



INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

安装、操作和维护手册

SPI

Heavy Duty, Single Stage, Overhung,

API 610 Process Pump

重型，单级，悬垂，API 610 工艺泵



FOREWORD序言

These units are vertical process pumps of the overhung bearing bracket configuration and identified by Ruhrpumpen as SPI. 这些装置是配有悬挂轴承支架的立式工艺泵，鲁尔泵公司称之为 SPI。

It is recommended that the services of a Ruhrpumpen installation technician be employed for the installation and initial starting of the pump. Such service will help to ensure the user that the equipment is properly installed, and will provide an excellent opportunity for the plant operator to receive useful tips and guidelines relative to the unit. The tools and/or equipment referenced in this manual are not supplied by Ruhrpumpen unless specifically ordered. This pump design can be serviced with standard maintenance tools.

我们建议最好让鲁尔泵公司的技术人员对泵进行安装和启动。这有助于确保用户设备的正确安装，并且将为工厂操作员提供不错的机会去学一些有用的技巧和与设备有关的指导。除非特别订购，否则鲁尔泵公司不提供本手册中使用的工具或设备。该泵设计可使用标准维护工具进行维修。

Instructions in this manual are written for trained, experienced technicians who are familiar with the basic principles and tools involved in the installation, care and service of a pump and who, as part of their trade education have acquired the ability to interpret and follow the detailed specifications required for such installation, care, and service. Successful operation of the unit is dependent on careful study of the manual and a well-planned maintenance program.

本手册中的指导说明是写给训练有素，经验丰富，熟悉基本操作原则的技术人员的，手册中也包括相关的安装，对工具的修理，此部分作为他们行业教育的一部分，他们有能力理解并遵循安装，护理和维修的详细规范。该装置能否成功运行取决于是否对手册仔细研究和有无精心维护泵设备。

A complete reading of this manual by personnel in contact with the pump is essential to safety. Incorrect installation, operation or maintenance can result in personal injury or death to personnel and damage to the pump and plant.

对于接触泵的工作人员来说，一定要把本手册全文通读，这至关重要。错误的安装，操作或维护可能导致人身伤害或死亡以及对泵和工厂的损坏。

IMPORTANT: For any component/accessory that has not been manufactured by Ruhrpumpen and is part of the pump's equipment, a complete reading of said component/accessory manufacturer's manual must be carried out for further information on proper maintenance procedures and relevant safety warnings.

重要事项：对于任何非鲁尔泵公司制造的泵的设备的组件/附件，必须对所述组件/附件制造商手册进行完整的阅读，以获取有关正确维护步骤和相关安全警告的更多信息。

Correct and orderly installation/assembly is necessary for trouble-free operation of the unit. Ruhrpumpen does not assume any liability for damage resulting from inadequate installation/assembly. The chosen location for

installation must offer enough space for maintenance activities. Ruhrpumpen recommends consulting also API Recommended Practice 686 to ensure proper installation in your facility.

为了使设备无故障运行，需要正确有序的安装/组装。鲁尔泵对由于安装/组装不当造成的损坏不承担任何责任。所选择的安装位置必须为进行维护作业时提供足够的空间。

Before performing any service function be certain that the unit is separate from its power source or that the power source is locked out to prevent any form of energy from entering the equipment.

在执行任何服务功能之前，请确保设备与其电源分离，或者电源被锁定以防止任何形式的能量进入设备。

Contact with hot surfaces of the pump can cause severe burns. Care must be taken where such surfaces are exposed. Care must also be taken to prevent ignition of flammable fluids or other material.

与泵的热表面接触会导致严重烧伤。一定要小心这些暴露在外的表面。还必须小心防止易燃液体或其他材料着火。

Information in this manual is believed to be reliable, but it is not guaranteed by Ruhrpumpen as to its completeness or accuracy.

本手册中的信息相对可靠，但鲁尔泵公司不能保证其完整性和精确性。

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SECTION ONE - PRODUCT DESCRIPTION

第一部分-产品说明

These operating instructions contain important information about the installation, operation and service of the unit. It is therefore imperative that the installing engineer and the responsible specialist/operating personnel read and understand these operating instructions before installation and commencement of operation.

这些操作说明中包含有关本机的安装，操作和维修的重要信息。因此，在安装和开始运行之前，安装工程师和负责的专业人员/操作人员必须阅读并理解这些说明。

This manual must always be available in the operational area of the machine/plant.

本手册必须始终放在机器/设备的操作区域中使用。

IMPORTANT: For any component/accessory that has not been manufactured by Ruhrpumpen and is part of the pump's equipment, a complete reading of said component/accessory manufacturer's manual must be carried out for further information on proper maintenance procedures and relevant safety warnings.

重要事项：对于任何非鲁尔泵制造，为泵的设备的组件/附件，组件/附件制造商手册必须全文通读，以正确维护步骤和相明白关安全警告。

Correct and orderly installation/assembly is necessary for trouble-free operation of the unit. Ruhrpumpen does not assume any liability for damage resulting from inadequate installation/assembly. The chosen location for installation must offer enough space for maintenance activities. Ruhrpumpen recommends consulting also API Recommended Practice 686 to ensure proper installation in your facility.

为了使设备无故障运行，需要正确有序的安装/组装。鲁尔泵对于由安装/组装不当造成的损坏不承担任何责任。所选择的安装位置必须给维护活动提供足够的空间。鲁尔泵公司建议咨询 API 推荐操作规程 686，以确保在操作中正确安装。

Please contact a Ruhrpumpen representative should problems arise. The pump may only be opened by a Ruhrpumpen approved technician during the guarantee period.

如果出现问题，请联系鲁尔泵客服。在保修期间，泵只能由鲁尔泵认可的技术人员打开。

In case of queries, please have your project number and type designation of the pump available. You can find both of these on the first page of these operating instructions or on the rating plate fixed to the pump.

如有疑问，请提供泵的项目编号和型号名称。您可以在这些操作说明的第一页或在泵的铭牌上找到这两个信息。

When ordering spare parts we would further request that you give the description of the required parts, together with their part numbers and identity numbers. You can find these on the sectional drawing and spare part list enclosed.

订购备件时，我们会要求您提供所需零件及其零件号和本体号码的详细信息。您可以在附图中的剖面图和备件列表中找到这些。

1.1 INTRODUCTION 引言

Ruhrpumpen pumps of type SPI are vertically in-line, mounted over their own base, centrifugal pumps, with a vertically (radially) split case, centerline supported heavy-duty construction with an overhung impeller, and are designed to meet the requirements of the latest Edition of API 610. These pumps are designed for continuous duty pumping of various fluids with combinations of metallurgical, mechanical, and installation features for application in petroleum, petrochemical, water, and industrial product service.

SPI 型鲁尔泵公司的泵设备是垂直直列式的，安装在其底座上，离心泵，带有垂直(径向)分开的外壳，中心线支撑的重型结构，带有悬垂叶轮，此设计满足 API 610 最新版本的要求。这些泵用于各种流体的连续工作泵送，具有冶金、机械和安装特征的组合，用于石油、石化、水和工业产品服务。

The SPI is a single stage, single suction pump. For these pumps, rotation is clockwise as viewed from the driver (coupling) end.

SPI 是单级单吸泵。这些泵，从驱动器(联轴器)端看，其旋转是顺时针方向。

The following information is included in the nameplate of your pump unit:

泵的铭牌中包含了以下信息：

- Serial number 序列号
- RPM 转速
- Head 扬程
- Capacity 容量
- Impeller trim diameter 叶轮修整直径
- Number of bearings (radial and thrust) 轴承数量(径向和推力)

Please quote the pump serial number when ordering parts; the information in the nameplate is relevant in some sections of this manual to ensure safety operation of this pump.

订购零件时，请报泵序列号；铭牌上的信息与本手册的某些章节相关，以确保该泵的安全运行。

1.2 PUMP CASE, IMPELLER, AND WEAR RINGS 泵壳，叶轮和磨损环

1.2.1 Pump Case 泵壳

The pump case is supported on its own base. Case-to-cover fit is machined to receive a confined, controlled compression spiral wound gasket. The case is divided radially. This allows the disassembly of the rotating parts in direction of the driver while the casing and piping stay connected to the piping network.

泵壳立在自己的底座上。外壳到盖子被加工成可以容纳一个有限的、受控的压缩螺旋缠绕垫圈。这个壳子是径向分开的。这允许在套管和管道连接到管网的同时，沿驱动器方向拆卸旋转零件。

1.2.2 Impeller and Wear Rings 叶轮和磨损环

The impeller is dynamically balanced. The balancing is either single or two-plane, to meet the requirements of API 610. It is keyed to the shaft, locked with an impeller nut, and set screw. Replaceable front and back wear rings are standard.

叶轮是动态平衡的。平衡是单平面或双平面的，以满足API 610的要求。它固定在轴上，用叶轮螺母和定位螺钉锁定。可更换的前磨损环和后磨损环都是标准的。

1.3 SEAL CHAMBER 密封

The seal chamber is designed to accept a wide variety of single or double mechanical seals and to comply with API 610 dimensional requirements.

密封装置被设计成接受各种各样的单或双机械密封，并符合API 610的尺寸要求。

1.4 BEARING HOUSING 轴承底座

The bearing housing is designed to handle oil mist lubrication and grease lubrication. It encloses the two axial bearings and the thrust bearing. The bearing bracket, closed at each end by a cover and labyrinth seal, is cast with fins for air cooling but fan cooling is available.

轴承支架也用作油润滑的大容器，包含两个滚珠式角接触推力和深沟滚珠径向轴承。轴承支架两端由盖和唇形密封或迷宫式密封封闭，铸造有散热片，用于空气冷却，但可选择水冷。

When pure oil mist is specified, appropriate connections will be identified on the bearing housing. See SECTION SIX - LUBRICATION for more details.

当用指定纯油雾时，轴承箱上会标明出适当的连接。详见第六节-润滑。

The fan is located at the outboard side, and is guarded by a cover retained over the bearing bracket by self-tapping machine screws.

风扇位于外侧，由自紧螺钉固定在轴承支架上的盖子用来保护。

SECTION TWO - SAFETY

第二部分-安全

This operation manual gives basic instructions that should be observed during installation, operation and maintenance of the pump. It is therefore imperative that this manual be read by the responsible personnel/operator prior to assembly and commissioning. It must always be kept available at the installation site. Not only are the general safety instructions contained under this SECTION TWO - SAFETY that must be observed but also the specific information provided in other sections.

本操作手册提供了在泵的安装，操作和维护期间应遵守的基本说明指导。因此，在组装和调试之前，责任人员/操作人员必须阅读本手册。手册必须始终放在安装间。不仅要遵守本第二章- 安全条款下的一般安全说明，而且还需要参考其他部分提供的具体信息。

2.1 IDENTIFICATION OF SAFETY INSTRUCTIONS IN THE OPERATING MANUAL

操作手册中的安全说明识别

Safety instructions given in this manual whose non-compliance would affect personal and equipment safety are identified by the following symbol.

如果违反本手册中提到的安全指令，将会影响人员和设备安全，现安全符号由以下符号标明。



Where electrical safety is involved, the following symbol is shown.

涉及电气安全处，则使用以下符号。



The **ATTENTION** symbol is inserted in safety instructions whenever non-compliance might endanger the machine or its function.

违反嵌入“注意”标志的安全说明可能给机器或其功能带来危险。

It is imperative that signs affixed to the machine are observed and kept legible, for example:

必须遵守贴在机器上的安全标志并使之保持清晰，例如：

- arrow indicating the direction of rotation 箭头所示为旋转方向
- symbols indicating fluid connections 表示流体连接的标志

2.2 QUALIFICATION AND TRAINING OF OPERATING PERSONNEL 操作人员资格和培训

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified. The responsibilities and supervision of the personnel must be exactly defined by the plant operator. If the staff does not have the necessary knowledge, they must be trained and instructed. Training may be performed by a Ruhrpumpen representative on behalf of the plant operator. Moreover, the plant operator is to make sure that the contents of the operating manual are fully understood by the personnel.

负责操作，维护，检查和装配的人员必须具有足够的能力。工厂管理者必须明确人员的职责并行使监督。如果工作人员没有所需的知识，必须对其进行培训和指导。培训可以由鲁尔泵公司的代表人代替工厂管理者主持。此外，工厂管理者应确保人员充分理解操作手册的内容。

2.3 HAZARDS IN THE EVENT OF NON-COMPLIANCE WITH THE SAFETY INSTRUCTIONS 不遵守安全说明指示的危险

Non-compliance with the safety instructions may produce a risk to the personnel as well as to the environment and the unit and results in loss of any right to claim damages.

不遵守安全说明可能对人员以及环境和设备造成危险，并导致丧失索赔权利。

Non-compliance may involve the following hazards:违反条例可能涉及以下危险：



- Risk of injury or death.有受伤或致死的风险
- Failure of important functions of the machine/plant导致机器/设备的重要功能的失灵
- Exposure of people to electrical, mechanical, chemical, and thermal hazards
人暴露于电气，机械，化学和热危害所遭受危险
- Endangering or damaging the environment due to hazardous substances being released.
由于有害物质释放而危及环境。

2.4 COMPLIANCE WITH REGULATIONS PERTAINING TO SAFETY AT WORK

遵守安全工作条例

When operating the pump, the safety instructions contained in this manual, the relevant national accident prevention regulations, local and federal health and safety regulations, quality system requirements, and any other service and safety instructions issued by the plant operator must be observed.

操作泵时，必须遵守本手册中包含的安全说明、相关的国家事故预防法规、地方和联邦健康和安

规、质量体系的要求以及工厂操作员发布的所有其他服务和安全说明。

2.5 SAFETY INSTRUCTIONS RELEVANT FOR OPERATION 与操作相关的安全说明



- If hot or cold machine components involve hazards, they must be guarded against accidental contact (attach warning signs).



- 如果冷热机组件涉及危险，则必须防止人员意外接触（附上警告标志）。



- Guards for moving parts (e.g. coupling) must not be removed from the machine while in operation (mounting must be possible only with tools).
- 移动部件（例如联轴器）的护罩在操作时不能从机器上移除（只能使用工具进行安装）



- Any leakage of hazardous fluids must be drained away to prevent any risk to persons or the environment. Statutory regulations are to be complied with.
任何危险流体发生泄漏必须排出，以防止对人员或环境造成任何风险。必须遵守法规。

- Hazards resulting from electricity must be prevented.
必需防止电力产生的危害。

2.6 SAFETY INSTRUCTIONS RELEVANT FOR MAINTENANCE, INSPECTION AND ASSEMBLY WORK

维护，检查和组装工作相关的安全说明

It is the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is performed by authorized and qualified personnel who have adequately familiarized themselves with the subject in matter by studying this manual in detail.

工厂管理者有责任确保所有维护，检查和组装工作由熟练掌握事宜的合格的授权人员执行。这些人员必须通过详细阅读本手册来熟悉工作。

Any work on the machine shall only be performed when it is at a standstill. To shut off the machine it is imperative to follow the procedure for shutting down the machine as described in SECTION 7.4 - STOPPING.

机器上的任何工作只能在关机状态下进行。要关闭机器，必须按照第7.5节“停止”中所述关闭机器的步骤。

Pumps and pump units that convey hazardous materials must be decontaminated before any maintenance work is performed.

在进行任何维护工作之前，必须对运输危险材料的泵和泵单元进行净化。

On completion of work all safety and protective facilities must be re-installed and made operative again.

完成工作后，所有安全和防护设施必须重新安装再投入新的使用。

Prior to restarting the machine, follow the instructions listed under SECTION 7.2 - STARTUP.

在重新启动机器之前，请遵循第7.2节“启动”中列出的指令。

2.7 UNAUTHORIZED ALTERATIONS AND SPARE PARTS 未经授权的变更和备件

Modifications may be made to the machine only after consultation with a Ruhrpumpen representative.

只有在与鲁尔泵工作人员协商讨论后才能对机器进行改装。

Using spare parts and accessories authorized by Ruhrpumpen is in the interest of safety. The use of parts not authorized by the dealer exempt the manufacturer from any liability, voiding the warranty.

使用鲁尔泵授权的备件和附件是为了安全起见。使用未经经销商授权的零件所带来的危险伤害，制造商的不负任何责任，且保修失效。

2.8 UNAUTHORIZED MODES OF OPERATION 未经授权的操作模式

The reliability of the machine is guaranteed if and only if it is used in the intended manner, in accordance with the statutes of this manual. The limit values specified in the data sheet must never be exceeded under any circumstance.

根据本手册的规定，当且仅当按预期方式使用机器时，才能保证机器的可靠性。在任何情况下都不得超过数据表中指定的极限值。

SECTION THREE - TRANSPORT & STORAGE

第三部分-运输与储存

3.1 SHIPPING ARRANGEMENTS 运输安排



The pump, couple, driver support, and driver are generally shipped in a wooden skid furnished for support and ease of transportation. Other required items (spare parts, for example) are boxed or secured to the skid.

泵、联轴器、司机支架和司机通常用木制撬装设备装运，以便于运输。其他需要的物品(例如备件)被装箱或固定在滑轨上。

3.2 UNLOADING AND CHECKING EQUIPMENT 卸载和检查设备

NOTE: The information portrayed in this section is intended as a general guideline. For further information refer to the corresponding section in API Recommended Practices 686.

注意：本节中描述的信息旨在作为一般准则。

The following steps should be completed for all pumps when received. 所有泵在收货时应完成以下步骤。

1. Handle all equipment carefully. 小心处理所有设备。
2. Remove unit only by properly supporting the wooden shipping skid. 只有正确地使用支撑木质运输滑板才能移除装置。
3. After unloading, inspect the pump, check the shipment against the packing list, and report damages or shortages immediately to freight carrier and to the designated Ruhrpumpen representative. 卸载后，检查泵，根据装箱单检查装运，并立即向货运公司和指定的鲁尔泵公司的代表报告损坏或短缺。



Do not use the eyebolt at the side of pump and bearing housing to lift unit.

不要在轴承框架周围或基板下放置升降架。不要使用泵顶部的眼螺栓和轴承框架来提升装置。

3.3 TRANSPORT 运输



- To avoid damage, the unit must be transported and handled with care. It should be gently lowered onto an even surface. Pay attention to and identify the signs marking the points of equilibrium and fastening places for ropes, or the openings for forklift trucks.



为了避免损坏，必须小心运输和处理设备。必须轻手轻脚地把机器降到平坦的表面上。注意标记平衡点和紧固位置的绳索或叉车开口的标志的位置。



- Observe the plant's safety precautions when lifting heavy components.

提起重型部件时，请遵守工厂的安全注意事项。



- When transporting with a crane, the rope should be slung as shown below in Figure 3.1

提起重型部件时，请遵守工厂的安全注意事项。

- The rope should not be slung around the lugs attached to the motor or around the lugs attached to the pump.

不应将绳索甩在连接在电机上的接线片周围或连接在泵上的接线片周围。

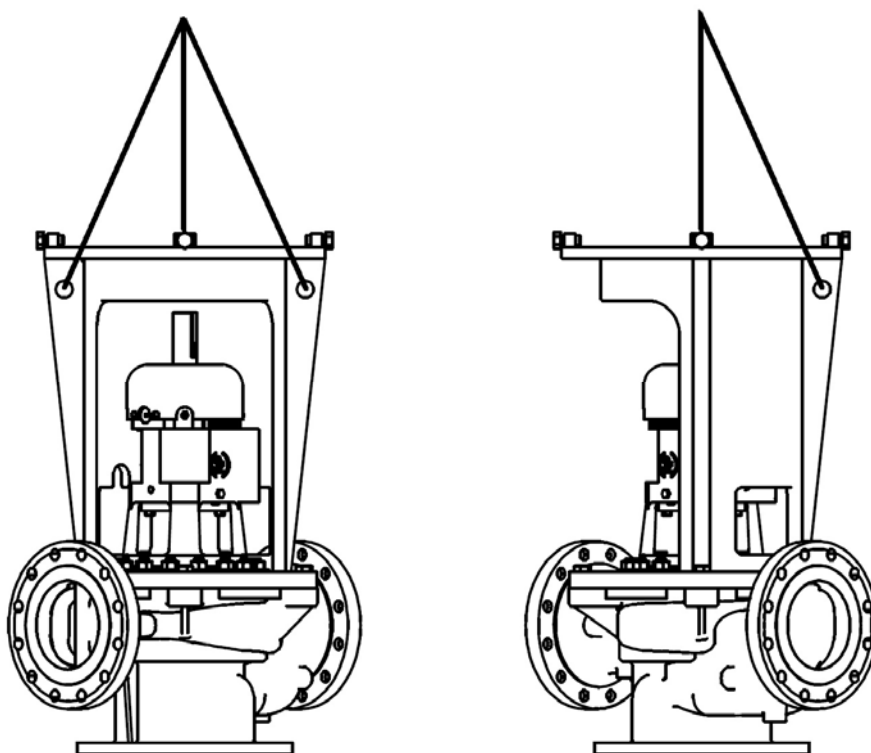


Figure 3.1 Correct Position of the lifting ropes or chains.图3.1提升绳索或链条的正确位置。

3.4 STORING 储存

If the pump is not installed immediately (within one month after shipping date), it should be safely stored prior to installation in a dry location free of dirt and grit. Furthermore, the pump unit (pump, driver, etc.) should not be subject to sudden temperature changes or vibrations.

如果泵没有立即安装（在发货日期后的一个月内），则应在安装前将其安全储存在干燥的地方，不要有灰尘和沙砾。此外，不要让泵元件（泵，驱动器等）遭到突然的温度变化或振动。

Observe the following steps: 请遵守以下步骤

1. Remove pump from shipping crate, but do not damage the crate because the unit is to be reboxed.

从运输箱中取出泵时，不用担心损坏箱体，因为泵需要重新装箱的。

2. Remove all instruments and mechanical seal; store them safely.

拆卸所有仪器和机械密封，妥善保管。

3. Plug the instrument taps.

拔去仪器的塞子。

4. Thoroughly dry the pump with hot air.

用热空气彻底干燥泵。

5. Any painted surface damaged in shipment should be repainted or sprayed with oil.

在运输中损坏的任何油漆表面应重新涂油或喷油。

6. Keep the pump moisture-free by the following two means:

通过以下两种方式保持泵无水分：

- a. Spray the pump case and bearing housing with acid-free, moisture-free, protective oil or kerosene.

用无酸，无水，保护油或煤油喷洒泵壳。

- b. Place desiccant or humidor bags inside the suction and discharge areas of the pump.

在泵的吸入和排出区域内放置干燥剂或湿气袋。



- Attach red tags with a “Remove Moisture Absorbent Material Bags Prior to Installing” to warn about the presence of this desiccant material.
- 在红色标签贴上“在安装前移除吸湿材料袋”这类文字，警告存在此干燥剂材料。

7. Cover all the openings with plywood or metal covers. Recheck the condition of these covers every month and replace as necessary.

用胶合板或金属盖覆盖所有开口。每月重新检查这些封面的状况，并根据需要更换。

8. If the pump's external parts have protective coatings, periodically inspect and renew the coating as required.

如果泵的外部部件具有保护涂层，请根据需要定期检查和更新涂层。

9. Rotate the shaft 1 ¼ revolutions every week. Lubricate shaft bearings prior to rotation.

每周旋转轴 1 ¼ 转。在旋转之前润滑轴承。



- The client must keep a record of the weekly rotation of the shaft. Failure to document and present these records as evidence will void the warranty.
- 用户必须记录轴的每周旋转。未能将这些记录记录在案，那么将导致保修失效。

10. Check the packaging for damage every month. 每月检查包装是否有损坏。

11. Ensure pump flange covers remain in place. 确保泵法兰盖保持在适当位置。

12. Return the unit to the shipping crate. 将货物放回集装箱。

13. When the pump is to be installed, remove all the protective coatings and desiccant or drain all oils.

当安装泵时，将所有保护涂层和干燥剂除去或排空所有油。

One month before installation, a Ruhrpumpen representative should be employed to conduct a final inspection.

To properly store the motor (driver) for periods longer than one month, follow these steps:

安装前一个月，应该聘请一名鲁尔泵公司的工作人员进行最后检查。

1. Store the motor in a clean, dry area, or cover it with a loose tarp (the tarp must be loose in order to prevent condensation).

将电机放在干净，干燥的地方，或用松散的篷布盖住（防水布必须松动以防止冷凝）。

2. Exercise precautions to avoid transit or nesting of rodents, snakes, birds, and insects.

需要采取预防措施来避免啮齿动物，蛇，鸟和昆虫出现或筑巢。

3. Inspect and, if necessary, recoat the rust preventive coating of external machined surfaces.

如有必要，重新涂覆外部加工表面的防锈涂层。

4. Fill with lubricant the grease-lubricated cavities of the motor, but first remove the drain plug and fill the cavity until the grease starts to purge.

润滑油填充润滑脂电机的润滑脂腔，但在此之前要先卸下排油塞并填充空腔，直到润滑脂开始清洗。

ATTENTION

- Follow the instruction manual of the driver manufacturer to ensure the lubrication is performed properly.
- 按照驱动制造商的使用说明书操作，确保正确使用润滑。

5. Upon receipt, considering that the oil-lubricated drivers are not shipped oil-filled, fill the reservoir to maximum level with properly selected oil with rust and corrosion inhibitors.

收到货后，考虑到油润滑的驱动器未装满油，请选用适当的含锈和腐蚀抑制剂的油，将油箱填充到最大液位。

ATTENTION

- Always drain the oil before moving the pump, to avoid any damages, and refill the motor on its new location.
- 在移动泵之前，请务必排出油，以避免任何损坏，并将电机重新装入其新位置。

6. Rotate the shaft of the motor once a month. 每月转动一次电机轴。
7. Some form of heating must be used to prevent condensation. This heating should maintain the winding temperature at a minimum of 9 °F (5 °C) above the surrounding ambient temperature. There are three options:

必须采用一定的加热形式来防止冷凝。该加热应保持绕组温度至少高于周围环境温度 9° F (5° C)。有三个选项：

If space heaters are supplied, they should be energized. 如果有空间加热器，则应接通它们。

If none is available, single phase or “trickle” heating may be utilized by energizing one phase of the motor’s windings with a low voltage, producing heat in the winding conductor.

如果没有可用的电源，可以通过用低电压激励电动机绕组的一相来利用单相或“涓流”加热，从而在绕组导体中产生热量。

ATTENTION

- Request the required voltage and transformer capacity from the driver manufacturer.
- 询问驱动器制造商所需的电压和变压器容量。

- o A third option is to use an auxiliary heat source and keep the windings warm by either convection or blowing warm dry air into the motor.
- o 第三种选择是使用辅助热源，并通过对流或将暖风干燥的空气吹入电机来保持绕组温度。

ATTENTION

- Be careful not to overheat, since keeping the temperature of the motor frame 9 °F (5 °C) above the surrounding ambient temperature is sufficient.
- 注意不要过热，只要将电机架的温度保持在 9° F (5° C) 以上，高于周围环境温度就足够了。

After the storing period, follow the next steps as start-up preparations:

经过储存期后，按照下列步骤作为启动准备工作：

1. Motor should be thoroughly inspected and cleaned to restore to an “As Shipped” condition.
电机应进行彻底的检查和清理，以恢复到“发货”前的状态。
2. Motors, which have been subjected to vibration, must be disassembled and each bearing inspected for damage.
已经受到振动的电机必须拆卸，并检查每个轴承是否损坏。
3. Oil and/or grease must be completely changed using lubricants and methods recommended on the motor's lubrication plate, in the “LUBRICATION” section of the driver manufacturer's manual.
在驱动器制造商手册的“润滑”部分，建议使用润滑剂和电机润滑板上推荐的方法彻底更换油和/或润滑脂。
4. If storage has exceeded one year, the motor manufacturer's Quality Assurance Department must be contacted prior to equipment start-up for any special recommendations.
如果存储已超过一年，必须在设备启动前联系电机制造商的质保部门以获得专业建议。

3.5 CONSERVATION 保存

All exposed, machined, working surfaces (flanges, seals, surfaces supporting the motor), shaft ends, unpainted couplings and the like have been cleaned and treated with anticorrosive agents. After being cleaned, all parts inside the pump housing have been sprayed with anticorrosive agents.

所有暴露的，加工的工作表面（法兰，密封件，支撑电机的表面），轴端，未上漆的联轴器等都已经用防腐剂进行清洁和处理。清洁后，泵壳内的所有部件均已喷涂防锈剂。

The period of protection offered by these conservation measures is approximately 18 months if stored in a dry place. If stored under unfavorable climatic conditions, this protective period may be considerably reduced. Should the anticorrosive layer become damaged, it can be repaired by repainting or respraying.

如果储存在干燥处，保存措施的保护期约为18个月。如果在不利的气候条件下储存，则该保护期可能会大大降低。如果防腐层被破坏，可以通过重新涂漆或重新涂覆来修复。



- Anticorrosive layers inside the pump housing must be removed with process neutral solvents before commencing pump operation.
- 在开启泵运行之前，泵壳内的防腐层必须用加工中性溶剂除去。



- When removing the protective coating with a neutral solvent, follow the safety instructions of the solvent manufacturer carefully.
- 用中性溶剂去除保护涂层时，请仔细按照溶剂制造商的安全说明进行操作。

-
- The anticorrosive layer applied to the exposed parts does not need to be removed before putting the pump into operation.
 - 在将泵投入运行之前，不需要去除暴露部件的防锈层。

ATTENTION

SECTION FOUR - INSTALLATION

第四部分-安装

Correct and orderly installation/assembly is necessary for trouble-free operation of the unit. Ruhrpumpen does not assume any liability for damage resulting from inadequate installation/assembly. The chosen location for installation must offer enough space for maintenance activities. Consult also API Recommended Practice 686 to ensure proper installation in your facility.

为了使设备无故障运行，需要正确有序的安装/组装。鲁尔泵对由于安装/组装不当造成的损坏不承担任何责任。所选择的安装位置必须为维护活动提供足够的空间。

4.1 CONCRETE FOUNDATION PREPARATION 混凝土底座准备

NOTE: The information in this section is intended as a general guideline. For further information refer to the corresponding section in API Recommended Practices 686.

注意：这部分的信息为一般准则。

IMPORTANT: The design of foundations is not the responsibility of Ruhrpumpen. It is therefore recommended that the customer consult a competent specialist skilled in the field of foundations, to insure proper design/installation of the foundation.

重要提示：底座设计不属于鲁尔泵的责任。因此，建议客户咨询对底座领域有能力的专业技术人员，以确保底座的正确设计/安装。

Before mounting the unit over the well-established foundation, follow these steps:

在将装置安装在牢固的基底上之前，请遵循以下步骤：

- Make sure the surface is completely clean. 确保设备表面非常干净。
- Clean the bolting holes. 清洁螺栓孔。
- Check that the foundation holes and the bolting holes correspond to the assembly plan.

检查基座孔和螺栓孔是否符合装配计划。

1. Choose a solid ground location for foundation; check that the bearing capacity of the soil is at least one third higher than both static and dynamic loads together.

为底座选择坚固的地面位置；检查土壤的承载力是否比静态和动态载荷一起高三分之一以上。

2. The effects of vibrating equipment on the surrounding area should be investigated and the isolation required for the foundation should be considered. It is important to consider that the driver and the driven machinery must be supported from a common foundation.

应调查振动设备对周边地区的影响，并考虑底座所需的隔离。重要的是要考虑驱动和从动

机

械必须从共同的底座上得到支撑。

ATTENTION

- A minimum compressive strength of 4061 psi (28 MPa) for the concrete is to be reached after 30 days. Check with your supplier the strength and time of setting.
- 30天后，混凝土的最小抗压强度将达到4061 psi (28 MPa)。与您的供应商核实设置的强度和时间。

ATTENTION

- All foundation materials shall be selected to prevent deterioration due to exposure to an aggressive environment; the use of a protective coating should be considered.
- 所有被选的底座材料，为防止因暴露于侵蚀性环境而导致变质；应考虑使用保护涂层。

ATTENTION

- The mass of the concrete foundation should be five (5) to ten (10) times the mass of the supported equipment.
- 混凝土底座的质量应为支撑设备质量的五（5）至十（10）倍。

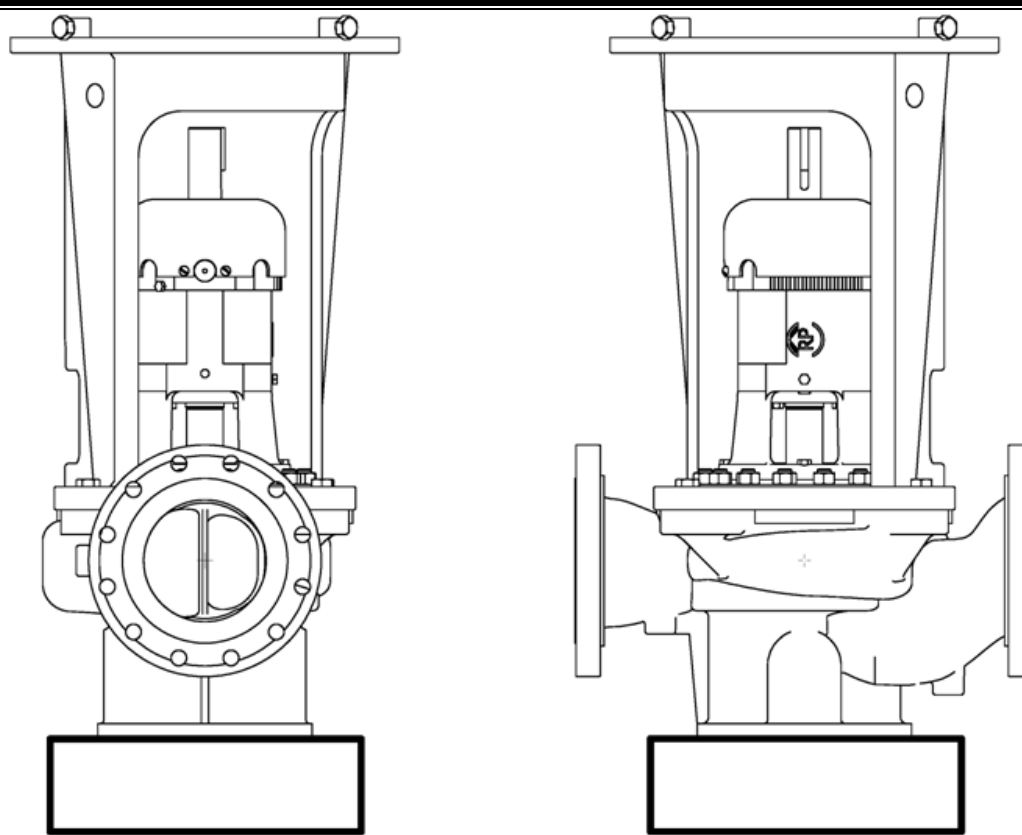


Figure 4.1 Foundation illustration.图4.1基础图示。

3. Since water can accidentally flow in the floor, a height for the surface of the foundation of 4 inches (100 mm) at least above floor level is recommended.

为防止水可能意外流入地板，因此建议底座表面的高度至少设在地面以上4英寸（100毫米）。

4. Use a template to accurately locate foundation bolts according to the General Arrangement.

使用模板，根据“总纲安排”精确定位底座螺栓。

- 4.1. Choose foundation bolts of size specified in drawing (ASTM A36, M 1020 and ASTM A575 are recommended), they should be long enough to allow a minimum of two threads above the nuts.

在图纸尺寸上选的基础螺栓（推荐型号ASTM A36，M 1020和ASTM A575）；它们的长度应该长到螺母上方至少留有有两根螺纹的距离。

5. Provide pipe enclosures for the bolts, which are three or four diameters larger than the bolts.

为螺栓提供三个或四个直径大于螺栓的管道外壳。

6. Protect area around the bolts from contact with the concrete.

保护螺栓周围的区域避免与混凝土接触。

7. Pour the concrete and provide a chamfer at all corners.

浇注混凝土，并在各个角落留有小槽。

8. Allow concrete to cure completely (at least seven days) before preparing the surface for grout preparation.

在准备表面进行灌浆之前，要让混凝土完全固化（至少7天）。

4.2 LEVELING THE BASEPLATE 调平基座

NOTE: The information included in this section is intended as a general guideline. For further information refer to the corresponding section in API Recommended Practices 686.

注:本节包含的信息旨在作为一般指南。欲知详情，请参阅API推荐做法686中的相应章节。

Before leveling the unit onto the foundation, the following preparations must be made:

在将设备移到基座之前，必须做好以下准备工作：

1. Chip away all damaged concrete with a hammer and chisel, eliminating about one inch of the surface of the foundation. After surface chipping is done, the foundation shall be thoroughly cleaned free of debris. Clean the anchor holes.

用锤子和凿子切掉所有受损的混凝土，消掉底座表面的大约一英寸的厚度。表面工作完成后，彻底清洁底座，无碎屑残留。清理锚孔。

2. Check that the placement and dimensions of the foundation and the anchor holes correspond to the assembly plan.

检查底座和锚孔的位置和尺寸是否符合装配计划中的尺寸。

The foundation must be kept free of all contamination after it has been prepared for grouting.

在准备灌浆后，必须让底座一尘不染。

The pump and its base are placed in the foundation, with the bolts placed over and aligned in height and within the correct dimensions of the assembly.

泵及其底座置于底座上，螺栓的放置需在组件的正确尺寸范围内，高度要与之对齐。

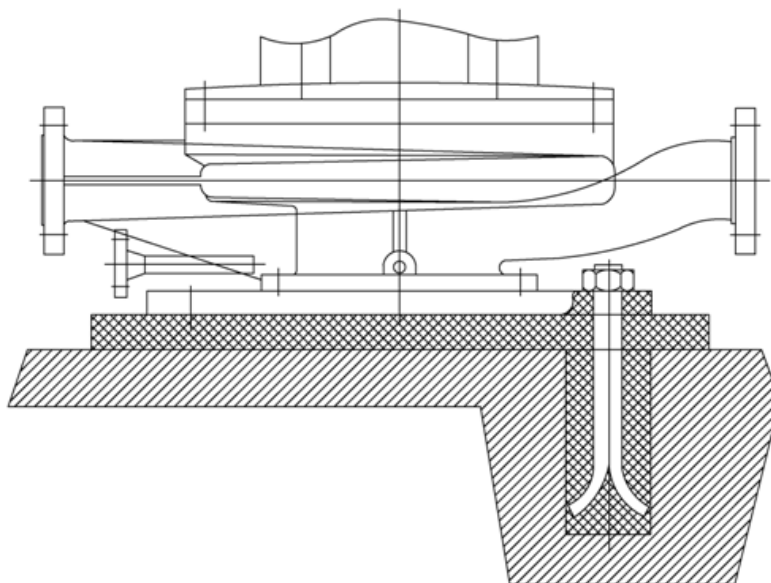


Figure 4.2 Foundation bolting for leveling (the image is not scaled, for illustrative purpose only).

图4.2调平用基础螺栓连接(图像未缩放, 仅用于说明)。

The deviation from the horizontal plane should not exceed ± 0.3 mm per meter. After aligning the bolts, they have to be grouted with grout without cavities. When the grout has hardened, the required height and flange alignment are checked and adjusted. The base of the pump is then fixed with a low contraction sealant. Once hardened, the bolts must be fastened.

距水平面的偏差不应超过 ± 0.3 毫米每米。对准螺栓后, 必须用无空腔的水泥浆将螺栓接地。在灌浆硬化后, 检查并调整所需的高度使之与法兰对齐。然后用低收缩密封剂固定泵的底部。一旦硬化后, 螺栓必须紧固。

ATTENTION

- The alignment of the baseplate is performed only with the help of adjusting screws. Wedges may not be used for this purpose.

ATTENTION

- 基板的对准仅在调节螺钉的帮助下进行。楔形物不得用于此目的。

ATTENTION

- NOTE: The baseplate should be mounted without distortion.
- 注:安装基板时, 不能使之变形。

3. When the baseplate is leveled, 'snug' the foundation bolt nuts, but do not tighten completely.

当底板放置水平时, “紧贴”地脚螺栓螺母, 但不要完全拧紧。

4.3 GROUTING*灌浆*

NOTE: The information included in this section is intended as a general guideline. For further information refer to the corresponding section in API Recommended Practices 686.

注:本节包含的信息旨在作为一般指南。有关更多信息,请参阅API推荐做法686中的相应章节。

IMPORTANT: It is recommended that the customer consult a competent specialist skilled in the field of grouting to insure proper installation of all grouting.

重要事项: 建议客户咨询专业的灌浆专业技术人员, 以确保正确的灌浆操作。

4.3.1 Equipment/Material Required 所需设备/材料

- Grout Mix: Non Shrink Type混合型灌浆: 无收缩型
- Sufficient lumber for foundation template and grout trough.基础模板和灌浆槽由足够的木材搭造。
- Risers or funnels for guiding grout.用于引导灌浆的立管或漏斗。
- Sufficient oil paint for grout protective covering.灌浆层上有足够的油漆来保护。

4.3.2 Grouting Precautions 灌浆注意事项

During all the grouting process, the involved personnel must follow these safety precautions:

在所有灌浆过程中, 有关人员必须遵守以下安全预防措施:

1. Wear goggles or face shields, aprons, and protective gloves at all times.

任何时候都戴护目镜或面罩, 工作裙和防护手套。

2. Wear dust masks if in contact with the dry aggregates.

与干燥骨料接触时, 请戴上防尘口罩。

3. Wash hands regularly with soap and water.

用肥皂和水定期洗手。



- Some epoxy grouts have highly exothermic reactive properties; they should be handled with care. They may become extremely hot and cause severe burns.
- 一些环氧树脂灌浆具有高放热反应性能; 需小心处理。 它们可能会非常烫, 还会引起严重烧伤。

4.3.3 Grouting Procedure 灌浆步骤

1. Verify that anchored bolt sleeves are clean and dry. Fill them with a nonbonding moldable material to prevent them from being grouted.

保证固定螺栓套筒干净，干燥。 可以用非接合的可模塑材料填充，以防止它们被灌浆。

2. The anchor bolt threads should be protected with tape before grouting.

灌浆前，使用胶带来保护锚栓螺栓避免也被灌浆。

3. Provide a form around the baseplate to contain the grout. The form should be chamfered at all corners.

在基板周围的放上格子以容纳灌浆。灌浆应该灌满格子。



- Grout forms should be attached with drilled anchors. Do not power nail.
- 表格应附有钻孔锚点。不要用力钉。



- Apply three coats of paste wax to the inside surfaces of the forms in order to prevent adherence. Do not use oil or liquid wax.
- 为了防止粘附，在表面的内表面涂上三层糊状蜡。不要使用油或液体蜡。



- Prevent grout leakage, as leaks will not self-seal.
- 防止水泥渗漏，因为泄漏不会自密封。

4. Apply the grout, starting at one end of the form and advancing toward the other end. The use of push tools to get rid of trapped air is allowed if done in long strokes.

涂抹水泥浆，从模板的一端开始，向另一端推进。如果是长行程的话，可以使用推压工具来排出滞留的空气。



- Do not vibrate or violently ram the grout (it may cause the aggregates to separate).
- 不要振动或猛烈地冲刷水泥浆（这可能导致骨料分离）。
- Do not plug any baseplate fill or vent holes until the grout has set to avoid baseplate distortion.
- 不要插入任何底板填充物或通风孔，除非灌浆已经设置好，不会让基板失真。

- Check with the supplier of the grout the preferred thickness for your installation.



- 检查与灌浆供应商建议的最佳安装厚度。

5. Tap baseplate to eliminate air pockets. 将底板打开以消除气袋。



- It is imperative to get rid of all trapped air before the grout hardens.
在灌浆硬化之前必须排出所有残留的空气。



- Check frequently for grout leaks.
经常检查灌浆是否泄漏。



- Leaks will not self-seal and may cause voids.
泄漏不会自封，可能导致空隙。

6. Remove jackscrews and grout-forms once the grout has completely hardened (takes around 3 days).

一旦浆液完全硬化(大约需要3天)，移除螺旋千斤顶和浆液模板。

7. Do not use grout to fill the jackscrew's holes; use a sealant material instead.

不要用水泥浆填充螺旋千斤顶的孔；用密封剂材料。

8. Tighten the foundation bolts with an appropriate torque value. In case of doubt, please contact your Ruhrpumpen representative.

用适当的扭矩值拧紧地脚螺栓。如有疑问，请联系鲁尔泵公司代表人。

9. Apply oil paint to exposed grout to protect from air and moisture.

在暴露的水泥浆上涂上油漆，以防止空气和湿气。

10. Use a lifting rig to position the pump and driver on their baseplate so that the mounting feet line up with their respective tapped holes.

用起重器将泵和驱动器定位在底板上，使安装脚与各自的螺纹孔对齐。

11. Fasten the pump and driver hold down bolts, attach all auxiliary piping and wiring.

紧固泵和驱动器压紧螺栓，连接所有辅助管道和线路。



- NOTE: *If by client specification the pump is to be used in a service where grouting will not be possible, for example fire duty, it is responsibility of the customer to use a PIP baseplate. Otherwise, please note that baseplates are not

pre-grouted, therefore this grouting procedure shall be followed by the customer.

- 注意：*如果按照客户协议，泵将用于不能进行灌浆的服务，例如消防，客户有责任使用PIP底板。 否则，请注意，底板没有预灌浆，因此用户应该遵循该灌浆步骤。

SECTION FIVE - PIPING AND ALIGNMENT

第五部分-管道和校准



- These units are furnished for a specific service condition. Any change in the hydraulic system may affect the pump performance adversely.
- 这些单元是为特定的服务提供的。 液压系统的任何变化可能会对泵的性能产生不利影响。



- The connection of the piping must be carried out with utmost care; otherwise, the pumping medium can escape during operation, which can seriously endanger the operating personnel.
- 管道的连接必须非常小心；否则，泵送介质在运行过程中会溢出，严重危害操作人员。



- Do not start the piping and alignment procedures until grouting, preliminary alignment (as seen in the previous sections of this manual) and on site welding have been performed.
- 不要启动管道和校准程序，直到灌浆，初步对准（如本手册前面部分所述）和现场焊接完成。
- In a new installation, great care should be taken to prevent dirt, scale, welding beads, and other items from entering the pump. The suction system should be thoroughly flushed before installing the suction strainer and suction piping.

- 在新的安装中，应特别注意防止灰尘，污垢，焊珠等东西进入泵内部。在安装吸尘器和抽吸管道之前，要彻底冲洗抽吸系统。
- Suction and discharge piping should be of ample size, be installed in direct runs with minimum bends.
- 吸入和排出管道的尺寸应该适度，直接安装在最小弯头处。
- Short radius elbows shall be avoided near the suction nozzle. If an elbow is necessary, it should be of the long radius type.
- ATTENTION • 在吸嘴附近应避免使用较短的半径弯头。如果需要弯头，则应使用长半径型。
- ATTENTION • Suction and discharge piping configurations should be in accordance with the Hydraulic Institute Standards.
- 吸排管道配置应符合“水利研究标准”。
- ATTENTION • Suction and discharge piping, fittings, and valves must be adequately supported and anchored close to the pump flanges to eliminate strains imposed on the pump casing, prevent excessive nozzle loads, maintain pump/driver alignment, and avoid pipe-induced vibration.
- ATTENTION • 吸排管道，管件和阀门必须在泵法兰附近得到充分的支撑和锚固，以消除泵壳上的应变，防止过多的喷嘴负荷，保持泵/驱动器对齐，并避免管道振动

5.1 PIPING THE SYSTEM 管道系统

NOTE: The information included in this section is intended as a general guideline. For further information refer to the corresponding section in API Recommended Practices 686.

注:本节包含的信息旨在作为一般指南。有关详情，请参阅API推荐做法686中的相应章节。

IMPORTANT: The design of piping and related systems is not the responsibility of Ruhrpumpen. It is, therefore

recommended that the customer consult a competent specialist skilled in the field of piping to insure proper design/installation of all the piping.

重点:管道和相关系统的设计不是鲁尔本公司的责任。因此，建议客户咨询管道领域的专家，以确保所有管道的设计/安装正确。

1. Check whether the piping is loosely laid, so that no strain is placed on the pump.

检查管道是否铺设松动，以免在安装泵时产生应变。



- Piping layout and installation shall provide adequate maintenance and operation accessibility. Field installed auxiliary equipment shall not interfere with removal of the machine or driver.
- 工作人员对管道的布置和安装应该保证维修和下次操作时的可行性。现场安装的辅助设备不得干扰机器或驱动器的拆卸。

2. Remove the covers of the pump flanges. 拆掉法兰泵的盖子。

3. Check whether the seals are correctly mounted. 检查密封件是否正确安装。

4. Install a check valve and a gate valve in the discharge pipe. When the pump is stopped, the check valve will protect the pump against excessive back-flow pressure and will prevent the pump from running backward.

排出管中安装止回阀和闸阀。当泵停止时，止回阀将保护泵免受过大的回流压力，并且将防止泵向后运动。



- The check valve should be installed between the gate valve and discharge flange in order to permit its inspection.
- 止回阀应安装在闸阀和排放法兰之间，以便检查。

5. A spool piece should be installed in suction line so that the suction strainer may be installed and removed with a pressure gauge between the strainer and pump.

一个阀芯应安装在吸入管路中，以便可以用过滤器和泵之间的压力表安装和拆除吸入过滤器。

6. The suction strainer should be installed between 5 to 20 pipe diameters upstream from the suction flange.

吸入过滤器应安装在抽吸法兰上游 5 至 20 个管道直径之间。

7. Cone type strainers (otherwise known as “witch-hat” strainers) should be mounted as recommended within the Hydraulic Institute, with the cone pointing upstream away from the pump, into the oncoming flow. As the strainer gradually gathers particles from the liquid and blocks up, this direction will result in the lowest turbulence impact onto the liquid flow entering the pump.

应当使用液压过滤器，推荐安装锥形过滤器（也称为“女巫-帽子”过滤器），其中锥体指向上游远离泵，进入迎面而来的水流。当过滤器逐渐从液体中收集颗粒并堵塞时，该方向将迎来对进入泵的液体流的最低湍流冲击。

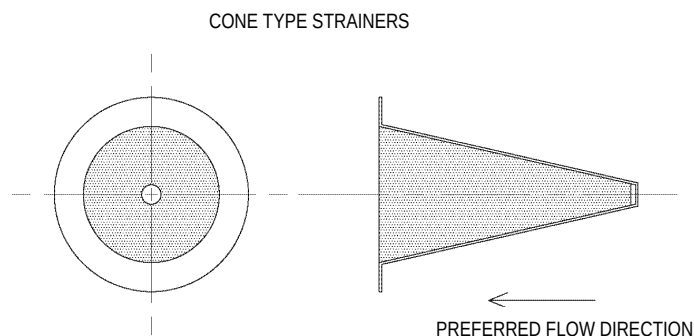


Figure 5.1. Correct position of the cone type strainers.

图 5.1 安装正确地锥形过滤器

8. Disconnect the piping from the pump if you heat one side of the pipe to align the pipe to the pump.

如果加热管道的一侧使管道与泵对准，则要断开管道与泵。

9. Pump and pipe flanges must be parallel; they should mate together without effort, and with the bolt holes properly in line.

泵和管道法兰必须平行；它们应该轻松地配在一起，并与螺栓孔正确排列在一起。

10. Check the fine alignment by clocking or using a Dial Type Indicator (DTI) on the coupling. Check the operating instruction for the coupling.

通过在联轴器上计时或使用表盘类型指示器（DTI）来检查精确对齐。检查联轴器的操作说明。

11. Connect and tighten the suction pipe and compare the alignment with the values of the fine alignment. In the case of deviations, warm the pipe so that the values of the fine alignment are reached.

连接并拧紧吸入管，并将对准与精细对准的值进行比较。在有偏差的情况下，加热管道，使得达到精细对准的值。



- When heating takes place close to the flange, there is a danger that the flange seal will become rippled and leaky. No more welding work should be carried out on the piping once it is screwed to the pump.

当靠近法兰进行加热时，会发生法兰密封件变得波纹和泄漏的危险。当管道拧入泵时，不能再对管道进行焊接。

12. Proceed in the same way with the discharge pipe. 以与排放管相同的方式进行。



- Make sure that there are isolation block valves at the pump for each type of auxiliary piping.
- 确保每种辅助管道在泵上都有隔离阀。



- Consider a slope in the suction piping to avoid high points.
- 考虑吸入管道中存在的斜坡，以避免高点。
- In horizontal suction lines, reducers should be eccentric (with the flat side of the reducer on top).
- 在水平吸入管路中，减速器应该是偏心的（减速器的平面在顶部）。



- No obstruction within at least five pipe diameters of the suction flange should be fitted
- 至少装有5个管径内无障碍的吸入法兰。
- Do not install unsupported piping on the pump.
- 不要在泵上安装无支撑的管道。
- Make sure electrical connections do not impose any stress on the pump unit
- 确保电气连接不会对泵单元施加任何压力。



- Remember that the pump must not be moved once the baseplate has been set: the piping (both suction and discharge) is the one aligned to the pump.



- 请注意，一旦设置了底板，泵不能随便移动：管道（吸入和排出）都是与泵对齐的管道。

- When aligning, all the elements to be aligned (including the pipes) should be at

the same temperature (ambient).

- 对齐时，要对齐的所有设施（包括管道）应处于相同的温度（环境）。



- It is important to confirm that the pump can be moved out from the baseplate without cutting or welding (only by adjusting connections and flanges).

- 确认泵可以从基板移出而不需要切割或焊接（仅通过调节连接和法兰），这一点很重要。



- Do not use drifts or cheater bars to force alignment of bolt holes – serious damage to the pump will result.

- 不要使用漂移物或加长撬杆来强制螺栓孔的对准 - 会导致泵的严重损坏。

5.2 ALIGNMENT*校准

NOTE: The information included in this section is intended as a general guideline. For further information refer to the corresponding section in API Recommended Practices 686.

注:本节包含的信息旨在作为一般指南。有关详情，请参阅API推荐做法686中的相应章节。

In the following pages, alignment procedures are explained with dial indicators. Laser alignment is also possible. The specific method in laser alignment will depend on the manufacturer's instructions; however, the basic principles and rotation of the shafts apply, as in the Reverse Indicator Alignment Method. Therefore, for laser alignment, you may follow the steps detailed on the next pages, mounting a laser bracket with a measurement device on each shaft and then proceed with the rotation of the shafts to obtain the readings to determine the misalignment and correct it.

在以下页面中，使用表盘指示器说明对齐过程。激光对准也是可以的。激光对准中的具体方法将取决于制造商的说明；然而，轴的基本原理和旋转适用，如反向指示器对准方法。因此，关于激光对准，您可以按照下页所述的步骤，在每个轴上安装带有测量装置的激光支架，然后继续进行轴的旋转以获得读数，以确定未对准并进行校正。

Even though the process is shown for a horizontal arrangement, the idea is to show the alignment procedures based on the magnitudes and their sense, even if it is referred to a vertical arrangement for the SPI pump.

尽管显示了水平布置的过程，但想法是基于量值和它们的意义来显示对准过程，即使它是指SPI泵的垂直布置。

NOTE: The driver base has four alignment jackscrews to adjust it radially. This allows the alignment of the driver

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shaft in two axes, simplifying the alignment process.

注:驱动器底座有四个对准螺旋千斤顶用来径向调整。这能让驱动器对齐。

*经Rexnord产品经销商Riddle & Hubbel公司许可, 在两个轴上转载, 简化了对齐过程。

A. ALIGNMENT OF EQUIPMENT 设备校准

Correct alignment is mandatory for the successful operation of rotating equipment. A flexible coupling is no excuse for misalignment. The relationship between shaft centerlines can easily be determined by 1) two step dial indicator method, 2) reverse indicator alignment, 3) across the disc pack alignment. These can all be solved by a graphical approach. This procedure will discuss methods 2 and 3. Method 1 is covered in Rexnord's Manual MT-SS-04-001, "Two Step Dial Indicator Method". Before we get into this alignment procedure, several items should be considered at this point.

旋转设备的成功运行必须基于正确的对准。柔性联轴器不能排除错位。轴中心线之间的关系可以很容易地通过1) 两步表盘指示器方法来确定, 2) 反向指示器对齐, 3) 跨盘盘对齐。这些都可以通过图形化方法来解决。本步骤将讨论方法2和3.方法1在Rexnord手册MT-SS-04-001“两步表盘指示方法”中有介绍。在我们进入这个对齐步骤之前, 应该考虑几个项目。

1. Indicator Set-Up指示灯设置

No matter what arrangement you use, indicator sag must be determined. This can easily be determined by clamping the set-up onto a rigid piece of pipe, rolling the indicator from top to bottom, and reading the difference. Once the indicator sag set-up has been determined, this number can be algebraically subtracted from the alignment readings obtain at the bottom. There is no need to be concerned about the side to side readings as the sag is equal on both sides.

无论使用什么布置, 都必须确定指标下垂度。这可以通过将设置夹紧到刚性管道上, 从上到下滚动指示器并读取差异来容易地确定。一旦确定了指示器下垂设置, 该数字可以从底部获得的对齐读数中代数减去。双方的下垂是相同的, 没有必要关注对边的读数。

2. Taking Alignment Readings采取校准阅读

It is suggested that the dial indicator be zeroed at the top. For convenience, you should mark your coupling at 0°, 90°, 180°, and 270° with a reference mark on the case so that you can be sure to turn the unit exactly 90°. Both shafts should be turned an equal amount if the coupling is not put together. Now rotate the coupling in 90° increments recording all readings. It is important to keep your side to side readings straight. A suggestion is to show compass orientation so that you know which reading to use. After you have made your four position check and have returned back to the top, it is absolutely necessary that the indicator return to zero where it started. If it did not, repeat your readings. It is also advisable to check the readings several times to make sure that they are repeatable.

建议将表盘指示灯置于顶部。为方便起见, 应该在 0°, 90°, 180° 和 270° 之间标记耦合, 并在外壳上加上参考标记, 以确保将本机正确旋转 90°。如果联轴器未放在一起, 两个轴应相等。现在旋转联轴器以 90° 增量记录所有读数。看的时候保持直视, 这点很重要。一个建议是显示罗盘方向, 以便知道要使用哪个阅读。在进行了四个位置检查并返回顶部后, 显示器返回到零开始是绝对必要的。如果没有, 请重复阅读。建议多次检查读数, 确保可重复操作。

3. Thermal Growth热增长

If there are thermal growth considerations on the piece of equipment, it is a good idea to get these numbers so that they can be added to or subtracted from the graphical solution before the equipment move is made, this is known as “Hot alignment”.

如果设备上存在热增长因素，最好先获取这些数字，以便在设备移动之前将其添加到图形解决方案中或从图形解决方案中减去，这被称为“热对齐”。

4. Soft Foot软脚

The fact that your equipment could have a soft foot can affect the alignment readings that you obtain. The soft foot should be checked first and eliminated. This can easily be done by mounting a dial indicator on the base plate indicating off the top of foot on the machine to be checked. Each foot in rotation is then checked by loosening only the bolt with the rest of the bolts being tight. A soft foot check should be carried out when the unit is stationary for safety reasons, and should be carried out on whole drive train. It should never be necessary to shim under the pump mounting feet. Soft foot issues could indicate excessive piping loads transmitted to the pump, or that the baseplate has been twisted, and is not grouted and mounted flat.

设备可能有一个软脚，这可能会影响获得的对齐读数。应先检查软脚，并取消。这可以通过在基板上安装一个表盘来指示要检查的机器上的脚的顶部来实现。然后通过只松开螺栓，其余螺栓紧固的方法来检查每只脚的旋转。为了安全起见，当本机静止时，应进行软脚检查，并应在整个传动系上进行。不需要在泵安装脚下垫垫片。软脚问题可能表明传输到泵的过多的管道负载，或者底板已经扭曲，并且没有灌浆和平放。

B. REVERSE INDICATOR ALIGNMENT GRAPHICAL ANALYSIS 反向指示器对准图形的分析

On a sheet of graph paper, lay out the equipment that you are trying to align. You should use a scale that is convenient to the size of the graph paper. The distances that are critical are:

在一张图纸上，排好需要对齐的设备。可以使用一个方便图形纸尺寸的刻度。距离是至关重要的：

1. Distance from where the first indicator rides on the pump hub to where the second indicator rides on the motor hub. In the example shown below, this is 10-1/2 inches (266.7 mm).

从泵股上的第一个指示器到第二个指示器在马达大轮毂上的距离。在下面的例子中，这是10-1/2英寸（266.7毫米）。

2. Distance from where the second indicator rides on the motor hub to the center of the front motor feet. In the example below, this is 2-1/2 inches (63.5 mm).

将第二个指示器从马达轮毂上移动到前马达脚的中心的距离。在下面的例子中，是2-1/2英寸（63.5毫米）。

3. Distance from the center of the motor front feet to the center of the motor back feet. In the example shown below, this is 5-1/4 inches (133.4 mm).

从马达前脚的中心到马达后脚的中心距离。在下面的示例中，这是5-1/4英寸（133.4毫米）。

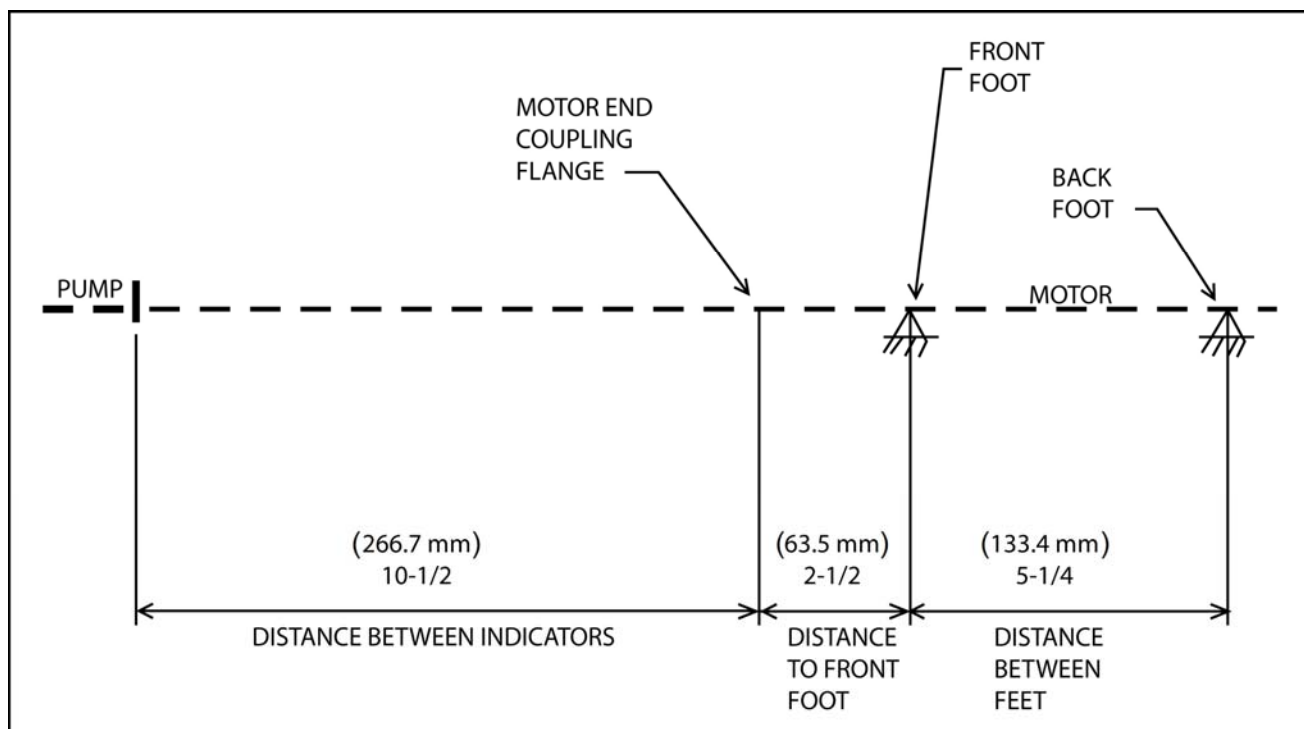


Figure 5.2 Example for reverse indicator graphical analysis.

图5.2 反向指示器图形分析示例

The next step is to determine indicator sag. Set up your bracket arrangement on a pipe. Set the indicator at '0' on top. Roll set up until indicator is at the bottom of pipe. It will read negative. In this example, it is found to be -0.005 inch (-0.127 mm).

下一步是确定指标下垂度。在管道上设置支架布置。将指标设置在顶部的“0”。滚筒设置直到指示器位于管道底部。它会读取负数。在该示例中，为-0.005英寸（-0.127mm）。

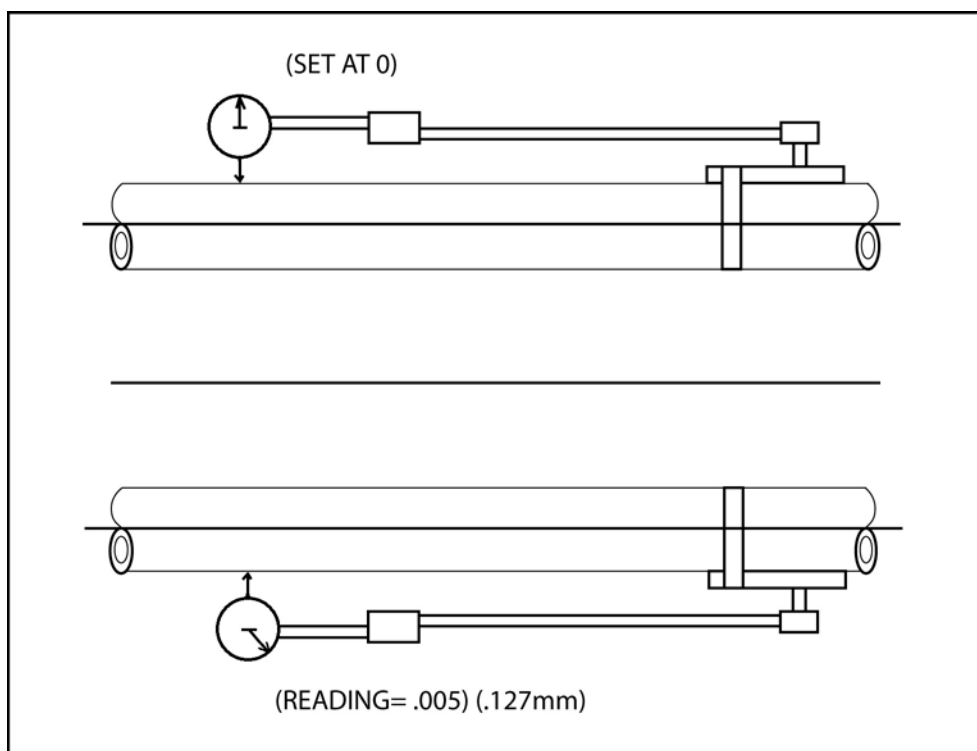


Figure 5.3 Indicator sag.

图5.3 指示器下垂度

With the indicator bracket attached to the motor hub reading off the pump hub, rotate unit in 90° increments and take readings.

将指示器支架连接到电机毂上，读取泵毂，以90°为单位旋转单元并读取数据。

Bottom reading is then corrected for indicator sag. Indicator sag in the example was determined to be 0.005 inch (0.127 mm). The -0.005 inch (-0.127 mm) was subtracted from the -0.025 inch (-0.639 mm) indicator reading to give an actual -0.020 inch (-0.508 mm) reading.

然后校正底部读数以获得指示器下垂度。示例中的指示器下垂度被确定为-0.005英寸（-0.127mm）。从-0.025英寸（-0.639mm）指示器读数中减去-0.005英寸（-0.127mm），得到实际的-0.020英寸（-0.508mm）读数。

As this is a TIR (Total Indicator Readout) it is two times the actual shaft to shaft rotation 0.020 inch (0.508 mm)/ 2 inch (50.8 mm) or 0.010 inch (0.254 mm) is used to show where the motor shaft extension is relative to the pump shaft center line at the hub. Minus at the bottom indicated motor shaft extension is low compared to the pump. Using a scale of one small division on the graph equals 0.001 inch (0.0254 mm); plot this point as show in the example.

由于这是一个TIR（总指示器读数），它是实际轴到轴旋转0.020英寸（0.508毫米）/ 2英寸（50.8毫米）或0.010英寸（0.254毫米）的两倍，用于显示电机轴延伸的位置相对于集线器的泵轴中心

线。底部的减号表示电机轴延伸与泵相比较低。使用图上一个分数的刻度等于0.001英寸（0.0254毫米）；在这个例子中会显示这一点。

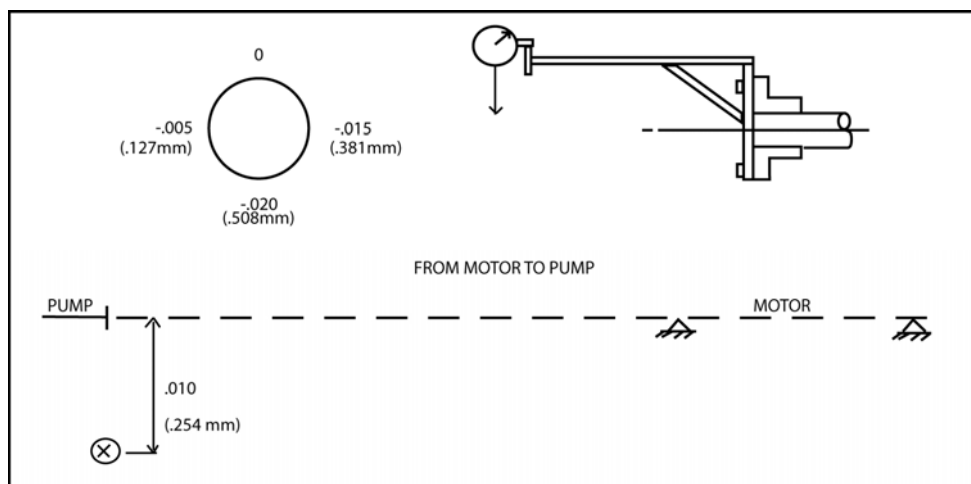


Figure 5.4 Motor shaft extension relative to the pump shaft center line.

图5.4 电机轴延伸相对于泵轴中心线。

Now with the indicator bracket attached to the pump hub reading off the motor hub, rotate unit again in 90° increments. NOTE: If you can set up both indicators at once, both sets of readings can be taken at one time.

现在，将指示器支架连接到泵毂上，读取电机毂，再次以90°为单位旋转单元。注意：如果同时设置两个指示器，则可以同时进行两组读数。

Bottom reading is then corrected for indicator sag. The -0.005 inch (-0.127 mm) was subtracted from the +0.005 inch (+0.127 mm) indicator reading to give an actual +0.010 inch (+0.254 mm) reading.

然后校正底部读数以获得指示器下垂度。从+0.005英寸（+0.127 mm）指示器读数中减去-0.005英寸（-0.127 mm），得到实际的+0.010英寸（+0.254 mm）读数。

The +0.010 inch (+0.254 mm) is divided by two to give +0.005 inch (+0.127 mm) which is the actual shaft extension to shaft relationship.

将+0.010英寸（+0.254mm）除以2，得到+0.005英寸（+0.127mm），这是实际轴向轴的关系延伸。

In this case, a plus reading at the bottom indicates the motor shaft is low compared to the pump shaft extension. Plot this point as shown in the example.

在这种情况下，底部的加读数表示电机轴与泵轴延伸部相比较低。绘制这一点，如示例所示。

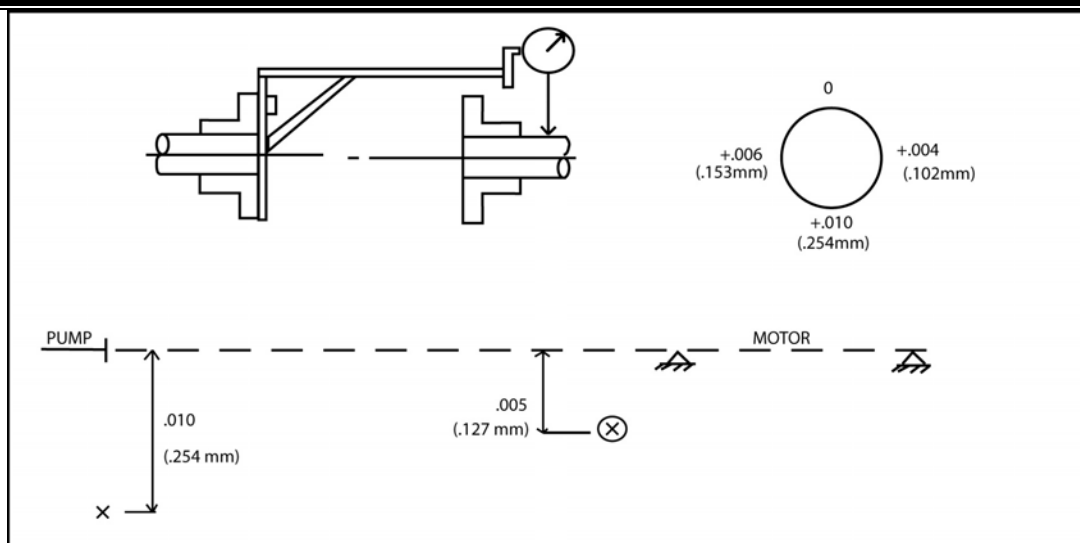


Figure 5.5 T.I.R. second reading.

图5.5 T.I.R. 二读

We have now located the motor shaft theoretical extension in two places:

我们现在将电机轴的理论延伸定位于两个位置：

- A. In the plane of the pump hub. 在泵毂的平面上。
- B. In the plane of the motor hub. 在发动机中心的平面上。

Drawing a straight line through these two points crossing the plane of the two motor feet. The shim adjustment can now be read directly off the graph. In this example, 0.004 inch (0.102 mm) should be added to the front foot and 0.001 inch (0.025 mm) should be added to the back foot.

通过这两个点穿过两个电机底脚的平面画一条直线。垫片调整现在可以直接从图表中读取。在这个例子中，前脚应加上0.004英寸（0.102mm），后脚应加0.001英寸（0.025mm）。

This solution can also be done by the use of pre-programmed, hand calculators for faster results.

此解决方案也可以通过使用预编程的手动计算器来实现，以获得更快的结果。

For the horizontal (side to side) results, the same procedure is used. Algebraically subtract the side to side readings. Indicator sag can be ignored as it cancels out. Plot these readings and the results can be read off the graph plot.

对于水平(左右)结果，使用相同的步骤。代数地减去左右读数。指示器下垂度可在取消时忽略。绘制这些读数，从曲线图中可以读出结果。

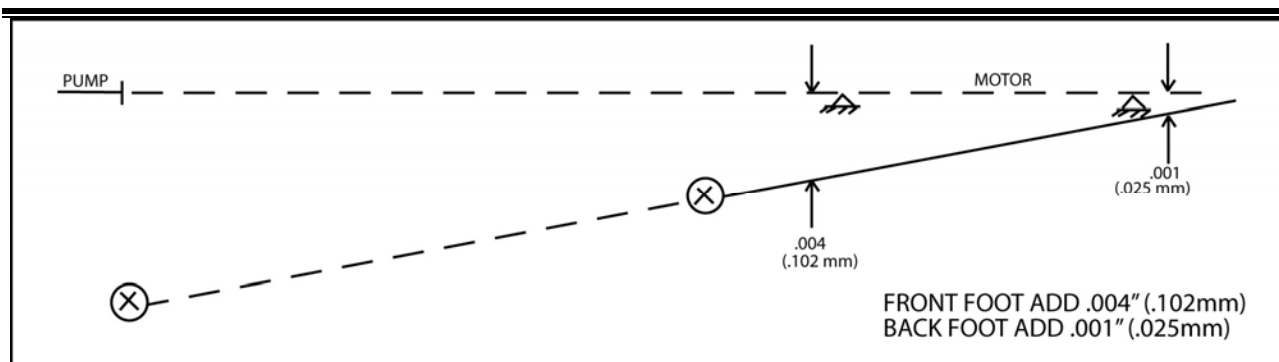


Figure 5.6 Final graph plot for reverse indicator alignment graphical analysis.

图5.6 反向指示器对齐图形分析的最终图形图。

C. REVERSE INDICATOR ALIGNMENT MORE THAN TWO UNITS GRAPHICAL ANALYSIS

反向指示器对准多于两个单元的图形分析

This method lends itself very well in solving alignment problems of three or more pieces of equipment in a line.

该方法很好地解决了一条线上三条或更多条设备的对准问题。

To solve this problem, follow the steps already outlined for each coupling in the train. Plot the shaft to shaft relationship of each set of shafts. Look at the total picture. In this example, a line was drawn through the average of all points plotted. The units were then aligned to this mean line.

要解决这个问题，请按照列出的每个耦合已经概述的步骤。绘制各轴的轴与轴的关系。看总图。在此示例中，通过绘制的所有点的平均值绘制线。然后将单元与该平均线对齐。

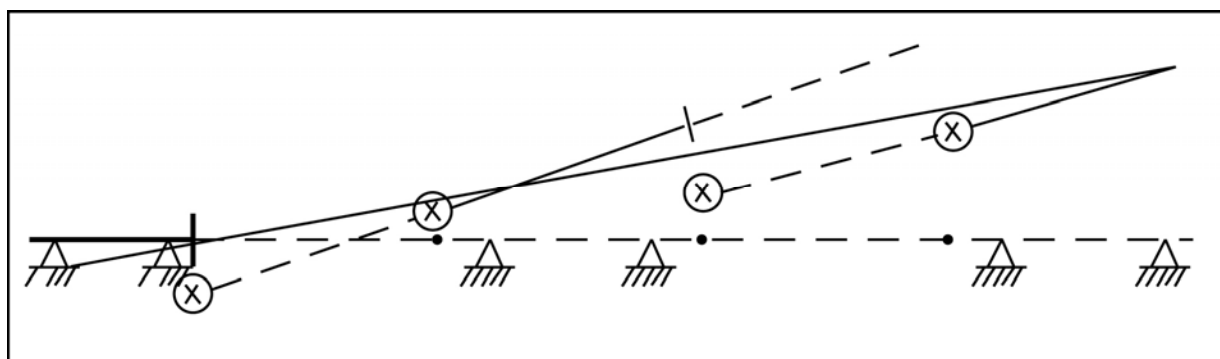


Figure 5.7 Reverse indicator alignment of more than two units.

图5.7两个以上单元的反向指示器对齐。

D. ACROSS THE DISC PACK ALIGNMENT GRAPHICAL ANALYSIS跨光盘组对齐图形分析

When the distance between disc packs is long where it is not practical to try to span the distance with indicator bracketry, the 'across the disc pack method' can be used.

当磁盘组之间的距离很长，用指示器支架跨越该距离是不现实的，可以使用“横跨磁盘组方法”。

On a sheet of graph paper, lay out the equipment that you are trying to align. You should use a scale that is convenient to the size of the graph paper. The distances that are critical are:

在一张图表纸上，试着安放对齐的设备。应该使用一个适合于图表纸大小的刻度。关键的距离是：

1. Distance from centerline of one disc pack to the centerline of the other disc pack. In the example, it is 9-1/2 inches (241.3 mm).

从一个磁盘组的中心线到另一个磁盘组的中心线的距离。在这个例子中，它是9 - 1 / 2英寸(241.3毫米)。

2. Distance from centerline of motor disc pack to center of front motor foot. In this example, it is 3 inches (76.2 mm).

从马达盘组中心线到马达前脚中心的距离。在这个例子中，它是3英寸(76.2毫米)。

3. Distance from the center of the motor front feet to the center of the motor back feet. In this example, it is 5-1/4 inches (133.4 mm).

从电机前脚中心到电机后脚中心的距离。在这个例子中，它是5 - 1 / 4英寸(133.4毫米)。

4. Distance from disc pack to dial indicator on center member. In this example, the distance is 8 inches (203.2 mm).

从圆盘组件到中心部件上的百分表的距离。在此示例中，距离为8英寸(203.2 mm)。

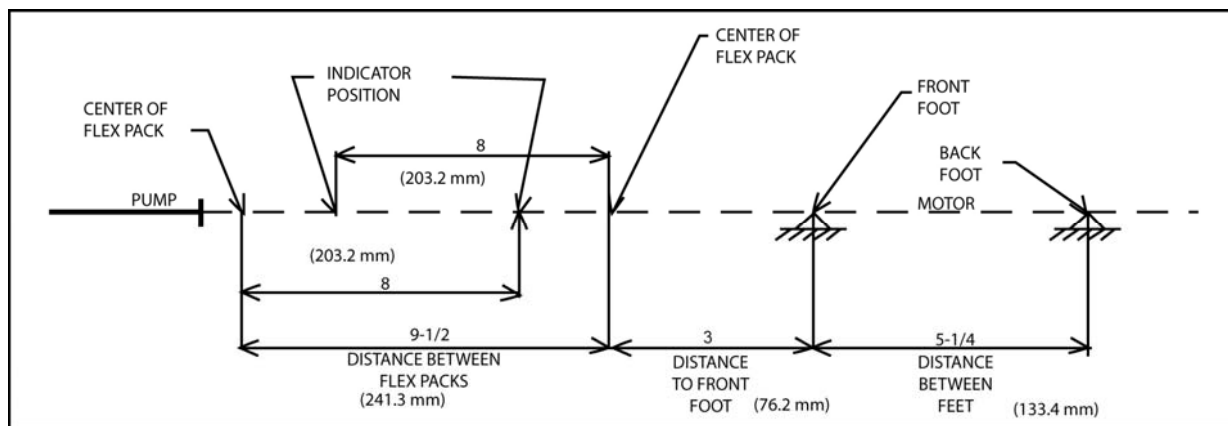


Figure 5.8 Across the disc pack alignment graphical analysis example.

图5.8整个磁盘组对齐图形分析示例。

The next step is to determine indicator sag. Set up your bracket arrangement on a pipe. Set the indicator at '0' on top. Roll set up until indicator is at the bottom of pipe. It will read negative. In this example, it was found to be -0.004 inch (-0.102 mm).

下一步是确定指示器下垂度。在管道上设置支架布置。将指示器设置在顶部的“0”。滚动设置，直到指示器位于管道底部。它读起来是负值。在这个例子中，它是- 0.004英寸(- 0.102毫米)。

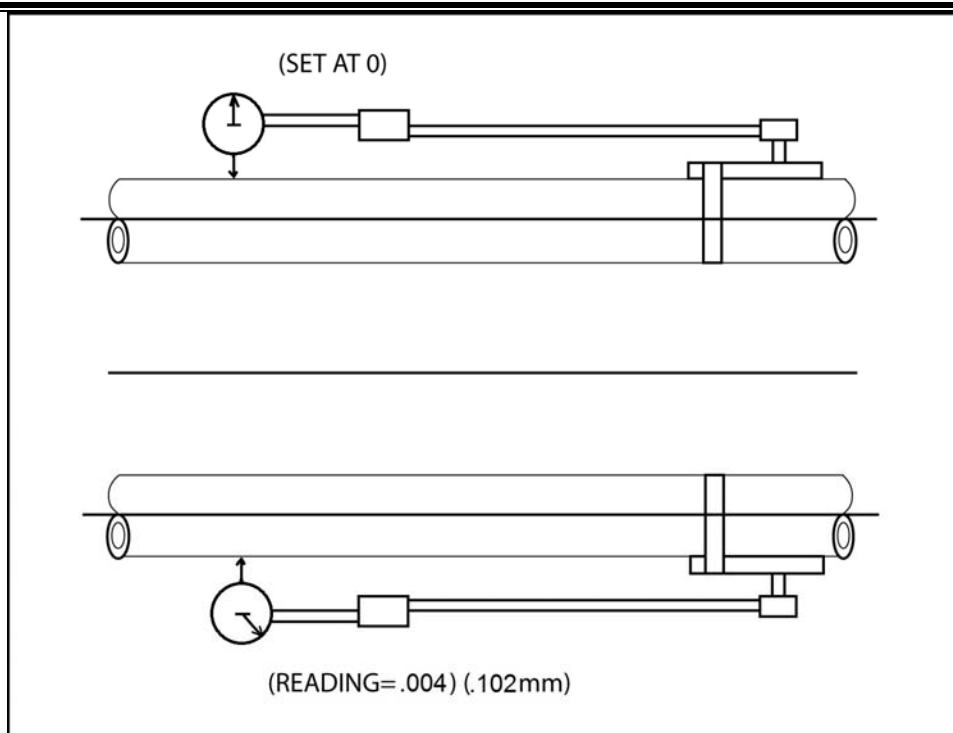


Figure 5.9 Indicator sag in across the disc pack alignment analysis example.

图5.9整个磁盘组对齐分析示例中的指示器下垂度

With the indicator bracket attached to the pump hub, reading out the center member a convenient distance, (in this example 8 inches [203.2 mm] was used) rotate the unit in 90° increments and take readings.

指示器支架连接到泵毂上，读出中心部件一段合适的距离(在本例中使用8英寸[203.2 mm])，以 90° 增量旋转该单元并读取读数。

Bottom reading is then corrected for indicator sag. The indicator sag in the example was determined to be -0.004 inch (-0.102 mm). The -0.004 inch (-0.102 mm) was subtracted from -0.025 inch (-0.635 mm) indicator reading to give an actual of -0.020 inch (-0.508 mm) reading.

然后，针对指示器下垂度校正底部读数。例中的指示器下垂度被确定为- 0.004英寸 (- 0.102 mm)。从- 0.025英寸 (- 0.635 mm)指示器读数中减去- 0.004英寸 (- 0.102 mm)，得到- 0.020英寸 (- 0.508 mm)的实际读数。

As this is a TIR (Total Indicator Reading) it is two times the actual center member center line location relative to the pump shaft extension or -0.020 inch (-0.508 mm) / 2 inches (50.8 mm) = -0.010 inch (0.254 mm). (What we are trying to do here is to determine the angle the center member makes with respect to the pump shaft.)

由于这是一个TIR（总指示器读数），它是实际轴到轴旋转-0.020英寸 (-0.508毫米) / 2英寸 (50.8毫米)或-0.010英寸 (0.254毫米)的两倍，用于显示电机轴延伸的位置相对于集线器的泵轴中心线。底部的减号表示电机轴延伸与泵相比较低。使用图上一个分数的刻度等于0.001英寸 (0.0254毫米)；在这个例子中会显示这一点。

A plus reading at the bottom indicates that the center member tips down as it extends away from the pump.

Using a scale of one small division on the graph equals 0.001 inch (0.0254 mm); plot the 0.010 inch (0.254 mm) as shown in the example.

底部的加号读数表示中心部件在远离泵延伸时向下倾斜。使用图表上的一个小刻度等于0.001英寸(0.0254 mm)；如示例所示绘制0.010英寸(0.254 mm)。

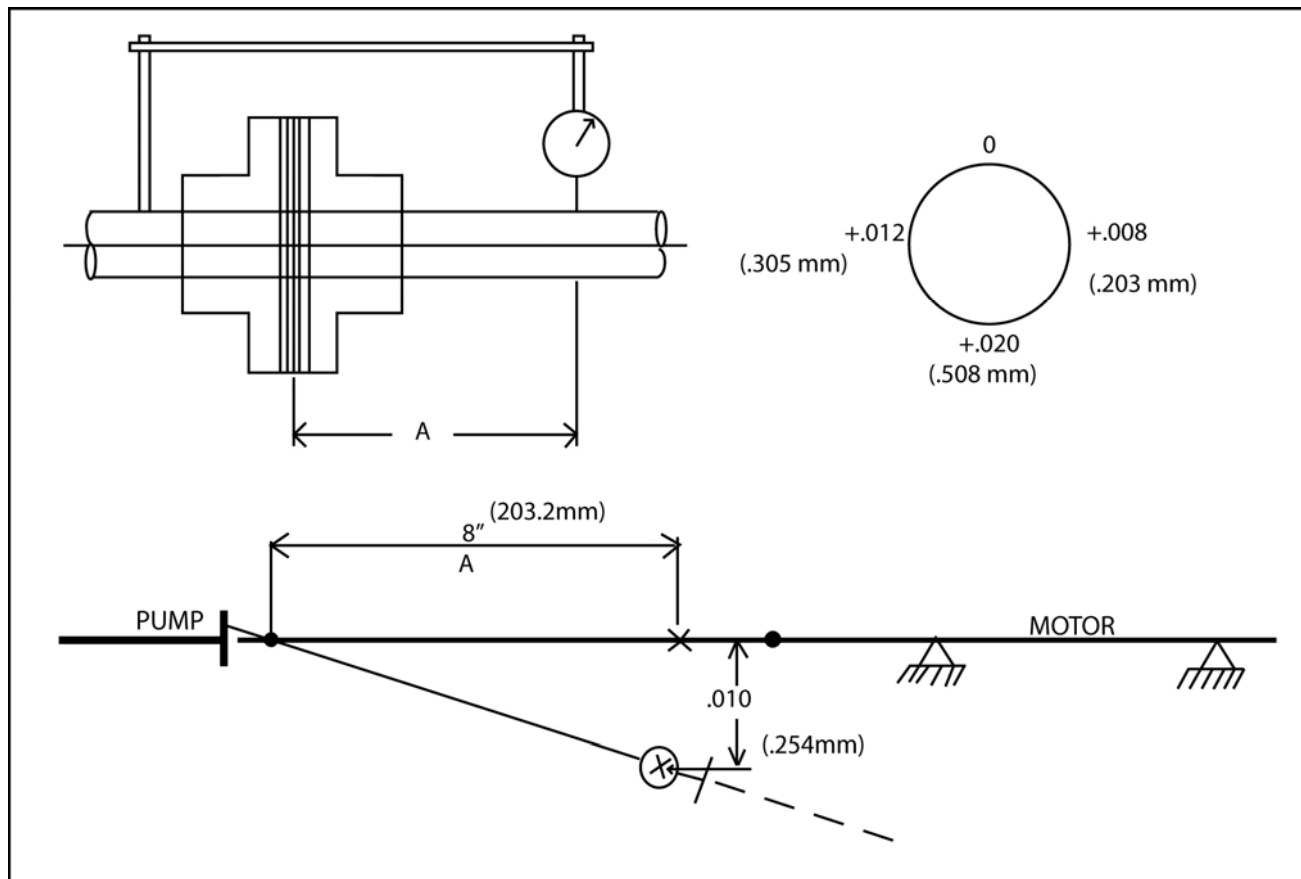


Figure 5.10 Plot of the plus reading in the across the disc pack alignment analysis example.

图5.10整个磁盘组对齐分析示例中的正读数图。

Now with the indicator bracket attached to the motor hub reading out on the center member, rotate the unit in 90° increments and take readings.

现在，将指示器支架连接到泵毂上，读取电机毂，再次以90° 为单位旋转单元。 注意：如果同时设置两个指示器，则可以同时进行两组读数。

Bottom reading is corrected for indicator sag: ± 0.008 inch (± 0.203 mm) $- 0.004$ inch (0.102 mm) = $+0.012$ inch ($+0.309$ mm). This is TIR so actual is $+0.006$ inch ($+0.152$ mm). (What we are trying to do here is determine the angle the center member makes with respect to the motor shaft.)

针对指示器下垂校正底部读数: 0.008 英寸(± 0.203 mm) $- 0.004$ 英寸(0.102 mm) = $+ 0.012$ 英寸($+ 0.309$ mm)。这是TIR，因此实际值为 $+ 0.006$ 英寸($+ 0.152$ 毫米)。 (在此试图确定中心构件相对于电机轴的角度。))

The minus reading on the bottom indicates that the center member tips up as it extends away from the motor. Using a scale of one small division on the graph equals 0.001 inch (0.025 mm), plot the 0.006 inch (0.192 mm) as shown on the example.

底部的负读数表明，当中心构件远离电机延伸时，中心构件向上倾斜。使用图表上一个除法，比例等于0.001英寸(0.025 mm)，绘制0.006英寸(0.192 mm)，如示例所示。

The motor shaft can now be drawn in because two points along it have been defined: 1. Center of the flex element. 2. The point just plotted 0.006 inch (0.152 mm) below center member. The shimming requirements can now be read off the plot where the motor shaft intersects the planes of the motor feet.

现在可以画出电机轴，因为沿着它已经定义了两点: 1. 挠性元件的中心。2 .刚刚绘制的点位于中心构件下方0.006英寸(0.152 mm)。摆振要求现在可以从电机轴与电机脚平面相交的图中读出。

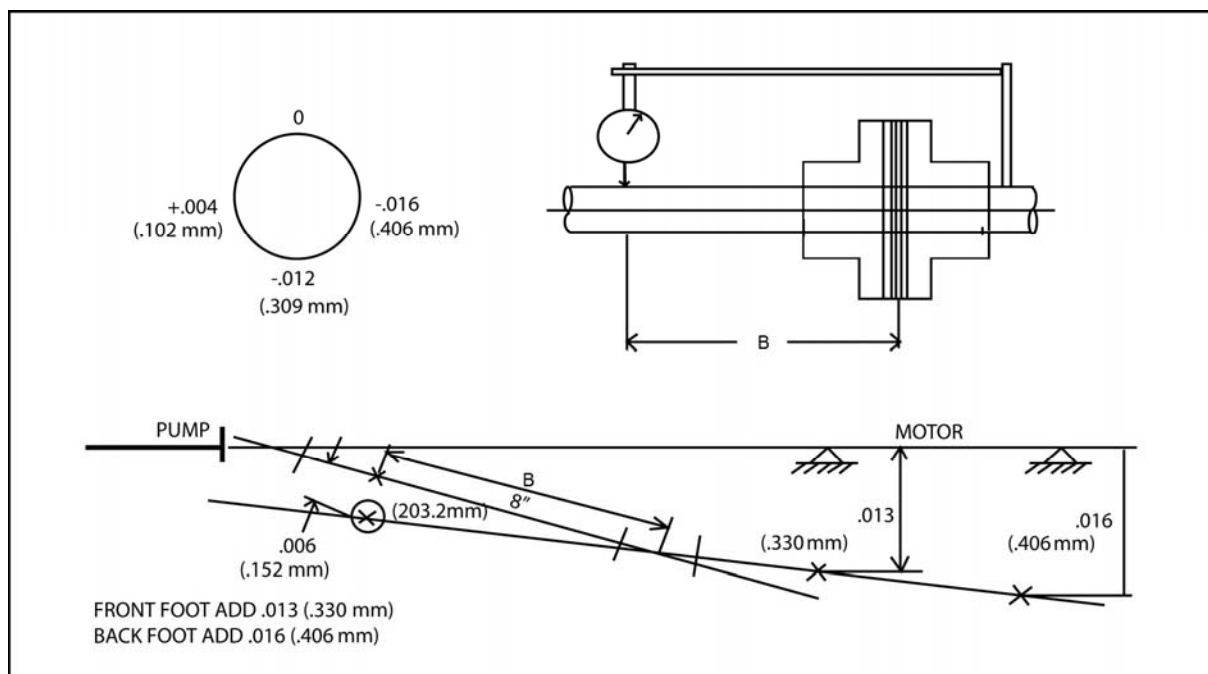


Figure 5.11 Plotting the motor in the across the disc pack alignment analysis example.

图5.11在整个磁盘组对齐分析示例中绘制电机。

In this example, the motor should be shimmed up 0.013 inch (0.330 mm) under front feet and shimmed up 0.016 inch (0.406 mm) under back feet.

在这个例子中，电机应该在前足下垫0.013英寸(0.330 mm)，在后足下垫0.016英寸(0.406 mm)。

This solution can also be done by use of a pre-programmed, calculator for faster results.

这个解决方案也可以通过使用预先编程的计算器来实现，结果会更快。

For the horizontal (side to side) results, the same procedure is used. Algebraically subtract the side to side

readings. Indicator sag can be ignored as it cancels out. Plot these readings and the results can be read off the graph.

对于水平(左右)结果，可以使用相同的程序。用代数方法减去左右读数。指示器下垂度可以忽略，因为它会抵消掉。绘制这些读数，可以从图表中读出结果。

SECTION SIX - LUBRICATION

第六部分-润滑

6.1 GREASE LUBRICATED BEARINGS 润滑油轴承

Grease lubricated bearings of the pump are prelubricated in the factory before shipping. Subsequent lubrication periods depend on local conditions, loads, velocities, operating hours and temperature.

装运前，泵的润滑脂润滑轴承在工厂要进行预润滑。随后的润滑周期取决于当地条件、负载、速度、工作时间和温度。

Periodic lubrication of the bearing must be performed and additional grease must be added as needed through the grease fitting. It is recommended to use Chevron SRI-2 or Shell Dolium “R” grease. It should not be overfilled; this will cause high temperatures on the bearings and reduce their operation life.

必须对轴承进行定期润滑，且必须根据需要通过润滑油嘴来添加额外的润滑脂。建议使用雪佛龙 SRI-2 或壳牌多利姆 “R” 润滑脂。不应过量灌装；这将导致轴承上的高温并缩短其使用寿命。

The following is a suggested interval for bearing lubrication: 以下是轴承润滑间隔的建议：

- Radial roller bearing – every two weeks. The recommended grease volume for lubrication is 0.15 dm³.
- 径向滚柱轴承 – 每两周一次。建议润滑油脂量为 0.15 dm³。
- Axial ball bearing – every three months. The recommended grease volume for lubrication is 0.20 dm³.
- 轴向滚珠轴承 – 每三个月一次。建议润滑油脂量为 0.20dm³ 。

However, it is important to mention that periodic inspection must be performed and the amount of grease added should be only as needed, without overgreasing.

然而，必须提到的是，一定要进行定期检查，润滑脂的添加量应仅根据需要，不得过量润滑。

6.2 PURE OIL MIST-DRY SUMP 纯油雾-干式集水坑



- When pure oil lubrication is supplied, the oil mist is the only lubricant provided.
- 当用纯油润滑时，只有油雾充当润滑剂。



- The oil mist generator must be running before starting the unit.
- 启动机组之前，油雾发生器必须先运行。

Basic oil-mist generating system should include the following:

基本油雾产生系统应包含以下内容:

1. An airline filter water separator to assure a clean air supply to oil-mist generator.
航空滤水分离器, 确保油雾产生器供应清洁空气。
 2. An air pressure regulator to control the oil-mist generator atomizing air pressure.
控制油雾产生器雾化空气压力的空气压力调节器。
 3. An oil-mist generator which includes a venturi nozzle, oil lift tube, reservoir and oil flow adjustment screw.
一种油雾产生器, 包括文丘里喷嘴、升油管、储油器和油流调节螺钉。
 4. Mist distribution manifold to convey the oil-mist application fittings.
用于输送油雾应用配件的雾分配歧管。
 5. Spray application fitting to meter and convert the oil-mist at each lubrication point.
喷涂配件, 用于计量和转换每个润滑点的油雾。
- Recommended Oil: ISO VG 68 Non-Detergent Oil suitable for oil misting. (Refer to instructions with Oil Mist Generator.) 推荐油: ISO VG 68非清洁剂油, 适用于油雾。(参见油雾发生器的说明。)
 - Air/Oil Ratio should be 0.40 cubic inches/hour/cfm (231.5 cc/hr/m³/min) 空气/油比例应为0.40立方英寸/小时/ cfm (231.5 cc /小时/m³/min)
 - Type of Oil Mist Fitting: Spray type 油雾配件类型:喷雾型

Provide oil mist through the oil mist inlet as indicated on the General Arrangement.

如总布置图所示, 油雾通过油雾入口提供。

Oil mist should be vented out thru the vent as indicated on the General Arrangement. (When pump is idle and mist generator is on, a mist should be visible exiting the vents. When pump is running, the windage associated with the shaft, bearing, and coupling makes it difficult to see the mist.)

油雾应通过通风孔排出, 如总布置图所示。(当泵闲置且薄雾发生器开启时, 应该可以看到从通风口排出的薄雾。当泵运行时, 与轴、轴承和联轴器相关的风阻使得很难看到雾。)

Maintenance: 保养

- Periodically inspect the sediment bottle underneath the bearing housing. (Drain as required.)
定期检查轴承箱下方的沉淀瓶。(根据需要排水。)
- If bearing housing is dismantled, flush bearing housing with clean lightweight oil (e.g. ATF).
如果拆卸轴承箱, 用干净的轻质油(例如ATF)冲洗轴承箱。

- Be certain bearings have a light coating of oil before startup.

启动前，确保在轴承上涂一层薄薄的油。

SECTION SEVEN - OPERATION

第七部分-操作

7.1 PRIMING 底漆

Pumps handling hot ($>500^{\circ}\text{F}$, $>260^{\circ}\text{C}$) fluids must be gradually preheated to operating temperature. The most common method used for warming a pump, or maintaining a standby pump in a warm condition, is the use of a warming line and orifice, thus circulating the hot pumpage through the idle pump.

处理热($> 500^{\circ}\text{F}$, $> 260^{\circ}\text{C}$)流体的泵必须逐渐预热到工作温度。用于加热泵或将备用泵保持在温暖状态的最常用方法是使用加热管线和节流孔,从而使热泵循环通过闲置泵。



- It is recommended that the pump be warmed at the rate of 100°F (55°C) rise per hour for normal warming, or 268°F (149°C) rise per hour for emergency warming.
- 建议以每小时 100°F (55°C)的速度对泵进行加温, 或者以每小时 268°F (149°C)的速度对紧急加温。
- It recommended that the idle pump temperature be maintained within 36°F (20°C) of the system operating temperature.
- 建议怠速泵温度保持在系统工作温度的 36°F (20°C)以内。

Circulation can be easily accomplished by guiding a small amount of flow from the discharge side of the system beyond the check valve via a multiple breakdown orifice into the bottom of the pump case. The hot liquid will then pass through the case and out the suction and return to some low pressure point in the system. In many cases, the pump drain line is used for the warming connection.

通过将少量流量从系统的排放侧通过多重破裂孔引导到泵壳的底部, 可以很容易地完成循环。然后, 热液体将通过外壳, 从吸入口流出, 并返回系统中的某个低压点。在许多时候, 泵排水管用于加温连接。

Note: Many variations are possible and one that is compatible with the customer's particular installation should be considered.

注意:很多变化都有可能, 应该先考虑与客户特定的安装兼容变化。

7.2 STARTUP 启动

- Every time before the pump is started up the safety devices must be mounted and fastened.



- 每次启动泵之前，必须安装并紧固安全装置。



- In order to avoid risks of injury or damage, all pump units must be equipped with emergency-stop devices.

- 为了避免受伤或损坏的风险，所有泵单元必须配备紧急停止装置。

- For operation of electrical drives, control systems and their cable routes, the safety instructions issued by their manufacturers must be observed.

- 对于电气驱动器、控制系统及其电缆线路的操作，必须遵守制造商发布的安全说明。



- Turn the mechanical seal locks outwards. To make this procedure, please follow the seal's manual instructions.

- 向外转动机械密封锁。要执行此程序，请遵循印章的手动说明。

The startup procedure is as follows:

启动程序如下:

1. Before starting the pump, check the security of all bolting, piping, and wiring.

启动泵之前，检查所有螺栓、管道和布线的安全性。

2. Check all gauges, valves and instruments for proper working order.

检查所有仪表、阀门和仪器是否正常工作。

3. Check all equipment for proper lubrication and correct rotation.

检查所有设备的润滑和旋转是否正确。

4. Verify that the discharge valve is closed.

确认排放阀是否关闭。

5. Open the suction valve. 打开吸入阀。

6. Open discharge valve and allow pump to fill with fluid (pump is self-venting).

打开排放阀，让泵充满流体(泵是自动排气的)。

7. Keep the valves open approximately 60 seconds to ensure that pump is completely full of fluid.

保持阀门打开约60秒，以确保泵完全充满流体。

8. Close discharge valve. 关闭排放阀。
9. Uncouple the driver and the pump. 松开驱动器和泵。
10. Start, and **IMMEDIATELY STOP**, the driver and observe the rotation of the shaft.

启动并立即停止驱动器，观察轴的旋转。

11. Correct rotation should be in direction of rotation arrow.

正确的旋转方向应该是旋转箭头方向。

- If shaft rotation is incorrect, consult driver manufacturer's instructions in order to change rotation.
- 如果轴旋转不正确，请参考驱动器制造商的说明以改变旋转。

12. Priming accomplished and correct shaft rotation established, the pump is ready for continued operation.

灌注完成，轴旋转正确，泵准备继续运行。

13. Securely couple the driver and the pump, and ensure the discharge valve is open to approximately ¼ fully open.

牢固地连接驱动器和泵，并确保排放阀打开至接近¼完全打开。

14. Start driver again, and completely open the discharge valve **IMMEDIATELY** when the operating speed has been reached.

再次启动驱动器，当达到操作速度时，立即完全打开排放阀。



- Danger: Do not allow discharge valve to remain closed for any length of time. Pumped fluid temperature will rise excessively causing damage to pump.
- 危险:不允许排放阀长时间关闭。泵送流体温度会过度升高，导致泵损坏。

7.3 OPERATING CHECK 运行检查

During the initial operating hours, the pump should be monitored constantly. It is thus possible to detect irregularities immediately and to take appropriate measures for their elimination (See SECTION ELEVEN - TROUBLESHOOTING CHART).

在初始工作时间内，应持续监控泵。因此，有可能立即发现违规行为，并采取适当措施予以消除(见第十一节-故障排除图)。

To monitor flow, pressure, temperature, and lubrication, regular visual inspection and monitoring is advisable and/or necessary during operation.

为了监控流量、压力、温度和润滑，在操作期间，定期目视检查和监控是可取的/或必要的。

Ruhrpumpen recommends checking the pump constantly at regular intervals in order to detect problems early, in case they arise.

鲁尔泵公司建议定期检查泵，以便及早发现问题，以防出现问题。

The operational check routine must include at least the following points:

操作检查程序必须至少包括以下几点:



- Beware of freely rotating parts, when the pump is in operation there is a high risk of injury.
- 当心自由旋转的部件，当泵运行时，有很高的危险。

- Check at regular intervals that the safety equipment is sound and is arranged and fastened according to the regulations, and energized where applicable.
- 定期检查安全设备是否完好，是否按照规定布置和紧固，并适时通电。
- Check the security of all bolting, piping, and wiring.
- 检查所有螺栓、管道和布线的安全性。
- Check all gauges, valves and instruments for proper working order.

检查所有仪表、阀门和仪器是否正常工作。

- Check all equipment for proper lubrication and correct rotation.
- 检查所有设备的润滑和旋转是否正确。
- Check the temperature of the bearing bracket surface. It should not exceed 185 °F (85 °C).
- 检查轴承支架表面的温度。不应超过 185 华氏度(85 摄氏度)。
- Check that the pumping unit is running quietly and without vibrating.
- 检查泵机组是否安静运行且无振动。



- Unusual or too loud noises point towards a possible fault.
- 异常或过大的噪音说明可能存在故障。

- Monitor the power consumption of the drive motor. Low or excessive power consumption indicates a possible fault.
- 监控驱动电机的功耗。功耗低或过高都表示可能存在故障。
- Check the sealing system:检查密封系统:



- Refer to the seal manufacturer for his estimate of maximum acceptable leakage rate, as this will depend on application, design, location and the sealed liquid characteristics

参考密封制造商对最大可接受泄漏率的估计，这将取决于应用、设计、位置和密封液体特性。

- If excessive leakage is present, switch the pump off as quickly as possible, isolate the pump by closing the discharge and suction valves or using some other approved method designated as safe for your system, and check the rotating seal ring and the stationary seal ring.

如果存在过度泄漏，请尽快关闭泵，通过关闭排放阀和吸入阀或使用其他对系统安全认可的方法隔离泵，并检查旋转密封圈和固定密封圈。



- If the sealing system of the mechanical seal fails, the pump must be taken out of operation immediately.
- 如果机械密封的密封系统出现故障，必须立即停止泵运行。



- The pump may only be operated under the minimum operating range for short periods. The minimum pump flow is given in the characteristic line.
- 泵只能在最小工作范围内短期运行。最小泵流量已在特征线中给出。

7.4 STOPPING 停止

- Throttle pump discharge to minimum flow.

节流泵排放至最小流量。

- Warning: do not close suction valve, this will cause the pump to run dry.
警告:不要关闭吸入阀，这会导致泵干运行。

- Turn the power off to the driver. 关闭驱动器的电源。

3. Close the pump discharge valve 关闭泵排放阀。
4. Observe the run - down of the pump until full stop. 观察泵的运行情况，直到完全停止。
 - If the rotor is jerky or suddenly stops, there is danger that the rotor has been blocked. The pump must be opened and all running clearances checked.
 - 如果转子跳动或突然停止，则存在转子被堵塞的危险。必须打开泵并检查所有运行间隙。
5. Close the suction valve when the pump shaft stops rotating as the pump must be isolated and made safe before examination.

.当泵轴停止转动时，关闭吸入阀，检查前必须隔离泵并确保安全。



- Do not close the suction valve until the pump has come to a full stop, as it may cause the pump to run dry.
- 在泵完全停止之前，不要关闭吸入阀，因为这会导致泵干燥。

6. Ensure the drive motor cannot be unintentionally turned on.
确保驱动电机不会突然开启。
7. Ensure the shut-off devices in the suction and pressure pipes cannot be unintentionally opened.
确保吸入管和压力管中的关闭装置不会突然打开。
8. Drain the pump and the auxiliary piping.
排空泵和辅助管道。



- If the outside temperature is below 32 °F (0 °C), all cooling chambers must be emptied, and all seal system cooling coils must be drained.
- 如果外部温度低于32° F (0° C), 则所有冷却室必须排空，所有密封系统冷却盘管必须排空。

7.5 SHORT-TERM SHUTDOWN 短期停工

If the pump has switched off correctly and has not suddenly come to a halt, it may be re-started without the need to take any special measures.

如果泵已经正确关闭，并且没有突然停止，则无需采取任何特殊措施就可以重新启动。

If the pump comes to a sudden halt, or if the pump was switched off because of a possible danger, it must be checked for damage.

如果泵突然停止，或者如果泵由于可能潜在的危险而关闭，必须检查泵是否损坏。

7.6 LONG-TERM SHUTDOWN 长期停机

1. Follow the stopping procedure described in SECTION 7.4 - STOPPING.

遵循第 7.4 节-停止中描述的停止程序。

2. Disconnect the vent filter and seal openings on the bearing housing to lessen the exchange of air.

断开通风过滤器并密封轴承壳上的开口，以减少空气流通。

3. While the unit is idle:当设备不工作时：



- a. If the plant is in an operational state, warm up and start the unit at monthly intervals (see SECTION 7.2 - STARTUP for details).

如果电厂处于运行状态，每月预热并启动一次机组(详见第 7.2 节-启动)

- b. If the plant is not in an operational state, turn the unit over by hand a couple of times at monthly intervals, ensuring the shaft is not returned to the same position, to allow the bearings to rest in a different position every time.

如果设备处于不运行状态，每月用手将设备翻转几次，确保轴不会回到相同的位置，允许轴承每次停留在不同的位置。

4. If there is danger of freezing, drain the pump, drain the oil from the pump bearings and all the auxiliary piping.

如果处于有结冰的危险，排空泵，排空泵轴承和所有辅助管道中的油。

5. Change the oil before recommencing operation, ensuring the correct grade and the correct volume has been installed in the bearing housing (see SECTION SIX - LUBRICATION for details).

重新开始操作前，更换机油，确保轴承箱中安装了正确的等级和合适的容量(详见第六节-润滑)。

SECTION EIGHT – MAINTENANCE

第八部分-保养维修

To perform the maintenance of the SPI pump, no special (custom made) tools are needed.

维护SPI泵，不需要特殊(定制的)工具。



- Before initiating maintenance procedures disconnect all power sources to the equipment and discharge any parts which may retain an electric charge. Use proper locks to avoid accidental start-up of the pump system. Failure to comply may result in severe personal injury.
- 在开始维护设备之前，断开设备的所有电源，并对任何可能保留电荷的部



件进行放电。使用适当的锁以避免泵系统意外启动。违反此操作可能会导致严重的人身伤害。



- When performing the maintenance of the pump, use the safety equipment appropriate for the pumped fluid, materials, and location of the equipment, such as gloves, safety glasses, harnesses and other equipment regarded as mandatory by the plant's safety instructions.



- 对泵进行维护时，使用适合泵送流体、材料和设备位置的安全设备，如手套、安全眼镜、安全带和工厂安全说明中规定的其他设备。
- Any work with pumps that include handling dangerous liquids should only be made with adequate protection equipment for handling hazardous liquids.



- 任何用泵操作的工作，包括处理危险液体，都应配备足够的保护设备来处理。
- When working near hot surfaces of the pump without insulation, safety equipment must be used at all times. Safety signs must be present to ensure that no one touches the pump accidentally.
- 当在没有绝缘的泵热表面附近工作时，必须始终使用安全设备。必须有安全标志，以确保没有人员不小心意外接触到泵。



- During both dismantling and assembly processes, pay special attention on the stability of the items to be removed. If necessary, use support equipment.
- 在拆卸和组装过程中，特别注意待拆卸物品的稳定性。如有必要，使用支撑设备。

8.1 DISASSEMBLY 拆卸

As a design feature, the entire rotor (driver, casing cover, mechanical seal, bearing housing and impeller) can be removed from the casing as a whole unit. The casing remains connected to the piping.

作为设计的一个特征，整个转子(驱动器、外壳盖、机械密封、轴承壳和叶轮)都可以作为一个整体从外壳上拆下。外壳要连着管道。

1. Stop the pump. See SECTION 7.4 - STOPPING. 停泵。参见第 7.4 节-停止。
2. Drain all possible fluids from the pump case and bearing housing.
从泵壳和轴承箱中排出所有液体。
3. Disconnect any auxiliary piping and wiring that could interfere with disassembly.
断开任何可能干扰拆卸的辅助管道和线路。

4. Disconnect the driver-to-pump coupling and remove coupling spacer.

断开驱动器-泵联轴器，并拆下联轴器隔套。

5. Separate the support of the driver from the casing. First, remove the hexagonal screws, afterwards, lift the entire support in a safe way and place it over a flat and stable surface.

将驱动器支架与外壳分离。首先，移除六角螺钉，然后，安全的抬起整个支架，并将其放置在平坦稳定的表面上。

6. When disassembling the pump, match mark, tag or otherwise identify all parts, and provide separate containers for small parts. Refer to the pump sectional drawing included in SECTION TEN - PARTS INFORMATION / SECTIONAL DRAWING for proper identification of parts.

拆卸泵时，匹配标记、标记或以其他方式识别所有零件，并把小零件单独装起来放好。有关零件的正确识别，请参考第十节零件信息/剖面图中包含的泵剖面图。

7. To separate pump cover from pump case, first remove the stud nuts, then use back-off screws in the taps provided to break the cover-to-case gasket joint.

为了把泵盖与泵壳分离，首先拆下双头螺栓螺母，然后在丝锥中使用倒扣螺钉来断开盖与壳之间的垫圈接头。

8. Remove the nuts from the studs that fasten the casing cover with the bearing housing.

从将外壳盖与轴承壳固定的螺柱上拆下螺母。

9. Remove the pump cover-bearing housing assembly by providing a chain or sling support for the assembly.

通过为组件提供链条或吊索支撑，拆下泵盖轴承壳体组件。



- Avoid bumping the impeller or the pump half coupling.
避免碰撞叶轮或泵半联轴器。

10. After removal, place the pump cover-bearing housing safely on suitable horizontal supports.

拆卸后，将泵盖轴承壳安全放置在合适的水平支架上。

11. To remove the impeller, first remove the cover-to-case gasket, and then remove the impeller nut, impeller, and key.

要拆下叶轮，首先拆下盖对壳垫圈，然后拆下叶轮螺母、叶轮和键。

- Do not heat the impeller. 不要加热叶轮。

12. Exercise care and remove mechanical seal as follows: 小心操作，拆卸机械密封，按照以下步骤操作：

- a) If seal has an outside drive collar, engage seal setter, then loosen setscrews prior to removal of assembly.

如果密封件有外部驱动轴环，则连接密封件定位器，然后在拆卸组件之前松开定位螺钉。

- b) Remove bearing housing-to-cover cap screws. 拆下轴承箱至盖的有盖螺钉。
- c) Slide pump cover, with seal attached, off pump shaft. Place the cover, with seal flange facing upward, on worktable.

将带有密封件的泵盖滑离泵轴。将密封法兰朝上的盖子放在工作台上。

- d) Apply protective wrap and store seal components. Refer to seal manufacturer's literature for disassembly, inspection, cleaning, and reassembly of the mechanical seal.

应用保护性包装并储存密封部件。关于机械密封的拆卸、检查、清洁和重新组装，请参考密封制造商的文件。

13. Disassemble the bearing housing as follows: 按以下步骤拆卸轴承箱:

- a) Remove pump half coupling and key. Application of heat is required for the removal and replacement of pump half coupling. Use a puller tool to remove the pump half coupling.

拆下泵半联轴器和键。拆卸和更换泵半联轴器需要加热。使用拉具工具拆下泵半联轴器。

- Use a safe heating method and provide protection for personnel handling the heated half coupling.



- 用安全加热方法，处理加热半联轴器的人员要有保护措施。

- b)  led bearings only, remove self-tapping screws and remove the fan housing from bearing bracket.

仅适用于风扇冷却轴承，拆下自攻螺钉并从轴承支架上拆下风扇外壳。

- c) Unscrew and remove the exterior radial cover and the exterior thrust cover.

拧下并拆掉外部径向盖和外部止推盖。

- d) Pump shaft can only be removed in one direction. Press pump shaft from impeller end through the bearing housing. Remove radial bearing from shaft and remove oil rings if applicable. Remove locknut, lock washer, and remove thrust bearings from shaft.

泵轴只能沿一个方向拆卸。将泵轴从叶轮端压过轴承壳。从轴上拆下径向轴承，如果合适，拆下油环。拆下锁紧螺母、锁紧垫圈，并从轴上拆下推力轴承。

- e) Remove the inside radial and thrust covers with their respective labyrinth seals.

拆下内部径向和推力盖及其各自的迷宫式密封。

8.2 INSPECTION AND CLEANING 检查与清理

1. Thoroughly clean all parts and dry them with compressed air or a clean, lint free cloth.

彻底清洁所有零件，并用压缩空气清洁或干净的无绒布擦干。

2. Inspect all components for corrosion, erosion, pitting, and scoring. If required, replace with Ruhrpumpen O.E.M. genuine replacement parts.

检查所有部件是否有腐蚀、侵蚀、点蚀和划痕。如有必要，用鲁尔泵欧美华原装来替换零件。

- a. Visually check all individual parts for any damage.视检所有单个零件是否有损坏。
- b. Check the casing for wear.检查套管是否磨损。
- c. Check the impeller for wear.检查叶轮是否磨损。

To remove wear rings, first remove screw pins (if not welded), then either machine the wear rings off, or remove by segmenting with a diamond pointed chisel tool. Replacement wear rings are installed by a light shrink fit (see SECTION 8.3 - REASSEMBLY).

要移除磨损环，首先移除螺旋销(如果没有焊接)，然后加工掉磨损环，或者用金刚石尖凿工具分割移除。替换磨损环通过轻度收缩配合安装(参见第8.3节-重新装配)。

- d. Check the radial clearance for wear. 检查径向间隙是否磨损。
- e. Check the antifriction bearings.检查减摩轴承。
- f. Check all auxiliary piping.检查所有辅助管道。
- g. Check for transmission elements of the coupling.检查联轴器的传动元件。
- h. Set pump shaft between the centers and indicate shaft run out. Shaft run out should not exceed 0.001 inch (0.0254 mm) T.I.R.

将泵轴设置在中心之间，并让轴开始跳动。轴的跳动不应超过0.001英寸(0.0254毫米)

- i. Inspect the mechanical seal to detect wear. Even the minimal damage to the mechanical seal means its components have to be replaced.

用检查机械密封来检测磨损。即使对机械密封的损坏很小，但也意味着必须更换部件了。

- j. Replace all the gaskets and o-rings.更换所有垫圈和o形圈。

8.3 REASSEMBLY 重组

Reassemble as follows: 重组步骤如下:



ATTENTION

ATTENTION

ATTENTION

- Observe the plant's safety precautions when lifting heavy components. Request help when moving or positioning them.
- 起吊重型部件时，遵守工厂的安全预防措施。移动或定位时可以请求别人帮助。
- Mounting of bearings should be carried out in a dry, dust free area away from metal working or other machines producing shavings and dust to avoid contamination of bearings.
- 轴承的安装应在干燥、无尘的区域进行，远离金属加工或其他产生刨花和灰尘的机器，以避免污染轴承。
- The bearings should remain in their original packaging. Once they are to be assembled in the shaft, they must be removed from their packaging, and the preservative in the outside diameter and the bore must be wiped out.
- 不要拆掉轴承的原始包装。一旦组装在轴上，就必须拿开包装，并且必须清除掉外径和孔中的防腐剂。

1. Put oil in the shaft to lubricate the bearing installation and preservation of parts.

在轴中倒油，用来在安装和零件保存时润滑轴承。

2. Place and heat the two thrust bearings in an induction heater. Turn on the heater. Continuously measure the temperature of the inner race, looking to reach 230 °F (110 °C).

将两个推力轴承放置在感应加热器中并加热。打开加热器。连续测量内圈的温度，最好达到 230 华氏度(110 摄氏度)。

ATTENTION

- Measure the temperature continuously with an infrared thermometer, pointing to the inner race of the bearings.
- 红外温度计指向轴承内圈，连续测量温度。

3. Position the shaft vertically (with the coupling side upward) in a press.

将轴垂直放置在压力机上(联轴器侧朝上)。

- Cover the jaws of the press with soft material to prevent damaging the shaft.
- 用软材料覆盖在压机钳口上，以防止轴损坏。

4. As soon as the bearings have reached the temperature of 230 °F (110 °C), place the bearings on the shaft in a back to back arrangement (the serial numbers in the outer race are in contact between the two bearings).

轴承温度达到 230° F (110° C)后，将轴承背对背放置在轴上(外圈的序列号在两个轴承之间有接触)。



- Wear sufficient hand protection to avoid personal injury.
穿戴好足够厚的手部保护，以避免人身伤害。



Figure 8.1 Placing the thrust bearings into the shaft.
图8.1将推力轴承装上轴。

5. With the locknut, but not the lock washer, tighten with a spanner wrench until snug, to ensure that there is no gap between both thrust bearings.

使用锁紧螺母，但不使用锁紧垫圈，用扳手拧，直到拧紧为止，以确保两个推力轴承之间没有间隙。



- Important: wait until both bearings have cooled down to room temperature before starting the next step. This cooling period is critical to ensure the final contraction of both bearings before the next adjustments.
- 重要提示:等到两个轴承都冷却到室温后，再开始下一步。这个冷却周期对于确保下一次调整前两个轴承的最终收缩至关重要。

6. Now, remove the locknut and position the lock washer so that it is in contact with the thrust bearings on the coupling side. The tab on the lock washer inner diameter must be bent to fit into the small keyway recess cut into shaft threads, to prevent rotation of the bearing locknut.

现在，拆下锁紧螺母并定位锁紧垫圈，使其与联轴器侧的止推轴承接触。锁紧垫圈内径上的凸舌必须弯曲，以配合切入轴螺纹的小键槽，防止轴承锁紧螺母旋转。



Figure 8.2 Positioning the lock washer into the shaft.
图8.2将锁紧垫圈定位到轴中。

7. Position the locknut with the taper towards the side of the lock washer at full-stop.
将带锥度的锁紧螺母在完全停止时朝向锁紧垫圈的一侧放置。

8. Tighten the bearing locknut as tight as possible by hand using a spanner wrench. Now, with the help of a hammer and the spanner wrench, advance the locknut at least one-eighth ($1/8$) and up to one-quarter ($1/4$) turn, to firmly snug the assembly, ensuring, at the end of the tightening process, that one of the lock washer tabs lines up with the slots in the locknut.

用扳手尽可能拧紧轴承锁紧螺母。现在，在锤子和扳手的帮助下，将锁紧螺母推进至少八分之一 ($1/8$) 或最多四分之一 ($1/4$) 圈，来固定组件，确保在拧紧完时，其中一个锁紧垫圈凸片与锁紧螺母中的槽对齐。



Figure 8.3 Placing the locknut into the shaft.

图 8.3 将锁紧螺母放入轴中。

9. The tab that aligns with one of the slots is bent into the slot so it works as a lock and the locknut cannot be loosened. Use a screwdriver and a hammer.

与其中一个槽对齐的凸舌弯曲到槽中，它起到锁的作用，锁紧螺母不能松开。可以使用螺丝刀和锤子来操作。

- Inspection point: Inspect that the bearings are adjacent to each other, and that both are assembled seated against the shaft shoulder. The thrust bearings must be able to run in opposite directions; if one or the other cannot rotate, there is a problem with the assembly.



- 检查点: 检查轴承是否彼此相邻，以及两者是否安装在轴肩上。推力轴承必须能够以相反的方向运行；如果这一个或另一个不能旋转，则组件有问题。

10. Now take the shaft out of the press and turn it over 180° , place it back in the press to reassemble the radial bearing.

现将轴从压力机中取出，翻转 180° 度，放回压力机中重新组装径向轴承。

11. In case of radial roller bearing, place only the inner race of the radial bearing in an induction heater. Turn on the heater and continuously measure the temperature of the inner race, looking to reach 230 °F (110 °C).

如果是径向滚柱轴承，请仅将径向轴承的内圈放入感应加热器中。打开加热器，持续测量内圈的温度，最好达到 230° F (110° C)。

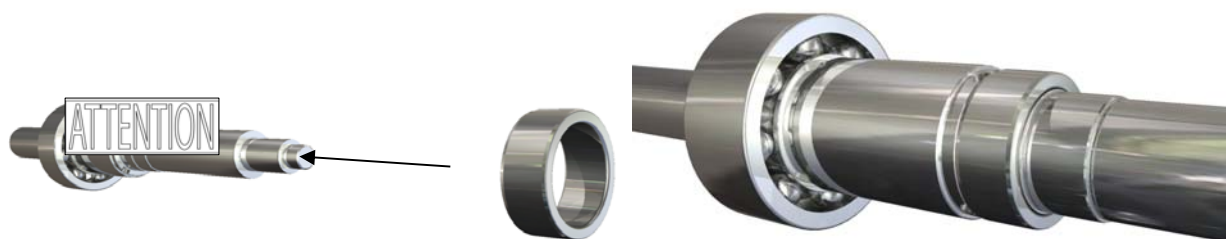


Figure 8.4 Placing the inner race of the radial bearing into the shaft.

图8.4将径向轴承的内圈放入轴中。



- Measure the temperature continuously with an infrared thermometer.
- 用红外温度计连续测量温度。

12. Put some oil to lubricate the shaft's radial-bearing area for bearing installation and preservation of parts.

放一些油在润滑轴的径向轴承区域，用于轴承安装和零件保存。

13. In case of radial ball bearing, insert the oil rings at the shaft. As soon as the bearing reaches the 230 °F (110 °C) temperature, it is manually positioned in the shaft (with the serial number visible from the outside). The bearing is maintained in position until it cools down enough to stay in place (to room temperature).

如果是径向滚珠轴承，将油环插入轴上。轴承一达到230° F (110° C)温度，就手动调位放在轴上(从外面可以看到序列号)。轴承保持在适当位置，直到冷却到足以保持在适当位置(室温)。



- Wear sufficient hand protection to avoid personal injury.
穿戴好足够的手部保护物，以避免人身伤害。
- Inspection point: Now that both thrust bearings and the radial bearing/radial bearing's inner race have been reassembled in the shaft, make sure that there is no gap between both thrust bearings, by holding them and trying to move them.



- 检查点:既然两个推力轴承和径向轴承/径向轴承的内圈已经在轴上重新组装，握住它们试着移动，确保两个推力轴承之间没有间隙。
- Protect the bearings with oil and cling wrap plastic if you are not going to continue the assembling process immediately. When resuming the assembling

process, remove this protection

- 如果不打算马上继续装配过程，用油保护轴承，并用保鲜膜包好塑料。恢复装配过程时，移除此保护。

We should now assemble the interior bearing covers directly to the bearing bracket.

现在应该将内部轴承盖直接组装到轴承支架上。

14. Insert the grease retainer NDE in the bearing bracket radial side making sure of placing the corresponding locating hole.

将护脂圈 NDE 插入轴承支架径向侧，确保放置在相应的定位孔。

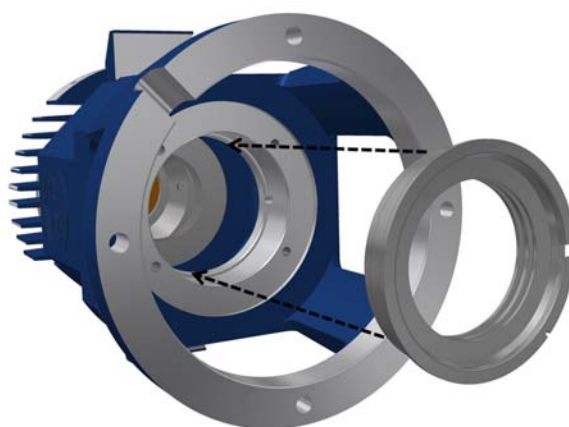


Figure 8.5 Inserting the grease retainer NDE in the bearing bracket radial side.

图8.5将护脂圈NDE插入轴承支架径向侧。

15. Next, place the spring pin in the corresponding location hole in the grease retainer NDE.

接下来，将弹簧销放入护脂圈 NDE 的相应位置孔中。

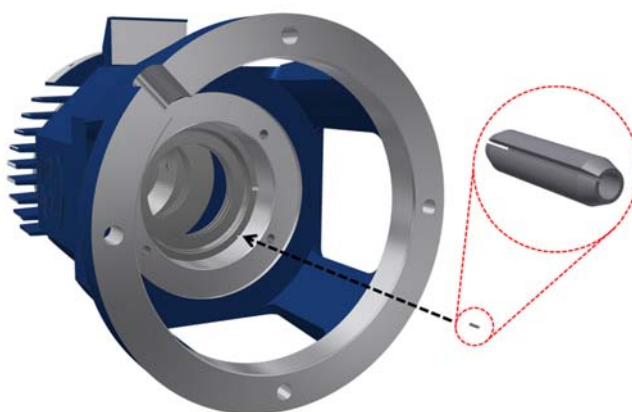


Figure 8.6 Placing the spring pin in the corresponding location hole in the grease retainer NDE.

图 8.6 将弹簧销放置在护脂圈 NDE 的相应位置孔中。

This locating spring pin must not be above or at level, but completely inside the grease retainer NDE. The locating spring pin allows the correct alignment of the channels for the grease fittings.

该定位弹簧销不得高于或处于水平位置，必须完全位于护脂圈 NDE 内。定位弹簧销应该与润滑油嘴的加油道准确对齐。



- Machining of the grease outlet in the interior axial/thrust bearing cover must be aligned with its corresponding machining in the bearing bracket.
- 内部轴向/推力轴承盖中油脂出口的加工必须与其在轴承支架中的相应加工对齐。

16. Insert the grease retainer DE in the bearing bracket axial side and make sure of matching the corresponding locating hole.

将护脂圈DE插入轴承支架轴向侧，并确保与相应的定位孔匹配。



Figure 8.7 Inserting the grease retainer DE in the bearing bracket axial side.

图8.7将护脂圈DE插入轴承支架轴向侧。

17. Place the spring pin in the corresponding locating hole in the grease retainer DE.

将弹簧销放入护脂圈 DE 的相应定位孔中。

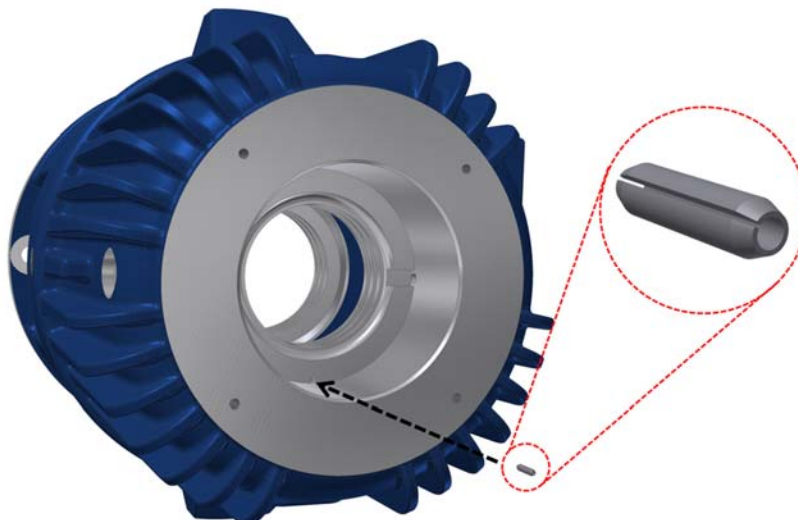


Figure 8.8 Placing and locating the spring pin in the grease retainer DE.
图 8.8 将弹簧销放置和定位在护脂圈 DE 中。

This locating spring pin must not be above or at level, but completely inside the grease retainer DE. The locating spring pin allows the correct alignment of the channels for the grease fittings.

该定位弹簧销不得高于或处于水平位置，必须完全位于护脂圈 DE 内。定位弹簧销应该与润滑油嘴的加油道准确对齐。



- Machining of the grease inlet in the interior radial bearing cover must be aligned with its corresponding machining in the bearing bracket.
- 内部径向轴承盖中润滑脂入口的加工必须与其在轴承支架中的相应加工一样对齐。

18. This step applies only for pumps with a radial roller bearing. You will need a hard plastic block. After oiling the bearing races and the bracket, position the outer race of the radial roller bearing (this must be aligned to ensure a correct assembly). Now, with a rubber mallet, hit (softly) the hard plastic block to insert the outer race all the way in (ensure the sleeve or block dimensions are similar to the outer race of the bearing).

此步骤仅适用于带有径向滚柱轴承的泵。你需要一个硬塑料块。给轴承座圈和支架上油后，定位径向滚柱轴承的外座圈(必须对齐以确保正确装配)。现在，用橡皮锤(轻轻地)敲击硬塑料块，将外圈插入(确保套筒或块的尺寸与轴承的外圈相似)。

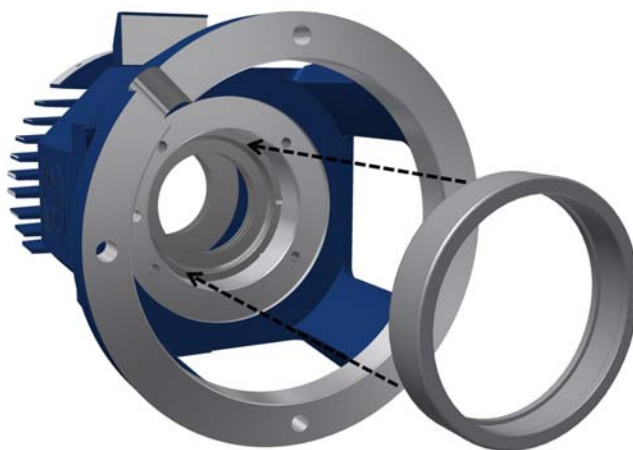


Figure 8.9 Placing the outer race of the radial roller bearing into the bearing bracket radial side.

图 8.9 将径向滚柱轴承的外座圈放入轴承支架径向侧。

ATTENTION

- Check visually that the outer race of the radial roller bearing has reached its limit within the housing, resting over the interior radial bearing cover.
- 视检径向滚柱轴承的外座圈是否已达到其在壳体內的极限，搁置其于内部径向轴承盖上。

19. With the bearing bracket in a vertical position (resting on the radial side), place the shaft assembly (moving the shaft downwards with the radial side of the shaft facing down) in the bearing bracket (from the coupling or thrust side of the bearing housing) until the array of the axial/thrust bearings seats completely on the shoulder.

轴承支架处于垂直位置(靠在径向侧)，将轴组件(轴的径向侧朝下移动轴)放置在轴承支架中(从轴承壳体的联轴器或止推侧)，直到轴向/止推轴承阵列完全位于肩部位置。



Figure 8.10 Placing of the shaft assembly into the bearing bracket.

图 8.10 将轴组件放入轴承支架。

20. Position the bearing cover NDE gasket in the bearing cover NDE ensuring that all the openings match.

将轴承盖无损检测垫圈放置在轴承盖无损检测中，确保所有开口匹配。

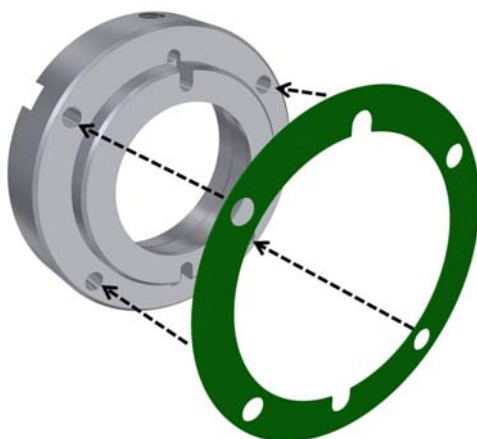


Figure 8.11 Positioning the bearing cover NDE gasket in the bearing cover NDE.

图 8.11 将轴承盖无损检测垫圈放在轴承盖无损检测中。



- Do not use a hydraulic press, since the seal can be broken.
- 不要使用液压机，密封可能会导致其破裂。

21. Manually position the bearing cover NDE on the bearing bracket radial side ensuring the cover is rotated in the correct position.

手动将轴承盖 NDE 放在轴承支架径向侧，确保盖旋转到正确的位置。

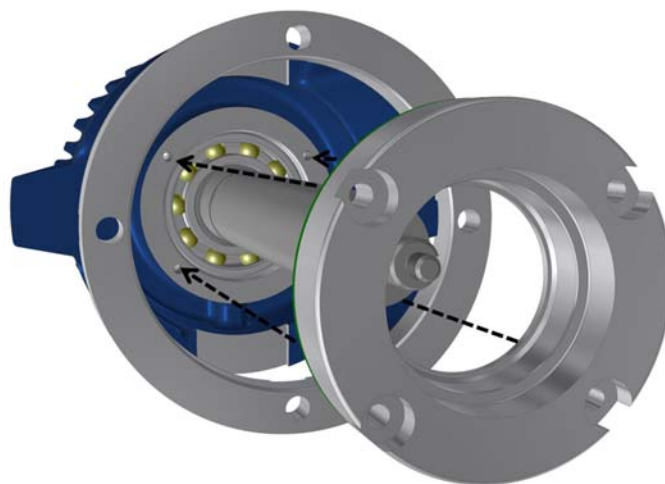


Figure 8.12 Positioning the bearing cover NDE in the bearing bracket radial side.

图 8.12 将轴承盖 NDE 放在轴承支架径向侧。

22. Position the socket head hex bolts (bracket sizes 35 & 55) or hex bolts (bracket size 75), previously protected with anti-seize, by hand.

手动放置之前用防咬合保护的內六角螺栓(支架尺寸 35 和 55)或六角螺栓(支架尺寸 75)。之前用防咬合保护。

23. Now tighten these bolts diagonally (crosswise) to ensure correct reassembly.

现在对角(交叉)拧紧这些螺栓，以确保正确重新组装。

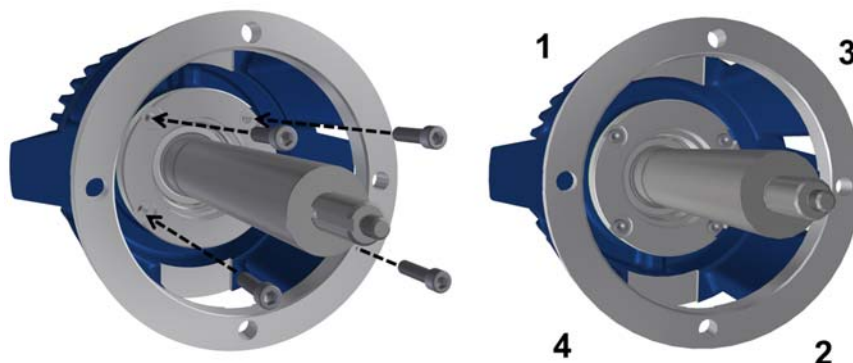


Figure 8.13 Placing and tightening the socket head hex bolts in the bearing bracket NDE.

图 8.13 将内六角螺栓放置在轴承支架 NDE 中并拧紧。



- Make sure that the gasket has not moved out or is not pinched during the process.
- 确保垫圈在加工过程中没有移出或被挤压。

24. Insert and press the labyrinth seal NDE into the bearing cover NDE

将迷宫式密封 NDE 插进并压入轴承盖 NDE 中。

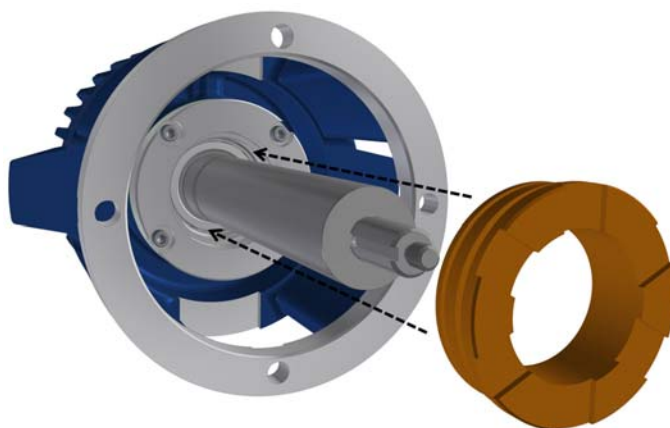


Figure 8.14 Inserting and tightening the labyrinth seal NDE in the bearing cover NDE

图8.14将迷宫式密封NDE插入轴承盖NDE并拧紧

25. Once the labyrinth seal NDE has been placed it needs to be locked by the retaining ring inserted in the radial side of the shaft.

一旦迷宫式密封 NDE 放好了，它需要用嵌入式轴径向侧的扣环锁定。

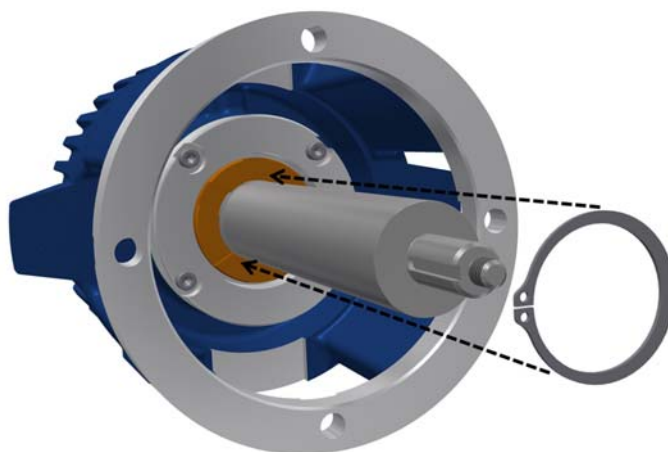


Figure 8.15 Inserting and placing the retaining ring in the radial side of the shaft

图8.15将扣环插入并放置在轴的径向侧

26. Insert the grease fitting and the hex plug on the correct place for radial lubrication.

将润滑油嘴和六角塞头插入径向润滑到正确位置。



Figure 8.16 Inserting the grease fitting and the hex plug on the radial side.

图8.16将润滑油嘴和六角塞头插入径向侧。

27. Hit (softly) the shaft on the coupling side to ensure the correct assembly.

轻敲联轴器侧的轴以确保正确安装。



- Inspection point: After this assembly, the shaft must be able to rotate by hand; however, there is some resistance to make it turn due to the action of the labyrinth seals.
- 检查点: 组装后, 轴必须能够手动旋转; 然而, 由于迷宫式密封的作用, 转动时会存在一些阻力。

28. On the axial/thrust side, use one or several hard plastic flat surfaces to hit (softly) the axial antifriction bearings with a rubber mallet, to ensure that the anti-friction bearings are completely in contact with the shoulder of the bearing bracket.

在轴心/推力侧, 用一个或几个硬塑料平面用橡胶锤(轻轻地)撞击轴心减摩轴承, 以确保减摩轴承完全与轴承支架的肩部接触。

29. In the case of bracket sizes 35 & 55, insert and place the round section joint ring (O-ring) in the bearing cover DE.

如果支架尺寸为 35 和 55，将圆形截面的连接环(O 形环)插入并放置在轴承盖 DE 中。

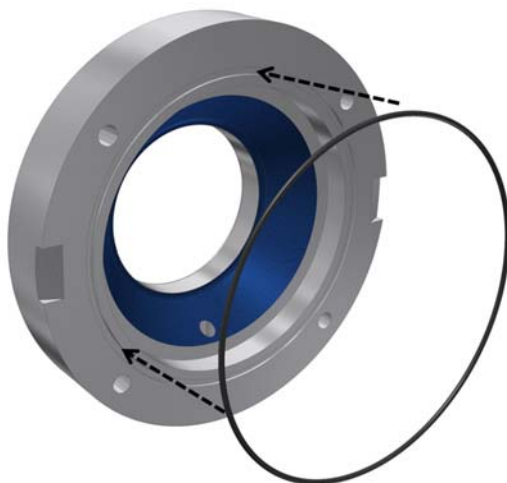


Figure 8.17 Inserting and placing the round section joint ring in the bearing cover.

图8.17将圆形截面连接环安插并放置在轴承盖中。

30. In the case of bracket size 75, position the bearing cover DE gasket in the bearing cover DE ensuring all the openings match.

在支架尺寸为 75 的情况下，将轴承盖 DE 垫圈放置在轴承盖 DE 中，确保所有开口匹配。

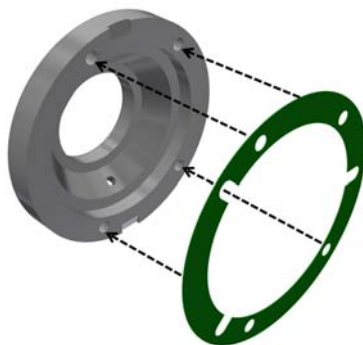


Figure 8.18 Positioning of the bearing bracket DE gasket in the bearing cover DE.

图8.18轴承支架DE垫圈在轴承盖DE中放置。

31. Position manually the bearing cover DE on the bearing bracket axial side ensuring the cover is rotated in the correct position.

手动将轴承盖 DE 放置在轴承支架轴心侧，确保盖旋转到正确的位置。

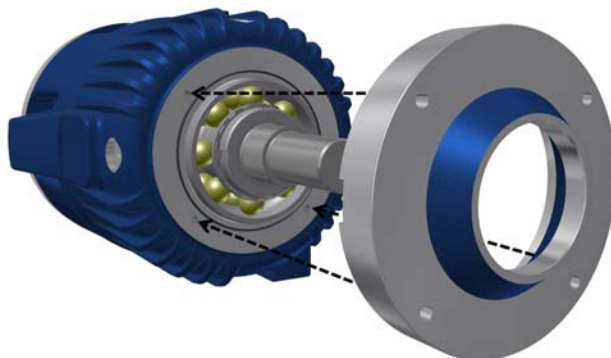


Figure 8.19 Positioning the bearing cover DE in the bearing bracket axial side.

图8.19将轴承盖DE定位在轴承支架轴心侧。

32. Position the hex bolts (previously protected with anti-seize) by hand.

手动调放好六角螺栓(以前用防扣装置保护)。

33. Now tighten these bolts diagonally (crosswise) to ensure a correct reassembly.

对角(交叉)拧紧这些螺栓，以确保正确重新组装。

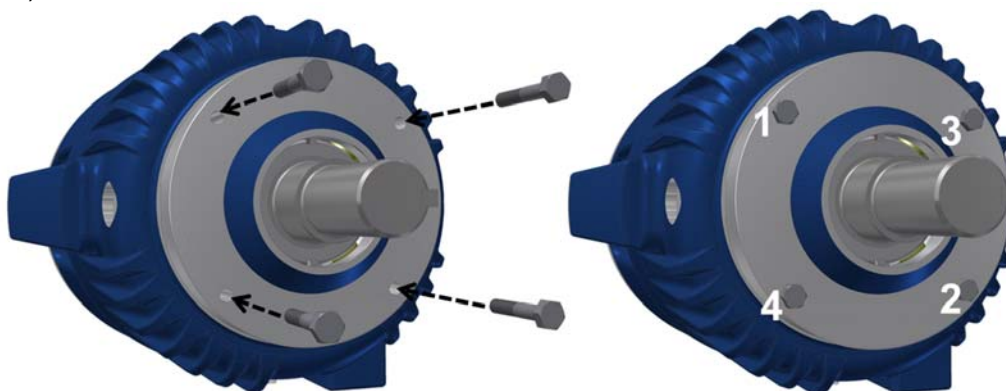


Figure 8.18 placing and tightening the hex bolts in the bearing cover DE.

图8.18将六角螺栓放置并拧紧在轴承盖DE中。

ATTENTION

- Make sure that the round section joint (O-Ring) or bearing cover DE gasket has not moved out or is not pinched during the process.
- 确保圆形截面接头(O形环)或轴承盖DE垫圈在加工过程中没有移出或被挤压。

34. Then insert and press the labyrinth seal DE into the bearing cover DE.
然后将迷宫式密封DE插入并压入轴承盖DE中。

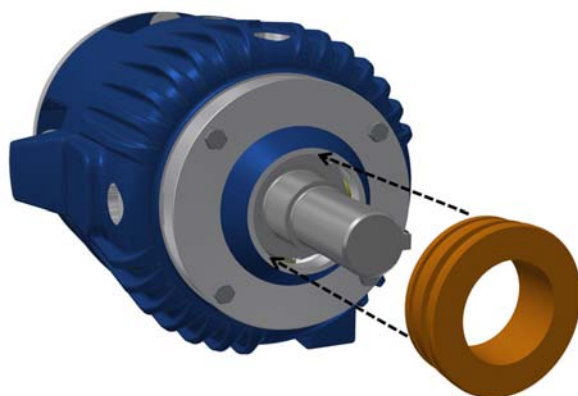


Figure 8.21 Inserting and tightening the labyrinth seal DE in the bearing cover DE.

图 8.21 在轴承盖 DE 中插入并拧紧迷宫式密封 DE。

35. Then insert the grease fitting and hex plug in the correct place for axial lubrication.
然后将润滑油嘴和六角塞头插入轴向润滑到正确位置。

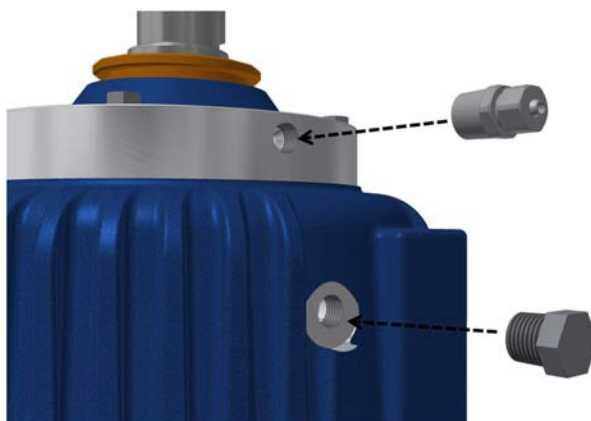


Figure 8.22 Inserting the grease fitting and hex plug on the axial side.

图8.22在轴向侧插入润滑油嘴和六角塞头。

ATTENTION

- Apply pipe tape sealant only if it is a pass-through thread.
- 仅当管道胶带是贯穿螺纹时，才涂抹管道胶带密封剂。

ATTENTION

- Inspection point: Check visually that all the threads in the bearing bracket have a plug installed (no thread should remain free after this step).
- 检查点:目视检查轴承支架中的所有螺纹是否安装了塞子(在此步骤后，任何螺纹都不能松)。

Wear rings may have been welded or screwed. In case of the screwed ones, follow the next steps, except where welding is indicated. In that case, replace welding with screws.

磨损环可能已经焊接或拧紧。如果是螺纹连接的，除非显示焊接的，否则请遵循下一步。在这种情况下，用螺钉替换焊接。

36. To insert the casing cover wear ring into the casing cover, follow these steps:

将套管盖耐磨环插入套管盖，按下步骤操作：

- a. Place the casing cover wear ring in the freezer for 3 hours, to shrink it and facilitate the reassembly of the casing cover.

将外壳盖磨损环冰冻 3 小时，使其收缩，便于外壳盖的重新组装。

- b. Insert the casing cover wear ring completely to the shoulder on the casing cover using a rubber mallet.

使用橡皮锤将套管盖耐磨环完全插入套管盖上的肩部。

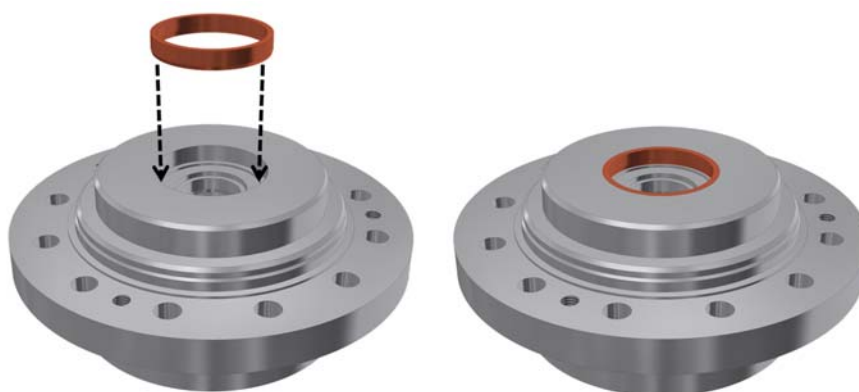


Figure 8.20 Placing the casing cover wear ring in the casing cover.

图 8.20 将套管盖耐磨环放置在套管盖中。



- Insert the casing cover wear ring so that the shoulder rests towards the inside of the casing cover.
- 插入套管盖耐磨环，使肩部朝向套管盖内部。

- c. Mark at approximately 120°, three evenly spaced points in the outer diameter of the casing cover wear ring.

在套管盖耐磨环外径上大约 120° 处标记三个均匀间隔的点。

- d. Tack weld at these three points. The length of the tacks are ¼ inch (6.35 mm) for rings with a 4 inch (100 mm) diameter or under, and ½ inch (12.7 mm) for rings with a diameter over 4 inches (100 mm).

在这三点进行点焊。对于直径为 4 英寸(100 mm)或更小的环, 所用大头钉的长度为英寸(6.35 mm), 对于直径超过 4 英寸(100 mm)的环, 所用大头钉的长度为英寸(12.7 mm)。

- e. The weld points are polished to give them a finish.

焊接点经过抛光处理, 使其光滑。

37. In the inner diameter of the casing cover, the stuffing box bushing is positioned. To do this, insert the stuffing box bushing with the rubber mallet to the limit (it is installed by the outer side of the casing cover). Tack weld at two evenly spaced points (at 180°). The length of the tacks are ¼ inch (6.35 mm) for rings with a 4 inch diameter or under, and ½ inch (12.7 mm) for rings with a diameter over 4 inches. The weld points are polished to give them a finish.

在外壳盖的内径中, 放好填料箱衬套。为此, 用橡皮锤将填料函衬套插入极限位置(它安装在外壳盖的外侧)。在两个均匀间隔的点(180 度)上点焊。对于直径为 4 英寸或更小的环, 所用大头钉的长度为英寸(6.35 mm), 对于直径超过 4 英寸的环, 所用大头钉的长度为英寸(12.7 mm)。焊接点完成后要抛光。



Figure 8.24 Positioning the throat bushing in the casing cover.

图 8.24 将喉部衬套放在套管盖中。



- Inspection point: Check visually that the rings are assembled to their corresponding limits in the casing cover. Check that all welded points are polished.
- 检查点: 目视检查环是否装配到外壳盖中的相应极限位置。检查所有焊接点是否抛光。

38. To place the wear ring that works with the casing, follow these steps:

放置与外壳配合使用的耐磨环, 按以下步骤操作:

- a. Place the casing wear ring in the freezer for 3 hours, to shrink it and facilitate the reassembly of the casing.

将外壳耐磨环冰冻 3 小时, 使其收缩, 便于外壳的重新组装。

- b. Insert it in its position (to the limit) with a rubber mallet.

用橡皮锤将其嵌入其位置(至极限)。



Figure 8.25 Placing the casing wear ring in the volute casing.

图 8.25 将壳体耐磨环放置在螺旋壳中。

- Insert the casing wear ring so that the shoulder rests towards the inside of the casing cover.
 - 插入套管磨损环，使肩部朝向套管盖内部。
- c. Mark at approximately 120° three evenly spaced points in the outer diameter of the casing wear ring.
- 在套管磨损环外径上大约 120° 处标记三个均匀间隔的点。
- d. Tack weld at these three points. The length of the tacks are ¼ inch (6.35 mm) for rings with a 4 inch diameter or under, and ½ inch (12.7 mm) for rings with a diameter over 4 inches (100 mm).
- 在这三点进行点焊。对于直径为 4 英寸或更小的环，所用大头钉的长度为英寸(6.35 mm)，对于直径超过 4 英寸(100 mm)的环，所用大头钉的长度为英寸(12.7 mm)。
- e. The weld points are polished to give them a finish.
- 焊接点经过抛光处理，使其光亮。



- Inspection point: Check visually that the casing wear ring is assembled to the limit of the volute casing. Check that the three welded points are polished.
- 检查点:目视检查外壳耐磨环是否装配到螺旋壳的极限位置。检查三个焊接点是否抛光。

39. To position the impeller wear rings, follow these steps:

定位叶轮磨损环，按以下步骤：

- a. Each of the impeller wear rings (two, one for each side) is inserted into its position (to the limit where it stops) with the rubber mallet.

用橡皮锤将每个叶轮耐磨环(两个，每侧一个)插入其位置(到其停止位置的极限)。

- b. Mark at approximately 120° three evenly spaced points in the outer diameter of the impeller wear ring.

在叶轮耐磨环外径上大约 120° 处标记三个均匀间隔的点。

- c. Tack weld at these three points. The length of the tacks are ¼ inch (6.35 mm) for rings with a 4 inch diameter or under, and ½ inch (12.7 mm) for rings with a diameter over 4 inches (100 mm).

在这三点进行点焊。对于直径为 4 英寸或更小的环，所用的大头钉的长度为英寸(6.35 mm)，对于直径超过 4 英寸(100 mm)的环，所用的大头钉的长度为英寸(12.7 mm)。

- d. The weld points are polished to give them a finish.

焊接点经过抛光处理，使其光亮。

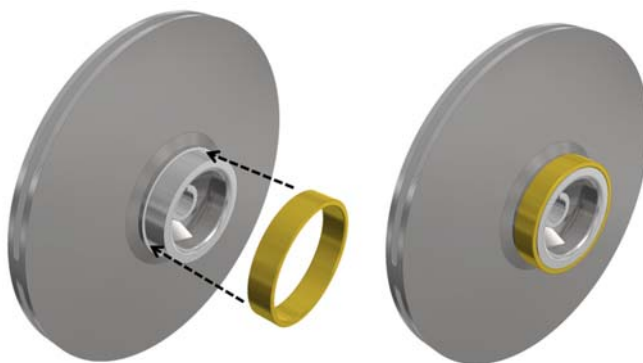


Figure 8.26 Placing the impeller wear ring (eye side) into the suction side of the impeller.

图 8.26 将叶轮耐磨环(眼侧)放入叶轮的吸入侧。

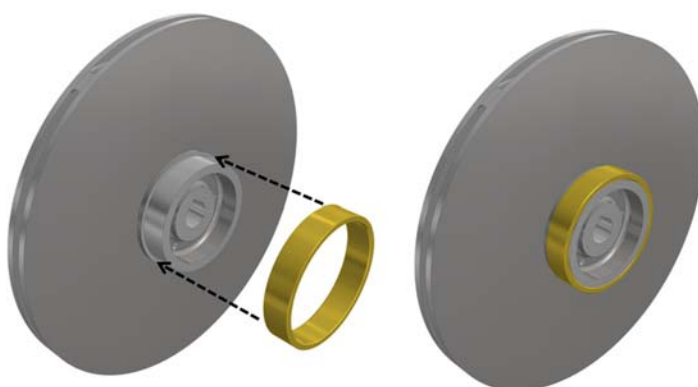


Figure 8.27 Placing the impeller wear ring (hub side) into the coupling side of the impeller.

图 8.27 将叶轮耐磨环(轮毂侧)放入叶轮的联轴器侧。



- Inspection point: Check visually that each of the impeller wear rings are

assembled to its corresponding limit on each side of the impeller. Check that all welded points are polished.

- 检查点:目视检查每个叶轮磨损环是否装配到叶轮每一侧的相应极限位置。检查所有焊接点是否抛光。

40. To place the mechanical seal in the casing cover, first check the drawing of the mechanical seal, to be sure of assembling the seal at its correct position.

要在外壳盖中机械密封，首先检查机械密封的图纸，确保将密封装配在正确的位置。

Now:现在

- Install the mechanical seal in the casing cover with the four studs and nuts.

用四个螺柱和螺母将在外壳盖上进行机械密封安装。

- Tighten these bolts diagonally (crosswise) to ensure correct assembly.

对角(交叉)拧紧这些螺栓，以确保正确组装。



- Inspection point: The pump shaft must be able to rotate without problems.
- 检查点:泵轴必须能够旋转无误。

41. To assemble the bearing bracket with the casing cover, follow these steps:

将轴承支架与外壳盖组装在一起，按以下步骤操作：

- Lay the casing cover down with the bearing bracket mounting surface up.

放低外壳盖，轴承支架安装面朝上。

- Lift the assembly of the bearing bracket and position it over the casing cover shoulder.

提起轴承支架组件，并将其放置在外壳盖肩部上。

- Position the bolts (previously protected with anti-seize) by hand.

用手定位好螺栓(以前用防扣装置保护)。

- Tighten these bolts diagonally (crosswise) to ensure the correct assembly.

对角(交叉)拧紧这些螺栓，以确保正确组装。

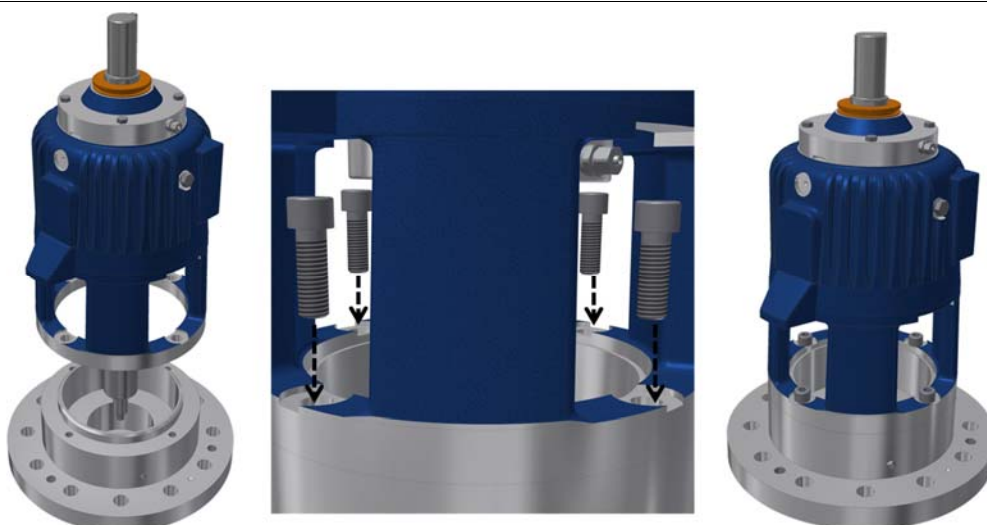


Figure 8.28 Placing the bearing bracket assembly with the casing cover.

图 8.28 将轴承支架组件与外壳盖放在一起。

42. To assemble the impeller on the pump shaft:

在泵轴上装叶轮步骤:

- a. Position the impeller key in the pump shaft.

将叶轮键放在泵轴中。

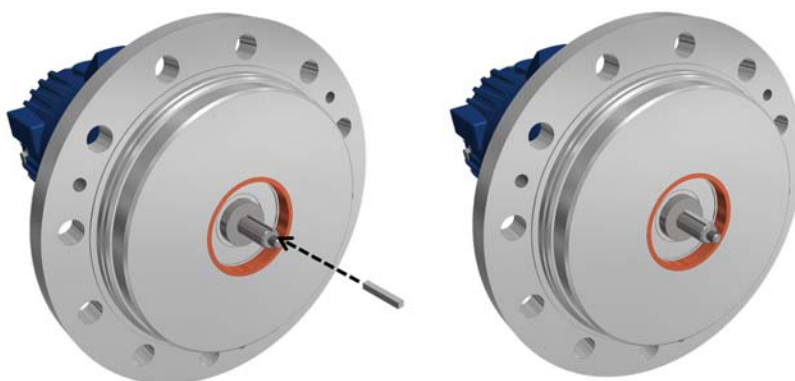


Figure 8.29 Positioning the impeller key in the shaft.

图 8.29 将叶轮键定位在轴中。

- b. Now position the impeller on the pump shaft until it stops on the shoulder.

现在将叶轮放在泵轴上，直到叶轮停在肩部。



- Make sure that the suction side of the impeller is directed towards the opposite side.

- 确保叶轮的吸入侧朝向相反侧。

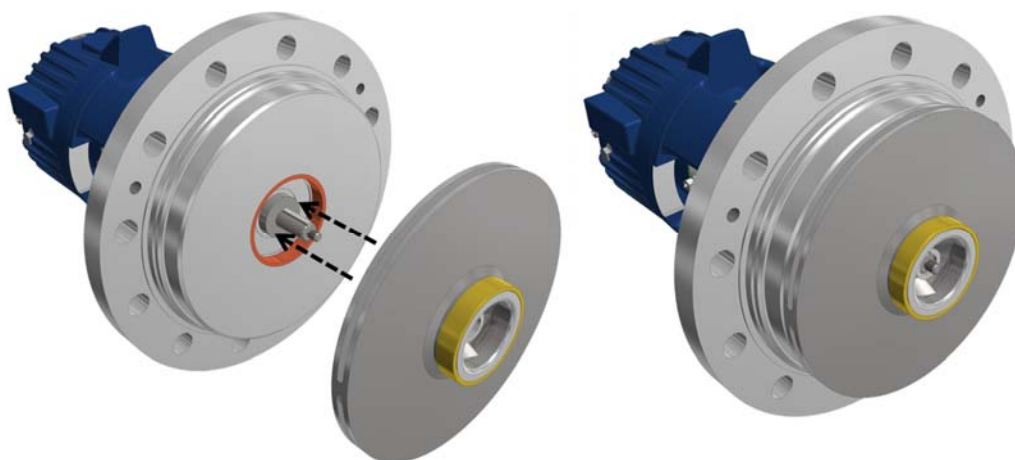


Figure 8.30 Introducing the impeller into the pump shaft.

图 8.30 将叶轮引入泵轴。

- c. Install the impeller nut ensuring it completely seats on the impeller (a pneumatic wrench is used).

安装叶轮螺母，确保其完全固定在叶轮上(用气动扳手)。

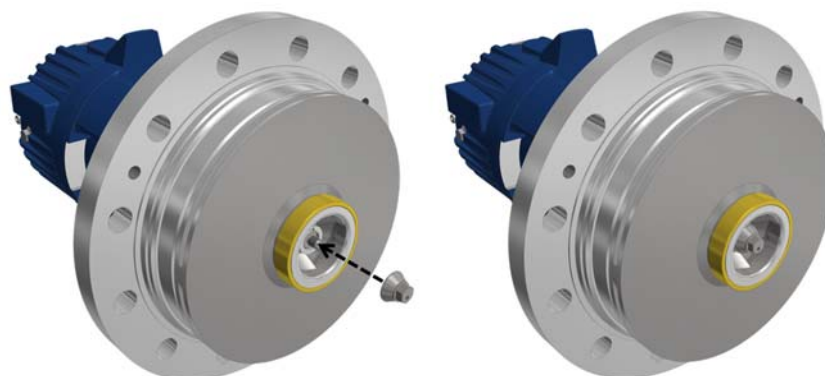


Figure 8.31 Installation of the impeller nut to tighten the impeller.

图8.31安装叶轮螺母以拧紧叶轮。

- d. Install the socket set screw with loctite and tighten it with an Allen key to secure the impeller nut.

用安装套筒固定螺钉，并用内六角扳手拧紧，以固定叶轮螺母。

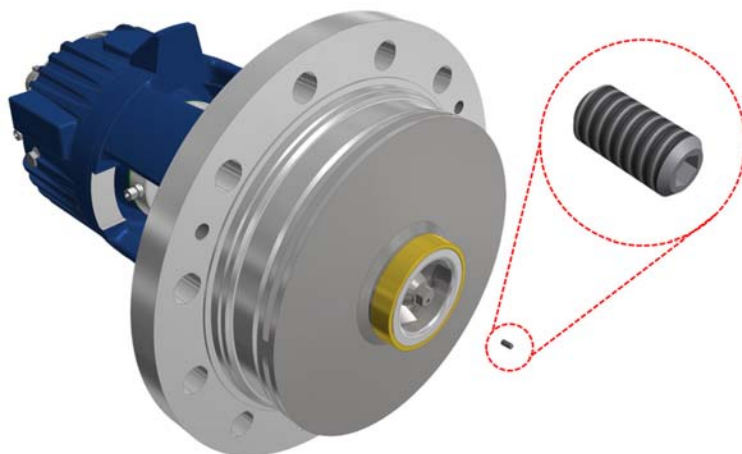


Figure 8.32 Inserting and tightening the socket set screw to tighten the impeller nut.

图 8.32 插入并拧紧套筒固定螺钉以拧紧叶轮螺母。



- Inspection point: Rotate the impeller and make sure that the wear rings do not make contact.
- 检查点: 旋转叶轮, 确保不摩擦到耐磨环。

43. To place the continuous studs in the volute casing, follow these steps:

要将连续螺柱放置在螺旋壳中, 请执行以下步骤:

- a. Clean the continuous studs and threads on the casing so they are free of foreign materials.
清洁外壳上的连续螺柱和螺纹, 使其没有异物。
- b. Insert each continuous stud (previously protected with an anti-seize agent). Each one must be hand-tightened.

嵌入每个连续螺柱(之前用防粘结剂保护)。每个都必须用手拧紧。



Figure 8.33 Inserting the continuous studs into the volute casing.

图 8.33 将连续螺柱插入螺旋壳。

- c. Now, use the double nut technique to fasten the studs all the way in (the studs do not require torque).

现在，使用双螺母技术一路拧紧螺柱(螺柱不需要扭矩)。



- Inspection point: Check visually that studs are fastened to the limit: all of them should have approximately the same height.
- 检查点: 视察螺柱是否拧紧到最大限度: 所有螺柱的高度应大致相同。

44. For the assembly of the volute casing with the rest of the pump, follow these steps:

对于螺旋壳与泵的其余部分组装，按以下步骤操作：

- a. Place the joint ring on the volute casing. Packing grease to hold in place can be used.

将连接环放置在螺旋壳上。可以用填充润滑脂来固定。



- The joint ring must be changed every time the volute casing and the casing cover are disassembled and reassembled.
- 每次拆卸和重新组装螺旋壳和壳盖时，必须更换连接环。



Figure 8.34 Placing the joint ring in the volute casing.

图8.34将连接环放置在螺旋壳中。

- b. Place all the bearing bracket assembly vertically over the volute casing. Lower the assembly inside the volute casing. Make sure the joint ring remains in its position.

将所有轴承支架组件垂直放在螺旋壳上。降低螺旋壳内的组件高度。确保连接环在其适当位置。



Figure 8.35 Placing the bearing bracket assembly into the volute casing.

图 8.35 将轴承支架组件放入螺旋壳。



- Inspection point: Rotate the pump shaft and make sure the wear rings do not make contact.
- 检查点: 旋转泵轴, 确保不与磨损环接触。

45. Position the hex nuts in the bearing bracket – casing cover assembly and tighten.

将六角螺母放在轴承支架-外壳盖组件中并拧紧。



Figure 8.36 Positioning and tightening of the hex nuts in the bearing bracket - casing cover assembly.

图 8.36 轴承支架-外壳盖组件中六角螺母的定位和拧紧。

46. Now to assemble the ventilator fan and the ventilator cap (if applicable), follow these steps:

现在要组装通风扇和通风盖(如果适用)，按以下步骤操作：

- a. Insert the ventilator fan on the pump shaft. Secure to the shaft using set screws. Ensure at least a $\frac{1}{8}$ inch (3.175 mm) gap in between.

将换气扇插入泵轴上。用固定螺钉固定到轴上。确保两者之间的间隙至少有一个 $\frac{1}{8}$ 英寸 (3.175 毫米)。



Figure 8.37 Placing the ventilator fan into the pump shaft.

图 8.37 将换气扇放入泵轴。

- b. Now position ventilator cap, and align the holes to the bearing bracket.

现在校准通风帽，并将孔对准轴承支架。

- c. Once aligned the four holes to screw it, tighten these screws to secure it to the bearing bracket.

一旦对准四个孔并将其拧紧，这些拧紧的螺钉就固定到轴承支架上了。

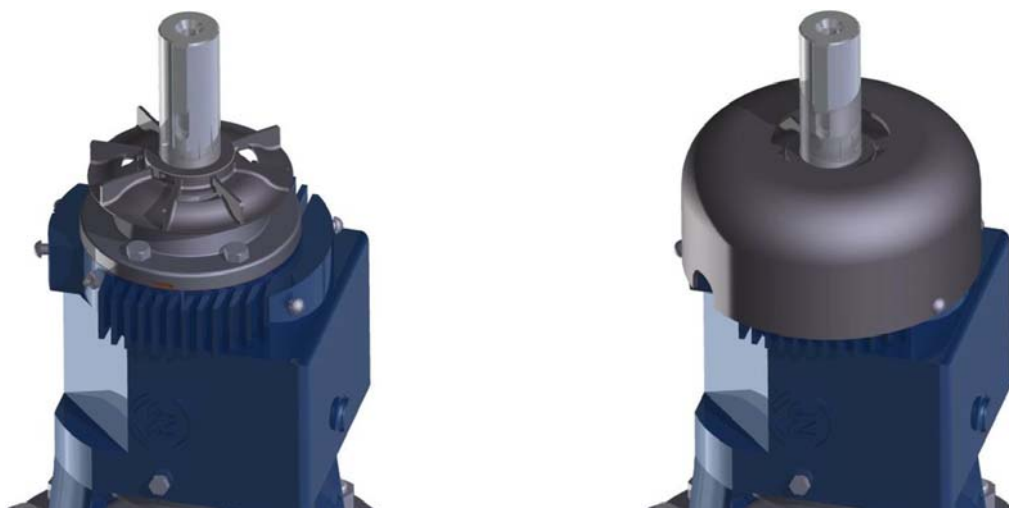


Figure 8.38 Placing and tightening the ventilator cap to the bearing bracket.

图8.38将通风盖放到到轴承支架上并拧紧。

ATTENTION

- Inspection point: Turn the pump shaft to ensure that the ventilator fan does not rub on ventilator cap.
- 检查点: 转动泵轴, 确保呼吸机风扇不会摩擦到通风盖。

47. Now place all the features back to the pump.

现在将所有东西放回泵中。

48. After this, place the motor stool over the entire pump and resting on the volute casing.

49. 然后, 将电机座放在整个泵设备上, 并放在螺旋壳上。



Figure 8.39 Placing the motor stool support over the volute casing.
图8.39将电机座支架放在螺旋壳上。

50. Screw the motor stool. 拧紧电机座。

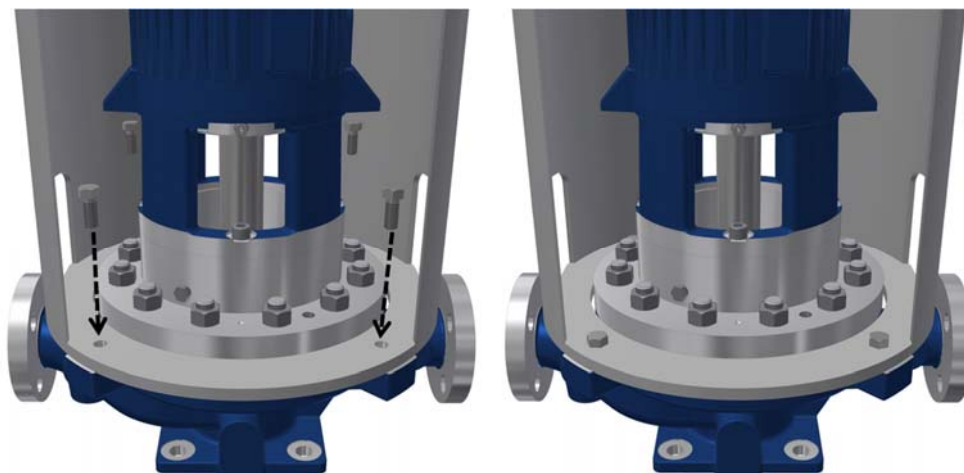


Figure 8.40 Placing the hex bolts to secure the motor stool.

图 8.40 放置六角螺栓以固定电机座。

51. Follow the steps indicated in SECTION 5.2 - ALIGNMENT to ensure the correct alignment of the driver shaft with the pump shaft and proceed to couple both of them.

按照第 5.2 节-校准中指示的步骤，确保驱动轴与泵轴对准无误，并继续耦合。

SECTION NINE - SPARE PARTS

第九部分-备件

The recommended quantities of spare parts to meet regular conditions of constant operation over a period of two years are given in the list below:

下表列出了两年内满足正常运行条件的备件数量:

	Number of identical pumps (including reserve pumps) 相同泵(包括备用泵)的数量						
	2	3	4	5	6 and 7 6 和 7	8 and 9 8 和 9	10 and more 10 个及以上
Spare parts 备件	Quantity of spare parts 备件数量						
Impeller 叶轮	1	1	1	2	2	3	30%
Casing wear ring, impeller ring 套管磨损环、叶轮环	2	2	2	3	3	4	50%
Impeller screw with security accessory 附有安全套件的叶轮螺钉	1	1	2	2	2	3	30%
Seals for pump casing (Sets) 泵壳密封件(套)	4	6	8	8	9	12	150%
Other seals (Sets) 其他密封件(套)	4	6	8	8	9	10	100%
Shaft Sleeve 轴套	2	2	2	3	3	4	50%
Rotary Seal Ring 旋转密封环	2	3	4	5	6	7	90%
Stationary Seal Ring 固定密封圈	2	3	4	5	6	7	90%
Round section joint ring 圆形截面连接环	2	3	6	8	8	10	150%
Seal in stationary ring seal	2	3	6	8	8	10	150%

固定环密封							
Spring弹簧	1	1	1	1	2	2	20%

The spare parts should be available from the time of first operation. 备件一开始就要处于可用状态。

Spare parts taken out and used must be replaced as soon as possible. 必须尽快更换取出和使用的备件。

Please give the following details when ordering: 订购时请提供以下详细信息:

- Order No. of the pump 泵的订单编号
- Type of pump and size 泵的类型和尺寸
- Identity number according to the list of spare parts (if applicable) 根据备件清单的认证号码(如果适用)
- Part number from the sectional drawing 剖面图中的零件号
- Quantity 数量
- Material 材料

Material Storage of spare parts 备件的材料储存

- Store the spare parts in their original packaging. 将备件储存在原始包装中。
- Store in a dry place, preferably at a constant temperature. 储存在干燥的地方，最好在恒温下。
- Check the spare parts and the state of the packaging every 6 months for signs of corrosion.
- 每 6 个月检查一次备件和包装状态是否有腐蚀迹象。
- Repair any damage or sign of corrosion with anticorrosive agents.
- 用防腐剂修复所有损坏或腐蚀处。
- It is highly recommended to follow the established requirements by DIN 7716 (rubber and natural rubber products).
- 强烈建议遵循 DIN 7716 (橡胶和天然橡胶产品)的要求。

Preservation of spare parts 备件保存

The preservation of spare parts corresponds to the preservation of the pump. Details can be found in SECTION 3.5 – CONSERVATION. 备件的保存相应于泵的保存。详情见第 3.5 节 – 维护。

SECTION TEN - PARTS INFORMATION / SECTIONAL DRAWING

第十节-零件信息/剖面图

10.1 PARTS LIST 10.1 零件清单

PARTS LIST 备件清单

PART 备件	DESCRIPTION 产品概述	PART 备件	DESCRIPTION 产品概述
102	VOLUTE CASING 螺旋形机壳	400.2	BEARING COVER NDE (NON-DRIVER END) GASKET轴承盖无损检测(非驱动端)垫圈
161	CASING COVER 外壳盖	411	JOINT RING接合密封环
211	PUMP SHAFT 水泵轴	412	ROUND SECTION JOINT RING 圆形截面接头环
230	IMPELLER 叶轮	423.1	LABYRINTH SEAL DE (DRIVER END) 迷宫式密封DE (驱动端)
320.1	AXIAL ANTI-FRICTION BEARING 轴向减摩轴承	423.2	LABYRINTH SEAL NDE (NON-DRIVER END) 迷宫式密封无损检测(非驱动端)
320.2	AXIAL ANTI-FRICTION BEARING 轴向减摩轴承	456	STUFFING BOX BUSHING填料函衬套
320.3	AXIAL ANTI-FRICTION BEARING 轴向减摩轴承	502.1	CASING WEAR RING套管磨损环
321	RADIAL BALL BEARING径向滚珠轴承	502.2	CASING COVER WEAR RING套管盖耐磨环
322	RADIAL ROLLER BEARING向心滚珠轴承	503.1	IMPELLER WEAR RING (EYE SIDE) 叶轮磨损环(眼侧)
330	BEARING BRACKET轴承座	503.2	IMPELLER WEAR RING (HUB SIDE) 叶轮磨损环(轮毂侧)
341	MOTOR STOOL 电机椅	506	RETAINING RING 扣环
360.1	GREASE RETAINER DE (DRIVER END) 护脂圈 DE (驱动端)	922	IMPELLER NUT 叶轮螺母
360.2	GREASE RETAINER NDE (NON-DRIVER END) 护脂圈无损检测(非驱动端)	923	BEARING NUT 轴承螺母
360.3	BEARING COVER DE (DRIVER END)	931	LOCKWASHER 锁扣垫圈

	轴承盖DE (驱动端)		
360.4	BEARING COVER NDE (NON-DRIVER END) 轴承盖无损检测(非驱动端)	940.1	IMPELLER KEY 叶轮键
400.1	1 DE (DRIVER END) GASKET 轴承盖DE (驱动端)垫圈	940.2	MOTOR KEY 电机钥匙

The corresponding bracket size for SPI pump sizes are: SPI 泵的相应支架尺寸为:

Pumps by Bearing Bracket Size 泵按轴承支架尺寸划分		
35	55	75
2 x 2 x 7	6 x 6 x 10	12 x 10 x 20
3 x 3 x 7	8 x 8 x 10	6 x 26
1.5 x 1.5 x 8	3 x 3 x 12	
4 x 4 x 8	4 x 4 x 12	
6 x 6 x 8	6 x 6 x 12	
3 x 3 x 9	8 x 8 x 12	
4 x 4 x 9	3 x 3 x 15	
2 x 2 x 10	4 x 4 x 15	
2 x 2 x 12	6 x 6 x 15	
	8 x 8 x 15	

10.2 SECTIONAL DRAWINGS 10.2 剖面图

10.1.1 Bracket Size 35 - Grease Version 支架尺寸 35 - 润滑脂版本

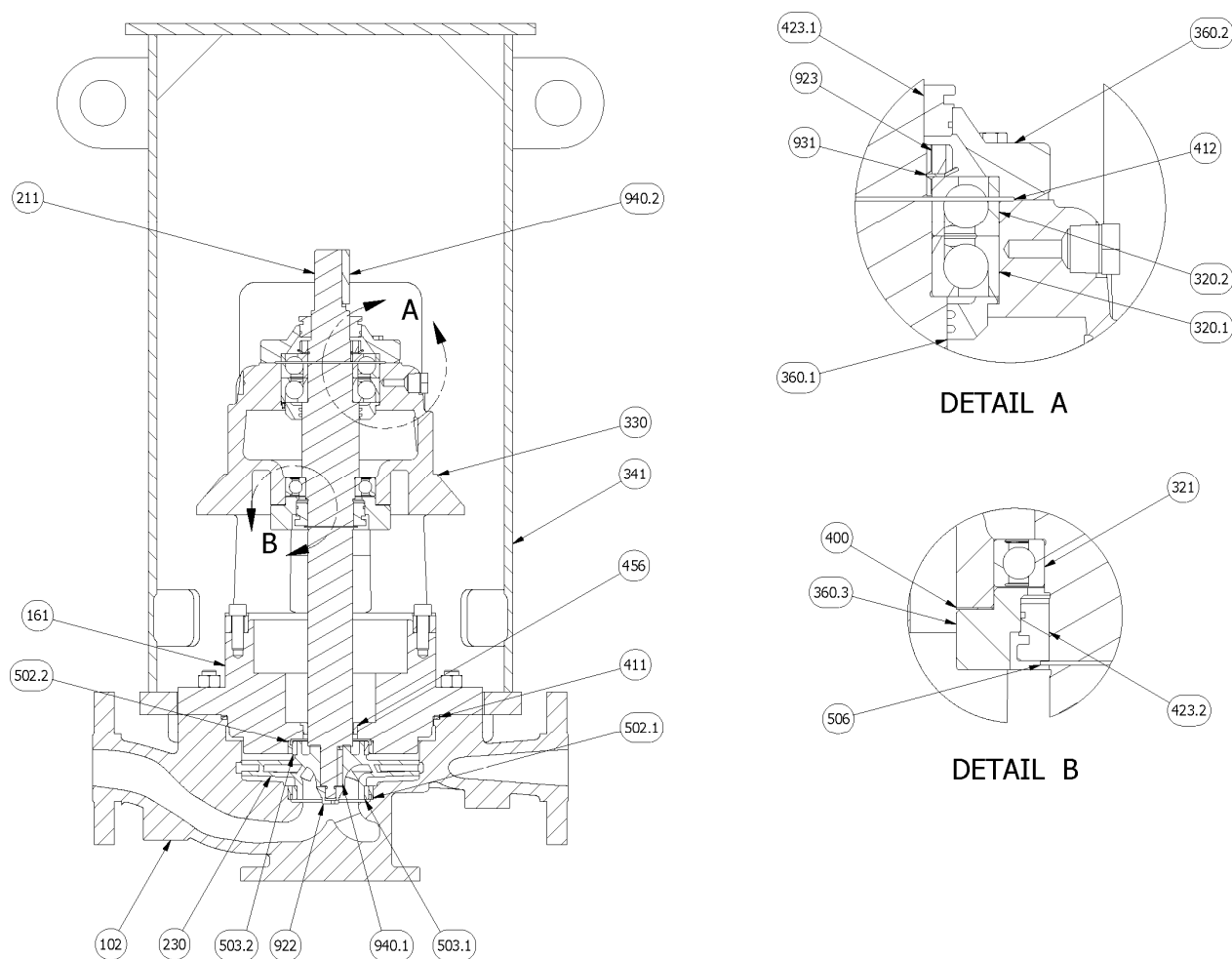


Figure 10.1 Sectional Drawing Bracket Size 35 - Grease Version

图10.1截面图支架尺寸35 - 润滑脂版本

10.1.2 Bracket Size 55 - Grease Version 支架尺寸 55 - 润滑脂版本

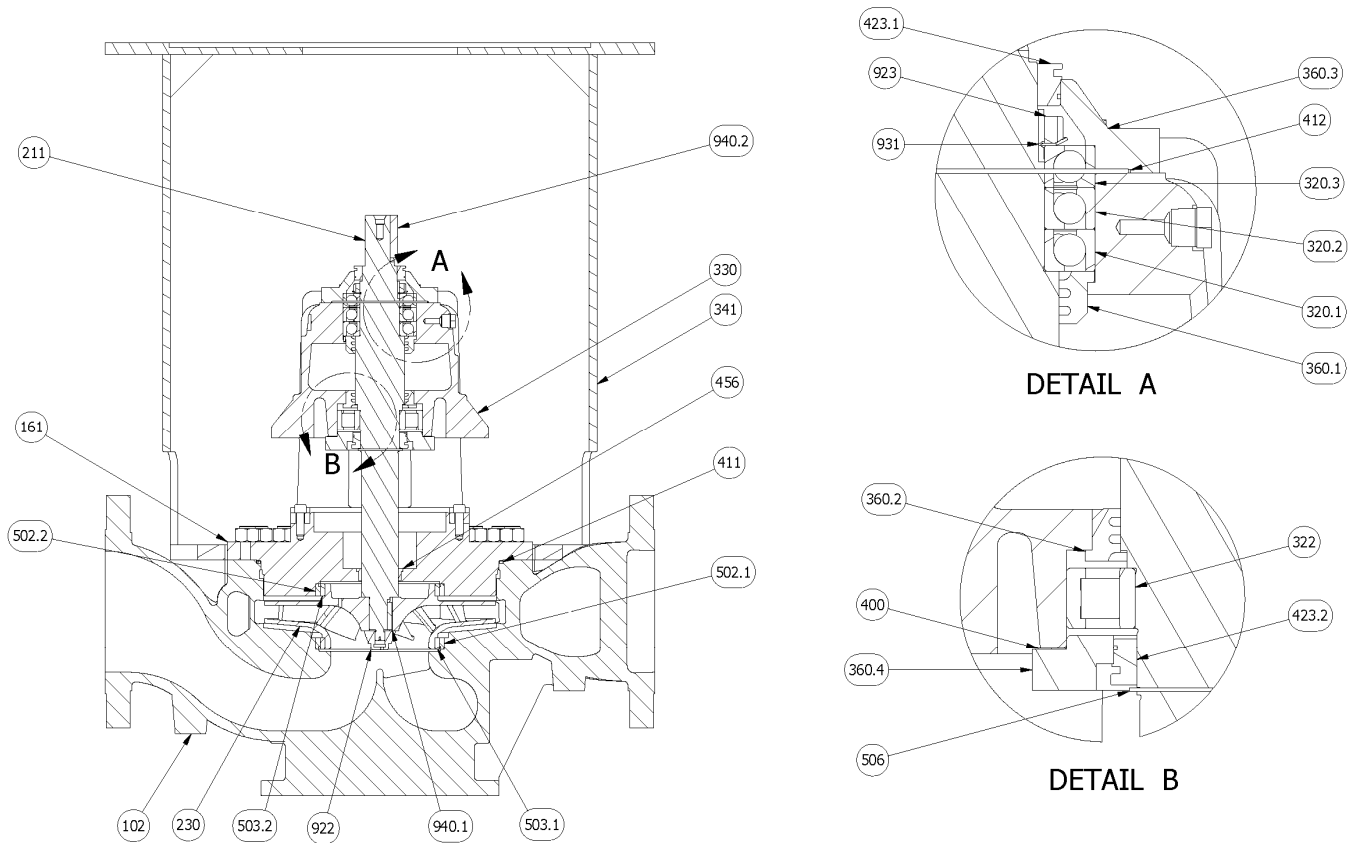


Figure 10.2 Sectional Drawing Bracket Size 55 - Grease Version

图10.2截面图支架尺寸55 - 润滑脂版本

10.1.3 Bracket Size 75 - Grease Version 支架尺寸 75 - 润滑脂版本

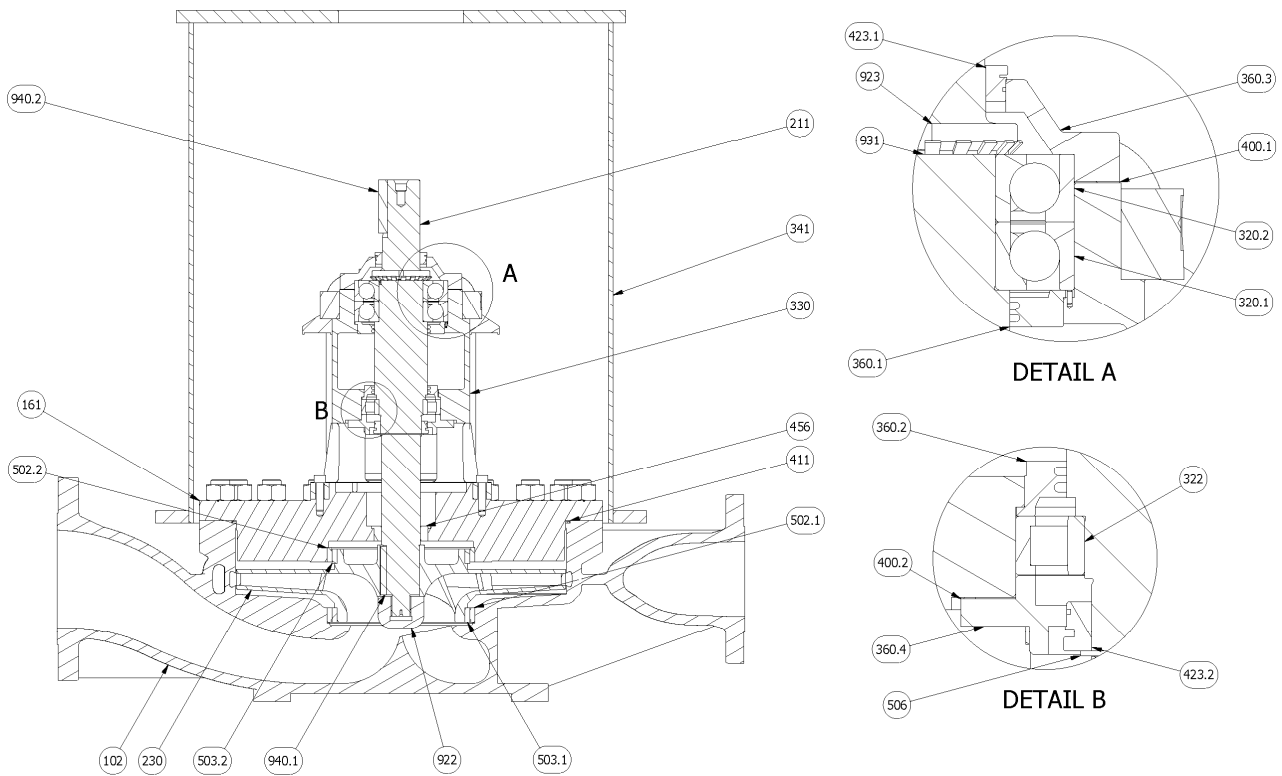


Figure 10.3 Sectional Drawing Bracket Size 75 - Grease Version

图10.3截面图支架尺寸75 - 润滑脂版本

10.1.4 Bracket Size 35 - Oil Mist Version 支架尺寸 35 -油雾版

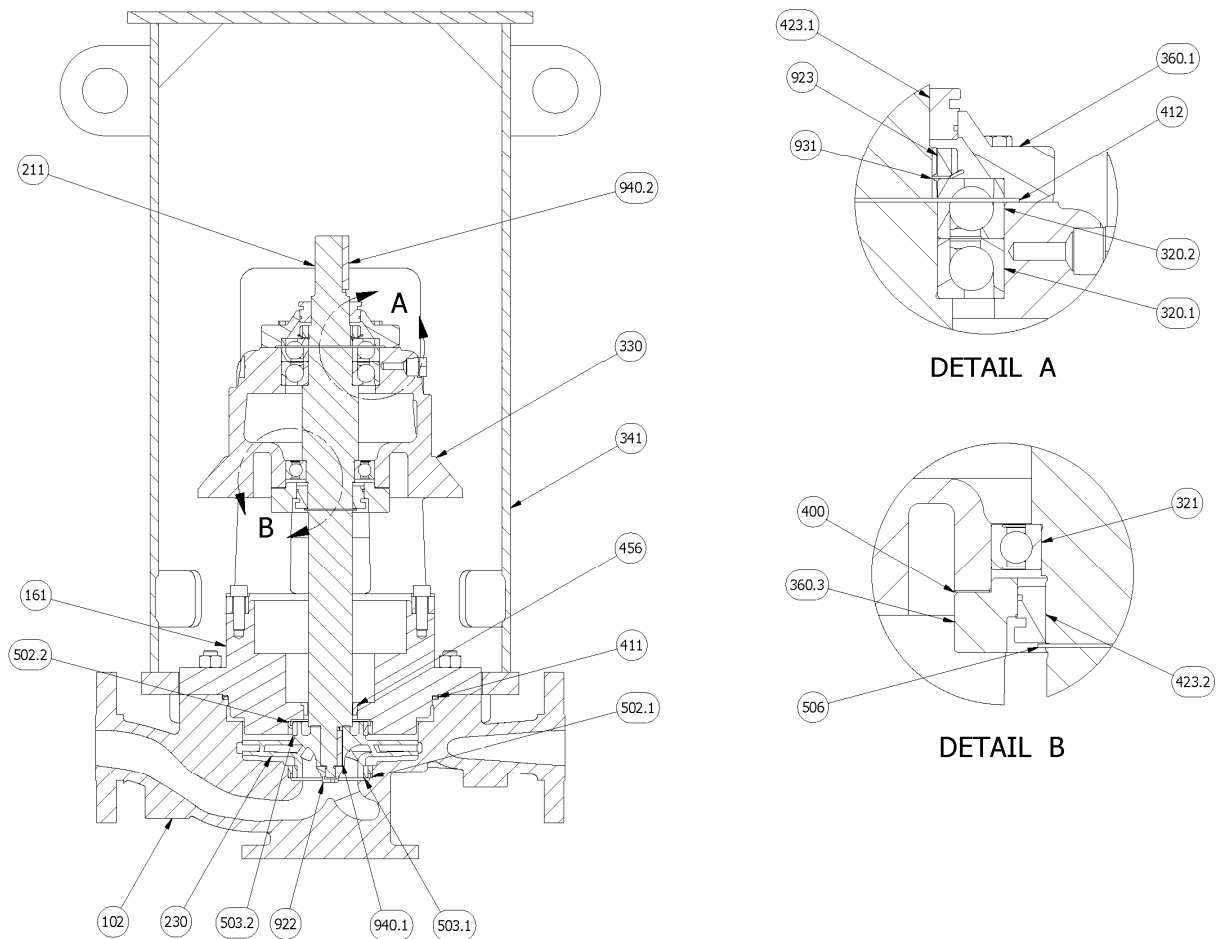


Figure 10.4 Sectional Drawing Bracket Size 35 - Oil Mist Version

图10.4截面图支架尺寸35 -油雾版

10.1.5 Bracket Size 55 - Oil Mist Version 支架尺寸 55 -油雾版

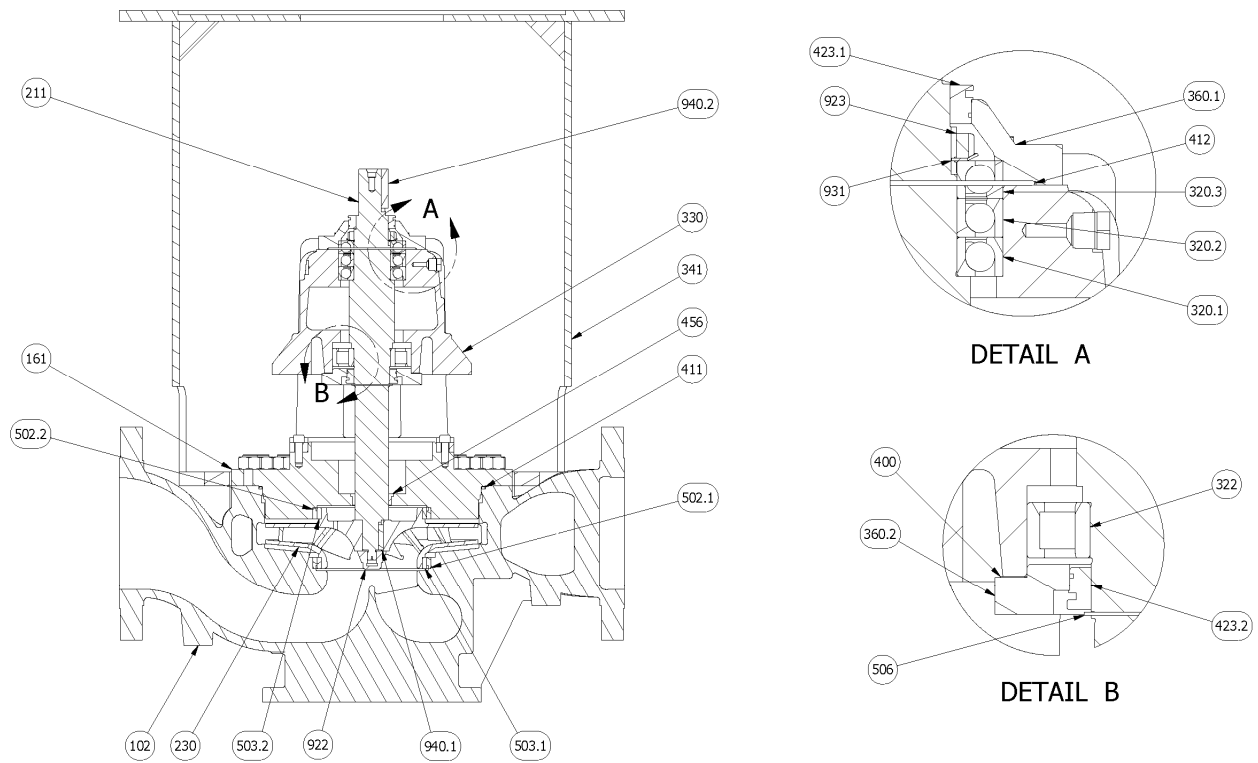


Figure 10.5 Sectional Drawing Bracket Size 55 - Oil Mist Version

图10.5截面图支架尺寸55 -油雾版

10.1.6 Bracket Size 75 - Oil Mist Version 支架尺寸 75 -油雾版

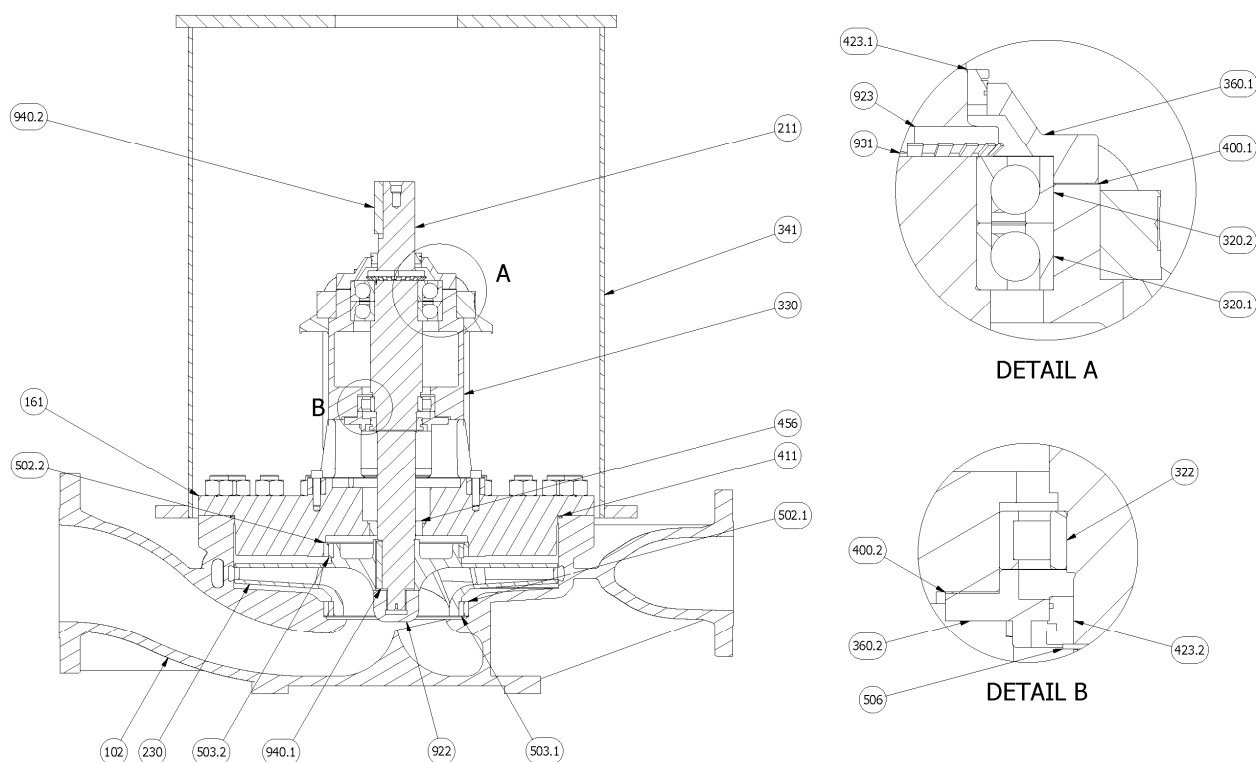


Figure 10.6 Sectional Drawing Bracket Size 75 - Oil Mist Version

图10.6截面图支架尺寸75 -油雾版

SECTION ELEVEN - TROUBLESHOOTING CHART

第十一节-故障排除表

The table is an example of some technical problems that may occur and their possible causes. If problems here not mentioned or not traceable occur, we recommend you get in touch with one of Ruhrpumpen specialist.

该表是一些可能出现的技术问题及其可能原因的示例。如果这里有没提到的或无法追溯的问题出现，建议联系鲁尔泵公司专家。

Problem 问题示例	Reference number for causes and solutions 原因和解决方案的参考编号
Pump flow too low 泵流量过低	1, 2, 3, 4, 5, 6, 7, 8, 9, 15, 16

Problem 问题示例	Reference number for causes and solutions
Differential water column pressure too low 水柱压差过低	2, 3, 4, 5, 6, 7, 8, 9, 15, 16
Differential pressure too high压差太高	9, 11
Power consume too high功耗太高	9, 10, 11, 13, 15, 16
Pump overheating泵过热	2, 5, 19
Erratic functioning 功能不稳定	2, 3, 4, 5, 6, 8, 10, 13, 18, 19
High driver bearing temperature 高驱动轴承温度	13, 14
Shaft seal leakage 轴封泄漏	12
Casing leakage套管泄漏	17

Causes and solutions 原因和解决方法

Reference No. 问题编号	Cause 问题原因	Solution 解决办法
1	The counter pressure of the system is greater than the design point of the pump. 系统的反压力大于泵的设计点。	Open the discharge valve as wide as necessary to reach the operating point. 尽可能打开排气阀，以达到工作点。
2	Pump or piping are not properly vented. 泵或管道没有正确排气。	Vent or top up.通风或加满。
3	Feed pipe or impeller plugged. 进料管或叶轮堵塞。	Clean pipe or impeller.清洁管道或叶轮。
4	Formation of air pockets in the piping 管道中气穴的形成	Install vent valve.安装排气阀。 Lay piping elsewhere.在别处铺设管道。
5	NPSH available too low可用的NPSH太低	Check the fluid level in the feed container. 检查进料容器中的液位。 Open the shut-off device completely 完全打开关闭装置 Lay suction pipe elsewhere if friction losses

Reference No.	Cause 问题原因	Solution 解决办法
		are too high. 如果摩擦损失过大，将吸入管放在别处。 Check for a possible filter in the feed pipe. 检查进料管中是否有可能的过滤器。
6	The pump flows in the opposite direction 泵以相反的方向流动	Change the poles of any of both phases of the driver. 改变驱动器任意两个相位的极点。
7	Speed too low 速度过慢	Check driver and its power source 检查驱动器及其电源
8	Inner pump parts are worn 内部泵部件磨损	Replace worn parts. 更换磨损的零件。
9	Fluid density or viscosity differs from design data. 流体密度或粘度与设计数据不同。	Consult a Ruhrpumpen specialist. 咨询鲁尔泵公司专家。
10	Differential in water column is less than pump's nominal differential. 水柱中的压差小于泵的标称压差。	Set operation points with the shut-off valve in the pressure piping. 使用压力管道中的截止阀设置操作点。
11	Speed too high 速度过快	Decrease driver speed 降低驾驶速度
12	The shaft seal is damaged. 轴封损坏。	Check the shaft seal and replace if necessary. 检查轴封，必要时更换。
13	The pump is under tension 泵处于紧绷状态	Check the piping for tension-free connections. 检查管道是否有无张力连接。
14	Excessive axial thrust 轴向推力过大	Clean the balance holes in the impeller and change the seal rings. 清洁叶轮中的平衡孔并更换密封圈。
15	The motor voltage is incorrect 电机电压不正确	Apply correct voltage to the motor. 向电机施加正确的电压。
16	Motor runs only in two-phase mode 电机仅在两相模式下运行	Check the cables, connections and fuses. 检查电缆、连接和保险丝。

Reference No.	Cause 问题原因	Solution 解决办法
17	The screws are not sufficiently snug. 螺钉没拧紧。	Snug the screws.拧紧螺丝。 Change the seals.更换封条。
18	The impeller is unbalanced 叶轮不平衡	Clean the impeller.清洁叶轮。 Rebalance the impeller.重新平衡叶轮。
19	Minimal flow has not been reached. 尚未达到最小流量。	Rise the flow to reach the minimal required.提高流量以达到最低要求。

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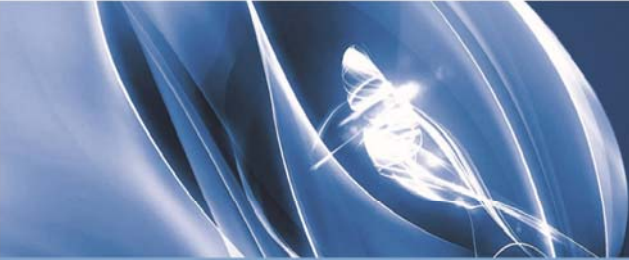
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