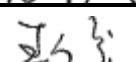


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THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

THAI BINH2 THERMAL POWERPLANT 2 x 600MW

FD FAN OPERATION & MAINTENANCE **MANUAL**

6 Jul.2015



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1. Introduction

1.1 Instructions to customers

Installation, operation and maintenance personnel shall seriously read and strictly comply with the manual. The installation and maintenance of the fan must be undertaken by professional personnel.

In case of important changes in the manual, CPMW will send pages with revisions to customers, but individual changes will be made without notice.

Large fans, high temperature fans, two-stage fans, etc. are slightly different from conventional fans in terms of a part of structures and the installation method. Attention shall be paid to distinguishing them in reference to random technical documents.

1.2 Safety rules

The fan is applicable only to purposes specified in the contract document. Other or wider applications are excluded.

Only the following personnel are allowed to install, operate or maintain the fan:

The designated safety director and personnel trained and experienced as necessary.

Following regulations shall be complied with for the installation and inspection of the fan:

- The main motor must be turned off and be prevented from unintentional startup (electric insulation);
- The actuator and auxiliary equipment such as oil pump and cooling seal fan must be turned off and be prevented from unintentional startup;
- Hazardous gas is not allowed to enter the fan directly or via pipelines, and the inlet temperature must be safe;
- The manual must be strictly followed as it points out conditions likely to cause damage to the human body, equipment or environment.

2. Operating Parameters

(see related performance curves and model selection forms in the document supporting preliminary design provided after the agreement has been signed)

2.1 Operating conditions (see Fig.9 and Fig.10)

2.2 Restriction on operating parameters: CPMW bears no responsibility for any damage caused by using the fan improperly or beyond the specified range.

- The fan and accessories are selected and designed on parameters provided by the customer. If any parameter is changed, the customer shall inform CPMW, to confirm its feasibility.



- Motor speed: Speed fluctuation resulted from power frequency fluctuation shall not exceed 2% of that specified by the operating data.
- Gas temperature: The maximum gas temperature at the fan inlet shall not exceed 150°C for a long time or 200°C for over 5 minutes. If the limit is exceeded, the fan shall be inspected for damage and CPMW shall be contacted.
- Try to avoid operating the fan in the unstable area, which is very likely to lead to stall and surge and system equipment faults and damage. The area can be seen in the characteristic curve graph.
- The fan shall never be started and operated when it is frozen, jammed and rotating reversely and is in environment that is corrosive, explosive and containing excessively concentrated dusty gas.

2.3 Performance curves and related technical documents of the fan will be provided after the order has been placed.

2.4 Contents of randomly provided drawings will be subject to the interpretation of CPMW.

3. Brief Introduction to Functions

3.1 Operating principle: The gas flow entering the fan via the system pipe changes its direction in the inlet box, and then flows to the impeller after being converged and accelerated by the collector. The motor power does work to the gas flow via the impeller blades. The blade operating angle and cascade can be subject to stepless adjustment, so as to change the air flow and pressure to meet the variation of the working condition. The gas flow having passed the impeller is in helical motion, and then enters the diffuser after being changed into axial motion by the guide vane. In the diffuser, a part of kinetic energy of the gas is converted into static pressure energy, after which the gas flows to the system. If the operating requirements are satisfied, the fan output process is completed. (See Fig. 1)

3.2 Major components

3.2.1 Stationary components with stators

Inlet box with shaft sleeve, casing with fairing and guide vane, diffuser, expansion joint, pipeline system, etc.

3.2.2 Rotary components (see Fig. 2)

Coupling, intermediate shaft, main bearing assembly, impeller, servomotor, etc.

3.2.2.1 Impeller

Impeller of the overhang type is the major component for the fan doing work. The hub is connected to the main shaft via the wheel and is fixed to the main shaft by the shaft head nut. The blade angle is subject to stepless adjustment. The blade shaft, installed in the hub body, has an axial thrust ball bearing able to withstand the blade centrifugal force, a radial ball bearing able to withstand the blade adjusting force and a self-lubricating shaft sleeve able to withstand the air impact. The blade bearing can be lubricated for a long time with oil/grease injected, and is sealed by the O ring.

3.2.2.2 Main shaft



It supports the coupling hub on one end and the impeller on the other, and the impeller is supported on both ends of the main shaft of the two-stage fan.

3.2.2.3 Main bearing (see Fig. 3)

The bearing seat is placed in the core of the fan. The main shaft is lubricated with circulating oil and is provided with a seal. The end cover of the bearing seat is split horizontally. The shaft sleeve at each side is provided with a pair of synthetic graphite rings movable radially. The ring is composed of three sections, hooped with a tube-spring and provided with a locating piece to prevent rotation. There is a channel between each two rings, leading to the atmosphere, able to prevent leakage by keeping a balance between the internal and external pressure. Laminated seal pack are contained in the ring groove on the shaft sleeve, which are located close to the external diameter, isolating inside splashed oil and outside dust.

3.2.2.4 Servomotor (see Fig. 4)

It is installed at the rear part of the impeller, including a control valve, an oil cylinder, a piston and a guide shaft and rotating with the impeller, used for keeping the valve casing static and for adjusting the blade. The control head is connected to the oil tube. After the oil station has been started, the control actuator outside the fan makes the valve casing move forwards and backwards along the shaft by means of a push-and-pull rod, so that the pressure oil enters the rear or front chamber of the oil cylinder (via the valve core oil conduit). The pressure in the oil cylinder makes the piston have displacement (slightly lagged behind) in the same direction and stroke as the control valve. The adjusting torque is transmitted to the adjusting disc via the guide shaft, realizing the increase and decrease of the blade opening (note: the actuator shall be operated only after the oil station has been started, and the full stroke time shall not be shorter than 40 seconds).

3.2.2.5 Adjusting disc

There is a snap ring groove on the external diameter of the adjusting disc. The slide block of the lever at the inside end of the trunnion is installed in the ring groove of the adjusting disc. Through the guide shaft, adjusting disc, slide block and crank, the axial displacement of the piston makes the blade rotate around the trunnion, achieving the purpose of adjusting the blade opening and the fan output.

3.2.2.6 Coupling

Rigid and flexible membrane coupling, which is maintenance free, is fixed at both ends of the intermediate shaft in the fan, with advantages of error compensation, vibration absorption, etc.

3.2.3 Oil station (as an accessory, including oil pump, filter, cooler, various valves and instrument elements)

The oil station supplies lubricating and cooling oil (low pressure) to the main bearing and supplies regulating oil (high pressure) to the servomotor. Upon special order, it can also supply lubricating and cooling oil (low pressure) to the motor.

4. Operation

- 4.1 In order that the system can operate safely and economically, the fan configuration must be suitable for the system, including the determination of operating parameters, arrangement of valves and bypasses, and regulation of the flow in pipelines. CPMW is ready to provide consultation on fan model selection for customers.



4.1.1 Operating area: see Section 2 “Operating Parameters”.

4.1.2 The fan must be operated in areas permitted on the performance curve. In order to avoid operation in non-operating areas, stall control is applied in the fan, where the stall zones on the performance curve are stored in the computer which determines the current locations of operating points and monitors the external pressure and the static pressure and fluid temperature at different points. Compare the operating points with the stall zones on the performance curve graph. If the current location is in the stall zone, the blade shall be adjusted properly. Measure the fluid differential pressure in the circumferential direction in the front part of the impeller. If the operating point is in the stable zone on the performance curve, the differential pressure varies slightly; if the operating point goes beyond the stall line, the variation of differential pressure will increase by multiple times. At this time, the angle of the blade shall be changed by means of the pressure switch and the control system, to realize safe operation. The planning and installation of the monitoring equipment must be performed by professional personnel.

4.1.3 Adjustment

The set values shall not be changed without proper reasons. Otherwise, the fan may be seriously damaged. Extreme care shall be taken during the adjustment. **The actuator can be operated only when the oil unit is in operation**, and the travel time of the actuator must be longer than 40s.

Prompt: At the shutdown of the oil station due to power failure or other faults, the central control room shall switch the actuator from automatic control to manual control, so as to avoid damage to the servo control device.

4.2 Inspection before testing running

Prompt: Avoid touching rotating or high temperature parts of the fan. The fan shall not be started before the intermediate shaft cover, coupling guard, protective covering and other protection devices are in place and the manhole door is closed.

The following work shall be done prior to the initial startup or after the change of any rotor and blade:

- Inspecting the clearance between the blade and the casing, between the blade and the hub, and between the hub and the core;
- Washing the oil tube system and injecting oil to the oil tank as specified (see Section 7 “Lubrication”).
- Testing the adjusting function of the blade; repeatedly adjusting the blade to the extreme position with the control oil pump opened;
- Testing the emergency power off switch;
- Inspecting and clearing all foreign objects from the inside of the pipes at the inlet and outlet sides of the fan impeller;
- Inspecting whether the rotating direction of the motor is correct before connecting the fan;
- Performing tests to ensure normal function after the system interlocking test and the display instrument being in place.



4.3 Test running

Test running shall be performed after assembly. In general, not all interlocking points can be correctly switched in the Test running. Great attention shall be paid to displayed data.

4.3.1 It shall be confirmed that the “emergency power off switch” of the main motor is in normal state.

4.3.2 The fan shall be inspected at its startup to see if its accelerated operation is stable. The bearing temperature and vibration data shall be recorded every 5 minutes. In case of relatively stable bearing temperature, the blade shall be opened slowly, until the motor current reaches its rating. The displayed data shall be recorded every 15 minutes after the bearing temperature becomes constant. The motor power shall be cut off (and the blade shall be closed to prevent powering on again unintentionally) after 3 hours of Test running, when all abnormal conditions detected shall be checked and corrected.

4.4 Startup

——Starting the oil unit (see the oil unit description); ——opening the cooling seal fan (if any); ——turning the blade to the “closed” position (0%); ——closing the air duct inlet damper; ——opening fully the air duct outlet damper; ——loosening the safety brake (if any); ——starting the main motor; ——opening all dampers in the air duct system within 1 minutes (the damper must be opened timely as the continuous excessively low flow in the fan will lead to unstable operation); ——adjusting the blade to required position.

4.5 Shutdown

——Stably adjusting the blade to the “closed” (0%) position; ——shutting down the main motor; ——tightly locking the brake equipment (if any); ——closing the air duct inlet damper; ——determining whether to close the air duct outlet damper based on needs (note: the outlet damper shall be closed 5-10 minutes after the main motor stops or the power goes off); ——closing the oil unit (including the cooling water); ——shutting down the cooling seal fan (if any) three hours later (if the air duct is not tight against gas, the fan should be kept operating continuously); corrosion (caused by the cooling of gas) will lead to the failure of important elements, so it shall be ensured that there is no residual corrosive fume in the fan after the shutdown.

4.6 Parallel running of the fan

When one fan is in operation, another fan shall be started in parallel.

(1) If the second fan is to be started and operated in parallel with the first fan in operation, it must to lower the operating point (air flow and pressure) of the first fan under the lowest point of the surge limit of the fan (see the fan performance curves), and then, the second fan can be started in parallel with the first fan at any time.

Before the second fan is to be put into parallel operation, it shall be started as required in Section 4.4. Then, the fan blade angle shall be adjusted to have a same opening angle and power consumption as the first fan in operation. At that time, the air flow and pressure of the two fans are consistent. The guide vane of the two fans shall then be opened to reach the required operating points.

(2) To stop one fan in the two fans operating in parallel, the operating points of both fans shall be lowered below the lowest point of the surge limit simultaneously, and then the fan concerned



shall be shut down as per Section 4.5.

4.7 Operation period monitoring (see the “Interlocking control sheet”)

By means of state monitoring and recording, faults can be detected and causes and effective measures to be taken can be identified timely.

Monitoring interval:

Sound, vibration, oil level and the like shall be inspected daily as per the interlocking control sheet.

The state of instrument and sensor, pollution of oil filter, sealing of the fan's expansion joints and movable joints, sealing of oil pressure elements and so on shall be inspected weekly (or more frequently in case of any change).

Prompt: If the fan is used for a booster fan, the blade is not allowed to operate with the same opening (without adjustment) for a long time (more than two days). The blade shall be subject to rotation at least once a day (making the main motor current change).

5. Maintenance

5.1 Operation period maintenance

Refer to Section 4.6 “operation period monitoring”, and determine, according to monitoring and inspection results, on:

- Cleaning of instruments and sensors;
- Filling oil and grease in place;
- Washing of filters;
- Washing of the filtering grid (if any) of the cooling seal fan;
- Cleaning of the overflow pipe grid;
- Tightening of all bolts and threaded connections.

If the instrument reading exceeds the allowable range, the cause must be identified and correction must be made.

5.2 Oil system maintenance

Lubrication inspection cycle: Six times per month.

If water is contained in the oil liquid, the oil liquid may be drained from the lowest point of the oil tank or undergo an oil separator.

Prompt: Oil mixed with different components will damage the bearing, servomotor and oil station. Therefore, it shall be identified and corrected timely.

Cleaning cycle: Once per year. The detergent oil shall be filtered and replaced and various parts of the



detergent oil system shall be inspected and carefully cleaned. If the laboratory inspection oil liquid is in good state, it can be cleaned less frequently as appropriate.

5.3 Planned shutdown (inspection and repair) maintenance

The regular cycle is 24000 operating hours or 3 years (the cycle is recommended to be 8000-10000 operating hours if the fan medium is high temperature fume or contains corrosive gas). Routine inspection and maintenance shall be as follows:

Fan body:

- Cleaning the outer casing;
- Inspecting the guide blade and support rib for abrasion;
- Cleaning the air duct;
- Inspecting the state of the expansion joint;
- Tightening the bolt of the expansion joint;
- Cleaning, inspecting and replacing oil in the oil unit;
- For the cooling seal fan (if any), cleaning the inlet grid, the impeller and the grid at the load discharge and adjusting the system;
- Adjusting the actuator;
- Inspecting the alignment between the couplings of the fan and the motor;
- Inspecting the impeller clearance.

blade:

- Removing the dirt, jamming and blade shank bolt rust;
- Inspecting for abrasion (around the inlet and outlet);
- Inspecting for damage or crack.

Impeller bearing:

- Removing two blade bearings from each impeller for inspection, to determine whether other bearings are to be removed;
- Abrasion of the bearing, slide block and adjusting disc;
- State of gaskets;
- State of the lube oil or grease;
- Cleaning the elements;



- Inspecting the trunnion and crank for crack;
- Elements with fitting surfaces (inspecting the size, circular motion and plane motion);
- Replacing the seals and accessories.

Servomotor:

- Removing the oil dirt from the oil cylinder;
- Cleaning the elements;
- Inspecting for abrasion (control edges, oil cylinder seals, bearings);
- Inspecting elements with fitting surfaces (inspecting the size, circular motion and plane motion);
- Inspecting the oil line;
- Replacing the seals and accessories.

Main bearing:

- Cleaning the elements;
- Inspecting the bearing for its state, fatigue and abrasion;
- Inspecting elements with fitting surfaces (inspecting the size, circular motion and plane motion);
- Replacing the seals and accessories.

Adjusting device:

- Cleaning the elements;
- Inspecting the control rod, and limited block for their state and the bearings for their abrasion.

Note: For inspection and repair in the overhaul period, it is recommended to entrust the original manufacturer with the inspection and repair of the fan's rotary assembly parts, which are connected, including the bearing housing, impeller assembly (with the blade removed) and servomotor.

5.4 Unplanned shutdown maintenance

Appropriate fan inspection and repair can be carried out during the unplanned shutdown. The followings are recommended:

- Cleaning the air duct, and inspecting the air duct, servomotor, core and oil unit for oil leakage;
- Inspecting for abrasion (blade, guide vane and internal support rib);
- For the cooling seal fan (if any), cleaning the inlet grid, the impeller and the grid at the load discharge and adjusting the system;



——Ensuring that the running of the actuator can consistently adjust all blades.

6 Lubrication

- 6.1 General: oil shall comply with the specification in terms of its quality, and the viscosity code that has quality guarantee and has been proven reliable in years of experience shall be selected.

▲Note: during contact with the oil, gloves and goggles shall be worn to prevent allergy; in addition, used oil shall never be allowed to permeate into land, running water and drainage pipes and shall be treated as per technical requirements to avoid pollution.

- 6.2 Oil for the main bearing and servomotor

- 6.2.1 Required characteristics (refer to Table 1)

Note: lubricating oil additives have bad effects on the oil quality and will damage fan components, and antifoaming or high pressure additives shall never be used.

- 6.2.2 Cautions: refer to section 5 “Maintenance”.

- 6.2.3 Oil system shall have no foreign matters; otherwise the bearing will be damaged. Instructions of the oil station shall be followed.

All oil tubes and tanks shall be clean and free of dust, ash, residual fiber of clothing cloth and solid impurity precipitates; for cleaning, only non-fiber cloth shall be used because nap will disturb the sensor of the oil system; newly connected tubes must be cleaned with acid to prevent dust and residual scales form damage the bearing and control devices, and shall be cleaned with oil whose amount is the half of the required amount before the first oiling. The oil tube shall be blocked with a baffle before the bearing housing, and oil shall be led to a return oil tube through bypass hose tube. Connect the supply oil tube to the return oil tube at the control head of the servomotor, then clean rinsing until no fine dust or foreign matters are observed at the oil filter. Such oil can be reused after being filtered.

- 6.2.4 Oiling: oiling into the oil tank may be done via a high standard filter or a oil-liquid separation device.

- 6.2.5 Oil replacement: oil must be replaced when it is proved that the oil cannot serve any more after a test. Once per year, the replacement quantities of Lubrication is 1.2x Oil tank capacity.

- 6.2.6 Document records: oiling, oil adding and replacement must be recorded, including date, viscosity code, manufacturer and quality. In addition, the viscosity code of oil shall be specially marked on the oil tank.

- 6.3 Oil for the blade bearing: the rolling bearing of the blade shall be lubricated with fully artificially synthesized lubricating oil (or grease).

- 6.3.1 Required characteristics (refer to Table 2)

Note: never mix mineral oil with synthetic oil, and mixing of oil of different categories and classes may resulting in great deterioration of the function the blade bearing and have bad effects on the performance.

- 6.3.2 Oil replacement: oil shall be replaced during scheduled shutdown or as required.



Table 1: Characteristic parameters of lubricating and control oil

Model of lubricating oil	L-TD46 (Germany), L-TSA46 (GB)
ISO viscosity grade	ISO VG 46
Viscosity @ +40°C	41.4-50.6mm ² /s
Viscosity index	at least 90
Open-air pour point temperature	at least 3°C lower than the min. outdoor temperature
Flash point	at least 180°C
Water content	<0.1g per 100g oil
Solid content	<0.05g per 100g oil
Water separation property	max. 200s
Gas separation property @ 50°C	max. 6min
Corrosion protection for steel	degree of corrosion 0-A (no corrosion)
Impact on copper corrosion	corrosion grade 2-100A3
Note: never use lubricating oil that has no foam (molybdenum disulfide) or includes high pressure additives.	

Table 2: Required characteristics of lubricating oil for blade bearing

Model of lubricating oil	polyethyleneglycol
ISO viscosity grade	ISO VG 460
Viscosity @ +40 °C	460 mm ² /s
Viscosity @ +100 °C	77 mm ² /s
Viscosity index	250.00
Density	1.048g/ml
Pour point	-46°C
Flash point	275°C

(LGMT3 lubricating oil may replace the oil for the blade bearing)

6.4 Suppliers of equivalent lubricants: Shell, Mobil, PetroChina



7 65L Hydraulic Lubrication system

7.1. Scope of manual

This manual is for Thai Binh 2 Thermal Power Plant 2x600MW project 65L Hydraulic Lubrication system unit using guide [it is referred to HPU for short in the manual]. And its content mainly refers to the following topics: Usage of HPU; Eliminating common failure; Regular maintenance; and main components parameters.

7.2. System Structure illustration

7.2.1 System components

The system consists of power unit, hose and referred hydraulic accessories.

7.2.2 Working parameter

7.2.2.1 pump

control oil Pump+ lubricate oil Pump:

PGP517B0280CD1H3NE7E6S- PGP517A0250XE7E6B1B1

Flow rate: 28ml/rev+25ml/rev

Qty: 2pcs

control oil pump working pressure Max. 1.5Mpa

lubricate oil pump working pressure Max. 0.18Mpa

7.2.2.2 The circulating cooling pump

Pump:

PGP517A0520CT1D7NE7E6B1B1

Flow rate: 52ml/rev

Qty: 1pcs

2.2.3 motor

E-motor: 1LE0001-1CB03-4GA4

Output power: 5.5KW

Rotating speed: 1460rpm

Qty: 2pcs

7.2.2.4 The circulating cooling motor

E-motor: 1LE0001-1AB52-2GA4 Output power: 3KW

Rotating speed: 1435rpm

Qty: 1pcs

7.2.2.5 Cooler

Part number: GLC3-5

Cooling area: 1.7M²

Quantity: 2 pcs (1 pcs for standby)

7.2.2.6 Power supply

Electric motor: Three-phase 400V AC, 50HZ

Electric heater: Three-phase 400V AC, 50HZ

Control power supply&Sensor power supply: 24V DC

7.2.2.7 Reservoir volume

Effective volume: 630L

Maximal volume: 1000L



7.2.3 The station consists of HPU and cylinders.

The HPU dimension: 1200[L] x 1100[W] x 2208[H] mm .The HPU is anchor bolt installation, refer to the outline drawing[PHSH-HC-14042-A0-0-SH].

7.3. System Working Principle

Please refer to hydraulic circuit diagram for more information.

7.3.1 Working Principle Of Pumps

The main system pump includes Vane pump (Item No.9), electric motor(Item No.12) and export control manifold etc., which provides the pressure and the flow rate for the whole system. Two sets of electric motor and pump are complementary. When one pump has malfunction, use the other pump. The pressure relief valve (Item No.21) control the max. pressure of lubricant system. The pressure relief valve (Item No.20) control the max. pressure of control system.

7.3.2 Direction For Control Valve Of System

The control oil from the pumps is filtered by the binocular medium pressure filtration (Item No. 33.1、 33.2), then it is input to Air-Cooled system. The lubricant from the pumps is filtered by the binocular medium pressure filtration (Item No. 33.3、 33.4), then whose flow rate is adjusted by four throttle and input to Air-Cooled system. The flow meter(Item No. 31) display the concrete value. The pressure sensor(Item No. 29.1、 29.2、 29.3) monitor the pressure of control oil circuit. When the pressure is less than 28 bar, alarm and use the standby pump. The pressure sensor(Item No. 29.4) monitor the pressure of lubricant circuit. When the pressure is less than 1.8 bar, alarm and use the standby pump. The temperature sensor(Item No. 30) monitor the temp of lubricant circuit. When the temp. is greater than 131° F (55°C), alarm and system closedown.

7.3.3 Direction For Use Condition

7.3.3.1 Oil level control

The oil level should be maintained at 85% of the oil tank height.

There is liquid level controller on the oil tank. When the oil level is low, the controller send the alarm signal for reminding the operator to add oil.

7.3.3.2 Oil temperature

The oil temp is controlled between 50° F (10°C) to 149° F (65°C)

If the oil temp is low, the temperature controller send alarm signal and the startup is forbidden.

If the oil temp is less than 50° F (10°C), the temperature controller close and the heater start work.

If the oil temp is greater than 77° F (25°C), the temperature controller close and the heater stop working. If the oil temp is greater than 140° F (60°C), the temperature controller close and send high temp alarm. Forbid operating system. If the oil temp is less than 131° F (55°C), the temperature controller disconnect, the alarm is lifted and continue to work.

7.3.3.3 Pressure siren of return oil filtration

When the medium pressure filtration (Item No.23) is blocked, the corresponding siren is disconnection and send alarm signal. Operator should switch filtration and replace the blocked filter element.

7.4. Troubleshooting

7.4.1 Electric Motor Cannot Start

- Check electric supply (including power supply and control circuit) and connection.
- Check oil temperature



- c. Check oil level is in working order.
- d. Check control components of electric motor.

7.4.2 Pump unit operates, but cylinder cannot move

- a. Check the rotation direction of the electric motor (counterclockwise rotation toward the end cover).
- b. Check electrical wire to the solenoid and power supply.
- c. Check the system pressure and control pressure is in working order. If abnormality, should adjust.

7.4.3 Pump unit operates, but no pressure

- a. Check whether the ball valve of the output port is started.
- b. Check whether the setting value of the system pressure relief valve is right and reliable.
- c. Check the relieve valve and directional control valve.
- d. Check the gear pump

7.4.4 Noise or shake from return filter

- a. The filter element is block, please replace it.

7.4.5 Leakage

- a. Check the seal element, and replace it. If have any trouble you can not handle, please contact Parker.

7.5. Maintenance Manual

7.5.1 Daily Check

- a. The appearance of the power unit is normal. There are no wound and move.
- b. Whether the oil level of the tank is normal.
- c. Check whether the ball valve of the output port is started.
- d. Check electrical wire to the solenoid and power supply.
- e. Check whether the pressure is stabilization.
- f. Check the oil temperature. If the temperature is greater than 149° F (65°C), must shut down the system for general inspection.
- g. No leakage in the connectors
- h. Pay attention to the alarm signal of filtration and replace the filter element.

7.5.2 Monthly Check

- a. Tighten the screws and connectors regularly.
- b. Check the leakage of the connector and replace the wearing seals.
- c. Check the quality of the oil, and pay attention to the contamination and emulsification.
- d. Clear the power unit and piping and keep the clean environment.

7.5.3 Yearly Check

- a. Test oil sample and archive according to the laboratory sheet semiyearly.
- b. Replace the system oil if invalidation after clearing the system piping and tank. Recommendation is that replacing the oil every 18 months.
- c. Check the performance of those elements about pump, valve, motor and cylinder etc. Replace the wearing element.
- d. Replace all system seals every two year.

Please Note The Following



- a. The system including oil, oil port, connector, filter etc. should be maintained absolute cleanliness. Should often clear the tank and piping and prevent system rusting.
- b. The grade of new oil must be in accord with the original when replacing the system oil.
- c. When replacing the system oil, the new oil must be filtered. If needing replace the oil grade, please evacuate the original system oil in the tank, piping and cylinder.
- d. Prevent the contamination (fibre, sludge) entering into the system when clearing the tank.

8 Spares

8.1 Storage: customers may consider to order and store a certain quantity of spares to ensure resume operation in case of abrasion or failure of special elements. In order to ensure utilization ratio of fans, it is recommended to store the following spares: one set of blade with fixing bolt; one set of main bearing and one angular ring; one set of sealing ring for main bearing (one carbon ring and one laminated ring); and one set of seal for the oil tank.

8.2 Order: for the convenience of cooperation, please provide the following information when ordering spares:

- Model of the fan is shown on the rating plate on the casing or in the order contract; description, specification, number and quantity of the spares are shown on Component Sheet.

Note: do not use spares which are not supplied by CPMW, otherwise the customer shall be liable for any running failures and safety hazards of the fan thusly caused.

8.3 Storage requirements: spares shall be stored in:

- Their original packages; in a dry place;
- Places without chemical corrosion;
- Bearings with pore diameter bigger than 200mm shall be laid horizontally with their circumference supported.
- Carbon ring seals and laminated seals shall be laid horizontally, without deformation or press;
- Elastic rubber ring seals shall be kept away from heat sources and sunlight, without deformation and press.

9 Protection

9.1 General: protection against wind, rain, dust and corrosion must be provided in case of installation suspension, not being put into operation immediately after delivery or long time shutdown, etc.

9.2 Protection during installation intermission

- For smooth and clean metal surface (seals, sliding parts, assembly parts and welding parts), protective agents must be applied and dried, and solvents in protective agents must fully evaporate before and during installation.
- The surface of the smooth and clean metal shaft and connections outside the casing shall be dried

with a clean piece of cloth without fiber, and applied with coatings of protective agents, with their total thickness being at least 150um.

- Instruments and testing equipment must be wrapped with PE membrane (more than 200um thick) or bubble membrane which shall be sealed with sticky tapes to prevent mechanical damage.

9.3 Protection during shutdown

Proceed with measures both above and below in case of 1-6 month shutdown, and contact CPMW in case of shutdown more than 6 months.

Note: corrosion (e.g. due to gas in cooling tubes) will result in failure of important components.

In the event of shutdown:

- It shall be confirmed that no corrosive gas is left in the fan;
- Continue to run and cool the seal fan until all corrosive gas is drained out of the fan (**note: if no isolation valve is provided at the inlet and outlet or the isolation valve cannot completely block the fume, the seal fan shall not be shut down and shall continue running**);
- Check the gap between the blade and the wheel for fouling; if there is serious sulfur pollution, the blade shall be removed for the purpose of cleaning and maintenance.

Note: the impurity of sulfur in the hub will result in corrosion and jamming/failure of the blade, and further result in fan failure;

- Loosen the fouling and then remove it with a suction pipe;
- The surface of the smooth and clean metal shaft and connections outside the casing shall be cleaned with a piece of cloth without fiber, and applied with coatings of protective agents, with their total thickness being at least 150um.
- The protective layer shall be checked every month. Position of damage or corrosion, if any, must be applied with protective agents again after proper cleaning;
- Paints shall be checked every three months. Position of damage or corrosion, if any, must be applied with paints again after proper cleaning;
- For the main bearing, servomotor and oil station, the oil unit shall operate for 30min and the blade shall be opened and closed repeatedly every month (**note: if shutdown period of a fan used for corrosive media is more than two days, the oil station shall be started, at least every day, to operate the blade to move from the closed status to fully open and then back to the closed status twice to prevent fume remaining in the fan from corroding the blade shank**);
- Cleaning shall be performed with oil on a regular basis to prevent oxidation, rust and contact corrosion, and the oil shall be operated on a regular basis, too;
- Check water content of oil every three months, and clean the filter if necessary.

Instruments and testing equipment not in operation must be protected as follow to avoid damage:



- They must be wrapped with plastic membrane (more than 200um thick) or bubble membrane which shall be sealed with sticky tapes;
- It is permitted to disassemble them and their holes must be blocked with plug screws and blind flanges to isolate oil and gas;
- The oil station and other equipment, if installed in the open air, shall be covered with waterproof canvas.
- Before trial running, waterproof canvas, sticky tapes and membrane shall be removed and elements previously removed shall be assembled.
- The main bearing, servomotor, oil unit and so on shall be subject to appearance inspection;
- Check seals of smooth metal elements, slide blocks and coordination surface for rust;
- Rust, if any, shall be carefully removed, then parts shall be dried and lubricated.

Note: check the blade of the impeller for flexibility before each startup.

10. Fault Analysis

Table 1: Vibration

Fault	Causes	Solutions
Exceeded vibration and unbalanced operation of bearings	Dirt on and peeling of impellers Worn and unbalanced impellers Exceeded bearing clearance Worn bearings Premature bearing failure Un-calibrated couplings Foundation subsidence and loose parts	Clean impellers and ascertain causes Balance impellers and measure the wear Readjust the bearing clearance to normal Substitute new bearings See Table 8 Re-calibrate couplings Restore foundation, tighten loose parts and re-calibrate couplings

The rigid connection between the vibration detector and the main bearing shall be as short as possible.



Vibration detection can be done either horizontally or axially. A spectrum analysis on vibration is recommended (if applicable), or vibration velocity (mm/s) and amplitude (um) as a minimum shall be detected.

Table 2: Bearing temperature

Fault	Causes	Solutions
Bearing over-temperature	Faulty temperature sensor at oil unit	Inspect, repair or replace
	Bearing damages caused by over-working or wear	Replace the bearing with a new one
	Unsuitable bearings and clearance	Replace the bearing according to the model and marks in the inventory and adjust the clearance properly
	Little or sticky lube oil	Make-up or substitute special lube oil
	Contaminated seal cooling fan (if any)	Clean impellers and inlet gratings of the fan
	Failed seal cooling fan (if any)	Repair the seal cooling fan

Table 3: Lube oil temperature

Fault	Causes	Solutions
Lube oil over-temperature	Active heater or high setpoints	Check the thermosistor and turn off the heater
	No or little cooling water	Turn on or increase the flow of cooling water
	Over-hot cooling water	
	Contaminated or substandard cooler	Increase the flow of cooling water
	Impact from external heat sources	Clean or replace the cooler
	Inactive heater	Protect lube oil supply from heat sources
Insufficient lube oil temperature		Check the thermosistor and the heater

Table 4: Lube oil pressure

	Causes	
--	--------	--



Fault		Solutions
Low lube oil pressure	Contaminated and clogged filter	Clean the filter or switch to a stand-by filter
	Oil tube leaks	Change a oil seal, tighten loose parts, and rectify the leaks
	Mal-adjusted or clogged valve	Calibrate or clean the valve
High oil pressure.	Faulty pressure valve with high oil temperature and low oil level	Clean or re-calibrate the valve, fill more oil
Fluctuation in oil pressure: < 6	Faulty oil pump	Replace the pump oil
	Mal-adjusted overflow valve	Adjust the valve
	Failed pressure accumulator	Inspect, refill nitrogen gas or replace according to specifications

Table 5: Lube oil conditions

Fault	Causes	Solutions
Dirty oil	Use of unsuitable oil	Replace the oil
	Faulty oil filter or filter screen with too-big meshes	Replace the filter screen replace tubes or seals
Oil color darkened	Unqualified tubes or bad sealing	Replace the oil as specified
High oil PH	Use of unsuitable or unqualified oil	Clean the air grating, check the pressure of sealing air, and replace the shaft seal
Water in oil	Air permeation in passageway	Provide protections
	Permeation of rainwater or clean water	Repair the cooler
	Cooler leaks	Drain the water regularly to eliminate faults thusly caused
	Un-drained water in oil tank	

Table 6: Lube oil level

Fault	Causes	Solutions
Decreasing oil level	Main bearing leaks	See Table 7



	Tube leaks at tube connections	Check and tighten both internal and external connections of tubes, replace seals
	Faulty hoses	Replace hoses
	Worn seals	Check and adjust seal cooling air (if any), replace seals

Table 7: Bearing leaks

Fault	Causes	Solutions
Oil leaks on main bearing	Broken shaft seals	Replace seals
	Excessive oil flow	Decrease oil flow
	High oil level	Lower the oil level
Oil leaks on blade bearings	Plugged balance tubes of air seal	Clean air tubes and gratings
	Damaged washers of blade bearings	Replace washers
	Non-original washers or the oil is no longer functional	Replace washers with original ones
	Exceeded and unbearable air temperature in the passageway	Control the air temperature in the passageway
		Repair blade bearings
		Check for fan damages (such as expansion joints)

Table 8: Bearing conditions

Fault	Causes	Solutions
Premature bearing failures	Insufficient lube oil	Fill more lube oil
	Dirty oil	See Table 5
	Contaminated bearing seats	Clean the bearing seats
	Damaged bearings	Replace the bearing and find out the cause



Table 9: Wear

Fault	Causes	Solutions
Wear of blades	High dustiness	Control dustiness, check the blade for excessive wear
Wear of guide vane/hollow struts	Over-intensive air impact	Install baffle plates

Table 10:Dynamic control

Fault	Causes	Solutions
Power consumption uncontrollable	The actuator does not act or act too fast	Adjust the actuator driver, action time and the connecting rod
Rated power unreachable	Low control oil pressure	Adjust and control oil pressure
	Worn piston seals of servomotor	Replace seals
	Stuck blade bearings	See Table 11
	Worn blades	Replace the blades
Broken high-pressure hose in servomotor	Impact from coating on blades	Clean blades
	Stuck control head	Check the coaxiality of control head, control valve element and piston.

Table 11:Stuck blade bearings

Fault	Causes	Solutions
Stuck blade bearings	Un-lubricated blade bearings	Lubricate
	Dirt on impellers (hubs)	Clean the impellers (hubs) and find out the cause
		Clean the impellers
		Close the damper of the fan, and run the sealing air fan (if any) without prohibited air leftovers



11. Installation Parameters

Rotation angle of blades

	"Close" position	"Open" position
Readings on control panel	0%	100%
Indication of field dial	-36°	+20°

Impeller clearance (including that between top of blades and the casing, and root of blades and hubs) is shown on General Assembly Drawing.

Tightening moment

blades/trunnions	See drawings
Main bearing seat/fan casing	See drawings
Rules for tightening bolts: ——Apply MoS ₂ (molybdenum disulfide) lubricant on the threads and underneath the nut; ——Use a clamping torque wrench to tighten bolts to the required moment	

Tightening moments are shown on Component Drawings

12. Settings for an AP fan

	Alarm	Trip	Remarks
Bearing temperature	90 °C	110°C	
Stall differential pressure	50mbar		
Casing vibration	4.6mm/s-0.16mm	10.0mm/s-0.27mm	Rotation speed 740pm and below
	4.6mm/s-0.12mm.	10.0mm/s-0.23mm	Rotation speed 980pm
	4.6mm/s-0.08mm	10.0mm/s-0.17mm	Rotation speed 1480pm

13. Figures

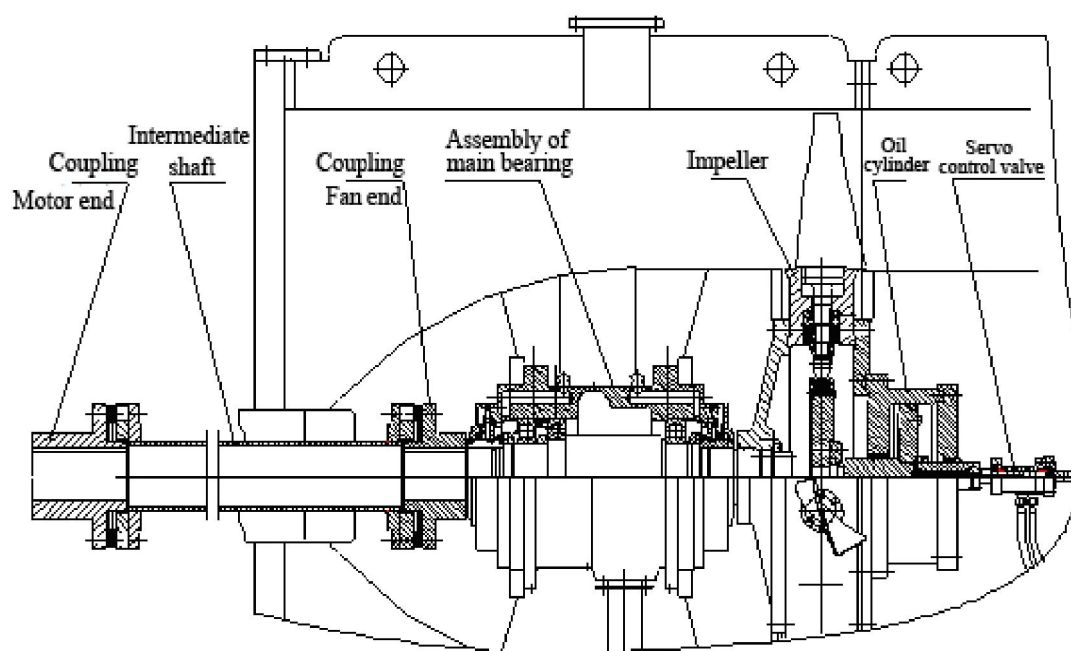


Fig. 1: Rotors of the fan; one-stage fan and

Typical spare parts for impellers include: blades (with fixings), combined sealing rings (used when the fan is transmitting corrosive substances), and axial ball bearings.

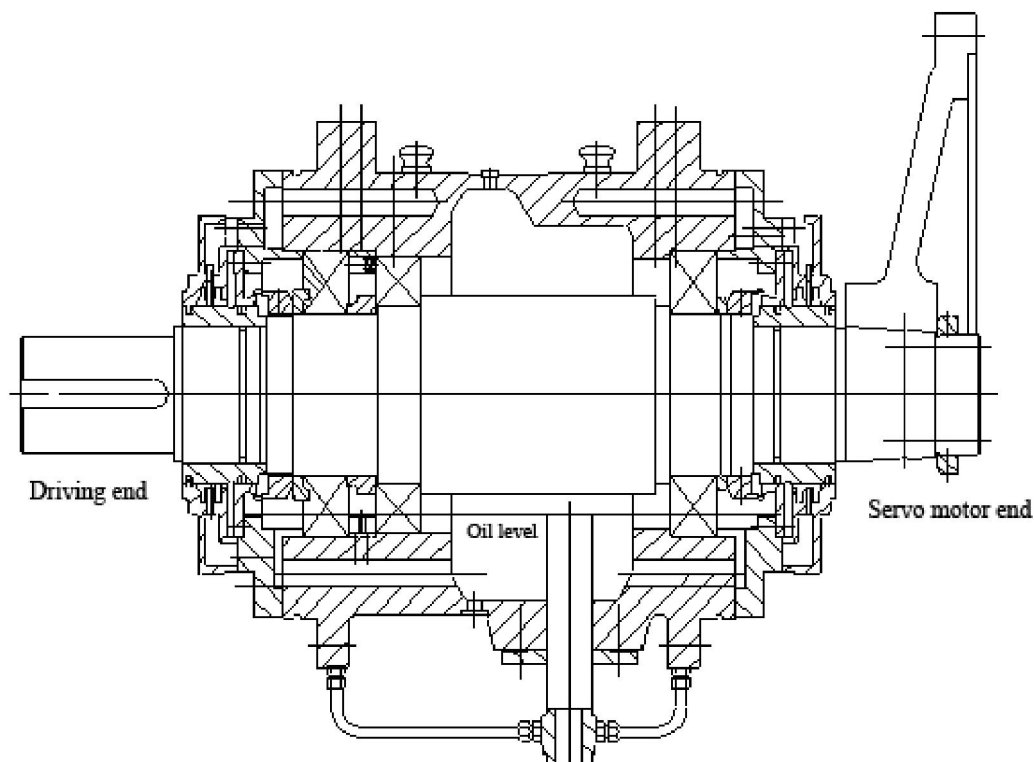


Fig. 2: Main bearing assembly

The typical spare parts include: a complete package of bearings, laminated sealing rings and other sealing rings.

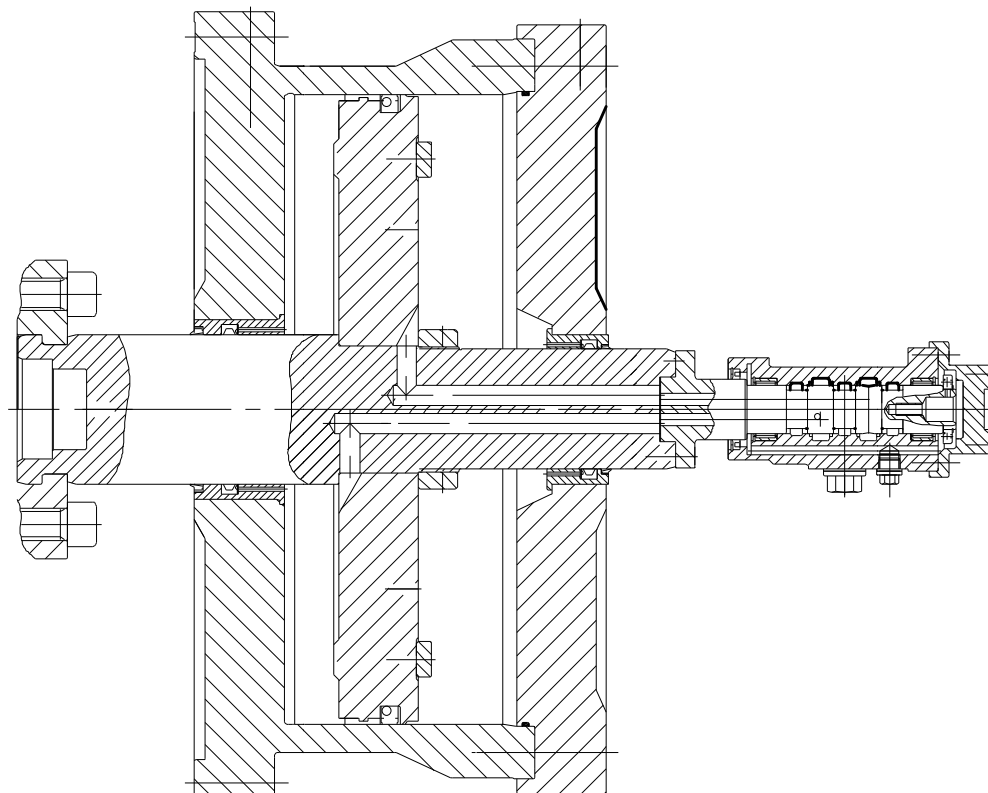


Fig. 3: Servomotor

The typical spare parts include: a complete package of bearings, scraper rings I and II, twin sealing rings I and II, and seal sleeves.

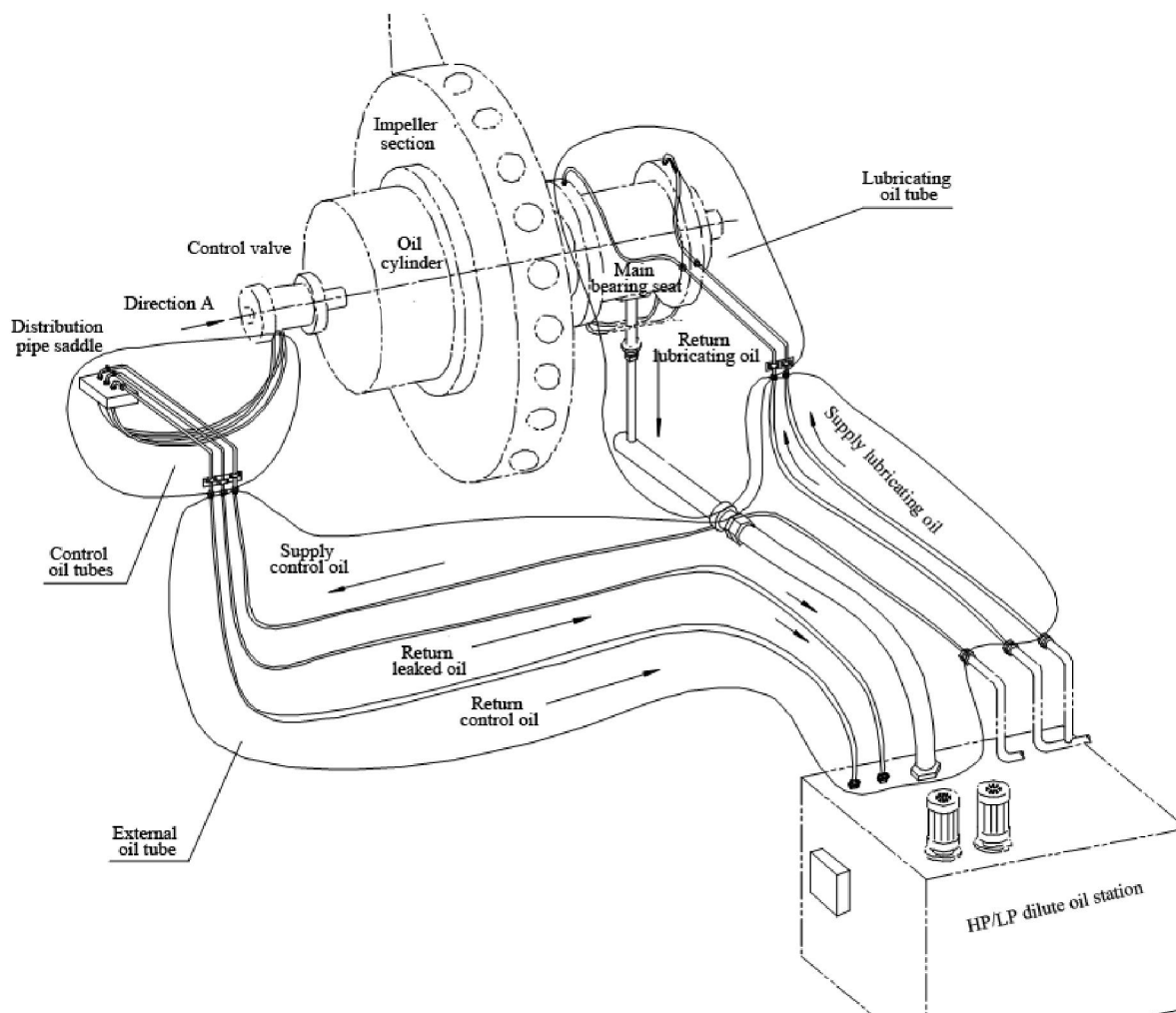


Fig. 4: Oil tubing system

The typical spare parts include: a complete package of oil tubes.

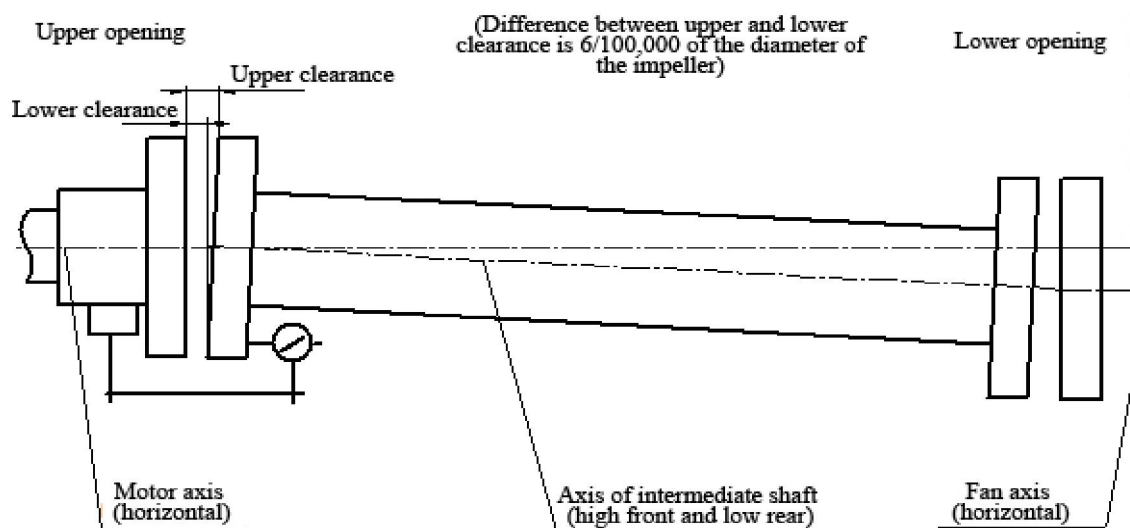


Fig. 5: Cold installation of couplings of high temperature fan

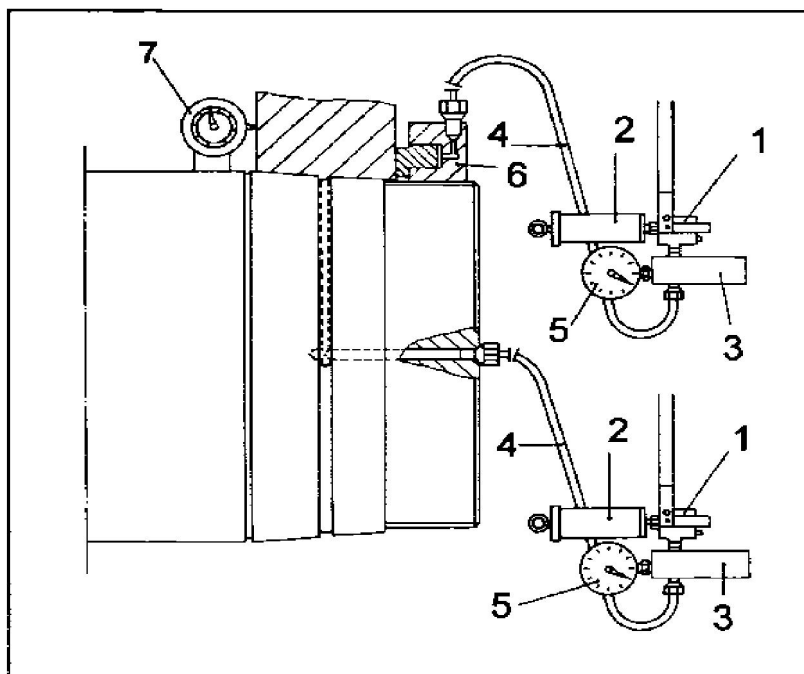


Fig. 6: Hydraulic locking device

1. High-pressure pump, 2. Oil tank, 3. Pump seat, 4. High-pressure hose, 5. Pressure meter, 6. Hydraulic nuts (with annular pistons), 7. Dial indicator

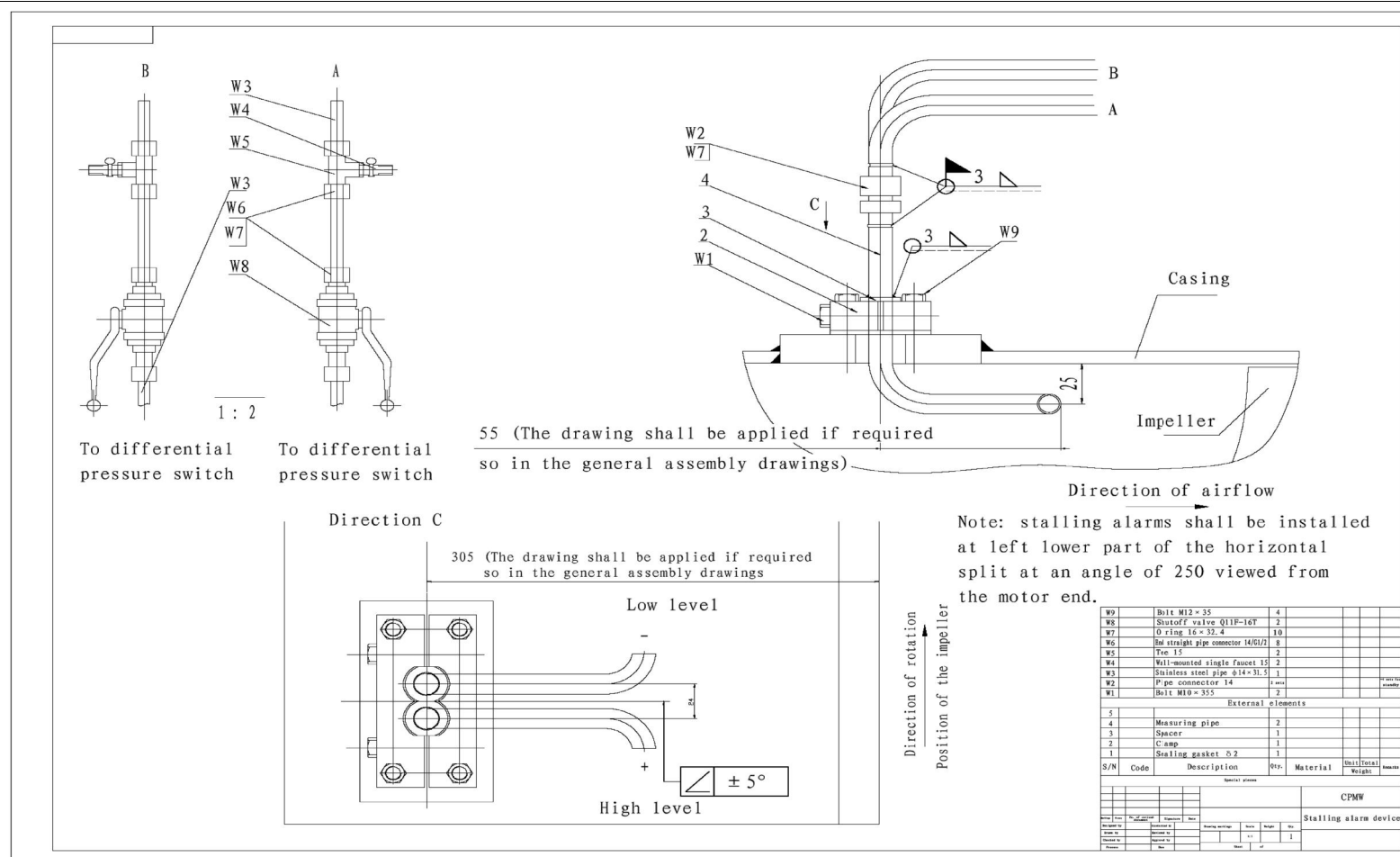


Fig. 7: Stall alarm device



Logic diagram of AP FD fan

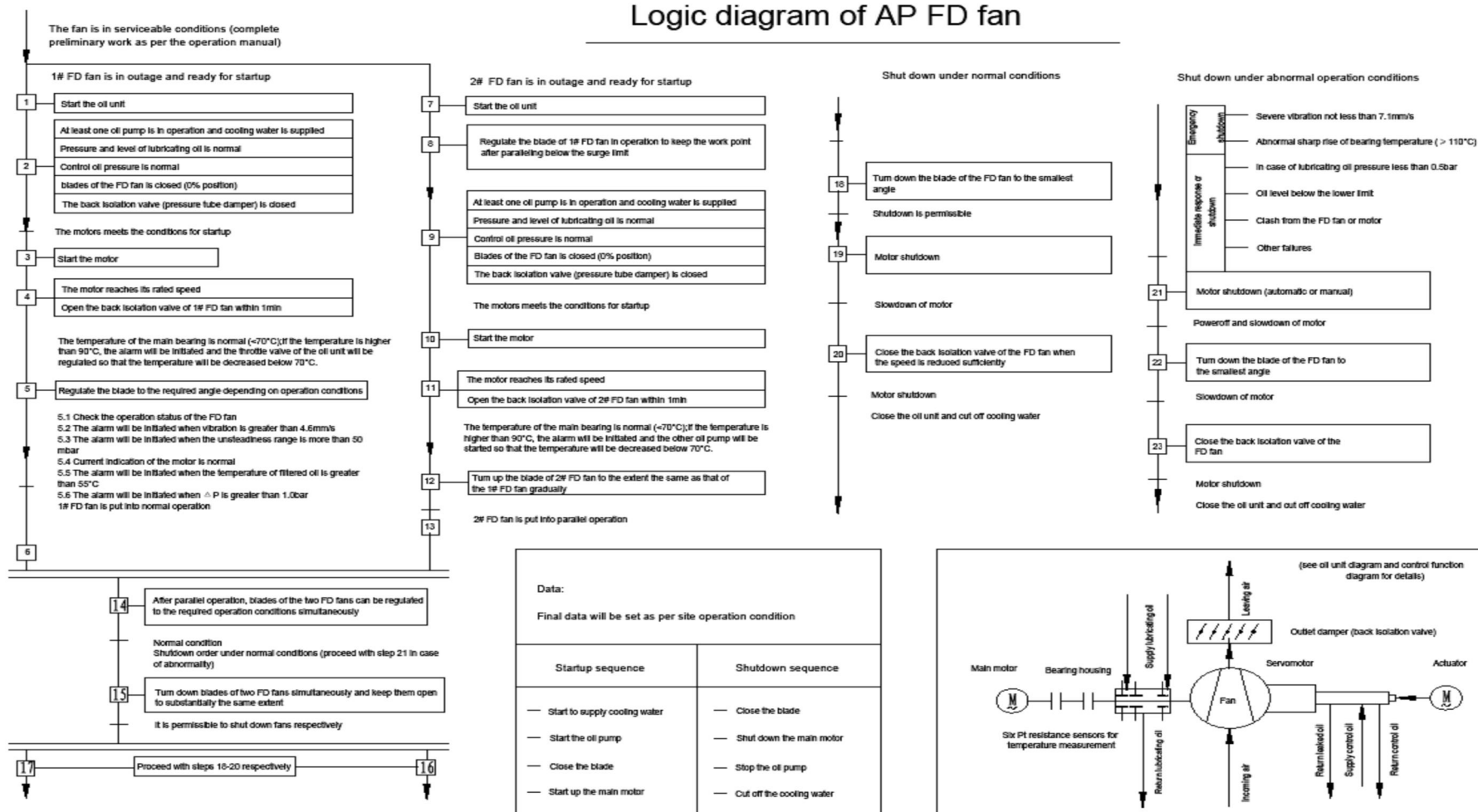


Fig. 8: Block diagram of fan control



THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

成都电力机械厂技术资料
918A
姓 名 2 页 数 2
Fan Model
GUI5038-02

用户 User	Thai Binh 2 Thermal Power Plant, Vietnam	机组容量 Capacity	2 x 600MW		风机型号 Fan Model	GUI5038-02		
风机类型 Fan Type	一次 P.A	送 F.D	引 I.D	增压 B.F	数量 No.	4	轴流 Axial	离心 Cen.
介质 含尘量 = Medium Dust Content = g/m ³	空气 Air	烟气 Gas	天然气 National Gas	煤 Coal	煤气 Gas			

单台风机参数 Parameters for per fan	condition unit	TB Design	B-MCR Design Check		RO Design Check	
风机入口流量 Inlet mass flow	kg/s					
风机入口流量 Inlet flow at N.T.P	Nm ³ /s					
风机入口流量 Inlet vol. flow	m ³ /s	250.4	219.9	218.6	206.8	205.6
当地大气压 Local Barometric	Pa	101080				
当地海拔 Local Elevation	m					
风机入口温度	℃	48.3	23.3	23.3	23.3	23.3
风机出口温度	℃	53.9	27.9	27.9	27.6	27.6
风机出口温度	℃					
风机入口标准密度	kg/Nm ³	1.288	1.288	1.288	1.288	1.288
风机入口标准密度	kg/m ³	1.089	1.181	1.181	1.181	1.181
风机入口密度 Fan inlet density	Pa	-278	-250	-250	-250	-250
风机入口全压	Pa					
风机入口全压	Pa					
风机出口全压	Pa					
风机全压升	Pa	5300	4760	4730	4440	4420
风机总压升	Pa					
压缩机修正系数 Modified Factor	K	0.9818	0.9836	0.9837	0.9847	0.9847
风机全压效率 Fan total efficiency	%	86.2	86.5	86.5	86.8	86.8
风机轴功率 Fan shaft power	kW	1527	1202	1188	1052	1041
电机所需功率 Motor power	kW	1700				
风机转速 Fan rotary speed	r/min	990				
电机额定电压/频率	kV/Hz	10 / 50				
电机电压/频率	kV/Hz	1000				
风机转动惯量 Fan rotary inertia	kg-m ²	21000				
单台风机重量 Weight for per fan	kg					
备注 Remarks						
编制 Compile	日期 Date	2012.11.13	审核 Verify	日期 Date	2013.2.27	

Fig. 9: Fan Selection Data List



THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

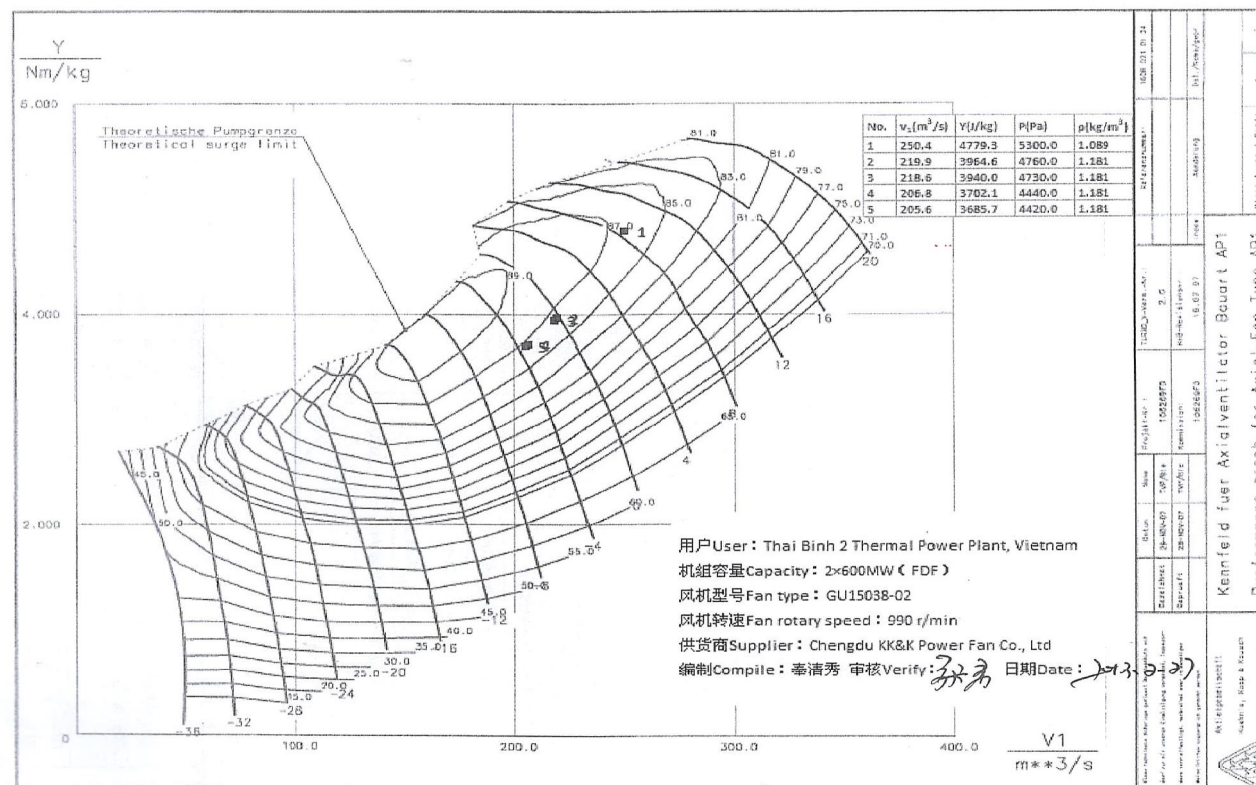


Fig. 10: Performance curve



THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

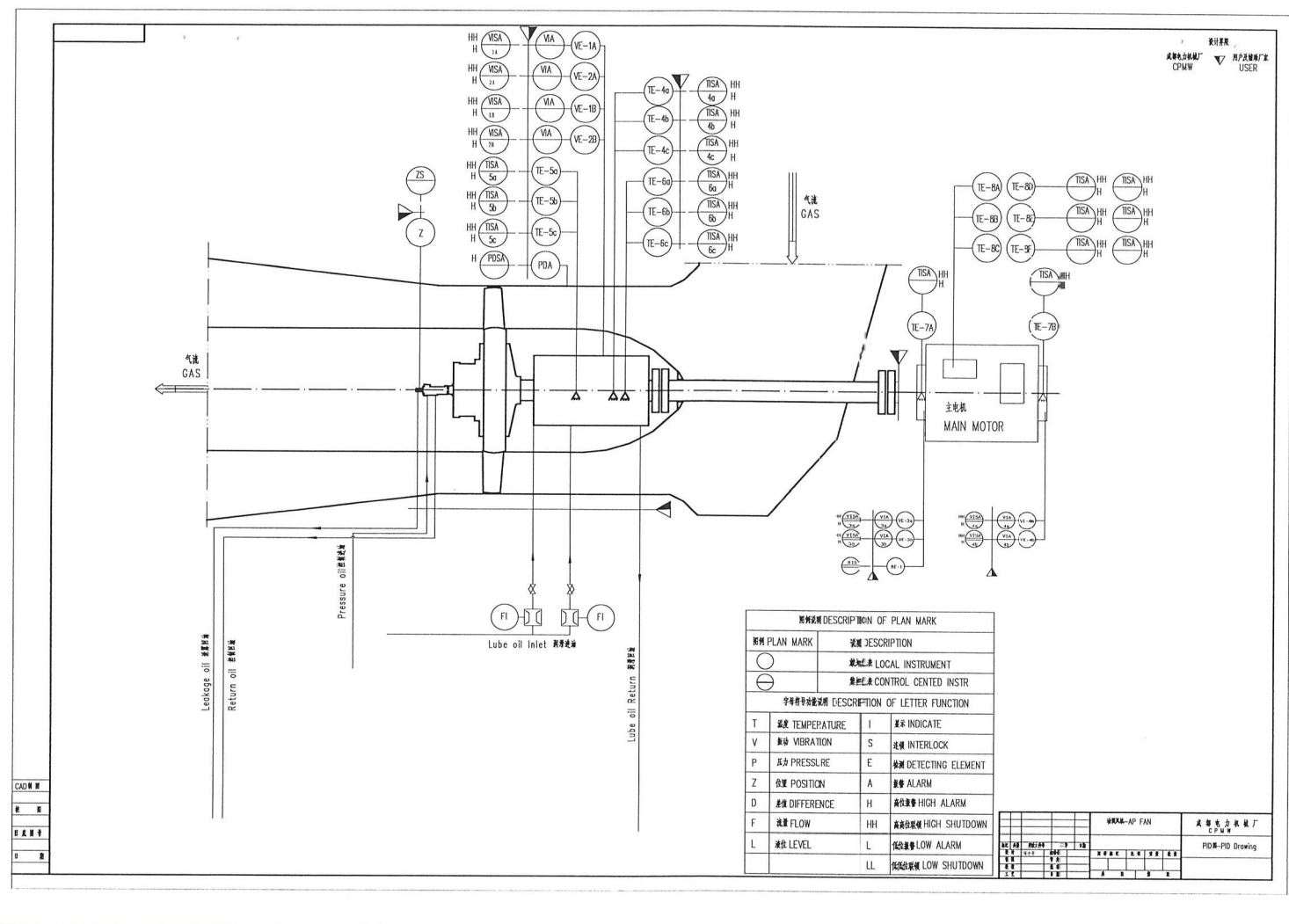


Fig. 11: FD Fan PID Drawing





THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

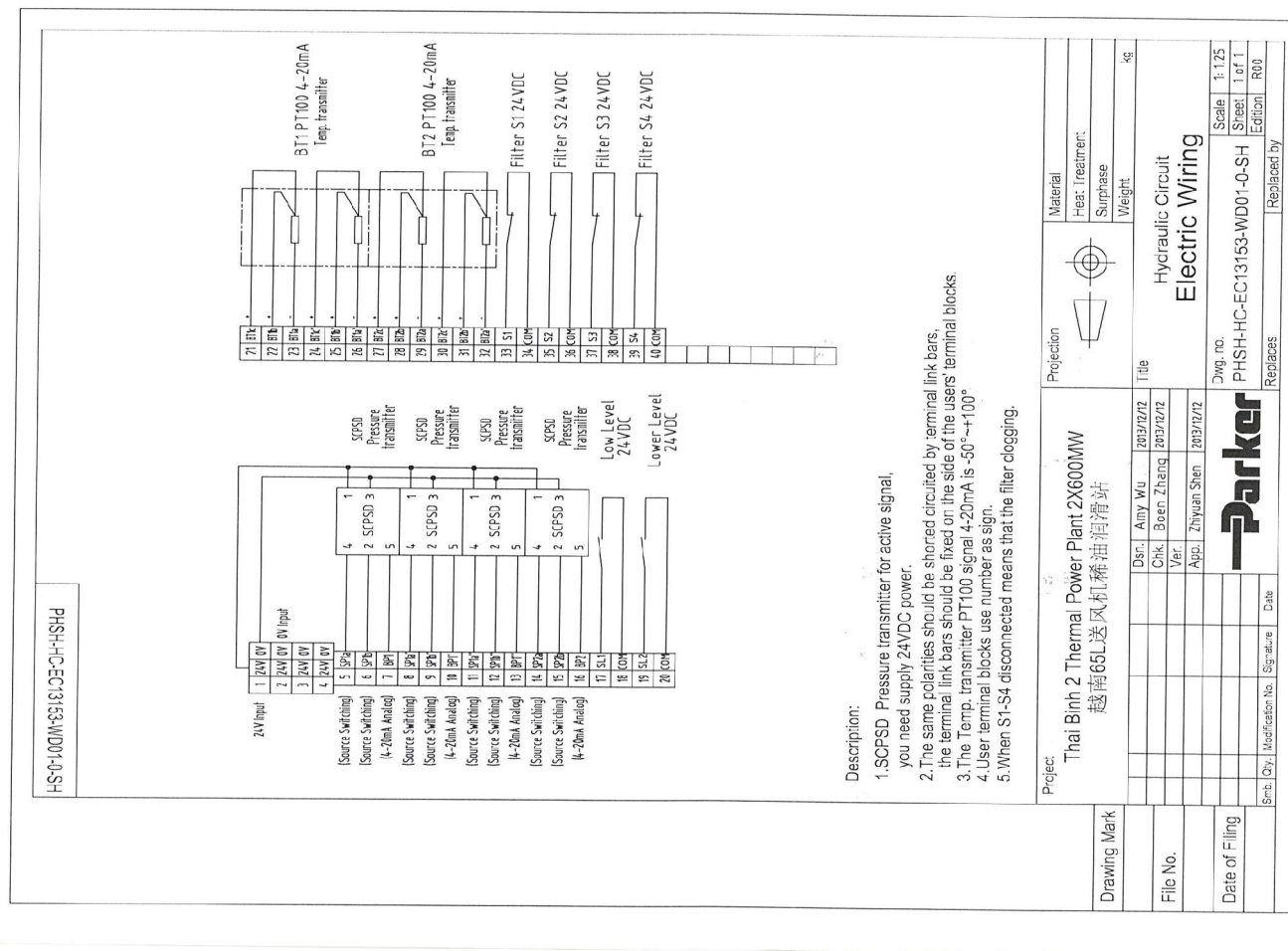


Fig. 13: Hydraulic Circuit Electric Wiring

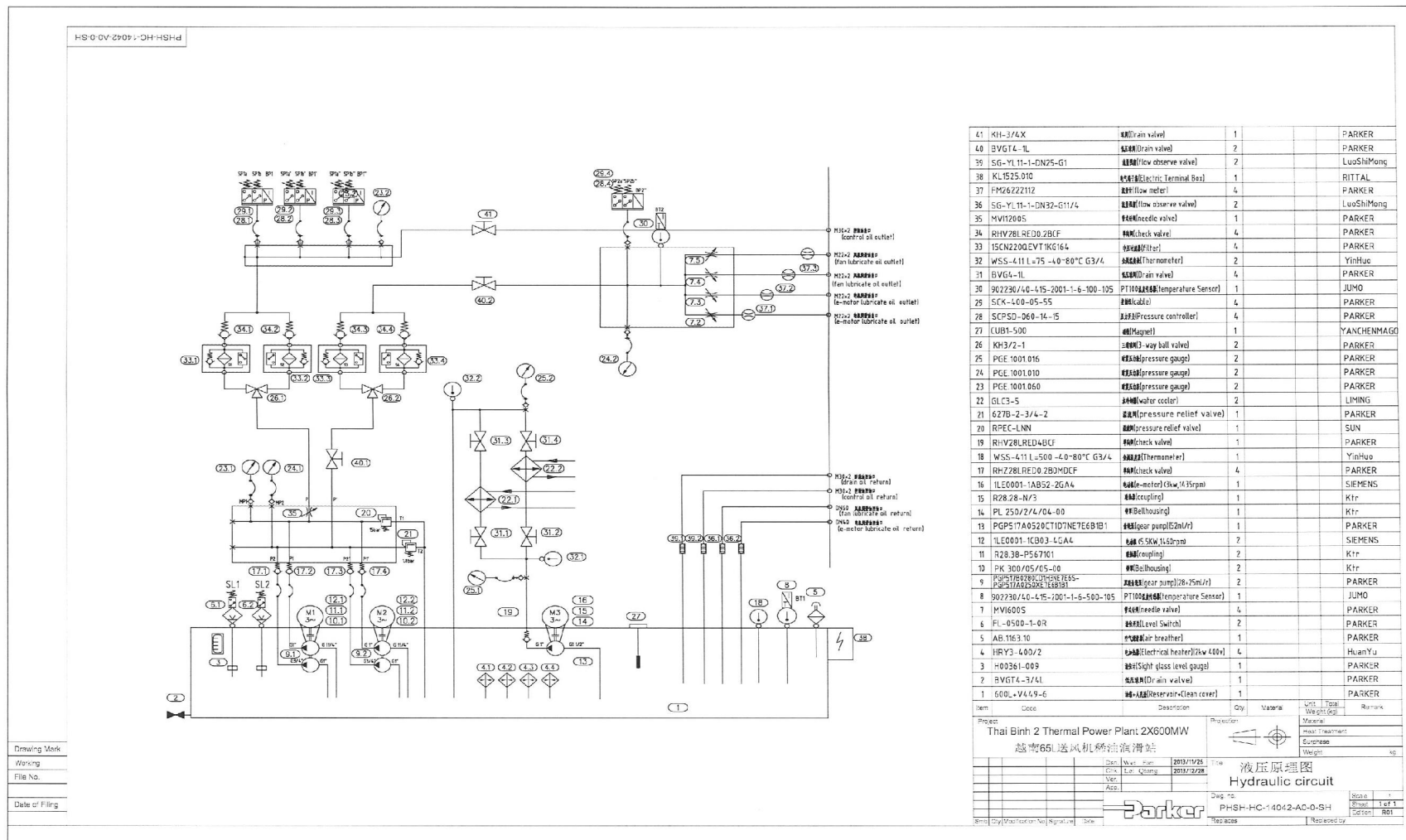


Fig. 14: Hydraulic Circuit

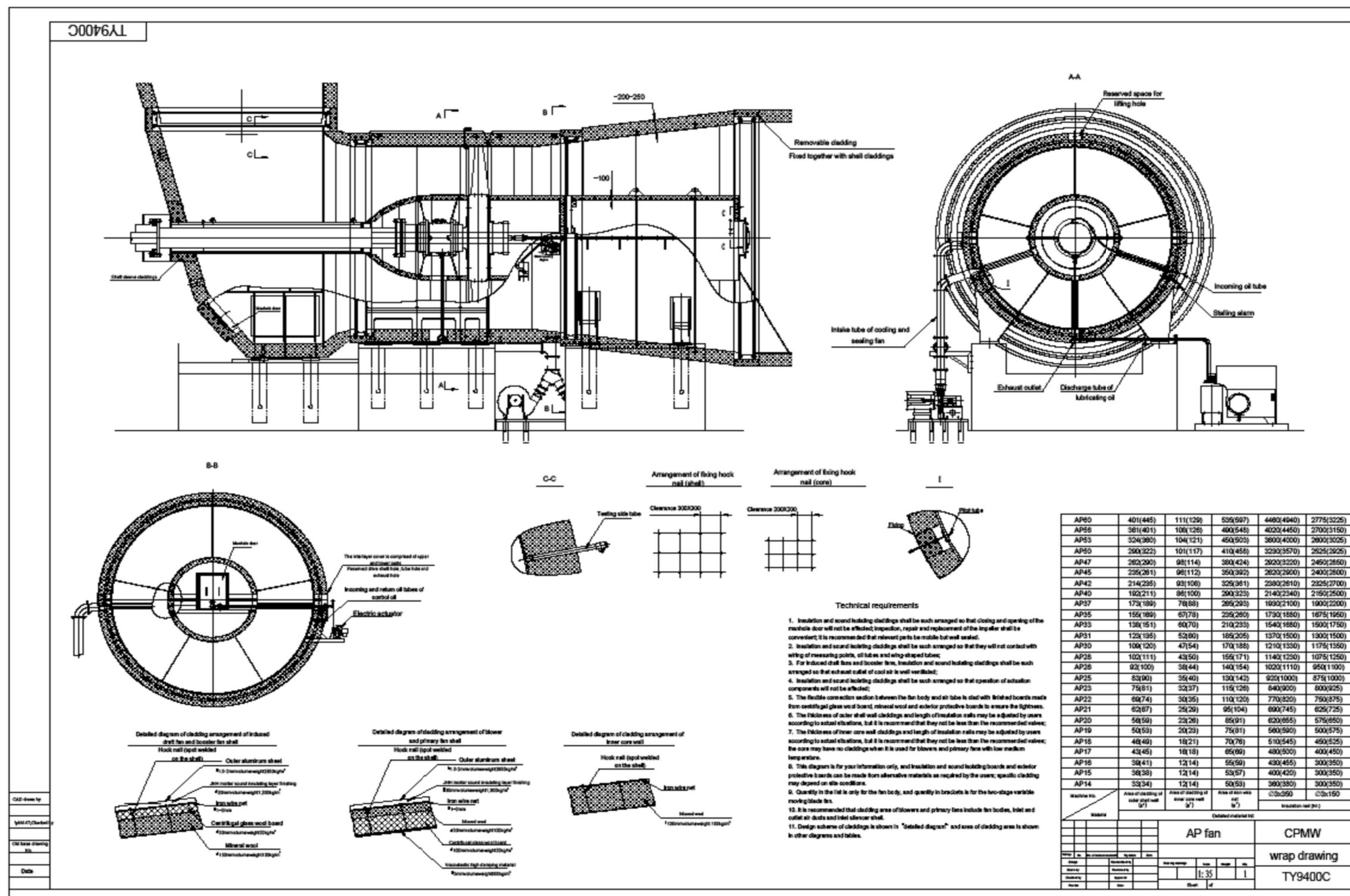


Fig. 15: Insulation (sound-proof) coating



14 Motor Operation Instructions

0EB. 460. 921DW

OPERATION INSTRUCTION

FOR LARGE-SIZE THREE-PHASE ASYNCHRONOUS MOTOR

**XITANGTAN ELECTRIC MANUFACTURING GROUP CO. LTD.
THE PEOPLE'S REPUBLIC OF CHINA**

2002



OPERATION INSTRUCTION FOR LARGE-SIZE
THREE-PHASE ASYNCHRONOUS MOTOR

0EB. 460. 921DW

Sheets 23 Sheet 1

1 Brief introduction

This operation instruction provides the description, advice and guidance on acceptance, storage, operation, running, and maintenance etc. for asynchronous motor.

The detail conditions of running and rating are shown on the motor's nameplate and label, the information of the base, electric connection of main circuit and auxiliary circuit and driven equipment interface is shown on the motor's outline drawing.

It's very important to read all the motor's warnings and nameplates carefully. Only when the motor is operated and installed according to the outline drawing and operation instruction strictly, can the Xiangtan Electric Manufacturing Group Co. Ltd's letters of guarantee become effective.

It's impossible that this operation instruction includes all those problems which may occur on installing, running and maintenance. If any problem out of the operation instruction or outline drawing occurs, contact with Xiangtan Electric Manufacturing Group Co. Ltd. Please.

2 General description

2.1 This operation instruction is suitable for the three-phase asynchronous motors of general use whose height of center is 710~1000 Y series and their derivative products. The motors have the following several structure types.

2.1.1 Structure and mounting mode.

The most general mode is IMB3 and IM7211.

2.1.2 Degree of protection

The general degree of protection is IP22, IP23, IP44, IP54, IP55 and IPW24.

2.1.3 Cooling type

IC01, IC11, IC21, IC31, IC37, IC81W, IC511 IC611, IC616 are used generally.

2.2 Mounting place

2.2.1 Altitude doesn't exceed 1000m. Ambient temperature shouldn't over 40℃.

2.2.2 The average highest relative humidity in the most humid month is 90% and the average lowest temperature shouldn't over 25℃ in this month.

2.2.3 No white ants permitted



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2.2.4 None of too much dust, salty fog and other corrosive gas for the motor with enclosure lower than IP54, but for the motor with enclosure IP54 and above is of dust-proof.

2.2.5 If the user has special requirements to the mounting environment of the motor, then an agreement will be signed and carried out by both sides.

2.3 The cooling water quality required by the motor should be of precipitated clean neutral water, its temperature should meet the requirements specified on outline drawing.

2.4 The rotating direction of the motor is clockwise seen from the main shaft extension end, it can also rotate counter-clock wise or both clockwise and counter-clockwise, according to the agreement signed by both sides.

2.5 The motor's rating is the maximum continuous rating, it can run on S1 operating duty, or according to the agreement signed by both sides.

2.6 The motor's specification, technical parameters, outline and mounting dimensions are shown on outline drawing furnished with the motor.

3 Description of motor structure

The asynchronous motor can meet the users requirements of different use by combining the basic parts and optional parts. The main parts of the motor are frame and stator assembly, rotor assembly, end shield type bearing assembly (or pedestal bearing assembly), top shield, terminal box in which the top shield will vary with the enclosure required by the concrete different running conditions.

3.1 Frame and stator assembly

3.1.1 Frame

The frame is of a case type welded structure, it can be equipped with air duct or water-air cooler, air-air cooler, weather proof top shield and other additional device on the top under the condition of no changing the basic design.

3.1.2 Stator assembly

The stator is of an external press stacking construction. The stator assembly mainly includes stator iron core, winding, slot wedges, stator leadout etc. Fasten the coil firmly in the stator slot by slot wedges according to requirement, the slot wedges may be of magnetic wedge or non-magnetic wedges. Coil overhang is bound with terylene sleeve tightly together with end bell and support. After VPI vacuum pressure impregnated in a solventless varnish,



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THREE-PHASE ASYNCHRONOUS MOTOR

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the complete stator assembly results in a tight consolidated core which enables to withstand electrodynamic force during the motor starting.

For single speed motor, U,V,W are used as the marks of main leadout. If the winding terminal is leadout also, U1-U2, V1-V2, W1-W2 will be used as the marks. If the motor is a pole-change motor or the voltage connection is changeable, reference to the detail leadout marks on outline drawing.

3.2 Rotor assembly

3.2.1 Cage rotor

The cage rotor mainly includes rotating shaft, rotor iron core, squirrel cage etc. Round steel or rib welded shaft is used according to motor's dimension and pole number.

The squirrel cage is normally made of red copper deep bar, for heavy starting conditions, it may be made of special trapezoid-shaped copper deep bar, even double cage rotor. After mounting the rotor bars into slots, they should be wedged tightly in order to avoid the rotor bar vibration or fatigue damage.

The rotor bar and end ring are designed to be suitable for thermal stress and mechanical stress occruiing during start and continuous load. When design the motor rotors, the computer programs considered the heat conduction from bars to rotor teeth and yoke. The requirement of the other system is considered carefully also at the same time when the rotor bar temperature is calculated.

3.2.2 Wound rotor

The wound rotor mainly includes rotating shaft, rotor core winding and slip ring etc. According to requirement the rotor insulation may be F class or B class. Winding over-hang is placed on the coil-support bracket and banded with woofless bandage.

3.3 End shield type bearing assembly or pedestal bearing assembly

3.3.1 End shield type rolling bearing

End shield type rolling bearing mainly includes end shield rolling bearing, bearing cover and seal device, oil-feed and drain device etc. in which one end-shield bearing has insulation construction.

3.3.2 End shield type sliding bearing

End-shield type sliding bearing is an independent component fixed on the end shield,



OPERATION INSTRUCTION FOR LARGE-SIZE
THREE-PHASE ASYNCHRONOUS MOTOR

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mainly includes bearing block, bearing pad, bearing cap and oil-air seal device etc. in which one bearing has insulation film on spherical interface between bearing block, cap and bearing pad.

The bearing block is provided with oil inlet hole, mounting hole for bearing temperature detector, oil level hole (used as oil outlet hole during circulating oil lubricating) and oil slot heating (or cooling) hole at its both sides from up to down, and an oil hole at its bottom.

The contact surface between bearing pad and bearing block, bearing cap is spherical, so it's called as self-regulation-center sliding bearing.

3.3.3 Pedestal sliding bearing

Pedestal sliding bearing is mounted on the motor's base plate, mainly includes bearing block, bearing pad, bearing cap and seal device etc., in which one bearing is equipped with insulation between bearing block and base plate. The bearing block is provided with oil inlet hole, mounting hole for temperature detector, oil level hole, oil outlet hole and oil drain hole on both side faces of bearing block, according to product requirements. The contact surface between bearing pad and bearing block, bearing cap is spherical also.

3.4 Top cover

3.4.1 Protective top cover

The protective top cover is provided with blind type air inlet and outlet.

3.4.2 Air-air cooler

Air-air cooler mainly includes outer cover, partition, cooling pipe etc.

3.4.3 Water-air cooler

Water-air cooler mainly includes outer cover, cooling water tank comprised of cooling pipes, air guide plate. etc. The cooling water tank can be drawn out from outer cover.

3.5 Temperature detector device

3.5.1 Stator temperature detector device

Normally a temperature detector is embedded between the upper and lower layers of the stator coil, its lead-out is connected into the terminal box for temperature detector.

3.5.2 Bearing temperature detector device



OPERATION INSTRUCTION FOR LARGE-SIZE
THREE-PHASE ASYNCHRONOUS MOTOR

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Bearing temperature detector is fixed on bearing block (or end shield). If the bearing is rolling bearing, the temperature detector's leadwire is connected to terminal box of temperature detector on frame side face which is shared with stator temperature detector. If it is sliding bearing, It has connection box with itself.

3.6 Space heater

The space heater is mounted under the frame, its leadout is connected into corresponding terminal box for space heater, it can be energized to heat the motor during the motor shut down in order to protect it from moisture condensation.

4 Package and transportation

4.1 All the motors packaged after passing out-works test.

4.2 It is not allowed to unpack the motor in the course of transportation.

4.3 It is necessary to avoid the motor to be turned upside down for safe transportation, and fasten the package case well.

4.4 On normal conditions, the motor is packaged in its entirety for transportation. The top cover and the body of the motor can be dismantled for transportation only on condition that the transportation in its entirety is not permissible.

4.5 When receiving goods, inspect and count carefully against packing list. If there is something wrong, contact with Xiangtan Electric Manufacturing Group. Co. Ltd. Please.

5 Lifting and handling

For lifting the whole motor, use the two lifting holes on the motor frame or two eyebolts on the base plate (for the motor with pedestal bearing) and use lifting ropes to distribute the weight evenly and avoid deformation caused by lifting ropes, clamping the top cover. It is forbidden to support the motor on the core laminations or coils for lifting. Carelessly handling and incorrectly using boom hanger during mounting will possibly cause the damage to the motor, which more than the damage caused by many years' normal running. Be careful and avoid damaging the winding when handling the motor.

Note: Never use the eyebolts on the top cover to lift the complete motor. When the motor is of sliding bearing construction, normally the motor is equipped with a rotor positioner device to avoid rotor moving. During lift the complete motor, the rotor positioner device should be mounted in motor to avoid the rotor damage caused by the rotor axial



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movement.

6 Storage

6.1 Upon receipt of the motor, if it's not put immediately into installation, don't unpack, but store it in clean, dry, warm storehouse or room.

6.2 Upon receipt of the motor. If store it for a long time before installation, then unpack and remove the dust, dirt off, clean out temporary protective coating; external deposited corrosion etc. from exposed surfaces of the shaft extension. If where rust-spots still in appearance after washed with gasoline, it would be lightly polished out by using of fine sound-cloth with oil, after which corrosion-proof grease or temporary paint materials may be used to recoat the expositive surface.

6.3 When the used motor is prepared to be out of operation and to be stored for a long period, it is necessary to dismantle the motor entirely for cleanliness, check the appearance of stator and rotor winding, conductors and rotating shaft journal, shaft extension etc. for no rubbing, the fastening parts no loose. Drain out the water residue (for water-air cooler type motor) and clean up dirty materials from interior of the water cooler. Further more, for the bearing lubricated with diluted oil, turn the rotor periodically. Check the conditions of the oil ring turning and the oil distribution forward to pad surface by observing through the inspect window provided on the upper cap of the bearing room to keep a layer of oil film on the surface of rotating shaft journal.

6.4 In the store interval, block off all the openings of the terminal box and cooler inlet/outlet flanges for preventing the small animals from entering.

6.5 The place where the motor stored should meet the following requirements:

6.5.1 None of white ants, salty fog, corrosive gas and excessive amount of dust.

6.5.2 Ambient temperature should be always kept above +5℃.

6.5.3 Relative humidity does not exceed 70%, except for TH type motor which is permissible with no more than 95%.

6.5.4 Well ventilated

7 Installation

7.1 The installation place should satisfy the requirements of item 2.2.

7.2 Before installation clean the motor according to the requirements of item 6.2.



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7.3 Motors must be installed on a rigid foundation. Designing and supervising the installation work should be done by the engineers who master the foundation design. Foundation's rigidity and the accuracy degree of the contact between the motor's bottom feet and the foundation surface can directly affect the vibration characteristics during motor operating. After finishing the installation the motor should be subjected to inspection in accordance with the standard concerned.

7.4 Centre alignment

The rotor of the sliding bearing motor should be located in magnetic centre position or rotor axial moving center position (mechanical center). If the magnetic center position can't be determined or no mark of magnetic center position is provided, then the rotor should be located in mechanical center position. Specially pay attention to that the shaft of driven equipment expands with heat under some conditions. Although the rotor is located in magnetic center position during motor installation at room temperature, the thermal expansion will cause the rotor axial deviating during normal running. So it should be ensured that the motor's rotor is always located in magnetic center aligned position under thermal running conditions. That is to say, in the case of motor installation at room temperature, move the stator for a short distance far away from the direction of the driven equipment, its value is just equal to the value caused by shaft of driven equipment expanding from the temperature during rated running to the room temperature during installation. The value should be provided by driven equipment manufacturer. If the total play value of sliding bearing motor is A mm. Then the coupler should limit the rotor's total play value in a range of $(0.36-0.38)A$ mm, after the motor location has met the axial playing requirement, then tighten up the bottom bolts.

Special notice: Although the resilient coupling can allow the shaft line to have much non-alignment, even a little failure during adjusting also can cause huge vibration into the system, so in order to obtain the longest bearing life and minimal vibration, it is important to align machine set center as well as possible and check the alignment in thermal condition. After alignment of the center position is finished finally, nail the locating pin into bottom plate through bottom feet, because it can ensure re-installing easily after the motor is lifted away from the installing position for some reasons.



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7.5 For the connection between the motor and the driven machine a coupler is used only. If it is necessary to use belt pulley drive an agreement for special order should be signed with the manufacturer.

7.6 Set the earthing wire on the frame.

7.7 In order to lead the supply cable into the terminal box, cut a round hole out on the rubber seal ring to suit the cable diameter and jam the cable into the hole so as to make a better seal. Carefully secure all incoming cables be tightened by lead-in clamps.

8 Starting

8.1 Preparation prior to initial starting

The first energization after new installation, complete overhaul or long time stop can be considered as the first starting. It is recommended to make the initial start without connection of the motor to the driven equipment.

8.1.1 After confirm that all the installation or maintenance have been finished, check the foundation, bottom feet bolts and locating pin to ensure their installation in place and tightness.

8.1.2 Regardless of that the motor has been tested and treated with drying in the factory, even if the insulation resistance of windings between phases and to ground in good condition, the windings should still be dried out prior to operation.

8.1.3 Remove dirt, dust out of the machinery room.

8.1.4 Clean off foreign materials (spanner, pinchers, rotary chisel, ribbons, shedding, bolts, etc) and dust from the interior of the motor. If blow the motor with compression air, the air should be clean and dry and it's pressure value shouldn't exceed $2 \times 10^5 \text{ Pa}$ (2 kg/cm^2).

8.1.5 Check whether supply voltage and frequency agree with the value on rating plate, whether the supply voltage value is within 5% of nameplate rating value.

8.1.6 Three leads in main terminal box; are connected according to rated voltage and phase sequence marks indicated on the nameplate, other leads are connected according to connection label or motor outline drawing. The three-phase winding lead-outs of secondary terminal box go through the current transformer(if there is current transformer) or not through it(if is no current transformer), then connect them together at last. If there is a current transformer, check the several current transformer secondary order wires, whether connected



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to instrument or shortly connected. Don't made the circuit open in order to avoid the danger caused by high voltage.

8.1.7 Check the mechanical rigidity and tightness of all fixing bolts of the motor.

8.1.8 Provided that the motor is shipped in disassembled state, it is necessary to check the air gap between stator core and rotor for uniformity by means of thickness gauges. The non-uniform air gap of motor ϵ / δ shouldn't be greater than the specified value in table 1

Table 1

δ (mm)	≤ 1.2	> 1.2
ϵ / δ (%)	13.0	10.0

Note: δ is nominal air gap ϵ is non-uniform value

$$\epsilon = \frac{2}{3} \sqrt{\delta_1^2 + \delta_2^2 + \delta_3^2 - \delta_1 \delta_2 - \delta_1 \delta_3 - \delta_2 \delta_3}$$

($\delta_1, \delta_2, \delta_3$ ----- air gap measured at points 120° apart)

8.1.9 Check the bearing to ensure the correct brand lubrication oil is added into oil chamber at suitable oil level (watch oil hole center position), for delute self-lubricating motor the oil should be added artificially to oil chamber before first starting. For using forced oil lubricating system, make the system in a proper running condition to supply the oil, and refer to the lubrication label on the motor or lubrication requirements specified on outline drawing.

8.1.10 For the end-shield rolling bearing grease lubricated, check bearing grease brand for its conformity to the motor outline drawing requirements or label requirements. If the grease is deteriorated or dirty, it should be replaced by new grease.

8.1.11 Check rotor for its freely rotating and whether there is abnormal noise during barring.

8.1.12 Push rotor to driven equipment to the limited value of the rotor axial play gap and confirm the motor half coupling at this limit position will not touch the driven equipment half coupling.

8.1.13 Confirm that all the protective devices and inspection device are well connected and operated properly.



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8.1.14 Check earth connections of motor frame and lead covered cables.

8.1.15 For the motor equipped with space heater, check the space heater's supply voltage and its supply cable for its good connection in terminal box.

8.1.16 Measure the insulation resistance of the motor winding with a 1000V megger, the reading should not be less than the value calculated by following formula:

$$R = \frac{U}{1000 + \frac{P}{100}}$$

Where: R ---- insulation resistance MΩ

U ---- motor rated voltage V

P ---- motor output kW

8.1.17 Check the water-air cooler and ensure it in normal water supply condition.

8.1.18 For wound-rotor motor, check the slipring to see if its surface is smooth, if the brushes between phases are collided each other, if all the brushes are closely fit to slipring. (contacting surface over 80%, the pressure: 0.14~0.25kg. f/cm²)

8.1.19 Energize the motor to start it for a movement (press the start control button first, then press stop control button at once) to check if the rotating direction is right. When the motor is a multispeed pole-change motor, repeat the above start-stop test under the different speeds in various connecting mode, and confirm the consistence of the motor's rotating direction with the requirement of driven machine. The motor with rotating direction indicator should rotate in the direction indicated in order to gain good ventilation.

8.1.20 Start the rotor again and make it running. Check the bearing temperature frequently, especially at the first two hours after motor running. In this period of time, the rate of bearing temperature rise, can suggest the faults condition better than that the absolute temperature can do. The bearing final temperature should not exceed 80℃ (for sliding bearing) or 95℃ (for rolling bearing). Stop the motor to check the installation condition and remove the fault, if any abnormal phenomenon is found out with the motor.

8.2 Start

8.2.1 The motor may be started either with full-voltage or by an autotransformer or reactor.



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8.2.2 Wound rotor motor should be started with all resistances connected into the circuit, then reduce the starting resistance progressively depending on motor speed up and observe that the stator and rotor current should not be higher than the permissible value. Whenever the rated speed is reached. The starting resistance should be completely cut off.

8.2.3 Starting duty

It is never permitted to exceed the following starting duty unless otherwise specified in the starting nameplate.

8.2.3.1 Start the motor twice continuously under initial condition of ambient temperature, only four hours later, can start twice continuously again. Do it again and again (if necessary).

8.2.3.2 If the initial condition is of rated running temperature, start it continuously one time, only four hours later, can start it continuously again. Do it again and again, (if necessary).

8.3 Motor stop out of service

8.3.1 On the working site, if the motor stopped out of service for over one month and the motor still remains on the foundation and keeps connecting condition with the driven machine, suggest the following stipulations to execute.

8.3.1.1 Replace the residual oil by clean lubricating oil (except for grease lubricating rolling bearing). Turn the rotating shaft several turns every month, or in shorter intervals if the place is moist and moisture condensation will occur.

8.3.1.2 Make the space heater on and check it periodically to ensure the motor is being in working condition, so as to keep the motor internal temperature higher than the outer temperature.

8.3.1.3 All the exposed metal surface of outdoor installed motor, should be coated with corrosion-proof grease.

8.3.1.4 Before restarting the motor, remove the corrosion-proof coat layer off the surface, drain the residual oil out and fill the oil chamber with clean working oil, and check the motor once time according to the content concerned in item 8.1.

8.3.2 Storage away from the working site

If the motor is carried away from the working site, and will be stored in someplace for over one month, the requirements of item 6 should be obeyed.



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9 Operation and maintenance

9.1 Cleanliness

There should be no dust, oil or grease in motor's interior and exterior. Oil fog, resultant, flying powder, chemical material or textile fabric dust can be stacked up to block the ventilation channel, which result in the coil overheating, further more, the conducting dust can shorten the insulation's creepage distance. Under the rotor fan driving, the sharp powder may be rub the stator's insulation so as to shorten its service life, the magnetic powder does harm to insulation specially. Blow the light and harmless dust with dry air of the pressure less than or equal to $2 \times 10^5 \text{ Pa}$ (2 kg/cm^2), and remove sand, metal, magnetic dust or carbon powder away by suction, and the suction pipe should be made of non-metallic material.

9.2 Bearing maintenance

9.2.1 Rolling bearing

9.2.1.1 Rolling bearing is a changeable standard component.

9.2.1.2 Bearings in common use are those: deep duct ball bearing, single row roller bearing and double-row spherical adjustable center roller bearing.

9.2.1.3 Rolling bearing has two basic lubricating mode: grease lubrication and oil lubrication, but most of them are of grease lubrication. The lubricating grease was added in according to outline drawing before delivery. The upper limit temperature of the mineral grease value is close to 130°C , the lubrication grease's life is limited. It will lose the lubricating function gradually under the influence of mechanical stress and chemical aging. So it is important to replace the grease with fresh one periodically and to keep the rolling bearing's running temperature value less than 90°C in order to reach normal life expectancy of the grease. The design of end shield type bearing can ensure the fresh grease to lubricate through the bearing's interior and by means of it to drain out the old grease. It's necessary to obey the maintenance indication on bearing nameplate or outline drawing.

9.2.2 Sliding bearing

9.2.2.1 Take care of the bearing lubrication, for the self-lubricating bearing, its oil ring should be under normal working conditions, sample the oil for analysis at regular. If the oil is



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darkening, with moisture or foreign matter it should be replaced immediately. The replacement interval of time is dependent on its uncleanness and the motor's operation condition, but not less than once a half year at least (regardless of running hours). This stipulation is for considering the oil aging. The replacement interval for the bearing with circulating oil lubricated may reach 20000 hours.

9.2.2.2 For the motor with pressure lubricated bearing or combined lubricated sliding bearing, during the motor running, the bearing should be kept in a certain oil level which is at the center position of the bearing observation port, when the motor is in a static state and the oil flows through oil pipe. The pumped oil supply flow and the oil pressure value at this time are regarded as the rated data.

9.2.2.3 Parts wear-out

The motor must have a mixed friction area during its starting or stopping. Because the shaft's speed is too low at this time, so the pressure produced in lubricating gap is too low also, which can not make the shaft turn entirely on oil film. This means that there is rubbing of metal against metal, so it's impossible to avoid wearing. The transition speed when the mixed friction change into fluid friction or it does oppositely is called change over rotating speed. A suitable design can keep low change over rotating speed. For the frequently shutdown motor and with high change over rotating speed, a brake can be used to shorten the stop intervals or pressure oil jack is provided. Pressure oil jack should be used when there is long time running under the change-over rotating speed and close to it. (such as low speed rotating for driving the refiner).

Check the bearing for leakage periodically. If leakage is found out, check the bearing seal size and replace it.

9.2.2.4 For both the end shield type bearing or the pedestal sliding bearing, the gaps between bearing pad and shaft of the end shield type and pedestal adjusted well during finishing, so it is unnecessary to scrape the bearing pad again principally before operating.

9.3 Wound rotor asynchronous motor with fixed brush (normally contact)

9.3.1 The sliprings are the links connecting the current between rotor winding and fixed brush. The sliprings are often made of steel or silicon brass, so they should be maintained



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smooth and true surface. The brushes should make good contact with them. If necessary, grind new brushes with 0# sandpaper. For doing this, cut out the sandpaper into narrow tape, put it under each brush with pressing against the contour of the slipring. The sandpaper should be pulled in the direction of rotation, and the brush to be pressed down firmly only by the normal pressure of the brush finger, not by hand.

9.3.2 When over heating of brush or sparks beneath brush, it is necessary to check if the brushes being stuck or inclined in brush box; if total face of brush is intimate contact with slipring; too high or low a value of brush tension; whether the grade of brush agrees with; if any fault detected, remedy it promptly.

9.3.3 To avoid a brush to be grind in flanged shape, the brush extending over, the slipring should not be allowed. Replace the brush by use of an identical grade with same size depending on its wear. The brush holder, support bolt's insulation, insulation between rings and conducting pole bolt should be all kept clean, when brush replacing. Check the brush device and slipring components for the dust accumulated once a month, and clean up once every three months, there will be a layer of oxide film containing graphite during operating, and there will be a smooth surface after the oxide film forms (after 1000 working hours), the surface film may be of the color between light gray to black, which is determined by the brush's brand, current density, air humidity and temperature, It's key to form a layer of even film on the slipring's circumference and width, which benefits the operating. So don't worry about and damage the film even during brush replacing, only when the deposition of oil and carbon powder is stuck tightly. Can remove it off from the slipring with petroleum spirit.

9.4 Air gap

9.4.1 Periodic checking of the air ap (from either end of the motor) is the insurance against the rotor to rub the stator.

9.4.2 The non-uniform air gap of motor does not greater than the specified value in table 1 of item 8.1.8.

9.5 Air-air cooler

9.5.1 The cooler interior should be frequently inspected to make sure that no foreign materials and no dust accumulated, if any, clean them away, otherwise the heat dissipation.



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Ventilation and cooling effectiveness could be influenced greatly, in addition dust could corrode the cooling pipes and shorten the service life of the cooler.

9.5.2 While cleaning up the cooler, only wooden (not steel wire) brush should be used.

9.5.3 Inspect and clean dust or foreign materials away periodically from the external fan and its housing.

9.6 Water-air cooler

9.6.1 The cooling water pressure in cooler should be kept within the scope specified on outline drawing. The water flow, quality, temperature should satisfy the requirements of outline drawing too, to ensure the motor works safely.

9.6.2 The cooler should be cleaned up at regular interval (once a year), clean up the scale and sediment deposit from the cooling pipes (with a round woolen brush but not a steel wire brush as mentioned above), thus to keep a better heat conductive ability, it is capable to reduce the corrosive effect and to prolong the service life of the cooling pipes.

9.6.3 Check cooler for its water leakage frequently. If any, remedy it promptly, otherwise it may cause deterioration of insulation and even faults.

9.7 Terminal box

9.7.1 Check the sealing condition of the terminal box periodically. Replace the seal ring and seal pad in time if they lose effectiveness of sealing due to ageing and deterioration.

9.7.2 Check the fixing condition of the power cable at the inlet on the terminal box frequently. Tighten it in time if any looseness is found out.

9.7.3 Periodically check the connectors of the power cable to see if there is a good contact between the terminal post and connectors and if the connectors and wires are burnt out. Replace them at once if it appears.

9.8 Often check the tightness of the fasteners, especially those fasteners which tighten the insulation part and rotating part.

9.9 Temperature measurement

9.9.1 During motor running, check the temperature of the stator winding regularly. The temperature of the stator winding is tested by means of the resistance temperature detector. The temperature rise should not exceed the values specified in Table 2.



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Table 2

Unit: K

Motor Parts	Type of product	B Class			F Class			H Class		
		A	B	C	A	B	C	A	B	C
Winding	General		80	90		105	110	105	125	130
(temp.	TH		80	90		105	110	105	125	130
rise)	TA		75	85		100	105	100	120	125

Note: A ---- Thermometer method B --- Resistance method

C ---- Thermodetector method

(1) TH --- Humid-tropical type; TA --- Dry-tropical type.

(2) Ambient temperature: 40°C for normal and TH type, 45°C for TA type.

(3) It is permitted to verify the temperature rise in accordance with the National Standard concerned unless otherwise specified.

9.9.2 During motor running, check the bearing temperature regularly, observe the instrument connected to the bearing thermodetector, the temperature should be in normal value, i.e. not more than 80°C for sliding bearing and 95°C for rolling bearing, otherwise it should be done to stop the machine for examining and repairing.

9.10 Periodically check the motor ground connection for its goodness.

9.11 Check the insulation resistance of the winding frequently. According to the requirement of item 8.1.16, if the insulation resistance of any phase winding is reduced, clean the dirt and dust on it carefully and treat it with drying.

9.12 Power source

9.12.1 The motor should be operated under the voltage stated on nameplate. If the power source voltage is deviated from its rated value over $\pm 5\%$ (or value specified in agreement), the motor should be stopped. It is permitted that the motor is operated under the instantaneous over-voltage or low-voltage.

9.12.2 Normally the motor should be operated under the rated frequency specified on nameplate. When the deviation of the power source frequency from the rated value exceeds $\pm 1\%$ (or value specified in agreement), the motor should be stopped. It is permitted that the motor is operated under the instantaneous high frequency or low frequency.



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9.12.3 The voltage and current wave of the power source should be conformed with the requirement of the real sine wave.

9.13 Load

9.13.1 During motor running, the current is not allowed to exceed the value specified on nameplate for a long time because the over-current will increase the temperature rise of the motor to affect its service life. When the load can not be adjusted to the adequate input power value, a motor with larger capacity should be selected.

9.13.2 The moment of inertia of the load driven by the motor should not be out of the range specified in IEC standard because an excessively large moment of inertia will cause the motor start with difficulty to affect its service life. If the user has its special requirement to the motor, a technical agreement between the user and manufacturer should be signed to meet the special requirement.

9.14 Space heater (if heater is provided)

9.14.1 Check the supply voltage of the heater for the conformity to the requirement in the motor outline drawing.

9.14.2 Periodically check the heater insulation for its goodness. Current leakage is not permitted because the current leakage of the heater will cause the motor housing to energize and an accident of electric shock will occur easily.

9.14.3 After the heater is energized and the motor interior has a stable temperature, the temperature at the place close to winding should not exceed 70% of the temperature permitted by insulation class specified on nameplate.

9.15 For the totally enclosed motor, in spite of that it is installed indoor or outdoor, a periodical check of the sealing should be done. Replace the sealing piece in time to prevent an accident form occurring, if it loses effectiveness of sealing due to ageing and deterioration or other cause.

9.16 For the totally enclosed motor outdoor installed, periodically remove the rust and coat with paint or oil to avoid the motor damage caused by corrosion.

10 Motor assembling and disassembling

10.1 Disconnect all cables and leading wires connecting to the power supply, instruments,



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detector devices and grounding unit.

10.2 For the bearing lubricated by thin oil, exhaust two bearing of oil, disconnect the oil supply and return pipeline if the bearing is provided with additional oil system.

10.3 Remove the whole top cover (if any) and the outer fan housing with fan (if any).

10.4 Remove the cover plate, the shutter or vent pipe (if any).

10.5 Disconnect the anchor bolts and positioning pin, and separate the coupling shaft.

10.6 Remove the coupler from the shaft extension end (if necessary).

10.7 When disassemble the wound-rotor motor, the leading wire between brush bracket and rotor terminal box, remove the brush from the brush holder. And remove the collector ring seat also if it is located outside the bearing at the non-extension end.

10.8 Dismantle the bearing cap and all temperature relay located at the bearings and thermo-resistance, and then remove the upper half bearing housing (for the sliding bearing).

10.9 Lift the motor up carefully to let it away from the base and put it in the place convenient to store and to work.

10.10 In the case of the rolling bearing used in motor, remove the end shields of both the shaft extension end and the non-shaft extension end.

10.11 When the sliding bearing is used in the motor, lift the upper half bearing pad and raise the rotor adequately to make the lower half pad released from the load at two ends, then turn over the lower half pad and lift it away. Remove the lower half bearing housing (for pedestal sliding bearing) or remove the lower half bearing housing with its lower half end shield (for end shield-type sliding bearing).

10.12 Insert a bakelite plate or a paperboard into the stator bore and put the rotor down to the stator bore.

10.13 Before the rotor is pulled out of the stator, remove the fan and fan shroud

10.14 Pulling the rotor out of the stator

Ensure enough space for the stator and rotor assembly surroundings so as to pull rotor out, wrap the shaft journal and the sealing area around thickly and firmly to avoid its damage.

10.14.1 Mount a steel tube with proper inner diameter, length and strength to the non coupling end of the rotor. Don't put the tube at the shaft journal position, but close to the shaft part of the rotor core, or make a red copper ring with a proper diameter and insert into



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the steel tube interior as a lining.

10.14.2 Put the lifting rope on the steel tube closing to the coupling shaft part.

10.14.3 Lift the rotor carefully close to the center position of the air gap. Pull the rotor out of the stator slowly and axially to the coupling end or non-coupling end (in special condition). Care should be taken to prevent the rotor from sliding down or rubbing the stator bore and stator winding.

10.14.4 After the rotor core has passed through the stator bore and is pulled out of the frame, put the third lifting rope on the shaft of the non-coupling end or at the rotor core and adjust the third lifting rope load to the weight loaded by the steel tube previously.

10.14.5 Remove the steel tube sleeved and lifting rope carefully to avoid bumping the stator winding.

10.14.6 After the rotor is pulled out of the stator bore, place it on a convenient field and put a piece of paperboard or other proper material under it. Lock the rotor at a proper position. At this time it can be done to check and maintain the rotor interior carefully.

10.15 The assembly of the motor is done according to the opposite procedure of the disassembly.

11 troubleshooting

It is important to identify the abnormal running symptom early and to take a remedial measure promptly. The meaning is to prevent a small defect from changing to a serious failure.

The following guidance of trouble shooting may help you to find the possible fault out and remove it. Always cut off the power supply of the motor first before you intent to find the fault out.

The following is a brief description of the problems met usually, their possible causes and remedial measure to be taken.

11.1 The motor can not be started.

Starting trouble (see Table 3).

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Table 3

Trouble	Possible causes	Remedial measure
Motor no response to starting at all	At least two leading wires of power source with open-circuit	Check fuse wire, power lead and leading terminal.
	No voltage	Check power lead
Motor has ripple noise, but cannot be started.	One phase with open-circuit for stator or rotor	Check power lead and remedy circuit breaker
Motor can not be started with load, but normal magnetic noise occur.	Excessive torque of load	Remedy transmission unit failure, disconnect the motor from load and check its running with no-load
	Too low power supply voltage	Measure the power supply voltage
	Rotor with open-circuit or improper selection of starter. (for wound-rotor motor)	Check rotor circuit or replace starter.
Motor idle running, but it can not be with load.	After starting, one piece of power lead disconnects.	Check power lead

11.2 Bearing heating

Trouble of bearing heating (see table 4)

Table 4

Trouble	Possible causes	Remedial measure
Bearing over-heating	Improper brand of lubricant	Review lubricating nameplate or motor outline drawing for recommended grease or oil
	Improper oil level	Verify the oil level
	Oil ring does not rotate	Check the oil ring for its roughness and alignment of guide slot with oil ring.
	Too excessive load	Check axis alignment, axial thrust load or not, check the shaft for bending.



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Table 4 Continued

Trouble	Possible causes	Remedial measure
	Rough surface of bearing	Check bearing metal for its displacement, concave point caused by axial current and corrosion, check the bearing insulation if any concave point exists Grind or rematch bearing metal. Polish shaft journal if necessary

11.3 Oil leakage Trouble of oil leakage (see Table 5).

Table 5

Trouble	Possible causes	Remedial measure
Oil leakage	Too excessive gap between sealing surfaces	Check leakage at the sealing gap
	Air intake blocked of the breather	Check air intake for its obstacle
	Incorrect brand of oil	Verify the oil brand against the lubricating name plate or motor outline drawing for its correctness

11.4 Vibration and noise

Trouble of vibration and noise (see Table 6)

Table 6

Trouble	Possible causes	Remedial measure
Vibration noise	No balancing rotor	Disconnect the motor from load, then check it.
	Motor installing infirmly or bad foundation	Retighten the bolts, check the shim and strengthen the installation base.
	Parts rub against each other which exhibits the change of vibration phase angle with the time	Check air gap for its evenness and rotor for its bending

	OPERATION INSTRUCTION FOR LARGE-SIZE THREE-PHASE ASYNCHRONOUS MOTOR	0EB. 460. 921DW	
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Table 6 Continued

Trouble	Possible causes	Remedial measure
	Rotor cage bar crack exhibits the change of amplitude With the time, which occur during running with load mostly	Check rotor, replace cage bar.
	No balancing coupler	Check the key extended part for its balancing
	No aligned axis	Realign the machine set, the base returns back to right level.
	Resonance of the motor supporting structure exhibits a great vibration at the motor footing, which will disappear with the speed change or after motor deenergized.	Replace the motor foundation, avoid the resonance area.
	Journal out of roundness exhibits that the vibration frequency is the integral multiple of the rotor frequency	Round the journal
	Bearing damage	Replace bearing or its pad.

11.5 Low insulation resistance

Trouble of insulation resistance (see Table 7)

Table 7

Trouble	Possible causes	Remedial
Low insulation resistance	Damp, dust, conducting particles or other pollutant	Clean the motor, dry the motor if necessary
	Mechanical damage	Check winding support and slot wedge. Check if there is any foreign matter or excessive vibration
	Too high temperature	Check if there is any overload, ventilation blocked, dust accumulated excessively, unbalanced voltage or improper voltage.



OPERATION INSTRUCTION FOR LARGE-SIZE
THREE-PHASE ASYNCHRONOUS MOTOR

0EB. 460. 921DW
Sheets 23 | Sheet 23

10.6 Motor overheating

Trouble of motor overheating (see table 8)

Table 8

Trouble	Possible causes	Remedial measure
Motor overheating during idle running	Incorrect connection of stator winding (e.g. delta connection instead of star connection)	Connect the winding in correct method
	Main power voltage too high	Check main power voltage and idle current
	Cooling failure due to ventilating duct blocked	Clean ventilating duct
	Fan rotation in wrong direction (for the motor designed in single rotating direction)	Check fan and its rotating direction
Motor overheating during running with load	Motor overloading	Check current and load torque
	Too high or too low voltage	Check voltage
	Motor running in single phase state	Check the lead-in for its open-circuit
	Rotor collides with stator	Check air gap
Stator overheating partly	Short circuit between stator turns (some coils overheating and with buzzing noise)	Disassemble the motor for carefully checking, or return it back to motor manufacturer for repairing if necessary

11.7 Wound-rotor motor with brush spark or collector ring arcing

Trouble causes and treatment (see table 9)

Table 9

Trouble	Possible causes	Remedial measure
Brush spark	Too small contact surface between brush and collector ring	Grinding brush
	Brush seizing in brush box	Make the brush be able to slide up and down freely in its box
	Dirt on the surface of collector ring and brush	Remove dirt away
Collector ring arcing	Too much brush dust adheres to collector ring and brush-holder	Clean the brush dust away
	Damaged insulation between collector ring	Replace the insulation between collector ring
	Rotor circuit broken	Check the rotor circuit and remedy it



15. Drawing list

15.1 FD Fan

No.	DrawingNo.	DrawingDescription
1	TB2-SDC.VP101-00100-M-M1A-MAN-9034	FD Fan Assembling DRAWING
2	TB2-SDC.VP101-00100-M-M1A-MAN-9035	FD FAN ASSEMBLY BLADE ACTUATING SECTION
3	TB2-SDC.VP101-00100-M-M1A-MAN-9036	FD Fan Outline Drawing

15.2 Motor

No.	DrawingNo.	DrawingDescription
1	/	/

15.3 Lubrication system

No.	DrawingNo.	DrawingDescription
1	Fig. 12	Assembling Layout
2	Fig. 13	Hydraulic Circuit Electric Wiring
3	Fig. 14	Hydraulic Circuit

16. Instrument list(each fan)

No.	Instrument List(each fan)					
	Name	quan	Specification	Intall position	Manufacturer	remark
1	Terminal Box	1	BXKG-223B		KKK	
2	Stall alarm equipement					
2.1	Stall sensor	1		fan	KKK	
2.2	Pressure difference	1	BH-208002-208	Terminal Box	SOR	DPDT
3	thermometer for fan			Bearing Housing	Shanghai	
3.1	platinum resistance	9	Pt100			



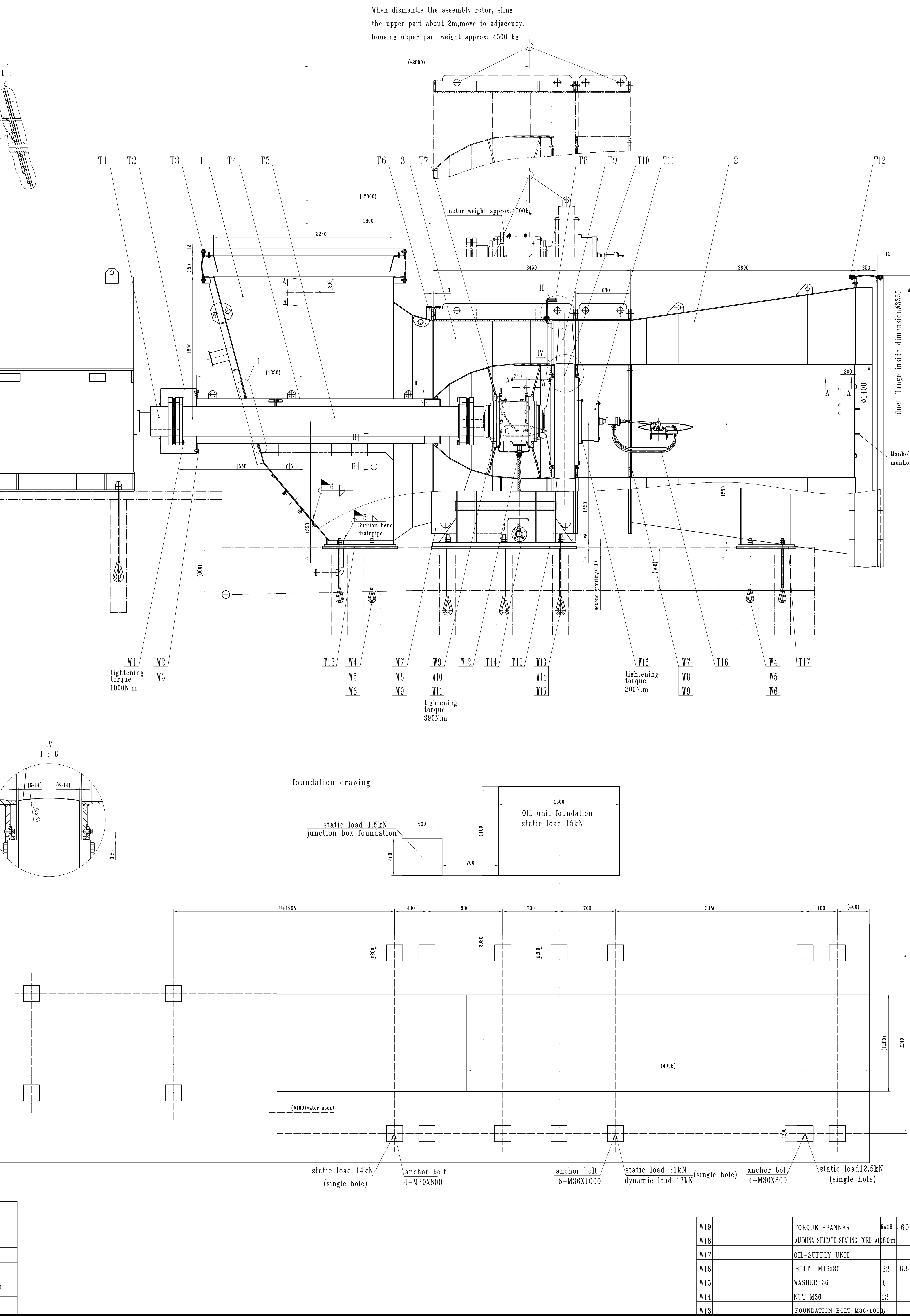
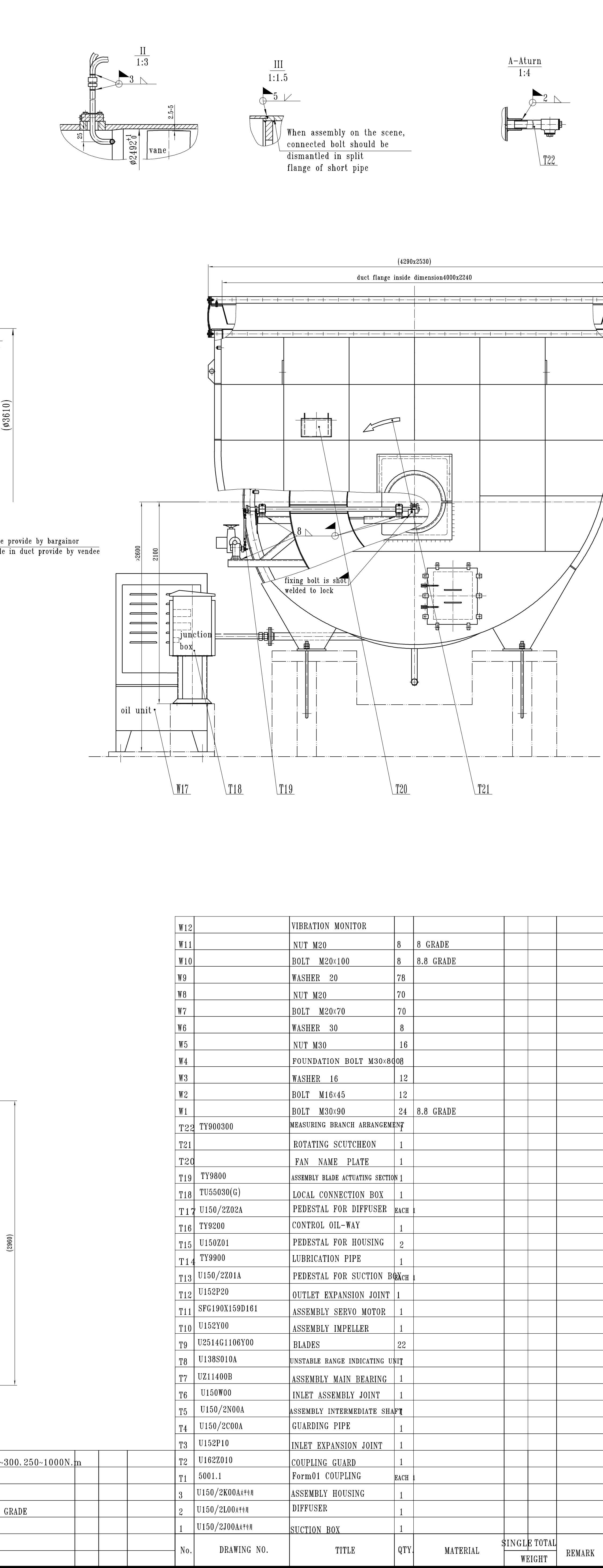
4	vibration monitoring system for fan				Shenke	
4.1	horizontal direction sensor	2		Bearing Housing		
5	Actuator	1	IQTM500		ROTORK	
6	Key phase measurement				Shenke	
6.1	Key phase probe	1				
7	thermometer for motor					
7.1	Motor Bearing temperature device	2	Pt100	Motor Bearing Housing		supplied by motor Manufacturer
7.2	Motor Winding temperature device	6	Pt100	Motor Winding		
8	vibration monitoring system for motor				Shenke	
8.1	eddy sensor	4				
9	Oil station for fan	1			Paker	
10	Oil station for motor					shared with Fan oil station



Special Notes & Instructions

To continue to perfect the field maintenance code for our adjustable blade axial fans and extend service life and according to our experiences in manufacture and maintenance, we propose the following with regards to fume-medium fans manufactured by us:

1. Isolation valves shall be equipped both on the front side and the back side of the fan (to keep off fume backflows when the fan is off). If isolation valves fail to keep the fume backflows off or such valves are not equipped when the fan stops (except for maintenance), the seal fan shall continue running.
2. To prevent the fan from “surging •”, it shall not operate when both the front and back isolation valves are closed; to prevent surging during idling, the isolation valves shall not be closed immediately when the motor is powered off, instead, they shall be closed when the fan stops running.
3. To prevent blades and hubs being stuck by hardened mud, during when the fan is not working, the oil station of the fan shall be activated every 6-8 hours, making blades go from the state of “off” to their greatest opening for 2-3 times. Otherwise, manual adjustment on blades after fan activation will cause the inner components and outer connection parts of impellers to fail and break, resulting in damage of connection keyway of cranks and trunnions, of cranks and their slide blocks, and of thrust ball bearings. Therefore, this procedure of maintenance is strongly advised.
4. Before starting of the fan, please make sure that impellers (including the blades and hubs) and outer surface of impellers are properly cleaned, check for wear and corrosions on them, and check if blades are able to rotate freely.



Technique Requirement:

- 1.Assembly and operation of fan insite according to (Product operation instruction).
- 2.Base bearing of fan is adopted with rolling bearing,lubricating mode is thin oil lubricating,oil brand: L-TSA46;Controls and instrument:six PTthermalresister;one set vibration monitoring system;and one set unstable range indicating unit.
- 3.Adjustable mode is that actuator push hydraulic pressure servo system with dynamic blade adjusted mode;
- 4.This drawing is the arrangement of actuator and oil-supply unit in left side(view in clockwise),the arrangement of actuator and oil-supply unit is in right side, is opposition direction;
- 5.The regulation requirement of electrical motor side and film coupling of impeller side:Radial displacement |r|< 0.1mm;Angle displacement for installment:|α|<0.25°;
- 6.The levelness tolerance of motor shaft is less than 0.05mm,The levelness tolerance of fan principal axis is less than 0.02mm;
- 7.Mainparts(including impeller,bearing fixing,mid-shaft,coupling,actuator,servo control device,oil-supply unit,pipeline accessories,standard element and casing etc)should be kept appropriate in water proof site room before assembled insite;
- 8.As assembled,the most heaviest units(casing assembly+bearing assembly+impeller assembly+servo control system)are lifted about 14000kg;and as repaired,the most heaviest units (rotor group)are lifted about 4500kg;
- 9.All the bolts should be tightened according to instruction and requirement of drawing in assembling and repairing;
- 10.As assembled,the flange between suction box and casing lower half-circle, the guide vane housing shell horizontal parting flange and cone horizontal parting flange,the diffuser horizontal parting flange as well as level are sealed with aluminum silicate sealing and the clearance for sealing is about 3mm;
- 11.The dimensions in parentheses only for reference.Relative dimensions of electrical motor is referred to outline drawing;
- 12.moment of inertia of fan is 1100kg.m².

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Job No.	110180
A - APPROVED	
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D - REJECTED	
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DOCUMENT SUBMISSION STATUS: FF

NOTE: Attachment 1.

REV	DATE	DESCRIPTION	DRWN	CHKD	REVD	APRD
1	24 Mar. 2015	FOR FINAL	Shuai Fu	Chen Huashin	Wang Jun	

OWNER'S CONSULTANT	OWNER
FICHTNER GmbH & Co. KG FICHTNER VIETNAM OIL AND GAS GROUP (VIG)	PETROVIETNAM PV POWER PCC

EPC CONTRACTOR	POWER ISLAND PACKAGE SUPPLIER
WorleyParsons PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)	sojitz SOJITZ CORPORATION

PROJECT TITLE	
THAI BINH2 THERMAL POWER PLANT 2 × 600MW	

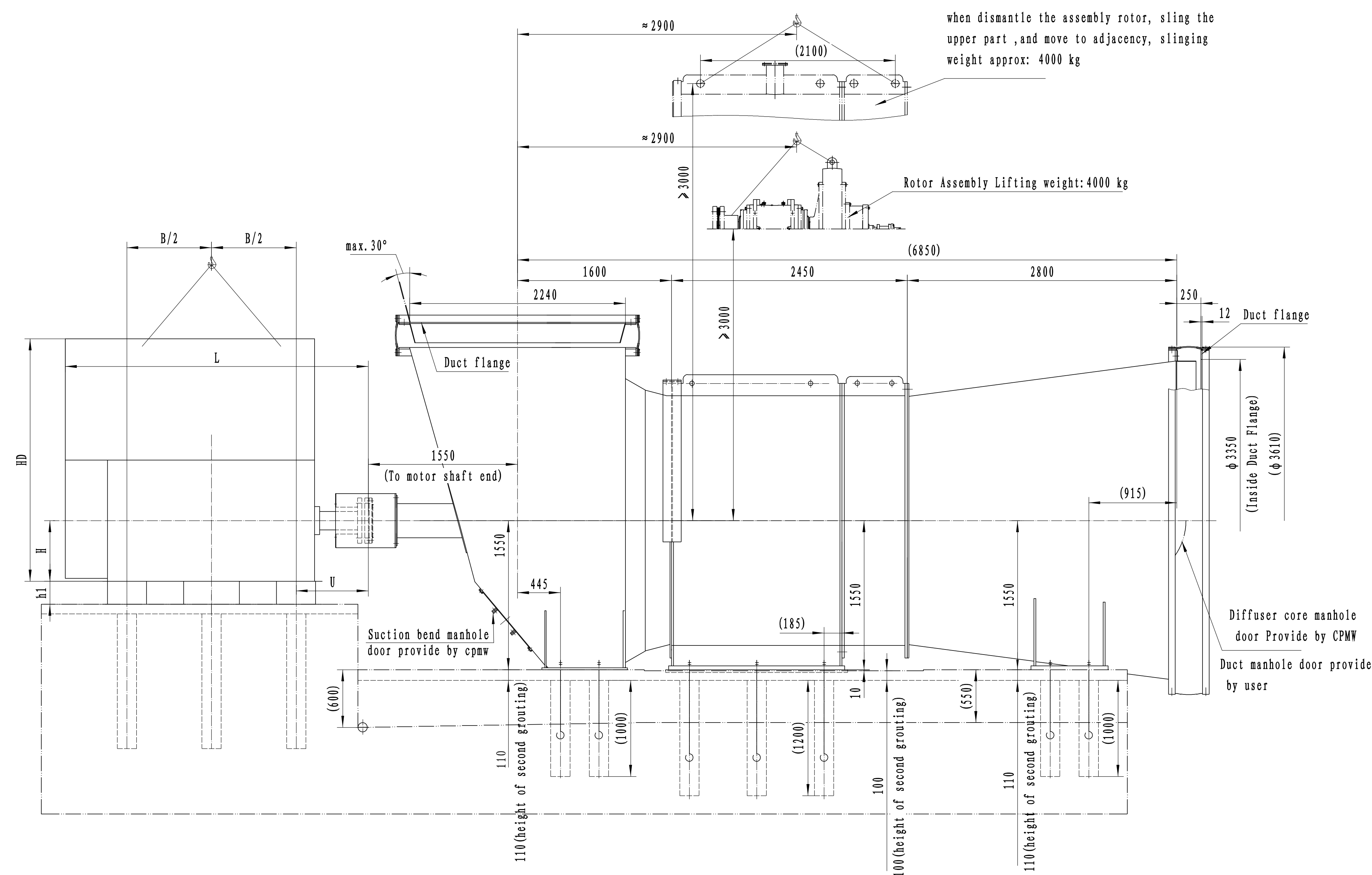
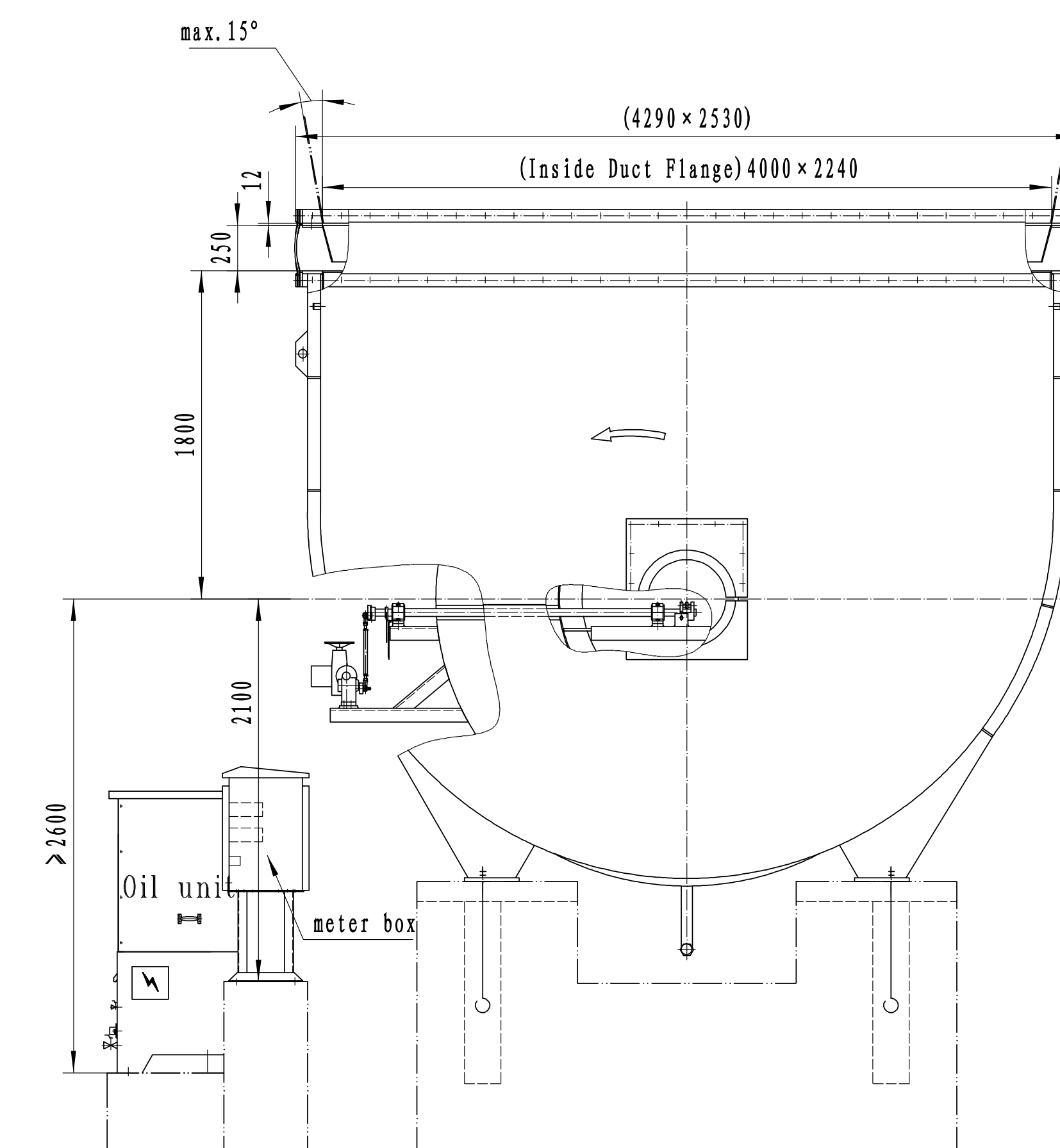
DRAWING TITLE	
FD Fan Assembling DRAWING	

BIP SUPPLIER	BIP SUB-SUPPLIER	FUNCTION	NAME	SIGN	DATE
BABCOCK & WILCOX BEIJING CO., LTD.	CEEC 广东省电力设计研究院 CHINA ELECTRIC POWER DESIGN INSTITUTE	DRWN	Shuai Fu	24 Mar. 2015	
		CHKD	Chen Huashin	24 Mar. 2015	
		REVD	Wang Jun	24 Mar. 2015	
		APRD			

DRAWING NO.	JOB NO.	SCALE	REV. NO.
TB2-SDC.VP101-00100-W-MIA-MAN-9034	110180		

FILE NAME:TB2-SDC.VP101-00100-W-MIA-MAN-9034 Rev0

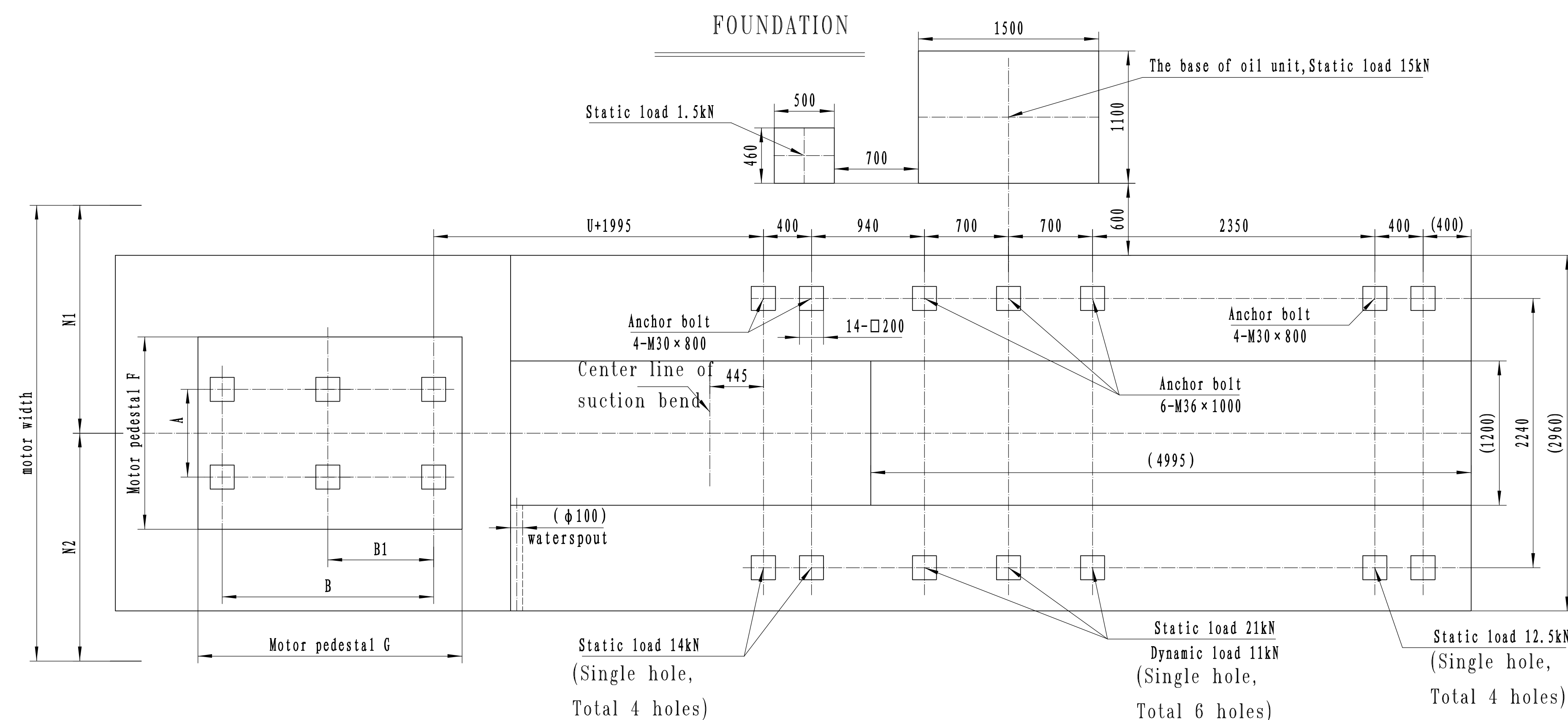
DWBC drawing No.



Technical requirement

1. Temperature measuring device is the surface thermal; Vibration measuring monitor system one set.
 2. When the fan is installed, the max lifting weight is about 12000kg; when examined and repaired, it is about 4000kg.
 3. Accommodation of this fan is toggle hydraulic pressure by actuator to adjust movable blade.
 4. The revising requirement of coupling of motor and impeller side: radial displacement $|r| < 0.1\text{mm}$, angle displacement $|\alpha| < 0.25^\circ$.
 5. The level error of electromotor shaft should be less than 0.05mm, the level error of fan shaft should be less than 0.02 mm.
 6. When assembled and overhauled, all the bolt should be fastened according to the moment required on the manual and drawing.
- Note: 1. The dimensions within brackets in the base lithography are reference for base construction.
2. The dimension of oil unit and meter box are preliminary.
 3. This drawing is the arrangement of actuator in left side (view in clockwise), the arrangement of actuator in right side is opposition direction;

Duplin Industrial Co., Ltd.	
job No.	110180
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	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
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Fan Property Data Sheet

N0.	Rotary speed r/min	Flow volume m ³ /s	Total pressure Pa	Air pressure Pa	Medium temperature °C	Medium density kg/m ³	Shaft power kW	Inertia kg. m ²	The weight of the fan kg	Notes
1	990	250.4	5300	101080	48.3	1.089	1527	1000	21000	T. 1

Motor Detail List

NO.	Type	Power kW	Voltage kV	Rotary speed r/min	Weight kg	Dynamic load (single bolt)		Static load (single bolt)		Dimension																Anchor bolt		Vendor	User	No
						kN	LB	kN	LB	A	A1	B	B1	B2	F	G	U	H	h1	HD	L	N1	N2	Drawing No	QTY.					
1	YKK710-6WTH	1700	10	995	13800	20.3	36.5	22.5	1400		2160	1080		1640	2440	700	710	250	2710	3580	1420	1420	M48×1400	6	Xiang	Yin Shih 2 Thermal Power Plant, Hsinan	F			

DOCUMENT SUBMISSION STATUSES: FF							
NOTE: <div style="text-align:center; color:red;">Attachment 3.</div>							
	24 Mar 2015	FOR FINAL			Shuai fu	Chen Huamin	Wang Jun
REV	DATE	DESCRIPTION			DRAWN	CHECK	APRO
OWNER <div style="float:left;"> VIETNAM OIL AND GAS GROUP (PVN)</div> <div style="float:right;">OWNER'S CONSULTANT FICHTNER GmbH & Co. KG FICHTNER PV POWER PCC</div>							
EPC CONTRACTOR <div style="float:left;"> PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PTVC) Sojitz SOJITZ CORPORATION</div> <div style="float:right;">EPC CONTRACTOR'S CONSULTANT WorleyParsons <small>WORLEYPARSONS</small> WORLEYPARSONS</div>							
POWER ISLAND PACKAGE SUPPLIER DAELIM INDUSTRIAL CO., LTD.							
PROJECT TITLE THAI BINH2 THERMAL POWER PLANT 2 x 600MW							
DRAWING TITLE FD Fan Outline Drawing							
BIP SUPPLIER 	BABCOCK & WILCOX BEULIN G.O. LTD.			FUNCTION	XNAME	SIGN	DATE
BIP SUB-SUPPLIER 中国能建 广东省电力设计研究院 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE				DRAWN	Shuai fu		24 Mar 2015
				CHECK	Chen huamin		24 Mar 2015
				REVD			
				APPD	Wang Jun		24 Mar 2015
DRAWING NO.	TB2-SDC.VP101-00100-M-MIA-MAN-9036			JOB NO.	110180	SCALE	REV. NO.