互邦变压器
HU BANG
TRANSFORMER

# 树脂浇注干式变压器

# 安装使用说明书

# CAST RESIN DRY-TYPE POWER TRANSFORMERS

# INSTALLATION,OPERATION &

# MAINTENANCE MANUAL

江苏北辰互邦电力股份有限公司

Jiangsu Beichen Hubang Electric Power CO;LTD

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|---|---|
| 本说明书适用于我公司生产的额定容量为 31500kVA及以下、电压等级 35kV及以下的无载/有载调压环氧树脂浇注干式电力变压器的装卸、运输、仓储保管、安装、使用及维护。 | The instruction manual is suitable for the loading and unloading, transportation, storage, installation, service, and maintenance of the cast resin dry type transformers with no-load or load ,of which the rated capacity is 25000kVA and the voltage rate is no more than 35kV, manufactured by HuBang Electric CO.,Ltd.. |
| **1. 产品概述**<br>我公司生产的环氧树脂浇注干式电力变压器是采用德国HUBERS公司的树脂浇注设备及乔格公司的硅钢片剪切设备生产而成，产品的技术性能指标完全符合 GB1094.11 及国际电工IEC60076-11 标准。 | **1.** PRODUCTS OVERVIEW<br>HB cast resin dry type transformer is made of superior quality materials through the vacuum cast equipments of HUBERS and George Cut-to-length Line from German. The product complies with GB1094.11 and IEC60076.11 standards. |
| **2. 条件** | **2.** SERVICE CONDITIONS |
| 2.1. 冷却方式：有空气自冷（AN）和强迫风冷（AF）两种。对空气风冷（AN）和强迫风冷（AF）的变压器，均须保证变压器具有良好的通风能力。当变压器安装在地下室或其它通风能力较差的环境时，须增设散热通风装置，通风量按每 1kW 损耗 4m3/min风量选取 | 2.1 Cooling method includes air-natural cooling (AN) and air-forced cooling (AF). For both AN and AF transformers, a well ventilated capability is required. If the site is not ventilated well, such as a basement, the ventilation of 4$m^3$/min each KW loss should be ensured. |
| 2.2. 变压器外壳保护等级有IP00、IP20、IP23 等型式。 | 2.2 Enclosure protection degree: IP00, IP20, IP23 etc. |
| 2.3. 变压器安装地点的海拔不超过 1000 米，若海拔超过 1000 米时，应按GB1094.11 和有关规定作适当调整。 | 2.3 The transformer should be installed in the locations where the altitude is less than 1000m . If not, corresponding adjustment should be conducted according to GB1094.11 |
| **3. 产品装卸** | **3.** LOADING AND UNLOADING |
| 3.1 装卸设备：采用合适吨位的起吊设备。产品装卸过程中，应小心轻放，严格按照国家有关装卸规程进行操作。 | 3.1 Device: Choose a crane with proper tonnage. When loading and unloading, the products should be handled with care, strictly according to the relevant regulations. |
| 3.2 底部吊装：外包装箱四角下方喷有“由此吊起”标识，起吊时，应严格按图所示在包装箱的四角下方垫木处挂钢丝绳起吊，如图 1 所示。<br>  <br>图 1 | 3.2 Lifting from the bottom: When lifting, hitch the steel wire to the blocks under the four corners of the package，as figure 1.<br>  <br>Figure 1 |

| | |
|---|---|
| 3.3 顶部吊装：外包装箱上喷有“顶部吊装”标识，起吊时，应按图所示进行顶部吊装，如图 2。需长期存放的产品，吊装完成后，应恢复顶部包装。<br>  <br><br>图 2 | 3.3 Lifting from the top (of package): There is a logo for lifting from the top sprayed on the outside packing. When lifting from the top, do as Figure 2 . After lifting, packing of the top should be returned to normal for long-term storage.<br>  <br><br>Figure 2 |
| 3.4 本体吊装：变压器没有外包装箱或变压器从包装箱中吊出时，应严格按图所示同时使用器身上四个吊孔或吊板同时起吊，如图 3 和图 4，具体以实物为准用吊孔或吊板。<br>  <br>  <br>图 3 图 4 | 3.4 Lifting without package: when lifting a transformer only or lifting it out of its package, four lifting lugs/holes provided on the top of the core and coil structure should be used, see Figure 3&4.<br>  <br>  <br>Figure 3 Figure 4 |
| **4. 产品运输** | **4. TRANSPORTATION** |
| 4.1 产品在运输过程中，应有防雨雪措施，避免雨、雪、潮气和尘土进入变压器，防止变压器外力拉伤。 | 4.1 Measures should be taken in the transportation and storage to keep the transformer away from raindrops, snowflakes, humidity, dirt and outside force. |
| 4.2 产品在运输过程中，其变压器倾斜度不大于 15° 。 | 4.2 During transportation, the obliquity of the transformer should not exceed 15°. |
| 4.3 对于有小车的变压器，为防止在运输过程中的位置移动，一般应卸掉小车轮。 | 4.3 For transformer with wheelbarrow, wheels are usually to be unloaded in order to avoid its moving during transportation. |
| 4.4 用叉车装卸时，叉头同下夹件接触处应垫相应木方，防止破坏铁芯，并采取措施防止变压器倾倒。 | 4.4 When loading and unloading with a forklift, bars should be used between forks and the lower clamps to avoid damage to the core. Measure must be taken to prevent leaning of the transformer. |
| 4.5 禁止绑拉线圈、绝缘子、垫块、引线等易损件。 | 4.5 Binding and pulling coils, insulations, supports, down-leads and other fragile parts are strictly prohibited. |
| **5. 检查验收** | **5. INSPECTION UPON RECEIPT** |
| 5.1 检查产品的铭牌数据与订货合同是否相符，如产品型号、额定容量、额定电压、分接范围、联结组标号、阻抗电压等。 | 5.1 Check whether the data on the nameplate is consistent with ordering contracts in terms of product type, rated capacity, rated voltage, tap range, connection type, impedance, etc.. |
| 5.2 检查变压器随机出厂文件（产品安装说明书、检验合格证书、出厂试验报告和装箱单等）是否齐全。 | 5.2 Check whether the documents attached to the transformer (the installation and service manual, qualification certificate, routine test report, packing list and etc.) are complete. |
| 5.3 检查包装箱内零部件是否与装箱单相符。 | 5.3 Check whether the elements and accessories listed in the packing list are inside the package. |

5.4 检查变压器在运输过程中有无损伤，变压器的零部件是否损伤或移位，接线是否松动、断裂，绝缘是否有破损，表面是否有脏物或异物等。同时，如有运输时使用的垫柱等物，必须把它们挪开。

5.4 Check whether the transformer has been damaged during transportation. Note should be made of loose or broken connections, damaged or displaced parts, cracked insulators, dirt or foreign material. The temporary brace for transportation must be removed.

5.5 检查总箱件数是否齐全。

5.5 Identify all units and check them against the shipping list to ensure complete.

5.6 产品开箱检查完毕后，如不立即投入运行，则必须重新包装并把它放在房内安全、干燥的地方，以防损、防盗。

5.6 If not to be put into use immediately after the inspection, the transformer must be repackaged and stored at dry and safe places where it is immune to damage and brigandage.

## 6. 仓储保管

## 6. STORAGE

6.1 需仓储保管的产品，不应拆除包装，验收完毕后应恢复包装

6.1 If the transformer needs to be stored, the package should be kept. Repackage the transformer after the inspection.

6.2 对长期仓储的产品，必须在库房存放，库房应清洁、干燥，不应同时储存活性化学药品和腐蚀性物品。

6.2 The products for long term storage should be stored in clean and dry warehouse. Don't store the active chemicals and corrosive things close to the transformer.

6.3 所有产品不许堆码。

6.3 Stacking products is not allowed.

6.4 短期户外放置的产品要用木方等垫好，垫高不小于100mm。

6.4 The products placed outdoors temporarily should be padded by woods, of which the height is not less than 100mm.

## 7. 变压器安装

## 7. INSTALLATION

7.1 安装前应认真阅读本说明书，产品铭牌和产品外形尺寸图，了解产品重量、安装方法等内容，准备好相应的起吊设备和工具

7.1 Before installation, the user must read this manual, the nameplate and outline drawing carefully. Besides, the user must know the weight of product, the way of installation, and prepare the corresponding equipments and tools for lifting.

7.2 变压器的安装环境不应有：有害烟雾和蒸汽、过量的腐蚀性尘埃、水蒸气、烟雾、严重潮湿、滴水等。

7.2 The installation location should keep off: harmful smog or steam, superfluous corrosive dust, vapor, smog, condensation, drip, etc.

7.3 变压器主机安装

7.3 Transformer installation

7.3.1 一般情况下，卸下变压器小车轮（如有）即可直接放置在使用场地安装，检查完毕后即可投入运行，对于有防震和其它特殊要求的情况，安装变压器的地基应埋置预埋件，通过预埋件把变压器固定。

7.3.1 Usually, a transformer can be installed at the site directly after removing its wheels (if it has), and then can operate after inspection. For transformers with tamperproof and other special requirements, anchor bolts in transformer's foundation should be fastened.

7.3.2 变压器安装设计应符合安全要求，确保变压器通电后不被人体触及。对于无外壳的变压器，应在变压器的周围安装接地良好的隔离围栏。变压器主体、柜、围栏等的醒目处应标有安全警告标志。

7.3.2 Safety should be taken into consideration when designing the transformer installation, which has to ensure that human body is kept away from current after the transformer is energized. For those without enclosure, isolation barrier should be set up around the transformer. Hazard-warning signs should be put up on the conspicuous places of main body, the cabinet and the barrier.

7.3.3 为安全起见，在海拔 1000m 及以下，变压器裸露带电导体之间及与对地间的最小安全绝缘距离应不小于:

| 电压 (kV) | ≤1 | 3 | 6 | |
|---|---|---|---|---|
| 线间对地距离（mm） | 25 | 60 | 90 | |
| | | | | |
| 电压 (kV) | 10 | 15 | 20 | 35 |
| 线间对地距离（mm） | 125 | 180 | 225 | 340 |

7.3.3 For the sake of safety, within 1000m above sea level, the safe insulation distance between bared phases and phase to earth shall not be less than:

| voltage (kV) | ≤1 | 3 | 6 | |
|---|---|---|---|---|
| Safety clearance（mm） | 25 | 60 | 90 | |
| | | | | |
| voltage (kV) | 10 | 15 | 20 | 35 |
| Safety clearance（mm） | 125 | 180 | 225 | 340 |

变压器带电体与工作人员活动范围的安全距离必须不小于：

| 电压等级 (kV) | ≤10 | 15~35 |
|---|---|---|
| 有围栏距离(mm) | 350 | 600 |
| 无围栏距离(mm) | 700 | 1000 |

And the safe clearance between transformer live parts and the working area of operator should not be less than:

| voltage (kV) | ≤10 | 15~35 |
|---|---|---|
| Clearance with barrier (mm) | 350 | 600 |
| Clearance without barrier (mm) | 700 | 1000 |

7.4 变压器外壳安装

7.4 Enclosure installation

| | |
|---|---|
| 7.4.1 变压器在配有外壳的情况下，其安装条件除满足变压器主机安装条件之外，外壳底部应与变压器底部（卸掉小车轮）在同一水平面上，对主机与外壳之间的相对位置的要求，见随机的变压器外形尺寸图。 | 7.4.1 If the transformer is with enclosure, make sure that the bottom of enclosure and that of the transformer (unloading the wheels) are on the same level except meeting the installation condition of its core & coil, but also to meet the condition that. And the relative site between core & coil and enclosure should be considered, according to the outline drawing of the transformer. |
| 7.4.2 整个外壳均为散件式结构，装配运输都非常方便。 | 7.4.2 The enclosure is divided into parts, so it is convenient to transport and assemble. |
| 7.5 电力线路的联结 | 7.5 Electrical connections |
| 7.5.1 所有端子的联结必须正确。联结电缆或母排应符合相关标准规定和本说明书 7.3 条的线间及对地间安全绝缘距离，联结电缆或母排应有固定支撑。 | 7.5.1 All the terminals must be connected correctly. The connection of cables and bus bars must be up to relevant standards and regulations for the safe insulation clearance described in 7.3 of this manual. Cables and bus bars must be supported with fixed braces. |
| 7.5.2 变压器主体接线端子与其它硬导线连接时，建议中间用软连接过渡，并适当加长、放松。联结用的螺栓须有防松动措施。 | 7.5.2 If terminals on the core & coil are to be connected with other hard-wire, it is proposed to connect a soft transition between them, which should be appropriately extended and slackened off. |
| 7.5.3 变压器高低压两侧均可采用上部或下部进线方式，外壳顶部已预留进、出线口，对于下部进、出线，外壳上配有电缆卡，用于固定进线电缆，如图 5。<br>  <br>图 5 | 7.5.3 Both high and low voltage sides of the transformer, cables entry are either from the top or the bottom. On the top of enclosure, the bracket is prepared. For entry from the bottom of enclosure, Cable Fixed-Caliper on the enclosure is to fix income wire as figure 5.<br>  <br>Figure 5 |
| 7.6 变压器的接地螺栓、变压器外壳的接地螺栓和变压器四周的隔离围栏必须可靠接入保护接地系统，保护接地系统应符合相关要求。 | 7.6 The grounding bolt of the transformer and the enclosure and the barrier must be well engaged to protect grounding system that should comply with relevant regulations. |
| 7.7 温控、温显系统安装 | 7.7 Installation of the temperature controller and monitor devices |
| 7.7.1 对于无外壳且仅有温显仪的情况，其安装可采用温显仪自带安装支架，固定在变压器夹件上。 | 7.7.1 For the transformer without enclosure, but with temperature controller only, their own mounting brackets will be fixed on the clamp of the transformer for its installation. |
| 7.7.2 对于无外壳，但有温控、温显的情况时，因为本公司的温控、温显是合二为一的结构，故可以安装在变压器夹件上或离变压器一定距离内的墙壁等固定建筑物上。 | 7.7.2 For the transformer without enclosure, but with temperature controller, temperature monitor, the temperature controller and monitor are combined, so they will be installed in the transformer clamp, or the walls of buildings within a certain distance. |
| 7.7.3 对于带外壳且仅含温显的情况下，温显可直接嵌入到外壳预留开孔内。 | 7.7.3 For the transformer with enclosure and only temperature monitor, the temperature monitor can be directly embedded within earmarked openings of the enclosure. |

7.7.4 对于既有外壳又有温控、温显的情况下，温控箱直接挂在外壳上

图 6

7.7.4 For the transformer with all of three, the temperature monitor will be directly linked on the enclosure as figure 6

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7.7.5 以上各种情况下，温控、温显的接线及使用方法请参照其使用说明书。产品出厂时温度的设置为：变压器的运行温度达到 100℃时，起动风机；运行温度达到 80℃时，停止风机；运行温度达到 130℃时，输出报警信号；运行温度达到 150℃时，输出跳闸信号。用户也可以根据要求调整设定温度（PTC 测温探头的温控报警和跳闸的设定值不可调）。

7.7.5 For the wiring method and usage of temperature monitor, temperature monitor for the above cases, please refer to the manual. Temperature on outgoing products was set: transformer's operating temperature reaches 100 ˚C, the fans start; operating temperature reaches 80 ˚C, the fans stop; operating temperature reaches 130 ˚C, alarm signal will be output; operating temperature reaches 150 ˚C, tripping signal will be output. Users can also adjust the temperature setting on request (Alarm and trip settings of PTC temperature probe are not adjustable).

7.8 风冷系统

当变压器按要求需要装配风机时，常用风机数量、功率及电源配置如下表：

| 容量(kVA) | 50~100 | 160~315 | 400~630 | 800~1600 |
|---|---|---|---|---|
| 风机功率(W) | 4×38 | 4×44 | 4×50 | 6×80 |
| 风机电源 | ~220V | ~220V | ~220V | ~220V |
| | | | | |
| 容量(kVA) | 2000~2500 | | 3150~5000 | 6300 ～ 16000 |
| 风机功率(W) | 6×90 | | 6×150 | 6×370 |
| 风机电源 | ~220V | | ～220V | ～380V |

7.8 Air cooling system

If the transformer is equipped with fans, the number, power and power supply of common fans are as follows:

| Capacity kVA） | 50~100 | 160~315 | 400～630 | 800~1600 |
|---|---|---|---|---|
| Fans Power（W） | 4×38 | 4×44 | 4×50 | 6×80 |
| Power supply | ~220V | ~220V | ~220V | ~220V |
| | | | | |
| Capacity（kVA） | 2000~2500 | | 3150~5000 | 6300～16000 |
| Fans Power（W） | 6×90 | | 6×150 | 6×370 |
| Power supply | ~220V | | ～220V | ～380V |

注：温控箱的功率相对于风机功率来说很小，可以忽略不计。一般情况下，风机在出厂前已经装配好，用户只要参照温控、温显电气接线图接线就可以了。

图 7

Note: The power of temperature monitor is far smaller than that of fans, so it can be neglected. Generally, fans have been assembled before delivery as figure 7 .The users only need to connect the wire of fans with reference to connection drawing of temperature monitor.

Figure 7

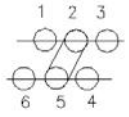
7.9 配电变压器调档方案

方案一：如下图所示

调档方法：当低压侧电压过高时，调至高档位；
当低压侧电压过高时，调至低档位；

分接连接指示

| 电 压 (v) | 分接连接 | 分接位置 | 示意图 |
|---|---|---|---|
| 10500 | 3 – 4 | I | |
| 10250 | 2 – 4 | II | |
| 10000 | 2 – 5 | III | |
| 9750 | 1 – 5 | IV | |
| 9500 | 1 – 6 | V | |

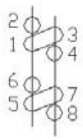



方案二：如下图所示

调档方法：当低压侧电压过高时，调至高档位；
当低压侧电压过高时，调至低档位；

分接连接指示

| 电 压 (v) | 分接连接 | 分接位置 | 示意图 |
|---|---|---|---|
| 10500 | 2 – 3, 6 – 7 | I | |
| 10250 | 2 – 3, 5 – 7 | II | |
| 10000 | 1 – 3, 5 – 7 | III | |
| 9750 | 1 – 3, 5 – 8 | IV | |
| 9500 | 1 – 4, 5 – 8 | V | |




以上两种方案仅供参考，实际以发货的图纸为准。

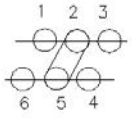
7.9 Distribution transformers tap changer program

Option One: As shown below

the primary windings should be connected to higher(lower) taps when secondary voltage is higher(lower).

分接连接指示

| 电 压 (v) | 分接连接 | 分接位置 | 示意图 |
|---|---|---|---|
| 10500 | 3 – 4 | I | |
| 10250 | 2 – 4 | II | |
| 10000 | 2 – 5 | III | |
| 9750 | 1 – 5 | IV | |
| 9500 | 1 – 6 | V | |

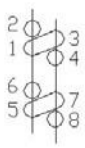



Option Two: As shown below

the primary windings should be connected to higher(lower) taps when secondary voltage is higher(lower).

分接连接指示

| 电 压 (v) | 分接连接 | 分接位置 | 示意图 |
|---|---|---|---|
| 10500 | 2 – 3, 6 – 7 | I | |
| 10250 | 2 – 3, 5 – 7 | II | |
| 10000 | 1 – 3, 5 – 7 | III | |
| 9750 | 1 – 3, 5 – 8 | IV | |
| 9500 | 1 – 4, 5 – 8 | V | |




Above the two o**ptions only** for reference，it is subject to the delivery drawings.

7.10 有载调压变压器

7.10 On—load tap changer transformer

7.10.1 变压器与有载调压开关之间的相对位置见变压器外形尺寸图，变压器与有载调压分接开关居中放置。

7.10.1 Transformer with the OLTC switch the relative positions between the transformer dimensions, see Fig, transformers with on-load switch position is not placed on, but switch B-phase load center and the transformer with the center of B is right.

7.10.2 有载调压分接开关与变压器之间的连线，由用户按照档位端子标号自行接线。

7.10.2 The caples between the OLTC switch and the transformer are connected by the user. Refer to the lable adhered near taps.

7.10.3 中部调压变压器接线方式

7.10.3 Regulating voltage from the middle

不论“Y”接或“Δ”接形式，有载调压分接开关各相的 N—9 个档位分别与变压器各对应相的 N—9 个档位分接端子一一对应相连接，如图 8。

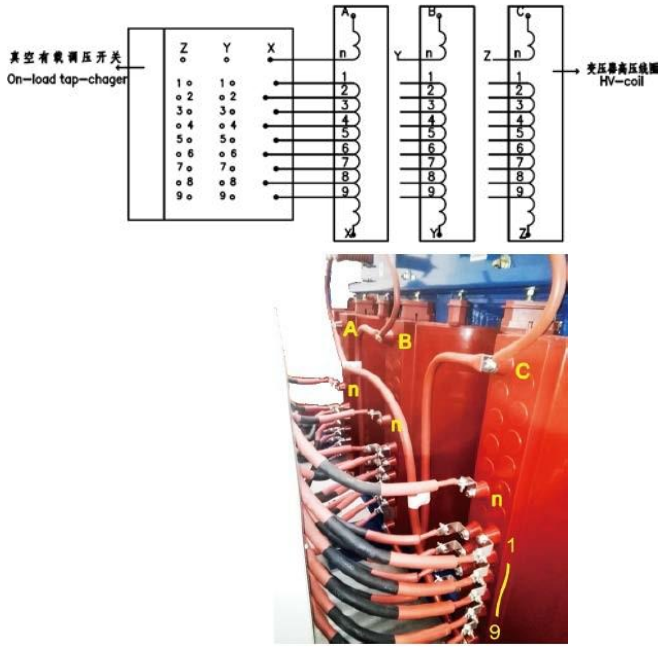



图 8

The N-9 termianals of the OLTC switch should be connected to the N-9 termianals of the transformer regardless of "Wye" or " Delta" as figure 8.

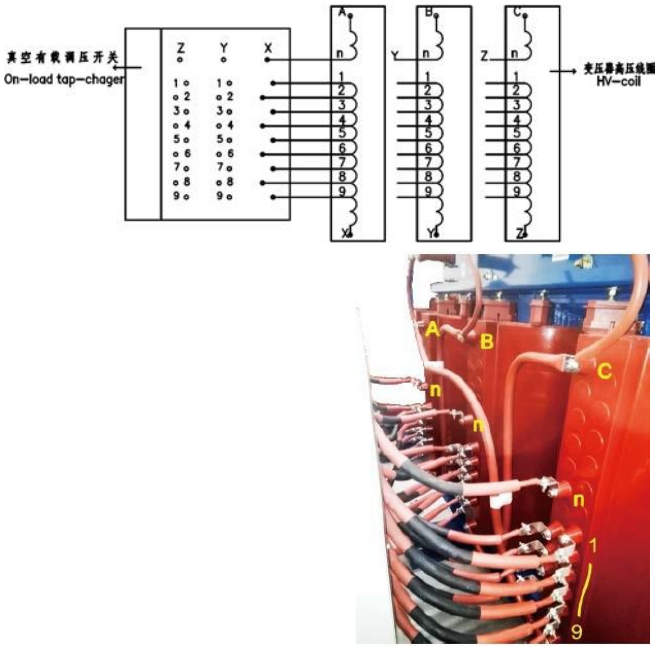



Figure 8

7.10.4 安装时，电联结部位螺栓拧紧力矩分别为：

| 螺栓规格 | 螺栓力矩（N.m） |
|---|---|
| M8 | 15±3 |
| M10 | 20±3 |
| M12 | 35±5 |
| M16 | 80±10 |

7.10.4 When installing, the tightening torque of bolts are recommended as follows.

| Bolts Specification | Bolts Torque（N.m） |
|---|---|
| M8 | 15±3 |
| M10 | 20±3 |
| M12 | 35±5 |
| M16 | 80±10 |

7.11 若变压器并联运行应符合以下条件：变压器联结组别相同；变压器高、低压额定电压相同、且电压比相差不超过 1%；变压器短路阻抗不超过 10%；变压器额定容量比为 1/3~3。

7.11 When the transformer is operated in parallel, the following conditions should be fulfilled: same connection group, same HV and LV rated voltages, the voltage ratio which is not more than 1%, the discrepancy in short-circuit impedance being not more than 10% and the rated capacity ratio of 1/3~3.

7.12 并且有载调压变压器并联运行时，必须配置同步并联运行控制器，且并联运行台数不能超过四台。

7.12 When transformer fitted with OLTC is operated in parallel, the synchronous parallel operation controllers should be collocated. And the number of the transformers in parallel is no more than four.

7.13 有载开关对外接线用户自行配置安装。

7.13 Customers shall install the external wiring of load switch by themselves.

## 8. 运行前的检查

## 8. INSPECTION BEFORE OPERATION

8.1 检查所有的紧固件、连接件、标准件是否松动，若有松动，应重新紧固一次。

8.1 Check all of the fasteners, connectors and the standard parts. Tighten them in case of loosening.

8.2 检查运输时拆卸的零部件安装是否妥当，并检查变压器是否有异物存在。

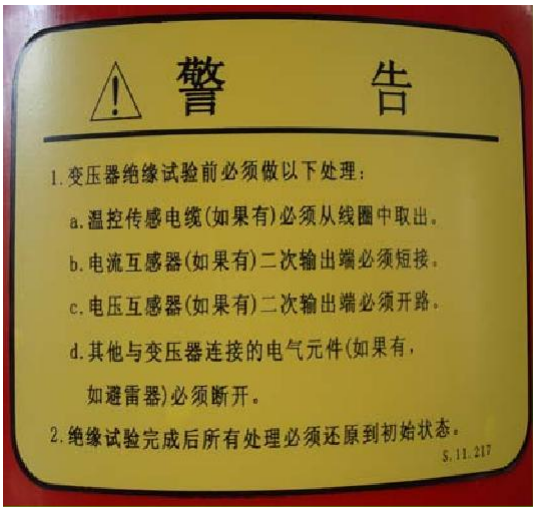
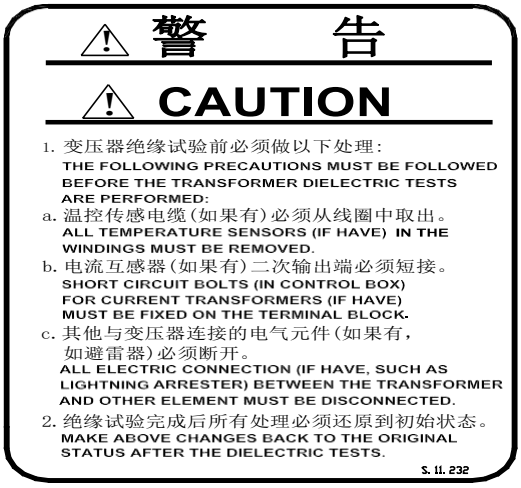
8.2 Check whether the parts disassembled during transportation are installed well, and whether there are any articles which don’t belong to the transformer.

8.3 检查风机、温控设备以及其它辅助器件能否正常运行。

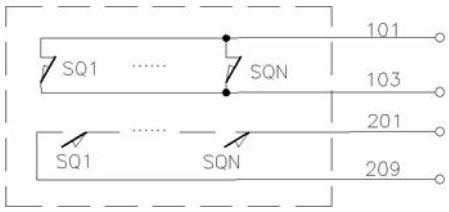
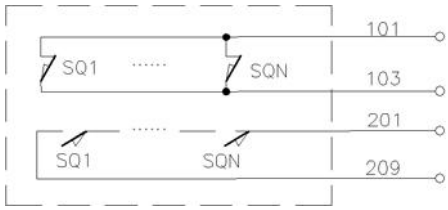
8.3 Check whether the cooling fans, temperature monitor and other accessories work normally.

8.4 检查变压器的箱体和铁芯装配是否可靠接地。

8.4 Check if the transformer box and core assembly is reliably grounding.

| | |
|---|---|
| 8.5 仔细检查在安装过程中有无金属或非金属异物掉入变压器中。 | 8.5 Check carefully whether there are metal or non-metal matters fallen into the transformer during installation. |
| **9. 运行前的试验** | **9.** INSPECTION BEFORE OPERATION |
| 变压器运行前应进行试验，试验前按照变压器上的警告标志做处理，试验完成后所有处理必须还原到初始状态。<br>  <br><br>图 9 | Test should be performed before operation. The precautions on the warning sign must be followed before test.<br>  <br><br>Figure 9 |
| **试验如下：** | Tests are as follows: |
| 9.1 绕组直流电阻的测试。 | 9.1 Test the Winding DC resistance |
| 9.2 检查所有分接头的电压比。 | 9.2 Check the voltage ratio of all the taps |
| 9.3 检查变压器三相联结组别 | 9.3 Check connection symbol |
| 9.4 检查变压器和铁芯是否真正地接地，检查穿心螺杆（如果有）的绝缘是否良好 | 9.4 Check whether the transformer and the core are grounded well, and check the insulation of the screw (if have) is all right |
| 9.5 检查线圈绝缘电阻是否满足要求。一般情况下，绝缘电阻须满足如下值：<br>高压～低压及地 ≥**300MΩ**，**2500V** 兆欧表；<br>低压～地≥**100 MΩ**，**2500V** 兆欧表。<br>在比较干燥的环境条件下，以上绝缘电阻值是很容易达到的。但是如果在比较潮湿的环境条件下，变压器的绝缘电阻值会有所下降，一般地，若每 1000V 额定电压，其绝缘电阻值不小于 **2MΩ**，就能够满足运行要求。但是，如变压器遭受异常潮湿发生凝露现象则不论其绝缘电阻如何，在其进行耐压试验或投入运行前，必须进行干燥处理。 | 9.5 Check whether the insulation resistance of the coil meets the requirement. Generally, insulation resistance value must be as follows:<br>HV~LV& ground≥300MΩ,2500V M Ohmmeter<br>LV~ground≥100 MΩ,2500V M Ohmmeter<br>In dry environment，the above insulation resistance value are easily achieved. But in the relatively wet environmental condition, the insulation resistance value will decline. Generally, for per 1000V rated voltage, its insulation resistance value is not less than 2 MΩ, and the transformer can be put into operation normally. However， when the extremely wet environment leads to the condensation of dew, and whatever the insulation resistance value are , the drying process must be done before induced voltage test or operation. |
| 9.6 铁芯绝缘电阻的测试，一般情况下，<br>铁芯~夹件及地 ≥2MΩ,2500V 兆欧表<br>穿心螺杆~铁芯及地 ≥2MΩ, 2500V 兆欧表。 | 9.6 In the test for insulation resistance of core, insulation resistance value are generally as follows:<br>Coil~Clamps and ground≥2MΩ,2500V M Ohmmeter<br>Screw~Coil and ground ≥2MΩ,2500V M Ohmmeter. |
| 9.7 **外施工频耐压试验，试验电压为出厂试验电压的 80%，历时 1 分钟。** | 9.7 It takes one minute to complete separate source power-frequency withstand voltage test, with the voltage accounting for 85% of the rated voltage. |
| 9.8 若为有载调压变压器，应根据有载调压开关的使用说明书作运行前的检查和试验。 | 9.8 For transformer fitted with OLTC, inspection and test should be performed before operation, according to the operation manual. |
| **10. 变压器投入运行** | **10** OPERATION |
| 10.1 投入运行前应将变压器的各个部位清扫擦拭干净 | 10.1 Clean every part of the transformer before operation |
| 10.2 无载调压时，应把调压分接头的联结片按铭牌上的标识接到相应的位置上 | 10.2 Tap-changer should be connected to the appropriate location according to the mark in the nameplate when regulating voltage in no-load situation. |

| | |
|---|---|
| 10.3 有载调压时，请参看有载调压分接开关使用说明书，将有载调压开关内的过流保护设定值按高压侧额定电流进 行设定，在分接开关调试正常后方可投入运行 | 10.3 When regulating the voltage in on-load situation, please refer to the OLTC switch manual, set the over-current protection value to HV rated current value. The transformer can perform after the tap changer debugging is normal. |
| 10.4 变压器装有温控系统时，请参看温控装置使用说明书 | 10.4 If the transformer is installed with temperature monitoring system, please refer to the manual of the temperature monitor |
| 10.5 变压器应在空载时合闸投运，合闸涌流峰值最高可达8～10 倍额定电流，对变压器的电流速动保护设定值应大于涌流峰值 | 10.5 When the transformer is put into operation with no load，the peak value of closing inrush current may up to 8～10 times of the rated current, and the instant protection current value should be set larger than the peak inrush current. |
| 10.6 所有保护装置投入后，变压器进行空载合闸冲击 5 次（每次相隔 10 分钟），应无异常。 | 10.6 When all protectors are in standby, nothing wrong would happen if the transformer is energized under idle load closing impulse for 5 times (10-minute interval). |
| 10.7 变压器投入运行后，所带负荷应由轻到重，且检查产品有无异响，切忌盲目一次大负载投入 | 10.7 After the transformer is put into operation，make the load increased gradually and check if there is weird sound. Don't blindly put heavy load into them at once. |
| 10.8 变压器退出运行后，一般不需要采取其它措施即可重新投入运行。但是如果是在高温下且变压器有发生凝露现象，则必须经干燥处理后，变压器才能重新投入运行。 | 10.8 After the transformer stops, it can be restarted at once. However, if the temperature is high and any condensation is found on its surface, it can be restarted only after being dried. |
| **11. 变压器监视与维护** | **11** SURVEILLANCE AND MAINTENANCE |
| 为了保证变压器能正常运行，需对它进行定期监视和维护,（详细说明可参照附录《干式变压器维护检修说明书》） | To guarantee the normal operation, surveillance and maintenance should be carried out regularly，pls refer to "Dry Type Transformer Maintenance Instruction Manual" |
| 11.1 应经常监视温控仪温度显示值，及时掌握变压器运行情况，并注意有无异常声音及振动 | 11.1 Watch the value on temperature monitor regularly in order to master the running status of the transformer, and pay attention to any abnormal noise and vibration |
| 11.2 变压器三相负载不平衡时，应监视最大一相的电流和最高一相的温度，接线为 Yyn0 的变压器允许的最大中性线电流为低压线电流的 25%。Dyn11 变压器允许的最大中性线电流可与低压线电流相同。 | 11.2 If any imbalance between the loads on the three-phase occurs, more attention should be paid to the phases with the highest current and the highest temperature. The highest current through the neutral wire in the transformer that is wired as Yyn0, is allowed to account for 25% of that through the LV wire. In the transformer that is wired as Dyn11, the highest neutral current can be the same as the LV current. |
| 11.3 当变压器有以下情况时，如风机运转不正常、温度显示异常、绕组树脂绝缘外观有微小裂纹等现象时，不准超铭牌运行。应查找原因或与制造单位联系确认 | 11.3 Super nameplate of the transformer are not allowed to run in the conditions such as abnormal operation of the blower, incorrectly displayed temperatures and cracks in the cast resin winding shell. Find out the causes or consult the manufacturer |
| 11.4 一般地干燥清洁的场所，每年或更长一点时间进行一次检查；在其它场合，例如：有灰尘或混浊的空气中运行，**每三至六个月**进行一次检查。重污秽地区，每月须进行停电维护检查 | 11.4 Normally, the maintenance and inspection of transformer should be carried out once a year or even longer if it is located in a dry and clean space. If surrounded by dirty or foul air, it should be checked every 3 or 6 months. In heavy pollution area, the transformer shall be serviced under the power cut every month. |
| 11.5 检查时，**如果发现灰尘聚集过多，则必须清除以保证空气流通和防止绝缘击穿，但不得使用挥发性的清洁剂， 特别注意要清洁变压器的绝缘子、绕组装配的顶部和底部，并使用压缩空气吹净通风气道中的灰尘。压缩空气的流动方向与变压器运行时冷却空气的流动方向相反。** | 11.5 During the inspection, a mass of dust must be removed to ensure good ventilation and avoid dielectric breakdown, but volatile depurative can not be used. More attention should be paid to the cleaning of the insulator, the top and bottom of coil installation. And clean dust in ventilating flue with dry compressed air. The flow direction of compressed air is against that of cooling air during transformer's operation. |

| | |
|---|---|
| 11.6 检查紧固件、连接件是否松动，导电零件以及其它零部件有无生锈、腐蚀的痕迹，还要观察绝缘表面有无碳化和电蚀痕迹。如发现，要采取相应的措施进行处理 | 11.6 Check the fasteners and connectors in case of looseness. Electric-conductive elements and other parts should be checked to ensure their immunity to rust and corrosion. In addition, any cracks on the cast resin layer of the winding, as well as any trace of electric corrosion and carbonization, should be paid attention to. It is necessary to take corresponding measures to deal with if any problem is found. |
| **12. 安全注意事项** | **12** AFETYNOTICE |
| 12.1 变压器、变压器外壳或变压器隔离围栏应接地良好，并有安全警告标志 | 12.1 The transformer, as well as its enclosure and the barrier should be grounded well and marked with a safety warning signs |
| 12.2 **变压器投入运行以后，禁止触摸变压器主体，以防止事故发生，无励磁调压变压器严禁带电调压** | 12.2 When the transformer is energized, touching is forbidden in case of accident. Restrict adjusting the voltage of the off-current regulation transformer when it is electrified. |
| 12.3 **变压器进行高压试验前，应将温度传感器电缆从温控箱上卸下，以防损坏温控箱。所有温度传感器、传感线、二次控制线不得与变压器的带电部分接触！！**如图 10。<br>  <br>图 10 | 12.3 Before the high-voltage test, the cable of temperature sensor should be unloaded from the temperature controller to avoid damage to the temperature controller. All the temperature sensors, sensing lines and the second controlling lines are forbidden to contact with the live parts of the transformer as figure 10.<br>  <br>figure 10 |
| **13. 二次接线** | **13** SECONDARY WIRING |
| 13.1 **行程开关接线，接线方式如图 11**<br>  <br>图 11 | 13.1 Door switch connection flow as figure11.<br>  <br>figure 11 |

13.2 **电磁锁接线，接线方式如图 12**

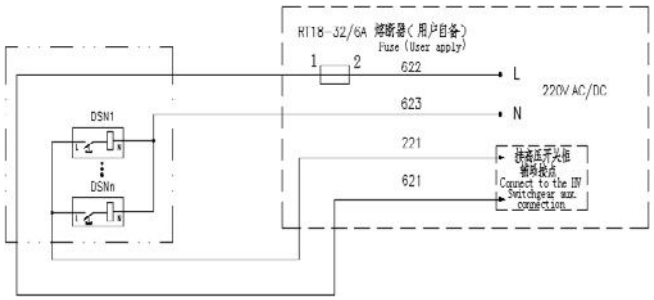



图 12

13.2 Electromagnetic lock flow as figure12.

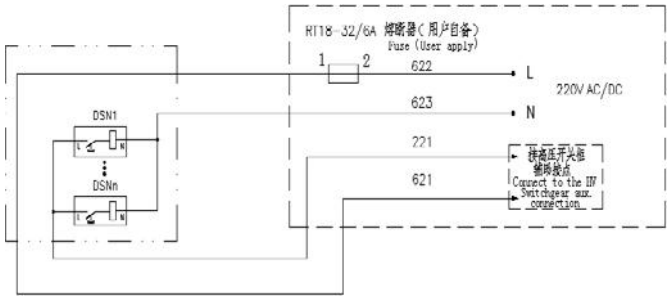



figure 12

13.3 **加热除湿器接线，接线方式如图 13**

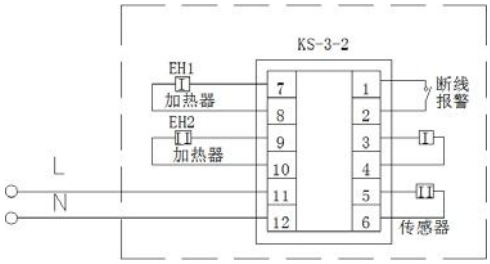



图 13

13.3 .Heat the dehumidifier flow as figure13

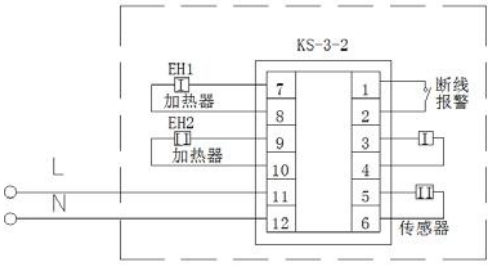



figure 13

13.4 **带电显示器接线，接线方式如图 14**

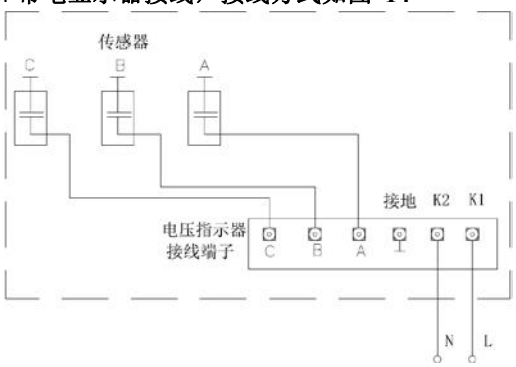



图 14

13.4 Live display connection flow as figure14

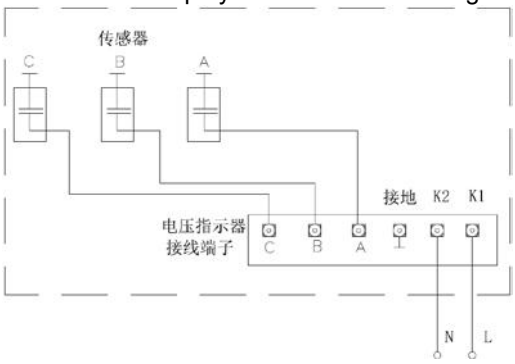



figure 14

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**If there are some changes on the stylebooks, notifications will not be released specially.**

## 干式变压器维护检修说明书

## Dry Type Transformer Maintenance Instruction Manual

1、变压器运行时的检查

1. Inspection during operation

1.1、检查变压器的运行温度

1.1 Inspect the operation temperature of transformer

1.1.1 、查看变压器铭牌，确保变压器的运行温度在规定的范围之内。

1.1.1 Check the transformer nameplate to ensure the operating temperature of the transformer within the specified range

1.1.2、查看变压器温度控制器的显示温度，并记录其温度值。温度控制器的出厂设置是 100℃启动风机、80℃停止风机（如有）、130℃发出超温报警信号、150℃发出超温跳闸信号。此设置是针对线圈的温度，于铁芯温度无关。

由于每个线圈散热条件不同，温控传感器放置的位置不同，变压器 ABC 三相温度会有差异，有时会相差二十多度。

1.1.2 Check the temperature showed on the transformer temperature controller and record it. The factory settings of the controller are to start fan at 100 °C , stop the fan (if any) at 80 °C, and send overtemperature alarm signal at 130 °C and overtemperature trip signal at 150 °C. This setting is for the coil temperature, not the core temperature. Because each coil has different heat dissipation conditions, the temperature control sensors are placed in different positions, and the temperature of the three phases ABC of transformer varies, sometimes by more than 20 degrees.

1.1.3、变压器室的环境温度，适当的通风是干式变压器正常冷却的必需条件。变压器室 24 小时内的平均环境温度应低于 30℃，最高环境温度低于 40℃。

1.1.3 The ambient temperature of the transformer room and proper ventilation are necessary conditions for the normal cooling of dry type transformer. The average environment temperature in transformer room for 24 hours should be lower than 30 °C, with the highest temperature below 40 °C.

1.1.4、变压器室的通风，当变压器安装在地下室或其它通风能力较差的环境时，须增设散热通风装置，通风量按每 1kW 损耗 4m3/min 风量选取。如果变压器室周围的空气质量不好，需要给通风口加装过滤网，过滤后的空气可以降

低维护难度。

1.1.4 As for ventilation in transformer room, if the transformer is installed in the basement or other environment with poor ventilation, the ventilation and cooling device shall be equipped to the ventilation system. The ventilation volume shall be selected at the rate of 4m3/min for every 1kW loss. If the air quality is not good around the transformer room, it is necessary to add a filter to the vents. The filtered air can reduce the maintenance difficulty.

1.2、检查变压器运行时的噪声

1.2 Check the noise during the transformer operation

1.2.1 、变压器的噪声来自于震动，每台变压器的震动幅度和震动频率不同，则不同。

1.2.1 The noise of the transformer comes from vibration. While the vibration amplitude and frequency of each transformer is different, then the noise is different.

1.2.2、变压器的非正弦负载会引起铁芯磁感应强度的增强从而导致噪音的增强。比如当机车过来时变压器的噪声会增强。

1.2.2 The non-sinusoidal load of the transformer can cause the increase of the core magnetic induction, leading to the enhancement of the noise. For example, the noise of the transformer will increase when the locomotive comes.

1.2.3、变压器的异常响声，不是变压器铁芯励磁发出的响声称之为异常响声。首先判断其异常响声是来自于变压器, 还是来自于通风风道及通风口百叶窗；其次判断其异常响声是震动产生的还是放电产生的。如果是震动产生的就检查变压器的螺栓是否有松动现象。通过耐压测试可以判断其异常响声是不是放电产生的。如果是放电产生的异响，则需要厂家技术人员指导处理。

1.2.3 If the sound of the transformer is not from the sound of the transformer core excitation, then it's called abnormal sound. First, determine the abnormal sound comes from the transformer or from the ventilation ducts and the louvers; then judge the abnormal noise is caused by vibration or discharge. If it is caused by vibration, check whether the bolts of the transformer are loose. Decide whether the abnormal sound is caused by discharge through high voltage insulation test. If it is caused by discharge, it is necessary to have the manufacturer’s technician’s instruction to handle it.

1.3、变压器运行环境的检查

1.3 Check the operating environment of transformer

1.3.1 、检查变压器本体是否聚集太多灰尘。高低压线圈、绝缘子等如有灰尘积累，须进行除尘处理，以避免造成爬电或绝缘击穿。清理灰尘时可用吸尘器或干净布子擦拭。

1.3.1 Check whether there is too much dust on the transformer body gathers. If there is any dust accumulation on high and low voltage coils, insulators or others, it must be dedusted to avoid creepage or insulation breakdown. Use a vacuum cleaner or a clean cloth when cleaning dust.

1.3.2、检查通风口过滤网是否聚集太多灰尘。如灰尘太多需要及时更换。

1.3.2 Check whether there is too much dust on the vent filter. If there is too much dust, change it in time.

1.4、变压器运行状态的检查

1.4 Inspection on the operating state of the transformer

1.4.1 、检查变压器运行的电流及电压，并做相应的记录。

1.4.1 Check the operating current and voltage of the transformer and make corresponding records.

1.4.2、使用红外成像仪检查变压器的温度及是否存在局部过热的现象。

1.4.2 Use infrared imager to check the temperature of the transformer and whether there is the phenomenon of local overheating.

1.4.3、将变压器室内的灯全部关掉，检查变压器运行时是否有爬电现象。

1.4.3 Turn off all the lights in the transformer room and check whether there is creepage phenomenon during the transformer operation.

2、变压器停电时的检查

2. Inspection during transformer power failure

2.1、变压器停电检查应至少每月一次。

2.1 Transformer power failure inspection should be conducted at least once a month.

2.2、变压器停电检查时采用扭矩扳手参照扭矩标识检查变压器上所有的紧固件是否有松动，特别是电连接紧固件。扭矩力大小的标识已经贴在变压器上。

2.2 In the power failure inspection, the torque wrench is used to check whether all the fasteners on the transformer are loose according to the identification on the wrench, especially the electrical connection fasteners. The torque force identification has been attached to the transformer.

2.3、检查温控传感线是否脱落，检查传感探头放置位置是否正确。

2.3 Check whether the temperature control sensor is off and check whether the sensing probe is positioned correctly.

2.4、检查变压器室屋顶是否渗水。如有渗水现象及时处理。

2.4 Check whether there is seepage on the roof of the transformer room. If there is seepage phenomenon, deal with it in time.

2.5、检查消防管道及通风管道的固定螺栓是否松动，如有松动及时处理。

2.5 Check whether the fixing bolts of the fire-fighting pipe and ventilation ducts are loose, if loose, handle it timely.

2.6、检查变压器线圈表面及绝缘子是否有放电痕迹，如有及时查找原因。

2.6 Check whether there is any discharge trace on the coil surface and insulators, if yes, find out the reason in time.

2.7、检查变压器本体、线圈表面及绝缘子表面是否积灰太多，必要时及时清理。

2.7 Check whether there is too much dust accumulated on the transformer body, coil surface and insulator surface, and clean it in time if necessary.

2.8、检查变压器本体接地及电缆支架接地是否牢靠。

2.8 Check whether the transformer body grounding and cable holder grounding is reliable.

2.9、检查是否有金属物之类的东西掉入到变压器内。

2.9 Check to see if anything like metal falls into the transformer.

2.10、变压器停电后如发现变压器器身凝露时需要对变压器进行干燥处理。

2.10 After the transformer power failure, if there is any condensation on the transformer body, it should be dried.

3、变压器维护

3. Transformer maintenance

3.1、对变压器进行全面维护应每年至少一次。

3.1 The comprehensive maintenance of the transformer shall be at least once a year.

3.2、对变压器进行全面清理

3.2 The transformer should be cleaned thoroughly

3.2.1 、使用压缩空气对变压器线圈内部及铁芯缝隙进行清理。

3.2.1 Use compressed air to clean the inside coil and core gap of the transformer.

3.2.2、使用吸尘器对变压器室进行清理。

3.2.2 Use the cleaner to clean the transformer room.

3.2.3、使用干净布子对变压器本体、线圈表面及绝缘子表面进行清理。

3.2.3 Use clean cloth to clean the transformer body, coil surface and insulator surface.

3.3、变压器螺栓紧固

3.3 Transformer bolts fastening

3.3.1 、采用扭矩扳手参照扭矩标识检查变压器上所有的机械连接紧固件是否有松动。

3.3.1 Use torque wrench to check whether all mechanical fasteners on the transformer are loose according to the identification on the wrench.

3.3.2、将变压器上所有电连接螺栓打开，特别是分接螺栓和连线管螺栓。用酒精清理除去氧化层，涂抹防氧化物品， 如凡士林、导电膏等。采用扭矩扳手参照扭矩力标识进行紧固，并做好扭矩标识。

3.3.2 Loose all electrical connection bolts on the transformer, especially the tapping bolt and connecting bolt. Remove the oxide layer with alcohol and apply antioxidant products such as vaseline and conductive paste. Use torque wrench to tighten the torque according to the identification and make the torque identification.

4、变压器例行试验检查

4. Routine test check of transformer

4.1、变压器直流电阻测试、变压器变比测试、变压器工频耐压测试、变压器绝缘测试。

4.1 Transformer DC resistance test, transformer ratio test, transformer withstand voltage working frequency test, transformer insulation test.

5、变压器日常消缺

5. Transformer daily defects elimination

5.1、试验时如发现产品工频耐压或绝缘较低时需要对变压器进行干燥处理。

5.1 The transformer should be dried when it is found that the power-frequency withstand-voltage or the insulation of product is low during the test.

5.2、变压器维护时如发现产品问题，请及时与厂家联系：技术支持和服务等处理。

5.2 During the transformer maintenance, if any problem is found, please contact the manufacturer in time for technical support and service.

6、变压器常见故障及分析

6. Common failures and analysis of transformers

| 序号<br>S/N | 故障现象<br>Fault | 原因或处理方法<br>Causes or treatments |
|---|---|---|
| 1 | 投运后温控不显示<br>The temperature control is not displayed after being put into operation | 检查温控电源是否接入。<br>Check whether the temperature control power is on. |
| | | 检查是否打开电源开关（温控箱内部）。<br>Check whether the power switch is on (inside the temperature control box). |
| | | 检查温控保险丝，更换损坏保险丝。<br>Check the temperature control fuse and replace the damaged fuse. |
| 2 | 风机不启动（如有）<br>The fan does not start (if any) | 检查风机电源线是否正确连接。<br>Check whether the fan power line is properly connected. |
| | | 单个风机堵转，更换风机。<br>When a single fan is plugged, replace the fan. |
| 3 | 空载运行时有异响<br>Abnormal sound during no-load running | 检查垫块及螺丝是否松动，重新紧固。<br>Check whether the spacer and screw are loose. Retighten it in case of any. |
| | | 检查是否风机振动引起，重新紧固。<br>Check if it is caused by the fan vibration. Retighten it in case of any. |

| | | |
|---|---|---|
| 4 | 变压器绝缘电阻低<br>Transformer insulation resistance is low | 采用太阳灯干燥处理。<br>Use the sun lamp to dry. |
| | | 采用空载载运行干燥处理。<br>Use no-load running to dry. |
| 5 | 输出电压过高或过低<br>The output voltage is too high or too low | 检查进网电压是否在范围之内。<br>Check whether the grid voltage is within range. |
| | | 按分接示意图调整电压输出。<br>Adjust the voltage output according to the tapping schematic diagram. |
| 6 | 温控显示温度偏差较大<br>Temperature control shows a large temperature deviation | 检查温控探头是否插入到位。<br>Check whether the temperature control probe is inserted in place. |
| | | 温控器显示不准，更换温控器。<br>The temperature controller does not show accurately, replace it. |
| 7 | 通电后无电压输出或三相电压出现大幅偏差<br>There is no voltage output or large deviation among the voltages of three phases after power supply. | 检查上一级负荷开关熔丝的通断。<br>Check the fuse of the load switch of the previous level. |
| | | 检查是否缺相运行。<br>Check whether it is phase-deficient operation. |

7、变压器运维常用工具

7. Common tools for operation and maintenance of transformer

| 序号<br>S/N | 名称<br>Name | 型号规格（精度）<br>Specification/Model (Precision) | 单位<br>Unit | 数量<br>Quantity | 备注<br>Remarks |
|---|---|---|---|---|---|
| 1 | 兆欧表<br>Megameter | KYORITSU 3125 | 个<br>Nr. | 1 | |
| 2 | 微欧计<br>Microhmmeter | WR50-13 | 个<br>Nr. | 1 | |
| 3 | 变比电桥<br>Variable ratio bridge | TR-SPY Mark II | 个<br>Nr. | 1 | |
| 4 | 高压数字表<br>High-voltage digital meter | SGB-100A | 个<br>Nr. | 1 | |
| 5 | 开口扳手<br>Open-end wrench | M18 | 把<br>Pcs. | 1 | |
| 6 | 扭矩扳手<br>Torque wrench | 100N.M | 个<br>Nr. | 1 | |