电气作业必须由专业电工执行。
- 安装/拆卸工作：必须由专业人员执行，而且要求该人员接受过相关培训，了解工作中会用到的工具以及当前施工现场需要使用的固定材料。

### 6.2 安装方式

- 带悬挂装置的垂直固定湿式安装
  - 带水泵支脚的垂直移动湿式安装
  - 垂直固定干式地坑安装
  - 水平固定干式地坑安装
- 注意！水平安装取决于型号和功率。这种安装方式的具体事宜，请咨询客户服务部！

### 6.3 运营者的责任

- 遵守本地现行的同业工伤事故保险联合会的事故防范规定和安全规定。
- 遵守有关处理重物或在悬挂物之下工作的所有法律法规。
- 提供防护装备并保证工作人员佩戴防护装备。
- 运行污水处理技术设备时，注意遵守当地实施的废水处理技术法规。
- 避免压力冲击！  
高压管道较长且有明显的起伏时，可能出现压力冲击。该压力冲击可能导致水泵损坏！
- 根据运行条件和集水坑规格，保证电机冷却时间。
- 建筑/地基必须具有足够的强度，这样才能安全可靠地固定并确保功能正常。准备建筑/地基并保证其适用性，是运营者的责任！
- 检查现有的规划资料（安装图、运行空间结构图、入流情况）是否齐全和正确。

### 6.4 安装

**危险****永磁电机：感应电压导致生命危险！**

如果在没有电能情况下驱动转子（比如在流体回流时），电机会产生感应电压。这时接线电缆会通电。触电导致生命危险！在连接前将接线电缆接地并导出感应电压！

**危险****独自执行危险作业导致生命危险！**

需要在竖井和狭窄空间内完成的工作，以及存在坠落危险的工作，这两个都是危险工种，不允许单人独自作业！为安全起见，必须有第二个人在场。

**警告****不佩戴防护装备会导致手脚受伤！**

工作时存在（严重）受伤危险。穿戴以下防护装备：

- 安全手套，用以预防切割伤害
- 安全鞋
- 如果使用提升设备，还必须佩戴安全头盔！

**注意****请只使用技术方面毫无瑕疵的提升设备！**

请只使用技术方面毫无瑕疵的提升设备提升和降低水泵。确保水泵在升降过程中不会卡住。切勿超过提升设备允许的最大承载能力！开始使用之前，先检查提升设备的功能是否正常！

- 如下准备运行空间/安装地点：
  - 干净，无大颗粒固体物
  - 干燥
  - 不上冻
  - 经过消毒处理
- 如果出现有毒气体或窒息气体汇集的情况，立刻采取对策！
- 将吊具通过一个卸扣固定在吊装孔上。只使用建筑技术允许使用的提升装置。
- 提升、降低和运输水泵时，使用吊具。绝对不得拉扯水泵的接线电缆！
- 必须能安全地安装提升设备。必须能通过提升设备到达储存位置和运行空间/安装地点。安装位置的地基必须坚实。
- 铺设的接线电缆必须能够安全运行。检查电缆横截面和电缆长度对于选择的铺设方式来说是否足够。
- 使用开关设备时，必须注意相应的防护等级。请将开关设备安装在潜在爆炸环境以外且注意使其具有防溢流特性！
- 在入口使用导流板或偏转板，避免流体内进入空气。如有空气进入，会汇集在管道系统中，导致形成不允许出现的运行条件。通过排气装置排出流体中的空气！
- 禁止水泵空运行！避免水力部件外壳或管道系统内进入空气。切勿低于最低水位。建议安装干转保护装置！

**6.4.1 双头泵运行注意事项**

如果在一个运行空间内使用多台水泵，则必须遵守水泵与水泵之间，以及水泵与墙壁之间的最小距离。不同类型的设备，距离有所不同：交替运行或并联运行。

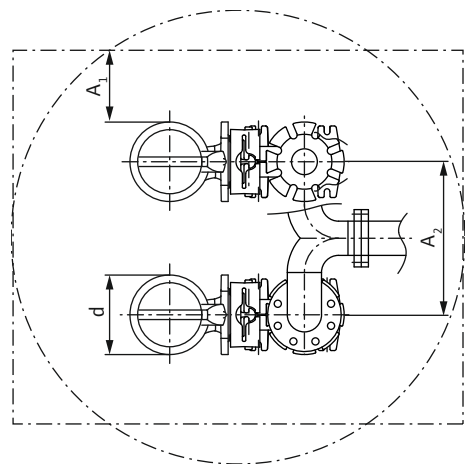


Fig. 3: 最小距离

6.4.2 维护工作

如果存放时间超过 6 个月，则在开始安装之前，需要进行以下维护工作：

- 转动叶轮。
- 检查冷却液。
- 检查密封室內的油（仅限 FKT 27.x）。

6.4.2.1 转动叶轮



**警告**  
叶轮和进水口的锋利边缘！  
叶轮和进水口可能形成锋利的边缘。导致四肢被割伤的危险！必须佩戴防护手套，防止出现切割受伤的情况。

小型水泵（出水口小于 **DN100**）

- ✓ 水泵未连接电网！
- ✓ 防护装备就位！
- 1. 将水泵水平放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 小心谨慎地慢慢把手从下方伸进水力部件外壳中，转动叶轮。

大型水泵（出水口大于 **DN150**）

- ✓ 水泵未连接电网！
- ✓ 防护装备就位！
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 小心谨慎地慢慢把手从出水口伸进水力部件外壳中，转动叶轮。

6.4.2.2 检查冷却液

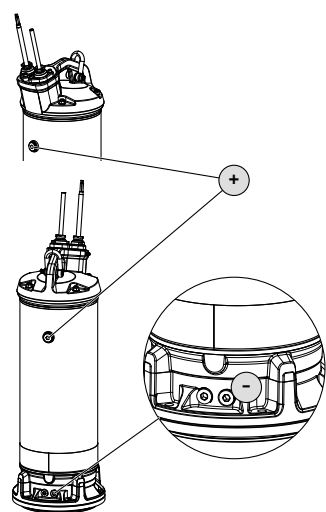


Fig. 4: 冷却系统：检查冷却液 FKT 20.2

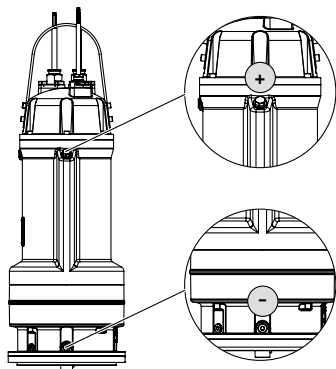


Fig. 5: 冷却系统：检查冷却液 FKT 27.1/27.2

电机 FKT 20.2

|   |          |
|---|----------|
| + | 填充/通风冷却液 |
| - | 排放冷却液    |

- ✓ 尚未安装水泵。
- ✓ 水泵尚未连接电网。
- ✓ 防护装备就位！
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 放置合适的蓄水罐用于收集工作介质。
- 3. 拧出螺旋塞 (+)。
- 4. 拧出螺旋塞 (-) 并排出工作介质。如果排放口装有截止球阀，则打开截止球阀进行排放。  
注意！冲洗冷却系统，以完全排水。
- 5. 检查工作介质：
  - ⇒ 如果工作介质清澈，可以重复利用工作介质。
  - ⇒ 如果工作介质脏污（浑浊/黑暗），则注入新的工作介质。按照当地法规对工作介质进行废弃处置！
  - ⇒ 如果工作介质内有金属屑，请联系客户服务部！
- 6. 如果排放口装有截止球阀，则关闭截止球阀。
- 7. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb) ！
- 8. 通过螺旋塞 (+) 的开孔注入工作介质。
  - ⇒ 遵守规定的工作介质类型和数量！重复利用工作介质时，也必须检查介质质量，必要时进行调整！
- 9. 清洁螺旋塞 (+)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb) ！

电机 FKT 27.x

|   |          |
|---|----------|
| + | 填充/通风冷却液 |
| - | 排放冷却液    |

- ✓ 尚未安装水泵。
- ✓ 水泵尚未连接电网。
- ✓ 防护装备就位！
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 放置合适的蓄水罐用于收集工作介质。
- 3. 拧出螺旋塞 (+)。
- 4. 拧出螺旋塞 (-) 并排出工作介质。如果排放口装有截止球阀，则打开截止球阀进行排放。  
注意！冲洗冷却系统，以完全排水。
- 5. 检查工作介质：
  - ⇒ 如果工作介质清澈，可以重复利用工作介质。
  - ⇒ 如果工作介质脏污（浑浊/黑暗），则注入新的工作介质。按照当地法规对工作介质进行废弃处置！
  - ⇒ 如果工作介质内有金属屑，请联系客户服务部！
- 6. 如果排放口装有截止球阀，则关闭截止球阀。
- 7. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb) ！
- 8. 通过螺旋塞 (+) 的开孔注入工作介质。
  - ⇒ 遵守规定的工作介质类型和数量！重复利用工作介质时，也必须检查介质质量，必要时进行调整！
- 9. 清洁螺旋塞 (+)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb) ！

6.4.2.3 检查密封室中的油

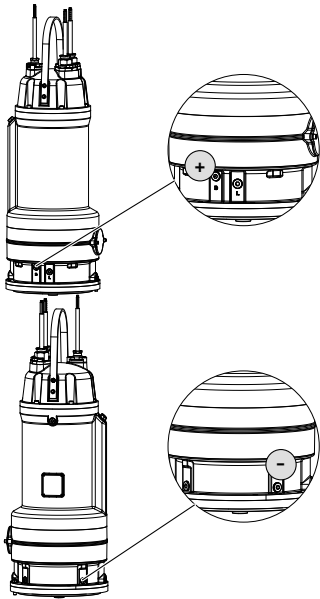


Fig. 6: 密封室：检查油

电机 FKT 27.x

|   |        |
|---|--------|
| + | 为密封室注油 |
| - | 为密封室排油 |

- ✓ 尚未安装水泵。
  - ✓ 水泵尚未连接电网。
  - ✓ 防护装备就位！
1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
  2. 放置合适的蓄水罐用于收集工作介质。
  3. 拧出螺旋塞 (+)。
  4. 拧出螺旋塞 (-) 并排出工作介质。如果排放口装有截止球阀，则打开截止球阀。  
注意！吸油或冲洗密封室，以完全排水。
  5. 检查工作介质：
    - ⇒ 如果工作介质清澈，可以重复利用工作介质。
    - ⇒ 如果工作介质脏污（黑色），则注入新的工作介质。按照当地法规对工作介质进行废弃处置！
    - ⇒ 如果工作介质中有水，则填充新工作介质。按照当地法规对工作介质进行废弃处置！
    - ⇒ 如果工作介质内有金属屑，请联系客户服务部！
  6. 如果排放口装有截止球阀，则关闭截止球阀。
  7. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft·lb)！
  8. 通过螺旋塞 (+) 的开孔注入工作介质。
    - ⇒ 遵守规定的工作介质类型和数量！重复利用工作介质时，也必须检查介质质量，必要时进行调整！
  9. 清洁螺旋塞 (+)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft·lb)！

6.4.3 固定湿式安装



注意

水位过低导致输送问题

如果流体降至过低的液位，可能导致输送断流。继而在水力部件中形成气垫，导致出现不允许的运行行为。允许的最低水位必须至少达到水力部件外壳的上边缘！

采用湿式安装方式时，将水泵安装在流体中。为此必须在集水坑中安装一个悬挂装置。在悬挂装置上，出口侧连接现场的管道系统，吸入侧连接水泵。连接的管道系统必须能够自行支撑。悬挂装置不得支撑管道系统！

工作步骤

|   |           |
|---|-----------|
| 1 | 截止阀       |
| 2 | 止回阀       |
| 3 | 悬挂装置      |
| 4 | 导流管（现场提供） |
| 5 | 提升设备吊装孔   |
| 6 | 最低水位      |

- ✓ 已备好安装所需的运行空间/安装地点。
  - ✓ 悬挂装置和管道系统安装完毕。
  - ✓ 水泵已备好，可以在悬挂装置上运行。
1. 将提升设备通过一个卸扣固定在水泵吊装孔上。
  2. 提升水泵，在集水坑开口摆动，慢慢将导向爪放在导流管上。
  3. 降下水泵，直到水泵固定在悬挂装置上并自动耦合。小心！在降下水泵的过程中，使接线电缆保持略微拉紧的状态！

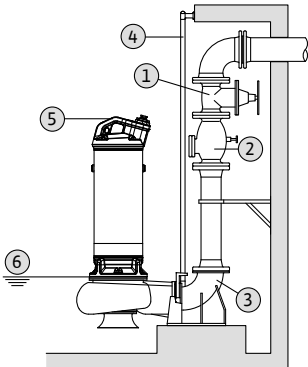


Fig. 7: 固定湿式安装

4. 将提升装置从提升设备上松开并固定在集水坑出口，防止掉落。
5. 安排一名专业电工在集水坑内铺设接线电缆，并按照规定将接线电缆从集水坑中引出。小心！切勿损坏接线电缆（无弯折位置，注意弯曲半径）！
- 水泵安装完毕，专业电工可以开始进行电气连接。

6.4.4 移动湿式安装



**警告**  
高温表面可能导致烫伤！  
电机外壳在运行过程中温度较高，可能导致烫伤。关闭后使水泵冷却到环境温度！



**警告**  
压力软管崩落！  
一旦压力软管崩落或崩裂，可能导致人员（重度）受伤。必须把压力软管牢牢固定在出口！防止压力软管弯折。



**注意**  
水位过低导致输送问题  
如果流体降至过低的液位，可能导致输送断流。继而在水力部件中形成气垫，导致出现不允许的运行行为。允许的最低水位必须至少达到水力部件外壳的上边缘！

采用便携式安装方式时，必须为水泵装备水泵支脚。水泵支脚可以保证水泵在抽吸区域的离地间隙不会低于最小值，同时还能使水泵稳固立在坚实的基底上。这样一来，采用这种安装方式时，就能将水泵随意放在运行空间/安装地点的任意位置。安装地点必须使用硬底座，避免软底座发生下沉事故。出口侧连接压力软管。如果水泵需要长时间运行，则将水泵固定安装在地面。这样可以避免振动，保证水泵安静且低磨损地运行。

工作步骤

|   |           |
|---|-----------|
| 1 | 水泵支脚      |
| 2 | 弯管        |
| 3 | Storz 联轴器 |
| 4 | 压力软管      |
| 5 | 提升设备      |
| 6 | 提升设备吊装孔   |
| 7 | 最低水位      |

- ✓ 已安装水泵支脚。
- ✓ 压力连接准备工作已完成：已安装带软管连接的弯管或者带 Storz 联轴器的弯管。
1. 将提升设备通过一个卸扣固定在水泵吊装孔上。
2. 提升水泵，将其放在指定的工作位置（集水坑、凹陷部分）。
3. 将水泵放在坚固的基底上。小心！必须注意避免下沉！
4. 铺设压力软管并在指定位置（比如排出口）进行固定。危险！一旦压力软管崩落或崩裂，可能导致人员（重度）受伤！必须把压力软管牢牢固定在出口。
5. 专业铺设接线电缆。小心！切勿损坏接线电缆（无弯折位置，注意弯曲半径）！
- 水泵安装完毕，专业电工可以开始进行电气连接。

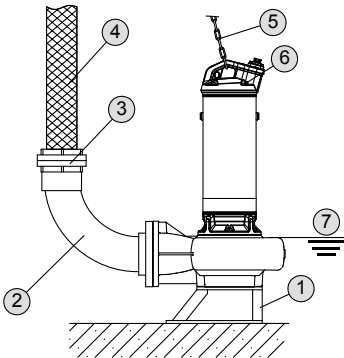


Fig. 8: 移动湿式安装



### 6.4.5 固定干式地坑安装



#### 注意

##### 水位过低导致输送问题

如果流体降至过低的液位，可能导致输送断流。继而在水力部件中形成气垫，导致出现不允许的运行行为。允许的最低水位必须至少达到水力部件外壳的上边缘！

采用干式地坑安装方式时，需要将运行空间划分为收集空间和机器空间。收集空间流通和收集流体，机器空间则安装水泵设备。水泵安装在机器空间，进水侧和出口侧与管道系统连接在一起。安装时注意下面几点：

- 进水侧和出口侧的管道系统必须能够自行支撑。水泵不可支撑管道系统。
- 将水泵无张力、无振动地连接在管道系统上。建议使用弹性连接件（补偿器）。
- 水泵不是自吸式产品，即流体必须自动进入或者在一定的供给压力下进入。收集空间的最低水位必须与水力部件外壳的上边缘等高！
- 最高环境温度：40 °C (104 °F)

#### 工作步骤

|   |           |
|---|-----------|
| 1 | 截止阀       |
| 2 | 止回阀       |
| 3 | 补偿器       |
| 4 | 提升设备吊装孔   |
| 5 | 收集空间的最低水位 |

- ✓ 机器空间/安装地点已准备完毕，可以开始安装。
- ✓ 已按规定安装管道系统且管道系统能自行支撑。
- 1. 将提升设备通过一个卸扣固定在水泵吊装孔上。
- 2. 提升水泵并在机器空间内定位。小心！定位水泵时，使接线电缆保持略微拉紧的状态！
- 3. 将水泵正确地固定在底座上。
- 4. 连接水泵和管道系统。注意！连接时注意保持无张力、无振动。必要时使用弹性连接件（补偿器）。
- 5. 将提升装置从水泵上松开。
- 6. 安排专业电工在机器空间内铺设接线电缆。注意！切勿损坏接线电缆（无弯折位置，注意弯曲半径）！
- 水泵安装完毕，专业电工可以开始进行电气连接。

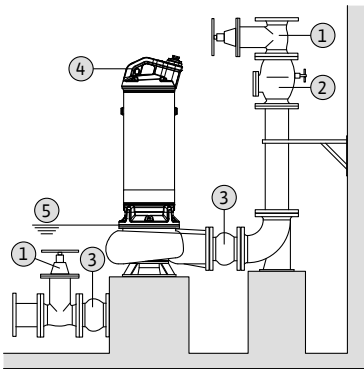


Fig. 9: 干式地坑安装

### 6.4.6 液位控制装置



#### 危险

##### 安装错误可能会发生爆炸！

如果在潜在爆炸环境中安装液位控制装置，需要通过防爆切断继电器或齐纳安全栅连接信号变送器。连接错误可能会发生爆炸！安装专业电工负责连接工作。

通过液位控制装置可以确定当前液位，水泵根据液位自动接通/关闭。液位检测通过不同类型的传感器（浮子开关、压力和超声测量装置或电极）实现。使用液位控制装置时注意以下几点：

- 浮子开关可以自由移动！
- 不得低于允许的最低水位！
- 不得超过最大开关频率！
- 液位剧烈波动时，建议使用两个测量点进行液位控制。从而达到较大的开关差。

### 6.4.7 干转保护

干转保护用于防止出现水泵运行时没有流体，空气进入水力部件的情况。为此必须借助信号变送器确定允许出现的最低液位。只要达到规定的极值，就会立刻关闭水泵并发出相应的信号。一个干转保护装置可以为现有的液位控制装置扩展出一个附加测量点，或者作为一般关闭装置工作。视设备安全情况而定，可以自动或手动重启水泵。建议安装干转保护装置来提高运行可靠性。



## 6.5 电气连接



### 危险

#### 小心触电死亡！

执行电气作业时不按规定操作，会发生电击致死事故！电气作业必须由专业电工按照当地的相关规定执行。



### 危险

#### 接线错误存在爆炸风险！

- 始终在潜在爆炸环境以外对水泵进行电气连接。如果在易爆区域内接线，则在获得防爆认证的外壳（符合 DIN EN 60079-0 标准规定的点火保护等级）内进行接线！如不遵守，爆炸会导致生命危险！
- 在标记的接地端连接电位均衡器。接地端设在接线电缆区域内。必须根据当地法规使用电位均衡器的电缆横截面。
- 接线工作须由专业电工执行。
- 进行电气连接时，也应注意本安装及操作说明附录中防爆章节的详细信息！

- 电源连接必须与铭牌上的说明一致。
- 三相交流机电源侧馈电具备顺时针旋转磁场。
- 按照当地法规的相关要求铺设接线电缆并按照芯线布局进行连接。
- 连接监控设备并检查功能是否正常。
- 按照当地法规的相关要求进行接地。

### 6.5.1 电源一侧的保险丝

#### 断路器

断路器的规格和开关属性取决于所连接产品的额定电流。注意遵守当地相关法规。

#### 电机保护开关

对于不带插头的产品，安装方应该准备一个电机保护开关！最低要求是配备一个符合本地规定，具备温度补偿、差分触发和重启锁定功能的热敏继电器/电机保护开关。针对反应灵敏的电网，安装方还应准备其他保护装置（比如超压、欠压或缺相继电器等）。

#### 漏电断路器 (RCD)

遵守当地供电公司的相关规定！建议使用漏电断路器。

如果人员可能接触到产品和导电液体，需要对电路连接采取安全措施，装备一个漏电断路器 (RCD)。

### 6.5.2 维护工作

开始安装之前，先执行下列维护工作：

- 检查电机绕组的绝缘电阻。
- 检查温度传感器的电阻器。

如果测得的数值与规定参数存在偏差，有多种原因：

- 电机内潮湿。
- 接线电缆内潮湿。
- 监控设备损坏。

如果发生故障，请联系客户服务部。

#### 6.5.2.1 检查电机绕组的绝缘电阻

使用绝缘测试仪（测量直流电压 = 1000 V）测量绝缘电阻。遵守下列数值：

- 预调试时：绝缘电阻不得低于 20 MΩ。
- 进行其他测量时：绝缘电阻值必须大于 2 MΩ。

#### 6.5.2.2 检查温度传感器的电阻

使用电阻表测量温度传感器的电阻。必须遵守下列测量值：

- 双金属片：测量值 = 0 Ohm（通过）。
- PTC 传感器（正温度系数电阻）：测量值取决于安装的传感器个数。PTC 传感器的冷态电阻介于 20 至 100 Ohm 之间。
  - 如果串联三个传感器，测量值介于 60 至 300 Ohm 之间。
  - 如果串联四个传感器，测量值介于 80 至 400 Ohm 之间。
- Pt100 传感器：Pt100 传感器在 0 °C (32 °F) 时的电阻值为 100 Ohm。在 0 °C (32 °F) 和 100 °C (212 °F) 之间时，温度每增加 1 °C (1.8 °F)，电阻值增加 0.385 Ohm。

6.5.3 异步电动机电源连接

环境温度为 20 °C (68 °F) 时，电阻值达到 107.7 Ohm。

为三相交流电机供货时末端已露出。通过连接开关设备中的接线电缆接入电网。接线的精确参数参见随附提供的接线图。电气连接工作须由专业电工执行！

注意！各芯线按照接线图命名。切勿切断芯线！芯线名称和接线图之间不存在其他分配关系。

| 直接启动时的电源连接芯线名称 |      |
|----------------|------|
| U, V, W        | 电源连接 |
| PE (gn-ye)     | 接地   |

| 星三角启动时的电源连接芯线名称 |            |
|-----------------|------------|
| U1, V1, W2      | 电源连接（绕组始端） |
| U2, V2, W2      | 电源连接（绕组末端） |
| PE (gn-ye)      | 接地         |

6.5.4 永磁电机电源连接

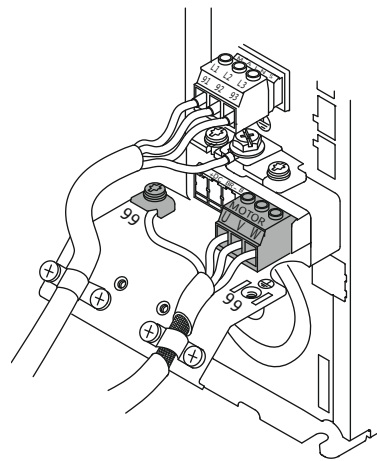


Fig. 10: 水泵接口：Wilo-EFC

变频器 Wilo-EFC

| 端子 | 芯线名称    |
|----|---------|
| 96 | U       |
| 97 | V       |
| 98 | W       |
| 99 | 接地 (PE) |

将电机接线电缆穿过电缆螺纹接头引入变频器中并进行固定。按照接线图连接芯线。

注意！大面积地放置电缆屏蔽层！

6.5.5 Digital Data Interface 接口



**注意**  
**注意Digital Data Interface的说明书！**  
阅读并遵守有关Digital Data Interface的单独说明书，以了解详细信息和高级设置。

说明

可使用混合电缆作为控制电缆。混合电缆将两种电缆统一为一体：  
→ 控制电压和绕组保护的信号电缆  
→ 网线

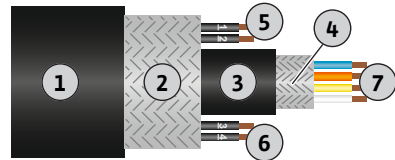


Fig. 11: 混合电缆示意图

| 序号 | 芯线编号/芯线颜色      | 说明   |
|----|----------------|--|
| 1  |                | 外侧电缆包皮   |
| 2  |                | 外侧电缆屏蔽层  |
| 3  |                | 内侧电缆包皮   |
| 4  |                | 内侧电缆屏蔽层  |
| 5  | 1 = +<br>2 = - | Digital Data Interface 电源连接芯线。工作电压：24 VDC (12-30 V FELV, 最高 4.5 W) |
| 6  | 3/4 = PTC      | 电机绕组中的 PTC 传感器连接芯线。工作电压：2.5 至 7.5 VDC                              |

|   |               |                       |
|---|---------------|-----------------------|
| 7 | 白色 (wh) = RD+ | 准备网线，安装一同提供的 RJ45 插头。 |
|   | 黄色 (ye) = TD+ |                       |
|   | 橙色 (og) = TD- |                       |
|   | 蓝色 (bu) = RD- |                       |

Digital Data Interface的接口取决于选定的系统模式和其他系统组件。注意Digital Data Interface说明书的安装建议和接头类型。

注意！大面积地放置电缆屏蔽层！

6.5.6 连接监控设备

监控设备概述

|                        | 异步电动机    |                    |          | 永磁电机               |
|------------------------|----------|--------------------|----------|--------------------|
|                        | FKT 20.2 | FKT 20.2           | FKT 27.x | FKT 20.2...-P      |
| 内部监控设备                 |          |                    |          |                    |
| Digital Data Interface | –        | •                  | –        | •                  |
| 端子室/电机舱：湿度             | –        | –                  | •        | –                  |
| 电机绕组：双金属               | •        | –                  | •        | –                  |
| 电机绕组：PTC               | o        | • (+ 1...3x Pt100) | o        | • (+ 1...3x Pt100) |
| 电机轴承：Pt100             | o        | o                  | o        | o                  |
| 密封室：电感式传感器             | –        | –                  | –        | –                  |
| 密封室：电容式传感器             | –        | •                  | –        | •                  |
| 泄漏腔：浮子开关               | •        | –                  | •        | –                  |
| 泄漏腔：电容式传感器             | –        | •                  | –        | •                  |
| 振动传感器                  | –        | •                  | –        | •                  |
| 外部监控设备                 |          |                    |          |                    |
| 密封室：电感式传感器             | o        | –                  | o        | –                  |

• = 标配，– = 不可用，o = 可选  
所有现有的监控设备必须始终处于连接状态！

有Digital Data Interface的电机



注意  
注意Digital Data Interface的说明书！  
阅读并遵守有关Digital Data Interface的单独说明书，以了解详细信息和高级设置。

通过 Digital Data Interface 分析所有现有的传感器。通过Digital Data Interface的图形操作界面显示当前值和设置极限参数。在超过极限参数时会发出警示或警报信息。为安全关闭水泵，电机绕组另外配备有 PTC 传感器。

无Digital Data Interface的电机

监控设备连接和规格精确参数，参见随附提供的接线图。电气连接工作须由专业电工执行！  
注意！各芯线按照接线图命名。切勿切断芯线！芯线名称和接线图之间不存在其他分配关系。

**危险****接线错误可能发生爆炸！**

如未正确连接监控设备，潜在爆炸环境中存在生命危险！接线工作须由专业电工执行。在潜在爆炸环境中使用时，适用下列原则：

- 通过一个评测继电器连接电机过热保护！
- 温度限制装置引发的关闭操作，必须通过重启锁定功能实现！只有手动操作解锁按键之后，才允许重启！
- 外部电极（比如密封室监控设备）通过一个评测继电器与本安电路连接在一起！
- 注意本操作说明附录中防爆章节的详细信息！

**6.5.6.1 端子室/电机舱监控**

通过一个评测继电器连接电极。建议使用“NIV 101/A”继电器。阈值为 30 kOhm。

**芯线名称**

|    |      |
|----|------|
| DK | 电极接口 |
|----|------|

达到阈值之后，必须执行一次关闭操作！

**6.5.6.2 电机绕组监控装置****配备双金属片**

双金属片直接接入开关设备，或者通过一个评测继电器接入控制开关。

连接值：最大 250 V(AC)，2.5 A， $\cos \varphi = 1$

**双金属片芯线名称****温度限制装置**

|           |        |
|-----------|--------|
| 20,<br>21 | 双金属片接口 |
|-----------|--------|

**温度调节和限制装置**

|    |      |
|----|------|
| 21 | 高温接口 |
| 20 | 中温接口 |
| 22 | 低温接口 |

**配备 PTC 传感器**

通过一个评测继电器连接 PTC 传感器。建议使用“CM-MSS”继电器。

**PTC 传感器芯线名称****温度限制装置**

|           |           |
|-----------|-----------|
| 10,<br>11 | PTC 传感器接口 |
|-----------|-----------|

**温度调节和限制装置**

|    |      |
|----|------|
| 11 | 高温接口 |
| 10 | 中温接口 |
| 12 | 低温接口 |

**温度调节和限制装置的触发状态**

对于带双金属或 PTC 传感器的电机过热保护装置，由安装的传感器确定反应温度。视电机过热保护规格而定，达到反应温度后必须实现下列触发状态：

- 温度限制装置（1 温度回路）：  
达到反应温度之后，必须执行一次关闭操作。
- 温度调节装置和限制装置（2 温度回路）：  
达到低温反应温度后，可以通过自动重启功能执行一次关闭操作。达到高温反应温度后，必须通过手动重启功能执行一次关闭操作。

注意附录中防爆章节的详细信息！

**6.5.6.3 泄漏腔监控**

浮子开关带有一个常闭无源触点。开关容量见随附的接线图。

|             |        |
|-------------|--------|
| 芯线名称        |        |
| K20,<br>K21 | 浮子开关接口 |

浮子开关响应后，必须发出警告或者执行关闭操作。

6.5.6.4 电机轴承监控

通过一个评测继电器关闭 Pt100 传感器。建议使用“DGW 2.01G”继电器。阈值为 100 °C (212 °F)。

|           |             |
|-----------|-------------|
| 芯线名称      |             |
| T1,<br>T2 | Pt100 传感器接口 |

达到阈值之后，必须执行一次关闭操作！

6.5.6.5 密封室监控设备（外部电极）

通过一个评测继电器连接外部电极。建议使用“NIV 101/A”继电器。阈值为 30 kOhm。

达到阈值之后，必须发出警告或者执行关闭操作。

小心

连接密封室监控设备

如果达到阈值后只发出一次警告，那么，进水可能导致水泵全盘受损。始终建议关闭水泵！

注意附录中防爆章节的详细信息！

6.5.7 电机保护设置

电机保护必须根据选择的启动模式进行设置。

6.5.7.1 直接启动

满负荷运行时，将电机保护开关参数设为额定电流（参见铭牌）。部分负荷运行时，建议设置的电机保护开关参数高于工况点所测得电流 5 %。

6.5.7.2 星三角启动

电机保护的设置视安装情况而定：

- 电机保护安装在电机支线中：将电机保护设置为 0.58 x 额定电流。
- 电机保护安装在电源线中：将电机保护设置为额定电流。

星形连接的起动时间最长为 3 s。

6.5.7.3 软启动

满负荷运行时，将电机保护开关参数设为额定电流（参见铭牌）。部分负荷运行时，建议设置的电机保护开关参数高于工况点所测得电流 5 %。此外还要注意以下几点：

- 电耗必须始终低于额定电流。
- 30 s 内完成启动和关闭。
- 达到正常运行模式后桥接电子启动器（软启动），避免出现功率损耗。

6.5.8 使用变频器运行

6.5.8.1 异步电动机

允许使用变频器运行异步电动机。变频器必须至少有以下接口：

- 双金属和 PTC 传感器
- 湿度电极
- Pt100 传感器（如果有电机轴承监控！）

其他要求参考并注意遵守章节“在变频器上运行 [► 50]”！

如果电机配备有 Digital Data Interface，另外要确保具备以下前提条件：

- 网络：Ethernet 10BASE-T/100BASE-TX，基于 IP
- 协议支持：Modbus TCI/IP

详细的要求请参考 Digital Data Interface 的单独说明书！

6.5.8.2 永磁电机

在运行永磁电机时，确保具备以下前提条件：

- 有 PTC 传感器接口的变频器
- 网络：Ethernet 10BASE-T/100BASE-TX，基于 IP
- 协议支持：Modbus TCI/IP

详细的要求请参考 Digital Data Interface 的单独说明书！

安装及操作说明 Wilo Motor FKT 20.2, 27.1, 27.2, EMU FA, Rexa SUPRA, Rexa SOLID

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永磁电机允许使用以下变频器运行：  
→ Wilo-EFC  
其他变频器敬请垂询！

7 试运行



**警告**  
不佩戴防护装备会导致脚受伤！  
工作时存在（严重）受伤危险。穿安全鞋！



**注意**  
**断电后自动接通**  
通过单独的控制器根据流程接通和断开产品。在停电之后，可自动接通产品。

7.1 工作人员资格鉴定

- 电气作业：电气作业必须由专业电工执行。
- 操作/控制：操作人员必须了解整台设备的工作原理。

7.2 运营者的责任

- 在水泵上或者指定位置放置安装及操作说明。
- 为工作人员提供以其母语写成的安装及操作说明。
- 保证所有工作人员均已阅读安装及操作说明书并且理解其中内容。
- 设备方面的所有安全装置和紧急停机开关都处于激活状态，并经检查确认功能正常。
- 水泵适合于在规定的工作条件下使用。

7.3 旋转方向监控（仅限三相交流电机）

出厂时水泵设为适合顺时针旋转磁场的旋转方向并且经过检查。按照“电气连接”章节的相关说明进行连接。

**检查旋转方向**

由一名专业电工，使用旋转磁场检测仪检查电源连接处的旋转磁场。如果旋转方向正确，则在电源连接处必须存在一个顺时针旋转磁场。水泵不允许在逆时针旋转磁场中运行！小心！如果通过测试运行来检查旋转方向，注意遵守环境和运行条件！

**旋转方向错误**

- 如果旋转方向错误，如下改变连接：
- 采用直接启动方式的电机：两相互换。
  - 采用星-三角启动方式的电机：互换两个绕组的连接（比如 U1/V1 和 U2/V2）。

7.4 在易爆环境中运行



**危险**  
水力部件中的火花放电可能导致爆炸！  
水力部件在运行过程中必须浸在水中（完全充满流体）。如果流量断开，或者水力部件浮出水面，可能会在水力部件中形成气垫。这可能引发爆炸，比如静电导致的火花放电！干转保护装置必须保证在相应的液位下关闭水泵。

|             | 异步电动机    |          | 永磁电机          |
|-------------|----------|----------|---------------|
|             | FKT 20.2 | FKT 27.x | FKT 20.2...-P |
| 经 IEC-Ex 批准 | o        | —        | o             |
| 经 ATEX 批准   | o        | o        | o             |
| 经 FM 批准     | o        | o        | o             |
| 经 CSA-Ex 批准 | —        | —        | —             |

**图例**  
— = 不存在/不可能，o = 可选，• = 标配

在爆炸性气体中使用时，水泵铭牌上必须具有下列标识：  
→ 相应认证的防爆标识

## → 防爆等级

关于防爆电缆的相关要求，参见本操作说明书的附录，并注意遵守要求！

**ATEX 认证**

水泵适合在潜在爆炸环境中运行：

- 设备组：II
- 类别：2，1 区和 2 区
- 水泵不可在 0 区使用！

**FM 认证**

水泵适合在潜在爆炸环境中运行：

- 防护等级：Explosionproof
- 类别：Class I, Division 1
- 注意：如果根据 Division 1 布线，则也允许在 Class I, Division 2 中安装。

**7.5 接通前**

接通前检查下列几项：

- 检查安装操作是否符合规定，是否符合本地现行的相关法规：
  - 水泵是否接地？
  - 是否检查过电源线铺设情况？
  - 电气连接是否符合规定？
  - 机械部件是否正确固定？
- 检查液位控制装置：
  - 浮子开关能否自由移动？
  - 是否检查过开关液位（水泵开，水泵关，最低水位）？
  - 是否附加安装了干转保护装置？
- 检查工作条件：
  - 是否检查过流体的最低/最高温度？
  - 有无检查最大潜水深度？
  - 是否根据最低水位指定了运行模式？
  - 是否遵守最大开关频率？
- 检查安装地点/运行空间：
  - 出口侧管道系统有无沉积物？
  - 是否清洁过入口或泵井？有无沉积物？
  - 是否所有截止阀都已打开？
  - 有无规定和监控最低液位？

水力部件外壳必须全部充满流体，水力部件内不允许出现气垫。注意！如果设备内有形成气垫的危险，必须设计使用合适的排气装置！

**7.6 接通和关闭**

启动过程中会短时超过额定电流。运行过程中不得超过额定电流。小心！如果水泵未启动，立刻关闭水泵。重启水泵之前，先排除故障！

通过单独的现场设置的操作位置（通/断开关，开关设备）来接通和关闭水泵。

**7.7 运行期间****危险**

**水力部件中过压可能导致爆炸！**

在运行过程中，如果入口侧和压力侧的截止阀处于关闭状态，则水力部件中的流体会因输送运动而升温。随着升温，水力部件中会形成数巴的压力。此压力可能导致水泵爆炸！请确保在运行过程中所有截止阀都处于打开状态。一旦截止阀关闭，请立刻打开！

**警告**

**转动的部件可能会割伤身体！**

任何人不得在水泵工作区停留！转动的部件可能导致人员（重度）受伤！接通时以及在运行过程中，禁止任何人在水泵工作区停留。



**警告****高温表面可能导致烫伤！**

电机外壳在运行过程中温度较高，可能导致烫伤。关闭后使水泵冷却到环境温度！

**注意****水位过低导致输送问题**

如果流体降至过低的液位，可能导致输送断流。继而在水力部件中形成气垫，导致出现不允许的运行行为。允许的最低水位必须至少达到水力部件外壳的上边缘！

在水泵运行期间，注意遵守下列主题相关的当地法规：

- 劳动保护
- 事故防范
- 电气机械使用

必须严格遵守运营者规定的操作人员工作范围。所有操作人员都有义务遵守工作范围和各项规定！

设计结构决定了离心泵装有不断转动又能随意接近的部件。运行条件决定了这些部件会形成锋利的边缘。警告！可能导致肢体被割伤和切断！必须定期检查以下几项：

- 工作电压（额定电压  $\pm 5\%$ ）
- 频率（额定频率  $\pm 2\%$ ）
- 各相位之间的电耗（最大  $5\%$ ）
- 各个相位之间的电压差（最大  $1\%$ ）
- 最大开关频率
- 最低水浸取决于运行模式
- 入口：无空气进入。
- 液位控制装置/干转保护装置：切换点
- 安静/无振动运行
- 所有截止阀都处于打开状态

**在极限范围内运行**

水泵可以短时（每天最长 15 分钟）在极限范围内运行。在极限范围内运行时，与运行数据的偏差会比较大。注意！禁止在极限范围内连续运行！这会导致水泵严重磨损，发生故障的几率变大！

在极限范围内运行时，适用下列参数：

- 工作电压（额定电压  $\pm 10\%$ ）
- 频率（额定频率  $\pm 5\%$ ）
- 各相位之间的电耗（最大  $6\%$ ）
- 各个相位之间的电压差（最大  $2\%$ ）

**8 停止运行/拆卸****8.1 工作人员资格鉴定**

- 操作/控制：操作人员必须了解整台设备的工作原理。
- 电气作业：电气作业必须由专业电工执行。
- 安装/拆卸工作：必须由专业人员执行，而且要求该人员接受过相关培训，了解工作中会用到的工具以及当前施工现场需要使用的固定材料。

**8.2 运营者的责任**

- 遵守本地现行的同业工伤事故保险联合会的事事故防范规定和安全规定。
- 遵守有关处理重物或在悬挂物之下工作的法律法规。
- 提供必要的防护装备并保证工作人员佩戴防护装备。
- 在封闭的空间内需提供足够的通风条件。
- 如果出现有毒气体或窒息气体汇集的情况，立刻采取对策！

**8.3 停止运行**

停止运行时会关闭水泵，但是继续保持安装状态。从而确保水泵随时处于待机状态。

✓ 为了保护水泵免遭霜冻和冰冻危害，必须将水泵整个浸入流体中。

✓ 最低流体温度： $+3\text{ }^{\circ}\text{C}$  ( $+37\text{ }^{\circ}\text{F}$ )。

1. 在操作台上关闭水泵。



2. 为操作台采取安全措施（比如锁住主开关），防止意外重启。

► 水泵现已停止运行，可以拆卸。

如果水泵在停止运行后继续保持安装状态，注意下列几项要求：

- 在停止运行的整个时段内保证符合上述前提条件。如果不能保证满足前提条件，请将水泵拆除！
- 如果定期长时间停止运行，需要执行一次功能运行：
  - 时间段：每月至每季度
  - 运行时间：5 分钟
  - 必须在有效的工作条件下执行功能运行！小心！不允许进行空运行！如不遵守，可能导致全损！

## 8.4 拆卸



### 危险

#### 危害健康的流体会导致危险！

如果在危害健康的流体中使用过水泵，则拆卸水泵后必须进行消毒处理，之后才能用于其他工作！有生命危险！遵守工作规程的相关规定！运营者必须保证工作人员已经收到并阅读工作规程！



### 危险

#### 小心触电死亡！

执行电气作业时不按规定操作，会发生电击致死事故！电气作业必须由专业电工按照当地的相关规定执行。



### 危险

#### 独自执行危险作业导致生命危险！

需要在竖井和狭窄空间内完成的工作，以及存在坠落危险的工作，这两个都是危险工种，不允许单人独自作业！为安全起见，必须有第二个人在场。



### 警告

#### 高温表面可能导致烫伤！

电机外壳在运行过程中温度较高，可能导致烫伤。关闭后使水泵冷却到环境温度！



### 注意

#### 请只使用技术方面毫无瑕疵的提升设备！

请只使用技术方面毫无瑕疵的提升设备提升和降低水泵。确保水泵在升降过程中不会卡住。切勿超过提升设备允许的最大承载能力！开始使用之前，先检查提升设备的功能是否正常！

### 8.4.1 固定湿式安装

- ✓ 停止水泵运行。
- ✓ 入口侧和压力侧的截止阀已关闭。
- 1. 断开水泵电源。
- 2. 将提升设备固定在吊装孔上。小心！不能拉扯接线电缆！这会损坏接线电缆！
- 3. 慢慢提起水泵，在导流管上方从运行空间内提出。小心！提升时可能损坏接线电缆！在提升过程中，使接线电缆保持略微拉紧的状态！
- 4. 展开接线电缆，固定在电机上。小心！不得弯折接线电缆，需要遵守弯曲半径。固定时切勿损坏接线电缆！注意挤压和电缆断裂。
- 5. 彻底清洁水泵（参见“清洁和消毒”段落）。危险！如果在危害健康的流体中使用水泵，需要对水泵进行消毒处理！

### 8.4.2 移动湿式安装

- ✓ 水泵已停止运行。

1. 断开水泵电源。
2. 展开接线电缆，放在电机外壳上。小心！不得弯折接线电缆，需要遵守弯曲半径。不得拉扯接线电缆。这样会损坏接线电缆！
3. 从出水口上松开压力管。
4. 将提升设备固定在接合点上。
5. 从运行空间中提出水泵。小心！放下时可能挤压和损坏接线电缆！放下时注意接线电缆！
6. 彻底清洁水泵（参见“清洁和消毒”段落）。危险！如果在危害健康的流体中使用水泵，需要对水泵进行消毒处理！

#### 8.4.3 固定干式地坑安装

- ✓ 水泵已停止运行。
  - ✓ 入口侧和压力侧的截止阀已关闭。
1. 断开水泵电源。
  2. 展开接线电缆，固定在电机上。小心！不得弯折接线电缆，需要遵守弯曲半径。固定时切勿损坏接线电缆！注意挤压和电缆断裂。
  3. 在进水口和出水口上松开管道系统。危险！危害健康的流体！管路和水力部件中可能仍有流体残留！放置收集池，立刻接收滴落的液体，按规定对液体进行废弃处置。
  4. 将提升设备固定在吊装孔上。
  5. 从底座上松开水泵。
  6. 将水泵缓慢地从管道工程中提起，放在合适的安放位置。小心！放下时可能挤压和损坏接线电缆！放下时注意接线电缆！
  7. 彻底清洁水泵（参见“清洁和消毒”段落）。危险！如果在危害健康的流体中使用水泵，需要对水泵进行消毒处理！

#### 8.4.4 清洁和消毒



##### 危险

##### 危害健康的流体会导致危险！

如果在危害健康的流体中使用过水泵，可能有生命危险！执行所有其他工作之前，需要对水泵进行消毒处理！进行清洁时需要佩戴下列防护装备：

- 封闭式护目镜
- 氧气面罩
- 防护手套

⇒ 所列设备是最低要求，注意工作规程中的相关规定！运营者必须保证工作人员已经收到并阅读工作规程！

- ✓ 已拆下水泵。
  - ✓ 脏污的清洁用水已经按照本地实行的相关规定排入污水管道。
  - ✓ 已准备消毒剂，供受到污染的水泵使用。
1. 防水地包装好插头或裸露的电缆末端！
  2. 将提升设备固定在水泵吊装孔上。
  3. 将水泵提升到距离地面大约 30 cm (10 in) 的位置。
  4. 从上到下，向水泵喷射清水。注意！如果水泵受到污染，必须使用相应的消毒剂！严格遵守生产商规定的使用注意事项！
  5. 为了清洁叶轮和水泵内部空间，通过出水口向内部喷水。
  6. 彻底冲洗通道底部残留的污垢残渣。
  7. 使水泵干燥。

## 9 维护和维修



### 危险

#### 危害健康的流体会导致危险！

如果在危害健康的流体中使用过水泵，则拆卸水泵后必须进行消毒处理，之后才能用于其他工作！有生命危险！遵守工作规程的相关规定！运营者必须保证工作人员已经收到并阅读工作规程！



### 危险

#### 永磁电机：在电机外壳打开时因强磁场造成生命危险！

在打开电机外壳时，会有强磁场冲击式地释放出来！这种磁场可能导致重伤。对于佩戴电子植入物（心脏起搏器、胰岛素泵等）的人来说，这种磁场可能导致死亡。绝对不能打开电机外壳！只有客户服务部可以在打开的电机上作业！



### 注意

#### 请只使用技术方面毫无瑕疵的提升设备！

请只使用技术方面毫无瑕疵的提升设备提升和降低水泵。确保水泵在升降过程中不会卡住。切勿超过提升设备允许的最大承载能力！开始使用之前，先检查提升设备的功能是否正常！

- 始终在干净且照明条件优良的地方执行维护工作。必须能够稳妥地放置水泵并采取安全措施。
- 只执行本安装及操作说明中列出的保养工作。
- 进行维护时穿戴以下防护装备：
  - 护目镜
  - 安全鞋
  - 安全手套

### 9.1 工作人员资格鉴定

- 电气作业：电气作业必须由专业电工执行。
- 保养工作：必须由熟悉所使用工作介质及其废弃处置的专业人员执行。此外工作人员还必须具有机械制造方面的基础知识。

### 9.2 运营者的责任

- 提供必要的防护装备并保证工作人员佩戴防护装备。
- 使用合适的容器收集工作介质并按规定进行废弃处理。
- 按规定对使用过的防护服进行废弃处理。
- 只使用生产商提供的原装部件。由于使用非原装部件而造成的任何损失，生产商概不承担任何责任。
- 一旦发生流体和工作介质泄露事故，立即收集泄漏物并按照当地现行法规进行废弃处理。
- 提供需要使用的工具。
- 使用易燃溶剂和清洁剂时，应禁止明火、明灯和吸烟。

### 9.3 工作介质

#### 9.3.1 加注量

| 电机类型               | 密封室<br>白油 | 冷却系统<br>冷却液 P35 |        |               |
|--------------------|-----------|-----------------|--------|---------------|
| 电机 <b>FKT 20.2</b> |           |                 |        |               |
| FKT 20.2.../17...  | –         | –               | 9.0 l  | 304 US.fl.oz. |
| FKT 20.2.../20...  | –         | –               | 9.0 l  | 304 US.fl.oz. |
| FKT 20.2.../22...  | –         | –               | 9.0 l  | 304 US.fl.oz. |
| FKT 20.2.../24...  | –         | –               | 11.0 l | 372 US.fl.oz. |
| FKT 20.2.../30...  | –         | –               | 11.0 l | 372 US.fl.oz. |
| FKT 20.2.../32...  | –         | –               | 11.0 l | 372 US.fl.oz. |
| 电机 <b>FKT 27.x</b> |           |                 |        |               |
| FKT 27.1...        | 3.9 l     | 132 US.fl.oz.   | 14.5 l | 490 US.fl.oz. |
| FKT 27.2...        | 6.5 l     | 220 US.fl.oz.   | 17.5 l | 592 US.fl.oz. |

9.3.2 冷却液 P35

冷却液 P35 是一种水-乙二醇混合物，它由最多 35% 的“Fragol Zitrec FC”浓缩液和最多 65% 的去矿物质水或蒸馏水构成。在补充和填充冷却系统时，只能使用指定比例的所述浓缩液。

小心

错误的浓缩液或混合比例会损坏电机！

在使用其他浓缩液时，可能损坏电机！在混合比例不同时，无法保证防冻和防腐蚀！只能使用比例为 35:65 的所列浓缩液。

| 浓缩液 | Fragol Zitrec FC | Pekasol L | 丙二醇 <sup>2)</sup> |
|-----|------------------|-----------|-------------------|
| 状态  | 目前使用             | 或可选择      | 或可选择              |

技术数据

|        |                                      |   |                                      |
|--------|--------------------------------------|---|--------------------------------------|
| 基础     | 丙烷-1,2-二醇                            |   |                                      |
| 颜色     | 无色                                   | 黄色  | 无色                                   |
| 纯度     | 96%                                  | -   | 98%                                  |
| 密度     | 1.051 g/ml<br>(8.771 lb/US.liq.gal.) | 1.050 g/cm <sup>3</sup><br>(8.762 lb/US.liq.gal.) | 1.051 g/ml<br>(8.771 lb/US.liq.gal.) |
| 沸点     | 164 °C (327 °F)                      | 185 °C (365 °F)                                   | 188 °C (370 °F)                      |
| pH 值   | 9.9                                  | 7.5-9.5   | -                                    |
| 水      | 最高 5%                                | -   | 0.20%                                |
| 不含亚硝酸盐 | •                                    | •   | •                                    |
| 不含胺    | •                                    | •   | •                                    |
| 不含磷酸盐  | •                                    | •   | •                                    |
| 不含硅酸盐  | •                                    | •   | •                                    |

批准

|                    |   |   |   |
|--------------------|---|---|---|
| 水污染类 <sup>1)</sup> | 1 | 1 | 1 |
| FDA                | • | - | - |
| HT1                | • | - | - |
| Afssa              | • | - | - |

<sup>1)</sup> 依据 1999 年版《对水有有害物质管理条例》。在废弃处理这些流体时注意当地有关丙二醇的准则！

<sup>2)</sup> 适用于医疗用途

9.3.3 油类型

- ExxonMobile: Marcol 52
- ExxonMobile: Marcol 82
- Total: Finavestan A 80 B（经过NSF-H1认证）

9.3.4 润滑脂

- Esso: Unirex N3
- Tripol: Molub-Alloy-Food Proof 823 FM（获得USDA-H1许可）

9.4 维护间隔

为了保证设备可靠地运行，必须定期进行维护。在实际应用中，可以根据实际工作条件，确定与合同中所列间隔时间不同的维护间隔！如果在运行过程中出现剧烈振动，必须检查水泵和安装情况，不可拘泥于规定的维护间隔。

9.4.1 一般工作条件下的维护间隔

8000 个运行小时或者最迟 2 年后

|  |        |      |             |           |       |        |         |
|--|--------|------|-------------|-----------|-------|--------|---------|
|  | 目检接线电缆 | 目检附件 | 目检涂镀和外壳是否磨损 | 检查监控设备的功能 | 更换冷却液 | 密封室换油* | 将泄漏腔排水* |
|--|--------|------|-------------|-----------|-------|--------|---------|

异步电动机

|               | 目检接线电缆 | 目检附件 | 目检涂镀和外壳是否磨损 | 检查监控设备的功能 | 更换冷却液 | 密封室换油* | 将泄漏腔排水* |
|---------------|--------|------|-------------|-----------|-------|--------|---------|
| FKT 20.2      | •      | •    | •           | •         | •     | —      | •       |
| FKT 27.x      | •      | •    | •           | •         | •     | •      | •       |
| 永磁电机          |        |      |             |           |       |        |         |
| FKT 20.2...-P | •      | •    | •           | •         | •     | —      | o       |

图例

• = 执行维护措施，o = 根据显示执行维护措施，— = 不涉及维护措施  
\* 注意“不同维护间隔时间”中的提示！

**15000 个运行小时或者最迟 10 年后**  
→ 大修

9.4.2 不同的保养间隔时间

无Digital Data Interface的电机

对于无Digital Data Interface的电机，可安装外部密封室监控（湿度电极）。如果装有该监控，则根据显示换油！

有Digital Data Interface的电机

对于有Digital Data Interface的电机，通过电容传感器监控密封腔和/或泄漏腔。如果达到预设的阈值，则通过Digital Data Interface进行警告。当显示警告时，执行相应的保养措施。

9.4.3 恶劣条件下的维护间隔

在恶劣条件下，必要时必须缩短规定的维护间隔。恶劣或者繁重的生产条件是指以下情况：

- 流体中含有长纤维成分
- 涡流式入口（例如由于空气进入、气蚀）
- 流体具有强度腐蚀或磨蚀性
- 流体生成大量气体
- 在不合适的工况点运行
- 存在压力冲击

在恶劣条件下使用水泵时，建议签订维护合同。相关事宜请联系客户服务部。

9.5 维护措施



警告

叶轮和进水口的锋利边缘！

叶轮和进水口可能形成锋利的边缘。导致四肢被割伤的危险！必须佩戴防护手套，防止出现切割受伤的情况。



警告

不穿戴防护装备会导致手、脚和眼睛受伤！

工作时存在（严重）受伤危险。穿戴以下防护装备：

- 安全手套，用以预防切割伤害
- 安全鞋
- 封闭式护目镜

开始采取维护措施之前，必须满足下列前提条件：

- 水泵已冷却到环境温度。
- 彻底清洁水泵，必要时进行消毒。

### 9.5.1 建议的维护措施

建议定期检查电耗和所有三个相位的工作电压，以此保证产品顺畅运行。在正常运行情况下，这些数值保持恒定。受输送流体性质的影响会稍许波动。根据电流消耗值可以早期识别出叶轮、轴承或者电机的损坏或功能失灵，然后修复。电压波动较大，会给电机绕组造成负担，并会导致水泵故障。定期检查可以避免造成严重的间接性损失，同时降低发生全损事故的风险。建议采用远程监控方式进行定期检查。

### 9.5.2 目检接线电缆

检查接线电缆的以下几方面：

- 气泡
- 裂纹
- 划痕
- 摩擦情况
- 挤压情况

一旦确定接线电缆受损，立刻将水泵停止运行！联系客户服务部更换接线电缆。只有经过专业排除故障之后，才能重新将水泵投入运行！

**小心！接线电缆损坏可能导致水泵进水！进水会导致水泵全损。**

### 9.5.3 目视检查附件

附件必检项：

- 是否正确固定
- 功能是否正常
- 有无磨损症状，比如振动导致的裂纹

一旦确定存在缺陷，必须立刻维修或者更换附件。

### 9.5.4 目检涂层和外壳是否磨损

涂层和外壳部件不允许任何损坏。如果确定存在缺陷，注意下面几项：

- 如果涂层损坏，必须修复涂层。
- 如果外壳部件磨损，请咨询客户服务部！

### 9.5.5 检查监控设备的功能

检查电阻之前，必须先将水泵冷却至环境温度！

#### 9.5.5.1 检查温度传感器的电阻

使用电阻表测量温度传感器的电阻。必须遵守下列测量值：

- 双金属片：测量值 = 0 Ohm（通过）。
- **PTC 传感器**（正温度系数电阻）：测量值取决于安装的传感器个数。PTC 传感器的冷态电阻介于 20 至 100 Ohm 之间。
  - 如果串联三个传感器，测量值介于 60 至 300 Ohm 之间。
  - 如果串联四个传感器，测量值介于 80 至 400 Ohm 之间。
- **Pt100 传感器**：Pt100 传感器在 0 °C (32 °F) 时的电阻值为 100 Ohm。在 0 °C (32 °F) 和 100 °C (212 °F) 之间时，温度每增加 1 °C (1.8 °F)，电阻值增加 0.385 Ohm。
  - 环境温度为 20 °C (68 °F) 时，电阻值达到 107.7 Ohm。

#### 9.5.5.2 检查端子室/电机舱监控装置内部电极的电阻

内部电极并联在一起，因此检查时请一起测量所有电极。

使用电阻表测量电极的电阻。测得的数值必须趋向于“无穷大”。如果数值  $\leq 30$  kOhm，说明端子室或电机舱有水。请咨询客户服务部！

#### 9.5.5.3 检查用于进行密封室监控的外部电极的电阻

使用电阻表测量电极的电阻。测得的数值必须趋向于“无穷大”。如果数值  $\leq 30$  kOhm，说明油中有水，换油！

### 9.5.6 有关使用截止球阀的注意事项

在排放口上加装截止球阀时请注意以下几点：

- 在打开截止球阀之前，去除螺旋塞。
- 沿流动方向（平行于截止球阀）旋转杠杆，以排出工作介质。
- 垂直于流动方向（朝向套筒球阀）旋转杠杆，以关闭排放口。
- 在关闭截止球阀之后，重新旋入螺旋塞。

9.5.7 给密封室换油



警告

工作介质承受高压！

电机内可能形成高达数巴的压力！打开螺旋塞时，这种压力会向外冲出。如果打开螺旋塞时不注意，它可能会高速弹出！请始终遵守以下指示，避免受伤：

- 遵守规定的工作步骤顺序。
- 缓慢转动螺旋塞，不要完全拧出。开始泄压之后（可听见空气鸣叫声或嘶嘶声），不要继续转动螺旋塞！
- 待泄压完成之后，完全拧出螺旋塞。
- 戴上封闭式护目镜。



警告

高温工作介质导致烫伤！

泄压时可能喷出高温工作介质，进而导致烫伤！请务必遵守以下指示，避免受伤：

- 将电机冷却到环境温度，之后打开螺旋塞。
- 佩戴封闭式护目镜或面部保护装置以及手套。

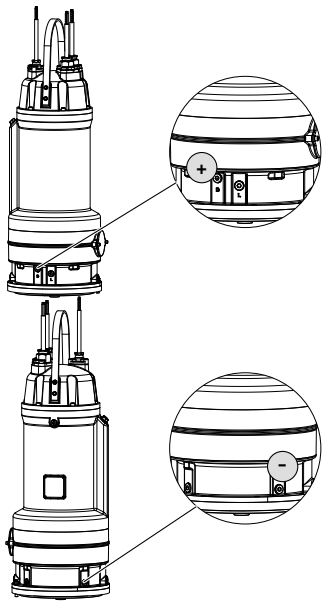


Fig. 12: 密封室：换油

电机 FKT 27.x

|   |        |
|---|--------|
| + | 为密封室注油 |
| - | 为密封室排油 |

- ✓ 防护装备就位！
- ✓ 水泵已拆卸并清洁（必要时消毒）。
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 放置合适的蓄水罐用于收集工作介质。
- 3. 缓慢转动螺旋塞 (+)，不要完全拧出。警告！电机过压！如果发出嘶嘶声或呼啸声，不要继续转动！等待，直到压力完全释放出来。
- 4. 待泄压完成之后，完全拧出螺旋塞 (+)。
- 5. 拧出螺旋塞 (-) 并排出工作介质。如果排放口装有截止球阀，则打开截止球阀。  
注意！吸油或冲洗密封室，以完全排水。
- 6. 检查工作介质：
  - ⇒ 由于机械密封的泄漏，少量水会渗入密封室内。之后油会呈乳状/浑浊。如果油与水的比例小于 2:1，那么可能损坏机械密封。进行换油并在 4 周后再次检查。如果再次有水进入油中，则通知客户服务部！
  - ⇒ 如果工作介质内有金属屑，请联系客户服务部！
- 7. 如果排放口装有截止球阀，则关闭截止球阀。
- 8. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft·lb)！
- 9. 通过螺旋塞 (+) 的开孔注入新的工作介质。
  - ⇒ 遵守规定的工作介质类型和数量！
- 10. 清洁螺旋塞 (+)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft·lb)！



9.5.8 更换冷却液



**警告**  
**工作介质承受高压！**  
电机内可能形成高达数巴的压力！打开螺旋塞时，这种压力会向外冲出。如果打开螺旋塞时不注意，它可能会高速弹出！请始终遵守以下指示，避免受伤：

- 遵守规定的工作步骤顺序。
- 缓慢转动螺旋塞，不要完全拧出。开始泄压之后（可听见空气鸣叫声或嘶嘶声），不要继续转动螺旋塞！
- 待泄压完成之后，完全拧出螺旋塞。
- 戴上封闭式护目镜。



**警告**  
**高温工作介质导致烫伤！**  
泄压时可能喷出高温工作介质，进而导致烫伤！请务必遵守以下指示，避免受伤：

- 将电机冷却到环境温度，之后打开螺旋塞。
- 佩戴封闭式护目镜或面部保护装置以及手套。

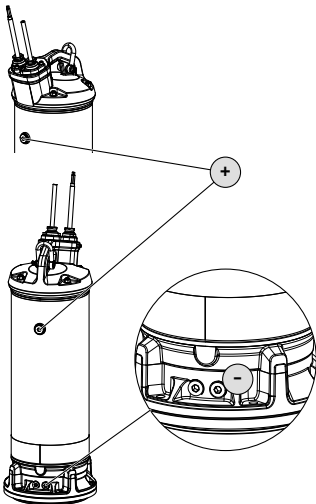


Fig. 13: 冷却系统：更换冷却液 FKT 20.2

电机 FKT 20.2

|   |          |
|---|----------|
| + | 填充/通风冷却液 |
| - | 排放冷却液    |

- ✓ 防护装备就位！
  - ✓ 水泵已拆卸并清洁（必要时消毒）。
1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
  2. 放置合适的蓄水罐用于收集工作介质。
  3. 缓慢转动螺旋塞 (+)，不要完全拧出。警告！电机过压！如果发出嘶嘶声或呼啸声，不要继续转动！等待，直到压力完全释放出来。
  4. 待泄压完成之后，完全拧出螺旋塞 (+)。
  5. 拧出螺旋塞 (-) 并排出工作介质。如果排放口装有截止球阀，则打开截止球阀。  
注意！冲洗冷却系统，以完全排水。
  6. 检查工作介质：如果工作介质内有金属屑，请联系客户服务部！
  7. 如果排放口装有截止球阀，则关闭截止球阀。
  8. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft·lb) ！
  9. 通过螺旋塞 (+) 的开孔注入新的工作介质。  
⇒ 遵守规定的工作介质类型和数量！
  10. 清洁螺旋塞 (+)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft·lb) ！



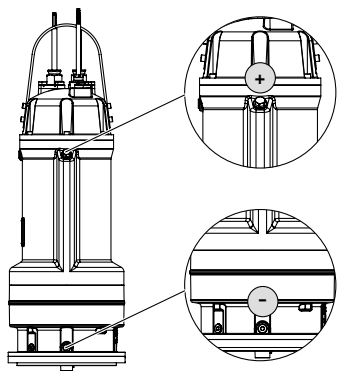


Fig. 14: 冷却系统：更换冷却液 FKT 27.1/27.2

9.5.9 泄漏腔排水

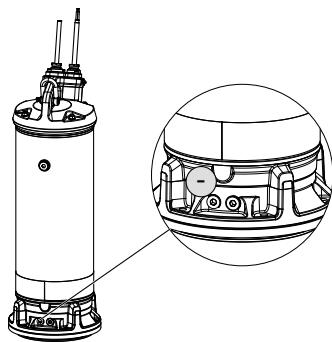


Fig. 15: 泄漏腔排水 FKT 20.2

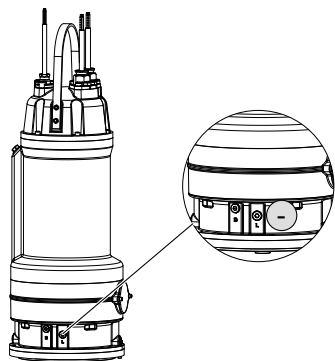


Fig. 16: 泄漏腔排水 FKT 27.1/27.2

9.5.10 大修

电机 FKT 27.x

|   |          |
|---|----------|
| + | 填充/通风冷却液 |
| - | 排放冷却液    |

- ✓ 防护装备就位！
- ✓ 水泵已拆卸并清洁（必要时消毒）。
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 放置合适的蓄水罐用于收集工作介质。
- 3. 缓慢转动螺旋塞 (+)，不要完全拧出。警告！电机过压！如果发出嘶嘶声或呼啸声，不要继续转动！等待，直到压力完全释放出来。
- 4. 待泄压完成之后，完全拧出螺旋塞 (+)。
- 5. 拧出螺旋塞 (-) 并排出工作介质。如果排放口装有截止球阀，则打开截止球阀。  
注意！冲洗冷却系统，以完全排水。
- 6. 检查工作介质：如果工作介质内有金属屑，请联系客户服务部！
- 7. 如果排放口装有截止球阀，则关闭截止球阀。
- 8. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb)！
- 9. 通过螺旋塞 (+) 的开孔注入新的工作介质。  
⇒ 遵守规定的工作介质类型和数量！
- 10. 清洁螺旋塞 (+)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb)！

电机 FKT 20.2

|   |       |
|---|-------|
| - | 排放泄漏液 |
|---|-------|

- ✓ 防护装备就位！
- ✓ 水泵已拆卸并清洁（必要时消毒）。
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 放置合适的容器用于收集工作介质。
- 3. 缓慢转动螺旋塞 (-)，不要完全拧出。警告！电机过压！如果发出嘶嘶声或呼啸声，不要继续转动！等待，直到压力完全释放出来。
- 4. 待泄压完成之后，完全拧出螺旋塞 (-) 并排放工作介质。
- 5. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb)！

电机 FKT 27.x

|   |       |
|---|-------|
| - | 排放泄漏液 |
|---|-------|

- ✓ 防护装备就位！
- ✓ 水泵已拆卸并清洁（必要时消毒）。
- 1. 将水泵垂直放置在坚固的底座上。警告！手可能被挤伤。请确保水泵不会翻倒或滑倒！
- 2. 放置合适的容器用于收集工作介质。
- 3. 缓慢转动螺旋塞 (-)，不要完全拧出。警告！电机过压！如果发出嘶嘶声或呼啸声，不要继续转动！等待，直到压力完全释放出来。
- 4. 待泄压完成之后，完全拧出螺旋塞 (-) 并排放工作介质。
- 5. 清洁螺旋塞 (-)，装入新密封环，重新拧入。最大拧紧扭矩：8 Nm (5.9 ft-lb)！

大修时检查下列部件的磨损和损坏情况：电机轴承、轴封、O 形圈和接线电缆。使用原装件更换损坏的部件。如此可保证正常运行。

大修由生产商或者授权的维修厂执行。

## 9.6 维修工作



### 警告

#### 叶轮和进水口的锋利边缘！

叶轮和进水口可能形成锋利的边缘。导致四肢被割伤的危险！必须佩戴防护手套，防止出现切割受伤的情况。



### 警告

#### 不穿戴防护装备会导致手、脚和眼睛受伤！

工作时存在（严重）受伤危险。穿戴以下防护装备：

- 安全手套，用以预防切割伤害
- 安全鞋
- 封闭式护目镜

开始维修前，必须满足下列前提条件：

- 水泵已冷却到环境温度。
- 水泵已断电并采取安全措施防止意外重启。
- 彻底清洁水泵，必要时进行消毒。

维修工作一般原则：

- 如有流体和工作介质滴落，立刻进行收集！
- 必须更换 O 形圈、密封垫和螺钉锁紧装置！
- 注意附录给出的拧紧扭矩！
- 实施这些工作时，严禁使用蛮力！

### 9.6.1 螺钉锁紧装置使用提示

螺栓可以配备一个螺钉锁紧装置。出厂时有两种螺栓锁紧方式：

- 液体螺栓防松
- 机械螺栓防松

**必须更换螺钉锁紧装置！**

#### 液体螺栓防松

使用中等强度的螺丝防松胶（比如 Loctite 243）实现液体螺栓锁紧。施加力度较大时，这种锁紧方式就会失效。如果螺栓锁紧松不开，必须将连接处加热到大约 300 °C (572 °F)。拆卸后彻底清洁部件。

#### 机械螺栓防松

机械螺钉锁紧装置由两个 Nord-Lock 楔形锁紧垫圈构成。螺栓连接的这种锁紧方式通过夹紧力实现。Nord-Lock 螺钉锁紧装置一般仅用于 10.9 强度等级的镀久美特涂层的螺栓。**禁止用于不锈钢螺栓！**

### 9.6.2 允许执行哪些维修工作

- 更换水力部件外壳。
- SOLID G 和 Q 叶轮：补充调整进水口。

### 9.6.3 更换水力部件外壳



### 危险

#### 禁止拆卸叶轮！

视叶轮直径而定，拆卸某些水泵的水力部件外壳时，必须拆下叶轮。开始任何工作之前，先检查是否有必要拆卸叶轮。如果确定需要拆卸，请联系客户服务部！叶轮拆卸工作必须由客户服务部或者获得授权的专业修理厂执行。

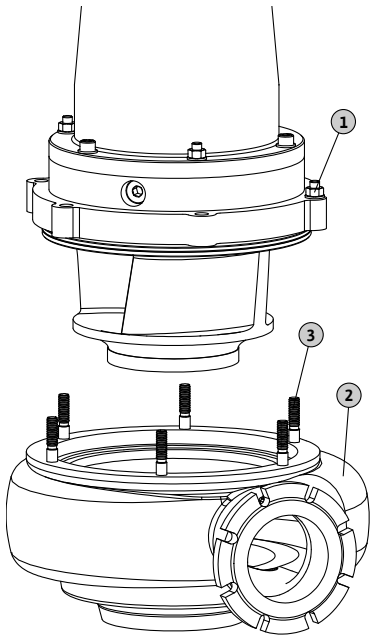


Fig. 17: 更换水力部件外壳

|   |                  |
|---|------------------|
| 1 | 用于固定电机/水力部件的六角螺母 |
| 2 | 水力部件外壳           |
| 3 | 螺栓               |

- ✓ 有具备足够承载能力的提升设备。
  - ✓ 防护装备就位。
  - ✓ 新水力部件外壳就位。
  - ✓ 切勿拆卸叶轮！
1. 将提升设备和相应的提升装置固定在水泵吊装孔上。
  2. 垂直放下水泵。  
小心！如果水泵放下速度过快，会导致水力部件外壳受损。将水泵慢慢放在进水口上！  
注意！如果水泵不能平放在吸水口上，则在下面放置相应的垫板。为了能够顺利提起电机，水泵必须垂直立起。
  3. 在外壳上标记电机/水力部件的位置。
  4. 拧松电机法兰上的六角螺母并将其拧出。
  5. 慢慢提起电机并从水力部件外壳上拔出。  
小心！垂直提起电机，切勿歪斜！如果歪斜，会损坏螺栓！
  6. 将新密封环放到电机法兰上。
  7. 在新水力部件外壳上方摆动电机。
  8. 慢慢降下电机。注意：电机/水力部件标记一致，螺栓精确穿入钻孔中。
  9. 拧紧六角螺母，将电机和水力部件牢牢连接在一起。注意！注意附录中规定的拧紧扭矩！

► 水力部件外壳更换完毕。可以重新安装水泵。

**警告！** 如果需要临时存放水泵且需拆下提升设备，注意采取保护措施，防止水泵翻倒或滑倒！

9.6.4 SOLID G 和 Q 叶轮：补充调整进水口

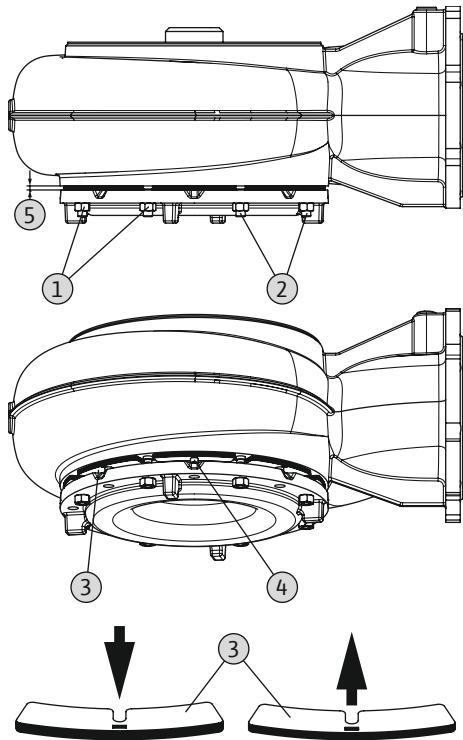


Fig. 18: SOLID G：补充调整间隙

|   |                 |
|---|-----------------|
| 1 | 用于固定进水口的六角螺母    |
| 2 | 螺栓              |
| 3 | 叠片铁芯            |
| 4 | 叠片铁芯紧固螺钉        |
| 5 | 进水口和水力部件外壳之间的间隙 |

- ✓ 有具备足够承载能力的提升设备。
  - ✓ 防护装备就位。
1. 将提升设备和相应的提升装置固定在水泵接合点上。
  2. 提起水泵，使水泵在悬在距离地面大约 50 cm (20 in) 处。
  3. 拧松用于固定进水口的六角螺母。拧出六角螺母，直至其与螺栓齐平。  
**警告！** 手指可能被挤伤！进水口可能由于结壳效应而粘连在水力部件外壳上，可能会突然滑落。只交叉拧松螺母，从下方接触。注意戴安全手套！
  4. 进水口在六角螺母上。如果进水口吸附在水力部件外壳上，则用楔子小心地松开进水口！
  5. 清洁滑动面和拧入的叠片铁芯，必要时消毒。
  6. 松开叠片铁芯上的螺栓并取下各叠片铁芯。
  7. 慢慢拧紧三个交叉的六角螺母，直至进水口贴合在叶轮上。小心！只能用手拧紧六角螺母！如果六角螺母拧得过紧，可能损坏叶轮以及电机轴承！
  8. 测量进水口和水力部件外壳之间的间隙。
  9. 根据尺寸调整叠片铁芯，再插入一块金属板。
  10. 重新拧出三个之前拧紧的六角螺母，直至其与螺栓齐平。
  11. 重新放入叠片铁芯，用螺栓拧紧。
  12. 交叉拧紧六角螺母，直至进水口贴合在叠片铁芯上，与之齐平。
  13. 交叉拧紧六角螺母。注意附录中规定的拧紧扭矩！

14. 从下方探入进水口中，转动叶轮。如果间隙正确，叶轮会自动转动。如果间隙过小，则叶轮难以转动。需要重新调整。警告！割伤肢体！进水口和叶轮会形成锋利的边缘。注意戴安全手套，防止割伤！

► 进水口已正确调整。可以重新安装水泵。

## 10 故障、原因和排除方法



### 危险

#### 危害健康的流体会导致危险！

如果水泵装在危害健康的流体中，可能有生命危险！工作时需要穿戴以下防护装备：

- 封闭式护目镜
- 氧气面罩
- 防护手套

⇒ 所列设备是最低要求，注意工作规程中的相关规定！运营者必须保证工作人员已经收到并阅读工作规程！



### 危险

#### 小心触电死亡！

执行电气作业时不按规定操作，会发生电击致死事故！电气作业必须由专业电工按照当地的相关规定执行。



### 危险

#### 独自执行危险作业导致生命危险！

需要在竖井和狭窄空间内完成的工作，以及存在坠落危险的工作，这两个都是危险工种，不允许单人独自作业！为安全起见，必须有第二个人在场。



### 警告

#### 禁止人员在水泵工作区域内停留！

水泵运行时会吸拉工作人员，导致（严重）受伤！因此禁止人员在其工作区域内停留。如果人员必须进入水泵工作区域，则必须将水泵停止运行并采取防护措施，以防被重新接通！



### 警告

#### 叶轮和进水口的锋利边缘！

叶轮和进水口可能形成锋利的边缘。导致四肢被割伤的危险！必须佩戴防护手套，防止出现切割受伤的情况。

### 故障：水泵不启动

1. 电源线断开或者导线/电机绕组发生短路/对地短路。
  - ⇒ 安排专业电工检查接线和电机，必要时进行更换。
2. 触发保险丝、电机保护开关或监控设备
  - ⇒ 安排专业人员检查接线和监控设备，必要时进行改动。
  - ⇒ 安排专业电工按照技术规定安装电机保护开关和保险丝并进行设置，重置监控设备。
  - ⇒ 检查叶轮的灵活性，必要时清洁水力部件
3. 密封室监控设备（选配）电路断路（取决于接线）
  - ⇒ 参见“故障：机械密封泄漏，密封室监控设备报告故障并关闭水泵”

### 故障：水泵启动后，很快就触发电机保护

1. 电机保护开关设置错误。

- ⇒ 安排专业电工检查触发器设置并进行修正。
- 2. 高电压降导致高电耗。
  - ⇒ 安排专业电工检查各相位的电压值。联系电网运营商。
- 3. 接线只有两相。
  - ⇒ 安排专业电工检查接线并进行修正。
- 4. 相位之间电压差异大。
  - ⇒ 安排专业电工检查各相位的电压值。联系电网运营商。
- 5. 旋转方向错误。
  - ⇒ 安排专业电工修正接线。
- 6. 水力部件堵塞导致高电耗。
  - ⇒ 清洁水力部件，检查入口。
- 7. 流体密度过高。
  - ⇒ 联系客户服务部。

**故障：水泵运行，无流量**

- 1. 无流体。
  - ⇒ 检查入口，打开所有截止阀。
- 2. 入口堵塞。
  - ⇒ 检查入口，清除堵塞。
- 3. 水力部件堵塞。
  - ⇒ 清洁水力部件。
- 4. 出口侧管道系统或压力软管堵塞。
  - ⇒ 消除堵塞，必要时更换损坏的部件。
- 5. 间歇运行。
  - ⇒ 检查开关设备。

**故障：水泵启动，但是达不到工况点**

- 1. 入口堵塞。
  - ⇒ 检查入口，清除堵塞。
- 2. 出口侧滑阀关闭。
  - ⇒ 完全打开所有截止阀。
- 3. 水力部件堵塞。
  - ⇒ 清洁水力部件。
- 4. 旋转方向错误。
  - ⇒ 安排专业电工修正接线。
- 5. 管道系统中形成气垫。
  - ⇒ 为管道系统排气。
  - ⇒ 频繁形成气垫：寻找进气口，避免进气，必要时在指定位置安装排气装置。
- 6. 水泵输送背压过高。
  - ⇒ 完全打开出口侧的所有截止阀。
- 7. 水力部件出现磨损迹象。
  - ⇒ 检查部件（叶轮、吸水口、水泵壳体）并联系客户服务部进行更换。
- 8. 出口侧管道系统或压力软管堵塞。
  - ⇒ 消除堵塞，必要时更换损坏的部件。
- 9. 流体生成大量气体。
  - ⇒ 联系客户服务部。
- 10. 接线只有两相。
  - ⇒ 安排专业电工检查接线并进行修正。
- 11. 运行期间，液位剧烈降低。

- ⇒ 检查系统供应/容量。
- ⇒ 检查液位控制装置的切换点，必要时进行调整。

#### 故障：水泵运行不安静，噪声大

1. 不允许的工况点。
  - ⇒ 检查水泵布局和工况点，咨询客户服务部。
2. 水力部件堵塞。
  - ⇒ 清洁水力部件。
3. 流体生成大量气体。
  - ⇒ 联系客户服务部。
4. 接线只有两相。
  - ⇒ 安排专业电工检查接线并进行修正。
5. 旋转方向错误。
  - ⇒ 安排专业电工修正接线。
6. 水力部件出现磨损迹象。
  - ⇒ 检查部件（叶轮、进水口、水泵壳体）并联系客户服务部进行更换。
7. 电机轴承磨损。
  - ⇒ 联系客户服务部；水泵返厂维修。
8. 水泵已夹紧安装。
  - ⇒ 检查安装情况，必要时安装橡胶补偿器。

#### 故障：密封室监控设备报告故障或者关闭水泵

1. 因存放时间较长或者温度波动大，形成了冷凝水。
  - ⇒ 在不使用铅芯湿度电极的情况下短时运行水泵（不超过 5 分钟）
2. 使用新机械密封时，入口处泄漏量增大。
  - ⇒ 换油。
3. 铅芯湿度电极的电缆损坏。
  - ⇒ 更换铅芯湿度电极。
4. 机械密封损坏。
  - ⇒ 联系客户服务部门。

#### 其他故障排除方法

如果所述方法于故障排除无益，请联系客户服务部。客户服务部门可如下提供帮助：

- 通过电话或邮件提供帮助。
- 提供现场支持。
- 返厂检查和维修。

如果向客户服务部门提出支援请求，可能会产生费用！具体金额请咨询客户服务部。

## 11 备件

请在客户服务部订购备件。为了减少询问，同时避免出现订购错误，请提供序列号或商品号。保留技术变更权利！

## 12 废弃处置

### 12.1 油和润滑剂

工作介质必须被收集到一个适当的容器中，并根据当地现行的指令废弃处置。一旦有介质滴落，立刻进行收集！

### 12.2 水-乙二醇混合物

此工作介质属于德国水污染行政法规 (VwVwS) 规定的水污染等级 1。废弃处置时必须遵守当地现行的指令（例如 DIN 52900 对丙二醇的规定）。

### 12.3 防护服

穿过的防护服必须根据当地现行的指令废弃处置。

### 12.4 关于收集损耗的电气产品和电子产品的相关信息

按规定废弃处置和正确回收这些产品，能避免环境污染、保护人身健康。



**注意****禁止作为生活垃圾废弃处置！**

在欧盟地区，该标志张贴在产品、包装或随附的资料中。它的意思是，相关的电气和电子产品不得作为生活垃圾废弃处置。

在按规定处理、回收和废弃处置相关旧产品时，要注意以下几点：

- 这些产品只能交给专门为此设立且获得认证的垃圾处理场。
- 注意当地现行的规定！

有关按规定废弃处置的信息，请咨询当地社区、最近的垃圾处理场或您购买产品的经销商。关于回收的详细信息请访问[www.wilo-recycling.com](http://www.wilo-recycling.com)。

**保留技术变更权利！****13 防爆认证**

本章节详细介绍在爆炸性环境中运行水泵的相关信息。所有工作人员都必须阅读本章节内容。本章节仅适用于获得防爆认证的水泵！

**13.1 获得防爆认证的水泵标识**

在爆炸性气体中使用，水泵铭牌上必须具有下列标识：

- 相应认证的防爆标识
  - 防爆等级
  - 认证编号（取决于认证机构）
- 如果认证机构要求，会在产品铭牌上刻印认证编号。

**13.2 防护等级**

电机的结构规格符合下列防护等级：

- 防火外壳 (ATEX)
- Explosionproof (FM)

为了限制表面温度，电机至少装有一个温度限制装置（单电路温度监控装置）。此外还能进行温度调节（双电路温度监控）。

**13.3 规定用途****危险****输送爆炸性流体会导致爆炸！**

严禁输送纯粹形态下的易燃易爆流体（汽油、煤油等）。爆炸导致生命危险！水泵不是针对这类流体设计出的产品。

**ATEX 认证**

水泵适合在潜在爆炸环境中运行：

- 设备组：II
  - 类别：2，1 区和 2 区
- 水泵不可在 0 区使用！

**FM 认证**

水泵适合在潜在爆炸环境中运行：

- 防护等级：Explosionproof
  - 类别：Class I, Division 1
- 注意：如果根据 Division 1 布线，则也允许在 Class I, Division 2 中安装。

**13.4 电气连接****危险****小心触电死亡！**

执行电气作业时不按规定操作，会发生电击致死事故！电气作业必须由专业电工按照当地的相关规定执行。

- 始终在潜在爆炸环境以外对水泵进行电气连接。如果必须在潜在爆炸环境内接线，则在获得防爆认证的外壳（符合 DIN EN 60079-0 标准规定的点火保护等级）内进行！如不遵守，爆炸会导致生命危险！接线工作须由专业电工执行。

- 所有位于“防火花区域”以外的监控设备，必须连接一个本安电路（比如 Ex-i 继电器 XR-4...）。
- 电压公差最大不得超过 ±10 %。

监控设备概述

|                        | 异步电动机    |                    |          | 永磁电机               |
|------------------------|----------|--------------------|----------|--------------------|
|                        | FKT 20.2 | FKT 20.2           | FKT 27.x | FKT 20.2...-P      |
| 内部监控设备                 |          |                    |          |                    |
| Digital Data Interface | –        | •                  | –        | •                  |
| 端子室/电机舱：湿度             | –        | –                  | •        | –                  |
| 电机绕组：双金属               | •        | –                  | •        | –                  |
| 电机绕组：PTC               | o        | • (+ 1...3x Pt100) | o        | • (+ 1...3x Pt100) |
| 电机轴承：Pt100             | o        | o                  | o        | o                  |
| 密封室：电感式传感器             | –        | –                  | –        | –                  |
| 密封室：电容式传感器             | –        | •                  | –        | •                  |
| 泄漏腔：浮子开关               | •        | –                  | •        | –                  |
| 泄漏腔：电容式传感器             | –        | •                  | –        | •                  |
| 振动传感器                  | –        | •                  | –        | •                  |
| 外部监控设备                 |          |                    |          |                    |
| 密封室：电感式传感器             | o        | –                  | o        | –                  |

• = 标配，– = 不可用，o = 可选

所有现有的监控设备必须始终处于连接状态！

13.4.1 有 Digital Data Interface 的电机



注意

注意Digital Data Interface的说明书！

阅读并遵守有关Digital Data Interface的单独说明书，以了解详细信息和高级设置。

通过 Digital Data Interface 分析所有现有的传感器。通过Digital Data Interface的图形操作界面显示当前值和设置极限参数。在超过极限参数时会发出警示或警报信息。为安全关闭水泵，电机绕组另外配备有 PTC 传感器。

Digital Data Interface的接口取决于选定的系统模式和其他系统组件。注意Digital Data Interface说明书的安装建议和接头类型。

13.4.2 无 Digital Data Interface 的电机

13.4.2.1 端子室/电机舱监控

按照“电气连接”章节的相关说明进行连接。

13.4.2.2 电机绕组监控



危险

电机过热导致爆炸风险！

如果温度限制装置接线错误，可能由于电机过热而引起爆炸！温度限制装置必须连接一个手动重启锁定装置。也就是说，“解锁按钮”必须手动操作！

电机配备一个温度限制装置（单回路温度监控）。电机可以选配一个温度调节和限制装置（双回路温度监控）。

对于电机过热保护，由安装的传感器确定反应温度。视电机过热保护规格而定，达到反应温度后必须实现下列触发状态：

- 温度限制装置（1 温度回路）：  
达到反应温度之后，必须通过重启锁定功能执行一次关闭操作！
- 温度调节装置和限制装置（2 温度回路）：  
达到低温反应温度后，可以通过自动重启功能执行一次关闭操作。达到高温反应温度后，必须通过重启功能执行一次关闭操作！



小心！过热会导致电机损坏！自动重启时，注意遵守规定的最大开关频率和开关暂停时间！

#### 连接电机过热保护

- 通过一个评测继电器连接双金属片。建议使用“CM-MSS”继电器。  
连接值：最大 250 V(AC)，2.5 A， $\cos \varphi = 1$
- 通过一个评测继电器连接 PTC 传感器。建议使用“CM-MSS”继电器。
- 如果使用变频器，将温度传感器与 Safe Torque Off (STO) 相连。这样可在硬件方面保证关闭水泵。

#### 13.4.2.3 泄漏腔监控

通过一个评测继电器连接浮子开关！建议使用“CM-MSS”继电器。

#### 13.4.2.4 电机轴承监控

按照“电气连接”章节的相关说明进行连接。

#### 13.4.2.5 密封室监控装置（外部电极）

- 通过一个获得防爆认证的评测继电器连接外部铅芯湿度电极！建议使用“XR-4...”继电器。  
阈值为 30 kΩ。
- 连接必须通过本安电路实现！

#### 13.4.3 在变频器上运行

- 变频器型号：脉冲宽度调制
- 连续运行时的最低/最高频率：
  - 异步电动机：30 Hz 至额定频率（50 Hz 或 60 Hz）
  - 永磁电机：30 Hz 至型号铭牌上指定的最高频率  
注意！最高频率可能低于 50 Hz！
  - 遵守最低流速！
- 最小开关频率：4 kHz
- 接线端子板最大过电压：1350 V
- 变频器输出电流：最高为额定电流的 1.5 倍
- 最长过载时间：60 s
- 扭矩应用：二次水泵特征曲线或者自动能量优化程序（比如 VVC+）  
可根据需求提供转速/扭矩特征曲线！
- 注意与电磁兼容性规定有关的附加措施（选择变频器、滤波器等）。
- 切勿超过电机的额定电流与额定转速。
- 必须能够连接电机自带的温度监控设备（双金属或 PTC 传感器）。
- 如果耐温等级标记为 T4/T3，则适用 T3 级别。

#### 13.5 试运行



#### 危险

##### 使用未获得防爆认证的水泵可能导致爆炸！

切勿在潜在爆炸环境中使用未获得防爆认证的水泵！爆炸导致生命危险！潜在爆炸环境中只能使用铭牌上标有相应的防爆标识的水泵。



#### 危险

##### 水力部件中的火花放电可能导致爆炸！

水力部件在运行过程中必须浸在水中（完全充满流体）。如果流量断开，或者水力部件浮出水面，可能会在水力部件中形成气垫。这可能引发爆炸，比如静电导致的火花放电！干转保护装置必须保证在相应的液位下关闭水泵。



#### 危险

##### 干转保护连接错误可能发生爆炸！

在易爆环境中运行水泵时，为干转保护装置配备单独的信号变送器（液位控制装置的冗余安全措施）。关闭水泵时，必须手动执行重启锁定！

- 潜在爆炸环境由运营者负责划分。
- 潜在爆炸环境中只允许使用获得相应的防爆认证的水泵。
- 获得防爆认证的水泵，铭牌上标有相应的标识。
- 切勿超过最高流体温度！
- 必须防止水泵空运行！为此，现场必须保证（干转保护）防止水力部件浮出水面。

13.6 维护和维修

- 根据 DIN EN 50495 标准，类别 2 需要装备一台 SIL 1 级安全装置，而且硬件必须达到零容错标准。
- 按规定进行保养。
  - 只执行本安装及操作说明中列出的保养工作。
  - 在防火花缝开展维修作业时，只能按照生产商提供的设计参数执行作业。不允许按照 DIN EN 60079-1 标准表 1 和表 2 的数值进行维修。
  - 请只使用生产商指定的螺钉，最低要求是强度等级达到 600 N/mm² (38.85 长吨-力/英寸²)。

13.6.1 修复壳体涂层

涂层厚度较大时，漆层可能产生静电。危险！有爆炸危险！静电在爆炸性环境中释放会导致爆炸！

修复壳体涂层时，厚度不可超过 2 mm (0.08 in)！

13.6.2 更换机械密封

切勿交换流体侧和电机侧密封件！

13.6.3 更换接线电缆

严禁更换接线电缆！

14 附件

14.1 拧紧扭矩

| A2/A4 不锈钢螺栓 |      |       |       |
|-------------|------|-------|-------|
| 螺纹          | 拧紧扭矩 |       |       |
|             | Nm   | kp m  | ft-lb |
| M5          | 5.5  | 0.56  | 4     |
| M6          | 7.5  | 0.76  | 5.5   |
| M8          | 18.5 | 1.89  | 13.5  |
| M10         | 37   | 3.77  | 27.5  |
| M12         | 57   | 5.81  | 42    |
| M16         | 135  | 13.77 | 100   |
| M20         | 230  | 23.45 | 170   |
| M24         | 285  | 29.06 | 210   |
| M27         | 415  | 42.31 | 306   |
| M30         | 565  | 57.61 | 417   |

| 配有 Nord-Lock 防松垫圈的镀久美特螺栓（强度等级 10.9） |       |       |       |
|-------------------------------------|-------|-------|-------|
| 螺纹                                  | 拧紧扭矩  |       |       |
|                                     | Nm    | kp m  | ft-lb |
| M5                                  | 9.2   | 0.94  | 6.8   |
| M6                                  | 15    | 1.53  | 11    |
| M8                                  | 36.8  | 3.75  | 27.1  |
| M10                                 | 73.6  | 7.51  | 54.3  |
| M12                                 | 126.5 | 12.90 | 93.3  |
| M16                                 | 155   | 15.81 | 114.3 |
| M20                                 | 265   | 27.02 | 195.5 |

14.2 在变频器上运行

批量规格的电机（遵守 IEC 60034-17 标准）可通过变频器运行。如果额定电压超过 415 V/50 Hz 或 480 V/60 Hz，必须咨询客户服务部。谐波导致额外升温，因此电机的额定功率必须比水泵所要求的功率高出约 10%。如果变频器配备无高次谐波的输出端，可能可将功率储备降低 10%。使用输出端滤波器可以减弱高次谐波。变频器必须与滤波器相互匹配。

根据电机额定电流对变频器进行配置。务必注意：尤其处于低转速范围的情况下，水泵工作时应该保持不晃动、不振动。否则机械密封会丧失密封性并损坏。此外，还应注意管路中的流速。如果流速过低，则水泵和连接管路中出现固体沉积物的危险会增加。测得的输送压力为 0.4 bar (6 psi) 时，建议最低流速为 0.7 m/s (2.3 ft/s)。

重要的是，水泵在整个调节范围内工作时，不得出现振动、共振、摆动力矩，噪音不能过大。电源受谐波影响，导致发动机噪音音量提升，属于正常现象。

为变频器设置参数时，注意遵守水泵和风扇二次特征曲线（U/f 特征曲线）的设置！U/f 特征曲线确保在频率低于额定频率（50 Hz 或 60 Hz）时，输出端电压能够满足水泵的功率需求。新型变频器具有能源自动优化功能 - 这种自动机制的目标是达到相同的效果。进行变频器设置时，请注意变频器的安装及操作说明。

如果电机与变频器配套运行，视型号和安装条件而定，电机监测可能受到干扰。采取下列措施，可以降低或避免干扰：

- 遵守 IEC 60034-25 标准规定的过电压极值和上升速度极值。可能必须安装输出端滤波器。
- 改变变频器的脉冲频率。
- 如果内部密封室监控设备发生故障，使用外部双杆湿度电极。

下列结构性措施也可以减少或者避免干扰：

- 干线和控制电缆具有单独的接线电缆（视电机结构尺寸而定）。
- 布线时，在干线和控制电缆之间留出足够的间距。
- 使用已屏蔽的接线电缆。

#### 汇总

- 连续运行时的最低/最高频率：
  - 异步电动机：30 Hz 至额定频率（50 Hz 或 60 Hz）
  - 永磁电机：30 Hz 至型号铭牌上指定的最高频率  
注意！最高频率可能低于 50 Hz！
  - 遵守最低流速！
- 注意与电磁兼容性规定有关的附加措施（选择变频器、使用滤波器等）。
- 不得超出电机的额定电流与额定转速。
- 必须能够连接电机自带的温度监控设备（双金属或 PTC 传感器）。

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## 1 General information

### 1.1 About these instructions

These instructions form part of the product. Adherence to these instructions is a requirement for the intended use and correct operation of the product:

- Carefully read the instructions prior to any activities on and with the product.
- Keep the instructions in an accessible place at all times.
- Observe all product specifications and labels on the device.

The language of the original operating instructions is German. Versions of these instructions in any other language are translations of the original operating instructions.

### 1.2 Copyright

Copyright remains with Wilo. Do not:

- Reproduce any content.
- Distribute any content.
- Use any content for competition purposes without authorisation.

Wilo shall reserve the right to change the listed data without notice and shall not be liable for technical inaccuracies and/or omissions.

### 1.3 Subject to change

Wilo shall reserve the rights to make technical changes to the product and individual components. The illustrations used may differ from the original and are intended as a sample representation of the device.

### 1.4 Exclusion from warranty and liability

Wilo shall specifically not assume any warranty or liability in the following cases:

- Inadequate configuration due to inadequate or incorrect instructions by the operator or the client
- Non-compliance with these instructions
- Improper use
- Incorrect storage or transport
- Incorrect installation or dismantling
- Insufficient maintenance
- Unauthorised repairs
- Inadequate construction site
- Chemical, electrical or electrochemical influences
- Wear

## 2 Safety

This chapter contains basic information for the individual phases of the life cycle. Failure to observe this information carries the following risks:

- Injury to persons from electrical, mechanical and bacteriological factors as well as electromagnetic fields
- Environmental damage from discharge of hazardous substances
- Property damage
- Failure of important functions of the product

Failure to observe the information contained herein will result in the loss of claims for damages.

**The instructions and safety instructions in the other chapters must also be observed!**

### 2.1 Identification of safety instructions

These installation and operating instructions set out safety instructions for preventing personal injury and damage to property. These safety instructions are shown differently:

- Safety instructions relating to personal injury start with a signal word, are **preceded by a corresponding symbol** and are shaded in grey.



#### **DANGER**

#### **Type and source of the danger!**

Consequences of the danger and instructions for avoidance.

- Safety instructions relating to property damage start with a signal word and are displayed **without** a symbol.

## CAUTION

### Type and source of the danger!

Consequences or information.

#### Signal words

##### → DANGER!

Failure to observe the safety instructions will result in serious injuries or death!

##### → WARNING!

Failure to follow the instructions can lead to (serious) injuries!

##### → CAUTION!

Failure to follow the instructions can lead to property damage and a possible total loss.

##### → NOTICE!

Useful information on handling the product

#### Markups

✓ Prerequisite

1. Work step/list

⇒ Notice/instructions

► Result

#### Symbols

These instructions use the following symbols:



Danger caused by electric voltage



Danger of bacterial infection



Danger caused by strong magnetic field



Danger of explosion



Danger caused by explosive atmosphere



General warning symbol



Warning – risk of cutting injuries



Warning – hot surfaces



Warning – high pressure



Warning – suspended loads



Personal protective equipment: wear a safety helmet



Personal protective equipment: wear safety footwear



Personal protective equipment: wear protective gloves



Personal protective equipment: wear face mask



Personal protective equipment: wear safety goggles



Working alone is prohibited! A second person must be present.



Useful information

## 2.2 Personnel qualifications

Personnel must:

- Be instructed about locally applicable regulations governing accident prevention.
- Have read and understood the installation and operating instructions.

Personnel must have the following qualifications.

- Electrical work: A qualified electrician must carry out the electrical work.
- Installation/dismantling: The technician must be trained in the use of the necessary tools and fixation materials for the relevant construction site.
- Maintenance tasks: The technician must be familiar with the use of operating fluids and their disposal. In addition, the technician must have basic knowledge of mechanical engineering.

### **Definition of “qualified electrician”**

A qualified electrician is a person with appropriate technical education, knowledge and experience who can identify **and** prevent electrical hazards.

## 2.3 Electrical work

- Electrical work must be carried out by a qualified electrician.
- Before commencing work, disconnect the product from the mains and safeguard it from being switched on again.
- Observe applicable local regulations when connecting to the mains power supply.
- Adhere to the requirements of the local energy supply company.
- Train personnel in connecting electrics.
- Instruct personnel in options for switching off the device.
- Comply with the technical specifications contained in these installation and operating instructions and on the rating plate.
- Earth the device.
- Observe regulations for connection to the electrical switching system.
- Comply with the specifications on electro-magnetic compatibility when using electronic start-up controllers (e.g. soft starter or frequency converter). If required, take into account special measures (e.g. shielded cables, filters etc.).
- Replace defective connection cables. Contact customer service.

## 2.4 Monitoring devices

The following monitoring devices must be provided on-site:

### **Circuit breaker**

The size and switching characteristics of the circuit breakers must conform to the rated current of the connected product. Observe local regulations.

### **Motor protection switch**

Make provision for an on-site motor protection switch for devices without a plug! The minimum requirement is a thermal relay/motor protection switch with temperature compensation, differential triggering and anti-reactivation device in accordance with the local regulations. In case of sensitive mains, make provision for the installation on-



site of other protective equipment (e.g. overvoltage, undervoltage or phase failure relay, etc.).

### **Residual-current device (RCD)**

Comply with the regulations of the local energy supply company! The use of a residual-current device is recommended.

If persons come into contact with the device and conductive fluids, secure the connection **with** a residual-current device (RCD).

## **2.5 Use in fluids hazardous to health**

There is a danger of bacterial infection when using the device in fluids hazardous to health! Thoroughly clean and disinfect the device after dismantling and prior to further use. The operator must ensure the following:

- The following protective equipment is provided and worn when cleaning the device:
  - Closed safety goggles
  - Breathing mask
  - Protective gloves
- All persons are informed about the fluid, the associated danger and its correct handling!

## **2.6 Permanent magnet motor**

Permanent magnet motors are driven by a permanently magnetised rotor. Please note the following when using permanent magnet motors:

- **Magnet and magnetic field**  
There is no risk from magnets and the magnetic field as long as the motor housing is closed. Persons with a pacemaker are also not at any particular risk. Screw plugs can be undone for maintenance purposes without hesitation. Do not open the motor housing! Only customer service staff are permitted to work on an open motor!
- **Generator operation**  
The motor generates an inductive voltage if the rotor is driven without electrical energy (e.g. when the fluid returns). In this case, the connection cable is live. Once the pump has been connected, energy is fed back into the connected frequency converter. Implement the following options to prevent destruction of the frequency converter and motor as a result of overvoltage:
  - Feed back input energy into the supply network.
  - Dissipate input energy using a brake resistor.

## **2.7 Transport**

- Wear the following protective equipment:
  - Safety shoes
  - Safety helmet (when using lifting equipment)
- Always hold the handle to transport the device. Never pull the device by the connection cable!
- Only use legally specified and approved lifting gear.
- Select the lifting gear based on the prevailing conditions (weather, attachment point, load, etc.).
- Always attach the lifting gear to the attachment points (handle or lifting eye).
- The stability of the lifting equipment must be ensured during operation.
- When using lifting equipment, ensure a second person is present to coordinate the procedure if required (e.g. if the operator's field of vision is blocked).
- Persons must not stand underneath suspended loads. Do **not** move suspended loads over workplaces where people are present.

## **2.8 Installing/dismantling**

- Wear the following protective equipment:
  - Safety shoes
  - Safety gloves for protection against cuts
  - Safety helmet (when using lifting equipment)
- Locally applicable laws and regulations for work safety and accident prevention must be complied with.
- Disconnect the device from the mains and secure it against being switched on again without authorisation.
- All rotating parts must be at a standstill.
- Provide adequate aeration in closed rooms.
- When working in chambers and closed spaces, a second person must be present for safety reasons.
- Take immediate countermeasures if there is a build-up of toxic or suffocating gases!
- Clean the device thoroughly. Disinfect devices that are used in fluids hazardous to health!

## 2.9 During operation

- Make sure that there is no risk of explosion when carrying out any type of welding work or work with electrical devices.
- Wear the following protective equipment:
  - Safety footwear
  - Hearing protection (in accordance with work regulations notice)
- The work area in which the device is used is not a recreational area. No persons are allowed in the work area during operation.
- Depending on the process, the product is switched on and off using separate controls. The product may automatically switch on following power cuts.
- Users must immediately notify the person in charge of every fault or irregularity.
- If hazardous defects occur, the operator must immediately deactivate the device. Hazardous defects include:
  - Malfunction of safety and monitoring devices
  - Damage to housing parts
  - Damage to electrical equipment
- Do not reach into the suction port. The rotating parts can crush and sever limbs.
- If the motor emerges during operation, as well as in dry well installation, the motor housing can heat up to above 40 °C (104 °F).
- Open all gate valves in the piping on both the suction and pressure sides.
- Ensure minimum water submersion by using dry-running protection.
- Under normal operating conditions, the sound-pressure level of the product is below 85 dB(A). However, the actual sound-pressure level depends on several factors:
  - Installation depth
  - Installation
  - Fixation of accessories and piping
  - Duty point
  - Immersion depth
- If the device is operated under normal operating conditions, the operator must measure the sound pressure. From a sound-pressure level of 85 dB(A), wear hearing protection and mark out the working area!

## 2.10 Maintenance tasks

- Wear the following protective equipment:
  - Closed safety goggles
  - Safety shoes
  - Safety gloves for protection against cuts
- Always carry out maintenance tasks outside the operating space/installation site.
- Only carry out maintenance tasks mentioned in these installation and operating instructions.
- Only original parts from the manufacturer may be used for maintenance and repairs. Use of parts other than the original parts releases the manufacturer from any liability.
- Collect any leakage of fluid and operating fluid immediately and dispose of it according to the locally applicable guidelines.
- Store tools at the designated locations.
- After completing work, reattach all safety and monitoring devices and check that they function properly.

### **Changing operating fluid**

In case of a defect, a pressure **of several bar can build up** in the motor! This pressure escapes when the screw plugs are **opened**. If screw plugs are opened without due caution, they can be ejected at high speed! To avoid injuries, observe the following instructions:

- Adhere to the prescribed sequence of work steps.
  - Unscrew the screw plugs slowly, but never unscrew them completely. As soon as the pressure escapes (audible whistling or hissing of air), stop turning the screw plug any further.
- WARNING! Hot operating fluids can also spray out when the pressure is escaping. This can result in scalding! To avoid injuries, allow the motor to cool down to the ambient temperature before carrying out any work!**
- When the pressure has completely dissipated, fully unscrew the screw plug.

## 2.11 Operating fluid

The sealing chamber and the cooling system of the motor is filled with white oil or a water-glycol mixture. Operating fluids must be replaced during regular maintenance work and disposed of according to the local guidelines.

## 2.12 Operator responsibilities

- Installation and operating instructions must be in a language which the personnel can understand.
- Make sure that the personnel is relevantly trained for the specified work.
- Provide the necessary protective equipment and make sure that the personnel wears it.
- Safety and information signs mounted on the device must be always legible.
- Train the personnel pertaining to the functioning of the system.
- Eliminate risk from electrical current.
- Equip hazardous components inside the system with an on-site guard.
- Identify and cordon off the work area.
- To ensure safe working practice, define the responsibilities of the employees.

Children and persons younger than 16 years or with reduced physical, sensory or mental capacities or limited experience are prohibited from handling the product! A technician must supervise persons younger than 18 years!

## 3 Application/use

### 3.1 Intended use

Submersible pumps are suitable for pumping:

- Sewage containing faeces
- Wastewater (with small amounts of sand and gravel)
- Process sewage
- Fluids with dry matter up to max. 8 %

### 3.2 Improper use



#### **DANGER**

##### **Explosion due to pumping of explosive fluids!**

Pumping of highly flammable and explosive fluids (gasoline, kerosene, etc.) in pure form is strictly prohibited. There is a risk of fatal injury due to explosion! The pumps are not designed for these fluids.



#### **DANGER**

##### **Danger due to fluids hazardous to health!**

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!

The submersible pumps must **not be used** for pumping:

- Drinking water
- Fluids containing hard components (such as stones, wood, metal, etc.)
- Fluids containing large quantities of abrasive contents (e.g. sand, gravel)

Intended use also includes compliance with this manual. Any other use is regarded as non-compliant with the intended use.

## 4 Product description

### 4.1 Design

Submersible sewage pump as submersible monobloc unit for wet well and dry well installation.

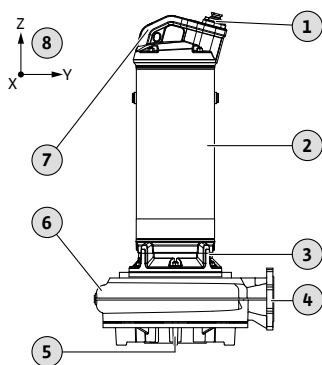


Fig. 1: Sample illustration

#### 4.1.1 Hydraulics

Centrifugal hydraulics with different impeller shapes, horizontal flange connection on the pressure side, casing and impeller wear rings.

The hydraulics are **not** self-priming, in other words, the fluid must flow in either automatically or with supply pressure.

##### **Impeller shapes**

The individual impeller shapes depend on the size of the hydraulics and not every impeller shape is available for every hydraulic system. The following is an overview of the different impeller shapes:

- Vortex impeller
- Single-channel impeller
- Two-channel impeller
- Three-channel impeller
- Four-channel impeller
- SOLID impellers, closed or half open

##### **Casing and impeller wear rings (depending on the hydraulics)**

The suction port and impeller are subjected to the most stress when pumping. In the case of channel impellers, the gap between the impeller and the suction port is an important factor for constant efficiency. The larger the gap between the impeller and the suction port, the higher the losses in the delivery rate. The efficiency decreases and the danger of clogging increases. In order to ensure long and efficient operation of the hydraulics, an impeller wear ring and/or neck ring is installed depending on the impeller and the hydraulics.

- Impeller wear ring  
The impeller wear ring is attached to the channel impellers and protects the incoming flow edge of the impeller.
- Neck ring  
The neck ring is installed in the suction port of the hydraulics and protects the incoming flow edge in the centrifugal chamber.

If worn, customer service can simply replace both components.

#### 4.1.2 Motor

Self-cooling asynchronous or permanent magnet motor as three-phase current version. An active cooling system takes care of cooling. The motor can be used for continuous duty both immersed and non-immersed, also as part of dry well installation. The connection cable has bare cable ends.

##### **Motor fittings overview**

|   | Asynchronous motor |              | Permanent magnet motor |
|---|--------------------|--------------|------------------------|
|   | FKT 20.2           | FKT 27.x     | FKT 20.2...-P          |
| Design type                                   | Asynchronous       | Asynchronous | Synchronous            |
| Max. efficiency category (based on IEC 60034) | IE3                | IE3          | IE5                    |
| Operation with frequency converter            | o                  | o            | ! (Wilo-EFC)           |
| Digital Data Interface                        | o                  | –            | •                      |
| Immersed operating mode                       | S1                 | S1           | S1                     |
| Non-immersed operating mode                   | S1                 | S1           | S1                     |

|   | Asynchronous motor |          | Permanent magnet motor |
|---|--------------------|----------|------------------------|
|   | FKT 20.2           | FKT 27.x | FKT 20.2...-P          |
| Dry well installation operating mode                            | S1                 | S1       | S1                     |
| Upper rolling bearings: permanently lubricated, low-maintenance | •                  | •        | •                      |
| Lower rolling bearings: permanently lubricated, low-maintenance | •                  | •        | •                      |
| Connection cable sealed as longitudinally wa-<br>tertight       | •                  | •        | •                      |

! = Required/mandatory, • = Standard, o = Optional, – = Not available

#### 4.1.3 Seal

Different methods are used for the seal to the fluid and the motor compartment:

- Version "G": two separate mechanical seals
- Version "K": two mechanical seals in a block seal cartridge made of stainless steel

The cooling system version is one of two types, depending on the motor size:

- FKT 20.2: The sealing chamber and the cooling system form a one-chamber system. The sealing chamber and the cooling system are filled with P35 coolant.
- FKT 27.x: The sealing chamber and the cooling system form a two-chamber system. The sealing chamber is filled with medicinal white oil and the cooling system is filled with P35 coolant.

Leakage from the seal is caught in the sealing chamber or leakage chamber:

- The sealing chamber accommodates any possible leakage of the seal on the fluid side.
- The leakage chamber accommodates any possible leakage of the seal on the motor side. The leakage chamber is empty ex works.

#### 4.1.4 Cooling system

The motor has an active cooling system with separate cooling circuit. The water-glycol mixture P35 is used as coolant. Coolant circulation is performed by an impeller. The impeller is driven by the motor shaft. The waste heat is transferred directly to the fluid via the cooling flange. The cooling system is not pressurised when in cold state.

#### 4.1.5 Material

The following materials are used in the standard version:

- Pump housing: grey cast iron
- Impeller: grey cast iron
- Motor housing: grey cast iron
- Seal on the motor side:
  - "G" = Carbon/ceramic or SiC/SiC
  - "K" = SiC/SiC
- Seal on the fluid side: SiC/SiC
- Static seal: FKM (ASTM D 1418) or NBR (nitrile)

The precise details of the materials used are shown in the respective configuration.

### 4.2 Digital Data Interface



#### NOTICE

##### Note the instructions for the Digital Data Interface!

Read the separate instructions for the Digital Data Interface and comply with them.

The Digital Data Interface is a communication module with integrated web server that has been integrated in the motor. It is accessed and controlled in an Internet browser using a graphical user interface. The user interface enables easy pump configuration, control and monitoring. Different sensors may have been installed in the pump for this purpose. External signal transmitters may also input additional system parameters in the control. The Digital Data Interface is capable of the following, depending on the system mode:

- Pump monitoring.
- Controlling the pump with a frequency converter.
- Controlling the complete system with up to four pumps.

### 4.3 Monitoring devices

#### Overview of monitoring devices

|                                     | Asynchronous motor |                    |          | Permanent magnet motor |
|-------------------------------------|--------------------|--------------------|----------|------------------------|
|                                     | FKT 20.2           | FKT 20.2           | FKT 27.x | FKT 20.2...-P          |
| <b>Internal monitoring devices</b>  |                    |                    |          |                        |
| Digital Data Interface              | –                  | •                  | –        | •                      |
| Terminal/motor compartment Humidity | –                  | –                  | •        | –                      |
| Motor winding: Bimetallic strip     | •                  | –                  | •        | –                      |
| Motor winding: PTC                  | o                  | • (+ 1...3x Pt100) | o        | • (+ 1...3x Pt100)     |
| Motor bearings: Pt100               | o                  | o                  | o        | o                      |
| Sealing chamber: conductive sensor  | –                  | –                  | –        | –                      |
| Sealing chamber: capacitive sensor  | –                  | •                  | –        | •                      |
| Leakage chamber: Float switch       | •                  | –                  | •        | –                      |
| Leakage chamber: capacitive sensor  | –                  | •                  | –        | •                      |
| Vibration sensor                    | –                  | •                  | –        | •                      |
| <b>External monitoring devices</b>  |                    |                    |          |                        |
| Sealing chamber: conductive sensor  | o                  | –                  | o        | –                      |

• = Standard, – = Not available, o = Optional

**All the monitoring devices fitted must always be connected!**

#### 4.3.1 Motor without Digital Data Interface

##### Monitoring the terminal room and motor compartment

The terminal room and motor compartment monitoring protects the motor terminals and winding from short-circuits. An electrode in both the terminal room and the motor compartment measures the moisture content.

##### Motor winding monitoring

Thermal motor monitoring protects the motor winding from overheating. A temperature limiter with a bimetallic strip is fitted as standard. Once the activation temperature has been reached, deactivation with reactivation lock must take place.

Optionally, the temperature can also be measured using a PTC sensor. Thermal motor monitoring can also be designed as temperature control. This allows two temperatures to be measured. Once the low activation temperature has been reached, an automatic reactivation can be initiated after the motor has cooled down. The unit is forced to deactivate with reactivation lock once the high activation temperature has been reached.

##### External monitoring of the sealing chamber

The sealing chamber can be equipped with an external pencil electrode. The electrode registers fluid ingress through the mechanical seal on the fluid side. An alarm or deactivation of the pump can therefore take place by pump control.

##### Leakage chamber monitoring

The leakage chamber is equipped with a float switch. The float switch registers fluid ingress through the mechanical seal on the motor side. An alarm or deactivation of the pump can therefore take place by pump control.

##### Monitoring of motor bearing

The thermal monitoring of the motor bearing protects the roller bearings against overheating. Pt100 sensors are used for temperature measurement.

#### 4.3.2 Motor with Digital Data Interface



#### NOTICE

##### Note the instructions for the Digital Data Interface!

Read the separate instructions for the Digital Data Interface and comply with them.

The Digital Data Interface evaluates all available sensors. Use the graphical user interface of the Digital Data Interface to display current values and set the limit parameters. A warning message or alarm signal is output upon exceeding the limit parameters. The motor winding additionally features PTC sensors to enable secure pump deactivation.

#### 4.4 Operating modes

##### **Operating mode S1: Continuous duty**

The pump can operate continuously at the rated load without exceeding the permissible temperature.

##### **Operating mode: Non-immersed operation**

The "non-immersed operation" operating mode describes the possibility of the motor emerging during the drainage pumping sequence. This allows a further lowering of the water level as far as the upper edge of the hydraulics. Observe the following points during non-immersed operation:

- Operating mode: Continuous duty (S1).
- Max. fluid and ambient temperature: The max. ambient temperature corresponds to the max. fluid temperature shown on the rating plate.

#### 4.5 Operation with frequency converter

##### 4.5.1 Asynchronous motor

It is possible to operate asynchronous motors at the frequency converter. The frequency converter must feature the following connections at a minimum:

- Bimetallic strip and PTC sensor
- Moisture probe
- Pt100 sensor (if motor bearing monitoring is available!)

Refer to section entitled "Frequency converter operation [► 104]" for additional requirements and comply with these!

If the motor features a Digital Data Interface, also guarantee the following prerequisites:

- Network: Ethernet 10BASE-T/100BASE-TX, IP-based
- Protocol support: Modbus TCI/IP

Refer to the separate instructions for the Digital Data Interface for detailed requirements!

##### 4.5.2 Permanent magnet motor

Guarantee the following conditions when operating permanent magnet motors:

- Frequency converter with connection for PTC sensor
- Network: Ethernet 10BASE-T/100BASE-TX, IP-based
- Protocol support: Modbus TCI/IP

Refer to the separate instructions for the Digital Data Interface for detailed requirements!

Permanent magnet motors have been approved for operation with the following frequency converters:

- Wilo-EFC

##### **Other frequency converters on request!**

#### 4.6 Operation in an explosive atmosphere

|                              | Asynchronous motor |          | Permanent magnet motor |
|------------------------------|--------------------|----------|------------------------|
|                              | FKT 20.2           | FKT 27.x | FKT 20.2...-P          |
| Approval according to IEC-Ex | o                  | –        | o                      |
| ATEX approval                | o                  | o        | o                      |
| FM approval                  | o                  | o        | o                      |
| CSA-Ex approval              | –                  | –        | –                      |

##### **Key**

– = Not available/possible, o = Optional, • = Standard

For use in explosive atmospheres, the pump must be marked as follows on the rating plate:

- "Ex" symbol of the corresponding approval

→ Ex classification

**For the relevant requirements, refer to the explosion protection chapter in the appendix of these installation and operating instructions!**

#### **ATEX approval**

The pumps are suitable for operation in potentially explosive atmospheres:

→ Device group: II

→ Category: 2, zone 1 and zone 2

**These pumps must not be used in zone 0!**

#### **FM approval**

The pumps are suitable for operation in potentially explosive atmospheres:

→ Protection class: Explosionproof

→ Category: Class I, Division 1

Notice: If the cabling is carried out according to Division 1, installation in Class I, Division 2 is also permitted.

## **4.7 Rating plate**

The following section provides an overview of the abbreviations and associated data on the rating plate:

| Rating plate designation | Value                           |
|--------------------------|---------------------------------|
| P-Typ                    | Pump type                       |
| M-Typ                    | Motor type                      |
| S/N                      | Serial number                   |
| Art.-No.                 | Article number                  |
| MFY                      | Date of manufacture*            |
| $Q_N$                    | Volume flow duty point          |
| $Q_{max}$                | Max. volume flow                |
| $H_N$                    | Delivery head duty point        |
| $H_{max}$                | Max. delivery head              |
| $H_{min}$                | Min. delivery head              |
| n                        | Speed                           |
| T                        | Max. fluid temperature          |
| IP                       | Protection class                |
| I                        | Rated current                   |
| $I_{ST}$                 | Starting current                |
| $I_{SF}$                 | Rated current at service factor |
| $P_1$                    | Power consumption               |
| $P_2$                    | Rated power                     |
| U                        | Rated voltage                   |
| $U_{EMF}$                | Inductive voltage               |
| f                        | Frequency                       |
| $f_{op}$                 | Max. operating frequency        |
| $\cos \varphi$           | Motor efficiency                |
| SF                       | Service factor                  |
| $OT_S$                   | Operating mode: immersed        |
| $OT_E$                   | Operating mode: non-immersed    |
| AT                       | Starting mode                   |
| $IM_{org}$               | Impeller diameter: original     |
| $IM_{korr}$              | Impeller diameter: corrected    |

\*The date of manufacture is stated in accordance with ISO 8601: JJJJWW

→ JJJJ = year



→ W = abbreviation for week

→ ww = calendar week

## 4.8 Type key

Type keys vary between individual hydraulics. The following section lists individual type keys.

### 4.8.1 Hydraulics type key: EMU FA

#### Example: Wilo-EMU FA 15.52-245E

|     |  |
|-----|--|
| FA  | Sewage pump  |
| 15  | x10 = Nominal diameter of pressure connection  |
| 52  | Internal performance coefficient   |
| 245 | Original impeller diameter<br>(for standard variants only, omitted for configured pumps)   |
| D   | Impeller shape:<br>W = Vortex impeller<br>E = Single-channel impeller<br>Z = Two-channel impeller<br>D = Three-channel impeller<br>V = Four-channel impeller<br>T = Closed two-channel impeller<br>G = Half-open single-channel impeller |

### 4.8.2 Hydraulics type key: Rexa SUPRA

#### Example: Wilo-Rexa SUPRA-V10-736A

|       |   |
|-------|---|
| SUPRA | Sewage pump   |
| V     | Impeller shape:<br>V = Vortex impeller<br>C = Single-channel impeller<br>M = Multi-channel impeller                               |
| 10    | x10 = Nominal diameter of pressure connection   |
| 73    | Internal performance coefficient  |
| 6     | Characteristic curve number   |
| A     | Material version:<br>A = Standard version<br>B = Corrosion protection 1<br>D = Abrasion protection 1<br>X = Special configuration |

### 4.8.3 Hydraulics type key: Rexa SOLID

#### Example: Wilo-Rexa SOLID-Q10-768A

|       |   |
|-------|---|
| SOLID | Sewage pump with SOLID impeller   |
| Q     | Impeller shape:<br>T = Closed two-channel impeller<br>G = Half-open single-channel impeller<br>Q = Half-open two-channel impeller |
| 10    | x10 = Nominal diameter of pressure connection   |
| 76    | Internal performance coefficient  |
| 8     | Characteristic curve number   |
| A     | Material version:<br>A = Standard version<br>B = Corrosion protection 1<br>D = Abrasion protection 1<br>X = Special configuration |

### 4.8.4 Motor type key: FKT motor

#### Example: FKT 20.2M-4/32GX-P5

|     |  |
|-----|--|
| FKT | Self-cooling motor with separate cooling circuit |
| 20  | Size   |
| 2   | Configuration version                            |

**Example: FKT 20.2M-4/32GX-P5**

|    |  |
|----|--|
| M  | Shaft design   |
| 4  | Number of poles  |
| 32 | Package length in cm   |
| G  | Seal version   |
| X  | Ex-rated   |
| P  | Motor design:<br>– None = Standard asynchronous motor<br>– E = Highly efficient asynchronous motor<br>– P = Permanent magnet motor |
| 5  | IE efficiency class (based on IEC 60034-30):<br>None = IE0 to IE2<br>3 = IE3<br>4 = IE4<br>5 = IE5                                 |

**4.9 Scope of delivery**

- Pump with free cable end
- Cable length per customer request
- Mounted accessories, e.g. external pencil electrode, pump support foot, etc.
- Installation and operating instructions

**4.10 Accessories**

- Suspension unit
- Pump support foot
- Special versions with Ceram coatings or special materials
- External pencil electrode for sealing chamber control
- Level control devices
- Fixation accessories and chains
- Switchgear, relays and plugs

**5 Transportation and storage****5.1 Delivery**

After receiving the shipment, this must be checked immediately for defects (damage, completeness). Defects must be noted on the freight documentation! Furthermore, defects must be notified to the transport company or the manufacturer immediately on the day of receipt of shipment. Subsequently notified defects can no longer be asserted.

**5.2 Transport****WARNING****Standing under suspended loads!**

Never allow anyone to stand under suspended loads! Danger of (serious) injuries caused by falling parts. Loads may not be carried over work places where people are present!

**WARNING****Head and foot injuries due to a lack of protective equipment!**

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety shoes
- Safety helmet must be worn if lifting equipment are used!

**NOTICE****Use only properly functioning lifting equipment!**

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

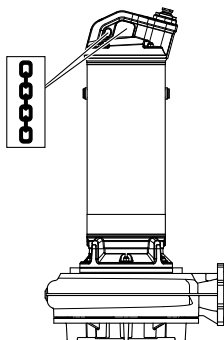


Fig. 2: Attachment point

### 5.3 Storage



#### DANGER

##### **Danger due to fluids hazardous to health!**

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!



#### WARNING

##### **Sharp edges on the impeller and suction port!**

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

#### CAUTION

##### **Permanent magnet motors: Connection wire may be live!**

Turning the rotor may mean a voltage applies at the connection wires. Insulate connection wires and do not short circuit!

#### CAUTION

##### **Total damage due to moisture ingress**

The ingress of moisture into the connection cable damages the cable and the pump! Never immerse the ends of the connection cable in fluid. Seal them tightly during storage.

Newly delivered pumps can be stored for one year. Contact customer service before storing the device for more than one year.

When storing the pump, please note the following points:

- Place the pump upright (vertical) on a firm bearing surface. **Secure the pump against falling over and slipping!**
- The max. storage temperature is  $-15\text{ °C}$  to  $+60\text{ °C}$  ( $5\text{ °F}$  to  $140\text{ °F}$ ). The max. relative humidity is 90 %, non-condensing. We recommend frost-proof storage. Ambient temperature:  $5\text{ to }25\text{ °C}$  ( $41\text{ to }77\text{ °F}$ ), relative humidity: 40 to 50 %.
- Do not store the pump in rooms in which welding work is carried out. The resulting gases or radiation can corrode the elastomer parts and coatings.
- Seal the suction and pressure connection tightly.
- Protect the connection cable against kinking and damage. Maintain a constant bend radius!

- Impellers must be turned by 180° at regular intervals (3 – 6 months). This prevents the bearings from jamming and renews the lubrication film on the mechanical seal.  
**WARNING! There is a risk of injury due to sharp edges on the impeller and suction port!**
- Elastomer parts and the coating are subject to natural brittleness. Contact customer service if the mixer has to be stored for more than 6 months.

After storage, remove any dust and oil from the pump and check the coating for damage. Repair damaged coatings before further use.

## 6 Installation and electrical connection

### 6.1 Personnel qualifications

- Electrical work: A qualified electrician must carry out the electrical work.
- Installation/dismantling: The technician must be trained in the use of the necessary tools and fixation materials for the relevant construction site.

### 6.2 Installation types

- Vertical stationary wet well installation with suspension unit
- Vertical portable wet well installation with pump support foot
- Vertical stationary dry well installation
- Horizontal stationary dry well installation

**NOTICE! Horizontal installation is not possible, depending on type and performance. For this installation type, contact customer service!**

### 6.3 Operator responsibilities

- Observe locally applicable accident prevention and safety regulations of trade associations.
- Observe all regulations for working with heavy loads and under suspended loads.
- Provide protective equipment and ensure that the protective equipment is worn by personnel.
- Observe local sewage technology regulations for the operation of sewage systems.
- Avoid pressure surges!  
Pressure surges can occur in long pressure pipes with steep terrain. These pressure surges can lead to the destruction of the pump!
- Ensure the cooling time of the motor depending on the operating conditions and the size of the pump chamber.
- Structural components and foundations must be of sufficient stability in order to allow the device to be fixed securely and functionally. The operator is responsible for the provision and suitability of the structural component/foundation!
- Check that the available consulting documents (installation plans, design of the operating space, inflow conditions) are complete and correct.

### 6.4 Installation



#### DANGER

##### Permanent magnet motors: Risk of fatal injury caused by inductive voltage!

The motor generates an inductive voltage if the rotor is driven without electrical energy (e.g. when the fluid returns). In this case, the connection cable is live. There is a risk of fatal injury caused by electric shock! Earth the connection cable prior to making the connection and dissipate inductive voltage!



#### DANGER

##### Risk of fatal injury due to dangerous lone working practices!

Work in chambers and narrow rooms as well as work involving risk of falling are dangerous work. Such work may not be carried out autonomously! A second person must be present for safety reasons.

**WARNING****Hand and foot injuries due to lack of protective equipment!**

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety gloves for protection against cuts
- Safety shoes
- Safety helmet must be worn if lifting equipment are used!

**NOTICE****Use only properly functioning lifting equipment!**

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

- Prepare the operating space/installation location as follows:
  - Clean, free of coarse solids
  - Dry
  - Frost-free
  - Decontaminated
- Take immediate countermeasures if there is a build-up of toxic or suffocating gases!
- Attach the lifting gear to the attachment point using a shackle. Only use lifting gear that has been technically approved.
- Use lifting gear for lifting, lowering and transporting the pump. Do not pull the pump by the connection cable!
- It must be possible to attach the lifting equipment safely. The storage location and the operating space/installation site must be accessible by the lifting equipment. The set-down location must have a firm surface.
- Routed connection cables must enable safe operation. Check whether the cable cross-section and the cable length are sufficient for the selected installation type.
- The corresponding IP class must be observed when using switchgears. Install the switchgear in an overflow-proof position and away from potentially explosive atmosphere areas!
- Avoid air intake into the fluid, use baffles or deflector plates for the inlet. Air that has entered the system can collect in the pipe system and lead to impermissible operating conditions. Air pockets must be removed using the ventilation systems!
- Do not allow the pump to dry run! Avoid air pockets in the hydraulics housing or in the pipe system. Ensure that the water never falls below the minimum level. The installation of dry-running protection is recommended!

#### 6.4.1 Indications for double pump operation

If several pumps are used in an operating space, minimum distances between the pumps and the wall must be complied with. Here there is a difference in the distances depending on the type of system: Alternating operation or parallel operation.

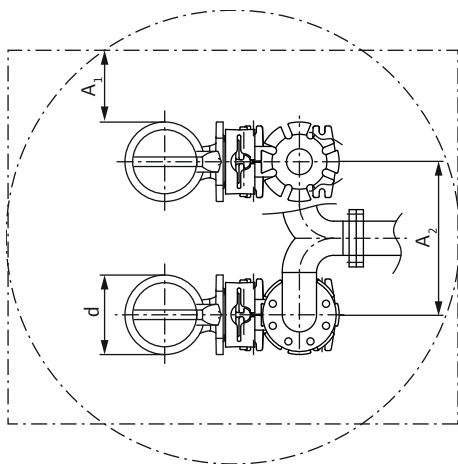


Fig. 3: Minimum distances

## 6.4.2 Maintenance tasks

After a storage period of more than 6 months, carry out the following maintenance tasks before installation:

- Rotate the impeller.
- Check the coolant.
- Check the oil in the sealing chamber (FKT 27.x only).

### 6.4.2.1 Rotate impeller



#### WARNING

##### Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

#### Small pumps (up to DN 100 pressure port)

- ✓ The pump is **not** connected to the mains!
  - ✓ Use protective equipment!
1. Place the pump on a firm surface in a horizontal position. **WARNING! Risk of hands being crushed. Make sure that the pump cannot fall over or slip!**
  2. Slowly and carefully reach into the hydraulics housing from below and rotate the impeller.

#### Large pumps (from DN 150 pressure port)

- ✓ The pump is **not** connected to the mains!
  - ✓ Use protective equipment!
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump cannot fall over or slip!**
  2. Carefully and slowly reach into the hydraulics housing through the pressure port and rotate the impeller.

### 6.4.2.2 Check the coolant

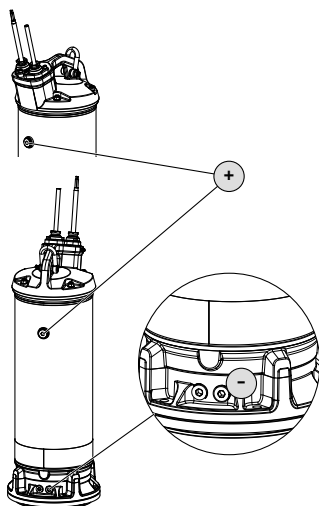


Fig. 4: Cooling system: Check the FKT 20.2 coolant

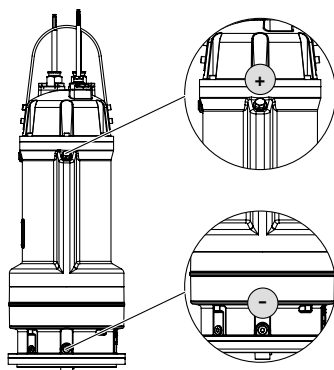


Fig. 5: Cooling system: Check the FKT 27.1/27.2 coolant

#### FKT 20.2 motor

|   |                       |
|---|-----------------------|
| + | Add/bleed the coolant |
| - | Drain the coolant     |

- ✓ Pump is **not** installed.
  - ✓ Pump is **not** connected to the mains.
  - ✓ Use protective equipment!
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
  2. Position a suitable reservoir to collect the operating fluid.
  3. Unscrew the screw plug (+).
  4. Unscrew the screw plug (-) and drain the operating fluid. If a ball valve is installed at the outlet opening, open the ball valve to drain.  
**NOTICE! Rinse to completely bleed the cooling system.**
  5. Check the operating fluid:
    - ⇒ If the operating fluid is clear, reuse the operating fluid.
    - ⇒ If the operating fluid is contaminated (cloudy/dark), add new operating fluid. Dispose of the operating fluid in accordance with local regulations!
    - ⇒ Notify customer service if the operating fluid contains metal swarf!
  6. If a ball valve is installed on the outlet opening, close the ball valve.
  7. Clean the screw plug (-), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**
  8. Pour new operating fluid in through the hole for the screw plug (+).
    - ⇒ Comply with the specifications for the operating fluid type and quantity! When recycling the operating fluid, check the quantity and adjust it, if required!
  9. Clean the screw plug (+), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**

#### FKT 27.x motor

|   |                       |
|---|-----------------------|
| + | Add/bleed the coolant |
| - | Drain the coolant     |

- ✓ Pump is **not** installed.
  - ✓ Pump is **not** connected to the mains.
  - ✓ Use protective equipment!
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
  2. Position a suitable reservoir to collect the operating fluid.
  3. Unscrew the screw plug (+).
  4. Unscrew the screw plug (-) and drain the operating fluid. If a ball valve is installed at the outlet opening, open the ball valve to drain.  
**NOTICE! Rinse to completely bleed the cooling system.**
  5. Check the operating fluid:
    - ⇒ If the operating fluid is clear, reuse the operating fluid.
    - ⇒ If the operating fluid is contaminated (cloudy/dark), add new operating fluid. Dispose of the operating fluid in accordance with local regulations!
    - ⇒ Notify customer service if the operating fluid contains metal swarf!
  6. If a ball valve is installed on the outlet opening, close the ball valve.
  7. Clean the screw plug (-), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**
  8. Pour new operating fluid in through the hole for the screw plug (+).

- ⇒ Comply with the specifications for the operating fluid type and quantity!  
When recycling the operating fluid, check the quantity and adjust it, if required!

9. Clean the screw plug (+), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

#### 6.4.2.3 Check the oil in the sealing chamber

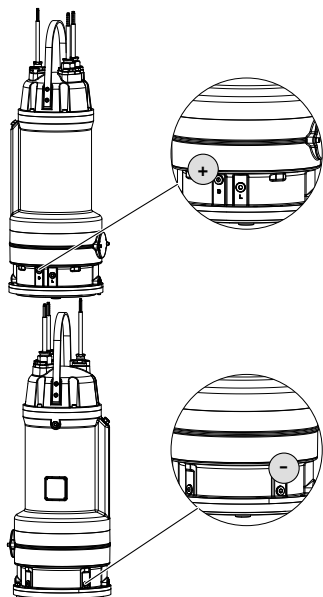


Fig. 6: Sealing chamber: Check the oil

#### FKT 27.x motor

|   |  |
|---|--|
| + | Add the oil to the sealing chamber     |
| - | Drain the oil from the sealing chamber |

- ✓ Pump is **not** installed.
  - ✓ Pump is **not** connected to the mains.
  - ✓ Use protective equipment!
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
  2. Position a suitable reservoir to collect the operating fluid.
  3. Unscrew the screw plug (+).
  4. Unscrew the screw plug (-) and drain the operating fluid. Open the ball valve if a ball valve has been installed at the outlet opening.  
**NOTICE! Vacuum the oil or rinse the sealing chamber to fully drain the system.**
  5. Check the operating fluid:
    - ⇒ If the operating fluid is clear, reuse the operating fluid.
    - ⇒ If the operating fluid is contaminated (black), fill with new operating fluid. Dispose of the operating fluid in accordance with local regulations!
    - ⇒ If there is water in the operating fluid, fill with new operating fluid. Dispose of the operating fluid in accordance with local regulations!
    - ⇒ Notify customer service if the operating fluid contains metal swarf!
  6. If a ball valve is installed on the outlet opening, close the ball valve.
  7. Clean the screw plug (-), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**
  8. Pour new operating fluid in through the hole for the screw plug (+).
    - ⇒ Comply with the specifications for the operating fluid type and quantity!  
When recycling the operating fluid, check the quantity and adjust it, if required!
  9. Clean the screw plug (+), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

#### 6.4.3 Stationary wet well installation



#### NOTICE

##### Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

The pump is installed in the fluid for the wet well installation. For this, a suspension unit must be installed in the chamber. On the pressure side, the on-site pipe system is connected to the suspension unit and on the suction side to the pump. The connected pipe system must be self-supporting. The suspension unit must **not** support the pipe system!



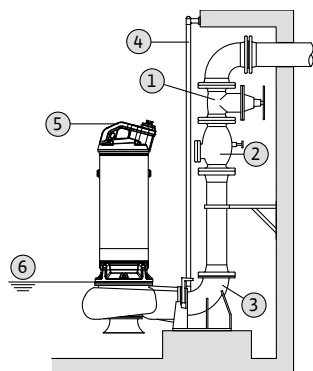


Fig. 7: Wet well installation, stationary

**Work steps**

|   |  |
|---|--|
| 1 | Gate valve                             |
| 2 | Non-return valve                       |
| 3 | Suspension unit                        |
| 4 | Guide pipes (provided by the customer) |
| 5 | Attachment point for lifting equipment |
| 6 | Minimum water level                    |

- ✓ Operating space/installation location has been prepared for the installation.
  - ✓ Suspension unit and pipe system have been installed.
  - ✓ Pump is prepared for operation on the suspension unit.
1. Use a shackle to attach the lifting equipment to the attachment point on the pump.
  2. Lift the pump, swivel it above the chamber opening and slowly lower the guide claw onto the guide pipe.
  3. Lower the pump until it sets on the suspension unit and is connected automatically. **CAUTION! Hold the connection cable slightly taut when lowering the pump!**
  4. Loosen the lifting equipment from the lifting gear and secure it against falling at the chamber outlet.
  5. Have the connection cable routed into the chamber by a qualified electrician and properly route it outside from the chamber. **CAUTION! Do not damage the connection cable (no kinks, note the bend radius)!**
- The pump is installed, the qualified electrician can make the electrical connection.

**6.4.4 Portable wet well installation****WARNING****Risk of burns from hot surfaces!**

Motor housing can become hot during operation. It may cause burns. Allow the pump to cool down at ambient temperature after switching it off!

**WARNING****Separation of pressure hose!**

Separation or movement of the pressure hose can lead to (serious) injuries. Securely attach the pressure hose to the outlet! Prevent buckling of the pressure hose.

**NOTICE****Pumping problems due to water level being too low**

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

For portable installation, the pump must be equipped with a pump support foot. The pump support foot ensures minimum ground clearance in the suction area and enables secure footing if placed on a solid bearing surface. In this installation type, the pump can be installed anywhere in the operating space/installation site. A hard base must be used at the installation location to prevent sinking in case of soft bearing surfaces. A pressure hose is connected on the pressure side. If operated for longer periods of time, fix the pump firmly to the floor. This prevents vibration and ensures quiet and low-wearing running.

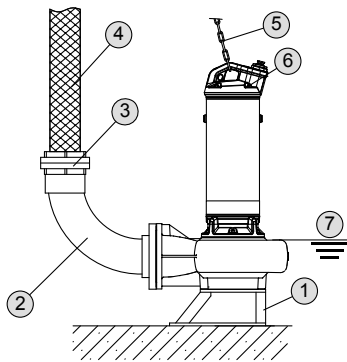


Fig. 8: Wet well installation, portable

### Work steps

|   |  |
|---|--|
| 1 | Pump support foot                      |
| 2 | Pipe elbow                             |
| 3 | Storz coupling                         |
| 4 | Pressure hose                          |
| 5 | Lifting equipment                      |
| 6 | Attachment point for lifting equipment |
| 7 | Minimum water level                    |

- ✓ Pump support foot mounted.
- ✓ Pressure connection prepared: Pipe elbow with hose connection or pipe elbow with Storz coupling mounted.
  1. Use a shackle to attach the lifting equipment to the attachment point on the pump.
  2. Lift the pump and lower it to the intended location (chamber, pit).
  3. Place the pump on a solid load bearing surface. **CAUTION! Sinking must be prevented!**
  4. Route the pressure hose and fasten it to an appropriate point (e.g. the drain off). **DANGER! Separation or movement of the pressure hose can lead to (serious) injuries! Secure the pressure hose at the outlet.**
  5. Correctly route the connection cables. **CAUTION! Do not damage the connection cable (no kinks, note the bend radius)!**
- The pump is installed, the qualified electrician can make the electrical connection.

#### 6.4.5 Stationary dry well installation



### NOTICE

#### Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

In dry well installation, the operating space is divided into the collecting space and the machine room. In the collecting space, the fluid flows and is collected; the pump technology is installed in the machine room. The pump is installed in the machine room and connected to the pipe system on the suction and pressure side. Observe the following points for installation:

- The suction- and pressure-side pipe system must be self-supporting. The pump must not support the pipe system.
- Connect the pump to the pipe system ensuring that it is free of stress and vibrations. The use of elastic connection pieces (compensators) is recommended.
- The pump is not self-priming, in other words, the fluid must flow in either automatically or with supply pressure. The minimum level in the collecting space must be at the same height as the upper edge of the hydraulics housing!
- Max. ambient temperature: 40 °C (104 °F)

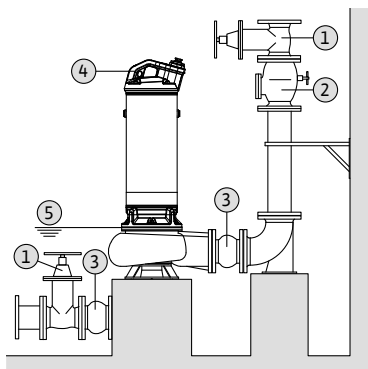


Fig. 9: Dry well installation

**Work steps**

|   |   |
|---|---|
| 1 | Gate valve                              |
| 2 | Non-return valve                        |
| 3 | Compensator                             |
| 4 | Attachment point for lifting equipment  |
| 5 | Minimum water level in collecting space |

- ✓ Machine room/installation location is prepared for the installation.
- ✓ Pipe system has been properly installed and is self-supporting.
- 1. Use a shackle to attach the lifting equipment to the attachment point on the pump.
- 2. Lift the pump and position it in the machine room. **CAUTION! Hold the connection cable slightly taut when positioning the pump!**
- 3. Secure pump to the foundation properly.
- 4. Connect pump to the pipe system. **NOTICE! Ensure the connection is free of stress and vibrations. If required, use plastic connection pieces (compensators).**
- 5. Loosen the lifting gear from the pump.
- 6. Have the connection cable installed in the machine room by a qualified electrician. **NOTICE! Do not damage the connection cable (no kinks, note the bend radius)!**
- The pump is installed, the qualified electrician can make the electrical connection.

**6.4.6 Level control****DANGER****Risk of explosion due to incorrect installation!**

If the level control is installed within a potentially explosive area, the signal transmitter must be connected via an Ex cut-off relay or a Zener barrier. There is a risk of explosion if connected incorrectly! Connection must be carried out by a qualified electrician.

With a level control device, the current fill levels are determined and the pump is switched on and off automatically depending on the fill levels. Fill levels are recorded by using different sensor types (float switches, pressure and ultrasound measurements or electrodes). The following must be observed when using a level control device:

- Float switches can move freely!
- The water level must **not fall below** the minimum permissible!
- The maximum switching frequency **must not be exceeded!**
- If the fill levels fluctuate strongly, a level control with two measuring points is recommended. This makes it possible to achieve larger differential gaps.

**6.4.7 Dry-running protection**

Dry-running protection must prevent the pump from operating without fluid and air from entering the hydraulics. The minimum permissible fill level must be determined with the help of a signal transmitter. Once the specified limit value is reached, the pump must be deactivated with an appropriate signal. Dry-running protection can expand the available level controls by an additional measuring point or function as an independent switch-off device. Depending on the system security, the pump can be restarted automatically or manually. Installation of dry-running protection is recommended for optimum operational reliability.

**6.5 Electrical connection****DANGER****Risk of death due to electrocution!**

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.

**DANGER****Risk of explosion due to incorrect connection!**

- Always connect the pump to an electrical outlet outside the explosive area. If the connection must be established within explosive atmospheres, the connection must be carried out in an Ex-rated housing (ignition protection class according to DIN EN 60079-0)! Non-compliance may lead to a risk of fatal injury from explosion!
- Connect the equipotential bonding conductor to the earth terminal indicated. The earth terminal is installed in the area near the connection cables. Use cable cross-sections as per locally applicable regulations for the equipotential bonding conductor.
- The connection must always be carried out by a qualified electrician.
- For the electrical connection, also note the additional information in the chapter on potentially explosive areas found in the appendix of these installation and operating instructions!

- The mains connection must match the specifications on the rating plate.
- Power supply on mains side for three-phase current motors with clockwise rotating field.
- Lay the connection cable in accordance with the locally applicable regulations and connect it according to the wire assignment.
- Connect the monitoring devices and check their function.
- Earth the device properly in accordance with applicable local regulations.

**6.5.1 Fuse on mains side****Circuit breaker**

The size and switching characteristics of the circuit breakers must conform to the rated current of the connected product. Observe local regulations.

**Motor protection switch**

Make provision for an on-site motor protection switch for devices without a plug! The minimum requirement is a thermal relay/motor protection switch with temperature compensation, differential triggering and anti-reactivation device in accordance with the local regulations. In case of sensitive mains, make provision for the installation on-site of other protective equipment (e.g. overvoltage, undervoltage or phase failure relay, etc.).

**Residual-current device (RCD)**

Comply with the regulations of the local energy supply company! The use of a residual-current device is recommended.

If persons come into contact with the device and conductive fluids, secure the connection **with** a residual-current device (RCD).

**6.5.2 Maintenance tasks**

Carry out the following maintenance tasks prior to installation:

- Check the insulation resistance of the motor winding.
- Test the resistance of the temperature sensor.

There are several reasons if the measured values differ from the specifications:

- Humidity in the motor.
- Humidity in the connection cable.
- Monitoring device faulty.

Contact customer service in the event of a fault.

**6.5.2.1 Checking the insulation resistance of the motor winding**

Use an insulation tester to measure the insulation resistance (measuring voltage = 1000 V). Observe the following values:

- At the time of initial commissioning: Insulation resistance may not be less than 20 MΩ.
- For further measurements: Value must be greater than 2 MΩ.

**6.5.2.2 Test the resistor of the temperature sensor**

Measure the resistor of the temperature sensors with an ohmmeter. The following measured values must be complied with:

- **Bimetallic strip:** Measured value = 0 ohms (continuity).

- **PTC sensor** (PTC thermistor): Measured value depends on the number of sensors installed. A PTC sensor has a cold resistance range of 20 to 100 ohms.
  - With **three** sensors in series, the measured value range is from 60 to 300 ohms.
  - With **four** sensors in series, the measured value range is from 80 to 400 ohms.
- **Pt100 sensor**: Pt100 sensors have a resistance value of 100 ohms at 0 °C (32 °F). Between 0 °C (32 °F) and 100 °C (212 °F), the resistance increases by 0.385 ohms per 1 °C (1.8 °F) increase.  
At an ambient temperature of 20 °C (68 °F), the resistance is 107.7 ohms.

6.5.3 Asynchronous motor power connection

The three-phase current version is supplied with bare cable ends. Connection to the mains is made by connecting the connection cables in the switchgear. Refer to the attached connection diagram for more precise details regarding the connection. **Electrical connection must always be carried out by a qualified electrician!**

**NOTICE!** The individual wires are designated according to the connection diagram. Do not cut the wires! There is no additional assignment between the wiring diagram and connection diagram.

| Wiring diagram of the power connections for direct starting |                  |
|---|------------------|
| U, V, W   | Mains connection |
| PE (gn-ye)  | Earth            |

| Wiring diagram of the power connections for star-delta starting |                                     |
|---|-------------------------------------|
| U1, V1, W2  | Mains connection (start of winding) |
| U2, V2, W2  | Mains connection (end of winding)   |
| PE (gn-ye)  | Earth                               |

6.5.4 Permanent magnet motor power connection

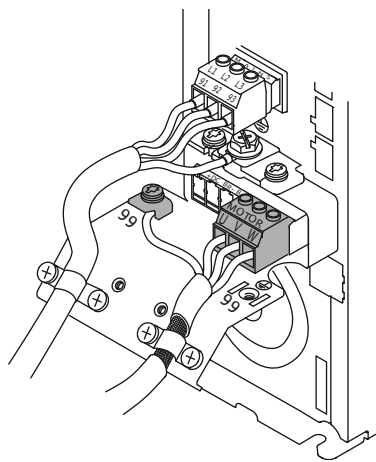


Fig. 10: Pump connection: Wilo-EFC

Wilo-EFC frequency converter

| Terminal | Wiring diagram |
|----------|----------------|
| 96       | U              |
| 97       | V              |
| 98       | W              |
| 99       | Earth (PE)     |

Insert the motor connection cables into the frequency converter through the threaded cable gland. Connect the wires as per the connection diagram.

**NOTICE!** Widely position cable shielding!

6.5.5 Digital Data Interface connection



**NOTICE**  
**Note the instructions for the Digital Data Interface!**  
Read the separate instructions for the Digital Data Interface and comply with them.

Description

- A hybrid cable is used as the control cable. The hybrid cable merges two cables in one:
- Signal cable for control voltage and winding monitor
  - Network cable

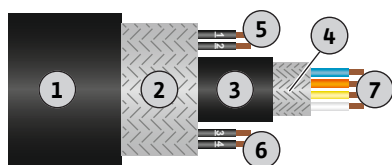


Fig. 11: Hybrid cable diagram

| Pos. | Wire no/colour  | Description  |
|------|---|--|
| 1    |   | Outer cable sheath   |
| 2    |   | Outer cable shielding  |
| 3    |   | Inner cable sheath   |
| 4    |   | Inner cable shielding  |
| 5    | 1 = +<br>2 = -  | Connection wires for Digital Data Interface power supply. Operating voltage: 24 VDC (12–30 V FELV, max. 4.5 W) |
| 6    | 3/4 = PTC   | PTC sensor connection wires in the motor winding. Operating voltage: 2.5 to 7.5 VDC                            |
| 7    | White (wh) = RD+<br>Yellow (ye) = TD+<br>Orange (og) = TD-<br>Blue (bu) = RD- | Prepare the network cable and install the supplied RJ45 plug.  |

The connection of the Digital Data Interface depends on the selected system mode and other system components. Note installation suggestions and connection variants in the instructions for the Digital Data Interface.

**NOTICE! Widely position cable shielding!**

## 6.5.6 Monitoring equipment connection

### Overview of monitoring devices

|                                     | Asynchronous motor |                    |          | Permanent magnet motor |
|-------------------------------------|--------------------|--------------------|----------|------------------------|
|                                     | FKT 20.2           | FKT 20.2           | FKT 27.x | FKT 20.2...-P          |
| <b>Internal monitoring devices</b>  |                    |                    |          |                        |
| Digital Data Interface              | –                  | •                  | –        | •                      |
| Terminal/motor compartment Humidity | –                  | –                  | •        | –                      |
| Motor winding: Bimetallic strip     | •                  | –                  | •        | –                      |
| Motor winding: PTC                  | o                  | • (+ 1...3x Pt100) | o        | • (+ 1...3x Pt100)     |
| Motor bearings: Pt100               | o                  | o                  | o        | o                      |
| Sealing chamber: conductive sensor  | –                  | –                  | –        | –                      |
| Sealing chamber: capacitive sensor  | –                  | •                  | –        | •                      |
| Leakage chamber: Float switch       | •                  | –                  | •        | –                      |
| Leakage chamber: capacitive sensor  | –                  | •                  | –        | •                      |
| Vibration sensor                    | –                  | •                  | –        | •                      |
| <b>External monitoring devices</b>  |                    |                    |          |                        |
| Sealing chamber: conductive sensor  | o                  | –                  | o        | –                      |

• = Standard, – = Not available, o = Optional

**All the monitoring devices fitted must always be connected!**

### Motor with Digital Data Interface



#### NOTICE

##### Note the instructions for the Digital Data Interface!

Read the separate instructions for the Digital Data Interface and comply with them.

The Digital Data Interface evaluates all available sensors. Use the graphical user interface of the Digital Data Interface to display current values and set the limit parameters. A warning message or alarm signal is output upon exceeding the limit parameters. The motor winding additionally features PTC sensors to enable secure pump deactivation.

### Motor without Digital Data Interface

Refer to the enclosed connection diagram for details regarding the connection and installation of the monitoring devices. **Electrical connection must always be carried out by a qualified electrician!**

**NOTICE! The individual wires are designated according to the connection diagram. Do not cut the wires! There is no additional assignment between the wiring diagram and connection diagram.**



#### DANGER

#### Risk of explosion due to incorrect connection!

If the monitoring devices are not connected correctly, there is a risk of fatal injury due to explosion in potentially explosive areas! Connection must always be carried out by a qualified electrician. If used in potentially explosive areas:

- Connect the thermal motor monitoring via an evaluation relay!
- Deactivation by the temperature limiter must be conducted with reactivation lock! It must only be possible to restart the unit when the unlock key has been actuated by hand!
- Connect the external electrode (e.g. sealing chamber control) via an evaluation relay with an intrinsically safe circuit!
- Note the additional information in the chapter on potentially explosive areas found in the appendix of these installation and operating instructions!

#### 6.5.6.1 Monitoring of terminal room/motor compartment

Connect the electrodes via an evaluation relay. Relay "NIV 101/A" is recommended for this. The threshold is 30 kOhm.

#### Wiring diagram

|    |                      |
|----|----------------------|
| DK | Electrode connection |
|----|----------------------|

**The system must be deactivated when the threshold is reached!**

#### 6.5.6.2 Monitoring of motor winding

#### With bimetallic strips

Connect the bimetallic strips directly to the switchgear or via an evaluation relay. Connection values: max. 250 V (AC), 2.5 A,  $\cos \varphi = 1$

#### Wiring diagram for bimetallic strip

Temperature limiter

|        |                             |
|--------|-----------------------------|
| 20, 21 | Bimetallic strip connection |
|--------|-----------------------------|

Temperature controller and limiter

|    |                             |
|----|-----------------------------|
| 21 | High temperature connection |
|----|-----------------------------|

|    |                 |
|----|-----------------|
| 20 | Centre terminal |
|----|-----------------|

|    |                            |
|----|----------------------------|
| 22 | Low temperature connection |
|----|----------------------------|

#### With PTC sensor

Connect the PTC sensor via an evaluation relay. "CM-MSS" relay is recommended for this purpose.

#### PTC sensor wiring diagram

Temperature limiter

|        |                       |
|--------|-----------------------|
| 10, 11 | PTC sensor connection |
|--------|-----------------------|

Temperature controller and limiter

|    |                             |
|----|-----------------------------|
| 11 | High temperature connection |
|----|-----------------------------|

|    |                 |
|----|-----------------|
| 10 | Centre terminal |
|----|-----------------|

|    |                            |
|----|----------------------------|
| 12 | Low temperature connection |
|----|----------------------------|

### Trigger status for temperature controller and limiter

The installed sensor specifies the trigger temperature as part of thermal motor monitoring using bimetallic or PTC sensors. Depending on the thermal motor monitoring version, the following triggering status must occur when the trigger temperature is reached:

- Temperature limiter (1 temperature circuit):  
The unit must be deactivated once the trigger temperature has been reached.
- Temperature controller and limiter (2 temperature circuits):  
Once the trigger temperature for the low temperature is reached, the motor can deactivate with automatic reactivation. Upon reaching the trigger temperature for the high temperature limit, the motor must deactivate with manual reactivation.

**Note the additional information in the section on potentially explosive areas described in the appendix!**

#### 6.5.6.3 Leakage chamber monitoring

The float switch is equipped with a potential-free normally closed contact. The switching capacity can be found in the supplied connection diagram.

| Wiring diagram |                         |
|----------------|-------------------------|
| K20,<br>K21    | Float switch connection |

**When the float switch is activated, a warning must be issued or deactivation must take place.**

#### 6.5.6.4 Monitoring of motor bearing

Connect the Pt100 sensor via an evaluation relay. Relay "DGW 2.01G" is recommended for this. The threshold is 100 °C (212 °F).

| Wiring diagram |                         |
|----------------|-------------------------|
| T1, T2         | Pt100 sensor connection |

**When the threshold is reached, deactivation must take place!**

#### 6.5.6.5 Sealing chamber monitoring (external electrode)

Connect the external electrode via an evaluation relay. Relay "NIV 101/A" is recommended for this. The threshold is 30 kOhm.

**Once the threshold is reached, a warning must be output or the unit must be switched off.**

### CAUTION

#### Connection of the sealing chamber control

If on reaching the threshold, there is only a warning, the pump could be irreparably damaged by the water ingress. Deactivation of the pump is always recommended!

**Note the additional information in the chapter on potentially explosive areas found in the appendix!**

#### 6.5.7 Motor protection adjustment

Motor protection must be set depending on the selected activation type.

##### 6.5.7.1 Direct activation

At full load, set the motor protection switch to the rated current (see rating plate). At partial load, it is recommended to set the motor protection switch 5 % above the current measured at the duty point.

##### 6.5.7.2 Star-delta activation

The motor protection setting depends on the installation:

- Motor protection installed in the motor line: Set the motor protection to 0.58 x the rated current.
- Motor protection installed in the mains supply cable: Set the motor protection to the rated current.

The maximum start-up time in star connection is 3 seconds.

##### 6.5.7.3 Soft starter

At full load, set the motor protection switch to the rated current (see rating plate). At partial load, it is recommended to set the motor protection switch 5 % above the current measured at the duty point. The following points must also be observed:



- Power consumption must always be below the rated current.
- Complete starting and stopping within 30 s.
- To avoid power dissipation, bypass the electronic starter (soft start) once normal operation is reached.

### 6.5.8 Operation with frequency converter

#### 6.5.8.1 Asynchronous motor

It is possible to operate asynchronous motors at the frequency converter. The frequency converter must feature the following connections at a minimum:

- Bimetallic strip and PTC sensor
- Moisture probe
- Pt100 sensor (if motor bearing monitoring is available!)

Refer to section entitled "Frequency converter operation [► 104]" for additional requirements and comply with these!

If the motor features a Digital Data Interface, also guarantee the following prerequisites:

- Network: Ethernet 10BASE-T/100BASE-TX, IP-based
- Protocol support: Modbus TCP/IP

Refer to the separate instructions for the Digital Data Interface for detailed requirements!

#### 6.5.8.2 Permanent magnet motor

Guarantee the following conditions when operating permanent magnet motors:

- Frequency converter with connection for PTC sensor
- Network: Ethernet 10BASE-T/100BASE-TX, IP-based
- Protocol support: Modbus TCP/IP

Refer to the separate instructions for the Digital Data Interface for detailed requirements!

Permanent magnet motors have been approved for operation with the following frequency converters:

- Wilo-EFC

**Other frequency converters on request!**

## 7 Commissioning



### WARNING

#### Foot injuries due to a lack of protective equipment!

Danger of (serious) injuries during work. Wear safety shoes!



### NOTICE

#### Automatic activation after power cut

Depending on the process, the product is switched on and off using separate controls. The product may automatically switch on following power cuts.

### 7.1 Personnel qualifications

- Electrical work: A qualified electrician must carry out the electrical work.
- Operation/control: Operating personnel must be instructed in the functioning of the complete system.

### 7.2 Operator responsibilities

- Providing installation and operating instructions by the pump or at a place specially reserved for it.
- Making the installation and operating instructions available in the language of the personnel.
- Making sure that the installation and operating instructions are read and understood by all personnel.
- All safety devices and emergency cut-outs on the system-side must be active and checked to ensure that they work properly.
- The pump is suitable for use under the specified operating conditions.

### 7.3 Direction of rotation check (for three-phase current motors only)

The pump is factory-checked and adjusted to the correct direction of rotation for a clockwise rotating field. Connection is made in accordance with the specifications in chapter "Electrical connection".

#### **Direction of rotation check**

A qualified electrician checks the rotating field at the mains connection with a rotating field-test device. For the correct direction of rotation, a clockwise rotating field must be available at the mains connection. The pump is **not** approved for operation with a counter-clockwise rotating field! **CAUTION! If the direction of rotation is checked with a test run, comply with the ambient and operating conditions!**

#### **Incorrect direction of rotation**

If the direction of rotation is incorrect, change the connection as follows:

- Swap two phases for motors with direct starting.
- Swap the connections of two windings (e.g. U1/V1 and U2/V2) for star-delta activation motors.

### 7.4 Operation in an explosive atmosphere



#### **DANGER**

#### **Risk of explosion due to flying sparks in the hydraulics!**

During operation the hydraulics must be flooded (completely filled with the fluid). If the volume flow is interrupted or the hydraulics emerges, air cushions can form in the hydraulics. If this happens, there is a risk of explosion, e.g. flying sparks due to static charge! Dry-running protection must ensure that the pump is deactivated at the appropriate level.

|                              | Asynchronous motor |          | Permanent magnet motor |
|------------------------------|--------------------|----------|------------------------|
|                              | FKT 20.2           | FKT 27.x | FKT 20.2...-P          |
| Approval according to IEC-Ex | o                  | –        | o                      |
| ATEX approval                | o                  | o        | o                      |
| FM approval                  | o                  | o        | o                      |
| CSA-Ex approval              | –                  | –        | –                      |

#### **Key**

– = Not available/possible, o = Optional, • = Standard

For use in explosive atmospheres, the pump must be marked as follows on the rating plate:

- "Ex" symbol of the corresponding approval
- Ex classification

**For the relevant requirements, refer to the explosion protection chapter in the appendix of these installation and operating instructions!**

#### **ATEX approval**

The pumps are suitable for operation in potentially explosive atmospheres:

- Device group: II
- Category: 2, zone 1 and zone 2

**These pumps must not be used in zone 0!**

#### **FM approval**

The pumps are suitable for operation in potentially explosive atmospheres:

- Protection class: Explosionproof
- Category: Class I, Division 1

Notice: If the cabling is carried out according to Division 1, installation in Class I, Division 2 is also permitted.

### 7.5 Before switching on

Check the following prior to activation:

- Check whether the device has been installed properly and in accordance with the locally applicable regulations:
  - Has the pump been earthed?

- Layout of power supply cable tested?
- Electrical connection made properly?
- Mechanical components attached correctly?
- Check level control:
  - Float switches can move freely?
  - Switching level tested (pump on, pump off, minimum water level)?
  - Additional dry-running protection installed?
- Test operating conditions:
  - Min./max. temperature of the fluid tested?
  - Max. immersion depth tested?
  - Operating mode defined depending on the minimum water level?
  - Maximum switching frequency adhered to?
- Check installation location/operating space:
  - Pipe system on the pressure side free of deposits?
  - Inlet or pump sump cleaned or free of deposits?
  - All gate valves open?
  - Minimum water level defined and monitored?

The hydraulics housing must be filled completely with the fluid and there must be no air cushions in the hydraulics. **NOTICE! Provide suitable venting devices if there is a risk of air cushions being formed in the system!**

## 7.6 Switch on and off

During the start process, the rated current is temporarily exceeded. During operation, the rated current may no longer be exceeded. **CAUTION! If the pump does not start, switch off the pump immediately. Remove the fault before reactivating the pump!**

The pump is switched on and off using a separate operating point (on/off switch, switchgear) provided by the customer.

## 7.7 During operation



### DANGER

#### Risk of explosion due to overpressure in the hydraulics!

If the gate valves on the suction and pressure sides are closed during operation, the fluid in the hydraulics housing is heated up by the pumping movement. This heating creates a pressure of several bars in the hydraulics. The pressure can result in the pump exploding! Make sure that all gate valves are open during operation. Open closed gate valves immediately!



### WARNING

#### Amputation of limbs due to rotating components!

No persons must be present in the work area of the pump! There is risk of (serious) injuries due to rotating components! No persons must be present in the work area of the pump during start-up or operation.



### WARNING

#### Risk of burns from hot surfaces!

Motor housing can become hot during operation. It may cause burns. Allow the pump to cool down at ambient temperature after switching it off!



### NOTICE

#### Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

When operating the pump, observe the locally applicable regulations on the following topics:

- Work safety
- Accident prevention

### → Handling electrical machines

Strictly adhere to the responsibilities of the personnel specified by the operator. All personnel are responsible for ensuring that the responsibilities of the personnel and the regulations are observed!

Due to their design, centrifugal pumps have rotating parts that are easily accessible. Depending on operating conditions, sharp edges can develop on these parts. **WARNING! This can lead to cuts and limbs may be severed!** Check the following at regular intervals:

- Operating voltage (+/- 5 % of the rated voltage)
- Frequency (+/- 2 % of the rated frequency)
- Current consumption between individual phases (max. 5 %)
- Voltage difference between the individual phases (max. 1 %)
- Max. switching frequency
- Minimum water submersion depending on the operating mode
- Inlet: no air intake.
- Level control device/dry-running protection: Switching points
- Quiet/low-vibration running
- All gate valves open

### **Operation in the limit range**

The pump can briefly be operated in the limit range (max. 15 min/day). During operation in the limit range, expect relatively large deviations from the operating data. **NO-TICE! Continuous duty in the limit range is prohibited! The pump is exposed to high wear and there is a greater risk of failure!**

The following parameters apply during operation in the limit range:

- Operating voltage (+/-10 % of the rated voltage)
- Frequency (+3/-5 % of the rated frequency)
- Power consumption between individual phases (max. 6 %)
- Voltage difference between the individual phases (max. 2 %)

## **8 Shut-down/dismantling**

### **8.1 Personnel qualifications**

- Operation/control: Operating personnel must be instructed in the functioning of the complete system.
- Electrical work: A qualified electrician must carry out the electrical work.
- Installation/dismantling: The technician must be trained in the use of the necessary tools and fixation materials for the relevant construction site.

### **8.2 Operator responsibilities**

- Locally applicable accident prevention and safety regulations of trade associations.
- Observe regulations for working with heavy loads and under suspended loads.
- Provide the necessary protective equipment and make sure that the personnel wears it.
- Provide adequate aeration in closed rooms.
- Take immediate countermeasures if there is a build-up of toxic or suffocating gases!

### **8.3 Shut-down**

The pump is deactivated during shutdown, but remains installed. This ensures that the pump is always ready for operation.

- ✓ Completely immerse the pump in the fluid to protect the pump from frost and ice.
- ✓ Minimum fluid temperature: +3 °C (+37 °F).
- 1. Switch off the pump at the operating point.
- 2. Secure the operating point against being switched on again by unauthorised persons (e.g. lock main switch).
- The pump has been shut down and can be dismantled.

If the pump remains installed after decommissioning, observe the following points:

- Ensure that the aforementioned requirements are maintained for the complete period of shutdown. Remove the pump if meeting these requirements cannot be guaranteed!
- For an extended period of shutdown, carry out a function test at regular intervals:
  - Period: monthly to quarterly
  - Running time: 5 minutes

- Only run a function test in valid operating conditions! **CAUTION! Do not run when dry! Non-compliance may result in irreparable damage!**

## 8.4 Removal



### DANGER

#### Danger due to fluids hazardous to health!

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!



### DANGER

#### Risk of death due to electrocution!

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.



### DANGER

#### Risk of fatal injury due to dangerous lone working practices!

Work in chambers and narrow rooms as well as work involving risk of falling are dangerous work. Such work may not be carried out autonomously! A second person must be present for safety reasons.



### WARNING

#### Risk of burns from hot surfaces!

Motor housing can become hot during operation. It may cause burns. Allow the pump to cool down at ambient temperature after switching it off!



### NOTICE

#### Use only properly functioning lifting equipment!

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

### 8.4.1 Stationary wet well installation

- ✓ Pump is decommissioned.
- ✓ Gate valves on the inlet and pressure sides are closed.
  1. Disconnect the pump from the mains.
  2. Attach the lifting equipment to the attachment point. **CAUTION! Do not pull on the connection cables! This damages the connection cables!**
  3. Slowly raise the pump and lift it above the guide pipes from the operating space. **CAUTION! There is a risk of damaging the connection cable when lifting the pump! Hold the connection cable slightly taut when lifting!**
  4. Coil up the connection cable and attach to the motor. **CAUTION! Do not kink the connection cable and maintain the bend radius. Do not damage the connection cables during attachment! Check for crushing and wire breaks.**
  5. Thoroughly clean the pump (see section entitled "Cleaning and disinfecting"). **DANGER! Disinfect the pump if the pump has been used in fluids that are hazardous to health!**

### 8.4.2 Portable wet well installation

- ✓ Pump has been taken out of service.
  1. Disconnect the pump from the mains.

2. Roll up the connection cable and lay it across the motor housing. **CAUTION! Do not kink the connection cable and maintain a constant bend radius. Never pull the device by the connection cable – doing so will damage the connection cable!**
3. Loosen the pressure pipe from the pressure port.
4. Attach the lifting equipment to the attachment point.
5. Lift the pump out of the operating space. **CAUTION! There is a risk of squeezing and damaging the connection cable when setting the pump down! Pay attention to the connection cable when setting the pump down!**
6. Clean the pump thoroughly (see "Cleaning and disinfecting"). **DANGER! If the pump has been used in fluids hazardous to health, disinfect the pump!**

#### 8.4.3 Stationary dry well installation

- ✓ Pump has been decommissioned.
  - ✓ Gate valves on the inlet and pressure sides are closed.
1. Disconnect the pump from the mains.
  2. Coil up the connection cable and attach to the motor. **CAUTION! Do not kink the connection cable and maintain the bend radius. Do not damage the connection cables during attachment! Check for crushing and wire breaks.**
  3. Undo the pipe system at the suction and discharge ports. **DANGER! Fluids are hazardous to health! Residue from the pumped fluid may still be present in the piping and hydraulics! Place collector tank, immediately wipe up drips and dispose of fluids properly.**
  4. Attach the lifting equipment to the attachment point.
  5. Undo the pump from the foundation.
  6. Lift the pump slowly out of the pipework and place on a suitable set-down location. **CAUTION! There is a risk of crushing and damaging the connection cables when setting down the pump! Pay attention to the connection cable when setting down the pump!**
  7. Thoroughly clean the pump (see section entitled "Cleaning and disinfecting"). **DANGER! Disinfect the pump if the pump has been used in fluids that are hazardous to health!**

#### 8.4.4 Clean and disinfect



##### **DANGER**

##### **Danger due to fluids hazardous to health!**

Danger to life if the pump is used in fluids hazardous to health! Decontaminate the pump before carrying out any further work! Wear the following protective equipment while performing cleaning tasks:

- Closed safety goggles
- Breathing mask
- Protective gloves

⇒ The equipment listed here is the minimum requirement, observe the specifications of the work regulations! The operator must make sure that the personnel have received and read the work regulations!

- ✓ Pump has been removed.
  - ✓ Contaminated cleaning water is disposed of in the sewer in accordance with local regulations.
  - ✓ Disinfectants are provided for contaminated pumps.
1. Ensure that the plug or bare cable ends are packed and stored in a watertight manner!
  2. Attach the lifting equipment to the attachment point on the pump.
  3. Lift the pump approximately 30 cm (10 in) above the ground.
  4. Spray the pump with clean water from top to bottom. **NOTICE! Use a suitable disinfectant on contaminated pumps! Strictly observe the manufacturer's specifications concerning use!**

5. Direct the water jet towards the inside via the pressure port to clean the impeller and the pump interior.
6. Flush any dirt residues on the floor into the drain.
7. Allow the pump to dry out.

## 9 Maintenance and repair



### DANGER

#### **Danger due to fluids hazardous to health!**

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!



### DANGER

#### **Permanent magnet motors: Risk of fatal injury with an open motor housing caused by a strong magnetic field!**

Opening the motor housing suddenly exposes a strong magnetic field! This magnetic field may lead to severe injuries. This magnetic field may cause death to persons with electronic implants (pacemakers, insulin pump, etc.). Do not open the motor housing! Only customer service staff are permitted to work on an open motor!



### NOTICE

#### **Use only properly functioning lifting equipment!**

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

- Always carry out maintenance tasks in a clean, well lit location. Securely position the pump and lock in place.
- Only carry out maintenance tasks described in these installation and operating instructions.
- Wear the following protective equipment while performing maintenance tasks:
  - Safety goggles
  - Safety footwear
  - Safety gloves

### 9.1 Personnel qualifications

- Electrical work: A qualified electrician must carry out the electrical work.
- Maintenance tasks: The technician must be familiar with the use of operating fluids and their disposal. In addition, the technician must have basic knowledge of mechanical engineering.

### 9.2 Operator responsibilities

- Provide the necessary protective equipment and make sure that the personnel wears it.
- Collect operating fluids in suitable tanks and dispose of properly.
- Dispose of protective clothing used in accordance with regulations.
- Use only original parts of the manufacturer. Use of parts other than the original parts releases the manufacturer from any liability.
- Collect any leakage of fluid and operating fluid immediately and dispose of it according to the locally applicable guidelines.
- Provide the tools required.
- If flammable solvents and cleaning agents are used, open flames, naked lights and smoking are prohibited.

### 9.3 Operating fluid

#### 9.3.1 Filling quantities

| Motor type | Sealing chamber | Cooling system |
|------------|-----------------|----------------|
|            | White oil       | P35 coolant    |

##### FKT 20.2 motor

|                   |   |   |        |               |
|-------------------|---|---|--------|---------------|
| FKT 20.2.../17... | – | – | 9.0 l  | 304 US.fl.oz. |
| FKT 20.2.../20... | – | – | 9.0 l  | 304 US.fl.oz. |
| FKT 20.2.../22... | – | – | 9.0 l  | 304 US.fl.oz. |
| FKT 20.2.../24... | – | – | 11.0 l | 372 US.fl.oz. |
| FKT 20.2.../30... | – | – | 11.0 l | 372 US.fl.oz. |
| FKT 20.2.../32... | – | – | 11.0 l | 372 US.fl.oz. |

##### FKT 27.x motor

|             |       |               |        |               |
|-------------|-------|---------------|--------|---------------|
| FKT 27.1... | 3.9 l | 132 US.fl.oz. | 14.5 l | 490 US.fl.oz. |
| FKT 27.2... | 6.5 l | 220 US.fl.oz. | 17.5 l | 592 US.fl.oz. |

#### 9.3.2 Coolant P35

The coolant P35, is a water–glycol mixture consisting of 35 % "Fragol Zitrec FC" concentrate and 65 % demineralised/distilled water. To top up or fill the cooling system, it is only permitted for the named concentrates to be used at the specified ratios.

#### CAUTION

##### Damage to the motor due to incorrect concentrate or mixing ratio!

The motor may be destroyed if other concentrates are used! If the mixing ratio differs, this means that frost and corrosion protection is not guaranteed! Use only the concentrates listed in the ratio 35:65.

| Concentrate | Fragol Zitrec FC | Pekasol L   | Propylene glycol <sup>2)</sup> |
|-------------|------------------|-------------|--------------------------------|
| Status      | Currently used   | Alternative | Alternative                    |

##### Technical data

|                  |                                      |   |                                      |
|------------------|--------------------------------------|---|--------------------------------------|
| Basic            | Propane–1,2–diol                     |   |                                      |
| Colour           | Colourless                           | Yellowish   | Colourless                           |
| Degree of purity | 96 %                                 | –   | 98 %                                 |
| Density          | 1.051 g/ml<br>(8.771 lb/US.liq.gal.) | 1.050 g/cm <sup>3</sup><br>(8.762 lb/US.liq.gal.) | 1.051 g/ml<br>(8.771 lb/US.liq.gal.) |
| Boiling point    | 164 °C (327 °F)                      | 185 °C (365 °F)                                   | 188 °C (370 °F)                      |
| pH value         | 9.9                                  | 7.5 – 9.5   | –                                    |
| Water            | max. 5 %                             | –   | 0.20 %                               |
| Nitrite-free     | •                                    | •   | •                                    |
| Amine-free       | •                                    | •   | •                                    |
| Phosphate-free   | •                                    | •   | •                                    |
| Silicate-free    | •                                    | •   | •                                    |

##### Approvals

|                                     |   |   |   |
|-------------------------------------|---|---|---|
| Water-polluting class <sup>1)</sup> | 1 | 1 | 1 |
| FDA                                 | • | – | – |
| HT1                                 | • | – | – |
| Afssa                               | • | – | – |

<sup>1)</sup> in accordance with VwVwS 1999. When disposing of these media, comply with the corresponding local guidelines for propanediol and propylene glycol!

<sup>2)</sup> Suitable for medical applications



**9.3.3 Oil types**

- ExxonMobile: Marcol 52
- ExxonMobile: Marcol 82
- Total: Finavestan A 80 B (NSF-H1 certified)

**9.3.4 Grease**

- Esso: Unirex N3
- Tripol: Molub-Alloy-Food Proof 823 FM (USDA-H1 approved)

**9.4 Maintenance intervals**

To ensure reliable operation, maintenance tasks must be carried out regularly. Depending on the real ambient temperatures, maintenance intervals different from those mentioned in the contract can be defined! If strong vibrations occur during operation, the pump and the installation must be checked regardless of the defined maintenance intervals.

**9.4.1 Maintenance intervals for normal conditions****8000 operating hours or after 2 years at the latest**

|                                | Visual inspection of the connection cables | Visual inspection of accessories | Visual inspection of the coating and the housing for wear | Function test of monitoring devices | Coolant replacement | Sealing chamber oil change* | Draining the leakage chamber* |
|--------------------------------|--|----------------------------------|---|-------------------------------------|---------------------|-----------------------------|-------------------------------|
| <b>Asynchronous motors</b>     |  |                                  |   |                                     |                     |                             |                               |
| FKT 20.2                       | •  | •                                | •   | •                                   | •                   | –                           | •                             |
| FKT 27.x                       | •  | •                                | •   | •                                   | •                   | •                           | •                             |
| <b>Permanent magnet motors</b> |  |                                  |   |                                     |                     |                             |                               |
| FKT 20.2...-P                  | •  | •                                | •   | •                                   | •                   | –                           | o                             |

**Key**

- = Carry out maintenance measures, o = Carry out maintenance measure as instructed,
- = Maintenance measure omitted
- \* Note information in "Deviating maintenance intervals"!

**15000 operating hours or after 10 years at the latest**

- Complete overhaul

**9.4.2 Deviating maintenance intervals****Motors without Digital Data Interface**

It is possible to install external sealing chamber control (pencil electrode) in motors without Digital Data Interface. Change the oil as instructed if this monitoring type has been installed!

**Motors with Digital Data Interface**

In motors with Digital Data Interface the sealing and/or leakage chamber is monitored by capacitive sensors. The Digital Data Interface outputs a warning once the predefined threshold has been reached. Carry out the corresponding maintenance measure if this warning is displayed.

**9.4.3 Maintenance intervals for harsh conditions**

Under harsh operating conditions, specified maintenance intervals must be shortened if required. Harsh operating conditions include:

- Fluids with long-fibre components
- Turbulent inlet (e.g. due to air intake, cavitation)
- Strongly corroding or abrasive fluids
- Heavily gas generating fluids
- Operation at an unfavourable duty point
- Pressure surges

When using pumps under hard conditions, it is recommended to sign a maintenance contract. Contact customer service.

## 9.5 Maintenance measures



### WARNING

#### Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.



### WARNING

#### Hand, foot or eye injuries due to the absence of protective equipment!

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety gloves for protection against cuts
- Safety shoes
- Closed safety goggles

The following pre-requisites must be fulfilled prior to starting maintenance measures:

- Pump cooled down to the ambient temperature.
- Pump cleaned thoroughly and disinfected (if required).

### 9.5.1 Recommended maintenance measures

Regular inspection of power consumption and the operating voltage in all three phases is recommended for smooth operation. In normal operation, these values remain constant. Slight fluctuations depend on the characteristics of the fluid. Power consumption can provide an early indication of damage or malfunctions in the impeller, bearings or motor, which can be rectified. Larger voltage fluctuations strain the motor winding and can cause the pump to break down. Regular inspections can therefore largely prevent major secondary damage and reduce the risk of total breakdown. In this regard, it is recommended to use remote monitoring for regular inspections.

### 9.5.2 Visual inspection of the connection cable

Check connection cable for:

- Bubbles
- Cracks
- Scratches
- Abrasion
- Pinch points

If damage is identified on the connection cable, decommission the pump immediately! Have the connection cable replaced by Wilo customer service. Only operate the pump up again once the damage has been properly remedied!

**CAUTION! Water may penetrate into the pump due to the damaged connection cable! Water ingress leads to total failure of the pump.**

### 9.5.3 Visual inspection of accessories

Accessories must be checked for:

- Correct fixation
- Smooth function
- Signs of wear, e.g. cracks caused by frequencies

Any defects detected must be repaired immediately or the accessories must be replaced.

### 9.5.4 Visual inspection of coatings and housing for wear

The coatings and housing parts must not show any signs of damage. If there are defects, the following must be observed:

- If the coating is damaged, it must be restored.
- Contact customer service if housing parts have worn out!

### 9.5.5 Function test of the monitoring device

To test resistances, the pump must be cooled down to the ambient temperature!

#### 9.5.5.1 Test the resistor of the temperature sensor

Measure the resistor of the temperature sensors with an ohmmeter. The following measured values must be complied with:

- **Bimetallic strip:** Measured value = 0 ohms (continuity).

- **PTC sensor** (PTC thermistor): Measured value depends on the number of sensors installed. A PTC sensor has a cold resistance range of 20 to 100 ohms.
  - With **three** sensors in series, the measured value range is from 60 to 300 ohms.
  - With **four** sensors in series, the measured value range is from 80 to 400 ohms.
- **Pt100 sensor**: Pt100 sensors have a resistance value of 100 ohms at 0 °C (32 °F). Between 0 °C (32 °F) and 100 °C (212 °F), the resistance increases by 0.385 ohms per 1 °C (1.8 °F) increase.  
At an ambient temperature of 20 °C (68 °F), the resistance is 107.7 ohms.

#### 9.5.5.2 Test the resistor for the internal electrodes for terminal room/motor compartment monitoring

The internal electrodes are switched in parallel. During testing, all the electrodes are thus measured together.

Measure the resistor of the electrodes with an ohmmeter. The measured value must approach "infinity". At values  $\leq 30$  kOhm, there is water in the terminal room or motor compartment. **Contact customer service!**

#### 9.5.5.3 Testing the resistor of the external electrode for sealing chamber control

Measure the resistor of the electrode with an ohmmeter. The measured value must approach "infinity". For values  $\leq 30$  kOhm, if there is water in the oil – change the oil!

#### 9.5.6 Note for the use of shut-off ball cocks

If shut-off ball cocks are installed on the drain holes, observe the following points:

- Remove the screw plug before opening the shut-off ball cock.
- To drain the operating fluid, turn the lever to the direction of flow (parallel to the shut-off ball cock).
- To close the drain hole, turn the lever so it is at right angles to the direction of flow (to the shut-off ball cock).
- After closing the shut-off ball cock, screw in the screw plug again.

#### 9.5.7 Oil change in the sealing chamber



##### WARNING

##### Operating fluid under high pressure!

A pressure of **several bar can build up** in the motor! This pressure escapes when the screw plugs are **opened**. If screw plugs are opened without due caution, they can be ejected at high speed! To avoid injuries, observe the following instructions:

- Adhere to the prescribed sequence of work steps.
- Unscrew the screw plugs slowly, but never unscrew them completely. As soon as the pressure escapes (audible whistling or hissing of air), stop turning the screw plug any further!
- When the pressure has completely dissipated, fully unscrew the screw plugs.
- Wear closed safety goggles.



##### WARNING

##### Scalding from hot operating fluids!

Hot operating fluids can also spray out when pressure is released. This can result in scalding! To avoid injuries, the following instructions must be observed:

- Allow the motor to cool down to the ambient temperature before opening the screw plugs.
- Wear closed safety goggles or face protection and gloves.

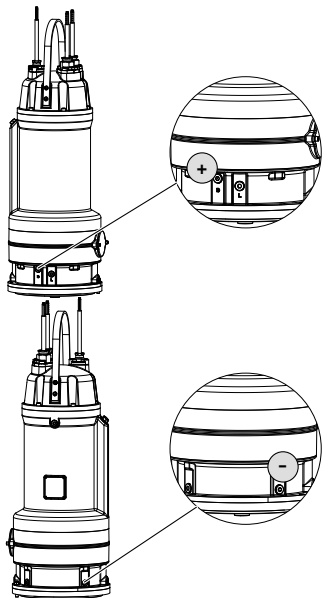


Fig. 12: Sealing chamber: Oil change

#### FKT 27.x motor

|   |  |
|---|--|
| + | Add the oil to the sealing chamber     |
| - | Drain the oil from the sealing chamber |

- ✓ Use protective equipment!
  - ✓ Pump has been dismantled and cleaned (decontaminated, if required).
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
  2. Position a suitable reservoir to collect the operating fluid.
  3. Unscrew the screw plug (+) slowly, but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if you can hear hissing or whistling! Wait until the pressure has completely dissipated.**
  4. Once the pressure has dissipated, fully unscrew the screw plug (+).
  5. Unscrew the screw plug (-) and drain the operating fluid. Open the ball valve if a ball valve has been installed at the outlet opening. **NOTICE! Vacuum the oil or rinse the sealing chamber to fully drain the system.**
  6. Check the operating fluid:
    - ⇒ If there is a leakage in the mechanical seal, small amounts of water may enter the sealing chamber. This turns the oil milky/cloudy. If the ratio of oil to water is less than 2:1, the mechanical seal may be damaged. Change the oil and check again after 4 weeks. If water is again present in the oil during the second check, contact customer service!
    - ⇒ Notify customer service if the operating fluid contains metal swarf!
  7. If a ball valve is installed on the outlet opening, close the ball valve.
  8. Clean the screw plug (-), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**
  9. Fill the new operating fluid through the opening for the screw plug (+).
    - ⇒ Comply with the specifications for the operating fluid type and quantity!
  10. Clean the screw plug (+), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

#### 9.5.8 Coolant change



#### WARNING

##### Operating fluid under high pressure!

A pressure of **several bar can build up** in the motor! This pressure escapes when the screw plugs are **opened**. If screw plugs are opened without due caution, they can be ejected at high speed! To avoid injuries, observe the following instructions:

- Adhere to the prescribed sequence of work steps.
- Unscrew the screw plugs slowly, but never unscrew them completely. As soon as the pressure escapes (audible whistling or hissing of air), stop turning the screw plug any further!
- When the pressure has completely dissipated, fully unscrew the screw plugs.
- Wear closed safety goggles.



#### WARNING

##### Scalding from hot operating fluids!

Hot operating fluids can also spray out when pressure is released. This can result in scalding! To avoid injuries, the following instructions must be observed:

- Allow the motor to cool down to the ambient temperature before opening the screw plugs.
- Wear closed safety goggles or face protection and gloves.

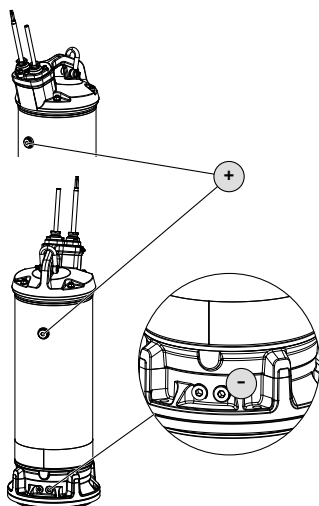


Fig. 13: Cooling system: FKT 20.2: coolant change

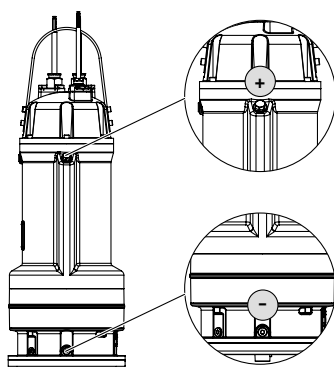


Fig. 14: Cooling system: FKT 27.1/27.2: coolant change

### FKT 20.2 motor

|   |                       |
|---|-----------------------|
| + | Add/bleed the coolant |
| - | Drain the coolant     |

- ✓ Use protective equipment!
  - ✓ Pump has been dismantled and cleaned (decontaminated, if required).
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
  2. Position a suitable reservoir to collect the operating fluid.
  3. Unscrew the screw plug (+) slowly, but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if you can hear hissing or whistling! Wait until the pressure has completely dissipated.**
  4. Once the pressure has dissipated, fully unscrew the screw plug (+).
  5. Unscrew the screw plug (-) and drain the operating fluid. If a ball valve is installed at the outlet opening, open the ball valve.  
**NOTICE! Rinse to completely bleed the cooling system.**
  6. Check the operating fluid: Notify customer service if the operating fluid contains metal swarf!
  7. If a ball valve is installed on the outlet opening, close the ball valve.
  8. Clean the screw plug (-), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**
  9. Fill the new operating fluid through the opening for the screw plug (+).  
⇒ Comply with the specifications for the operating fluid type and quantity!
  10. Clean the screw plug (+), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**

### FKT 27.x motor

|   |                       |
|---|-----------------------|
| + | Add/bleed the coolant |
| - | Drain the coolant     |

- ✓ Use protective equipment!
  - ✓ Pump has been dismantled and cleaned (decontaminated, if required).
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
  2. Position a suitable reservoir to collect the operating fluid.
  3. Unscrew the screw plug (+) slowly, but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if you can hear hissing or whistling! Wait until the pressure has completely dissipated.**
  4. Once the pressure has dissipated, fully unscrew the screw plug (+).
  5. Unscrew the screw plug (-) and drain the operating fluid. If a ball valve is installed at the outlet opening, open the ball valve.  
**NOTICE! Rinse to completely bleed the cooling system.**
  6. Check the operating fluid: Notify customer service if the operating fluid contains metal swarf!
  7. If a ball valve is installed on the outlet opening, close the ball valve.
  8. Clean the screw plug (-), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**
  9. Fill the new operating fluid through the opening for the screw plug (+).  
⇒ Comply with the specifications for the operating fluid type and quantity!
  10. Clean the screw plug (+), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**

### 9.5.9 Drain the leakage chamber

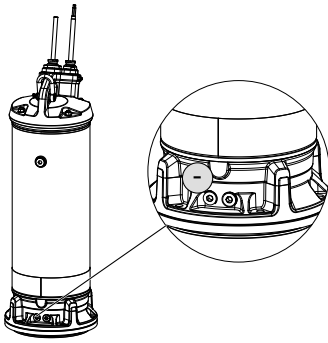


Fig. 15: FKT 20.2: draining the leakage chamber

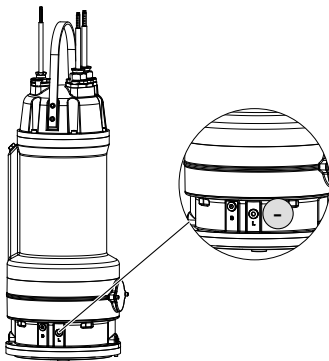


Fig. 16: FKT 27.1/27.2: draining the leakage chamber

### 9.5.10 General overhaul

## 9.6 Repairs

### FKT 20.2 motor

#### - Drain the leakage

- ✓ Protective equipment has been put on!
  - ✓ Pump has been dismantled and cleaned (decontaminated if required).
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
  2. Place a suitable tank to collect the operating fluid.
  3. Unscrew the screw plug slowly (–) but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
  4. After the pressure has dissipated, fully unscrew the screw plug (–) and drain the operating fluid.
  5. Clean the screw plug (–), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**

### FKT 27.x motor

#### - Drain the leakage

- ✓ Protective equipment has been put on!
  - ✓ Pump has been dismantled and cleaned (decontaminated if required).
1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
  2. Place a suitable tank to collect the operating fluid.
  3. Unscrew the screw plug slowly (–) but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
  4. After the pressure has dissipated, fully unscrew the screw plug (–) and drain the operating fluid.
  5. Clean the screw plug (–), replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft-lb)!**

During the general overhaul, the motor bearings, shaft sealings, O-rings and connection cables are checked for wear and damage. Damaged components are replaced with original parts. This ensures correct operation.

The general overhaul is performed by the manufacturer or an authorised service centre.



#### WARNING

##### Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.



#### WARNING

##### Hand, foot or eye injuries due to the absence of protective equipment!

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety gloves for protection against cuts
- Safety shoes
- Closed safety goggles

The following preconditions must be met prior to starting repair work:

- Pump cooled down to the ambient temperature.
- Pump is switched voltage-free and secured against being activated inadvertently.

→ Pump cleaned thoroughly and disinfected (if required).

For repair work the following generally applies:

- Wipe up spillage quantities of fluid and operating fluid immediately!
- Always replace O-rings, gaskets and screw locking devices!
- Observe the tightening torques in the appendix!
- Never use force when carrying out this work!

### 9.6.1 Instructions on using screw locking devices

A screw locking device can be used on the screws. Screw locking is done at the factory using two different methods:

- Thread-locking fluid
- Mechanical screw locking device

**Always re-apply the screw locking device!**

#### Thread-locking fluid

Medium-strength thread-locking fluid (e.g. Loctite 243) is used for the liquid screw locking compound. This threadlocker can be loosened with increased force. If the thread-locking fluid cannot be loosened, then the compound must be heated to approx. 300 °C (572 °F). Clean the components thoroughly after dismantling.

#### Mechanical screw locking device

The mechanical screw locking device consists of two Nord-Lock wedge lock washers. The screw connection is secured by the clamping force. The Nord-Lock screw locking device must only be used on bolts with strength class 10.9 which have been coated with Geomet. **The use of stainless screws is prohibited!**

### 9.6.2 Which repair work may be carried out

- Changing the hydraulics housing.
- SOLID G- and Q impeller: Readjusting the suction port.

### 9.6.3 Changing the hydraulics housing



#### DANGER

#### Dismantling the impeller is prohibited!

Depending on the impeller diameter, the impeller must be removed for dismantling the hydraulics housing on some pumps. Before carrying out any work, check whether dismantling the impeller is necessary. If yes, notify customer service! The dismantling of the impeller must be carried out by customer service or an authorized specialist workshop.

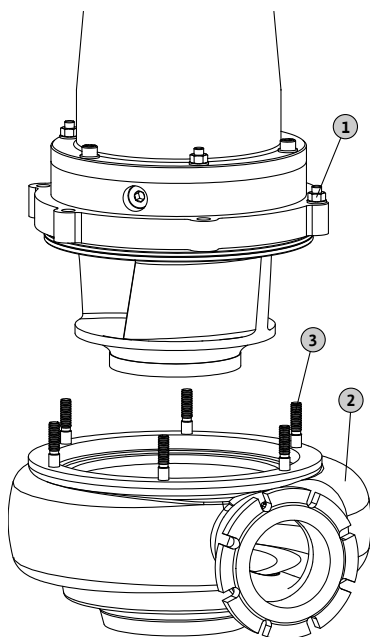


Fig. 17: Changing the hydraulics housing

|   |   |
|---|---|
| 1 | Hexagon nuts for fixation of the motor/hydraulics |
| 2 | Hydraulics housing                                |
| 3 | Threaded bolt                                     |

- ✓ Lifting equipment with sufficient bearing capacity is available.
- ✓ Protective equipment is used.
- ✓ New hydraulics housing is ready.
- ✓ Impeller **must not** be dismantled!

1. Attach lifting equipment with suitable lifting gear to the attachment point of the pump.

2. Position the pump upright.

**CAUTION! The hydraulics housing will be damaged if the pump is put down too quickly. Set the pump down slowly on the suction port!**

**NOTICE! If the pump cannot be placed level on the suction port, use appropriate adjustment plates. The pump must be positioned vertically to be able to lift the motor without issues.**

3. Mark the motor/hydraulics position on the housing.

4. Undo and remove hexagon nuts at the motor flange.

5. Slowly lift the motor and pull it off the hydraulics housing.

**CAUTION! Lift the motor vertically and do not tilt! Threaded bolts are damaged if the unit is tilted!**

6. Insert a new seal ring at the motor flange.



7. Swivel the motor over the new hydraulics housing.
8. Slowly lower the motor. Make sure that the motor/hydraulic markings match and the threaded bolts screw exactly into the drilled holes.
9. Screw hexagon nuts and connect the motor to the hydraulics firmly. **NOTICE! Observe the tightening torques stated in the appendix!**
- Hydraulics housing changed. Pump can be reinstalled.

**WARNING! If the pump is placed in temporary storage and the lifting equipment is dismantled, secure the pump against falling over and slipping!**

#### 9.6.4 SOLID G- and Q impeller: Readjusting the suction port

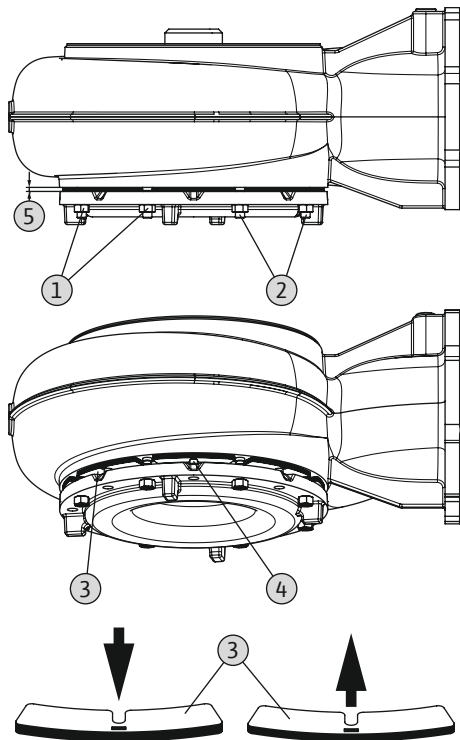


Fig. 18: SOLID G: Readjusting the gap

- |   |   |
|---|---|
| 1 | Hexagon nut for suction port attachment         |
| 2 | Threaded bolt                                   |
| 3 | Laminated core                                  |
| 4 | Laminated core fastening screw                  |
| 5 | Gap between suction port and hydraulics housing |
- ✓ Lifting equipment with sufficient bearing capacity is present.
  - ✓ Protective equipment has been put on.
  1. Attach lifting equipment with suitable lifting gear to the attachment point of the pump.
  2. Lift the pump so that the pump is approx. 50 cm (20 in) above the ground.
  3. Loosen the hexagon nuts for fixation of the suction port. Unscrew the hexagon nut until the hexagon nut is flush with the threaded bolt.  
**WARNING! Risk of crushing fingers! The suction port can stick on the hydraulics housing due to encrustations and slide down suddenly. Loosen the nuts only in a crosswise manner and grasp them from the bottom. Wear protective gloves!**
  4. Suction port is on the hexagon nuts. If the suction port sticks to the hydraulics housing, carefully loosen the suction port with a wedge!
  5. Clean the sliding surface and the screwed-on laminated cores and disinfect (if necessary).
  6. Loosen the screws from the laminated cores and remove the individual laminated cores.
  7. Slowly re-tighten the three hexagon nuts crosswise until the suction port is in contact with the impeller. **CAUTION! Only tighten the hexagon nuts by hand! If the hexagon nuts are excessively tightened, the impeller and the motor bearings may get damaged!**
  8. Measure the gap between the suction port and hydraulics housing.
  9. Adjust the laminated cores according to the measured dimensions and add another metal sheet.
  10. Unscrew the three hexagon nuts again until the hexagon nuts are flush with the threaded bolt.
  11. Reinsert the laminated cores and screw into place.
  12. Tighten the hexagon nuts crosswise until the suction port is flush with the laminated cores.
  13. Firmly tighten the hexagon nuts crosswise. **Observe the tightening torques in the appendix!**
  14. Reach into the suction port from below and turn the impeller. When the gap is correctly set, the impeller can be rotated. If the gap is too small, the impeller is difficult to rotate. Repeat setting. **WARNING! Danger of amputation of limbs! Sharp edges can form on the suction port and impeller. Wear safety gloves to protect against cuts!**
  - Suction port correctly set. Pump can be reinstalled.



## 10 Faults, causes and remedies



### DANGER

#### Danger due to fluids hazardous to health!

Danger of death in case of pumps with fluids hazardous to health! Wear the following protective equipment while performing the work:

- Closed safety goggles
- Breathing mask
- Protective gloves

⇒ The equipment listed here is the minimum requirement, observe the specifications of the work regulations! The operator must make sure that the personnel have received and read the work regulations!



### DANGER

#### Risk of death due to electrocution!

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.



### DANGER

#### Risk of fatal injury due to dangerous lone working practices!

Work in chambers and narrow rooms as well as work involving risk of falling are dangerous work. Such work may not be carried out autonomously! A second person must be present for safety reasons.



### WARNING

#### No persons are allowed to be present inside the working area of the pump!

Persons may suffer (serious) injuries while the pump is in operation! No persons may therefore be present inside the working area. If persons must enter the working area of the pump, the pump must be decommissioned and secured against being switched on again without authorisation.



### WARNING

#### Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

#### **Fault: Pump does not start**

1. Electricity supply interrupted or short-circuit/earth fault in the cable or motor winding.
  - ⇒ Have the connection and motor checked by a qualified electrician and replace if necessary.
2. Tripping of fuses, of the motor protection switch or the monitoring device
  - ⇒ Have the connection and the monitoring device checked by a qualified electrician and change it if necessary.
  - ⇒ Have the motor protection switches and fuses installed and adjusted according to the technical specifications by a qualified electrician and reset monitoring device.
  - ⇒ Check the impeller to make sure that it runs smoothly, clean the hydraulics if necessary.
3. The sealing chamber control (optional) has interrupted the electric circuit (connection-related)

- ⇒ See “Fault: Mechanical seal leakage, sealing chamber control reports a fault and switches the pump off”.

**Fault: Pump starts up, motor protection trips after short period**

1. Motor protection switch set incorrectly.
  - ⇒ Have the adjustment of the trigger checked and corrected by a qualified electrician.
2. Increased power consumption due to major voltage drop.
  - ⇒ Have the voltage of individual phases checked by a qualified electrician. Contact the electricity distribution network.
3. There are only two phases at the connection.
  - ⇒ Have the connection checked and corrected by a qualified electrician.
4. Excessive differences in voltage between the phases.
  - ⇒ Have the voltage of individual phases checked by a qualified electrician. Contact the electricity distribution network.
5. Incorrect direction of rotation.
  - ⇒ Have the connection corrected by a qualified electrician.
6. Increased power consumption through jammed hydraulics.
  - ⇒ Clean the hydraulics and check the inlet.
7. The density of the fluid is too high.
  - ⇒ Contact customer service.

**Fault: Pump runs, there is no volume flow**

1. There is no fluid.
  - ⇒ Check the inlet, open all gate valves.
2. Inlet clogged.
  - ⇒ Check the inlet and remove clogging.
3. Hydraulics jammed.
  - ⇒ Clean the hydraulics.
4. Pipe system on the pressure side or pressure hose clogged.
  - ⇒ Remove clogging and replace the damaged components if necessary.
5. Intermittent operation.
  - ⇒ Check the switching system.

**Fault: Pump starts, duty point is not reached**

1. Inlet clogged.
  - ⇒ Check the inlet and remove clogging.
2. Slide valves on the pressure side closed.
  - ⇒ Completely open all gate valves.
3. Hydraulics jammed.
  - ⇒ Clean the hydraulics.
4. Incorrect direction of rotation.
  - ⇒ Have the connection corrected by a qualified electrician.
5. Air cushion in the pipe system.
  - ⇒ Vent the pipe system.
  - ⇒ If air cushions occur frequently: Locate and prevent the air intake, if required install ventilation systems at specified locations.
6. Pump pumping against excessive pressure.
  - ⇒ Open all gate valves on the pressure side completely.
7. Signs of wear on the hydraulics.
  - ⇒ Have the components (impeller, suction port, pump housing) checked and replaced by customer service.
8. Pipe system on the pressure side or pressure hose clogged.

⇒ Remove clogging and replace the damaged components if necessary.

9. Strongly gassing fluid.

⇒ Contact customer service.

10. The connection only has two phases.

⇒ Have the connection checked and corrected by a qualified electrician.

11. Excessive decrease in the fill level during operation.

⇒ Check supply/capacity of the system.

⇒ Have the switching points of the level control checked and adjusted if necessary.

***Fault: The pump does not run smoothly and is noisy***

1. Improper duty point.

⇒ Check the pump configuration and the duty point, contact customer service.

2. Hydraulics jammed.

⇒ Clean the hydraulics.

3. Strongly gassing fluid.

⇒ Contact customer service.

4. There are only two phases at the connection.

⇒ Have the connection checked and corrected by a qualified electrician.

5. Incorrect direction of rotation.

⇒ Have the connection corrected by a qualified electrician.

6. Signs of wear on the hydraulics.

⇒ Have the components (impeller, suction port, pump housing) checked and replaced by customer service.

7. Motor bearings have worn.

⇒ Inform customer service; send the pump back to the factory for overhauling.

8. Pump is installed under tension.

⇒ Check installation, install rubber compensators if necessary.

***Fault: Sealing chamber control reports fault or switches the pump off***

1. Condensation water build-up due to extended storage or high temperature fluctuations.

⇒ Operate the pump for a short period (max. 5 min.) without pencil electrode.

2. Increased leakage when running in new mechanical seals.

⇒ Change the oil.

3. Pencil electrode cable is defective.

⇒ Replace the pencil electrode.

4. Mechanical seal is defective.

⇒ Inform customer service.

***Further steps for troubleshooting***

If the points listed here do not rectify the fault, contact customer service. Customer service can assist in the following ways:

→ Telephone or written support.

→ On-site support.

→ Inspection and repair at the factory.

Costs may be incurred if you request customer services! Please contact customer services for more information.

## 11 Spare parts

Spare parts are ordered via customer service. To avoid return queries and incorrect orders, the serial or article number must always be supplied. **Subject to change without prior notice!**

## 12 Disposal

### 12.1 Oils and lubricants

Operating fluid must be collected in suitable tanks and disposed of in accordance with the locally applicable guidelines. Wipe up drips immediately!

### 12.2 Water-glycol mixture

The operating fluid complies with Water Hazard Class 1 of the German Administrative Regulation of Substances Hazardous to Water (VwVwS). When disposing of it, the locally applicable guidelines (e.g. DIN 52900 on propanediol and propylene glycol) must be observed.

### 12.3 Protective clothing

Used protective clothing must be disposed off in accordance with the locally applicable guidelines.

### 12.4 Information on the collection of used electrical and electronic products

Proper disposal and appropriate recycling of this product prevents damage to the environment and putting your personal health at risk.



#### NOTICE

##### Disposal in domestic waste is prohibited!

In the European Union this symbol may be included on the product, the packaging or the accompanying documentation. It means that the electrical and electronic products in question must not be disposed of along with domestic waste.

Please note the following points to ensure proper handling, recycling and disposal of the used products in question:

- Hand over these products at designated, certified collection points only.
- Observe the locally applicable regulations!

Please consult your local municipality, the nearest waste disposal site, or the dealer who sold the product to you for information on proper disposal. See [www.wilo-recycling.com](http://www.wilo-recycling.com) for more information about recycling.

#### Subject to change without prior notice!

## 13 Ex rating

This section contains further information on the operation of the pump in an explosive atmosphere. All personnel must read this section. **This section applies only to Ex-rated pumps!**

### 13.1 Identification of Ex-rated pumps

For use in explosive atmospheres, the pump must be marked as follows on the rating plate:

- "Ex" symbol of the corresponding approval
  - Ex classification
  - Certification number (depending on the approval)
- The certification number, if required by the approval, is printed on the rating plate.

### 13.2 Protection class

The motor's design version corresponds to the following protection classes:

- Flameproof enclosure (ATEX)
- Explosionproof (FM)

In order to limit the surface temperature, the motor must be equipped with at least one temperature limiter (1-circuit temperature monitoring). It may also be equipped with a temperature controller (2-circuit temperature monitoring).

### 13.3 Intended use



#### DANGER

##### Explosion due to pumping of explosive fluids!

Pumping of highly flammable and explosive fluids (gasoline, kerosene, etc.) in pure form is strictly prohibited. There is a risk of fatal injury due to explosion! The pumps are not designed for these fluids.

**ATEX approval**

The pumps are suitable for operation in potentially explosive atmospheres:

- Device group: II
- Category: 2, zone 1 and zone 2

**These pumps must not be used in zone 0!**

**FM approval**

The pumps are suitable for operation in potentially explosive atmospheres:

- Protection class: Explosionproof
- Category: Class I, Division 1

Notice: If the cabling is carried out according to Division 1, installation in Class I, Division 2 is also permitted.

**13.4 Electrical connection****DANGER****Risk of death due to electrocution!**

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.

- Always connect the pump to an electrical outlet outside the explosive area. If the connection must be made within the explosive area, then the connection must be carried out in an Ex-rated housing (ignition protection class according to DIN EN 60079-0)! Non-observance may lead to fatal injury due to explosion! Connection must always be carried out by a qualified electrician.
- All monitoring devices outside the "spark-proof areas" must be connected via an intrinsically safe circuit (e.g. Ex-i relay XR-4...).
- The voltage tolerance may not be higher than max.  $\pm 10\%$ .

**Overview of monitoring devices**

|                                     | Asynchronous motor |                    |          | Permanent magnet motor |
|-------------------------------------|--------------------|--------------------|----------|------------------------|
|                                     | FKT 20.2           | FKT 20.2           | FKT 27.x | FKT 20.2...-P          |
| <b>Internal monitoring devices</b>  |                    |                    |          |                        |
| Digital Data Interface              | –                  | •                  | –        | •                      |
| Terminal/motor compartment Humidity | –                  | –                  | •        | –                      |
| Motor winding: Bimetallic strip     | •                  | –                  | •        | –                      |
| Motor winding: PTC                  | o                  | • (+ 1...3x Pt100) | o        | • (+ 1...3x Pt100)     |
| Motor bearings: Pt100               | o                  | o                  | o        | o                      |
| Sealing chamber: conductive sensor  | –                  | –                  | –        | –                      |
| Sealing chamber: capacitive sensor  | –                  | •                  | –        | •                      |
| Leakage chamber: Float switch       | •                  | –                  | •        | –                      |
| Leakage chamber: capacitive sensor  | –                  | •                  | –        | •                      |
| Vibration sensor                    | –                  | •                  | –        | •                      |
| <b>External monitoring devices</b>  |                    |                    |          |                        |
| Sealing chamber: conductive sensor  | o                  | –                  | o        | –                      |

• = Standard, – = Not available, o = Optional

**All the monitoring devices fitted must always be connected!**

**13.4.1 Motor with Digital Data Interface****NOTICE****Note the instructions for the Digital Data Interface!**

Read the separate instructions for the Digital Data Interface and comply with them.

The Digital Data Interface evaluates all available sensors. Use the graphical user interface of the Digital Data Interface to display current values and set the limit parameters. A warning message or alarm signal is output upon exceeding the limit parameters. The motor winding additionally features PTC sensors to enable secure pump deactivation.

The connection of the Digital Data Interface depends on the selected system mode and other system components. Note installation suggestions and connection variants in the instructions for the Digital Data Interface.

### 13.4.2 Motor without Digital Data Interface

#### 13.4.2.1 Monitoring of terminal room/motor compartment

The connection is made as described in the “Electrical connection” section.

#### 13.4.2.2 Monitoring of motor winding



#### **DANGER**

#### **Risk of explosion due to overheating of the motor!**

If the temperature limiter is connected incorrectly, there is a risk of explosion due to overheating of the motor! Always connect the temperature limiter to a manual re-activation lock. This means that a “release button” must be manually activated!

The motor is equipped with a temperature limit (1-circuit temperature monitoring). As an option, the motor can be fitted with a temperature control and limit function (2-circuit temperature monitoring).

The installed sensor specifies the trigger temperature as part of thermal motor monitoring. Depending on the thermal motor monitoring version, the following triggering status must occur when the trigger temperature is reached:

→ Temperature limiter (1 temperature circuit):

The unit must be deactivated **with anti-reactivation lock** once the trigger temperature has been reached!

→ Temperature controller and limiter (2 temperature circuits):

Once the trigger temperature for the low temperature is reached, the motor can deactivate with automatic reactivation. Upon reaching the trigger temperature for the high temperature limit, the motor must deactivate with manual **anti-reactivation lock!**

**CAUTION! Motor damage due to overheating! In the event of automatic reactivation, comply with the specifications for the maximum switching frequency and switching break!**

#### **Connection of the thermal motor monitoring**

→ Connect the bimetallic strip using an evaluation relay. “CM-MSS” relay is recommended for this purpose.

Connection values: max. 250 V(AC), 2.5 A,  $\cos \varphi = 1$

→ Connect the PTC sensor via an evaluation relay. “CM-MSS” relay is recommended for this purpose.

→ If a frequency converter is used, connect the temperature sensor at the Safe Torque Off (STO). This guarantees that the hardware deactivates the pump.

#### 13.4.2.3 Leakage chamber monitoring

Connect the float switch using an evaluation relay! “CM-MSS” relay is recommended for this purpose.

#### 13.4.2.4 Monitoring of motor bearing

The connection is made as described in the “Electrical connection” section.

#### 13.4.2.5 Sealing chamber monitoring (external electrode)

→ Connect the external pencil electrode via an Ex-rated evaluation relay! Relay “XR-4...” is recommended for this.

The threshold is 30 kOhm.

→ The connection must be made using an intrinsically safe circuit!

#### 13.4.3 Frequency converter operation

→ Converter type: Pulse-width modulation

→ Min./max. frequency during continuous duty:

– Asynchronous motors: 30 Hz up to rated frequency (50 Hz or 60 Hz)

– Permanent magnet motors: 30 Hz up to the stated maximum frequency as per rating plate

**NOTICE! The maximum frequency may be below 50 Hz!**

- Comply with the minimum flow velocity!
- Min. switching frequency: 4 kHz
- Max. overvoltage at the terminal board: 1350 V
- Output current at the frequency converter: max. 1.5 times rated current
- Max. overload time: 60 s
- Torque applications: quadratic pump curve or automatic energy optimisation procedure (e.g. VVC+)  
Required speed/torque curves are available on request!
- Observe additional measures with regard to EMC regulations (choice of frequency converter, filters, etc.).
- Do not exceed the rated current or rated speed of the motor.
- It must be possible to connect the motor's own temperature monitoring (bimetallic strip or PTC sensor).
- If the temperature class is marked as T4/T3, temperature class T3 applies.

### 13.5 Commissioning



#### DANGER

##### Risk of explosion when using non Ex-rated pumps!

Pumps without Ex rating may not be used in potentially explosive areas! There is a risk of fatal injury due to explosion! Only use pumps which have the appropriate Ex labelling on the rating plate within potentially explosive areas.



#### DANGER

##### Risk of explosion due to flying sparks in the hydraulics!

During operation the hydraulics must be flooded (completely filled with the fluid). If the volume flow is interrupted or the hydraulics emerges, air cushions can form in the hydraulics. If this happens, there is a risk of explosion, e.g. flying sparks due to static charge! Dry-running protection must ensure that the pump is deactivated at the appropriate level.



#### DANGER

##### There is a risk of explosion if dry-running protection is connected incorrectly!

If the pump is operated within an explosive atmosphere, the dry-running protection must have a separate signal transmitter (redundant protection of the level control). Pump deactivation must be performed with a manual reactivation lock!

- The operator is responsible for defining the potentially explosive area.
- Only pumps with corresponding Ex rating may be used within a potentially explosive area.
- Pumps with Ex rating must be labelled on the rating plate.
- Do not exceed the **maximum fluid temperature!**
- Dry running of the pump must be prevented! Ensure on-site (dry-running protection) that emerging of the hydraulics is prevented.  
According to DIN EN 50495, a safety device with SIL level 1 and hardware fault tolerance 0 must be provided for category 2.

### 13.6 Maintenance and repair

- Carry out maintenance tasks according to the regulations.
- Only carry out maintenance tasks described in these installation and operating instructions.
- The spark-proof gaps must **only** be repaired according to the manufacturer's design specifications. Carrying out repairs according to the values in tables 1 and 2 of DIN EN 60079-1 is **not** permitted.
- Only use screws as stipulated by the manufacturer, which at a minimum correspond to a strength class of 600 N/mm<sup>2</sup> (38.85 long tons-force/inch<sup>2</sup>).

#### 13.6.1 Repair of housing coating

The paint layer can become electrostatically charged in case of thicker coats. **DANGER! Risk of explosion! In explosive atmospheres, a discharge can cause an explosion!**

If the housing coating has to be repaired, the maximum coat thickness is 2 mm (0.08 in)!

### 13.6.2 Changing the mechanical seal

Changing the seal on the fluid and motor side is strictly prohibited!

### 13.6.3 Replacing the connection cable

Changing the connection cable is strictly prohibited!

## 14 Appendix

### 14.1 Tightening torques

| Rust-free screws A2/A4 |                   |       |       |
|------------------------|-------------------|-------|-------|
| Threaded               | Tightening torque |       |       |
|                        | Nm                | kp m  | ft·lb |
| M5                     | 5.5               | 0.56  | 4     |
| M6                     | 7.5               | 0.76  | 5.5   |
| M8                     | 18.5              | 1.89  | 13.5  |
| M10                    | 37                | 3.77  | 27.5  |
| M12                    | 57                | 5.81  | 42    |
| M16                    | 135               | 13.77 | 100   |
| M20                    | 230               | 23.45 | 170   |
| M24                    | 285               | 29.06 | 210   |
| M27                    | 415               | 42.31 | 306   |
| M30                    | 565               | 57.61 | 417   |

| Geomet-coated screws (strength 10.9) with Nord-Lock washer |                   |       |       |
|--|-------------------|-------|-------|
| Threaded   | Tightening torque |       |       |
|  | Nm                | kp m  | ft·lb |
| M5   | 9.2               | 0.94  | 6.8   |
| M6   | 15                | 1.53  | 11    |
| M8   | 36.8              | 3.75  | 27.1  |
| M10  | 73.6              | 7.51  | 54.3  |
| M12  | 126.5             | 12.90 | 93.3  |
| M16  | 155               | 15.81 | 114.3 |
| M20  | 265               | 27.02 | 195.5 |

### 14.2 Frequency converter operation

The motor in series design (confirming to IEC 60034-17) can be operated with a frequency converter. Contact customer service if the rated voltage is over 415 V/50 Hz or 480 V/60 Hz. As a result of the additional heating caused by harmonics, the rated power of the motor must be around 10 % more than the power requirement of the pump. For frequency converters with a low-harmonic output, it may be possible to reduce the 10 % power reserve. Harmonic waves are reduced by means of output filters. The frequency converter and filter must be compatible.

The configuration of the frequency converter depends on the rated motor current. Make sure that the pump operates without jerking or vibration, specifically in the lower speed range. Otherwise, the mechanical seals may leak or be damaged. The flow rate in the pipe must also be observed. A low flow rate increases the risk of solids depositing in the pump and piping. A minimum flow rate of 0.7 m/s (2.3 ft/s) with a pumping pressure of 0.4 bar (6 psi) is recommended.

It is important that the pump operates across the entire control range without vibrations, resonance, oscillation or excessive noise. Increased motor noise caused by the harmonics of the power supply is normal.

During parameter configuration of the frequency converter, observe the setting of the quadratic characteristic curve (U/f curve) for pumps and fans! The U/f characteristic curve ensures that the output voltage at frequencies below the rated frequency (50 Hz or 60 Hz) is adjusted to the power requirement of the pump. More recent frequency



converters feature an automatic power optimisation function – this automation achieves the same effect. For the frequency converter setting, refer to its installation and operating instructions.

Motor monitoring faults may occur in motors operated with a frequency converter depending on the type used and the installation conditions. The following measures can help to reduce or avoid these faults:

- Keeping within the limit values stated in IEC 60034-25 for overvoltage and rise speed. Output filters may need to be installed.
- Vary the pulse frequency of the frequency converter.
- In the event of a fault in the internal sealing chamber control, use the external double-rod electrode.

The following construction measures can also help to reduce or prevent faults:

- Separate connection cables for the main and control cable (depending on the motor size).
- Keep an adequate distance between main and control cable during routing.
- Use shielded connection cables.

#### **Summary**

- Min./max. frequency during continuous duty:
  - Asynchronous motors: 30 Hz up to rated frequency (50 Hz or 60 Hz)
  - Permanent magnet motors: 30 Hz up to the stated maximum frequency as per rating plate

**NOTICE! The maximum frequency may be below 50 Hz!**

  - Comply with the minimum flow velocity!
- Observe additional measures with regard to EMC regulations (choice of frequency converter, using filters, etc.).
- Do not exceed the rated current or rated speed of the motor.
- It must be possible to connect the motor's own temperature monitoring (bimetallic strip or PTC sensor).



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