

# YLX 系列半直驱动力系统 安装使用维护说明书


## Installation & Operation Instructions for

## YLX Series Semi direct Drive System

(2024 版本)

重庆齿轮箱有限责任公司

**CHONGQING GEARBOX CO., LTD**

|   |   |                            |       |
|---|---|----------------------------|-------|
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YLX 系列半直驱动力系统由齿轮箱和永磁电机两部分组成,故本说明书由齿轮箱和永磁电机两部分组成。我们推荐在开始安装使用半直驱动力系统前进行此说明书的学习,若未学习而导致半直驱动力系统损害与运行故障,我公司不承担任何责任。

## 安全事项

### 1.要求:

说明书是专门为半直驱动力系统现场安装、使用、维修人员和相关设备操作人员编写配置的;为了您的人身安全和产品的正常使用,请在安装之前仔细阅读本安装使用说明书。只有完全掌握此操作手册,才能防止半直驱动力系统工作出现失误,并确保无故障运行。

## 2.符号和指令的说明

### 2.1 工厂安全符号



在本说明书中,该符号表示极可能会对生命和身体造成危险,必须注意,必须告知使用者。同时必须注意国家或行业相关的通用安全事故预防管理措施。

### 2.2 警告说明

**WARNING!**

在本说明书中该符号表示需要给予特别的关注,以便遵守相应的规定进行准确的维护工作,从而避免半直驱动力系统和其它零件损坏或发生故障。

**2.3** 任何会危及半直驱动力系统安全的工作方法都必须避免。

**2.4** 只能由具有相应资格的专业人员进行安装、检修,防止任何未经授权的人员操作半直驱动力系统。

**2.5** 若半直驱动力系统有任何改变会影响其安全时,操作员有义务立即报告。

## Safety particulars

### 1. Notes:

This manual is especially prepared for people who install, operate and maintain the machine. It must be read through before operation. Please read carefully prior to installation for your personnel safety and smooth operation of the machine. Only with the complete mastery of this manual can the error of the Half-direct drive system work be prevented and the operation of the gearless operation can be ensured.

## 2. The description of symbols and instructions

### 2.1 Factory safety symbol



In the instruction, the symbol indicates that it is very to cause danger to life a body, and must be paid attention to. The user must be informed. At the same time, it is necessary to pay attention of general safety accidents related to the state or industry.

### 2.2 Warning

**WARNING!**

In the instruction, the symbol indicates the need for attentions, so as to comply with the relevant provisions and make proper maintenance work, so as avoid damage to the Half-direct drive system and other parts.

**2.3** Any working methods that will endanger the safety of the Half-direct drive system must be avoided.

**2.4** Maintenance work is done only by qualified workers. Prevent unauthorized staff form operating the Half-direct drive system.

**2.5** If any change in the Half-direct drive system affects its safety. The operator reports immediately.

**2.6** 进入设备工作区必须穿戴相应的防滑、防碰撞的保护用具。

**2.7** 半直驱动力系统仅供观察用。

### 3. 重要性

#### 3.1 潜在危险

##### **WARNING!**

设备边缘 3 米内严禁有明火出现，设备附近应有干粉灭火器用于紧急灭火。

##### **WARNING!**

设备安装、运行、维护期间的废润滑油，应根据润滑油厂家所提供建议，妥善安置。

#### 3.2 防护：

用户必须建立安全操作的规章制度，一定要按说明书的要求安装、使用、维护。

按要求安装各种互锁保护装置，否则可能造成严重的意外事故。

### 4. 重要申明

安装使用半直驱动力系统之前，请务必仔细阅读本手册；

如未得到本公司的书面许可，半直驱动力系统及配套部件不能露天安装使用；

使用环境与本手册不相符者，需本公司认可后，方能投入使用；

连锁、报警和保护条件与本手册不相符者，需本公司认可后，方能投入使用；

### 5. 保修条件

我公司产品的质保时间按与贵公司签订的合同或协议执行。

质保不包括由于使用不当或者不正确安装所产生的损坏。

必须使用在与预先设计的使用条件一致的工作环境中。

严禁不正确的安装、使用和维护半直驱动力系统。

在没有我公司授权前提下对半直驱动力系统进行的任何改动所引起的损失，我公司不承担任何责任。

**2.6** Wear anti-slipping and anti-collision articles when entering into working area.

**2.7** Inspection windows on the reducer are used for checking only.

### 3. Significance

#### 3.1 Potential hazard:

##### **WARNING!**

Naked fire is not allowed to appear within 3 meters from the equipment. CO<sub>2</sub> fire extinguisher for emergency must be provided nearby the machine.

##### **WARNING!**

Old used lubrication oil should be disposed properly according to the recommendations from the oil maker.

#### 3.2 Protection:

The customer must constitute safety regulations. Installation, operation & maintenance must be performed in accordance with this manual.

Various interlocking devices should be fitted as required, otherwise severe accidents may be caused.

### 4. Important notes

Please read this manual carefully prior to installation and operation.

The Half-direct drive system and associated components can not be installed in open area.

Without receiving written approval from my company.

For application environment, interlocking, alarming and protection devices not corresponding to this manual, those can be accepted only after getting permission from my company.

### 5. Condition of warranty

The warranty time of the company's products is based on the technical agreement.

The warranty does not include damage caused by improper use or incorrect installation.

The drive must be used in an environment that is consistent with the predefined use conditions.

Strictly prohibit the incorrect installation and maintenance of the Half-direct drive system.

In the absence of our company's authorization, our company is not liable for any loss caused any changes in

半直驱动力系统在出厂前已试车,并按合同的规定进行包装。除双方另有规定外,设备出厂后进行的所有活动均属用户责任,包括:运输、存放防腐、超期存放、安装、拆卸、启动前的检验、操作和维护。

## 6. 半直驱动力系统的版权限制

我公司将保留所有半直驱动力系统版权的权利。禁止复制本产品或其中的某一部分结构以及本说明书,我公司将保留追究的权利。

## 7. 修订

本公司保留对本手册修订的权利,如有变更,恕不另行通知。

the Half-direct drive system.

The drive has been tested in front of the factory and packaged in accordance with the contract. Except for the two parties, user is responsible for the production of the drive. It includes: transportation, preservation, overdue storage, installation, disassembly, inspection, operation and maintenance before starting.

## 6. The copyright restrictions of the drive

Our company will retain the right to copyright all drive .It is prohibited to copy the product or part of the structure and this specification, and our company will retain the right to investigate.

## 7. Revise

My company preserves modification rights for this manual, which is subject to any change without prior notice.

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## 前言

立磨半直驱动力系统由 YLX 系列半直驱动力系统和稀油润滑装置两大部分组成。该系列减速机主要用于电力、建材等行业立式磨机用传动减速装置，也可用于其它机械作传动装置。

齿轮箱及配套设备的现场安装工作应按本说明书规定和立式磨机有关规定进行，还应执行现场指导工程师的意见和决定。

齿轮箱机房的建筑标准主要取决于当地情况和气候条件。要考虑出现最低的环境温度和整个粉磨车间所容许的最大噪音，特别要考虑防止粉尘直接沉积在减速机上，机房应有足够的检修场地，为的是方便日后的大修工作。

包装箱本身不完全具备防潮、防雨、防尘、防火、防碰撞等功能，故请妥善保存、运输。齿轮箱及其配套部件在收到后应当及早安装，不能立即安装的须存放在温度 $-20^{\circ}\text{C}\sim+50^{\circ}\text{C}$ 、湿度 70%RH 以下及酸碱为中性的仓库中，存放半年（6 个月）后应开包装箱进行防锈保养。

开箱时应按照装箱清单或零件目录、图纸仔细查对零部件数量和完好状况。同时贮备必要的材料和工具以备安装需要。如因特殊原因未能及时安装使用，须用包装胶布密封输出法兰与箱体以及透气帽孔等处的所有与空气相通的地方，通过透气帽孔按“表 1-1”要求加入 NP-20 气相防锈油，迅速将灌注口密封，做好保养记录并明确下一次保养时间，避免内部零件锈蚀。

如果由于用户保养不当，造成齿轮箱锈蚀等其它损坏，我公司将不承担任何责任。

## Preface

The vertical mill semi direct drive power system consists of two main parts: the YLX series semi direct drive power system and the thin oil lubrication device, which is mainly used as vertical driving reduction device for electricity industry and as other mechanical driving device as well.

Installation of gearbox and associated equipment in the field shall be carried out in accordance with the manual herein and vertical mill for electricity industry as well. Meanwhile, the advices and comments from the field service engineers shall be considered.

Gearbox house is constructed mainly depending on the local actual condition and weather condition. Consideration shall be given to lowest ambient temperature and allowable max. noise present in the whole milling plant, particularly to the fact that dust shall not be directly deposited on the gear reducer. Sufficient room should be kept for maintenance in the house to facilitate the expected turnaround.

Install the gearbox and auxiliary parts as soon as possible upon receipt and those which can not be installed immediately shall be stored in the damp-proof warehouse with temperature between  $-25^{\circ}\text{C}\sim+50^{\circ}\text{C}$ , humidity below 70%. Parts shall be subject to rust-resistant painting after 6-month storage.

When opening box for this purpose, check the amount and condition of parts against the packing list or part catalog or drawings. Prepare the materials and tools necessary for installation. If the reducer can not be installed timely due to special reason, Seal with adhesive tapes the output flange and casing. where is bare to air. Volatile corrosion inhibitor NP-20 should be applied as table 1-1 through the vent cap hole at casing to protect inner parts against corrosion, and seal the openings. Make the maintenance record and indicate the time for next maintenance.

Due to improper maintenance of users, gearbox corrosion and other damage, our company doer not assume any responsibility.

表 1-1 气相防锈油 NP-20 加入量 Table.1-1 Volume of volatile corrosion inhibitor NP-20 put into

| 产品型号<br>type | NP-20<br>单位 unit (L) |
|--------------|----------------------|
| YLX200       | 1.5                  |

为了使安装工作顺利进行，必须准备好所需要的各种工具和仪器，要有合适的运输和吊装设备，最好用移动式起重机来完成。

In order to make the installation progress smoothly, it is necessary to prepare the required tools and instruments, appropriate transportation and lifting equipment, preferably using movable crane.

安装前必须仔细阅读本说明书，看懂安装基础图、外形图，熟悉安装程序，仔细查看齿轮箱各部件和其它配套件的形状尺寸、重量以及数量。清除灰尘、杂物，保证安装工程周围环境的整洁。

Carefully read the manual before installation, particularly erection foundation drawing and dimensional drawing; be familiar with erection procedure. Check the size, dimension, weight and quantity of gearbox parts and relevant pieces. Ensure that the surroundings for the installation field is clean and free of dust or foreign matter.

由经过齿轮箱专业培训合格的员工对齿轮箱进行安装，对由未经培训合格的非专业技术员工的安装而导致的损坏，我们不予以认可。

The crane is able to work under the During construction, safety is the most important thing to be considered. Carefully inspect the lifting sling is tight or not. During transportation, nobody is allowed to stand under the crane.

**吊装注意事项:**

**Precautions for hoisting**



安装施工中，一定要注意安全，在吊运产品前，要仔细检查吊装索具是否牢靠。



Be sure to pay attention to safety during the installation and carefully check the safety of the lock before the crane is shipped.



在吊运过程中，吊运物下面严禁站人，以防意外的发生。



In the lifting process, nobody is allowed to stand under the lifting, to prevent accident from happening.



齿轮箱起吊安装过程要求平稳、缓慢，起吊时，应避免碰坏齿轮箱及附件的损坏。



The requirement of the gearbox to be suspended is smooth and slow, and the damage of the gearbox and accessories should be avoided.



起吊过程时钢丝绳与箱体接触的地方垫上硬木块，不允许钢丝绳直接与箱体接触。要求对称两支钢丝绳的起吊夹角不得大于60°。



During transportation, place hard wood blocks to prevent from direct contact between the steel ropes and casing. No direct contact with the steel rope and the box. The angle is recommended less than 60° between both symmetric steel ropes

## 1. 半直驱动力系统的安装

### 1.1 概述

YLX 系列半直驱动力系统由永磁电机和机械传动两部分组成。

### 1.2 半直驱动力系统的技术参数

|       |       |                 |
|-------|-------|-----------------|
| 传递功率  | kW    | } 详见合同、技术协议和外形图 |
| 输入转速  | r/min |                 |
| 输出转速  | r/min |                 |
| 传动比   |       |                 |
| 垂直静负荷 | kN    |                 |
| 垂直动负荷 | kN    |                 |
| 稀油站型号 |       |                 |

旋向:

输出法兰旋向: (从上向下看) 顺时针。

### 1.3 半直驱动力系统的安装程序

大型齿轮箱安装, 因其结构形式不同而安装内容和方法存在较大差别。由于受到整个车间的安装计划和厂房条件的影响, 实际安装程序并不总是一成不变的。从技术上看, 可以采用不同的分步安装程序, 然而作为减速机制公司推荐的安装程序如下:

#### 1.3.1 设备基础的验收

检查半直驱动力系统的基础底板安装在基础上是否牢固。在基础底板上划出磨机中心线的位置, 并检查基础底板上地脚螺栓孔的位置尺寸是否符合减速机外形和基础安装图的要求并存档备查。找正基础底板的平行度, 使之符合 0.08mm/m 的平行度要求, 且基础应进行了二次灌浆并达到防护要求。

## 1. Installation of Semi direct drive system

### 1.1 Generals

YLX series Semi direct drive system consists of permanent magnet motor and mechanical transmission.

### 1.2 Specifications for Semi direct drive system

|                                 |       |  |
|---------------------------------|-------|--|
| Transmitted power:              | kW    | } Refer to the Contract , Agreement and dimensional drawing. |
| Input rpm:                      | r/min |  |
| Output rpm:                     | r/min |  |
| transmission ratio :            |       |  |
| Vertical static load:           | kN    |  |
| Vertical dynamic load:          | kN    |  |
| Model of oil lubrication system |       |  |

Sense of rotation:

(Viewing from up to down) output flange rotates clockwise.

### 1.3 Installation procedure for Semi direct drive system

Installation of large gearbox greatly varies on installation content and method due to different structures. Limited by the installation plan for the whole workshop and its condition, the actual installation procedure is not always kept unchanged. Technically, it is possible to carry out the installation based on phased means. However, the gear reducer maker recommends the installation procedure as follows:

#### 1.3.1 Acceptance of equipment foundation

Check that the soleplate for the base of Semi direct drive system is properly secured. Mark on the soleplate the location of central line for the mill and check that anchor bolt hole is properly sized for the gear reducer installation as per the drawing. Alignment the base soleplate and ensure the parallelism to be 0.08mm/m. Second grouting shall be done for foundation to ensure protection.

### 1.3.2 半直驱动力系统的安装就位

用汽油或其它溶剂清洗齿轮箱安装面，在加工面上涂一层薄薄的机油。将半直驱动力系统推拉（吊）到已划好中心线的立式辊磨基础底板上，可用四个千斤顶，东西南北各 1 个，顶住动力系统底板，前后左右移动，使动力系统底板四周上刻画的中心线与基础底板的中心线对齐，误差在 1mm 内，检查动力系统底板上地脚孔与基础底板孔的位置是否重合，螺栓是否干涉。

插入固定地脚螺栓，拧紧地脚螺栓将动力系统紧固在立磨基础底板上。通过动力系统底板上预钻的定位销孔，与立磨基础底板同钻铰定位销孔并装好定位销。清洗减速机输出法兰，检查输出法兰联接螺孔并清洗干净，接合面涂少量的油脂，按磨机安装要求对磨机盘等其它部件进行安装。

### 1.3.3 安装注意事项

动力系统就位前需把电机底板底面、减速机输出法兰联接位置清理干净并涂抹一层很薄的轻油。如果在安装磨机过程中需转动减速机输出法兰时，必须在齿轮箱上部油池中注入一定量的齿轮油，达到油标规定油位，以防止转动时损坏推力瓦和轴承。动力系统地脚螺栓及销的安装拧紧，需待按磨机安装要求完成后才进行。



当使用特殊装置时，如液压和气压等工具，要求参照该装置的使用说明书正确使用。

在动力系统安装和拆卸过程中，不能对齿轮箱传动轴、管道及附件等部位进行敲打、撞击、踩踏等，都可能会导致齿轮箱的损坏。



安装时，应确保周围人员与设备的安全。

### 1.3.2 Installation of Semi direct drive system in place

Clean the mounting surface of the gearbox with gasoline or other solvents, and apply a thin layer of engine oil on the machining surface. Push the Semi direct drive system to the central line marked on the base soleplate of vertical roller mill for preliminary orientation. Making sure that the co-axial level can meet the requirement. During the alignment, 4 jacks at each direction are used to jack up the soleplate of Semi direct drive system for slightly tuning.

Finally, with the anchor bolt holes on the casing soleplate, tighten the drive system to the base soleplate of vertical mill with anchor bolts. Meanwhile, with the dowel pin holes predrilled on the casing soleplate of the drive system, drill and ream the locating pin holes on the base soleplate of vertical mill and then put dowel pins in. Lastly, put dust guard .

### 1.3.3 Notes

Before mounting the reducer in proper position, the bottom of the base plate and the connecting place of output flange must be cleaned and coated with very thin light oil. If rotation of output flange during installation of mill is necessary, the upper oil sump of reducer must fill gear oil to required level for protecting the thrust pad and bearing inside the reducer against damage. The tightening of foundation bolts and pins must be done after ensuring the mill is installed in good condition.



When a special device is used, such as hydraulic, air pressure, etc. it is required to use the relevant instructions correctly.

In the drive system installation and disassembly process, not on the gearbox drive shaft, pipes and accessories to beat hit and stampede, damage are likely to cause the gearbox.



When the drive system is installed, the safety of the surrounding personnel and equipment should be ensured.

## 2. 稀油润滑装置的安装及控制要求

### 2.1 稀油润滑装置的安装

YLX 系列半直驱动力系统根据工况要求，配置有低压稀油润滑装置。

稀油润滑装置的安装按其使用说明书要求进行，现将主要程序说明如下：

**2.1.1** 按总体安装布置要求将清洗干净的稀油站、仪表盘和控制柜安放在指定位置，基础要牢固可靠，安放应平稳，四周要考虑有足够的用于维护、保养和检修的空间。

**2.1.2** 安装稀油站与仪表盘联接的  $\phi 10 \times 1$  紫铜管；稀油站，仪表盘与电控柜联接的线路（仪表单独放置时才有上述安装过程）；按电控原理图安装电气元件。

**2.1.3** 安装板式油站、减速机、油箱的进油管 and 回油管（注意安装副回油泵油管）。回油管道应保证油回流畅通，高度差每米应大于 80mm；配制好的管路应进行酸洗，彻底清除氧化皮，砂尘和焊渣。清洗并吹干后，内壁涂润滑油，外表面涂防锈漆，管与管的法兰联接处用无石棉垫片防漏。

**2.1.5** 按图纸规定，安装齿轮箱联锁控制线路。

### 2.2 稀油润滑装置的控制要求

该系列减速机，所配置的稀油润滑装置为低压油站。油站主要控制要求见 2.2.1--2.2.8。

## 2. Installation of oil lubricating device and control requirements

### 2.1 Installation of oil lubricating device

YLX series Semi direct drive system is equipped with low pressure oil lubricating device on the request of working condition.

Oil lubricating system shall be installed as per this manual and the main procedure is described as follows:

**2.1.1** As per the general arrangement, it is required to put at the designated location properly cleaned oil lubrication system, instrument panel and control cabinet, where it shall have solid foundation and adequate room for future maintenance and overhaul.

**2.1.2** Install  $\phi 10 \times 1$  red copper tubes connecting the oil lubrication system and instrument panel; run the wiring for the oil lubrication system, instrument panel and electrical cabinet; install electric components according to electric circuit diagram.

**2.1.3** Install the oil inlet and return pipes for the plate oil station, reducer, and fuel tank (pay attention to installing the auxiliary oil return pump oil pipe). The return line shall be properly sloped to allow smooth return of oil, height difference per meter shall be bigger than 80mm. Properly fitup pipes shall be pickled to thoroughly get rid of oxidization, dust and welding slag. After cleaning and purging, apply the lubricating oil to the inner wall and anti-rusting paint to the outer surface. Flange connections of pipes shall be treated with non asbestos backup plate against leak.

**2.1.5** Run the wiring for the gear reducer and main motor, etc. and their interlocking wiring according to the drawing.

### 2.2 Requirements on controls of oil lubricating device

The associated oil lubricating device is low pressure oil station. Please see 2.2.1-2.2.8 for requirements on control of low pressure oil station.

油站的详细控制要求见所配油站的使用说明书。

Regarding the detailed control requirements for the oil station, please see the relevant operation manual.

**2.2.1** 稀油站油箱油温低于 30°C，电加热器自动开启(指示灯亮)。油温升至 35°C 时，电加热器自动关闭(指示灯灭)。

**2.2.1** When the oil temperature in the oil sump of oil station is below 30°C, electrical heater will automatically startup (indication lamp on). When the oil temperature moves up to 35°C, electrical heater will automatically shut down (indication lamp off).

**2.2.2** 当油站供油口油温低于 25°C 时,主电机不能启动。油站向减速机供油不少于 10 分钟后,同时供油口油温大于 25°C,主电机才允许启动。供油口油温高于 50°C 时报警并停主电机。

**2.2.2** When the oil temperature in oil supply port of oil station is lower than 25°C, main engine cannot startup. After supplying oil from oil station to reducer for 10 minutes, meanwhile oil temperature in oil supply port is higher than 25°C, main engine is allowed to startup. Alarm is activated and stop main engine when oil temperature in oil supply port is higher than 50°C.

**2.2.3** 当稀油站出油口压力低于 0.12 MPa 时,备用泵启动,同时声光报警。当油压升至 0.3MPa 时,备用泵停止工作。

**2.2.3** When discharge pressure for the oil lubrication system is below 0.12MPa, standby pump will startup and acousto-optic alarm will be activated. When the oil pressure moves up to 0.3MPa, standby pump will stop.

**2.2.4** 当油泵出油口压力低于 0.1 MPa 时报警,同时主电机停止工作。高于 0.45 MPa 时,声光报警。

**2.2.4** When discharge pressure is below 0.1MPa for the oil pump, alarm will be activated and meanwhile main motor stops working. Acousto-optic alarm will be activated in case of pressure higher than 0.45MPa.

**2.2.5** 当稀油站油箱油位高于油标刻度值时,声光报警,低于油标刻度值时停机报警。

**2.2.5** When the oil sump level in the oil lubrication system is higher than that of the oil gauge, acousto-optic alarm will be activated; and alarm will be triggered when below oil gauge, causing the stoppage of equipment.

**2.2.6** 当稀油站过滤器压差高于 0.08 MPa 时,声光报警。稀油站换热器压差高于 0.1MPa 时,声光报警。

**2.2.6** When filter DP is higher than 0.08MPa for the oil lubrication system, acousto-optic alarm will be activated. and heat exchanger DP is higher than 0.1MPa for oil lubricating station, acousto-optic alarm will be activated.

**2.2.7** 输入轴承等滚动轴承温度高于 80°C 报警,90°C 时停主电机,推力 1、推力 2、推力 3、推力 4 轴承温度高于 70°C 时报警,高于 80°C 主电机停止工作;上箱体油池温度高于 60°C 时报警,高于 65°C 时停止主电机。(注:油池的测点是根据用户要求定)

**2.2.7** In case of input 1 or input 2 bearing temperature above 80°C alarm will start and meanwhile above 90°C main motor stops work; In case of thrust 1, thrust 2, thrust 3, thrust 4 bearing temperature above 70°C, an alarm will start and meanwhile above 80°C main motor stops work; In case of oil reservoir temperature in

the upper casing above 60°C alarm will start meanwhile above 65 °C main motor stops work. (Note: the view point of oil pool required by clients)

**2.2.8** 当稀油站出油口油温高于 45°C 时，声光报警并开启冷却器供水开关。当稀油站出油口油温低于 38°C 时，声光报警并关闭冷却器水。

**2.2.8** When the discharge oil temperature is above 45°C for the oil lubrication system, acousto-optic alarm will be activated and the cooler is working. When the temperature is below 38°C, acousto-optic alarm will be activated and the cooler stops working.

### 3. 安装施工中的注意事项

### 3. Precautions on the installation

**3.1** 齿轮箱应存放在干燥、防晒、防潮的库房内。存放半年后应对齿轮箱进行检查保养，特别是齿轮、轴、轴承等重要零部件，以防锈蚀，并按“前言”中“表一”要求加入 NP-20 气相防锈油。

**3.1** Gearbox shall be stored in a dry, sunshine shield, damp-proof warehouse. After six months, gear reducer shall be checked, particularly gear, shaft, bearing, etc. to prevent rust, and put into volatile corrosion inhibitor NP-20 according to Tab 1 in the preface.

**3.2** 按照工艺设备图、土建图，以立磨中心线为基础，检查所有基础标高及地脚螺栓孔尺寸，位置是否相符，发现不符及时修正。

**3.2** According to equipment process drawings and civil construction drawing, with central line of vertical mill as a basis, check all foundation elevations, anchor bolt hole size, location and correct any findings.

**3.3** 由于齿轮箱是精密设备，为了保证安装质量，清洁防尘是重要环节，应特别加以重视。

**3.3** Special care shall be taken on dust removal to guarantee the installation quality since the gearbox is a precision equipment.

**3.4** 为保证齿轮箱精确定位及防止安装后的长期使用情况下，齿轮箱底面与基础底板锈蚀在一起，应在基础底板表面上均匀涂以一层薄薄的 MoS2 润滑脂。

**3.4** In order to assure the accurate positioning of gearbox and prevent the possibility that gearbox base may bond with soleplate due to rust after long-term operation, it is required to uniformly apply a thin film of MoS2 grease on base soleplate.

**3.5** 齿轮箱在找正测量时，应注意避免损坏齿轮箱内零件，特别是润滑管系和测温用的 PT100 铂热电阻。

**3.5** Try to avoid damaging gearbox internals during alignment, particularly PT100 platinum thermal resistance used for lubricating pipe set and temperature measurement.

**3.6** 齿轮箱重要零部件的清洗，应使用 EC-30.D-40.PSC-003 等清洁剂。清洗时禁用棉纱擦拭，以防粘附在轴、齿轮、轴瓦上影响安装质量。应采用绸、棉毛衫等为好。

**3.6** EC-30.D-40.PSC-003 Cleaning agent could be used to clean critical components of gearbox. No cleaning with cotton is allowed to avoid cohesion on shaft, gear, bearing pad, which may impact erection quality. It is

**3.7** 在安装磨机过程中需转动齿轮箱输出法兰时，必须在齿轮箱上部油池中注入一定量的齿轮油，达到油标规定油位，以防止转动时损坏齿轮箱内推力瓦和轴承。

better to use silk, jumper, etc.  
**3.7** If rotation of output flange during installation of mill is necessary, the upper oil sump of reducer must fill gear oil to

required level for protecting the thrust pad and bearing the reducer against damage

#### 4. 试运转、使用及维护

齿轮箱和稀油润滑装置按规定安装完毕，各种电器控制，互锁系统准确无误的情况下才能进行试运转。

##### **WARNING!**

齿轮箱的设计制造是严格按用户提供的技术规范所要求的载荷与条件下进行的，任何超出以上条件的使用，本公司对可能出现的问题不负任何责任。

##### 4.1 串油清洗

齿轮箱润滑系统的清洁度是十分重要的，运转前必须进行串油清洗。接好稀油站与齿轮箱之间的进油管和回油管，向油箱内注入其容积约 80% 的 L-CKD320 工业闭式齿轮油，在稀油站低压供油法兰处放置铜滤网。

注：减速机加油口可以选择透气帽接口。

清洗前，将清洗油加热到 45°C（开通旁路阀并关闭出油口阀门，使油在油箱内自循环，以防加热时结碳），然后打开出油阀，关闭旁路阀，启动油站串油。

清洗过程中，开始每小时检查并清洗一次磁过滤器和双联过滤器滤网。4 小时后每隔两小时检查一次，串油 12 小时并确认没有杂物后，停止冲洗。拆下稀油站出油口处安放的铜滤网并清洗干净后放回原处。拧紧螺栓，继续进行串油清洗，直到安放的铜滤网确认无杂物后，此项工作才可结束。

串油清洗结束后，取出稀油站供油口法兰处安放的铜滤网，排干油箱内清洗用油，彻底清除油箱内油泥杂物，必要时用面团将箱内砂粒粘贴干净后灌入规定的润滑油。

#### 4. Commissioning, operation and maintenance

Gearbox, oil lubricating device are installed to the standard and electronics controls, interlocking system are properly checked.

##### **WARNING!**

The design and manufacture of gearbox is strictly carried out according to the load and condition required by user specifications, and any company that is beyond the specification is not liable for possible problems.

##### 4.1 Oil batching cleaning

It is crucial to guarantee that the lubricating system for the gearbox is clean. Thus oil flushing must be carried out prior to running. Properly get connected oil feed line and return line between oil lubrication system and gearbox so as to feed L-CKD320 gear oil into the oil sump up to 80% of oil sump capacity. Install copper strainer between LP oil supply flange for oil lubrication system.

Note: The ventilation cap interface of the reducer can be selected.

Prior to cleaning, heat the cleaning oil to 45°C (open bypass valve and shut oil discharge valve so as to allow oil to self-circulate in the sump and to prevent carburization when heating). Then open discharge valve, shut bypass valve and startup oil station for oil flushing.

During cleaning, check and clean magnetic filter and duplex filter screen every 1 hour in the beginning and later once every 2hrs after 4 hours' operation. After oil flushing for 12hrs, check and confirm no impurity and then stop flushing. Remove the copper screen at oil discharge of lubricating station for cleaning and then put back. Tighten the bolts and continue batching operation again until there is no impurity present at copper screen.

After oil flushing, remove the copper screen at oil supply flange of oil lubrication system and empty oil sump to thoroughly get rid of any foreign matters and used oil in

the sump. When necessary, absorb sand particles in the sump with flour dough before feeding required lubricating.

整个串油过程中仔细检查管路有无渗漏，特别是各法兰联接处，同时通过箱体上各观察孔，查看各润滑点是否有油润滑。

During oil flushing, carefully check for any leakage from lines, particularly connections of each flange. Meanwhile, check each lubricating point for oil through sight glass on the casing.

## 4.2 齿轮箱试运转

## 4.2 Commissioning of gearbox

### 4.2.1 试运转前的准备和检查项目

### 4.2.1 Preparations and checks prior to commissioning

检查整个系统地脚螺栓和所有联接螺栓是否紧固，检查整个控制系统是否完备和准确可靠。特别是稀油站和齿轮箱的互锁，以及要求的其它联锁。

Check all anchor bolts and attachment bolts for tightness. And check the whole control system in good condition, in particular the interlocking of main motor, oil lubrication system and gearbox and other necessary interlocks.

运转前使油站加热器工作，将润滑油加热到 25°C（注意：加热时使油站自循环），才可向减速机供油。供油 30min 后，检查上箱体蓄油池是否充满油（可通过油标孔观察）并检查确认管系各联接法兰，油站油压、油温及各系统工作正常后，停止稀油站工作，马上检查稀油站油箱油位是否在规定刻度线上，否则再加油至规定油位。

Prior to commissioning, startup the heater in the oil station so that the lubricating oil shall be heated up to 25°C (note: make oil station self circulate during heating) before feeding oil to gear reducer. After supplying oil for 30min, check oil reservoir if full or not in the upper casing (via oil gauge hole). After check and confirm that piping, each connection flange, oil pressure for oil station, oil temperature and each system are working properly, stop oil lubrication system and immediately check that oil sump level in oil lubrication system is above the specified level, otherwise continue feeding until the specified oil level.

**4.2.2 齿轮箱空负荷（磨机未装物料，磨辊脱离磨盘）运转时间为 180min，运行中每 30min 检查记录内容如下：**

**4.2.2 Gearbox shall be operating for 180min under no load (mill is not loaded and grinding roller is not in contact with grinding disc) and check and record the following items every 30min:**

环境温度 (°C)

Ambient temperature (°C)

主电机转速 (r/min)

main motor rpm (r/min)

润滑油出口温度 (°C)

Outlet temperature of lubricating oil (°C)

主机电压 (V)

main motor voltage (V)

润滑油低压出口压力 (MPa)

LP outlet pressure of lubricating oil (MPa)

主电机电流 (A)

main motor current (A)

各轴承处温度 (°C)

temperature at each bearing (°C)

**4.2.3 负荷试运转****4.2.3 Commissioning with load**

齿轮箱负荷试运转按表 1-2 进行:

Gearbox shall be commissioned with load as per the following Table 1-2:

表 1-2 负荷试运转各工况及运行时间

Table 1-2 Commissioning load and operation time

| 序号<br>No. | 电机转速<br>Motor rpm<br>(r/min) | 电机功率<br>Motor power<br>(kW) | 磨机额定负荷<br>Rated load for<br>roller mill (%) | 运行时间<br>Operation time<br>length<br>(H) | 备注 Remark   |
|-----------|------------------------------|-----------------------------|---|---|---|
| 1         | 额定转速<br>Rated speed          | 3/4P                        | 70  | 24                                      | P: 电机额定功率各工况运行时间可根据磨机试运行规定进行。P: motor's rated power. The operation time for each duty shall be defined according to commissioning of roller mill. |
| 2         | 额定转速<br>Rated speed          | 4/5P                        | 80  | 16                                      |   |
| 3         | 额定转速<br>Rated speed          | 9/10P                       | 90  | 16                                      |   |
| 4         | 额定转速<br>Rated speed          | P                           | 100   | 48                                      |   |

各工况运行时, 每隔 60min 除按 5.2.2 记录内容记录外, 补充记录如下内容:

For operation under each duty, record every 60min additional information plus those listed in 5.2.2:

冷却水流量 (m<sup>3</sup>/h)

Cooling water flowrate (m<sup>3</sup>/h)

冷却水出口温度 (°C)

cooling water outlet temperature (°C)

冷却水进口温度 (°C)

cooling water inlet temperature (°C)

减速机噪音及振动

gear reducer noise and vibration

**4.2.4 试运转的注意事项****4.2.4 Precautions for commissioning**

每次主电机停止运行时, 在 5 分钟后, 方可关闭稀油站。

Each time stop oil lubrication system 5min after main motor stops.

试运转期间操作人员应加强巡回检查, 作好运行记录, 发现异常声响或其它问题应立即停机检查。

During commissioning, the operators shall carefully monitor the operation and make records. Stop motor immediately in case of any abnormal operation or noise.

每隔 4 小时检查一次过滤器滤网, 如发现有金属碎屑或其它杂质, 应停机查明原因并确认故障完全排除后, 方可继续运转。

Check the filter screen every 4hr. Stop the equipment and do troubleshooting whenever any metal scrap or impurity is spotted. Resume the operation when trouble is eliminated.

各轴承温度、滑油压力或其它系统超过额定整定值时, 报警系统报警后应立即停机并查明原因予以排除, 不允许原因未查明或故障未排除前强行启动或拆除保险装置。

In case of bearing temperature, lubricating oil pressure or other system higher than the rated settings, alarm system is activated and stop the system immediately for troubleshooting. It is not allowed to restart the system or remove safeguard before the cause of problem is found out or eliminated.

#### 4.2.5 检查和验收

试运转结束后，进行详细检查，检查并记录各齿轮副齿面接触印痕情况；检查并整理试运转的各项记录；检查各控制系统的准确可靠性；检查滑油过滤器并清洗干净；检查整个运转系统各联接处是否松动。

上述检查内容应作全面文字记录和图片记载，并作为验收的依据。

#### 4.3 使用维护

YLX 系列减速机是精密、重要的设备，必须加强管理和维护，操作人员应全面了解掌握各项设备的使用说明书的要求，并切实遵照执行。

除其它很多因素外，齿轮箱的运行安全性和寿命取决于正确的维护。设备管理人员应每天根据运行记录分析减速机的运行情况，必要时停机检查并及时排除故障，以防酿成严重后果。未经许可，擅自拆开齿轮箱，我公司不承担任何责任。

##### 4.3.1 启动前的准备和操作程序

**4.3.2** 每次启动齿轮箱前，（若配置有慢速驱动减速器，需确保慢速驱动取下才能运转主电机），必须先启动稀油站向减速机供油，先启动油泵5分钟后，确认供油压力达到规定值，并且减速机上箱体蓄油池装满润滑油后才能启动电机进行工作。

##### 4.3.3 停机操作程序

因各种原因需停止齿轮箱工作时，应停主电机工作。由于惯性缘故，齿轮箱还会运转，必须待齿轮箱完全停止运转后，才能关闭油站停止供油，否则会烧损轴瓦甚至损坏齿轮箱。

#### 4.2.5 Inspection and acceptance

After commissioning, carry out careful inspection and record down the tooth contact pattern of gear wheel pair; check and compile each commissioning record; check each control system in good condition: check grease filter and clean it; check each connection of the whole driving system for any looseness.

The above checks shall be properly documented and pictured as basis for acceptance.

#### 4.3 Operation and maintenance

YLX series gear reducer is a precision and important equipment, requiring careful management and maintenance. Operators shall get themselves familiarized with operation requirements on each equipment and abide by them in practice.

Equipment serving people shall analyze the operation condition of gear reducer according to operation records. The equipment management personnel shall analyze the operation of the gearbox every day according to the operation records, stop and check and check the faults timely if necessary, so as to prevent serious consequences. If necessary, stop the equipment for troubleshooting to avoid serious consequences.

##### 4.3.1 Preparations before startup and operation procedure

**4.3.2** Each time before startup, (Ensure that the slow drive is removed in order to operate the main motor), it is required to startup oil lubrication system firstly to feed oil to gear reducer. Start the oil pump for 5 min, making sure that oil supply pressure is up to the required value and oil reservoir in the upper casing of gear reducer is filled with lubricating oil, then motor can be started.

##### 4.3.3 Shutdown procedure

For whatever reasons that gearbox has to be stopped, first stop main motor. Due to inertia, gearbox will continue rotation. Therefore, you cannot shut oil

supply from oil lubrication system until gearbox comes to a

full stop. Otherwise, bearing pad may be burned or even gearbox is damaged.

#### 4.3.4 运行中的检查

##### 4.3.4.1 每日检查内容

按 4.2.2 款检查记录内容每隔 60min 检查记录一次；检查各联接部位是否漏油；检查各紧固螺栓有否松动；按油站规定进行维护保养。

##### 4.3.4.2 每月检查内容

检查并清洗油站磁性过滤器和双联过滤器，如发现有铁屑，巴氏合金的碎屑，塑料碎屑等应立即停机查明原因并加以排除；按油站规定进行每月的维护保养内容进行。

每月对油品化验一次，检查其中各类化学元素的含量及其变化，以便及早分析齿轮箱内部情况，并及时提供预案，提出解决措施。

##### 4.3.4.3 半年的检查内容

检查润滑油的质量，发现变质，及时更换。换油时，齿轮箱内部和油站油箱内的残油必须彻底排放干净，以利于保证新油的工作寿命。检查控制系统的准确可靠性。

##### 4.3.4.4 定期检查及维护（详见表 1-3）



在维护齿轮箱之前，必须使机组安全停机，并确保不会因为误操作而启动，防止意外发生。



在齿轮箱维护和维修过程中，应严防各种

#### 4.3.4 Checks during operation

##### 4.3.4.1 Daily checks

Check every 60min and make record as per 4.2.2: check each connection for any leakage: check each bolt for loose: Maintenance shall be exercised as per oil station regulations.

##### 4.3.4.2 Monthly checks

Check and clean the magnetic filter and duplex filter in the oil station. Stop the equipment for troubleshooting whenever iron chips, white metal chips, plastic scrap, etc. are spotted. Get rid of problems identified. Maintenance shall be exercised every month as per oil station regulations.

Oil test shall be performed every month for checking chemical composition and content change.

##### 4.3.4.3 Checks every half a year

Check the quality of oil and replace when deteriorated. For replacement, remaining oil must be completely emptied out of gearbox and oil tank of oil station to improve the life of new oil. Check control systems in good condition.

##### 4.3.4.4 Regular check and maintenance (see table 1-3)



Before maintaining the gearbox, the unit must be shut down safely and ensure that it will not be started by misoperation to prevent accidents.

异物进入齿轮箱内部，以免造成齿轮箱的损坏。



During the maintenance of the gearbox, ~~the~~ kinds of foreign objects should be prevented from

entering the gearbox so as not to caused the gearbox to

表 1-3 定期检查及维护

Table 1-3 Regular check and maintenance

| 检查部位<br>Check location           | 检查项目及内容<br>Check item and content  | 备注<br>Remark                       |
|----------------------------------|--|------------------------------------|
| 基础<br>Foundation                 | 基础沉降<br>Foundation settlement  | 每年检查一次<br>Check every year         |
| 减速机内部<br>Gear reducer inside     | 齿轮表面损伤及接触印痕<br>Tooth face damage or contact impression                       | 每月检查一次<br>Check every month        |
|                                  | 内部各零件联接螺栓<br>Connection bolt of each part inside the reducer                 | 是否松动<br>Loose?                     |
|                                  | 有否其它异常现象<br>Any other abnormal condition                                     |                                    |
| 减速机外部<br>Gear reducer outside    | 地脚螺栓有否松动<br>Anchor bolt is loose?  |                                    |
|                                  | 各密封面、管路<br>Each seal face and piping   | 是否漏油、漏水<br>Oil leak or water leak? |
| 稀油润滑装置<br>oil lubrication system | 更换油时清洗油箱<br>Clean oil tank during oil replacement                            |                                    |
|                                  | 油泵、油冷却器、电加热器<br>Oil pump, oil cooler, electrical heater                      |                                    |
|                                  | 磁过滤器、双联过滤器、阀门<br>Magnetic filter, duplex filter, valve                       |                                    |
|                                  | 控制柜、仪表盘上仪表及电器元件<br>Control cabinet, instruments on the panel and electronics |                                    |

#### 4.3.4.5 特别注意事项及建议

齿轮箱运行 1 年后，应重新对动力系统基础底板的水平度进行复查，如有超差，应查明原因（如基础下沉），并按 1.3.2 的规定重新调整。

齿轮箱首次使用的润滑油应半年进行更换，以后换油期为 10000-13000h（根据油品分析检验结果定）。油液更换时，必须使用和先前同一牌号的油液。不允许使用混合油或不同生产厂家的油液。如果更换不同品牌的油液，要彻底清洗齿轮箱后更换。

#### WARNING!

旧的油液应该在停机后齿轮箱冷却之前尽快排出。

#### 4.3.4.5 Special precautions and proposals

After the gear reducer is working for one year, it is required to recheck the level of base plate of system. Find out the reason why the limit is exceeded (such as foundation settlement). Carry out alignment once again as per Item 1.3.2 .

The lubricating oil used for the gearbox shall be replaced every half a year for the first time and later the interval is 10000 to 13000h (according to oil analysis result). When the oil is replaced, it must use the same type of oil as the previous one, and it is not allowed to use mixed oil or different manufactures' oil. If you replace the different brands of oil, clean the gearbox thoroughly and replace it.

#### WARNING!

The old oil should be discharged before the gearbox is cooled.

减速机如长期停止运行（15 天以上）每周需启动油泵向其供油，同时启动主电机使其运行 10min。 and meanwhile startup main motor to make it work for

If the gear reducer stops operation for a long time (15in.

days above), it is required to startup oil pump for feeding

当电机由于紧急跳闸而停车时，跳闸原因没有查清和完全排除以前，不得重新启动电机。

When the motor trips on emergency, you are not allowed to re-startup the motor until the trip reason is spotted and eliminated.

润滑油质量是减速机安全运行的重要保证条件之一，我们推荐选用 GB5903 工业闭式齿轮油标准中的 L-CKD220 或 L-CKD320 齿轮油。油品推荐厂家及型号（详见“附表二”）

Quality of lubricating oil is one of the factors contributing to the safe operation of gear reducer. We recommend L-CKD220 or L-CKD320 as shown in GB5903 Gear Lubricating Oil. Oil type recommendations seeing Appendix Table 2.

正确选用润滑油添加剂，可改善减速机的润滑条件和效果，延长齿轮和轴承的使用寿命。

Correct choice of additive for lubricating oil can improve the lubricating condition of gear reducer and extend the life of gears and bearings.

齿轮箱在运行过程中，每月或季度定期须对润滑油进行油品检测化验，如达到下述情况应对润滑油进行处理或更换：

During reducer operation, check the oil quality every month or every quarter. The lubrication oil must be checked or replaced in following conditions:

- 1) 40 摄氏度时的粘度变化量大于 10%
- 2) TAN（酸性值）大于
- 3) 水含量大于 0.5%（5000 ppm）

- 1) viscosity at 40°C varies greater than 10%
- 2) 2TAN greater than 2
- 3) Water content greater than 0.5%(5000ppm)

X 光线检测出的各项元素含量值须符合油品出厂时的规定；金属含量反映了齿面及轴承的磨损情况，对前后两期检验结果进行比较，如某种或几种金属含量明显且较大，请咨询相关人员，并查找原因。

The element contents checked by X-ray shall be as specified oil quality when delivery. The wear condition can be evaluated from metal contents by comparing results from previous and later inspections. In case results vary greatly for one metal or some metals, please consult relevant personnel to find out causes

所有电气仪表自出厂之日起，应每年检定一次。

All electrical instruments shall be calibrated once a year since the date of ex-work.

#### 4.4 故障的分析及排除

#### 4.4 Troubleshooting and elimination

齿轮箱发生故障的原因往往比较复杂，需要作多方面的调查了解分析研究。这里讲述的是一般的现象与初步原因的分析。（详见表 1-4）。

Since there may be complex causes for the problem associated with gearbox, it is required to carry out diverse investigations for troubleshooting. Listed below is the

common problems and preliminary troubleshooting.

表 1-4 故障原因及排除措施

Table 1-4 Troubleshooting and elimination

| 现象 Phenomenon  | 故障原因<br>Cause of problem  | 采取措施<br>Measures to be taken  |
|--|---|---|
| 推力轴承温度高<br>High temperature of thrust bearing in reducer | 1.轴承损伤 bearing damaged  | 检查滤网有否合金碎屑, 检查轴承合金瓦面<br>Check filter screen for any alloy chips and check bearing alloy bush. |
|  | 2. 推力轴承瓦面接触不良 Bad Contact of thrust bearing                           | 检查推力轴承瓦面接触区域<br>Check the contact area of thrust bearing                                      |
|  | 3.润滑油质量发生变化 quality of lubricating oil changed                        | 观察和化验润滑油质<br>Observe and test lubricating oil   |
|  | 4.过载荷 overloaded  | 检查电动机电流、电压(输出功率)<br>Check motor current, voltage (output power)                               |
|  | 5.温度传感器失真 temperature sensor distorted                                | 校验或更换<br>Calibration or replacement   |
|  | 6.供油量不足 insufficient oil supply                                       | 检查供油压力和润滑管路畅通情况<br>Check oil supply pressure and lubricating oil piping                       |
|  | 7.供油温度过高 high temperature of oil supply                               | 检查冷却器供水情况和水温<br>Check cooler water supply and water temperature                               |
|  | 8. 磨煤机热风温度过高 High hot air temperature of the coal pulverizer          | 检查磨煤机热风温度<br>Check the hot air temperature of the coal pulverizer                             |
|  | 9. 磨煤机密封风压力过低 Low seal wind pressure of the coal pulverizer           | 检查磨煤机密封风压力 Check the seal wind pressure of the coal pulverizer                                |
|  | 10. 磨煤机煤层厚度不足 Insufficient thickness of coal seams in coal pulverizer | 检查磨煤机煤层厚度 Inspection of coal seam thickness of coal pulverizer                                |
|  | 11. 煤磨机导热 Heat conduction of coal mill                                | 检查煤磨机密封系统<br>Inspection of the sealing system of coal mill                                    |
| 异常<br>噪音或振动 Gearbox<br>abnormal noise or vibration       | 1.齿轮或轴承损伤 gears or bearings damaged                                   | 开盖检查<br>Open cover for inspection   |
|  | 2.过载荷或冲击载荷 overloading or impact load                                 | 检查磨机或电动机是否有故障<br>Check roller mill or motor for problem                                       |
|  | 3.轴承松动 bearing becomes loose  | 检查并紧固轴承盖的锁定螺栓<br>Check and tighten lock bolts for bearing cover                               |
|  | 4.地脚螺栓松动 Anchor bolt loosening  | 检查并紧固地脚螺栓 Check the anchor bolts and fasten   |
| 漏油<br>Oil leakage happens to gearbox                     | 1.油封和垫片损坏或安装不当 oil seal or gasket damaged or improper installation    | 检查或更换油封、垫片<br>Check or replace oil seal, gasket   |
|  | 2.联接螺栓松动 connection bolts become loose                                | 拧紧螺栓 Tighten bolts  |
|  | 3.通气帽堵塞 vent cap blocked  | 检查并排除堵塞物 Check and get rid of blockage  |
| 供油压力跌落<br>Oil supply pressure drops for gearbox          | 1.油泵或油泵电机损坏 oil pump or pump motor damaged                            | 检查、修理或更换<br>Check, repair or replace  |
|  | 2.油站旁通阀未关严 bypass valve for the oil station not closely shut          | 检查并调整旁通阀<br>Check and adjust bypass valve   |
|  | 3.管路或冷却器漏油 piping or cooler leaking                                   | 检查并排除<br>Check and repair   |
|  | 4.油泵吸油管吸入空气 oil suction tube for the oil pump happen to air intake    | 检查油站的油位<br>Check oil level for oil station  |
|  | 5.压力表失灵 pressure gauge fail   | 检查校验压力表<br>Check and calibrate pressure gauge   |

|  |   |   |
|--|---|---|
| 供油压力陡升<br>Oil supply pressure rises for gearbox  | 1. 油管或轴承进油口堵塞<br>piping or cooler leak                            | 检查并排除<br>Check and repair   |
|  | 2. 油的粘度过高<br>oil viscosity too high                               | 检查供油牌号和供油温度<br>Check oil designation and oil temp. supplied                     |
|  | 3 压力表失灵<br>pressure gauge fail                                    | 检查校验压力表<br>Check and calibrate pressure gauge                                   |
| 油泵异常噪音或振动<br>Oil pump happen to noise or vibration                                       | 1. 油泵过载, 油的粘度过高<br>oil pump overloaded and oil viscosity high     | 油泵齿轮被杂质咬住<br>Oil pump gears are seized by foreign matters.                      |
|  | 2. 油泵轴和电机轴不同心<br>oil pump shaft and motor shaft eccentric         | 校验同轴度<br>Calibrate co-axial level   |
|  | 3. 联轴器损坏<br>coupling damaged                                      | 检查并更换橡胶圈<br>Check and replace rubber ring                                       |
|  | 4. 油泵轴承、齿轮和泵体损坏<br>oil pump bearing, gear and pump casing damaged | 检查、修理或更换<br>Check, repair or replace  |
| 油泵漏油或端盖发热<br>Oil pump leak or end cover overheated                                       | 1. 油泵轴和电机轴不同心<br>oil pump shaft and motor shaft eccentric         | 校验同轴度<br>Calibrate co-axial level   |
|  | 2. 端盖内的油封损坏<br>oil seal in the end cover damaged                  | 检查并更换填料<br>Check and replace filling  |
| 油箱的油位增高或降低<br>Oil level in the oil tank increase or decrease                             | 1. 冷却器损坏或漏水<br>cooler damaged or water leak                       | 对冷却器泵压试验, 检查油中水份<br>Pressure test on cooler pump and check water content in oil |
|  | 2. 管路漏油<br>piping happen to oil leak                              | 检查进回油管<br>Check oil feed and return line  |
| 油站供油温度过高<br>too high temperature of oil supply in the oil station                        | 1. 冷却水温度过高<br>cooling water temperature high                      | 采取措施降低水温<br>Take measures to reduce water temperature                           |
|  | 2. 冷却水水量不够<br>insufficient cooling water supply                   | 加大供水量<br>Increase water supply  |
|  | 3. 冷却器管路积垢<br>cooler piping fouling                               | 去积垢<br>Remove fouling   |
|  | 4. 管路内留有空气<br>air in the piping                                   | 开启放气塞<br>Open air relief plug   |
| 油站磁过滤器发现金属碎屑<br>Metal scrap is found at magnetic filter in the oil station.              | 1. 串油清洗不彻底<br>oil flushing not properly carried out               | 重新串油清洗<br>Fresh oil cleaning  |
|  | 2. 齿轮或轴承损伤<br>gears or bearings damaged                           | 检查、修理或更换<br>Check, repair or replace  |
| 油品化验中某一种化学元素<br>急剧增加<br>In oil test, one chemical composition content suddenly increased | 齿轮或轴承磨损加剧或损坏<br>Gear or bearing further worn or damaged           | 检查、修理或更换<br>Check, repair or replace  |

附表一 联接螺栓的拧紧力矩

Attached table 1:Tightening torque connected to bolts

| 螺栓直径<br>Dia. Of bolts | 扭力扳手力矩<br>Torsion wrench torque | 螺栓直径<br>Dia. Of bolts | 扭力扳手力矩<br>Torsion wrench torque | 螺栓直径<br>Dia. Of bolts | 扭力扳手力矩<br>Torsion wrench torque |
|-----------------------|---------------------------------|-----------------------|---------------------------------|-----------------------|---------------------------------|
| D (mm)                | Dr (N*m)                        | D (mm)                | Dr (N*m)                        | D (mm)                | Dr (N*m)                        |
| M6                    | 7                               | M30                   | 1004                            | M80×6                 | 20368                           |
| M8                    | 18                              | M36                   | 1749                            | M90×6                 | 29492                           |
| M10                   | 35                              | M42                   | 2806                            | M100×6                | 41122                           |
| M12                   | 61                              | M48                   | 4236                            | M110×6                | 54799                           |
| M16                   | 149                             | M56                   | 6791                            | M125×6                | 80284                           |
| M20                   | 290                             | M64                   | 10147                           | M140×6                | 113326                          |
| M24                   | 500                             | M72×6                 | 14689                           | M160×6                | 171027                          |

注：

1. 表中所列拧紧力矩数值为：螺栓强度为 8.8 级的拧紧力矩。
2. 力矩公差±5%。
3. 螺栓级别见螺栓头部。头部无级别标记的为自制件，级别全部为 8.8 级。

Notes:

1. The torque values listed in table above refer to that of bolts with a strength grade of 8.8.
2. Tolerance of torque is ±5%.
3. The bolt grade see the bolt head. Bolts without marks in the head are self-made parts and are all of grade 8.8.

4. 对于其它等级的螺栓所需拧紧力矩，按机械设计手册要求计算。

4. The required tightening torque for bolts of other grades is calculated according to Mechanical Design Manual.

5. 所给数值为使用润滑剂的螺栓，对于无润滑剂的螺栓的拧紧力矩应为表中值的 133%。

5. the torque values are for using anti-friction material bolts, for non anti-friction material bolts, the torque values are 133% of table's value.

附表二：推荐润滑油

Attached table 2: Recommended lubricating oil

| 油品种类<br>Oil grade                   | 粘度 ISO VG<br>(40 °C,<br>mm <sup>2</sup> /s)<br>viscosity | 克鲁勃 Klüber               | 壳牌 Shell           | 美孚 Mobil              | 嘉实多 Castrol     | 长城 Great Wall         |
|-------------------------------------|--|--------------------------|--------------------|-----------------------|-----------------|-----------------------|
| 合成烃<br>PAO<br>Composite hydrocarbon | VG 320   | Kluebersynth GEM 4-320 N | Shell Omala HD 320 | Mobilgear SHC XMP 320 | Tribol 1510/320 | AP-HD 320 Synthetical |

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# 1.概述

## 1.1 适用范围

为了保证设备连续安全可靠使用，特制定本说明书。

本说明书适用于生产的立磨半直驱动力系统电动机部分的使用和维护。

本说明书对有关保存、使用、维护等方面的问题做了详细介绍，其它有关运行及定额的具体情况参见电动机铭牌或标牌。基础，主回路及辅助的电气连接以及与被驱动设备的接口信息可参见电动机外形图。请仔细审阅电动机的所有警告提示及铭牌。电动机只有严格按照外形图及使用维护说明书来使用，产品的质量保证才生效。

## 1.2 执行标准

|                  |                                     |
|------------------|-------------------------------------|
| GB/T 191-2008    | 包装储运图示标志                            |
| GB 755-2008      | 旋转电机 定额和性能                          |
| GB/T 13958-2008  | 无直流励磁绕组同步电动机试验方法                    |
| GB/T 1029-2005   | 三相同步电机试验方法                          |
| GB/T 1993-93     | 旋转电机冷却方法                            |
| GB/T 24478-2009  | 电梯曳引机                               |
| GB/T 997-2008    | 旋转电机结构型式、安装型式及接线盒位置的分类              |
| GB/T 2423.4-2008 | 电工电子产品基本环境试验规程 试验 Db: 交变湿热试验方法      |
| GB/T 4942.1-2006 | 旋转电机整体结构的防护等级(IP 代码)分级              |
| GB/T 10068-2008  | 轴中心高为 56mm 及以上电机的机械振动 振动的测量、评定及限值   |
| GB/T10069.3-2008 | 旋转电机噪声测定方法及限值第 3 部分: 旋转电机 噪声测定方法及限值 |
| GB 12665-2008    | 电机在一般环境下使用的湿热试验要求                   |
| GB4208-2008      | 外壳防护等级 (IP 代码)                      |
| GB/T22669-2008   | 三相永磁同步电动机试验方法                       |
| GB/T22711-2008   | 高效三相永磁同步电动机技术条件                     |
| GB/T21418-2008   | 永磁无刷电动机系统通用技术条件                     |

## 1.3 电动机结构

立磨半直驱动力系统电动机主要有电动机壳体、定子绕组线圈、定子硅钢片、转子永磁体、及附属设施组成。

## 1.4 电动机基本参数

### 1.4.1 基本参数说明

本系列电动机的外壳防护等级为 IP55，冷却方式为 IC46W（水冷），电动机的定额是以连续工作制（S1）为基准的连续定额。电动机的额定电压为 6000V，接法 Y。

## 1.5 防护形式

电动机防护形式根据使用环境而定，可提供防爆等形式产品，需取得国家安全部门的有关认证。

## 1.6 绝缘等级及绝缘测量

电动机绝缘等级是依据电动机所以绝缘材料的允许极限温度划分的，立磨半直驱动力系统电动机绝缘等级为 H 级，绝缘材料极限温度为 180 度。电动机使用时要进行绝缘测量，冷态绝缘电阻测量值达到要求方可使用。

表 1 绝缘水平

| 额定电压 (V) | 额定短时工频耐压 (V) |
|----------|--------------|
| 6000     | 2 倍额定电压+1000 |

额定电压大于 1kV 的电机，定子成型绕组的绝缘电阻在冷态时，最小绝缘电阻不低于 50MΩ。

表 2 绝缘电阻测量工具规格

| 电动机额定电压 (V) | 兆欧表规格 (V) | 绝缘电阻 (Ω) |
|-------------|-----------|----------|
| 100-3000    | 1000      | ∞        |
| 3000 以上     | 2500      | ∞        |

注：1. 每3 个月要测试一次。

2. 测量埋置式检温计（如埋置在上下层绕组之间的铂热电阻Pt100）的绝缘电阻时，应采用不高于250V的兆欧表。

3. 如果绝缘达不到最低绝缘要求，应检查原因并进行干燥处理，不得烘干，此后每2至3小时测一次，观察绝缘电阻变化情况。

## 1.7 防护等级

立磨半直驱动力系统电动机防护等级为 IP55。

**表 3 第一位表征数字及数后补充字母表示的防护等级**

| 第一位表征数字 | 表征符号  | 防护等级                               |  |
|---------|-------|------------------------------------|--|
|         |       | 简 述                                | 含 义  |
| 0       | IP0X  | 无防护                                | 无专门防护  |
| 1       | IP1X  | 防止大于 50mm 的固体异物                    | 能防止人体的某一大面积(如手)偶然或意外地触及壳内带电部分或运动部件,但不能防止有意识的接近这些部分,能防止直径大于 50mm 的固体异物进入壳内。 |
| 2L      | IP2LX | 防止大于 12.5mm 的固体异物                  | 能防止直径大于 12.5 mm 的固体异物进入壳内和防止手指或长度不大于 80mm 的类似物体触及壳内带电部分或运动部件。              |
| 3       | IP3X  | 防止大于 2.5mm 的固体异物                   | 能防止直径(或厚度)大于 2.5mm 的工具,金属线等进入壳内。   |
| 3L      | IP3LX | 防止大于 12.5mm 的固体异物进入和防止 2.5mm 的探针触及 | 能防止直径大于 12.5mm 的固体异物进入壳内和防止长度不大于 100mm 直径为 2.5mm 的试验探针触及壳内带电部分和运动部件。       |
| 4       | IP4X  | 防止大于 1mm 的固体异物                     | 能防止直径(或厚度)大于 1mm 的固体异物进入壳内。  |
| 4L      | IP4LX | 防止大于 12.5mm 的固体异物进入和防止 1mm 的探针触及   | 能防止直径大于 12.5 mm 固体异物进入壳内和防止长度不大于 100mm 直径为 1 mm 的试验探针触及壳内带电部分和运动部件。        |
| 5       | IP5X  | 防尘                                 | 不能完全防止尘埃进入壳内,但进尘量不足以影响电器的正常运行。   |
| 6       | IP6X  | 尘密                                 | 无尘埃进入。   |

表 4 第二位表征数字表示的防护等级

| 第二位<br>表数字 | 表征符号 | 防 护 等 级 |  |
|------------|------|---------|--|
|            |      | 简 述     | 含 义                                      |
| 0          | IPX0 | 无防护     | 无专门防护。                                   |
| 1          | IPX1 | 防滴      | 垂直滴水应无有害影响。                              |
| 2          | IPX2 | 15° 防滴  | 当电器从正常位置的任何方向倾斜至 15° 以内任一角度时，垂直滴水应无有害影响。 |
| 3          | IPX3 | 防淋水     | 与垂直线成 60° 范围以内的淋水应无有害影响。                 |
| 4          | IPX4 | 防溅水     | 承受任何方向的溅水应无有害影响。                         |
| 5          | IPX5 | 防喷水     | 承受任何方向由喷嘴喷出的水应无有害影响。                     |
| 6          | IPX6 | 防海浪     | 承受猛烈的海浪冲击或强烈喷水时，电器的进水量应不致达到有害的影响。        |
| 7          | IPX7 | 防浸水影响   | 当电器浸入规定压力的水中经规定时间后，电器的进水量应不致达到有害的影响。     |
| 8          | IPX8 | 防潜水影响   | 电器在规定的压力下长时间潜水时，水应不进入壳内。                 |

## 1.8 使用环境要求

1. 海拔不超过 2000m。
2. 环境空气温度应不超过 40℃，不低于-15℃。
3. 冷却水入口处温度应不高于 25℃（根据我国自然环境，如有需要，冷却水温应不高于 33℃），也应不低于 5℃。
4. 特殊环境工况如极寒/极热环境下，需在订货时说明清楚，以便确定电动机结构及冷却方式。

## 1.9 工作运行条件

### 1.9.1 控制方式

立磨半直驱动力系统电动机只能使用专用的永磁同步变频驱动装置，不得使用其他变频驱动装置进行驱动，更不允许直接接入三相工频电源进行使用。

### 1.9.2 电压/频率的变化

电压和频率在下列情况下变化时电动机可以正常运行。

- (1) 电网电压为额定值的±5%以内，频率为额定值的±2%

电动机可以在此工况下连续运行，并实现其基本功能，但其性能与额定电压和频率时的性

能可能呈现差异，温升可能较额定电压和频率时高。

(2) 电网电压为额定值的 $\pm 10\%$ 以内，频率为额定值的 $+3\% \sim -5\%$

电动机可以在此工况下运行，并实现其基本功能，但其性能与额定电压和频率时的如温升较额定电压和频率时过高，且对电动机使用寿命有影响，不建议在此工况下持续运行，需检查排除故障。

电动机的其余电气运行条件可参照 GB 755-2008 旋转电机 定额和性能。

## 1.10 接线盒与温控传感器

### 1.10.1 主接线盒

立磨半直驱动力系统电动机产品供电电压为单一等级电压，电动机主电源接线盒内有三个接线螺栓（或接线板），结构示意图如图 2。

立磨半直驱动力系统永磁同步电动机，接线盒为防护型，接线盒内有三个接线螺栓和一个接地螺栓，三个接线螺栓分别为 U、V、W 三相，电源进线电缆通过接线喇叭口上的密封圈进入接线盒内部，进线电缆用喇叭口上的卡板固定。

### 1.10.2 温控线接线

用户选用的轴承测温、定子测温等装置，如不特别说明，测温元件为铂热电阻 Pt100，输出信号为电阻信号。

(1) 定子测温

定子测温元件埋置在定子槽中、上下层线圈之间最热部位，每相一支，共六支。测温元件的引接线引到单独的接线盒中。立磨半直驱动力系统电动机定子测温接线腔端子接线图见图 1。

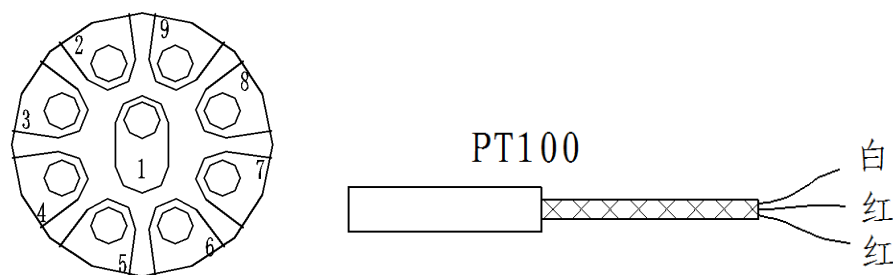


图 1 温控线用九芯接线端子及温控元件接线图

当电动机正常工作时，三相定子测温元件测得的温度存在差异的主要原因有：

- 1) 测温元件的误差；
- 2) 不同部位的电磁线和硅钢片不完全相同，使各部位产生的损耗不同；
- 3) 冷却系统不完全对称。

图 1 所示测温元件为三线制，通过测温接线盒用引接线连接到控制室，三线制的优点是通  
过补偿电路可以消除引接线电阻引起的测量误差。当测温元件为两线制时，引接线的电阻与测  
温元件的电阻叠加在一起，使测得的阻值大于铂热电阻的实际阻值，测得的温度大于实际温度。  
从测温元件到接线盒的引接线的电阻约为  $0.05\ \Omega$ ，引起的测量误差约为  $0.15\ ^\circ\text{C}$ ，可以忽略不  
计。从接线盒到控制室的引接线引起的测量误差与引接线的材质、直径、长度有关，可用下式  
计算：

$$\Delta t = K \rho S / L$$

式中

$\Delta t$ ——引接线电阻引起的温度误差， $^\circ\text{C}$ ；

$K$ ——铂热电阻的电阻变化  $1\ \Omega$  时温度变化值，约为  $2.65\ ^\circ\text{C} / \Omega$ ；

$\rho$ ——引接线的电阻率，铜为  $0.017\ \Omega\ \text{mm}^2 / \text{m}$ ；

$L$ ——两根引接线的总长度， $\text{m}$ ；

$S$ ——引接线截面积， $\text{mm}^2$ 。





当测温元件为两线制时，从接线盒到控制室的引接线可以接成三线制，即在铂热电阻一个  
接线端子上接一根引接线，在另一个接线端子上接两根引接线，三根引接线接到控制室的补偿  
电路上，可以消除从接线盒到控制室的引接线电阻引起的测量误差。

注： 绕组测温——  $115\ ^\circ\text{C}$  报警       $120\ ^\circ\text{C}$  停机



## 2.安全须知

为了确保您的人身和设备安全，在使用立磨半直驱动力系统电动机之前，请务必仔细阅读  
本章内容，并在以后的搬运、安装、运行、调试与检修过程中遵照执行。


### 2.1.安全标识定义


|   |                                  |
|---|----------------------------------|
|  | 本符号提示如果不按要求操作，可能导致死亡、重伤或严重的财产损失。 |
|  | 本符号提示如果不按要求操作，可能使身体受伤或设备损坏。      |
|  | 本符号说明操作时需注意的事项。                  |
|  | 本符号提示一些有用的信息。                    |


### 2.2 注意事项


-  立磨半直驱动力系统电动机的冷却方式全部为水冷，所以用户在冬天使用时注意电动机周边环境温度不得低于  $0\ ^\circ\text{C}$ ，或加防冻液，以免冷却水结冰，造成电动机冷却系统损坏。
-  电动机采用水冷却时，必须保证出水孔畅通，不得堵塞出水孔。以免水压过高，造成


电动机冷却系统损坏。

 用户因工作需要，需要停机并解除电源线时，必须运用专用工具对电动机接线端子进行放电，以免触电。

 引入的电缆芯线，须用接线压板压紧固定，防止电缆窜动，否则易发生短路，引起放电爆炸。

 电动机外接地螺栓必须有可靠的接地。


 严禁带电开盖！


 安装、使用、维护过程中注意保护隔爆面，严禁磕碰、划伤！


 使用屈服应力 $\geq 640\text{MPa}$ （8.8级）的紧固件！


## 3. 产品运输、验货、存放

### 3.1 产品运输吊装

 电动机运输时要将电动机固定好，防止电动机因撞击而损坏零部件。

 电动机在运输时，必须对电动机做好防雨、防晒措施。

 电动机搬运时必须使用电动机上方的吊耳孔，不得使用非吊耳孔进行起吊，以免机体变形或造成不必要的安全事故。

 在起吊前要注意整机的重量，只能用机座上的起重吊耳起吊，将吊索拉紧，不要猛拉或突然移动电动机。

### 3.2 长期存放

停放期间应经常保持电动机之绝缘电阻在规定值以上。电动机安装后(或使用一段期间后)，拟长期停机(一周以上)，每三个月需试运转一次。存放期间的保养工作请做记录，以便为日后的保养工作提供依据。

### 3.3 一般保护

周围及上部应有防尘罩遮住，但须保持通气良好。水冷式电动机必须确认管内的水已经去除，以避免长期存放时水管被腐蚀或因结冻造成损坏。

## 4. 电动机部分安装

### 4.1 安装前注意事项

(1) 按照电动机使用说明书，编制操作规程。

(2) 核对电动机基础。

- (3) 核对电动机及其配套的其它电气设备的选型是否符合设计要求。
- (4) 检查设备有无“合格证”及“安全标志”。
- (5) 检查管路、电缆等安装配件是否备齐。
- (6) 绝缘检查，绝缘电阻的测定及规定值，请参照 1.6 项的规定执行。

## 4.2 电气连线

- (1) 确定所有临时性支撑都已拆除；
- (2) 开盖后将接线盒外盖按照防爆要求正确放置，对接线腔内部件进行检查有无缺少会松动，然后对电动机进行绝缘检查，绝缘检查参照 4.1 项执行；
- (3) 根据接线示意图检查电动机、变频控制器及信号控制连接部件是否完整；
- (4) 检查供电系统的电压、相位、频率等是否符合电动机铭牌上的额定值；
- (5) 接线前将接线盒清理干净，检查电缆进线口的密封，卡紧及电动机内、外接地线按规定接牢；
- (6) 检查电动机随机使用记录及标签；
- (7) 检查水冷管路接头是否连接好，参照 4.4 项执行；
- (8) 起动控制和过载控制必须符合电动机额定值。为了安全和方便起见，可以将他们安装在与电动机保持一定距离的地方；
- (9) 按照变频控制装置的说明，正确地安装和连线，但所用电源要符合国家电力标准，线路电压和导线容量要符合铭牌上的额定值。

## 4.3 水冷系统连接

立磨半直驱动力系统电动机的冷却方式为：IC46W（水冷），可直接使用软化水，冷却水应满足水压在 0.45Mpa 以下，流量>50L/min，如无合适水源可选配我公司永磁电机自循环水冷系统。

冷却水尽量为中性水质、无颗粒杂质，水质不好的要加过滤器，地面使用冬季需要防止水结冰；不得造成进出水口堵塞，防止温度升高及水压过大造成电机损坏。

## 4.4 电动机的调试

立磨半直驱动力系统电动机具体调试内容如下：

- (1) 设备运行  
调试后设备能够正常运行且显示参数正确无误；
- (2) 设备操作  
调试后设备操作按钮、开关等功能同其铭牌或说明书标注作用一致；

### (3) 设备技术指标

调试后设备性能能够达到技术指标；设备安装后正常运行一个月，达到使用要求，即可完成试运行验收竣工工作。

## 5. 电动机运行维护

### 5.1 维护检查记录

为了避免频繁的停机造成的绕组击穿或严重的损坏，应设有预防性维护检查一览表。这张表取决于立磨半直驱的运行情况和类似设备的使用经验。为了保证适当的维护，要保存每一台设备的完整记录，参考附表三执行，包含电网状态、电动机运行参数、运输负载情况、温升数据、维护情况（水冷和注油）等，以便巡检人员查看、及时方便了解每一台设备的运行情况。

### 5.2 周期性检查

电动机应进行周期性的维护和检查，应保证：

- (1) 电动机清洁，电动机工作环境要通风、无积水、无腐蚀性液体存在。
- (2) 负载不超过额定值和使用系数；
- (3) 绕组线圈温度不超过 120℃；
- (4) 绝缘电阻要大于 50MΩ。
- (5) 电压、频率的变化应符合 1.9.2 的规定；
- (6) 轴承检查，检查润滑脂贮存、注油时间、注油量及监测轴承温度；
- (7) 没有异常的振动和噪声；
- (8) 必要零件的贮备及备用件库存一览表；

### 5.3 维护计划

#### 5.3.1 一般检查

(1) 在提供的测温装置处测量温度，测量定子绕组、冷却空气及轴承的温度。（例如埋入式电阻测温元件）。

(2) 查听整个电动机是否有不正常的机械噪声或者出现变化的响声（例如摩擦或敲击声等）。

(3) 当具有水——空气交换器装置时，用目检查水管是否漏水。

(4) 当采用过滤器装置时，检查过滤器的沾污程度。

(5) 用手检查或用温度计（如果装有）在测温装置处测量并记录轴承温度。

### 5.3.2 每月的检查。

- (1) 查看轴承振动值，是否有明显增大情况（与平时对比）。
- (2) 联接线及其紧固情况。
- (3) 当具有过滤器装置时，在过滤监视器动作后（例如流量开关）则应更换或清理过滤器。
- (4) 检查轴承运转是否平稳以及温度情况，检查是否漏油，如果已弄脏，则清除脏物。

### 5.3.3 每季的检查。

- (1) 测量绕组的绝缘电阻、温升情况；
- (2) 检查轴承的温升及润滑脂情况；
- (3) 目测检查电机外部及轴缝隙处灰尘沉积的程度。
- (4) 检查电源、仪表及控制接线上灰尘沉积的程度。

### 5.3.4 定期检查

按照使用条件每年或每半年应该对电机进行检查。检查需注意的主要事项：

- (1) 腐蚀性的或导电性的灰尘。
- (2) 所积累的灰尘会影响正常通风及运转。
- (3) 化学的烟雾、蒸汽、盐雾气或油雾。
- (4) 潮湿或非常干燥、辐射热、害虫侵扰或导致霉菌生长的大气。
- (5) 不正常的冲击、振动或者外来的机械负荷。
- (6) 与额定电压及（或）频率的偏离过大。
- (7) 房间的通风差或环境的空气温度超过 40℃。
- (8) 电机承受扭转冲击负载，反复的过载，反接或制动，或者由于负载惯量大而产生长的加速时间。
- (9) 检查所有螺栓及螺母，确保是紧固的。
- (10) 检查主引出线，是否有过热或电晕的迹象。

## 5.4 外壳清洁

(1) 以喷射的空气吹掉灰尘只用于几乎无法接近的缝隙处并且电动机不能是潮湿的，空气吹拂的方向应不使灰尘被带入电动机内部深处。以免难于清除并且可能阻塞通风道。

特别注意：所用空气压力不得高于  $2 \times 10$  帕（2 公斤力/厘米），这是为了避免损伤绝缘。在绝缘松散的情况下吹拂灰尘，确保空气是干燥的并且不含来自空气管路的冷凝水。

### (2) 溶剂清洁法

对于清除电气设备上的沥青、脂、蜡及油，溶剂清洁法特别有效，用一块蘸有溶剂的布块

揩抹表面，然后用干布揩擦。建议用无机类挥发性溶剂或石油类溶剂清洁绝缘。

特别注意：当采用溶剂清洗时，应备有适当的通风以免火灾、爆炸以及有害于人体的健康。

## 5.5 绝缘电阻

绝缘电阻（绕组的）定义为绝缘对于直流电压的电阻，此电压导致产生通过绝缘体及表面的泄漏电流。

绕组的绝缘电阻揭示了绕组有关吸潮及灰尘沉积程度的信息，即使没有达到最低值，也应视情况干燥电机并且根据需要清洁电机。

## 5.6 电动机的拆卸

立磨半直驱动力系统中采用电机与减速机一体化设计，电动机转子中含有大量的稀土永磁体，转子对金属具有很强的吸附性，整机拆卸时必须使用专用设备，用户不可随意拆卸，所以我公司规定：

如果电动机在使用过程中出现故障，用户不能判断其故障原因的，必须通知我公司售后技术人员，由专业技术人员进行判断。

如果确定电动机需要拆除转子等主要零部件时，必须将电动机返厂处理，用户不得私自拆卸该电动机，防止对用户造成财产损失以及人员伤亡等。

## 5.7 附属部件维护

### 5.7.1 测温元件

测温元件是铂热电阻---PT100。

### 5.7.2 定子测温元件

当提供这些绝缘的元件时,将其装在槽内的上、下层定子线圈之间作定子绕组温度的监视.槽的选择使其含有同相的线圈.各相监视绕组温度的测量元件数目相等.可提供两根或三根引线的电阻测温元件.三引线型的测温元件可以用来补偿测温元件引线对温度计读数的影响.

## 6. 常见故障及处理

及早识别异常的运行征兆并迅速采取补救措施是很重要的.其意义在于防止一个小故障以后发展为极其严重的故障.

以下故障排除的指导有助于查出并修理可能存在的故障.在打算要查出故障前,要先切断电动机的电源.

以下简述是较常遇到的问题,可能的原因以及处理方法。

## 6.1 电动机不能起动

表 5 电机不能启动故障

| 故障                   | 可能的原因         | 处理方法                        |
|----------------------|---------------|-----------------------------|
| 电动机完全不动              | 至少有两根电源引线开路   | 查对熔丝、电源进线及引线端子              |
|                      | 无电压           | 查电源进线                       |
| 电动机不能带负载起动,但发出正常的磁噪声 | 过大的负载转矩       | 修理传动装置的故障,不对接电动机并检查电动机空载运转. |
|                      | 电源电压太低        | 测量电源电压                      |
| 电动机空转,但不能带负载         | 起动后,一根电源进线断开. | 检查电源进线                      |

## 6.2 振动、噪声

表 6 振动、噪声故障

|       | 可能的原因      | 判别方法与处理方法                       |
|-------|------------|---------------------------------|
| 振动、噪声 | 转子不平衡      | 将电动机与负载不对接,再作检查                 |
|       | 安装不紧固或基础不好 | 重新拧紧螺栓、检查垫片、加固定装置固定             |
|       | 轴中心线未对准    | 机组重新对中,基础恢复到正确的平面               |
|       | 电动机支承结构的共振 | 在电动机底脚处振动大—随着速度的改变或者在电动机断电后迅速消失 |

## 6.3 绝缘电阻低

表 7 绝缘电阻故障

| 故障    | 可能的原因            | 处理方法                       |
|-------|------------------|----------------------------|
| 绝缘电阻低 | 潮湿、灰尘、导电微粒或其他污染物 | 清洁电动机.按需要清洁并干燥电机           |
|       | 温度过高             | 检查是否过负荷，冷却系统、积灰是否过多,电压是否平衡 |

## 6.4 电动机过热

表 8 电动机过热故障

| 故障       | 可能的原因   | 处理方法         |
|----------|---------|--------------|
| 电动机过热    | 主电源电压太高 | 检查主电源电压及空载电流 |
|          | 水冷系统故障  | 检查水冷系统       |
| 电动机负载时过热 | 电动机过负荷  | 核对电流         |
|          | 电压太高或太低 | 核对电压         |
|          | 电动机单相运行 | 查出进线断开处      |
|          | 转子碰定子   | 检查气隙         |

## 7. 随同产品装箱时的附带文件

|         |        |
|---------|--------|
| 产品使用说明书 | 1 份    |
| 产品合格证   | 1 份    |
| 其他备品、备件 | 根据用户要求 |

## 8. 售后服务

需到用户现场解决问题。一般 48 小时内到达现场。

遇到重大技术问题，售后技术人员及设计人员进行会诊，并采取相应措施以确保持续的正常运行。

为便于用户维护，卖方提供全面、准确的技术文档。技术文档包括：设备的安装、参数配置，使用说明书。

售后服务工程师完成指导设备调试后，调试工作通过且无遗留问题后，开始试运行工作，设备运行良好经用户确认后，安装指导调试工作完成。

附表三

YLX 系列半直驱检查记录表

| 时间      | 频率 (HZ) | 电压 (V) | 电流 (A) | 输入转速 (r/min) | 振动 (mm/s) | 轴承温度 (°C) |      |      |      |      |      | 绕组温度 (°C) |      |      | 油压 (Mpa) | 供油温度 (°C) |
|---------|---------|--------|--------|--------------|-----------|-----------|------|------|------|------|------|-----------|------|------|----------|-----------|
|         |         |        |        |              |           | 输入轴上      | 输入轴下 | 推力 1 | 推力 2 | 推力 3 | 推力 4 | 绕组 1      | 绕组 2 | 绕组 3 |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
|         |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |
| 噪音 (dB) |         |        |        |              |           |           |      |      |      |      |      |           |      |      |          |           |

操作员: \_\_\_\_\_

日期: \_\_\_\_\_