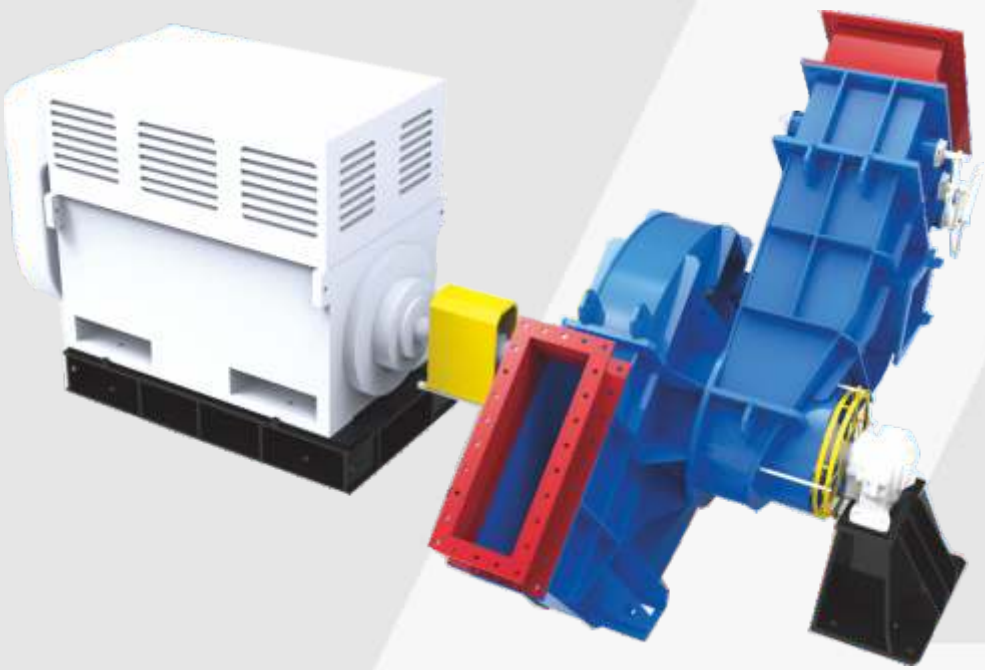
大通宝富
FAN FACTORIES

高效离心式通风机
High Efficiency Centrifugal Ventilator
安装、运行、维护手册
Installation, Operation and Maintenance Manual



南通大通宝富风机有限公司
NANTONG DART-RICH FAN CO., LTD.

前 言
Foreword

本说明书叙述高效离心式通风机的安装、组装、运行、使用和维护必须注意的事项及应遵循的步骤。

This instruction describes the matters needing attention and the steps to be followed in the installation, assembly, operation, use and maintenance of single-stage high speed centrifugal blower.

在机器安装、组装和拆卸或运转之前，必须阅读本说明书。阅读本说明书能为操作维护人员提供方便。

This manual must be read before the machine is installed, assembled, disassembled or operated. Reading this manual can provide convenience for operation and maintenance personnel.

当机器或部件出现故障，需要南通大通宝富风机有限公司协助分析问题时，请说明部件名称、产品编号、出厂日期及出现问题前后现场历史情况。

When a machine or component breaks down and Nantong Dart-Rich Fan Co., Ltd. is required to assist in analyzing the problem, please state the component name, product model, manufacturing date and site history before and after the problem occurs.

本说明书提供的数据及资料为标准版，有关保证事项请参见合同。非经大通宝富同意，本说明书任何部分所提供材料和数据不得提供给第三方。

The data and information provided in this manual are the standard version, please refer to the contract for relevant guarantees. Without the consent of Dart-Rich, the materials and data provided in any part of this manual shall not be provided to a third party.

我公司售后服务工程师负责现场指导安装，请安装前提前一周联系我司，联系电话：0513-85554411/400-625-2668接转售后服务部门。

Our company's after-sales service engineer is responsible for on-site installation guidance. Please contact our company one week in advance before installation, and the telephone number is 0513-85554411/400-625-2668, which will be transferred to the after-sales service department.

特 别 说 明
Special Explanation

本文件可能含有保密信息并涉及知识产权，仅供收讫者使用，严禁分发、复制和打印。安装人员有责任采取适当防护措施避免施工时受到伤害。

This document may contain confidential information and involve intellectual property rights. It is only for the receiver's use. Distribution, copying and printing are strictly prohibited. The installer has the responsibility to take appropriate protective measures to avoid being hurt during construction.

本文件及合同规定的其它文件所示不明或不同之处必须通知大通宝富，否则视为已正确理解和实施。

Any ambiguity or difference in this document and other documents specified in the contract must be notified to Dart-Rich, otherwise it will be deemed as correct understanding and implementation.

企 业 概 况
Company Profile

南通大通宝富风机有限公司（原国营南通风机厂），创建于1966年，至今已有五十多年的风机生产历史，是中国通用机械工业协会风机分会副理事长单位。1991年获得国务院颁发的“国家重大技术装备研制突出贡献奖”、2015年获得 “电力科学技术一等奖”， 2018年10月入选《寻找中国制造隐形冠军》（人民出版社出版）。2018年DM1000型MVR蒸汽压缩机被江苏省工业和信息化厅认定为江苏省首台（套）重大装备产品，2020年8月取得军工核安全设备设计与制造许可证。是水蒸气压缩机团体标准主笔人。为确保在市场快速突破、销售额连年高增长的情况下能够继续给广大客户提供优质服务，大通宝富于2020年12月成立了大通宝富（湖南）风机有限公司。

Nantong Dart-Rich Fan Co., LTD. (former as State-Owned Nantong Fan Factory) was founded in 1966, the company introduced German technology in 2004 and made significant technological breakthroughs in the aspects of product stability, reliability, high efficiency, low noise, wear resistance and temperature resistance, etc. at the same time, it had a number of technical exchanges and cooperation with many scientific research institutes and internationally renowned wind turbine manufacturing companies. The company won the "Outstanding Contribution Award of the Development of National Major Technical Equipment" issued by the State Council in 1991, the "First Prize of China Electric Power Science and Technology Progress" in 2015, and was selected in the book of "Looking for the Hidden Champion Made in China" (published by People's Publishing House) in October 2018. In 2018, DM1000 MVR steam compressor was recognized by Jiangsu Provincial Department of Industry and Information Technology as the first (set) major equipment product in Jiangsu Province, and in August 2020, it obtained the design and manufacturing license of military nuclear safety equipment, and is the chief author of the group standard of steam compressors. In order to ensure that we can continue to provide quality services to our customers with rapid market breakthrough and high sales growth year after year, DART-RICH established DART-RICH (HUNAN) FAN CO., LTD in December 2020.

大通宝富一直坚持管理创新、机制创新、文化创新以及自主研发与引进相结合的技术创新，持续进行管理的数字化、产品的平台化、组织的流程化、设备的自动化建设，不断取得新突破，实现了快速健康发展。目前，大通宝富已具备大型循环流化床机组、钢铁行业大型除尘系统及烧结主抽系统、千万吨级炼化一体化装置、乙烯裂解炉、煤化工气化装置、军用核工业装置通风机，硫磺回收系统、脱硫氧化送气装置、煤气输送装置、制碱过滤抽真空装置、煤气化装置高压氮气循环系统鼓风机，以及浓缩、蒸发、结晶装置蒸汽压缩机（高温升、低温升、高速直驱）等大型及高端设备的研发制造能力。相关产品设计制造技术已达到国际先进水平。

Dart-Rich is always persisting in the management innovation, mechanism innovation, cultural innovation, and the technological innovation combined with independent research & development and introduction, the company continuously implements digital management, platformization of products, process of organization and automatic construction of equipment, constantly achieve new breakthroughs, and achieve the rapid and healthy development. Dart-Rich has the R&D and manufacturing abilities for large and high-end equipment, such as fans for large circulating fluidized bed units, large dust removal system for steel industry, ten million tons of refining and chemical integration devices, ethylene cracking furnaces, coal chemical gasification devices and military nuclear industry device; blowers for desulfurization and oxidation air supply devices, gas transmission devices and alkali chemical vacuum pumping device steam compressors (high temperature rise, low temperature rise,

magnetic) for concentration and evaporation crystallization devices. The design and manufacturing technologies of related products has attained the international advanced standards.

近年来，大通宝富先后添置了12米数控卧式车床和磨床、大型数控镗铣床和镗床、6米龙门刨铣床、德国哈默五轴加工中心、数控车铣复合中心、叶片自动成型机器人、叶轮自动焊接机器人、机壳自动焊接机、龙门视觉焊接系统、丹麦全自动旋压机、大型激光切割机等大、精、稀加工设备，12米德国申克动平衡机、三坐标测量仪等先进检测设备，装备和制造能力达到行业领先水平。

In recent years, Dart-Rich has successively installed many large, fine and rare equipment, such as the 12-meter CNC horizontal lathe and grinding machine, the large CNC boring-milling machine, the large boring lathe, the 6 meter planer milling machine, the German Hermle five-axis machining center, CNC turning and milling compound center, automatic blade forming robot, the impeller automatic welding robot, the casing automatic welding machine, gantry vision welding system, the spinning machine imported from Denmark and the large-scale laser cutting machine and other large, fine, thin processing equipment. There are also some advanced testing equipment like the 12-meter German Schenck dynamic balancing machine, CMM and others. Equipment and manufacturing capacities reach industry-leading level.

大通宝富坚守“诚实守信、专注专业、利他共生”的核心价值观，始终坚持“以客户为中心、匠心专注，提供核级品质的绿色动力设备和系统集成服务”的经营方针。持续创新发展，不断提升企业价值，致力于成为可靠、绿色流体机械的引领者！

Dart-Rich adheres to the core values of “honest and trustworthy; concentrated and professional; benefitting others, support and develop in a mutual way”. It also sticks to the management policies of “customer-centeredness, originality and concentration, supplement nuclear-grade green power equipment and system integration services”. Continuous innovation and development, continuous enhancement of enterprise value, and commitment to become the leader of reliable green fluid machinery!

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第1节 风机工作原理、结构说明
Section 1 Working principle and structure description of fan

1.1 风机工作原理 Working principle of fan

本手册所述风机为高效离心式通风机。

The fans described in this manual are high efficiency centrifugal fans.

高效离心式通风机是现代社会出现的一种以动力机（主要是电动机）驱动叶轮在蜗形机壳内旋转，气体经吸气口从叶轮中心处吸入。由于叶片对气体的动力作用，气体压力和速度得以提高，并在离心力作用下沿着叶道甩向机壳，从排气口排出。

High efficiency centrifugal fan is a type of fan that appears in modern society, the impeller is driven by a power machine (mainly a motor) to rotate in a volute casing, and the gas is sucked from the center of the impeller through an air inlet. Due to the dynamic action of the blades on the gas, the pressure and speed of the gas are increased, and the gas is thrown to the casing along the blade path under the action of centrifugal force and discharged from the exhaust port.

1.2 风机结构组成 Structure composition of fan

风机本体包括机壳、叶轮、进风口等主要部件。根据结构和用途的不同可分别配有主轴、进气箱、传动部和进口调节门等。叶轮安装在主轴（或电机轴）上，机壳将其封闭在内并与进、出口管道连接。进口调节门调节所需风量，进口调节门由手动或电（气）动执行器通过联动杆驱动。

The fan body includes the main components such as the casing, the impeller, and the air inlet. According to different structures and uses, it can be equipped with main shaft, inlet box, transmission part and inlet damper, etc. The impeller is installed on the main shaft (or motor shaft), which is enclosed by the casing and connected with the inlet and outlet pipes. The inlet damper regulates the required air volume, and the inlet damper is driven by manual or electric (gas) actuator through linkage rod.

第2节 安 装 Section 2 Installation

综 述 Summary

风机到货后应检查所有的零部件是否损坏或缺件，任何缺损和偏离应尽快报告给大通宝富。

Upon arrival of the fan, check whether all parts are damaged or missing, and any defects and deviations should be reported to Dart-Rich as soon as possible.

1.散件发货的风机部件，有些配合零部件已在大通宝富进行了预装配并在拆卸和包装运输前作好了配合标记，现场须按照标记进行安装。

1. For the fan parts delivered in bulk, some matching parts have been pre-assembled in Dart-Rich and marked before disassembly, packaging and transportation, and must be installed on site according to the markings.

2.整机安装的风机到现场后，安装前须要盘动传动部，查看转动部件是否有碰擦、卡涩等现象，并检查风机和电动机之间的联轴器同轴度（要求见2.11.3），如有问题需要及时调整和校正。

2. It is necessary to drive the transmission part before installation after the installed ventilator of the whole machine arrives at the site, check whether the rotating parts are rubbed or jammed, and check the coaxiality of the coupling between the fan and the motor (see 2.11.3 for requirements). If there are any problems, it is necessary to adjust and correct them in time.

以下是对风机安装基本要求：

The following are the basic requirements for fan installation:

风机进口管道尺寸要求：92% ×A风机进口面积＜进口管道的横截面积＜112%×A风机进口面积，收敛连接件斜度不超过15°，扩散连接件斜度不超过7°，进口有效管道长度大于3倍进口直径。 Size requirements of inlet duct of fan: 90% × A fan inlet area < cross-sectional area of inlet pipe < 112 %× A fan inlet area, the inclination of convergent connector shall not exceed 15°, the inclination of diffusion connector shall not exceed 7°, and the effective length of inlet pipe shall be greater than 3 times the inlet diameter.

风机出口管道尺寸要求：85% ×B风机出口面积＜出口管道面积＜110%×B风机出口面积，收敛连接件斜度不超过15°，扩散连接件斜度不超过7°，出口有效管道长度大于3倍出口当量直径。

Size requirements of outlet duct of fan: 85% × B fan outlet area < area of outlet pipe < 110 %× B fan outlet area, the inclination of convergent connector shall not exceed 15°, the inclination of diffusion connector shall not exceed 7°, and the effective length of outlet pipe shall be greater than 3 times the equivalent diameter of the outlet.

1) 安装过程中一些关键配合尺寸及调整要求等应该记录在检查报告上。

1) Some key matching dimensions and adjustment requirements during the installation process should be recorded on the inspection report.

2) 对于现场组装的风机所有的法兰连接处应用密封填料密封。

2) All flange connections of the field assembled fan shall be sealed with a packing seal.

3) 在运输和安装过程中某些部件可能会发生变形，如果连接法兰孔没有完全对齐，不要强行将其拉正，应进行彻底检查，采取适当的措施进行矫正。

3) Some parts may be deformed during transportation and installation. If the connection flange holes are not fully aligned, do not force them to be straightened. Check them thoroughly and take appropriate measures to correct them.

4) 建议在安装风机设备之前先安装梯子、护栏和廊道，做到施工人员行动方便，确保安全施工。

4) It is recommended that ladders, guardrails, and corridors be installed before installing fans to facilitate construction and ensure safety.

2.1 吊运 Hoist

1) 吊运风机时，应特别小心避免风机、电机等受到冲击。在吊运之前，应检查各部位的联接螺栓是否拧紧、焊接部位是否牢固，风机上有无不该放置的物品。

1) When hoisting the fan, special care should be taken to avoid the impact of the fan and motor. Before lifting, check whether the connecting bolts of each part are tightened, whether the welding parts are firm, and whether there are items that should not be placed on the fan.

2) 要保持被吊动风机在纵横向上保持平衡，因此，在风机刚刚吊离地面时，就应使风机确保平衡。

2) It is necessary to keep the suspended fan balanced vertically and horizontally, therefore, when the fan is just lifted off the ground, it should be balanced.

3) 起吊轴时应避免在其表面使用吊索，必须避免划伤及撞伤轴的表面。

3) When lifting the shaft, it should be avoided to use the sling on its surface, and must avoid scratching and bumping the shaft surface.

4) 在轴的两侧布置吊索使载荷均匀吊装组部件是必要的，使用衬垫防止吊索损坏轴。

4) It is necessary to place slings on both sides of the shaft so that the load is even to lift the group parts. Use pads to prevent damage to the shaft by the slings.

5) 风机机壳和进气箱组由吊耳或索具起吊，严禁索具连接在法兰孔上起吊。

5) The fan casing and inlet box group shall be lifted by lifting lugs or rigging, and it is strictly forbidden to connect the rigging to the flange hole for lifting.

6) 无论何时吊运风机，只要不是一个人来操作，就应采取相互间给出信号来协同进行。

6) Whenever the fan is hoisted, as long as it is not operated by one person, signals should be given to each other to carry out cooperatively.

2.2 部件的储存和保管 Storage and custody of components

在风机零部件包装和装卸期间就应采取预防措施以保证货物安全到达现场。在运输、装卸和安装时的粗心处理会导致货物严重损坏，因而在这些操作中必须非常细心。

Precautions should be taken during the packing, loading and unloading of fan parts to ensure the goods arrive at the site safely. Careless handling during transportation, loading, unloading and installation will cause serious damage to the goods, so we must be very careful in these operations.

下列预防措施必须注意：

The following precautions must be taken:

1) 所有零部件应存放在枕木或垫块上，放置在通风良好的地方保存。

1) All parts should be stored on sleepers or blocks in a well-ventilated place.

2) 叶轮、主轴、轴承和所有松散件（如螺栓、螺母、仪表等）必须妥善存放。

2) The impeller, main shaft, bearings and all loose parts (such as bolts, nuts, gauges, etc.) must be stored properly.

3) 叶轮单独存放时需要水平放置。叶轮安装在主轴上后，转子组不能以叶轮的周边作支点，应使用适合的主轴托架（单独叶轮存放和转子组存放，转子组至少需要每周盘动一次，盘动角度为180度。）。

3) When the impeller is stored separately, it needs to be placed horizontally. After the impeller is installed on the main shaft, the rotor group can't take the periphery of the impeller as the fulcrum, and a suitable main shaft bracket should be used (separate impeller storage and rotor group storage. The rotor group needs to be turned at least once a week, and the turning angle is 180 degrees)).

4) 轴承在发货前密封好，在现场安装时拆卸，在整个安装过程中轴承必须得到很好的保护，防止损坏。

4) Bearings must be sealed before delivery and disassembled during on-site installation. Bearings must be well protected from damage during the entire installation process.

5) 整机或者散件发货到现场的风机，暂时不安装使用时，需要对风机做好防护处理，在无特殊情况时风机的部件必须存放在室内或者有防雨顶棚的地方（即使室外安装风机也需要保存在室内），现场人员要定期（不少于一个月一次，并形成记录）检查

现场风机，一旦发现需防锈的表面的防锈油已干，须立即重新涂上防锈油。现场人员操作时所佩戴的防护手套、使用的装配工具等应干净无油污。

5) When the whole machine is delivered to the site in parts, it is necessary to protect the fan. When there are no special circumstances, the parts of the fan must be stored indoors or in a place with rain-proof roof (even if the fan is installed outdoors, it should be stored indoors), on-site personnel should check the on-site fan regularly (at least once a month, and keep a record). Once the antirust oil on the surface to be antirust is found to be dry, it must be reapplied immediately. Protective gloves and assembly tools worn by personnel during field operation should be clean and oil-free.

6) 如果风机必须保存在室外，用户必须采取保护措施，以防止风机生锈和损坏，每周检查一次。

6) If the fan must be kept outdoors, the user must take protective measures to prevent the fan from rusting and damage, and check it once a week.

7) 最低存放要求：

7) Minimum storage requirements:

风机部件 Fan parts	存储地点 Storage Location	检查周期 Examination period
机壳、进风箱、联轴器轴护罩 Casing, air inlet box, coupling shaft guard	室外加防护 Outdoor protection	每周Every week
叶轮和轴组件 Impeller and shaft assembly	室内、防潮 Indoor, moisture-proof	每周Every week
底座 Base	室内、防潮 Indoor, moisture-proof	每周Every week
驱动电机 Drive motor	室内(使用前启用内部防冷凝加热器) Indoor (Turn on the internal anti-condensation heater before use)	每月Every month
集流器、导叶调节装置 Current collector, guide vane adjustment device	室内、防潮 Indoor, moisture-proof	每周Every week
轴承、联轴器、仪表、润滑系统 Bearing, coupling, instrument, lubrication system	室内、防潮 Indoor, moisture-proof	每月Every month

2.3 基 础 Foundation

基础设计应该由具有资质的专业方设计，并符合动力设备基础的标准，大通宝富不负责相关基础的设计。

The foundation design should be designed by a qualified professional party and meet the standards of power equipment foundation. Dart-Rich is not responsible for the design of the relevant foundation.

2.3.1 基础检查Foundation inspection

1) 开始安装前，检查基础以确保其与总图要求的相关高度、地脚螺栓位置等一致。

1) Before starting installation, check the foundation to ensure that it is consistent with the relevant height, anchor bolt position, etc. as required by the general drawing.

2) 检查二次灌浆所需高度。

2) Check the height required for secondary grouting.

3) 在平台和基础上标记中心线。

3) Mark the centerline on the platform and foundation.

4) 地脚螺栓应按总图所示在坑中垂直就位。

4) The anchor bolts shall be seated vertically in the pit as shown in the general drawing.

5) 此阶段不要灌浆。

5) Do not grout at this stage.

6) 所有需要灌浆的表面应避免有油、油脂和脏污。

6) All surfaces requiring grout should be free of oil, grease and dirt.

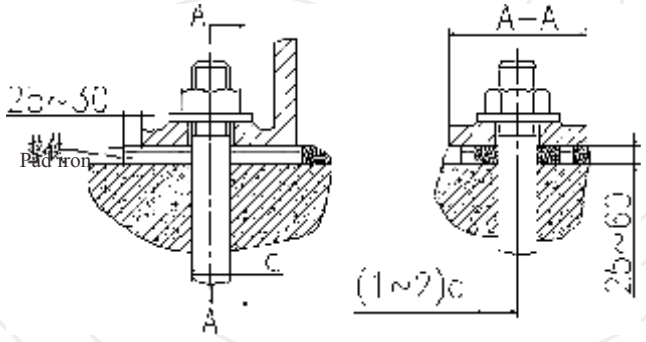
7) 准备大约100mm宽，长度至少相当于地脚宽度钢片以便轴承座找正。

7) Prepare a steel sheet about 100mm wide and the length is at least equal to the width of the foot so that the bearing seat can be aligned.

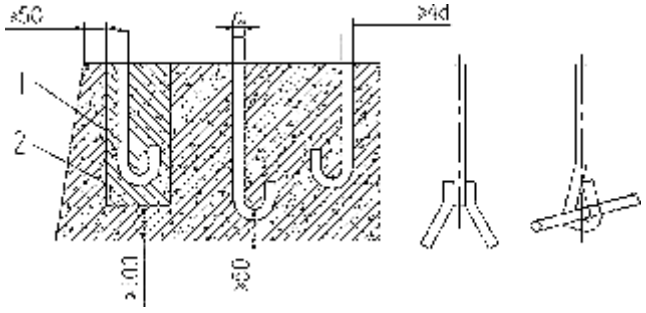
斜垫铁必须成对使用。垫铁的表面必须平整，每组垫铁数一般不超过3~4块；厚垫铁放在下层，而最薄的应夹在中间，以免产生翘曲变形，同一组垫铁放置必须整齐。设备调整好方位，再将每组垫铁焊接固定好。

Wedged pad iron must be used in pairs. The surface of the pad iron must be smooth, and the number of pads in each group generally does not exceed 3~4 pieces; the thick pad iron should be placed on the lower layer, and the thinnest should be sandwiched in the middle to avoid warping and deformation. The same group of pad iron must be placed neatly.

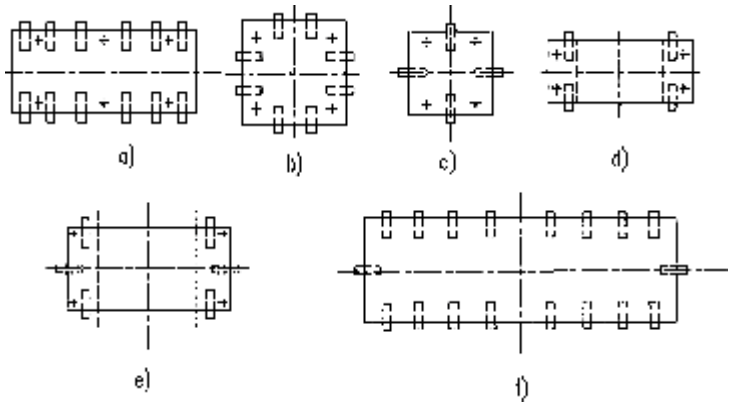
- 所有垫铁边缘应与地脚螺栓中心相距（1～2）d的距离。
- The edge of all pads shall be a distance of (1 ~ 2) d from the center of the anchor bolt.



- 地脚螺栓的形式、埋置深度和基础边缘距离可根据风机本身安装要求确定，或可参照下图。
- The form of anchor bolts, the embedded depth and the distance from the edge of the foundation can be determined according to the installation requirements of the fan itself, or refer to the following figure.



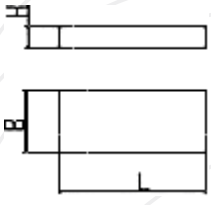
● 垫铁的垫置方法 Pad method of pad iron



a）标准垫法　b）井字垫法　c）十字垫法　d）单侧垫法　e）三角垫法　f）铺助垫法
a) Standard pad method　b) Tic–tac–toe pad method　c) Cross pad method　d) One–sided pad method
e) Triangle pad method　f) Auxiliary pad method

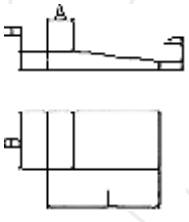
● 垫铁的种类与尺寸 Type and size of pad iron

➢ 平垫铁的尺寸 Size of flat pad iron (mm)



L	B	H
200	100	20

➢ 斜垫铁的尺寸 Size of wedged pad iron (mm)



L	B	H	h	A
200	100	20	8	10

本节概述了地脚螺栓的灌浆。在风机和附属设备的安装过程中应使用这些规程，可以使用任何一种不收缩灌浆材料。

This section provides an overview of the grouting of anchor bolts. These procedures should be used during the installation of fans and ancillary equipment, and any non-shrink grouting material may be used.

1) 灌浆前先检查设备已准确找正。

1) Check that the equipment has been correctly aligned before grouting.

2) 将地脚基础孔灌满浆至平台顶部的水平，保证灌实。

2) Fill the foot foundation hole with slurry to the level of the top of the platform to ensure solid filling.

3) 检查设备的找正没有破坏后，拧紧地脚螺栓，小心拧紧地脚螺栓时不要使机座变形。

3) After checking that the alignment of the equipment is not damaged, tighten the anchor bolts. Be careful not to deform the machine base when tightening the anchor bolts.

4) 在此阶段不要做二次灌浆层，二次灌浆是在风机整体精调完成后进行。

4) Do not do the secondary grouting layer at this stage. The secondary grouting is carried out after the overall fine adjustment of the fan is completed.

2.4 机壳和进气箱初安装 Initial installation of casing and inlet box

对于拆分几部分的机壳和进气箱，所有剖分面均配有法兰以便螺栓连接。

For split casing and inlet box, all split surfaces are provided with flanges for bolting.

1) 吊起机壳和进气箱的底部，放入垫板，调整机壳直到其侧板垂直。调整垫板及所附垫片使机壳水平。

1) Lift the bottom of the casing and inlet box, place the backing plate, and adjust the casing until its side plate is vertical. Adjust the gasket and the attached gasket to make the casing level.

2) 此阶段不要拧紧其地脚螺栓，也不要把机壳底脚灌浆。

2) Do not tighten its anchor bolts at this stage, and do not grout the casing feet.

3) 机壳和进气箱安装完成后，若有临时支撑必须拆除。

3) After the casing and inlet box are installed, any temporary supports must be removed.

2.5 轴承箱底座安装 Bearing box base installation

1) 将轴承箱底座安装在准备好的基础上。

1) Install the bearing box base on the prepared foundation.

2) 将底座垫至正确高度。

2) Pad the base to the correct height.

3) 使底座水平是很必要的。在水平面的两个方向上，用水平仪判断横跨底座加工底脚的直边的水平度，同时把底座放在距离机壳和进气箱正确距离的位置处。轴承座的校正校平，可用大平尺按中心线量取平行线进行检查，偏斜可用橇杠拔正；校平用水平仪进行，把水平仪放在主轴上或联轴器（带轮）上检查，使轴承座的纵向水平度不超过0.1/1000 把水平仪放在轴承的水平中分面上检查，使轴承座的横向水平度不超过0.2/1000。

3) It is necessary to level the base. In both directions of the horizontal plane, use a level gauge to judge the levelness of the straight edge across the processing foot of the base, and at the same time place the base at a correct distance from the casing and the inlet box. For the correction and leveling of the bearing seat, a large level ruler can be used to measure parallel lines by the center line for inspection, and the deflection can be straightened with a crowbar; Leveling shall be carried out with a level meter, which shall be placed on the main shaft or the coupling (pulley) for inspection, so that the longitudinal levelness of the bearing seat shall not exceed 0.1/1000; Check the level gauge on the horizontal split surface of the bearing so that the lateral levelness of the bearing seat does not exceed 0.2/1000.

4) 找正合格后，可以拧紧底座的紧固螺栓并灌浆。必须注意拧紧螺栓时不要使底座变形。详情见2.3.2：地脚螺栓灌浆。

4) After the alignment is qualified, the fastening bolts of the base can be tightened and grouted. Care must be taken not to deform the base when tightening the bolts. See 2.3.2: Anchor bolt grouting for details.

5) 此阶段不要给底座底脚灌浆。

5) Do not grout the base feet at this stage.

2.6 风机轴承调整与检查 Fan bearing adjustment and inspection

1) 所有到货的轴承座、轴承必须要打开用煤油或柴油清洗干净(含轴承未安装发货的主轴轴承档)。

1) All incoming bearing seats and bearings must be opened and cleaned with kerosene or diesel oil (including bearings not installed on the delivered main shaft bearing files).

2) 拆卸轴承箱侧盖时必须做好标记，确保回装时回油孔在最下侧。

2) It must be marked to ensure that the oil return hole is at the lowest side when reinstalling and removing the side cover of the bearing box.

3) 对于F式风机需要根据风机总装图来检查轴承的间隙配合，以确保可以正常使用。

3) For F-type fans, it is necessary to check the clearance fit of the bearings according to the fan assembly drawing to ensure that they can be used normally.

2.7 叶轮/主轴的安装 Installation of impeller/ main shaft

1) 将进风口串在主轴上，暂时将它们连在一起。

1) String the air intakes on the main shaft to temporarily connect them together.

2) 去掉主轴轴颈上的保护包装和保护层。

2) Remove the protective packaging and protective layer from the main shaft journal.

3) 吊起叶轮/主轴组确保主轴在进入机壳的过程中完全水平，不要撞伤主轴和轴承。

3) Lift the impeller/ main shaft set to ensure that the main shaft is completely level as it enters the casing, and do not damage the main shaft and bearings.

4) 将叶轮/主轴组移到风机壳体的上方，检查位置正确后，小心将其下落至轴承座上，不要损坏轴肩、轴承和密封。检查进风口法兰位于机壳内侧。

4) Move the impeller/ main shaft set to the top of the fan casing, check the correct position, and carefully drop it onto the bearing box without damaging the shoulders, bearings and seals. Check that the inlet flange is located inside the casing.

5) 在主轴即将就位轴承座前，撤开聚乙烯罩或轴承上盖（如果装上的话）。

5) Remove the polyethylene cover or bearing cap (if installed) just before the main shaft is about to fit into the bearing seat.

6) 当主轴下落至轴承座上时，必须极为小心，避免任何碰伤及损坏发生在主轴轴承和轴承座上。

6) When the main shaft falls onto the bearing seat, extreme care must be taken to avoid any collision and damage to the main shaft bearing and bearing seat.

7) 用少量螺栓将进风口连在机壳和进气箱的侧板上，检查配合标记。

7) Connect the air inlet with a few bolts to the side plate of the casing and inlet box and check the fit mark.

8) 检查风机主轴的找正和轴向位置，如果必要，调整轴承下的垫片使主轴水平，根据规定的扭矩再次拧紧紧固螺栓。必须检查相对于轴承中心线的位置，如果必要，在底座上重新就位轴承壳体。

8) Check the alignment and axial position of the main shaft of the fan, if necessary, adjust the gasket under the bearing to level the main shaft, and tighten the fastening bolts again by the specified torque. It is necessary to check the position relative to the center line of the bearing, and if necessary, reposition the bearing box on the base.

2.8 轴承箱最终组装 Bearing box final assembly

1.对于没有轴承箱底座的轴承箱安装，按以下步骤执行：

1. For bearing box installation with bearing box bottom seat, follow the following steps:

1) 将轴承箱安装在准备好的基础上。

1) Install the bearing box on a prepared base.

2) 将轴承箱垫至正确高度。

2) Pad the bearing box to the correct height.

3) 轴承箱找正、调平时，纵横向水平度用水平仪在轴承箱中分面上测量，纵向水平也可在主轴上测量，其纵横向水平度允差均不超过0.1/1000；

3) Alignment and levelling of the bearing box, the horizontal and horizontal levelness is measured in the bearing box on the plane with a level instrument, and the vertical level can also be measured on the main shaft, and the horizontal and horizontal levelness tolerance is not more than 0.1/1000;

4) 找正合格后，可以拧紧地脚螺栓并灌浆。详情见2.3.2 地脚螺栓灌浆。

4) After the alignment is qualified, the anchor bolts can be tightened and grouted. See 2.3.2: Anchor bolt grouting for details.

2.对于有轴承箱底座的轴承箱安装，按以下步骤执行：

2.For bearing box installation with bearing box bottom seat, follow the following steps:

1) 轴承箱与底座应紧密结合；

1) The bearing box and the base should be tightly combined;

2) 整体式轴承箱找正、调平时，纵横向水平度用水平仪在轴承箱中分面上测量，纵向水平也可在主轴上测量，其纵横向水平度允差均不超过0.1/1000；

2) Alignment and levelling of the integral bearing box, the horizontal and horizontal levelness is measured in the bearing box on the plane with a level instrument, and the vertical level can also be measured on the main shaft, and the horizontal and horizontal levelness tolerance is not more than 0.1/1000;

3) 左右分开式轴承箱找正、调平时，纵横向水平度用水平仪在其中分面上测量，主轴水平度在主轴上测量，水平度允差应符合下列要求：

3) The horizontal and vertical levelness is measured on the partial surfaces of them with a level meter when the left and right split bearing boxes are aligned and leveled, and the levelness of the main shaft is measured on the main shaft, the levelness tolerance shall meet the following requirements:

① 主轴水平度误差应不超过0.04/1000（如配减振器的风机应在配减振器之前进行调整）；

① The levelness error of the main shaft should not exceed 0.04/1000 (The fan equipped with shock absorber should be adjusted before being equipped with shock absorber);

② 两个轴承箱孔的同轴度误差不超过 ϕ 0.06mm。

② The coaxiality error of the two bearing box holes shall not exceed φ0.06mm.

4) 对使用滑动轴承的通风机，应检查轴瓦与轴颈的接触情况、轴承间隙和压盖过盈量，如不合格时，应进行修刮和调整。检查时，应按图纸要求进行，若图纸未规定时可参照下列要求进行：

4) For fans using sliding bearings, check the contact between bearing bush and journal, bearing clearance and excess pressure, if it is unqualified, it should be scraped and adjusted. The inspection shall be carried out according to the requirements of the drawings. If the drawings are not specified, the following requirements can be referred to:

① 轴瓦表面与轴颈接触应均匀，接触弧面不应小于60°，接触面与非接触面之间不应有明显的界限。轴向接触长度应不小于80%；

① The contact between the bearing surface and the journal should be uniform, the contact cambered surface should not be less than 60°, and there should be no obvious boundary between the contact surface and the non-contact surface. Axial contact length should be no less than 80%;

② 轴承推力瓦与主轴推力盘的接触应均匀，接触面积应不小于70%；

② The contact between the bearing thrust pad and the main shaft thrust plate should be uniform, and the contact area should not be less than 70%;

③ 轴瓦孔直径与轴颈直径之差，称为滑动轴承直径间隙，简称轴承间隙Δ（或称径向间隙、顶间隙），Δ一般经验值为：

③ The difference between the diameter of the bearing bush hole and the diameter of the journal is called the sliding bearing diameter clearance, which is referred to as the bearing clearance Δ (or radial clearance and top clearance). The general empirical value of Δ is:

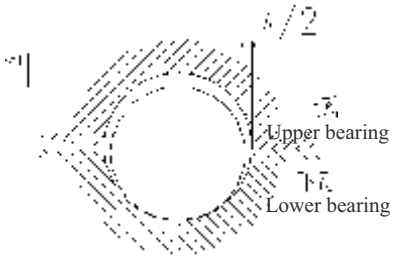
- 高转速、中等压力时，Δ为轴颈直径的0.002~0.003倍；
- At high speed and medium pressure, Δ is 0.002~0.003 times of journal diameter.
- 高转速、高等压力时，Δ为轴颈直径的0.0015~0.0025倍；
- At high speed and high pressure, Δ is 0.0015~0.0025 times of journal diameter.
- 低转速、中等压力时，Δ为轴颈直径的0.0007~0.0012倍；
- At slow speed and medium pressure, Δ is 0.0007~0.0012 times of journal diameter.
- 低转速、高等压力时，Δ为轴颈直径的0.0003~0.0006倍；
- At slow speed and high pressure, Δ is 0.0003~0.0006 times of journal diameter.
- 侧间隙一般取轴承间隙的一半。
- The side clearance is generally half of the bearing clearance.

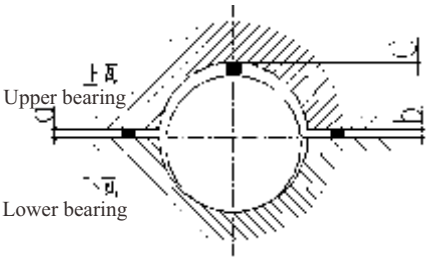
④ 轴承推力瓦与主轴推力盘之间的轴向总间隙一般为轴颈直径的0.002~0.0035倍，顶间隙应用压铅法测量，侧间隙、轴向间隙应用塞尺测量；

④ The total axial clearance between the bearing thrust pad and the main shaft thrust plate is generally 0.002~0.0035 times the diameter of the journal; The top clearance should be measured by pressing lead method, and the side clearance and axial clearance should be measured by feeler gauge;

间隙表示示意及压铅法见下图：

The schematic diagram of the clearance and the method of pressing lead are shown in the following figure:





间隙的表示
Representation of clearance

轴承间隙 Δ=c−(a+b)/2　测量间隙的压铅法
Bearing clearance Δ=c−(a+b)/2　Press lead method for measuring clearance

⑤轴瓦与压盖之间的过盈量为0.03~0.06mm，用压铅法测量；

⑤The interference between the bearing bush and the gland is 0.03~0.06mm, which is measured by the lead pressing method;

5) 对具有滚动轴承的通风机，轴承外圈与轴承箱内孔之间为基轴制过渡配合；同时还应检查轴承外圈与轴承座的轴向定位情况，如不合格时，应进行调整。检查时，应按图纸要求进行，若图纸未规定时可参照下列要求进行：

5) For fans with rolling bearings, the transition fit between the outer ring of the bearing and the inner hole of the bearing box is the basic shaft system; At the same time, the axial positioning of the bearing outer ring and the bearing seat should also be checked. If it is not qualified, it should be adjusted. The inspection shall be carried out according to the requirements of the drawings. If the drawings are not specified, the following requirements can be referred to:

① 支撑端轴承外侧与轴承座的轴向间隙：

① Axial clearance between the outer side of the bearing at the support end and the bearing seat

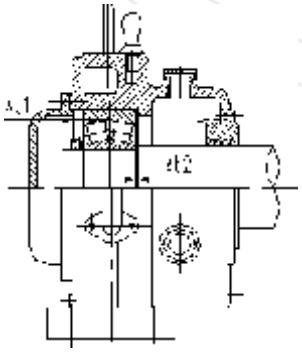
1.风机侧Fan side　5mm≥Δt2≥2 mm;

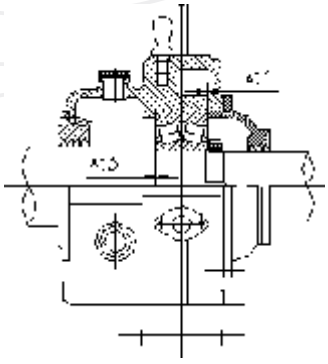
2.非风机侧Non-fan side　Δt1≥5mm;

3.间隙表示见下图。The clearance is shown in the figure below.

② 支推端轴承外侧与轴承座的轴向间隙不大于0.2 mm；即：Δ=Δt3+Δt4≤0.2 mm　间隙表示见下图。

② The axial clearance between the outer side of the thrust end bearing and the bearing seat is not greater than 0.2 mm, that is: Δ=Δt3+Δt4≤0.2 mm





支撑端轴承安装示意图
Installation diagram of supporting end bearing

支推端轴承安装示意图
Schematic diagram of thrust end bearing installation

6) 彻底清理轴承箱；经检查合格后，方可加注润滑油。

6) Thoroughly clean the bearing box; only add lubricating oil after passing the inspection

2.9 机壳和进气箱的最终安装 Final installation of the casing and inlet box

1) 将机壳和进气箱组的可拆卸部分就位并用螺栓连接。

1) Position and bolt the detachable parts of the casing and inlet box assembly.

2) 螺栓连接进风口法兰和机壳进气箱组的侧板。

2) Bolted the inlet flange to the side plate of the casing inlet box group.

3) 根据总图所示及进风口插入叶轮进口圈的尺寸检查叶轮的轴向位置。根据总图所示检查进风口与叶轮进口圈的径向间隙。如果必要的话，调整进风口或机壳以得到正确的间隙设定值，确保机壳进气箱的侧板相对于主轴和主轴密封校准在正确的位置上。检查机壳和进气箱的进出口端面位置是否符合总装图及连接管道要求一致。

3) Check the axial position of the impeller by the general drawing and the size of the air inlet inserted into the impeller inlet ring, check the radial clearance between the air inlet and the impeller inlet ring as shown in the general drawing. If necessary, adjust the air inlet or casing to get the correct clearance setting, and ensure that the side plate of the casing inlet box is aligned in the correct position relative to the main shaft and the main shaft seal. Check whether the positions of the inlet and outlet end faces of the casing and inlet box conform to the requirements of the general assembly drawing and connecting pipes.

2.10 进口调节门和执行器的安装 Installation of inlet damper and actuator

进口调节门是已经全部组装好的，便于安装到风机的进气箱或进风口上。

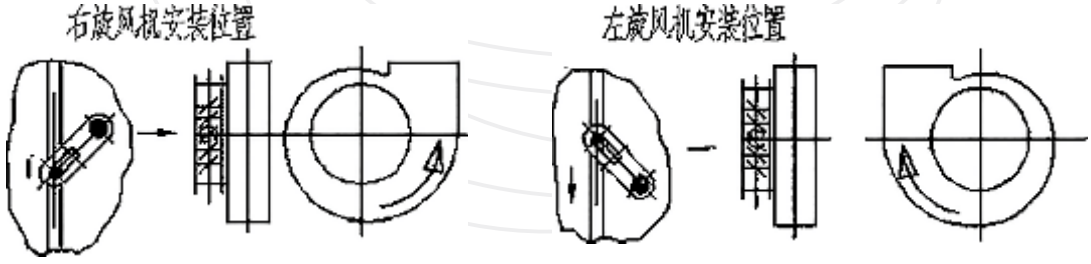
The inlet damper is fully assembled, which is easy to install on the inlet box or air inlet of the fan.

1) 检查进口调节门组的方向位置，保证导叶片的旋转方向相对于叶轮的旋转方向是正确的。气流流向应与旋转方向一致，详见安装总图；图示见下图：

1) Check the direction and position of the inlet damper to ensure that the rotation direction of the guide vane is correct relative to the rotation direction of the impeller. The airflow direction should be consistent with the rotation direction, see the general installation drawing for details. The diagram is shown below.

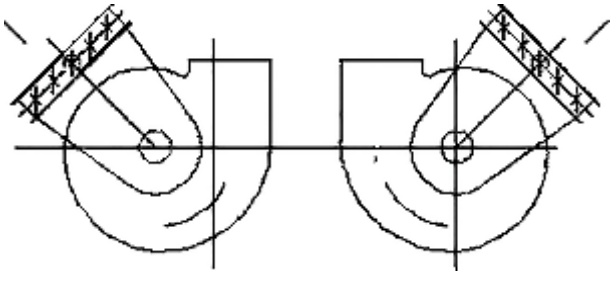
轴向进气的调风门安装方式：

Installation method of the damper for axial air intake:



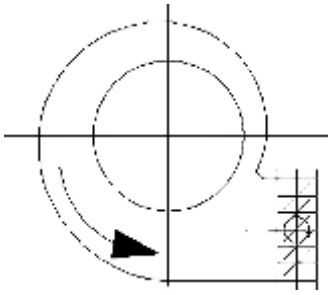
Right-hand fan installation device　　Left-hand fan installation device

- 带进气箱的调风门安装方式：
- Installation method of air damper with inlet box:



● 风机出口调风门安装方式:

● Installation method of fan outlet air regulating door:



2) 将进口调节门组吊装就位在进气箱或进风口上并用螺栓连接。

2) Hoist the inlet damper group into place on the inlet box or air inlet and connect with bolts.

3) 将驱动连杆与导叶驱动柄用所供组件连接在一起，检查各连接当导叶在关闭位置时其位置同调节门设置图中所示，用配套的自锁销钉将连杆固定在导叶轴上。

3) Connect the driving rod with the guide vane driving handle with the supplied component, check each connection when the guide vane is in the closed position, its position is as shown in the damper setting diagram, and fix the connecting rod on the guide vane shaft with the supporting self-locking pin.

4) 执行器安装时按照总装图上的位置进行正确安装。

4) Install the actuator correctly according to the position on the assembly drawing.

5) 检查执行器可以驱动导叶由全闭到全开位置，保证所有连杆都固定到其各自的导叶轴上且所有的连接是紧固的。

5) The inspection actuator can drive the guide vane from fully closed to fully open position, ensuring that all connecting rods are fixed to their respective guide vane shafts and that all connections are secured.

注：执行器调试详情参见执行器说明书。

Note: For details of actuator debugging, please refer to the actuator manual.

2.11 联轴器和电机的安装与找正 Installation and alignment of couplings and motors

2.11.1 安装

2.11.1 Installation

1) 安装风机和电机半联轴器。轴与联轴器的配合为过渡配合，推荐在油中均匀加热半联轴器，可便于安装，联轴器端面应与轴端面平齐（或微凸出）。

1) Install the fan and motor half couplings. The fit between the shaft and the coupling is a transition fit. It is recommended to heat the half-coupling evenly in the oil to facilitate installation. The end face of the coupling should be flush (or slightly protruding) with the end face of the shaft.

2) 将电机座落在垫板上并用垫片按下述方法将其与风机轴找正以达到要求的水平度。

2) Place the motor on the washer plate and align it with the fan shaft in the following way to achieve the required levelness.

2.11.2 轴的找正

2.11.2 Alignment of the shaft

连接轴的正确找正是非常必要的，偏心或找正不好会导致振动、轴疲劳、轴承磨损，且增加能耗。尽管使用了挠性联轴器，其挠性是减小在运行过程中偏心的影响。

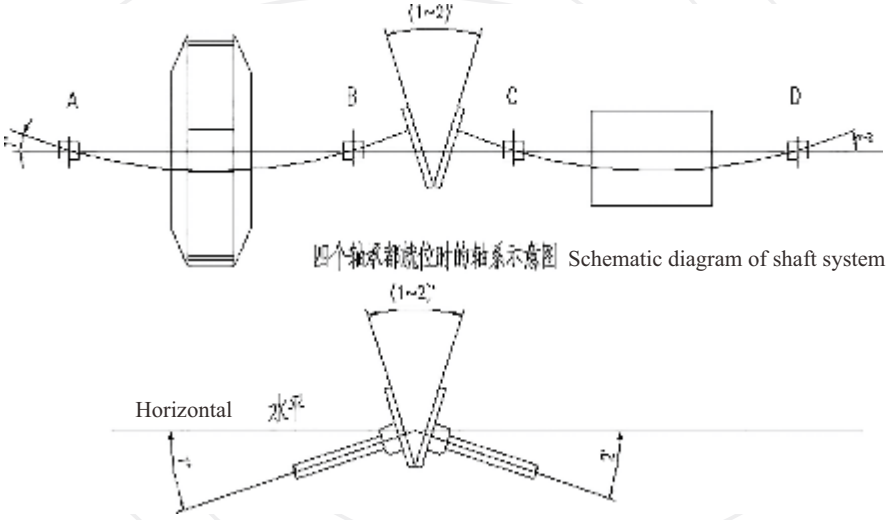
Correct alignment of the shaft is very necessary. Eccentricity or poor alignment will lead to vibration, shaft fatigue, bearing wear and increase energy consumption. Although the flexible coupling is used, its flexibility is to reduce the influence of eccentricity during operation.

如果两个轴是完全刚性的，当轴承就位后就可以很好地进行找正，实际上这种情况是无法达到的，因为重力使联轴器顶部间隙增加，找正程序自然应考虑这种偏差并指出解决的措施。

If the two shafts are completely rigid, they can be well aligned when the bearings are in place. In fact, this situation cannot be achieved, because gravity increases the clearance at the top of the coupling, naturally, the alignment procedure should consider this deviation and point out the solutions.

用测量表在90°内正确读数且通过计算保证两轴是同时运转的，这很有必要。

It is necessary to have a correct reading within 90° with a measuring table and to ensure that the two shafts are running at the same time by calculation.



四个轴承都就位时的轴系示意图 Schematic diagram of shaft system

2.11.3 找正步骤

2.11.3 Alignment steps

联轴器必须进行径向和角向找正，在此阶段风机轴必须进行正确找正。

The coupling must be aligned radially and angularly, and the fan shaft must be properly aligned at this stage.

1) 以风机轴为准对电机轴找正。通过调整垫片改变电机位置达到要求。确保风机和电机的间隙满足总图的规定。

1) Align the motor shaft with the fan shaft as the criterion. Align the motor shaft with the fan shaft as the criterion. Make sure that the clearance between the fan and the motor complies with the general drawing.

2) 获得满意的找正结果且联轴器装好后，拧紧电机的地脚螺栓。

2) After a satisfactory alignment is obtained and the coupling is installed, tighten the motor anchor bolts.

3) 电动机与风机的同轴度允差：

3) Coaxiality tolerance of motor and fan:

角向找正Angular alignment: ≤0.05mm；

径向热找正Radial thermal alignment: ≤0.05mm:

4) 配用液力耦合器的找正，需按随机液偶说明书中的要求注意预留中心线的浮动距离。

4) For alignment of the hydraulic coupler, it is necessary to pay attention to the floating distance of the reserved center line according to the requirements in the manual of the random liquid coupler.

5) 膜片联轴器的安装注意点：

5) Precautions for the installation of diaphragm couplings:

a.切断原动电源，用煤油或柴油清洗所有零件。当机器安装时，应进行对中调整，包括轴向、径向和角向。为保证联轴器的安装使用，提高寿命和效率，安装误差必须调整到不大于20%的许用补偿量。各型号的安装允许偏差值见下表1(DJM型)、表2(SJM_加长段）。

a. Cut off the motive power supply and clean all parts with kerosene or diesel oil. When the machine is installed, it should be aligned, including axial, radial and angular directions. In order to ensure the installation and use of the coupling and improve its service life and efficiency, the installation error must be adjusted to the allowable compensation of no more than 20%. The allowable installation deviation of each model is shown in Table 1(DJM) and Table 2 (SJM_ extended section) below.

表 1 Table 1

规格 Specification	公称扭矩 Nominal torque N▪m	许用转速 Allowable speedr/▪min	转动惯量 Rotational inertia Kg▪cm²	dmax min	D mm	A mm	B mm	许用补偿量 Allowable compensation	
02	90	20000	24	32	81	6.6	26	1°	±1.0
03	173	18000	48	35	93	8.4	29	1°	±1.2
04	245	15000	80	42	104	11.2	34	1°	±1.4
05	420	13000	224	50	130	11.7	42	45 '	±16
06	772	12000	440	60	143	11.7	48	45 '	±18
07	1270	10000	1080	75	170	17	58	45 '	±2.0
08	2080	10000	2080	80	194	17	64	45 '	±2.2
09	3328	9000	3520	95	214	21	77	45 '	±2.4
10	4900	8000	7200	110	246	23.9	89	45 '	±2.6
11	6368	8000	12800	110	276	23.9	102	45 '	±2.8
12	8900	6300	14400	120	296	17.5	128	30 '	±1.8
13	15280	5000	22200	135	308	19	160	30 '	±2.0
14	25410	4700	40800	150	346	21.5	182	30 '	±2.0
15	37130	4300	64800	160	375	24	198	30 '	±2.0
16	47120	3900	100200	180	410	29.5	214	30 '	±2.2
17	57000	3500	150000	190	445	29.5	225	30 '	±2.2
18	63186	3500	186600	205	470	31	248	30 '	±2.4
19	82590	3200	288000	230	512	32	278	30 '	±2.4
20	102100	2800	448200	255	556	32.5	305	30 '	±2.5

表 2 Table 2

规格 Specification	公称扭矩 Nominal torque N•m	许用转速 Allowable speedr/•min	转动惯量 Rotational inertia Kg•cm²	dmax min	D mm	A mm	B mm	许用补偿量 Allowable compensation	
								角向 Angular	轴向mm Axial direction
03	173	18000	48	35	93	8.4	29	2°	±2.4
04	245	15000	80	42	104	11.2	34	1° 30 '	±2.8
05	420	13000	224	50	130	11.7	42	1° 30 '	±3.2
06	772	12000	440	60	143	11.7	48	1° 30 '	±3.6
07	1270	10000	1080	75	170	17	58	1° 30 '	±4.0
08	2080	10000	2080	80	194	17	64	1° 30 '	±4.4
09	3328	9000	3520	95	214	21	77	1° 30 '	±4.8
10	4900	8000	7200	110	246	23.9	89	1° 30 '	±5.2
11	6368	8000	12800	120	276	23.9	102	1° 30 '	±5.6
12	8900	6300	18000	120	296	17.5	128	1°	±3.6
13	15280	5000	37000	135	308	19	160	1°	±4.0
14	25410	4700	68000	150	346	21.5	182	1°	±4.0
15	37130	4300	108000	160	375	24	198	1°	±4.0
16	47120	3900	167000	180	410	29.5	214	1°	±4.4
17	57000	3500	250000	190	445	29.5	225	1°	±4.4
18	63186	3500	311000	205	470	31	248	1°	±4.8
19	82590	3200	480000	230	512	32	278	1°	±4.8
20	102100	2800	747000	255	556	32.5	305	1°	±5.2

b.当主、从动轴完成对中后，即可安装中间轴和膜片，并装上联接螺栓，拧紧螺母。机器安装联轴器后，要求在联轴器运转部位装上防护罩，以加强安全。

b. The intermediate shaft and diaphragm can be installed when the driving and driven shafts are aligned, and the connecting bolts and nuts can be tightened. After the machine coupling is installed, it is required to install a protective cover at the running part of the coupling to enhance safety.

c.半轴节找正：尽管联轴器具有较强的补偿能力，但安装时要严格找正，使得机组工作平稳，以提高联轴器的使用寿命，为了确保半轴节正确安装，请确保外圆和端面的跳动值在0.04~0.10之间。

c. Alignment of half shaft section: Although the coupling has strong compensation ability, it should be strictly aligned during installation, so that the unit can work stably and the service life of the coupling can be prolonged. In order to ensure the correct installation of the half shaft segment, please ensure that the runout value of the excircle and the end face is between 0.04 ~ 0.10.

d.膜片联轴器安装间隙：确保两个半法兰端面间隙要大于膜片组实际厚度，法兰外径小于200mm 间隙不可以超过0.2mm 法兰外径大于200mm,间隙不可以超过0.5mm. 双膜片也要按此标准。

d. Diaphragm coupling installation clearance: ensure that the end face clearance of the two half-flanges is greater than the actual thickness of the diaphragm group, the outer diameter of the flange is less than 200mm, the clearance cannot exceed 0.2mm, the outer diameter of the flange is greater than 200mm, and the clearance cannot exceed 0.5 mm. Double diaphragms are also subject to this standard.

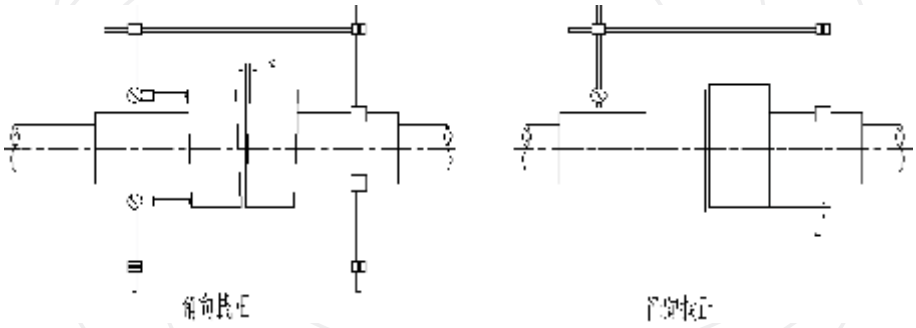
e. 正确安装膜片联轴器螺栓方法：把螺栓从法兰小孔外侧穿入，再穿入膜片孔中(注意膜片的方向，膜片是由许多单个薄片由铆钉和铆钉垫圈，铆钉垫圈处应与缓冲套相接触，否则会影响铆钉组的使用寿命)，再从法兰盘大孔外侧套上缓冲套，拧上螺母紧固时要注意使螺栓不要转动，安装螺栓时一定要注意螺栓方向，不要随意更改螺栓方向，否则会造成螺栓断裂，膜片扭曲变形，

长期运转会使膜片和螺栓配合段表面及半轴节小孔处的损坏。螺栓光杆与法兰小孔配合是传递转矩最重要的接触面，表面完好性直接影响使用性能。如果在运转过程中膜片联轴器出现异常声音,请立即停止运行,并对安装精度,螺丝松动情况等分别进行检查建议安装调试完毕后在螺丝外表面涂粘接剂,增加保护性能。

e. Correct installation method of diaphragm coupling bolts: Insert the bolt from the outside of the flange hole and then into the diaphragm hole (pay attention to the direction of the diaphragm, the diaphragm is made up of many single pieces of rivets and rivet washers, and the rivet washers should be in contact with the buffer sleeve, otherwise it will affect the service life of the rivet group), and then put the buffer sleeve on the outside of the flange hole. When screwing on the nut, be careful not to turn the bolt, pay attention to the bolt direction when installing bolts, and don't change the bolt direction at will, otherwise it will cause bolt fracture and diaphragm distortion, and long-term operation will damage the surface of diaphragm and bolt fitting section and the small hole of half shaft joint. The fitting of polished rod and flange hole is the most important contact surface for torque transmission, and the surface integrity directly affects the service performance. If there is abnormal sound in the diaphragm coupling during operation, please stop running immediately, and check the installation accuracy and screw looseness, etc. it is recommended to coat adhesive on the outer surface of the screw after installation and debugging to increase the protection performance.

注：对具有滑动轴承的电动机，应在测定电动机转子的磁力中心位置后再确定联轴器间的距离。磁力中心一般为转子轴向可窜动量的中间位置，也可起动电动机实测确定。

Note: For motors with sliding bearings, the distance between couplings should be determined after measuring the magnetic center position of the motor rotor. Generally, the magnetic center is the middle position of the axial momentum of the rotor, or it can be determined by starting the motor.

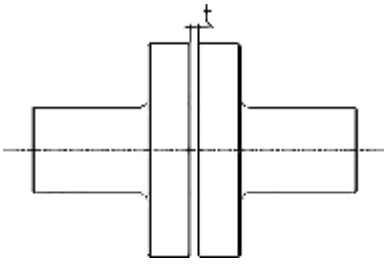


Angular alignment　　Radial alignment

2.11.4 联轴器的间隙

2.11.4 The clearance of the coupling

对于采用联轴器的通风机，还应检查两联轴器端面间的间隙，如不合格时，应进行调整。检查时，应按图纸要求进行：



For fans with couplings, the clearance between the end faces of the two couplings should also be checked, and if it is unqualified, it should be adjusted. When checking, it should be carried out according to the drawing requirements:

两联轴器端面到端面间的间隙值t见风机总装图，间隙表示见下图。

The clearance value t between the end faces of the two couplings is shown in the fan assembly drawing, and the clearance is shown in the following figure.

2.12 皮带轮和电机的安装与找正 Installation and alignment of pulleys and motors

1) 电动机轴和风机轴必须严格地平行，不许带轮有歪斜和摆动；倾斜度不超过0.2/1000。

1) The motor shaft and the fan shaft must be strictly parallel, and the belt wheel is not allowed to tilt and swing; The inclination does not exceed 0.2/1000.

2) 当两带轮宽度相同时，它们的端面应该位于同一平面上；若是不同宽度的两皮带轮，则两带轮的垂直轴中心线的中间平面应该重合（也可以保证它们的端面在同一平面，具体安装时调整）。

2) When the width of two pulleys is the same, their end faces should be on the same plane; If there are two pulleys with different widths, the middle planes of the vertical axis centerlines of the two pulleys should coincide (it can also be ensured that their end faces are in the same plane, which should be adjusted during installation).

2.13 风机采用隔振器时安装要求 Installation requirements for fans using vibration isolators

风机与基础间采用隔振装置，即风机与基础平台之间不采用螺栓联接，仅采用隔振器隔振，风机安放在隔振器上，隔振器平摆放在基础平台上，靠风机自重来压缩隔振器，起到隔振作用。

Vibration isolation device is used between the fan and the foundation, that is, the fan and the foundation platform are not connected by bolts, only vibration isolators are used for vibration isolation, the fan is placed on the vibration isolators, which are horizontally placed on the foundation platform, and the vibration isolators are compressed by the dead weight of the fan, thus playing a role in vibration isolation.

要求基础平台上表面水平，平面度每平方米不大于2mm，从而使各隔振器受力一致，压缩量相等，基础本身所能承受载荷按常规进行设计。

It is required that the upper surface of the foundation platform should be horizontal, and the flatness should not be greater than 2mm per square meter, so that all vibration isolators have the same stress and equal compression, and the load that the foundation itself can bear should be designed by the routine.

如安装在设备上的各隔振器变形量不相等时，可移动隔振器，以使其变形量相等，即使隔振器上的设备（包括支座）重心与隔振器垂直度中心刚度方向重合，这不但是机组处于水平状态的需要，而且也是达到隔振要求的需要。因为变形量大小直接关系到隔振系统的固有频率，关系到其隔振的效果，因此必须力求一致。

If the deformation of each vibration isolator installed on the equipment is not equal, the vibration isolator can be moved to make its deformation equal, even if the center of gravity of the equipment (including the support) on the vibration isolator coincides with the stiffness direction of the vertical center of the vibration isolator, this is not only the need for the unit to be in a horizontal state, but also the need to meet the vibration isolation requirements. Because the deformation is directly related to the natural frequency of the vibration isolation system and its vibration isolation effect, it must be consistent.

如所提供的风机基础平面图上隔振器放置位置不适宜时，可适当移动隔振器位置，确保各隔振器受力一致、压缩量相等。

If the location of the vibration isolators on the provided fan base plan is not suitable, the vibration isolators can be moved appropriately to ensure that the vibration isolators bear the same force and have the same amount of compression.

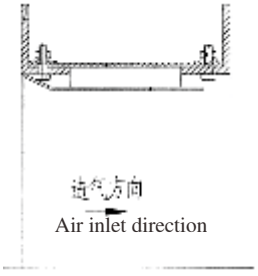
注：隔振器安装详情参见隔振器隔振器说明书。

Note: Please refer to the vibration isolator instruction manual for vibration isolator installation details.

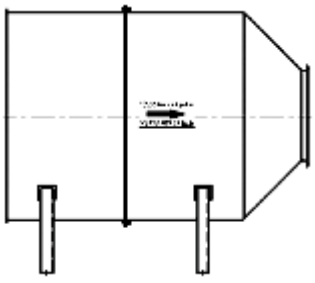
2.14 消音器和软连接安装 Muffler and soft connection installation

安装时要按照部件的进气标识安装，注意进气的方向。

Install according to the air intake mark of the component and pay attention to the direction of the air intake.



软连接
Soft connection



消音器
Muffler

2.15 最终安装注意事项 Final Installation Notes

1) 安装轴承温度监测仪表和检测仪表。

1) Install bearing temperature monitoring instrument and testing instrument.

2) 安装所有检查门和护罩。

2) Install all inspection doors and shields.

3) 对旋转部件的找正进行检查，合格后用不收缩的浆料对混凝土基础上的设备基础进行最终灌浆，一个月后检查。

3) The alignment of the rotating parts is checked, and the equipment foundation on the concrete foundation is finally grouted with non-shrinking slurry after passing the inspection, and the inspection is carried out after one month.

4) 由于基础及结构在安装初期会下陷或移动，因此设备应在最终灌浆30天后最后固定。

4) Since the foundation and structure may sag or move during the initial installation, the equipment should be finally fixed 30 days after the final grouting.

设备只有在严格检查找正及位置定好后才可最终销定定位，定位销的孔应通过轴承底座和轴承配钻并铰至合适定位销的尺寸。

The equipment can be finally pinned and positioned only after strict inspection and alignment, and the hole of the positioning pin should be drilled through the bearing base and the bearing and hinged to the appropriate size of the positioning pin.

注：其它配套件（电机、液力偶合器、冷却器、稀油站、变速箱、联合器等）的安装与维护，详情阅读并符合各自说明书或维护手册的要求。

Note: For the installation and maintenance of other accessories (motor, fluid coupling, cooler, thin oil station, gearbox, coupling, etc.), please read and meet the requirements of their respective manuals or maintenance manuals for details.

第3节 运 行 Section 3 Run

3.1 简 介 Brief introduction

本节叙述了风机启动、运行和停车的必要程序，只作为推荐并且可以根据现场服务工程师的意见作改动。

This section describes the necessary procedures for start-up, operation and shutdown of the fan, which is only recommended and can be changed according to the opinions of site engineers.

3.2 安全注意事项 Safety precautions

安装、运行和维护必须根据本手册的说明，所有工作必须由经过培训的适合人员执行。

Installation, operation and maintenance must be in accordance with the instructions in this manual, and all work must be carried out by trained and suitable personnel.

下列特别注意事项应注意：

The following special precautions should be noted:

1) 检查门及护罩Inspect doors and shields:

风机运行时其检查门打开是不安全的，风机运行时所有的护罩都应安装好。

It is not safe to open the inspection door when the fan is running, and all shields should be installed when the fan is running.

2) 叶轮Impeller:

应定期检查叶轮的腐蚀、裂纹。

Check the impeller periodically for corrosion and crack.

3) 机壳和进气箱组 The casing and inlet box unit:

应定期检查机壳和进气箱的积污情况，任何积灰都应除去，以避免风机性能的下降。

Check the fouling of the casing and inlet box regularly, and remove any dust to avoid the performance degradation of the fan.

4) 安装Installation:

保证风机的机械和电气均已正确安装。

Ensure that the mechanical and electrical components of the fan are installed correctly.

5) 运行Run:

风机必须在其设定条件下运行，特别应注意对温度和介质的控制。

The fan must operate under its set conditions, with special attention to temperature and medium control.

6) 接线 Connection:

所使用的电线电缆应按国标及电机额定参数选型。

The wire and cable used should be selected according to the national standard and rated parameters of the motor.

不要与能够产生噪声的设备，如电焊机、高频淬火机等共用一个电源配电盒。

Do not share a power distribution box with noise-generating equipment, such as welding machines, high-frequency quenching machines, etc.

应由熟练的电气人员来连接动力线。

Power lines should be connected by skilled electrical personnel.

7) 接地 Ground connection

一般来讲，每台风机电机的地线应良好联接至全厂动力接地系统。

Generally speaking, the ground wire of each fan motor should be well connected to the power grounding system of the whole plant.

3.3 预启动规程 Pre-start procedure

风机第一次启动、长期停车后启动或大修后启动时必须遵守本规程。

This regulation must be observed when the fan is started for the first time, after long-term parking or after overhaul.

3.3.1 风机准备

3.3.1 Fan preparation

1) 检查风机主轴和电机的找正。

1) Check the alignment of fan main shaft and motor.

保证轴承和所有需要润滑的设备充满润滑油（脂）的牌号按图纸要求，若图纸未规定时可参照下述要求进行：

Ensure that bearings and all lubricating equipment are filled with lubricating oil (grease) in accordance with the requirements of the drawings. If not specified in the drawings, please refer to the following requirements:

滚动轴承 Rolling bearing:

润滑油一般为冬天用N32机械油（可用L-TSA32汽轮机油），夏天用N46机械油（可用L-TSA46汽轮机油）（GB/T3141-1994）；加油量以轴承箱上的上、下油标线为准，即保证油位在上、下油标线之间的中线油位（换油周期：首次3个月，其余6个月）。若为脂润滑，一般为2号锂基脂，应以装满轴承座填充空间的百分之四十为宜。

Lubricating oil is generally used in winter with N32 mechanical oil (available L-TSA32 turbine oil), summer with N46 mechanical oil (available L-TSA46 turbine oil) (GB/T3141-1994), the amount of oil to the bearing box on the upper and lower oil marking line shall be subject, that is, to ensure that the oil level in the middle line between the upper and lower oil marking line oil level (oil change cycle: first 3 months, remaining 6 months). If it is grease lubrication, it is generally No. 2 lithium grease, which should be filled with 40% of the filling space of the bearing seat.

滑动轴承Sliding bearing:

润滑油一般为冬天用L-TSA32汽轮机油，夏天用L-TSA46汽轮机油（GB/T3141-1994）加油量按稀油站或轴承箱油位要求添加。

The lubricating oil is generally L-TSA32 steam turbine oil in winter and L-TSA46 steam turbine oil (GB/T3141-1994) in summer. The amount of lubricating oil should be added according to the oil level of thin oil station or bearing box.

2) 推荐的润滑油或润滑脂至正确的油位。

2) Recommended lubricating oil or grease to correct oil level.

3) 检查风机进气、出气侧，保证空气自由通过。

3) Check the inlet and outlet sides of the fan to ensure the free passage of air.

4) 检查所有螺栓已充分拧紧，如果松动，会损坏风机，特别是用于电机、联轴器、轴承和基础的螺栓。

4) Check that all bolts are fully tightened. If they are loose, the fan will be damaged, especially the bolts used for motor, coupling, bearing and foundation.

5) 检查电机轴和风机叶轮的旋转方向是正确的。

5) Check that the rotation direction of motor shaft and fan impeller is correct.

6) 检查是否有杂物如扳手或螺母和螺栓留在风机内，因为这些东西会在风机旋转时严重损坏风机。

6) Check that no debris, such as wrenches or nuts and bolts, are left in the fan, because these things will seriously damage the fan when it rotates.

7) 在轴承加油后，手工盘车，人工转动叶轮至少一圈保证叶轮与壳体有足够的间隙。

7) After the bearing is oiled, manual turning, manually rotate the impeller at least once to ensure that there is enough clearance between the impeller and the shell.

8) 确定所有人员均已撤出风机，紧固所有进入门和检查门。

8) Make sure all personnel are removed from the fan and secure all entry and inspection doors.

9) 保证所有电机已正确保险。

9) Ensure that all motors are properly insured.

10) 检查在风机和管道中没有积水。

10) Check that there is no stagnant water in the fan and pipeline.

11) 检查进口调节门控制的运行确保能正常工作。

11) Check the operation of inlet damper control to ensure it works properly.

12) 检查水阀是否打开，冷却水是否通畅。

12) Check whether the water valve is open and the cooling water is unobstructed.

13) 带水冷的风机轴承座可采用≤32℃工业用循环水，水量2~4t/h、进口水压0.35~0.4MPa、进出口压差≥0.2MPa。

13) The fan bearing seat with water cooling can use industrial circulating water ≤32℃, the water volume is 2~4t/h, the inlet water pressure is 0.35~ 0.4mpa, the inlet and outlet pressure difference is ≥ 0.2mpa.

14) 检查调节门的旋转方向是否正确。

14) Check if the rotation direction of the damper is correct.

15) 电机的冷却水是否畅通，电机绝缘是否良好。

15) Whether the cooling water of the motor is smooth and whether the motor insulation is good.

16) 进出风口方向10米内不许站人。

16) No one is allowed to stand within 10 meters of the air inlet and outlet.

17) 检查系统的管路和支撑是否焊接牢固、无异物。

17) Check that the piping and supports of the system are firmly welded and free of foreign objects.

3.3.2 首次风机启动

3.3.2 Initial fan start

1) 检查轴承的油位是否正常。

1) Check whether the oil level of the bearing is normal.

2) 关闭进口调节门以减少启动时电机载荷。

2) Close the inlet damper to reduce motor load at start-up.

3) 启动电机：如果调节门打开时风机启动，驱动电机可能会过载。

3) Start the motor: If the fan starts when the damper is open, the drive motor may be overloaded.

4) 出口挡板全开，然后逐渐打开进口调节门，风机启动后不能在调节门完全关闭状态下运行以避免振动和温升。

4) The outlet baffle is fully open, and then the inlet damper is gradually opened. After the fan is started, it cannot run in the state of the damper is completely closed to avoid vibration and temperature rise.

5) 监测轴承温度，查看任何不正常的振动。

5) Monitor bearing temperature and check for any abnormal vibration.

6) 检查轴承的油位并与设计值比较。

6) Check the oil level of the bearing and compare with the design value.

3.4 常规启动规程 General Startup Procedure

1) 检查风机油位。

1) Check the fan oil level.

2) 关闭进口调节门以减少电机启动时的载荷。

2) Close the inlet damper to reduce motor load at start-up.

3) 启动电机：如果调节门打开时风机启动，驱动电机可能会过载。

3) Start the motor: If the fan starts when the damper is open, the drive motor may be overloaded.

4) 出口挡板全开，然后逐渐打开进口调节门。风机启动后不能在调节门完全关闭状态下运行以避免振动和温升。

4) The outlet baffle is fully open, and then the inlet damper is gradually opened. After the fan is started, it cannot run in the state of the damper is completely closed to avoid vibration and temperature rise.

5) 检查风机和电机轴承温度在报警值以下。

5) Check that the bearing temperature of fan and motor is below the alarm value.

6) 检查电机绕组和任何其它控制回路的温度在报警设定值以下。

6) Check that the temperature of the motor windings and any other control loops is below the alarm setpoint.

7) 监测轴承温度并检查任何非正常的振动。

7) Monitor bearing temperature and check for any abnormal vibration.

3.5 正常运转 Normal running

风机启动且运行正常后，应注意下列常规事项：

After the fan is started and operating normally, the following general precautions should be noted:

1) 轴承温度是否在正常范围内

1) Whether the bearing temperature is within the normal range.

2) 轴承的油位在最高和最低运行范围内。

2) The oil level of the bearing is within the maximum and minimum operating range.

3) 没有过度的噪声和振动来自风机。

3) There is no excessive noise and vibration from the fan.

4) 风机控制的载荷可由下列方法调节：

4) The load controlled by the fan can be adjusted by the following methods

- 使用进口调节门调节负荷
- Use the inlet damper to adjust the load
- 采用调速装置来调节负荷
- Use speed regulating device to adjust the load

注：确保风机不在出现喘振的条件下运行，因为喘振会对风机及其附属风道产生严重的损坏。调节门开度必须≥30%。

Note: Make sure that the fan does not run under the condition of surge, because surge will cause serious damage to the fan and its auxiliary air duct. Inlet damper opening must be ≥30%.

3.6 停车规程 Parking Procedure

1) 关闭主驱动电机。

1) Turn off the main drive motor.

2) 关闭隔离挡板。通常是以轻载荷使风机停车，停车后进气阀、排气阀处于全闭。

2) Close the isolation baffle. The fan is usually shut down with light load, and the intake valve and exhaust valve are completely closed after the stop.

3) 有强制供油轴承时，应连续向轴承供油，直到风机主轴完全停止为止。

3) When there is a forced oil supply bearing, oil should be continuously supplied to the bearing until the main shaft of the fan stops completely.

4) 使用冷却水时，停车后，再关闭冷却水阀。

4) When using cooling water, close the cooling water valve after parking.

5) 输送有害气体的风机、应注意从轴封部分向外漏气。

5) Fans that transport harmful gases should pay attention to air leakage from the shaft seal part.

6) 输送高温气体的风机中，直至机壳内的气体温度降到100℃以下为止，应连续运转为宜。

6) In the fan that transports high-temperature gas, it is advisable to run continuously until the gas temperature in the casing drops below 100°C.

3.7 紧急/报警动作 Emergency/alarm action

相关报警值按图纸规定要求，若图纸未规定时可参照下述要求进行：

The related alarm value shall be in accordance with the requirements specified in the drawing. If the drawings are not specified, the following requirements can be referred to:

名 称 Name		设 置 Setting	动作或评述 Action or comment
进口调节门限位开关 Inlet regulating door limit switch		导叶关闭 Guide vanes closed	允许启动风机 Allowable starting fan
风机轴承热电阻温度计（RTD）（滚动轴承） Fan bearing thermal resistance thermometer（Rolling bearing）		高于80℃ 高于85℃ Higher than 80℃ Higher than 85℃	轴承温度报警 Bearing temperature alarm 轴承温度跳闸 Bearing temperature trip
风机轴承热电阻温度计（RTD）（滑动轴承） Fan bearing thermal resistance thermometer（Sliding bearing）		高于75℃ 高于80℃ Higher than 75℃ Higher than 80℃	轴承温度报警 Bearing temperature alarm 轴承温度跳闸 Bearing temperature trip
滚动轴承 刚性支撑 Rolling bearing rigid support	风机轴承振动速度极限（转速小于1000r/min） Fan bearing vibration speed limit (The rotational speed is less than 1000r/min)	高于5mm/s 高于9 mm/s Higher than 5mm/s Higher than 9 mm/s	轴承振动报警 Bearing vibration alarm 轴承振动跳闸 Bearing vibration trip
	风机轴承振动速度极限（转速大于1000r/min） Fan bearing vibration speed limit (The rotational speed is greater than 1000r/min)	高于6.3mm/s 高于11 mm/s Higher than 6.3mm/s Higher than 11 mm/s	轴承振动报警 Bearing vibration alarm 轴承振动跳闸 Bearing vibration trip
滚动轴承 柔性支撑 Rolling bearing flexible support	风机轴承振动速度极限（转速小于1000r/min） Fan bearing vibration speed limit (The rotational speed is less than 1000r/min)	高于9mm/s 高于11mm/s Higher than 9mm/s Higher than 11mm/s	轴承振动报警 Bearing vibration alarm 轴承振动跳闸 Bearing vibration trip
	风机轴承振动速度极限（转速大于1000r/min） Fan bearing vibration speed limit (The rotational speed is greater than 1000r/min)	高于9mm/s 高于12mm/s Higher than 9mm/s Higher than 12mm/s	轴承振动报警 Bearing vibration alarm 轴承振动跳闸 Bearing vibration trip
滑动轴承 Sliding bearing	风机轴承振幅极限（按1000r/min核算） Fan bearing amplitude limit （Calculated at 1000r/min）	高于110um 高于120um Higher than 110um Higher than 120um	轴承振动报警 Bearing vibration alarm 轴承振动跳闸 Bearing vibration trip
电机轴承热电阻温度计（RTD） Motor bearing thermal resistance thermometer		见电机说明书 See motor manual	轴承温度报警 Bearing temperature alarm 轴承温度跳闸 Bearing temperature trip
电机绕组温度计（RTD） Motor winding resistance thermometer		见电机说明书 See motor manual	绕组温度报警 Winding temperature alarm 绕组温度跳闸 Winding temperature trip

第4节 维 护 Section 4 Maintenance

4.1 安全措施 Safety measure

4.1.1 维修前的完全预防

4.1.1 Complete prevention before maintenance

在进行风机的任何维护前必须注意下述安全预防措施：

Before any maintenance of the fan, the following safety precautions must be taken:

1) 得到工作许可。

1) Get a work permit.

2) 确定风机处于电绝缘状态，即风机及其附属设备的电供应处于关闭状态，同时在维护工作完成前保持该状态。如果做不到这点，会导致风机部件突然运转，从而导致维修人员的伤亡。

2) Make sure that the fan is in an electrically insulated state, that is, the power supply of the fan and its auxiliary equipment is turned off, and keep it in this state until the maintenance work is completed. Failure to do so will lead to sudden operation of the fan components, resulting in casualties of maintenance personnel.

3) 确定风机已完全停止。

3) Make sure the fan has stopped completely.

4) 确定风机隔离挡板关闭。

4) Make sure the fan isolation damper is closed.

5) 打开入孔门并保持充分的通风。

5) Open the entry door and maintain adequate ventilation.

6) 确定进入风机的工作人员处于安全状态。

6) Ensure that the personnel entering the fan are in a safe condition.

4.1.2 维修后的安全预防

4.1.2 Safety precautions after maintenance

维修工作完成后应采取下述安全预防措施：

After the maintenance, the following safety precautions should be taken:

1) 检查所有经过维修的部件其螺栓是紧固的。

1) Check that the bolts of all repaired parts are tight.

2) 检查使用过的零部件都已重新润滑过。

2) All the used parts have been re-lubricated.

3) 检查所有外部设备，工具和碎片都已撤出风机。

3) Check that all external equipment, tools and debris have been removed from the fan.

4) 人工转动叶轮一圈以确定叶轮转动自如。

4) Manually rotate the impeller once to make sure that the impeller rotates freely.

5) 所有人员撤出风机安装现场后，重新安装上人孔门并紧固。

5) After all personnel withdraw from the fan installation site, reinstall the manhole door and fasten it.

6) 确定所有电源已恢复。

6) Make sure all power is restored.

4.2 风机零部件的保护 Protection of fan parts

1) 轴承：如果轴承箱解体，必须小心保护以免灰尘侵入和损坏轴承。

1) Bearing: If the bearing box is disassembled, care must be taken to prevent dust from invading and damaging the bearing.

2) 叶轮和主轴：不要让叶片或侧盘支撑叶轮，如果以叶轮外缘作支撑，其重量应作用到侧盘上，不能在叶片或侧盘处起吊叶轮，起吊叶轮时应注意吊索必须在叶轮的两侧以使载荷均匀，注意保护主轴表面，避免划伤和碰伤。

2) Impeller and main shaft: Do not let blades or side plates support the impeller. If the outer edge of the impeller is used as support, its weight should be applied to the side plates. The impeller cannot be hoisted at the blade or side discs. When lifting the impeller, pay attention to slings on both sides of the impeller to make the load even, and protect the surface of the main shaft to avoid scratches and bumps.

3) 如风机不运行时需要把轴承座中的冷却水放干净，以免冬天冻裂。

3) If the fan is not running, it is necessary to drain the cooling water in the bearing seat to avoid freezing and cracking in winter.

4) 调节门每6个月需要在转轴和轴套接合处用油枪注入润滑油，以免锈蚀卡死。

4) The damper needs to be injected with lubricating oil at the joint of the rotating shaft and the shaft sleeve every 6 months to avoid rust and stuck.

4.3 常规维护 Routine maintenance

4.3.1每八小时检查项目

4.3.1 Check the project every eight hours

下列项目应至少每八小时且换班初始检查一次：

The following items should be checked at least once every eight hours and at the beginning of shift change:

1) 轴承不发热（低于80℃）及油位正常。

1) The bearing is not hot (below 80℃) and the oil level is normal.

2) 轴承振动值正常。

2) The vibration value of bearing is normal.

4.3.2 日检项目

4.3.2 Daily inspection items

1) 检查轴承温度。

1) Check the bearing temperature.

2) 检查轴承油位，如油位过低补充新油。

2) Check the bearing oil level. If the oil level is too low, add new oil.

3) 无过度的噪声及振动来自风机。

3) No excessive noise and vibration come from the fan.

4) 轴承箱冷却水是否通畅。

4) Whether the cooling water of the bearing box is unobstructed.

5) 外部电线、电缆线有无断裂处，绝缘包皮有无破损。

5) Whether the external wires and cables are broken, and whether the insulating sheath is damaged.

4.3.3 周检项目

4.3.3 Weekly inspection items

1) 全面检查日检项目。

1) Check the daily inspection items comprehensively.

2) 检查联轴器的不正常噪声及振动，同时检查油位是否正常。

2) Check the abnormal noise and vibration of the coupling, and check whether the oil level is normal.

3) 检查轴承的泄漏，不正常噪声及振动，同时检查油位是否正常。

3) Check the bearing for leakage, abnormal noise and vibration, and check whether the oil level is normal.

4) 检查整个风机装置是否有明显缺陷如螺栓松动。

4) Check the whole fan device for obvious defects such as loose bolts.

5) 检查风机轴承温度。

5) Check the fan bearing temperature.

6) 检查风机轴承振动。

6) Check the vibration of fan bearing.

7) 三角皮带的张紧力是否合适、表面是否有裂纹，清理皮带。

7) Whether the tension of the triangle belt is appropriate and whether the surface is cracked, clean the belt.

8) 外部电线、电缆线有无断裂处，绝缘包皮有无破损。

8) Whether the external wires and cables are broken, and whether the insulating sheath is damaged.

4.3.4 两个月维护项目

4.3.4 Two-month maintenance project

1) 全面进行周检项目内容。

1) Conduct a comprehensive weekly inspection of project content.

2) 轴护罩：检查护罩紧固连接。

2) Shaft shield: check the tight connection of the shield.

3) 从轴承座中提取油样检查，如果颜色有改变或怀疑有污染，将油样进行化学检测。

3) Take the oil sample from the bearing seat for inspection. If the color changes or pollution is suspected, the oil sample will be tested chemically.

4) 人孔门和检查门进行检查以达到满意的开、关要求。

4) Entrance doors and inspection doors are inspected to meet satisfactory opening and closing requirements.

5) 三角皮带的张紧力是否合适、表面是否有裂纹，清理皮带。

5) Whether the tension of the triangle belt is appropriate and whether the surface is cracked, clean the belt.

6) 外部电线、电缆线有无断裂处，绝缘包皮有无破损。

6) Whether the external wires and cables are broken, and whether the insulating sheath is damaged.

4.3.5 年检

4.3.5 Annual inspection

1) 全面进行两个月检查项目的内容。

1) Conduct a comprehensive two-month inspection of the contents of the project.

2) 叶轮：检查叶轮，叶片的腐蚀和裂纹。若有裂纹应立即与大通宝富商量。如果没有，叶轮可再次使用而不用修理，但应检查平衡。如需要大通宝富可进行现场平衡。

2) Impeller: check the corrosion and crack of impeller and blade. If there is any crack, consult Dart-Rich immediately. If not, the impeller can be reused without repair, but the balance should be checked. If you need Dart-Rich, you can carry out on-site balance.

3) 基础和支撑结构：检查其裂纹变形和其它损坏，如果需要进行能够年修、检查、支撑钢结构的松动螺栓，需要时重新紧固。

3) Foundation and supporting structure: check its crack deformation and other damages. If it is necessary to carry out annual repair and check the loose bolts of supporting steel structure, re-tighten them if necessary.

4) 风机壳体：检查所有外部连接点是否紧固，并紧固所有地脚螺栓。

4) Fan casing: Check whether all external connection points are fastened and tighten all anchor bolts.

5) 检查驱动装置的找正，检查叶轮在机壳中的位置及轴的水平，如需要进行调整。

5) Check the alignment of the driving device, the position of the impeller in the casing and the level of the shaft, and make adjustments

if necessary.

6) 风机轴承：检查，调整需要时更换。

6) Fan bearings: Check, adjust and replace if necessary.

7) 进口调节门：检查导叶全程的自由度，检查导叶、导叶轴承及连接点的磨损，必要时修理或更换。

7) Inlet damper: Check the freedom of the guide vane in the whole process, check the wear of the guide vane, guide vane bearing and connection point, repair or replace if necessary.

4.4 转子组的维护 Maintenance of rotor group

注意：由于使用了合金钢，维修叶轮时需要特殊的焊接技术，此操作应事先与大通宝富商量。

Note: Due to the use of alloy steel, special welding techniques are required to repair the impeller, which should be discussed with Dart-Rich in advance.

4.4.1 叶轮/主轴的拆卸与安装

4.4.1 Disassembly and installation of impeller/ main shaft

为了便于叶轮的维护与更换，主轴和进风口组应从风机上拆下。

In order to facilitate the maintenance and replacement of the impeller, the main shaft and the air inlet group should be removed from the fan.

1) 拆下联轴器护罩。

1) Remove the coupling housing.

2) 拆下轴承监测仪表。

2) Remove the bearing monitoring instrument.

3) 拆下主轴密封。

3) Remove the main shaft seal.

4) 沿进气箱人孔门及机壳/进气箱可拆卸部分的剖分法兰拆下隔声层。

4) Remove the sound insulation layer along the split flange of the inlet box manhole door and the detachable part of the casing/inlet box.

5) 从人孔门进入进气箱，松开其法兰与及机壳连接的螺栓，留下一些已松动的螺栓来支撑进风口。

5) Enter the inlet box from the manhole door, loosen the bolts connecting the flange and the casing, and leave some loose bolts to support the air inlet.

6) 松开机壳/进气箱可拆卸部分的螺栓并将该部分拆下。

6) Loosen the bolts on the detachable part of the casing / inlet box and remove the part.

7) 拆下联轴器（皮带轮）。

7) Remove the coupling (pulley).

8) 放空轴承座中的润滑油，拆卸轴承座端盖侧面及中分面上的螺栓，拆下中分面弹性销，拆下轴承端盖，拆下轴承座中分面连接螺栓并拆下轴承座上半。注意避免损坏主轴和轴承。

8) Empty the lubricating oil in the bearing seat, remove the bolts on the side and split surface of the bearing seat end cover, the elastic pin of the split surface, the bearing end cover, the connecting bolts of the split surface of the bearing seat and the upper half of the bearing seat. Avoid damaging the main shaft and bearing.

9) 用带衬垫的吊索吊起主轴组，不要碰到主轴或轴承，小心将其撤出机壳并落在支架上，保护轴承。也可以带着轴承组拆下叶轮/主轴组，但油管必须拆下，并密封好以免灰尘侵入。安装前检查所有部件的情况，特别是叶轮，轴颈和风机轴承。详见本手册相关章节。

9) Lift the main shaft group with a sling with a gasket, and do not touch the main shaft or the bearing. Carefully pull it out of the casing and land it on the bracket to protect the bearing. The impeller/ main shaft unit can also be removed with the bearing unit, but the oil pipe must be removed and sealed to prevent dust intrusion. Check all parts before installation, especially impeller, journal and fan bearings. See relevant chapters in this manual for details.

叶轮/主轴组的安装步骤与其拆卸步骤相反，必须进行下列安装章节的内容：

The installation steps of impeller/main shaft set are the opposite of the disassembly steps. The following installation chapters must be carried out:

2.7节：叶轮/主轴安装

Section 2.7: Impeller/ main shaft installation

2.8节：轴承箱最终安装

Section 2.8: Bearing box final installation

2.9节：机壳/进气箱最终组装

Section 2.9: Casing / inlet box final assembly

2.11节：联轴器和电机的安装和找正

Section 2.11: Coupling and motor installation and alignment.

4.4.2 从主轴上拆下叶轮

4.4.2 Remove the impeller from the main shaft

拆下进风口后，就可以用加热的方法使轮毂内孔增大从而拆下叶轮（保持主轴是冷却的）。尽管如此，仍不推荐现场从主轴上拆下叶轮，除非有特殊情况。如果注明有必要，须与大通宝富商讨并准备详细规程。

After the air inlet is removed, the inner hole of the hub can be enlarged by heating to remove the impeller (keep the main shaft cool). However, it is not recommended to remove the impeller from the main shaft on site unless there are special circumstances. Discuss and prepare detailed procedures with Dart-Rich if indicated as necessary.

更换叶轮应按下列程序进行

The replacement of the impeller should be carried out according to the following procedures:

4.4.3 叶轮安装在主轴上

4.4.3 The impeller is mounted on the main shaft

进行组装前，应完成叶轮定位的所有准备工作。使用下列程序：

Before assembly, all preparations for impeller positioning should be completed. Use the following procedures:

1) 确保叶轮旋转方向是正确的。

1) Make sure the impeller is rotating in the correct direction.

2) 用二硫化钼润滑主轴。

2) Lubricate the main shaft with molybdenum disulfide.

3) 如果需要加热，应加热整个叶轮，从外缘开始逐渐向内加热，可以用气或烤灯加热；与加热叶轮相反的方法是用干冰冷却主轴。

3) If heating is required, the entire impeller should be heated, starting from the outer edge and gradually heating inward, which can be heated with gas or a baking lamp; the opposite method to heating the impeller is to cool the main shaft with dry ice.

4) 按标记快速将叶轮安装在主轴上，不要使用锤子。

4) Install impeller on the main shaft quickly as marked, do not use hammer.

4.4.4 平衡

4.4.4 Balance

叶轮进行任何检修后都应检修再平衡，由于更换叶轮和再平衡叶轮均须极度地小心和特殊的技术，所以在检修任何操作前推荐与大通宝富协商。

The impeller should be overhauled and rebalanced after any overhaul. Since the impeller replacement and rebalancing of the impeller require extreme care and special techniques, it is recommended to consult with Dart-Rich before overhauling any operation.

叶轮必须按JB/T标准JB/T9101进行平衡。

The impeller must be balanced according to JB/T standard JB/T9101.

叶轮焊接时应尽可能接地，防止通过轴承接地，损坏轴承。

When the impeller is welded, it should be grounded as far as possible to prevent the bearing from being damaged by grounding through the bearing.

4.5 主轴找正 Alignment of the main shaft

主轴正确找正是非常重要的，找正不好会导致主轴疲劳、轴承磨损及增加功耗。尽管使用了挠性联轴器，其挠性只是减少出现在运行条件下的偏心的作用，如果主轴本身找正不好，同样会影响联轴器的功能，主轴找正应是定期检查并在需要时对磨损部件修补时作调整。检查主轴找正的步骤在安装组内说明2.11节中描述：联轴器和电机安装及找正。

Correct alignment of the main shaft is very important. Poor alignment will lead to main shaft fatigue, bearing wear and increase power consumption. Although the flexible coupling is used, its flexibility only serves to reduce the eccentricity under the operating conditions. If the main shaft alignment is not good, it will also affect the function of the coupling. The main shaft alignment should be checked regularly and adjusted when the worn parts are repaired when necessary. The steps to check main shaft alignment are described in section 2.11 of the instructions in the installation group: coupling and motor installation and alignment.

4.6 主轴修整 Main shaft dressing

如果主轴在与轴承配合部损坏，有两种可行措施：

If the main shaft is damaged in the mating part of the bearing, there are two feasible measures:

1) 换一根新主轴。

1) Replace a new main shaft.

2) 可以加工主轴，刷镀后再加工到原尺寸。在没有与大通宝富事先协商不能采取这些措施。

2) Main shaft can be machined, brushed and then machined to original size. These measures cannot be taken without prior consultation with Dart-Rich.

4.7 故障分析 Fault analysis

本节叙述了故障查找知识可以帮助维修人员，表中列出了可能出现的故障，同时提出了解决的方法，如果出现的故障没有相应合理的解决办法，与制造厂家商讨。

This section describes how fault finding knowledge can help maintenance personnel, the table lists the possible faults and proposes solutions. If there is no corresponding reasonable solution to the fault, discuss with the manufacturer.

项 目 Items	原 因 Reason	解决措施 Solutions
振动 Vibration	叶轮积灰 Dust on impeller	全面水洗叶轮，用砂磨或线刷，保证所有积灰均已去除。 Thoroughly wash the impeller with sand or wire brush to ensure that all deposits are removed.
	叶轮磨损 Impeller wear	叶轮磨损可以引起不平衡，即使磨损没有严重到维修或更换叶轮，检查并进行再平衡。 Impeller wear can cause unbalance, even if the wear is not severe enough to repair or replace the impeller, check and rebalance.
	偏心 Eccentricity	纠正风机和驱动装置的找正。 Correct alignment of fan and drive units.
	主轴弯曲 Spindle bending	检查偏心，维修或更换主轴。 Check eccentricity, repair or replace spindle.
	轴承螺栓松动 Loose bearing bolts	紧固所有螺栓并检查所有底脚和底板的找正。 Tighten all bolts and check alignment of all feet and bottom plates.
	叶轮损坏 Impeller damage	修复所有损坏部分，重新就位找平衡，需要时更换叶轮。 Repair all damaged parts, reposition for balance, replace impeller if needed
	基础或灌浆故障 Foundation or grouting failure	用高强度高质量材料重新修复并加固基础，确定底板固定到混凝土基础或钢结构上。 Repair and reinforce the foundation with high strength, high quality materials and make sure the bottom plate is fixed to the concrete foundation or steel structure.
	结构支撑强度不够 Insufficient structural support	用合适的钢带加强现有支撑结构。 Reinforce the existing support structure with suitable steel bands.
轴承温度高 The bearing temperature is high	冷却不充分 Insufficient cooling	检查冷却水系统的运行情况。 Check the operation of the cooling water system.
	油位低 Low oil level	轴承箱时候漏油并重新加油到要求的油位。The bearing box leaks oil and refuel to the required oil level.
	轴承损坏 Bearing damage	检查轴承，必要时更换。 Check the bearings and replace them if necessary.
	非驱动轴承不能满足主轴热膨胀 The non-drive bearing cannot meet the thermal expansion of the main shaft.	检查非定位端轴承壳体无约束，必要时重新使轴承就位以达到规定的轴向间隙。 Check that the non-positioning end bearing housing is free of constraints, and reposition the bearing if necessary to achieve the specified axial clearance.
	油质量等级低 Low oil quality grade	检查油的型号。 Check the type of oil.
	轴承油流量不足 Insufficient bearing oil flow	必要时进行整流。 Rectify if necessary.
轴承间隙过大 Excessive bearing clearance	轴承磨损 Bearing wear	更换轴承 Replace the bearing.
	频繁启停风机 Start and stop the fan frequently	增加风机启停的间隔。 Increase the interval between fan start and stop.
	油脏 Oily	进行油样检查，必要时更换新油。 Check oil sample and replace new oil if necessary.

控制部件 无输出 The control component has no output	机械故障 Mechanical failure 控制部件松动或损坏 Control components are loose or damaged	检查所有可拆卸部件运动自如。 Check that all removable parts move freely. 维修或更换损坏的连杆或部件。 Repair or replace damaged connecting rods or components.
机械噪声 Mechanical noise	叶轮与进风口磨擦 The friction between the impeller and the air inlet 叶轮在主轴上松动 Impeller loose on main shaft	检查间隙是否符合规定，检查机壳变形必要时修正。 Check whether the clearance conforms to the regulations, check the deformation of the casing and correct it if necessary. 与大通宝富协商 Negotiate with Dart-Rich.
主轴密封泄漏过高* Spindle seal leakage is too high *	主轴密封磨损或损坏 Spindle seal is worn or damaged	修正，必要时更换。 Revise and replace if necessary.
空气侵入 Air invasion	连接螺栓松动 Loose connection bolt 垫片损坏 Gasket damage	拧紧螺栓 Tighten bolts 必要时更换 Replace if necessary
膨胀节脱位 Dislocation of expansion joint	基础定位 Basic positioning	重新就位膨胀节，必要时修正管道以适应不同的定位。 Reposition the expansion joint and correct the pipe if necessary to accommodate the different positioning.

*非正常的“哨声”表示有过量的空气进入风机。
*An abnormal "whistle" indicates that excess air is entering the fan.

第5节 附 录 Section 5 Appendix

附录 1 Appendix 1

部件储存 Component storage

1) 检查到货情况。

1) Check the arrival status.

2) 确定非涂装的钢部件有防腐保护，必要时重加保护层。

2) Make sure that the uncoated steel parts have anti-corrosion protection, and add protective layer if necessary.

3) 进行常规检查以保证没有腐蚀现象。检查时间间隔取决于防护层的形成及环境条件。

3) Carry out routine inspection to ensure that there is no corrosion. The inspection interval depends on the formation of protective layer and environmental conditions.

4) 小部件如仪表、轴承和小电机必须储存在保护罩下；如果存在潮湿问题，按上述的同样方法处理。

4) Small parts such as instruments, bearings and small motors must be stored under protective covers; if there is a wet problem, treat it in the same way as above.

短期存放 Short-term storage

本节用于已安装的风机。如果停车超过三个月应遵照长期存放规程。

This section applies to installed fans. If parking for more than three months, follow the long-term storage rules.

1) 推荐每两个星期盘车（风机及电机轴）数圈。

1) It is recommended to rotate the fan and motor shaft several times every two weeks.

2) 在风机启动前应进行油位和油质检查以保证轴承有充足的洁净的供油并防止腐蚀。

2) Before starting the fan, the oil level and quality should be checked to ensure that the bearings have sufficient clean oil supply and prevent corrosion.

3) 环境温度低于0℃时，如果风机停转，轴承箱等需通冷却水的部分，应放掉冷却水，以防结冰而冻裂。

3) When the ambient temperature is lower than 0℃, if the fan stops working, the bearing box and other parts that need cooling water should be drained to prevent freezing and cracking.

长期保存 Long term preservation

本节用于已安装的风机且准备停放三个月以上的情况。

This section applies to the situation where the installed fan is ready to be parked for more than three months.

1) 根据轴承拆卸规程拆下轴承上盖。

1) Remove the bearing upper cover according to the bearing disassembly procedure.

2) 用干抹布擦干油，将轴承表面、轴及轴承相关部分涂上油脂，确保轴承和主轴密封受到很好的保护。

2) Dry the oil with a dry rag, and grease the bearing surface, shaft and related parts of the bearing to ensure that the seal of the bearing and the main shaft is well protected.

推荐油脂：黄干油

Recommended oil: Huang Gan oil

3) 轴承安装步骤与拆卸步骤相反。

3) The installation step of the bearing is the reverse of the disassembly step.

4) 每两个月进行一次检查，检查间隔时间可根据经验调整，如果出现腐蚀，在轴作任何转动前需进行全面清洗并涂保护油脂。

4) Check every two months, and the inspection interval can be adjusted according to experience. In case of corrosion, the shaft should be thoroughly cleaned and coated with protective grease before any rotation.

5) 轴承箱等需通冷却水的部分，应放掉冷却水，以防冬季结冰而冻裂。

5) The cooling water should be drained from the parts that need cooling water, such as the bearing, to prevent freezing and cracking in winter.

6) 转子每隔一定时间，旋转180°，以防主轴静态变形弯曲。

6) At regular intervals, the rotor rotates 180° to prevent static deformation and bending of the main shaft.

7) 定期检查仪表和端子箱的罩是否安装正确及紧密，以防止灰尘和湿气进入将其损坏。

7) Regularly check whether the covers of instrument and terminal box are installed correctly and tightly to prevent dust and moisture from entering and damaging them.

重新投入使用 Put it back into use

1) 揭开轴承上盖检查轴承和轴的情况。

1) Uncover the upper cover of the bearing and check the condition of the bearing and shaft.

2) 清洁所有不干净的地方，将用于保存而涂在轴承及轴各部的油脂全部清除掉。

2) Clean all unclean places, and remove all grease applied to bearings and shafts for protection.

3) 经过一段过长的存放期后，按运行说明书中调试一节所述的运行是必要的。

3) After a long storage period, it is necessary to operate according to the commissioning section in the operation instruction.

4) 清除聚集在风机机壳内的所有积水；并对有锈迹的部分重新涂漆。

4) Remove all the accumulated water in the fan casing and repaint the rusty parts.

报废处置 Scrap disposal

1) 报废的产品可以根据不同的生产材质，送至合适的回收站点进行回收再利用；

1) Discarded products can be sent to the appropriate recycling site for recycling according to different production materials;

2) 机油和橡胶等类似物品若不合理处置，将破坏环境，请将这些材料送之相应的回收系统进行回收再利用。

2) Unreasonable disposal of such items as motor oil and rubber will damage the environment, please send these materials to the appropriate recycling system for recycling.

附录 2 Appendix 2

南通大通宝富风机有限公司 现行产品执行标准清单
Nantong Dart-Rich Fan Co., LTD. List of current product implementation standards

序号 No.	标准编号 Standard Number	标准名称 Standard Title	序号 No.	标准编号 Standard Number	标准名称 Standard Title
1	JB/T6444-2004	风机包装通用技术条件 General technical conditions for fan packaging	10	JB/T7259—2006	烧结厂用离心式鼓风机 Centrifugal blower for sintering plant
2	GB/T17774—1999	工业通风机尺寸 Industrial ventilator dimensions	11	JB/T8690-2014	通风机噪声限值 Ventilator Noise Limits
3	JB/T6886-2010	通风机涂装技术条件 Ventilator coating technical conditions	12	JB/T10563-2006	一般用途离心通风机技术条件 Specifications for General Purposes Centrifugal Ventilator
4	JB/T6887-2004	风机用铸铁件技术条件 Technical conditions for iron castings for fans	13	JB/T10562-2006	一般用途轴流通风机技术条件 Specifications for General Purposes Axial Flow Ventilator
5	JB/T6888-2004	风机用铸钢件技术条件 Technical conditions for steel castings for fans	14	GB26410-2011	防爆通风机 Explosion-proof ventilator
6	JB/T4358—2008	电站锅炉离心通风机 Centrifugal ventilator for power station boiler	15	JB/T8822—2013	高温离心通风机 技术条件 Technical conditions for high temperature centrifugal ventilator
7	JB/T4357—2008	工业锅炉用离心引风机 Centrifugal induced draft fan for industrial boiler	16	JB/T9101-2014	通风机转子平衡 Ventilator rotor balance
8	JB/T8689-2014	通风机振动检测及其限值 Ventilator vibration detection and its limits	17	JB/T10214-2014	通风机铆焊技术条件 Technical conditions for riveting and welding of ventilators
9	JB/T7258—2006	一般用途离心式鼓风机 General purpose centrifugal blower	18	JB/T10832-2008	工业通风机 法兰 Industrial ventilator Flange

以上标准可能会升版，如有需要请与大通宝富联系。
The above standards may be upgraded, if necessary, please contact Dart-Rich.

大通宝富
FAN FACTORIES

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