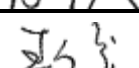


DOCUMENT SUBMISSION STATUS: FF						
NOTE:						
0	13 Aug.2015	For Final	Shuai Fu	Chen Huamin	Wan Jun	
B	28 Jul.2014	For Reference	Zeng Manjun	Chen Huamin	Wan Jun	
A	21 Mar.2014	For Reference	Zeng Manjun	Chen Huamin	Wan Jun	
REV.	DATE	DESCRIPTION	DRAWN	CHECKED	APPRDVED	APPRDVED
OWNER  VIETNAM OIL AND GAS GROUP (PVN)			OWNER'S CONSULTANT FICHTNER GmbH & Co. KG FICHTNER			 PVPOWER PCC
EPC CONTRACTOR  PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC)			EPC CONTRACTOR'S CONSULTANT  WorleyParsons resources & energy WORLEYPARSONS			
POWERISLAND PACKAGE SUPPLIER  SOJITZ CORPORATION			DAELIM DAELIM INDUSTRIAL CO., LTD.			
PROJECT TITLE THAI BINH 2 THERMAL POWER PLANT 2 x 600MW						
DRAWING / DOCUMENT TITLE PA FAN OPERATION & MAINTENANCE MANUAL						
BIP SUPPLIER:  BABCOCK & WILCOX BEIJING COMPANY LTD.			FUNCTION	NAME	SIGN	DATE
			DRWN	Shuai Fu		13 Aug. 2015
			CHKD	Chen Huamin		13 Aug. 2015
			APPD	Wan Jun		13 Aug. 2015
DOCUMENT No. TB2-SDC.VP101-00100-M-M1A-MAN-5001			No. of page: 80		Scale	Rev0

P.O NO.	110180-1600-101-001-A01
ITEMNO.	ALL
ITEM DESCRIPTION	BOILER AND BOILER BOP
DOCUMENT NO.	TB2-SDC.VP101-00100-M-M1A-MAN-5001
DOCUMENT TITLE	PA FAN OPERATION & MAINTENANCE MANUAL
REVNO.	0

Daelim's Approval Status

Daelim Industrial Co., Ltd.	
Job No.	110180
	A - APPROVED
	B - APPROVED WITH COMMENTS
	C - RETURNED FOR CORRECTION
	D - REJECTED
	N - NOT APPLICABLE(REFERENCE ONLY)
SIGNED BY : _____ DATE : _____	
<p>DIC'S PERMISSION TO PROCEED OR REVIEW TAKEN ON VENDOR PRINTS SHALL NOT RELIEVE VENDOR FROM ITS RESPONSIBILITIESOR LIABILITIES UNDER THE PURCHASE ORDER.</p>	

BIP SUPPLIER: BWBC



BIP SUB-SUPPLIER: GEDI



Document Review Comment Sheet

Daelim's Ref. No : TB2-DIC-BWBC-T-1318

No.	Document No.	Rev	Title	Purpose	Approval Status
1	TB2-SDC.VP101-00100-M-M1A-MAN-5001	B	AP Series Adjustable Profile Axial Fan Product Operation Manual	AP	C
No.	Daelim's Comments		Vendor's Response		
1	TB2-SDC.VP101-00100-M-M1A-MAN-5001				
1.1	If then,current fan design should adopt this issue carefully.		Noted.		
1.2	Please add the note for better understanding.		The condition for motor's startup is that all the preparatory work has been completed,just like the motor has been installed correctly,the wire connection is right and so on.		
1.3	If fan outlet damper is opened prior to fan motor startup,then is it possible to operate the run out point which will lead to harmful situation to fan?		It will not be harmful to the fan.If fan outlet damper is not opened prior to fan motor startup,fan will operat in the continuous excessively low flow condition which will be harmful to fan.		
1.4	Fan opening time is also required to be considered? If then,how opening time (sec) can be determined?		Fan need 25s to reach the rated speed from startup,then open all dampers in the air duct system within 1 minute that this 25s dosn't to be considered.		
1.5	What kind of “need” can be considered?		If fan is still at high speed,the air duct outlet damper should not be closed.		
1.6	If operating point of running fan is adjusted to start second fan,boiler furance pressure will be fluctuated.Even though that,there is no problem?		In this case,the fluctuation of boiler furance pressure is small,so there is no problem.		

* Legend

Purpose:

AP - For Approval
 RE - For Reference
 FF - For Final / FC - For Construction
 F - Final / AB - As Built
 INFO - For Information

Approval Status:

A - Approved
 B - Approved with Comments
 C - Returned for Correction
 D - Rejected
 N - Reference Only

Document Review Comment Sheet			Ref. No TB2-PEB-SDC-M1A-TVI-07552			
No.	Document No.	Rev	Title	Purpose	Approval Status	
					In	Out
1	TB2-SDC.VP101-00100-M-M1A-MAN-5001	B	AP Series Adjustable Profile Axial Fan Product Operation Manual	RE	-	R
No	TB2PEB's Comments	Item status	Contractor's Response			
1	This is to be an Operation and Maintenance manual. See the following comments	Note				
2	The documents title indicates that it is an operation manual, yet it contains information regarding maintenance and erection. Please note the following; 1. An Operation & Maintenance (O&M) manual will be submitted for each fan, not one manual to cover all three fans. 2. Separate Erection Manuals will be submitted for each fan. 3. The manuals to include information regarding fan motors, lubrication system, blade pitch controller, seal air fan (where applicable) and instrumentation. 4. Manuals will have a list to detail ALL documents and drawings associated with the fans, motors and lube system. 5. Manuals are to be written with the thought that the reader is not familiar with the fans and motors. 6. Sketches are not to be provided. Only project drawings are to be part of the manuals.	OPEN	1. Noted and revised. 2. Noted and revised. 3. Please reference item 6, item 7, item 14, item 3.2.2.4, item 16. 4. Please reference item 15. 5. Noted and revised. 6. Noted and revised. Drawings reference TB2-SDC.VP101-00100-M-M1A-MAN-9034~TB2-SDC.VP101-00100-M-M1A-MAN-9047.			
3	O&M, Operations - Please note the following; 1. Provide introduction regarding general design and operating philosophy. 2. Provide a detailed section regarding commissioning the fans, motors, lubrication system and instrumentation. 3. Provide detailed and specific start-up and shutdown instruction, including actions to be taken during abnormal operating conditions. 4. Tag numbers shall be provided when describing equipment. 5. Project P&IDs, general arrangement and logic drawings shall be provided. 6. Valve & Instrument Lists shall be provided.	OPEN	1. Please reference item 3. 2. Please reference item 4. 3. Start-up and shutdown instruction please reference item 4.4, 4.5, actions to be taken during abnormal operating conditions please reference item 10. 4. Noted and revised. (Reference Erection Manual and TB2-SDC.VP101-00100-M-M1A-MAN-9034~TB2-SDC.VP101-00100-M-M1A-MAN-9047) 5. Reference Fig. 8, Fig. 11. 6. Please reference item 16.			
4	O&M, Maintenance - Please note the following; 1. Provide an introduction regarding scheduled maintenance. 2. Provide specific and detailed assembly and disassembly instructions, and provide all drawings associated with it. 3. Provide a detailed section regarding periodic and scheduled maintenance. Include a lubrication schedule list including; a. 3 international suppliers of equivalent lubricants. b. Lubrication quantities (replacement and periodic fill) c. Detailed lubrication limits for contaminants 4. Provide a scheduled maintenance list based upon a time frame. For example, 1-month, 3-months, 6-months, etc., based upon equipment supplier recommendations. 5. Fault, Cause & Checks to include motor and lubrication system. 6. Detailed bearing and servomotor drawings shall be provided and identify all components including manufacturer and part numbers.	OPEN	1. Please reference item 5. 2. Assembly and disassembly instructions please reference "Erection manual", drawings reference TB2-SDC.VP101-00100-M-M1A-MAN-9034~TB2-SDC.VP101-00100-M-M1A-MAN-9047. 3. Please reference item 5. A. Mobil, Shell, PetroChina (reference item 6.4) B. Once per year, the replacement quantities of Lubrication is 1.2x Oil tank capacity (reference item 6.2.5) C. It is required to NAS 9 (reference item 6.3.2) 4. Please reference item 4.7, item 5.4, item 7.5.1, item 7.5.2, item 7.5.3. 5. Please reference item 10, item 15. 6. It is technology secret, cannot be provided.			
No	Owner/PMC's Comments	Item status	Contractor's Response			
1	Item 2.1: Pls to add the contents		Noted and revised.			
2	Item 3: Supplier is requested to introduce more detail above adjustment of fan blade angle.		Please reference item 3.2.2.4.			

Thai Binh 2 Thermal Power Plant Project - PEB Comment for Transmittal Ref. No TB2-SDC-PEB-TV-4336

No	TB2PEB's Comments	Item status	Contractor's Response
3	<u>In the Item 3.2: Major component, Please add more the main motor.</u>		Motor vendor can' t provide.
4	<u>Item4.7: Temperature of the main bearing shall be inspected daily.</u>		The temperature can be inspected daily by DCS.
5	<u>Item 5.1: Revise –“filling oil in place” to “filling oil and grease in place”</u>		Noted and revised.
6	<u>Item 7: The fan supplier should be recommended difference lubricant suppliers in order to easy purchase when it's on service.</u>		Noted and revised.
7	<u>To confirm that the fans operation configuration shall be informed and integrated with DCS and ICMS programme designer.</u>		Yes.Fan operation configuration is informed and integrated with DCS and ICMS programme.
8	<u>To clarify the “CPMW” meaning.</u>		"Chengdu Power Machinery Works".
9	<u>To update the detail parameter of each fans from data sheet and specification documents.</u>		Noted and revised.



CEEC 广东省电力设计研究院
中国能建 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

THAI BINH2 THERMAL POWERPLANT 2 x 600MW

PA 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 75L Hydraulic Lubrication system

7.1 Scope of manual

This manual is for Thai Binh 2 Thermal Power Plant 2X600MW project 75L 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:
PGP517B0380CD1H3NE7E6S- PGP517A0250XE7E6B1B1
Flow rate: 38ml/rev+25ml/rev
Qty: 2pcs
control oil pump working pressure Max. 2.8Mpa
lubricate oil pump working pressure Max. 0.18Mpa

7.2.2.2 The circulating cooling pump

Pump:
PGP517A0520CT1D7NE7E6B1B1
Flow rate: 52ml/rev
Qty: 1pcs

7.2.2.3 motor

E-motor: 1LE0001-1CB23-4GA4 Output power: 7.5KW
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 olume: 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-14041-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



- a. Check electric supply (including power supply and control circuit) and connection.
- b. 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 Bearing damages caused by over-working or wear Unsuitable bearings and clearance Little or sticky lube oil Contaminated seal cooling fan (if any) Failed seal cooling fan (if any)	Inspect, repair or replace Replace the bearing with a new one Replace the bearing according to the model and marks in the inventory and adjust the clearance properly Make-up or substitute special lube oil Clean impellers and inlet gratings of the fan Repair the seal cooling fan

Table 3: Lube oil temperature

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

Table 4: Lube oil pressure

Fault	Causes	Solutions
Low lube oil pressure	Contaminated and clogged filter Oil tube leaks	Clean the filter or switch to a stand-by filter Change a oil seal, tighten



High oil pressure. Fluctuation in oil pressure: < 6	Mal-adjusted or clogged valve Faulty pressure valve with high oil temperature and low oil level Faulty oil pump Mal-adjusted overflow valve Failed pressure accumulator	loose parts, and rectify the leaks Calibrate or clean the valve Clean or re-calibrate the valve, fill more oil Replace the pump oil Adjust the valve Inspect, refill nitrogen gas or replace according to specifications
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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
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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
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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°
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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

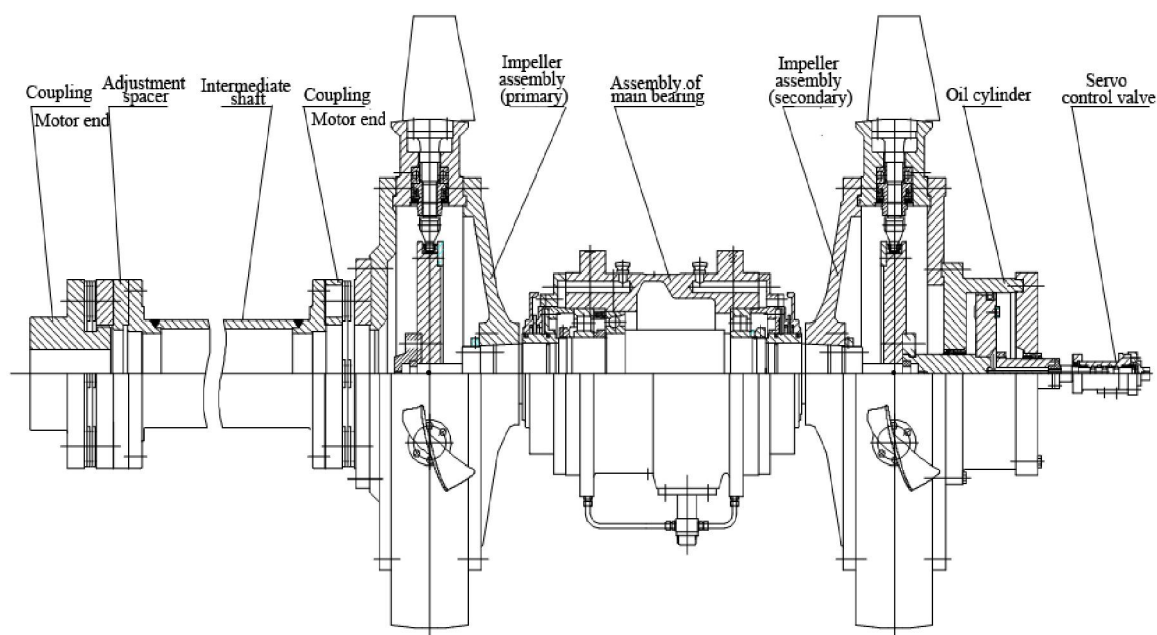


Fig. 1: Rotors of the fan; two-stage fan

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

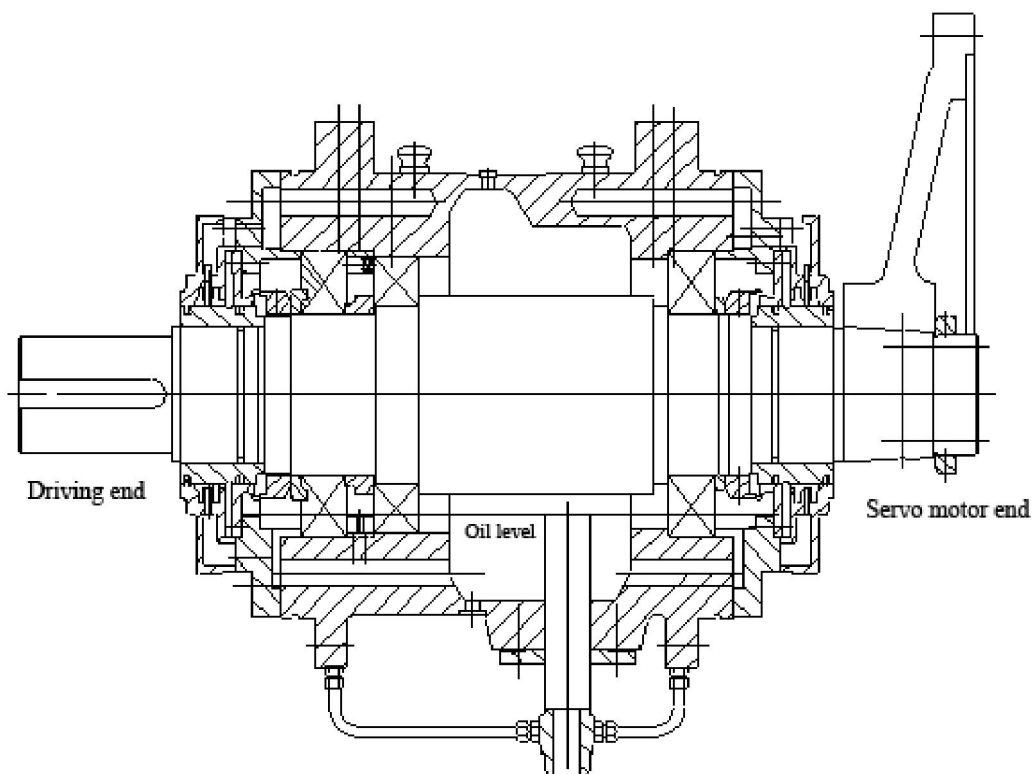


Fig. 2: Main bearing assembly

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

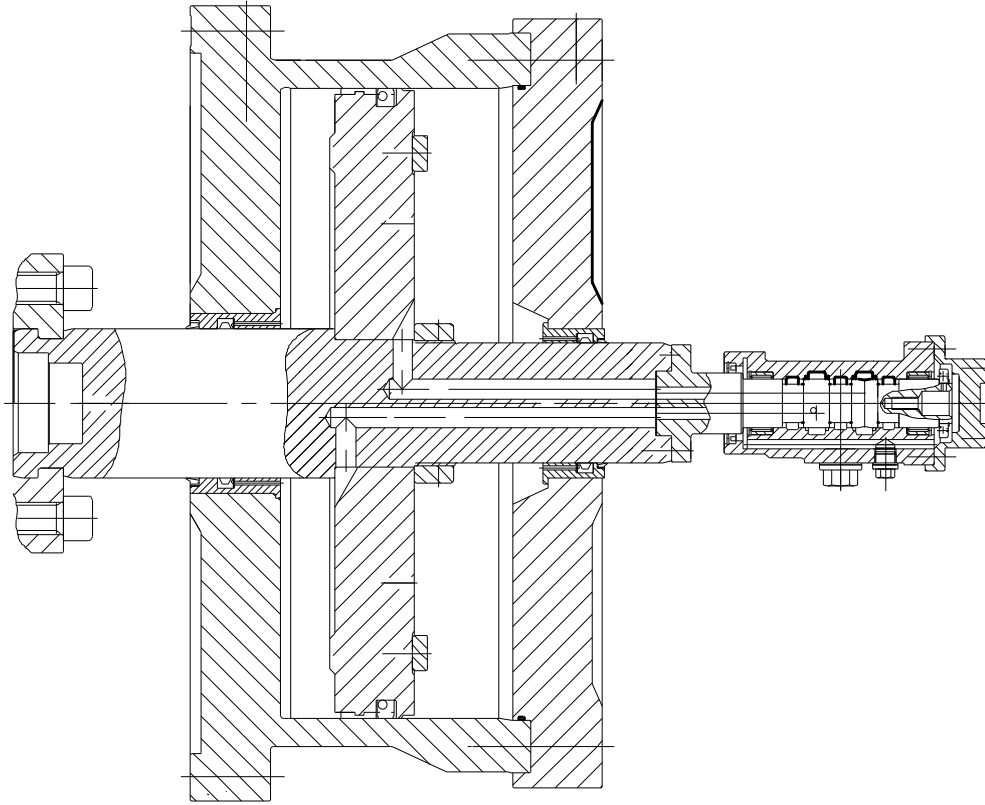


Fig. 3: Servomotor

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

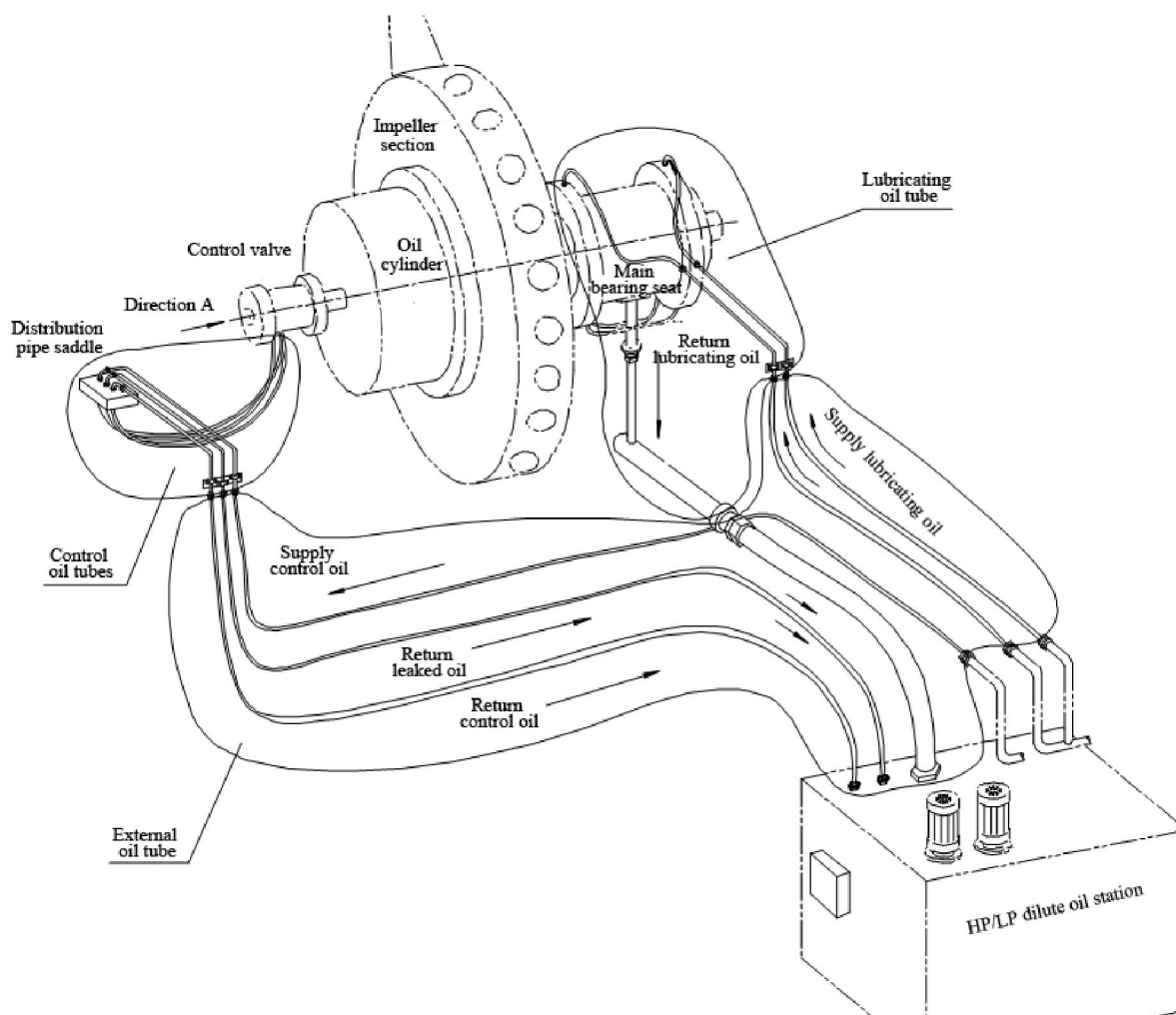


Fig. 4: Oil tubing system

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

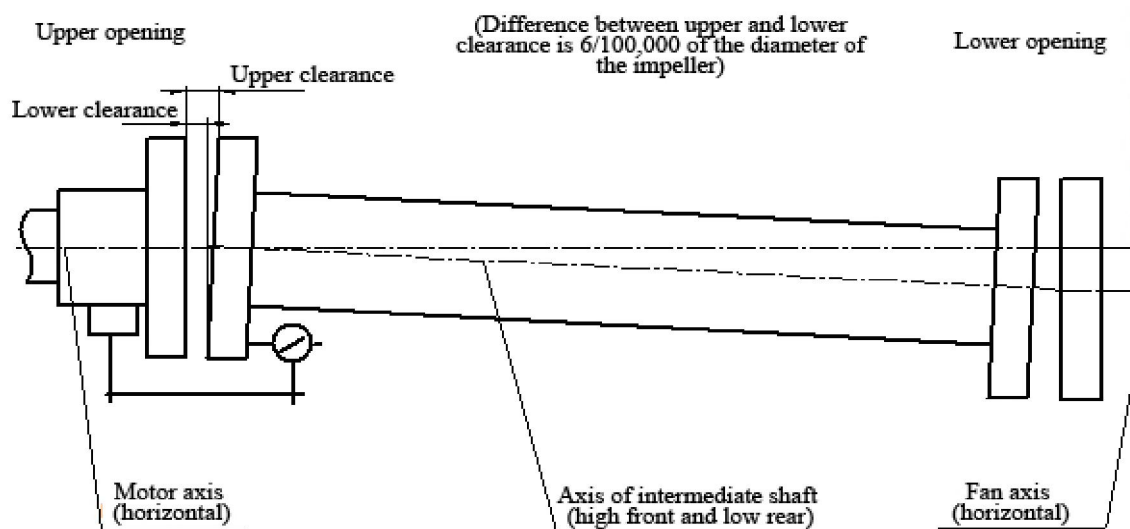


Fig. 5: Cold installation of couplings of high temperature fan

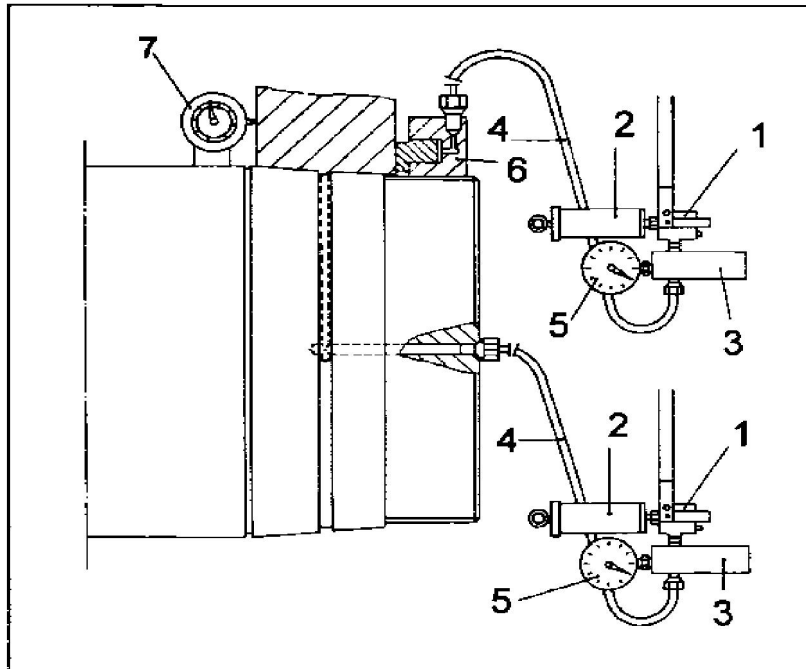


Fig. 6: Hydraulic locking device

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

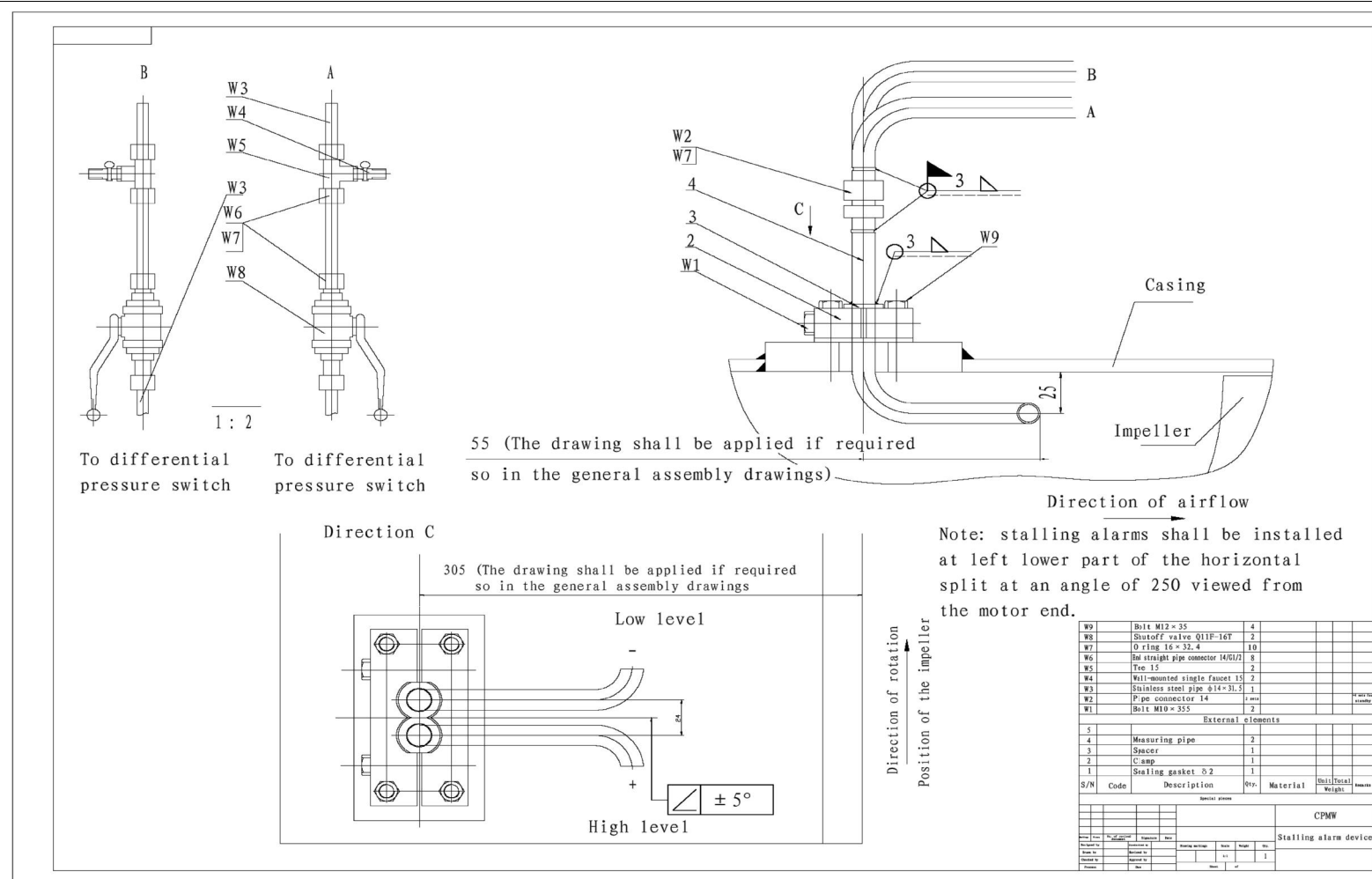


Fig. 7: Stall alarm device

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

Logic diagram of AP PA Fan

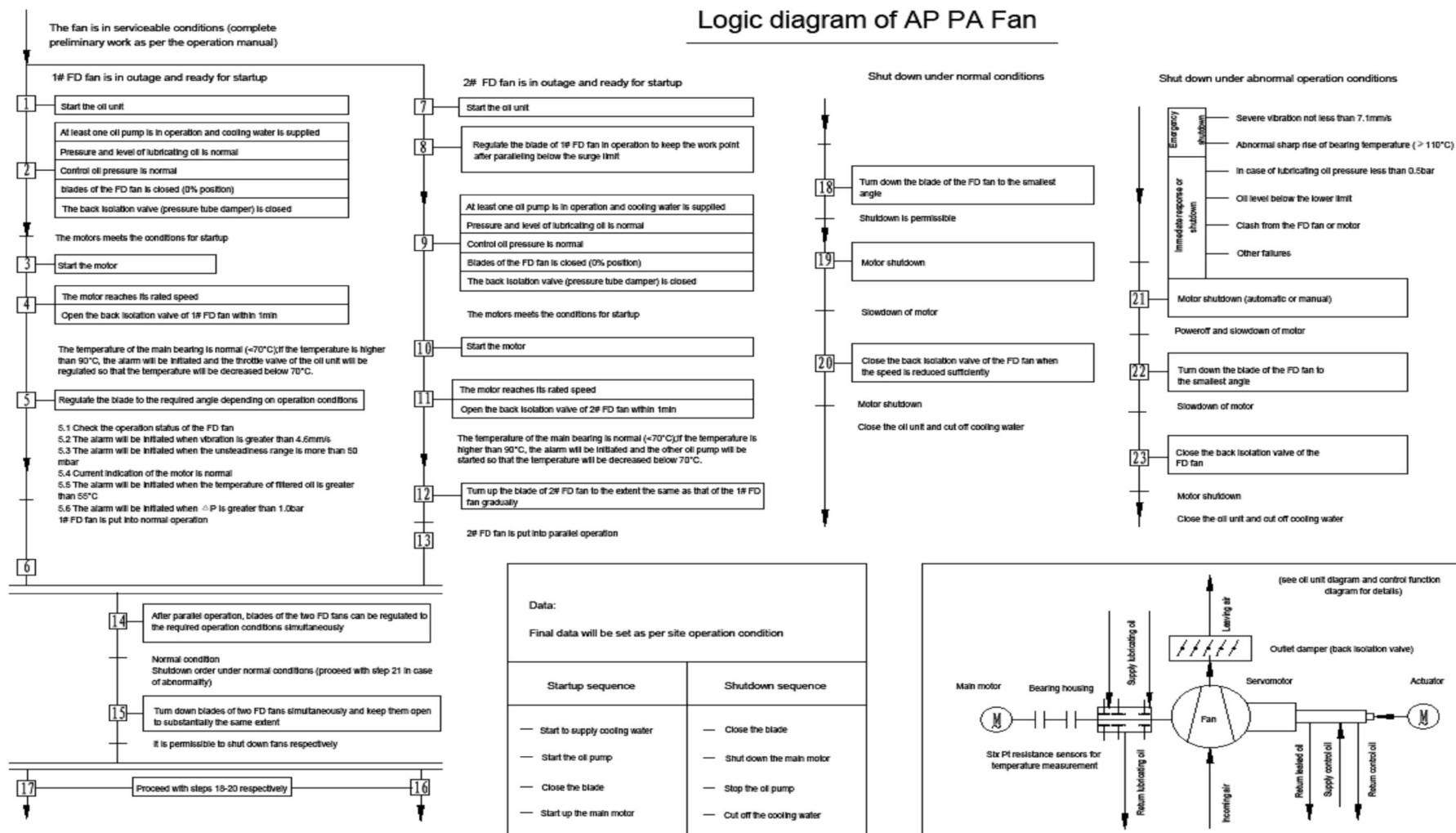


Fig. 8: Block diagram of fan control



THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

通风机型设计参数表 Fan Selection Data List
成都电力机械厂技术资料
图号: 2 页数: 2

用户 User	Thai Binh 2 Thermal Power Plant, Vietnam	机组容量 Capacity	2×600MW	风机型号 Fan Model	GU23432-11			
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	coal	TB Design	B-MCR Design	Check	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		94.1	63.72	64.27	62.69	63.23	
当地大气压 Local Barometric	Pa		101080					
当地海拔 Local Elevation	m							
风机入口温度 Fan inlet temperature	℃		48.3	23.3	23.3	23.3	23.3	
风机出口温度 Fan outlet temperature	℃		61.3	31.8	32.2	31.5	31.9	
风机入口标态密度 Fan inlet standard density	kg/Nm ³		1.288	1.288	1.288	1.288	1.288	
风机入口密度 Fan inlet density	kg/m ³		1.088	1.181	1.181	1.181	1.181	
风机入口全压 Fan inlet total pressure	Pa		-344	-250	-250	-250	-250	
风机出口全压 Fan outlet total pressure	Pa							
风机全压升 Fan total pressure rise	Pa		12400	9020	9530	8690	9180	
压缩性修正系数 Modified Factor	K		0.9589	0.9696	0.9680	0.9707	0.9691	
风机全压效率 Fan total efficiency	%		85.0	88.0	88.3	88.0	88.0	
风机轴功率 Fan shaft power	kW		1330	640	678	607	646	
电机所需功率 Motor power	kW		1500					
风机转速 Fan rotary speed	r/min		1490					
电机额定电压/频率 Motor Voltage/Frequency	kV/Hz		10 / 50					
风机转动惯量 Fan rotary inertia	kg·m ²		600					
单台风机重量 Weight for per fan	kg		15000					
备注 Remarks								
编制 Compile	奉清秀	日期 Date	2012.11.13	审核 Verify	日期 Date	2012.11.13	2012.11.13	

Fig. 9: Fan Selection Data List



THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

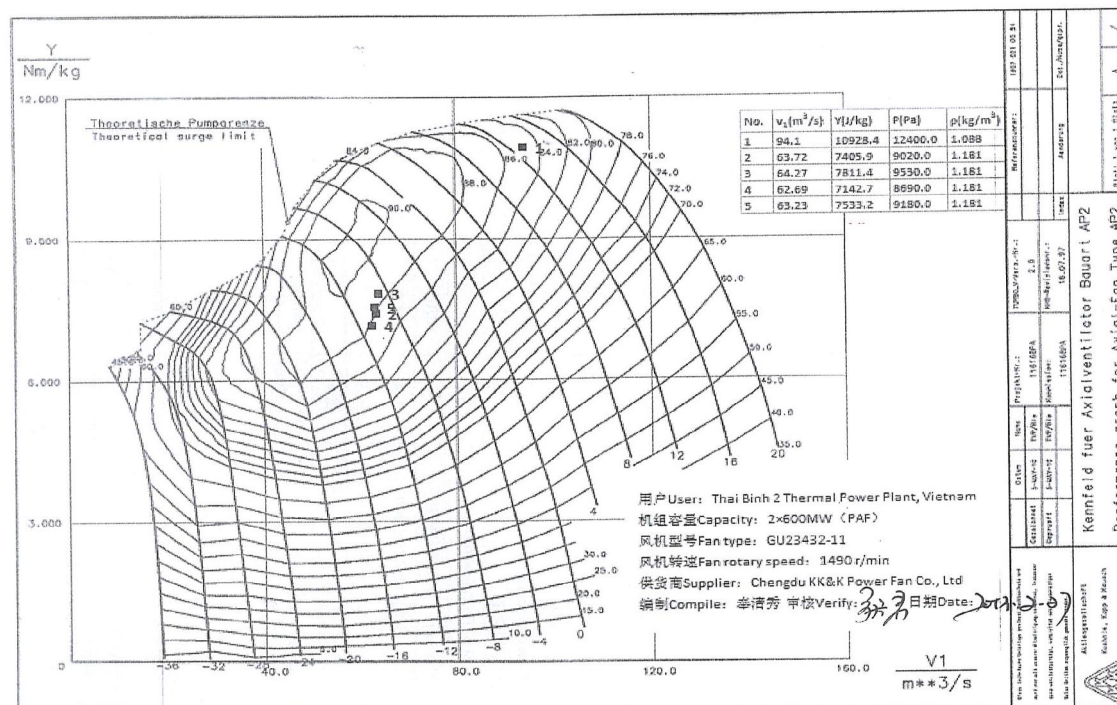


Fig. 10: Performance curve

THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

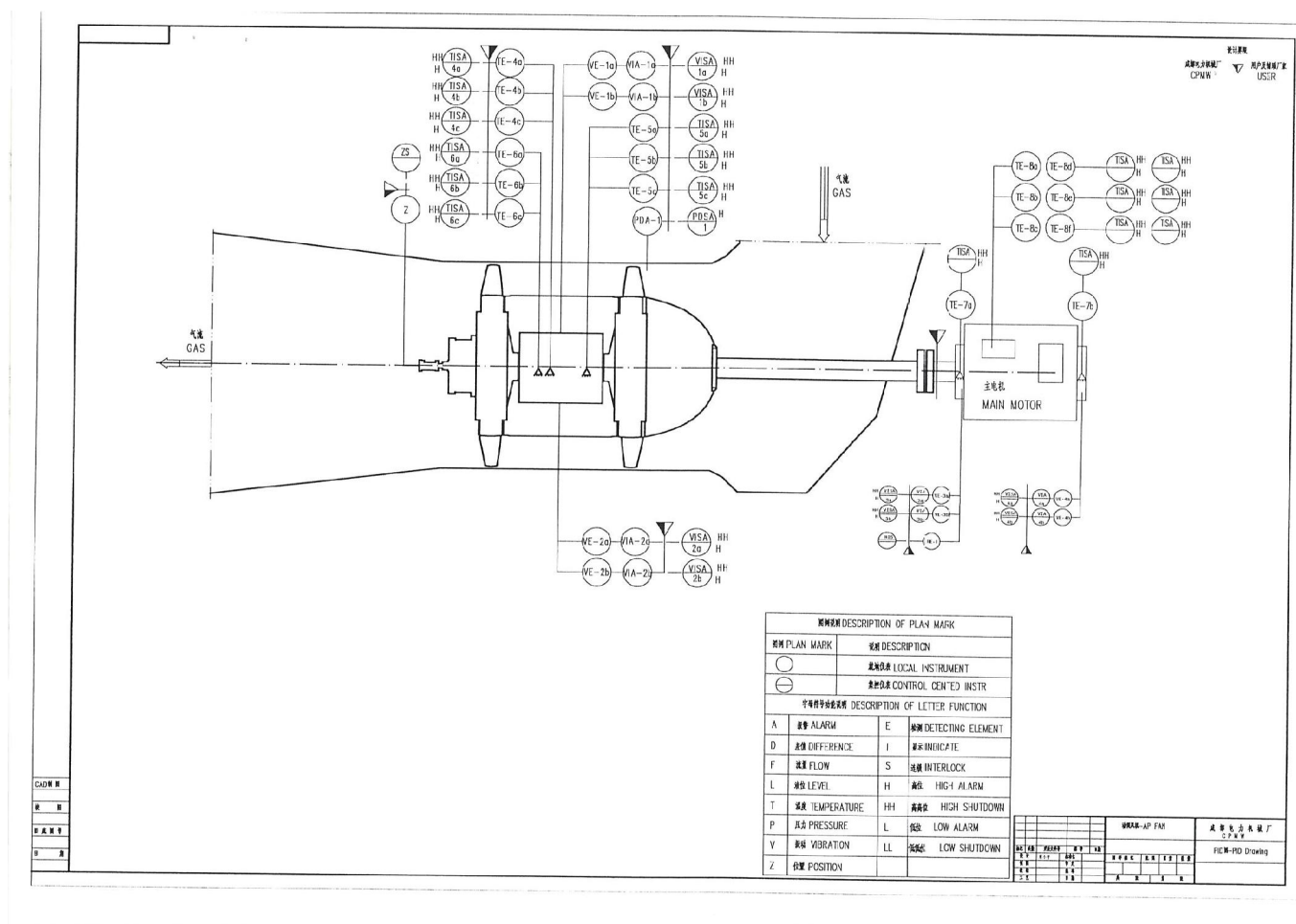


Fig. 11: PA Fan PID Drawing

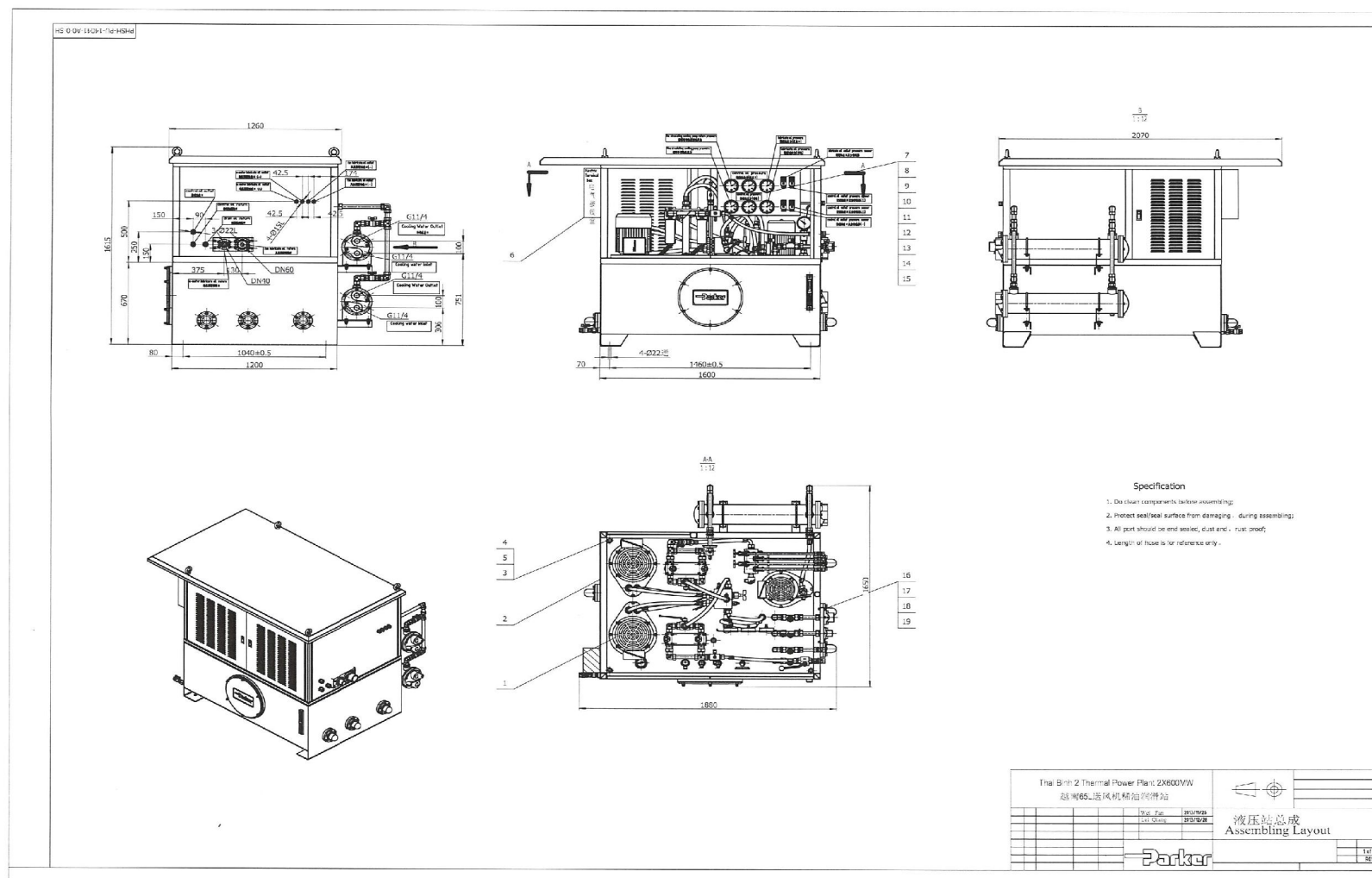


Fig. 12: Oil Unit Assembling Layout

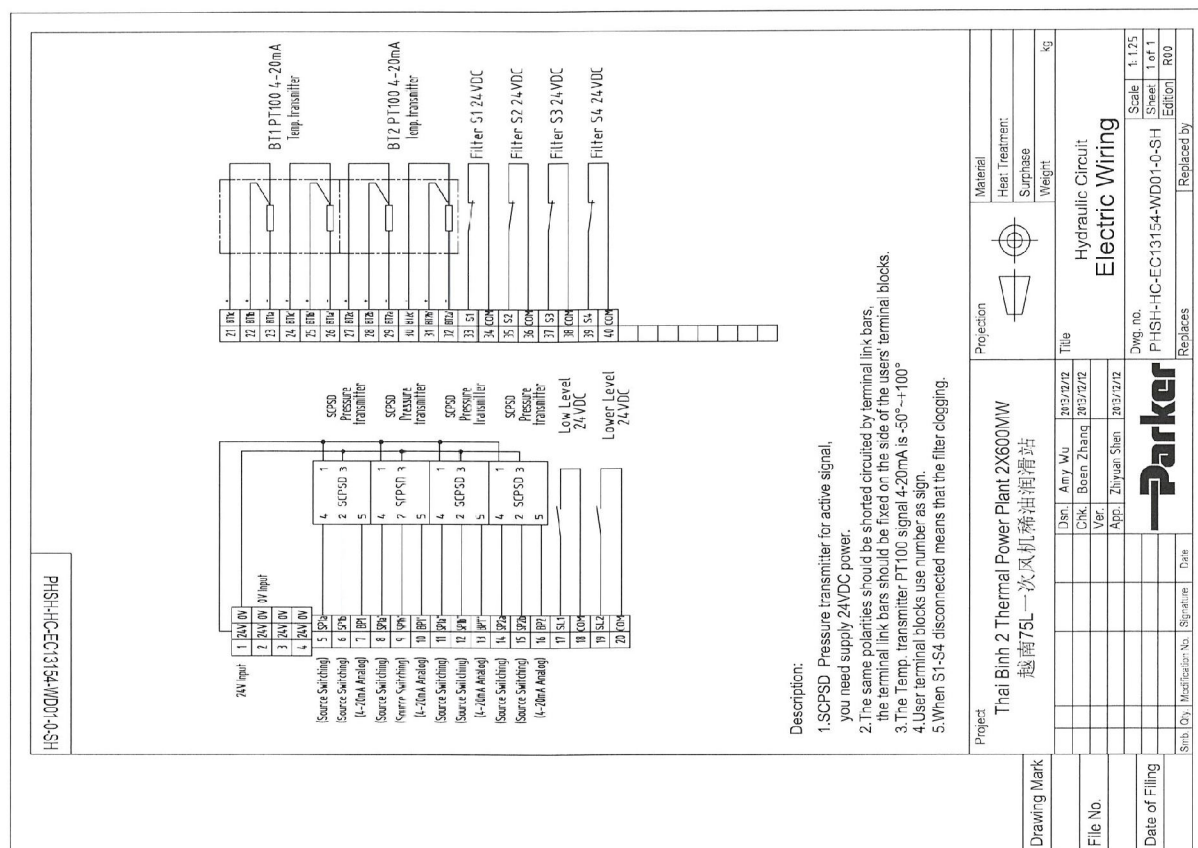


Fig. 13: Hydraulic Circuit Electric Wiring

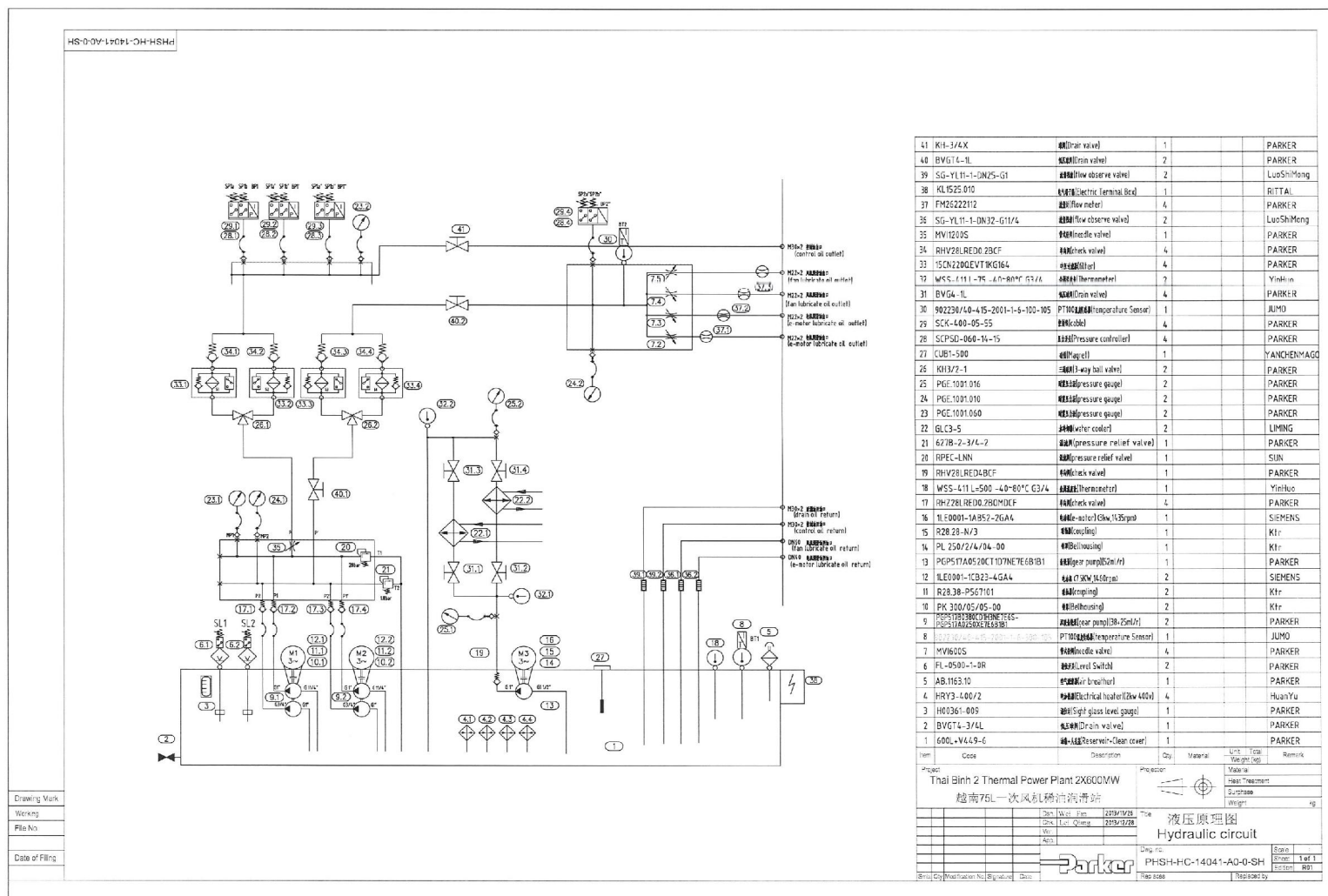
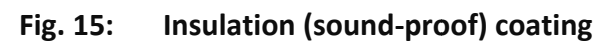


Fig. 14: Hydraulic Circuit





14. Motor Operation Instructions

OPERATION INSTRUCTIONS FOR H355-630 3-PHASE ASYNCHRONOUS MOTOR



CONTENTS

- 1 General Description
- 2 Construction Description
- 3 Transportation
- 4 Storage
- 5 Installation
- 6 Checks prior to initial starting
- 7 Start and shutdown of wound-rotor type motor
- 8 Start and shutdown of squirrel-cage motor
- 9 Starting time, number of consecutive starts and starting current
- 10 Checks in service
- 11 Troubles and the resulting causes occurring in running and method of repair
- 12 Drying up the motor
- 13 Disassembling the motor
- 14 Reassembly of motor
- 15 Special Note



OPERATION INSTRUCTIONS FOR H355~630 3-PHASE ASYNCHRONOUS MOTOR

12
A

This operation instruction is supplied together with the ordered motor. It has demonstrated the requirements and the cautions of the structure, storage and transportation, installation, as well as the requirements and cautions about operation and maintenance. The stipulations in this instructions and the rating plate, mark plate, warning plate, as well as the outline drawing, should be carefully read by the professional technicians and strictly performed. Only when professional technicians should be trained and get qualified certificates could they work on these posts.

Only the motor is assembled, operated and maintained strictly according to the stipulations in the operation instruction, outline drawing, rating plate, mark plate, wiring plate and cautions plate, does the warranty of Xiangtan Mfg. Group Ltd. Come into effect.

It is impossible for this instruction hold all the probable problems occurring in assembling, running and maintenance. For these problems not including in the instruction and the outline drawing, please directly contact with Xiangtan Electric Mfg. Group. Ltd.

1 General Description

1.1 The operation instruction is applied to the 3-Phase asynchronous motor and the derived products of H355~630 serial for common application.

1.2 The mounting arrangement is IMB3.

1.3 Enclosure

The usual enclosure modes include: IP22, IP23, IPW23, IPW24, IP44, IP54 and IP55.

1.4 Cooling Mode

The usually cooling modes include: IC01, IC11, IC21, IC31, IC37, IC611, IC81W, IC86W.

1.5 Rotating direction

1.5.1 The mark plate of rotating direction is nailed on the end shield at shaft-extension end. The shaft should rotate according to the stipulated direction, reverse is not allowed.

1.5.2 The motor without rotating direction mark plate, wiring sequence according to the sequence of phase U.V.W, should rotate clockwise seen from the shaft-extension end. It can rotate counter clockwise, but must reverse after the motor's stop, braking by reversely wiring before the motor's stop is forbidden.

2 Construction Description

2.1 Form of construction

Either for squirrel-cage or wound type motor a variety of constructions may be offered such as self-ventilated type, air-to-air or water-to-air cooler type, pipe-ventilated type and external fan-ventilated forced air-cooled type. The typical structures of motors are shown on fig. 1, fig. 2, fig. 3, fig. 4, fig. 5, fig. 6.

2.1.1 Fig. 7, fig. 8, fig. 9 show the typical assembly samples of the motor with sliding bearing



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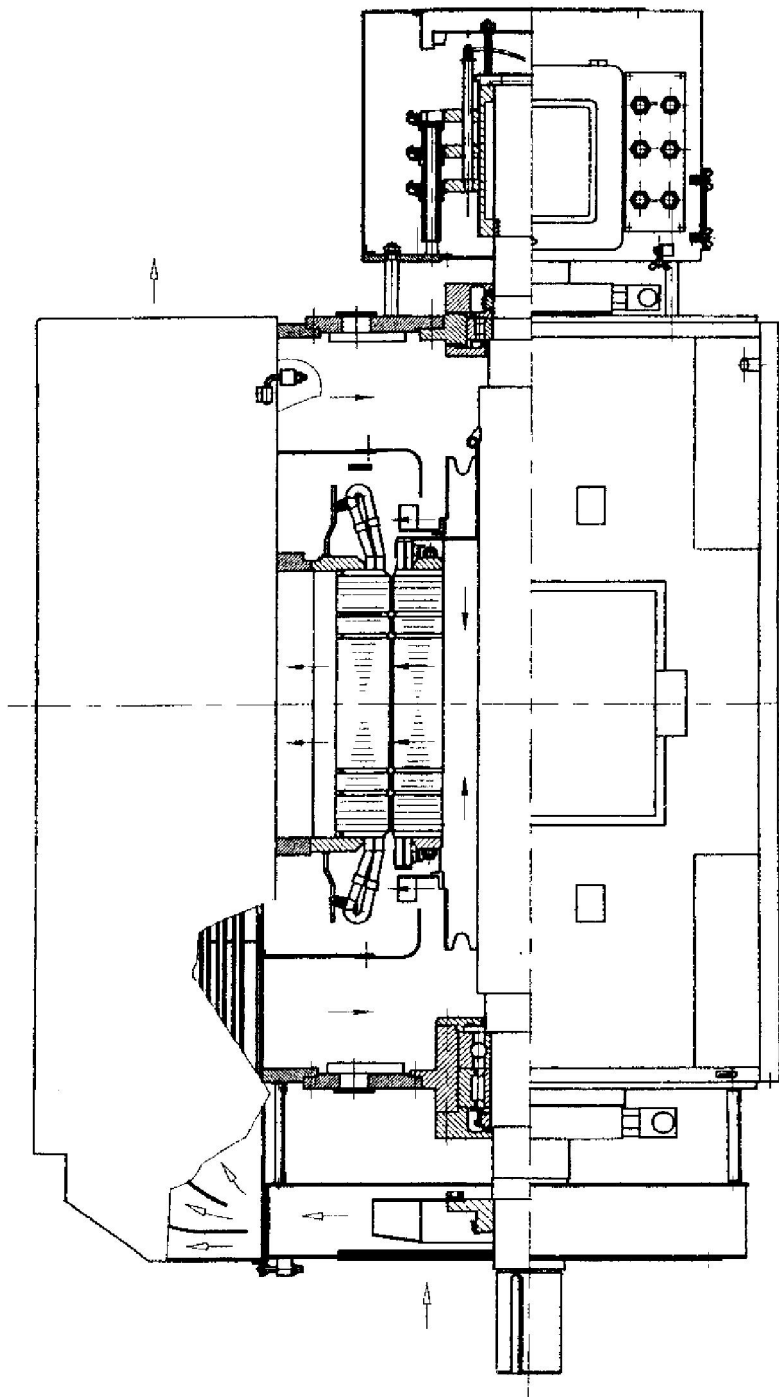


Fig. 1 Typical Assembly of YRKK Motor

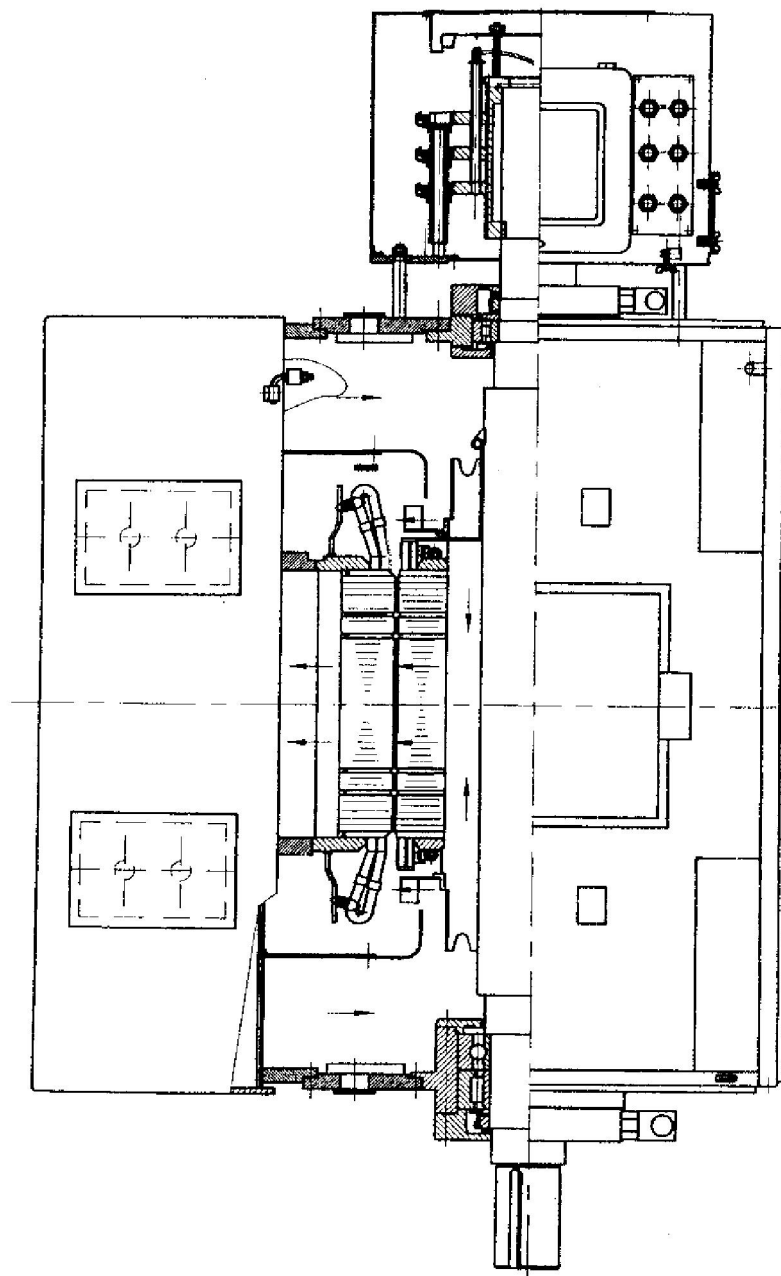


Fig. 2 Typical Assembly of YRKS Motor



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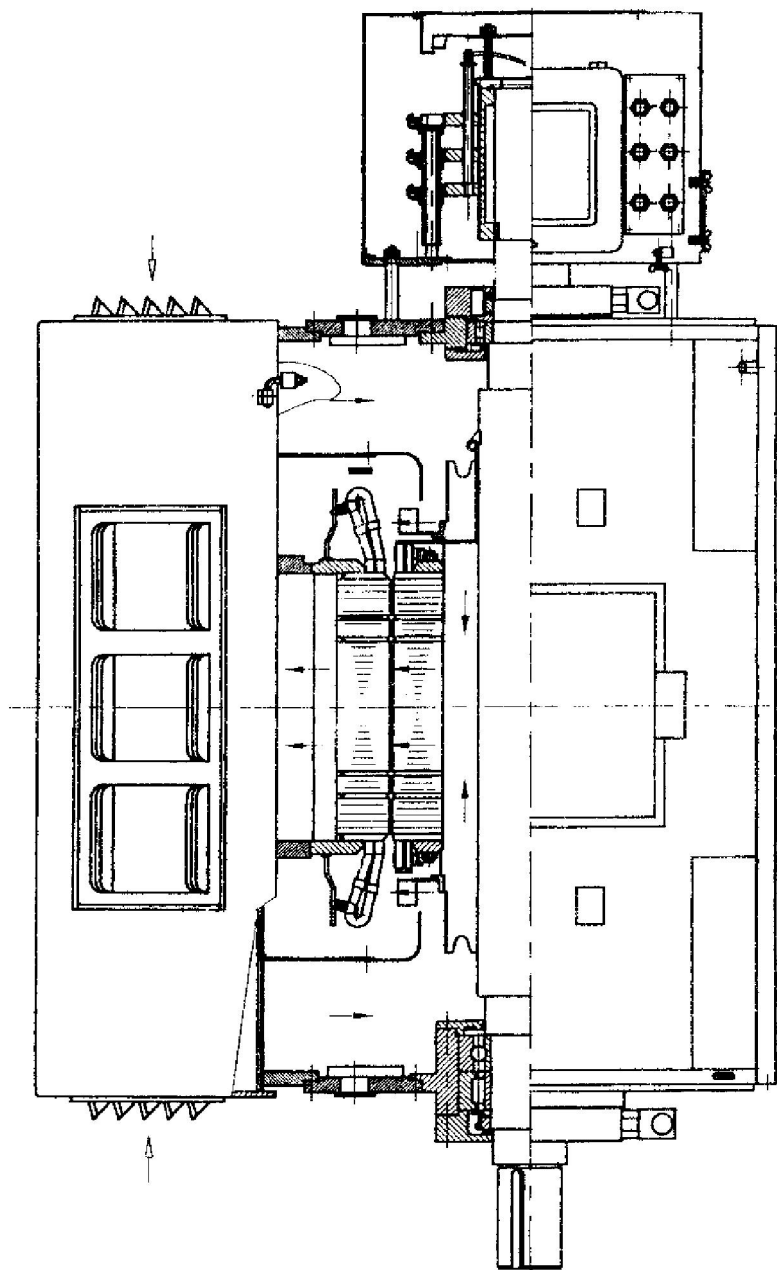


Fig. 3 Typical Assembly of YR Motor



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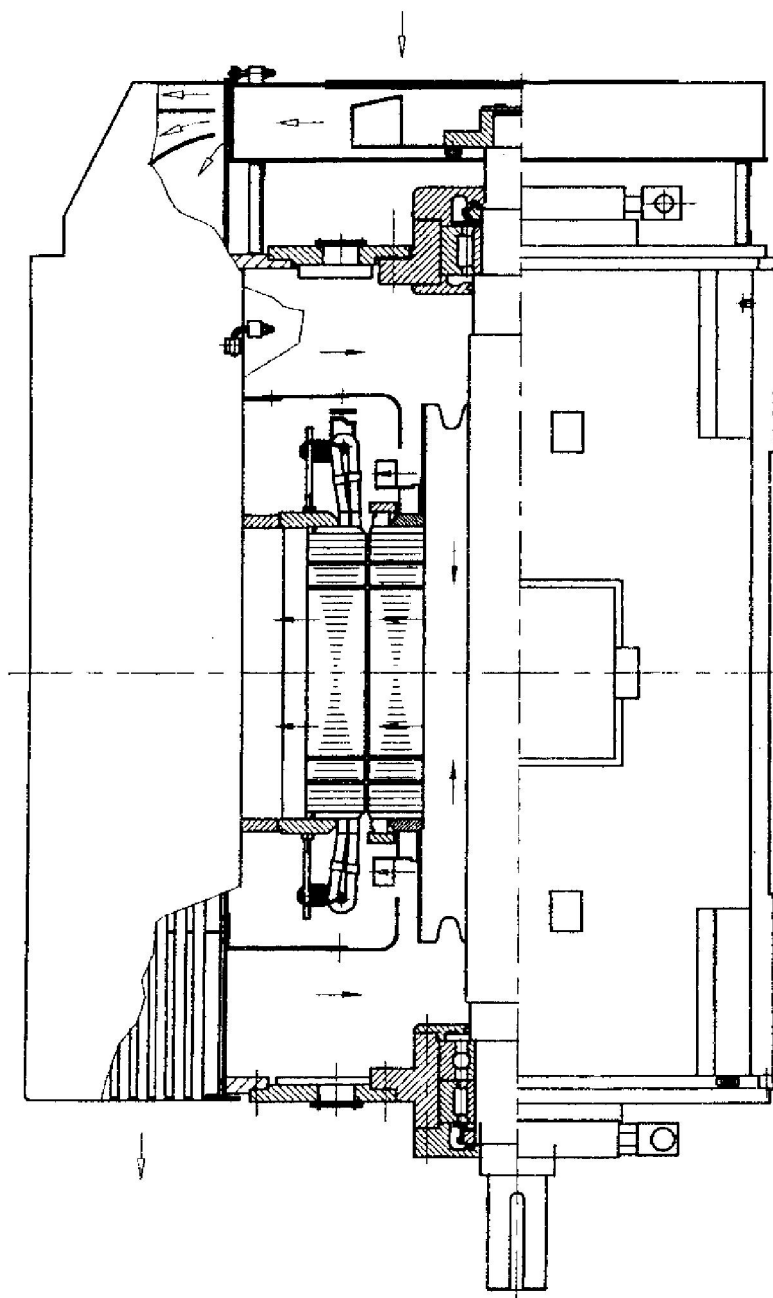


Fig. 4 Typical Assembly of YKK Motor



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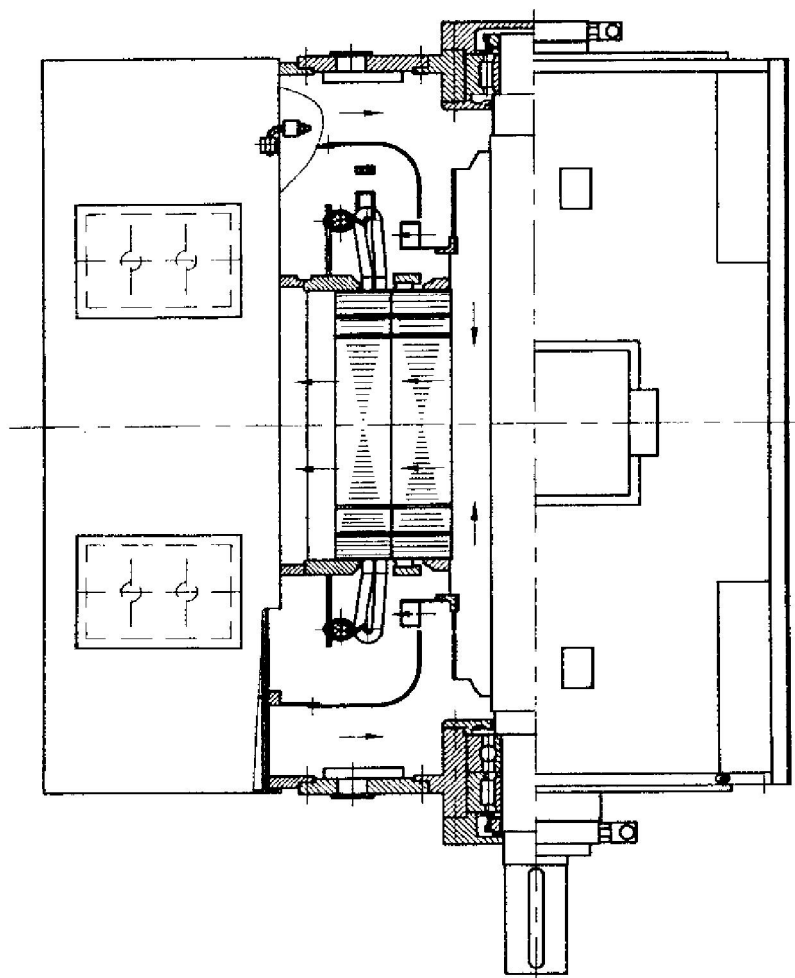


Fig. 5 Typical Assembly of YKS Motor



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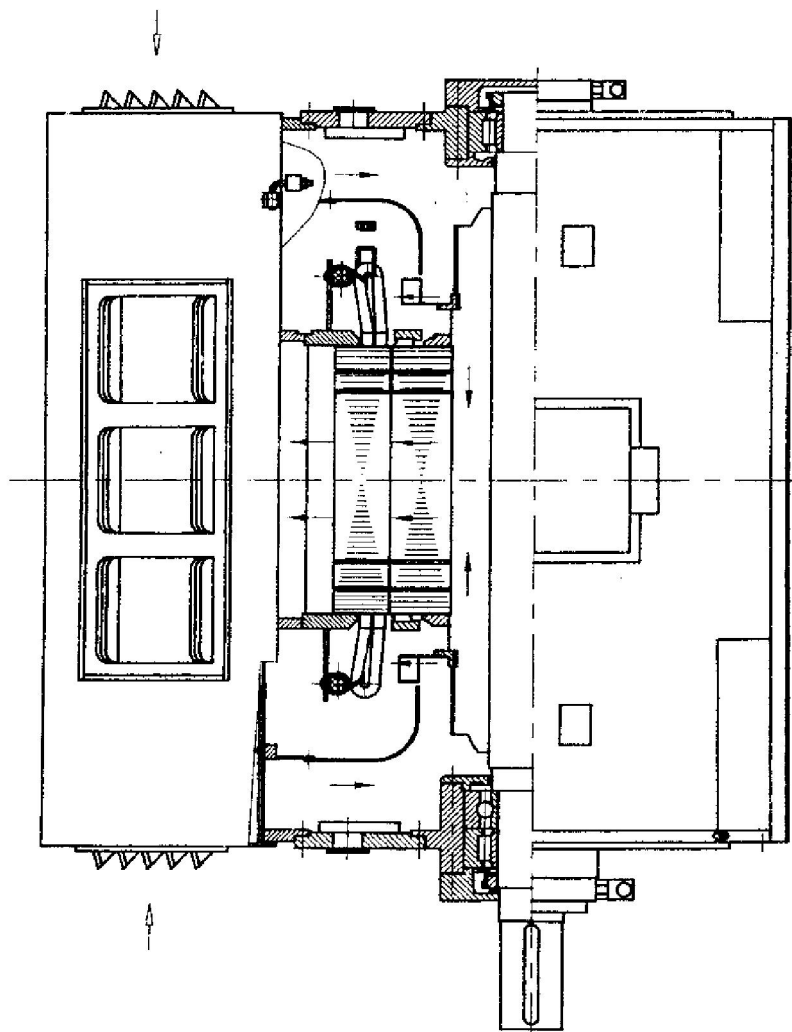


Fig. 6 Typical Assembly of Y Motor



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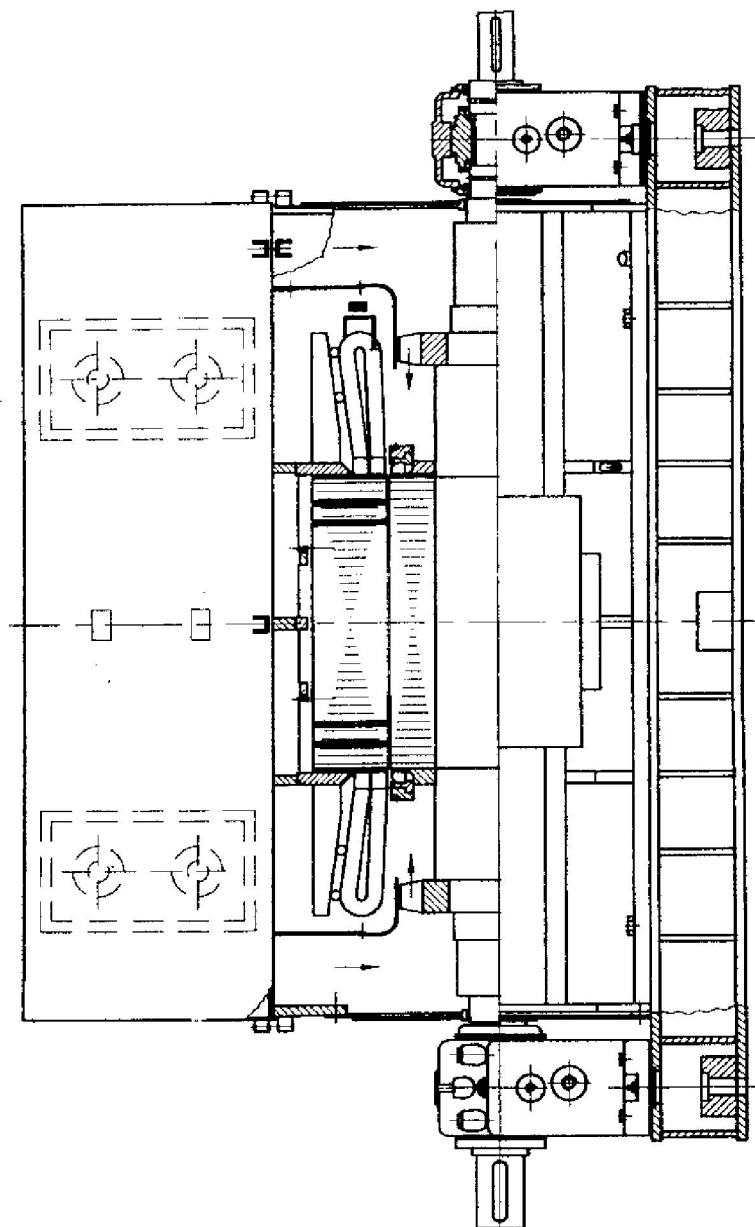


Fig. 7 Typical Assembly of YKS Motor



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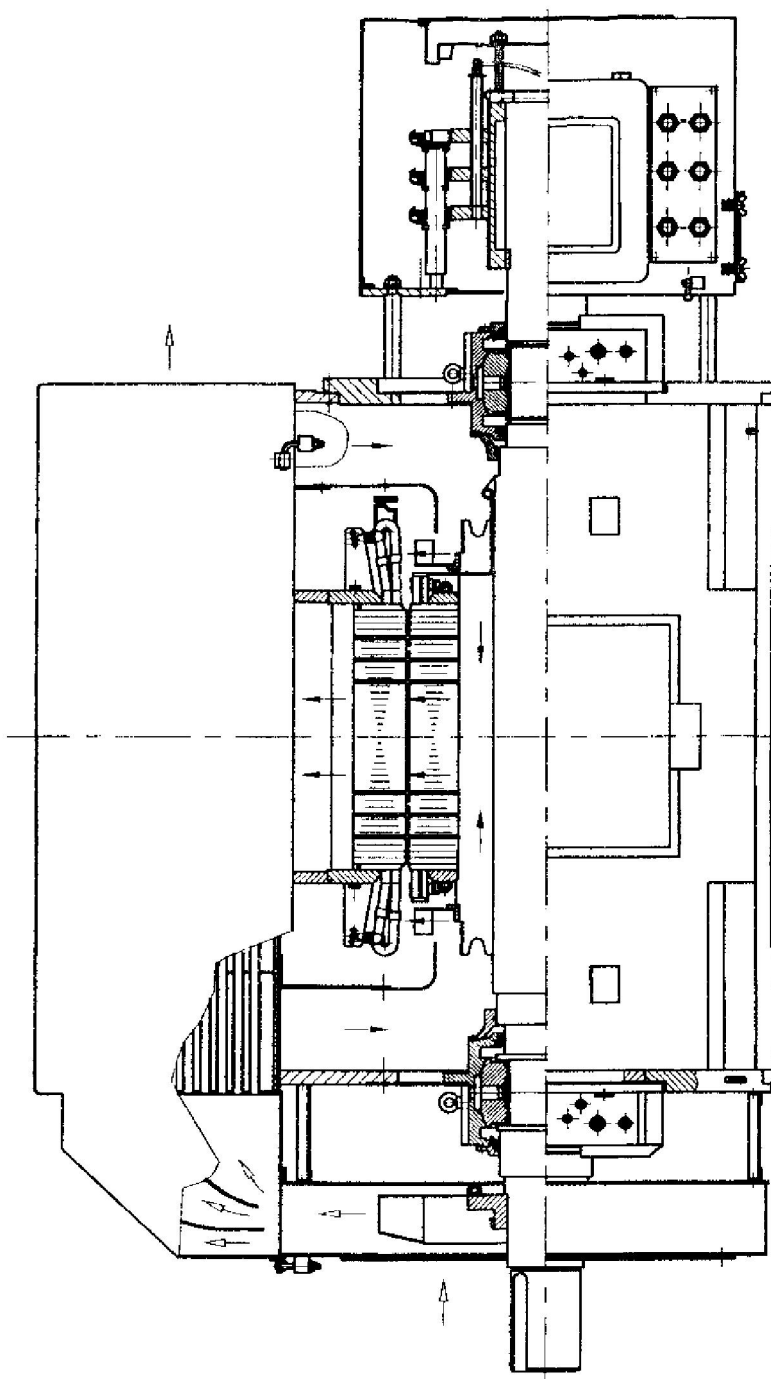


Fig. 8 Typical Assembly of YRKK Motor



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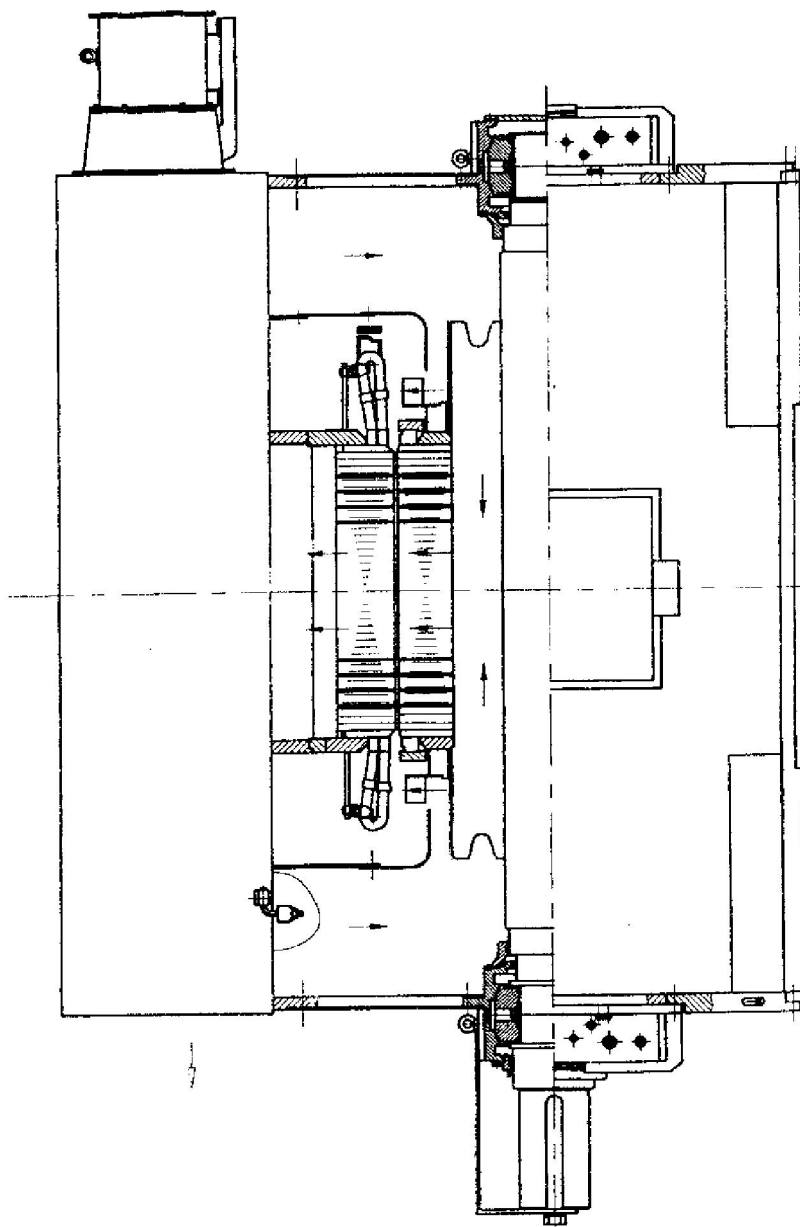


Fig. 9 Typical Assembly of YKK Motor



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and external fan-ventilated air-cooled type motor.

2.1.2 Regardless of which construction type of motors, all consist of the main components of stator, rotor, frame, end shields, bearings and terminal box, etc.

2.1.3 Self-ventilated type motors are furnished with a hood in degree of protection IP23 at the frame top. According to the customers' requirements, the top hood could be in degree of protection of IPW23 and IPW24.

2.1.4 For the type of air-air cooling motor, on the top of whose frame a air-air cooler is mounted, and at the non-shaft extension or the shaft extension end an external fan and a fan housing are mounted, or the air-air cooler is with a cooling fan itself. For the outdoor motor at the cooler's air outlet a fan housing is mounted.

2.1.5 At the top of the frame of the water-air cooling type motor, a water-air cooler is mounted, or water cooler is with a cooling fan itself.

2.1.6 For the pipe-ventilated cooling type motor, at the top of the frame, the air inlet and the air outlet pipe are mounted, or only the top protection cover for either of them is mounted.

2.1.7 There is a slipring mounted on the non-shaft extension end of the wound-rotor motor.

2.1.8 Normally a motor has only one shaft extension, but it can also have two shaft extensions. Facing the terminal box, the left is the main shaft extension while the right is the subsidiary shaft extension, if the terminal box is mounted on another side, it is just on the contrary. In the construction, the word of "non-shaft extension end" refers to the subsidiary shaft extension end of the motor with two shaft extensions.

2.2 Frame

2.2.1 Stator frame of lifting-in type is of a rectangular box-shaped construction, inside of which there are axial ribs for supporting and securing the stator. The stator core is lifted into the frame from the top end, and is secured in position with an uniform air gap by the longitudinal ribs and stator damp rings. The frame and the stator are tightened together by bolts. Inner flange of the end plates of the frame, closely match with the external flange of the end shields to secure an excellent airgap uniformity

2.2.2 Stator frame of pressing type motor is of a rectangular box-shaped construction, inside of which there are radial support plates for supporting and securing stator, the stator core is pressed into the frame from one end and is secured in position by stator clamp rings and the flange of the frame supporting plates to secure an excellent air gap uniformity.

2.3 Stator coils

The stator coils are double layer lap windings with class F insulation being corona-proof and capable of withstanding the voltage of above 3kV.

2.4 Rotor coils



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Rotor coils of a wound-rotor motor are the double-layer wave winding made of rectangular flat copper bars with class F insulation.

2.5 Stator assembly

The stator is of a external press stacking construction with magnetic slot wedges, upon request, non-magnetic slot wedges are also adopted. A suitable contour shaped insulation material is blocked between end coils which are braced tightly together with end rings and end windings supporters. After vacuum pressure impregnated in a solventless varnish, the complete stator assembly results in a consolidated core which enables to withstand vibrations and to increase moist resistance.

2.6 Rotor assembly

2.6.1 Squirrel-cage motors are provided with cast aluminum rotor which is reliable for running and available for severe starting conditions as well as full voltage line starting. Upon request a copper bar squirrel cage may be adopted.

2.6.2 For the wound rotor motor the rotor coils are fitted in semiclosed slots of the rotor core, the coil connections are soldered in accordance with the given wiring diagram, and the bare sections wrapped with insulation tape, then the complete rotor is varnish-impregnated and stoven cured.

2.6.3 Rotor shaft weld with radial ribs and cured by heat treatment has a better mechanical performance.

2.7 Bearing device

2.7.1 Rolling bearing device

2.7.1.1 In order to increase the carrying capacity of the bearing at the shaft extension end and its service life, the rolling bearing device is of triple bearing construction, at drive-end the motor is equipped with two bearings, one is a ball bearing for with-standing axial load only and a cylindrical roller bearing for with-standing radial load (between the outer race of the ball bearing and the inner circle of the end shield normally a space is reserved radially). The non-drive end has a roller bearing only. The rolling bearing device also can be of double bearing construction, at drive end is a roller bearing and non-drive end is a ball bearing.

2.7.1.2 For prevention of bearing races rotating movement occurring during the motor's running, the outer race is clamped by a pair of flange-type inner and outer bearing caps which are tightly fitted with the end shields or bearing bush, and the inner race is clamped by a labyrinth ring.

2.7.1.3 Labyrinth seals are adopted for both drive and non-drive bearing device, which can prevent not only the grease from the bearing house leaking into the motor interior to damage the coil insulation, but also the entry of dust and moisture condensation into the bearing house



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where cleanness is always kept.

2.7.1.4 The bearing is equipped with lubricating pipe and grease outlet pipe so as to regrease with ease. Instruction nameplate fitted on the frame indicate the grease inlet and outlet and regreasing intervals. Regreasing and draining grease can be done during the motor's running.

2.7.1.5 Bearings have type of enclosure IP54. Upon request the enclosure of bearings can be type of IP55 for the outdoor motor.

2.7.1.6 Type of the bearings and brand of lubricant please refer to the outline drawing attached to the motor.

2.7.2 Sliding bearing device

2.7.2.1 Sliding bearing is a separate device which is fixed on the end plate of motor frame.

2.7.2.2 On both sides of sliding bearing there are oil inlet, oil-level observer or oil outlet, bearing thermodetector element mounted hole, oil drainage hole and space for heater. The oil inlet and the oil outlet are ready for the cycling lubricating oil with pressure.

2.7.2.3 The sliding bearing is the type of end shield automatic self aligning ball, the surface of contact between bush and bearing socket as well as bearing cover is the type of spherical face.

2.7.2.4 The sliding bearing adopt the construction type of suspension labyrinth seals and air seals, which enable to prevent the oil leaking from bearing.

2.7.2.5 On the bearing socket of the sliding bearing at non-shaft extension end there is a layer of insulation material to avoid current through motor shaft occurring.

2.7.2.6 There are three types of lubricating modes in sliding bearing:

Self-lubricating mode, of which the bearing is oiled by a oil ring; lubricating mode of cycling oil with pressure, of which the bearing is oiled by a oil supply system consisting of outer oil pump, oil pipeline and bearing; combination lubricating mode which is a combination of the above-mentioned two modes, i.e. Combination of pressure and oil ring. Brand of lubricant please refer to the outline drawing.

2.7.2.7 Basic enclosure of sliding bearing is the degree of protection IP44. On request, the enclosure could be degree of protection IP54 and IP55 which are that an external cover of water resistance and dust proof is added based on the enclosure of IP44.

2.7.2.8 The bearing bush adopt the construction of single oil wedge cylinder, has two construction type of with thrust face and without thrust face, the bush with thrust face is for limiting the axial thrust resulting from the motor itself, and doesn't bear the outer thrust load. When the motor with sliding bearing has to bear the outer axial thrust, which should be demonstrated at ordering.

2.7.2.9 The front and the rear bearing bush of same type could be interchanged (different bearings couldn't be interchanged).



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2.8 Terminal box

2.8.1 Terminal box consists of a terminal box base, a cover and some insulation bushes.

2.8.2 For the terminal box rated at voltage of 3kV and above, its insulation bush is made of chemically pressing resin element or electric porcelain. For the terminal box used for low voltage rating, terminal stud is adopted.

2.8.3 The terminal box is wholly sealed, and the space between the terminal box and the motor is also sealed, which can prevent water and dust from ingressing in the terminal box and motor interior. Enclosure degree is of IP54, and also can be of IP55 on request.

2.8.4 There are three insulation bushes inside the terminal box for a single rated voltage; of the rated voltage in two type, there are six or nine insulation bushes inside the terminal box, among which the lower three insulation bushes are for inlet cables.

2.8.5 There are grounding device and wiring markplate inside the terminal box.

2.8.6 Upon request, there is tightening arrestor or mutual inductor mounted in the terminal box.

2.9 Sliprings

For the wound type motor the slipring is normally mounted outside the frame at the non-drive end whose enclosure degree is IP23, and it also can be IP44 or IP54 on request, it also can be mounted inside the frame.

2.9.1 No brush-lifting device is used, after a starting is completed brushes still contact with the slipring. Brush-lifting device may be used for rated voltage of 380V and below.

2.9.2 Number of brushes and cross section of leading cables required differ from each other depending on the rated current.

2.9.3 Some motors are equipped with the carbon collecting device, mounted under the slipring, being the type of drawer, when it is cleaned off periodically, screw off the securing studs, take out the device and clean off it by water or compressing air, put it back in its position.

2.9.4 The brand of brush is J204 or J206, upon request, other brand is also appropriate.

2.10 Air-air cooler

It is so-called air-air cooler that heat of circulating air in the motor interior is exchanged by its cooling pipes from which heat is carried away by cooling air forced from an external fan located at the non-drive end. It is suitable for totally enclosed type motor.

2.10.1 The cooling pipes fitted on two end plates by way of opening expanded at both ends, having good sealing function.

2.10.2 As the complete cooler being impregnated in a corrosion protected varnish so it is capable of corrosion stability.

2.10.3 Air-to-air cooler is put on the frame top and may be dismantled for installing and lifting.



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2.11 Water-to-air cooler

It is so called water-to-air cooler that heat of circulating air in the motor interior is exchanged by its cooling pipes from which heat is carried away by cooling water in the cooling pipes. It is suitable for totally enclosed type motor with better cooling efficiency and noise relieving function than air-to-air cooler.

2.11.1 Cooling pipes fitted on two end-plates by way of opening expanded are made of specific rolled steel tubes with ribs, and have excellent seals.

2.11.2 The cooler has been tested for water-tight under 0.5MPa.

2.11.3 The cooler may be taken out from its enclosure in order to maintain or renew with ease.

2.11.4 Water-air cooler is put on the motor frame top may be dismantled during installing and lifting.

2.11.5 Quality of cooling water required is the same as supply water. The temperature of inlet water should not exceed 33°C, but not less than 5°C, its flow under inlet pressure of 0.1~0.2MPa can be seen from the outline drawing furnished with the motor at delivery.

2.12 Protection cover

2.12.1 Protection covers of IP23 and IPW23 have several elbows at air inlets to meet with requirements of preventing water and foreign things from invading.

2.12.2 The protection cover of IPW24 has more than three elbows at air inlets and dust collecting opening.

2.12.3 Upon request, protection cover could be provided over, the motor used outdoors to shield the rain and sunshine.

2.13 Thermodetector elements

On request of customer, the stator winding and bearing may be equipped with thermodetector, the type and number of the thermodetector and its wiring method are shown on the outline drawing attached to the motor.

2.14 Space heater

On request of customer, the motor may be equipped with heater. When the motor stopped or the insulation resistance of the winding is lower, energize the heater to heat the motor or the winding so as to prevent condensate or raise the insulation resistance. The type and specification of the heater are shown on the outline drawing attached to the motor.

2.15 Impact protection device

The impact protection device is set up on request of customer. It includes arrester, current transformer, over voltage protection device. These devices may be set up on the motor or separately mounted, convenient for leading to circuit to achieve the motor protection, so as to avoid the circuit impact caused by switch operation and thunder. These live devices are enclosed to



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ensure the personnel safety.

3 Transportation

3.1 All motors have been packed and then delivered by the manufacturer. It is not allowable to unpack in transportation because of packless motor would be easily damaged.

3.2 During transportation the motor must be tightly fixed on base wood beam of the packing box in which moist-resistant packing paper and packing felt are necessary. When packing a humid-tropical zone type motor drying agent is needed.

3.3 It is necessary to avoid the motor to be turned upside down for safe transportation.

3.4 As all motors should be inspected, tested and packed after the assembly is finished, hence it is in general shipped in a completely assembled condition not disassembled condition. For air-air (and water-air) cooling type motors, it is possible to face some troubles in transportation, if any, the cooler and the fan-shield may be dismounted, In this case care must be taken to prevent against any foreign material dropping into the motor interior and against loss of accessories.

3.5 Drain up the water residue in the cooler before transportation for water-air cooling type motors.

3.6 For motors with sliding bearings the lubricating oil should be drained off from bearing before transportation and shaft journal should be coated with corrosion-proof grease as well as bushes.

4 Storage

4.1 Upon receipt of the motor, if it is not installed immediately, unpack and clean off dust, dirt, wash out the temporary protection coating, external moisture condensate and deposited corrosion from exposed surfaces of the shaft extension, sliprings and water inlet and outlet flanges with petrol or kerosene. If where rust-spots still in appearance, it could be lightly polished out with No.00 fine sand-cloth with oil, then the exposed surface should be recoated with corrosion-proof grease or temporary paint materials.

4.2 During the motor's storage, in order to avoid babbit alloy deforming resulting from the long term static pressure affection especially for the motor with sleeve the rotor should be rotated periodically. For the wound-rotor type motor, in order to avoid spots formed on the working surface of sliprings, some insulation plates may be used to insert under the brush face.

4.3 When the service motor is not of operation and planned to be stored, it should be dismantled entirely for cleaning, regreasing the bearings; for the water-air cooling type motor, the water residue and the dirty materials should be cleaned off from interior of the cooler. In addition, for the shaft extension, slipring and water inlet and outlet flanges, the work described in item 4.1 should be done. The lubricating oil should be drained up from the sliding bearings, and the



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shaft journal and bushes should be coated with corrosion-proof grease.

4.4 Motors wanted to be stored should be put in a packing box when the inspection and cleaning have been finished. The place where the motor is inspected, cleaned or packed must meet with the requirements as free of excessive dust, salty fog and corrosive gases which may cause deterioration of the insulation or corrosion of the bare conductors.

4.5 In the store interval, block off all the openings of the terminal box and cooler inlet/outlet flanges for preventing the entry of any small animals.

4.6 Inspect the stored motor once every six months to ensure whether the temporary paint has been deteriorated, or any small animal has housed in interior of the motor or in the packing box so as to keep a good storing condition.

4.7 The place where the motor stored should comply with the following requirements.

4.7.1 None of white ants, salty fog, corrosive gases and excessive amount of dust.

4.7.2 Ambient temperature should be always kept above +3℃.

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

4.7.4 The place where motors are stored should be well ventilated, but outdoor storage (including for outdoors motors) is not allowed.

5 Installation

5.1 The installing site should satisfy the follows, otherwise, the special requirement should be put forward at ordering.

5.1.1 Altitude above sea level does not exceed 1000m.

5.1.2 Ambient temperature will not exceed +40℃ for general purpose and TH type motors, and be within in the range of 45℃ to -5℃ for TA type motors.

5.1.3 The relative humidity for general purpose motors is less than 70%, and no more than 95% for TH type.

5.1.4 No white ants permitted.

5.1.5 Motors with degree of protection lower than IP54 are not capable of protecting against excessive dust, salty fog and corrosive gases, Although IP54 and superior ones are dust-proof, salty fog and corrosive gases is not permitted.

5.2 In order to load cables into terminal box, cut the rubber seal rings with a small hole less than the cables diameter, then squeeze the cables into rubber seal rings to make an excellent seal, secure the cables to be tightened by the lead-in clamps which should be suitable to the cable diameter. The cables connectors should be secured on the wiring poles with proper pressure so as to avoid crashing the insulating ceramic elements. The nuts beneath connectors should be tightened up till just press the spring washer plain; while tightening up the nuts above the con-



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nectors, in order to avoid continuous tightening of the nuts beneath the connectors to which should be damped by a tool.

5.3 Before installation of the motor, work described in item 4.1 should be done.

5.4 Motors must be located on a rigid foundation, and then subject to inspection and acceptance under national standard for safety operation of motors. During inspection any excuse to lower the qualified standard is forbidden, for the unqualified motors, they are forbidden to use.

5.5 Unless otherwise specified at the time of ordering, only coupling or hydraulic one is used for combining the motor with its load. If belt drive is needed, a special ordering contract should be signed with the manufacturer.

5.6 Use only the two eyebolts on the components frame housing to lift the motor, take care of the hood or the cooler on motor top not damaged by ropes, if necessary dismount the hood or the cooler, but don't allow the foreign material entry into the motor interior.

5.7 For the self-aligning sliding bearing, it is unnecessary and forbidden to scrap the bushes.

5.8 Make a voltage withstanding test to the motor windings if necessary. When doing it:

- a) connect all the thermodetector terminals to ground to avoid damaging them;
- b) all the protection elements which can't bear the high voltage, such as arrester etc., should be disconnected.

5.9 Magnetic center aligning

5.9.1 After the sliding bearing is mounted, align the magnetic center first before putting the coupler on.

5.9.2 Run the motor with no-load, after the motor rotor is running stably, at this time the shaft position is the magnetic center position of the motor running.

5.9.3 Mount the bearing according to the data shown on the mark plate of magnetic center located on the motor frame or magnetic center indicating mark located on the endshield. Recommend it is better to do it according to clause 5.9.2.

6 Checks prior to initial starting

6.1 A new motor or a motor after a long shutdown should be started once with no load and confirmed to be in good condition prior to couple with driven machine.

6.2 Precautions to motors newly installed or after a long shutdown.

6.2.1 Remove dirt, dust out of the machinery room, and sure that there is not salty fog, dangerous and corrosive gases.

6.2.2 Clean off dust or foreign materials from the interior of the motor. If clean with compressed air, which should be dry and clean and with pressure less than 0.2MPa.

6.2.3 Although the motor has been tested and treated with drying in the factory, even if the insulation resistance of windings between phases and to ground is in good condition, the wind-



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ings should still be dried out prior to operation. The motor which is not checked for insulation resistance and treated with drying is forbidden to operation. For drying work refer to section 13.

6.2.4 Check whether supply voltage and frequency of motor agree with the rating plate.

6.2.5 Check the switch or the magnetic contactor for correctly connecting to power source, check the power supply cables of motor for correctly connecting to switch or magnetic contactor.

6.2.6 Arrangement of leads in terminal box; with three motor leads connected according to rated voltage and phase sequence marks indicated on the nameplate; six or nine leads connected by reference to instruction plate or wiring diagram shown on the outline drawing.

6.2.7 Check the mechanical rigidity and tightness of all fixing bolts.

6.2.8 Provided that the motor is shipped in pieces, it is necessary to check the air gap between stator core and rotor for uniformity by means of thickness gauges, the maximum permissible deviation is specified in item 10.4.2.

6.2.9 For the water-air cooling type motor, although the manufacturer has made hydraulic test with pressure 0.5MPa to its cooler without water leakage in the manufacturing process, before putting into service the cooler also should be tested by means of water flowing with pressure 0.25MPa. Because in the process of the transportation, installation or storage the water inlet or outlet flange, cooler or its other parts may be damaged, so cause the leakage water drop will be brought into the motor interior by the recirculating air. Even the frequently running motor before starting also should be tested. If leakage is found out, starting the motor is not allowed. When leakage of the cooler exists, water from cooler will follow to the back end cover of the cooler along the water collecting disk which is mounted at the bottom of cooler, and is drained out from drainage of the end cover. Before starting motor and during running of motor, routinely check whether there is water follow from the drainage, if there is any, starting is forbidden or immediately stop the motor.

6.2.10 Check bearings for lubricating: lubricating grease for the rolling bearings should be clean, without foreign matter and water, don't deteriorate. Inspection and treatment could be according item 10.2. If the lubricating grease need renewing or increasing, it should be according to the brand stipulated in the outline drawing. If it is not described, usually use NO.7008 aviation lubricating grease for 2-8 pole motor. No.3 Molykote grease for above 10 pole motor. The above mentioned two brands of greases couldn't replace the other brand grease specified on outline drawing and could not mix together for use. If the previous grease brand is not ascertained or the above two brands are not available, NO.3 lithium base grease or NO.2 motor grease may be used, but the old one should be cleaned off. If the bearing temperature in the



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running period exceeds the alarm temperature, it could not be used.

For the sliding bearings, the corrosive-proof grease coating should be firstly cleaned off, then reoil the lubricating oil according to the brand in outline drawing, oil leakage shouldn't exist.

Note: In the case of short of oil ring, the user should equip the oil tank of high level.

6.2.11 Check rotor for free rotating.

6.2.12 Check slipring for smooth surfaces.

6.2.13 Check brush leads spacing between phases.

6.2.14 The normal working pressure to the brush is 0.0143 ~0.0255MPa.

6.2.15 Perform functional testing of protective and signal devices.

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

6.2.17 Measure insulation resistances with a megger, the readings should not be less than that calculated by following formula:

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

Where: R ----- insulation resistance (MΩ);

U ----- motor rated voltage (V);

P ----- motor capacity (kW)

Note: Measurements can be performed with a 500V megger for windings of 500V and below; a 1000V megger for windings of 500~3300V, and a 2500V megger for windings above 3300V.

6.2.18 Check rotating direction of a non-reversible motor whether agrees with the direction rotation plate.

6.2.19 Check the controlling circuits and protection measures to the motor for correct wiring. For the wound rotor type motor, check the starting equipment for matching and in accordance with specifications.

6.2.20 Before starting the motor with sliding bearings should be rotated manually so as to make the lubricating oil along with the oil ring spread over shaft journal. For the motor's lubricating system with pressure oil shall be started first and assure to be in good condition prior to starting.

Start the motor only after above mentioned checks have been performed and let it run with no-load for a suitable interval during which take care of the temperature of bearing not exceed-



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ing the limit specified in table 2, and of the presences of abnormal noise, excessive vibration of local hot spots. If the motor doesn't start after having being electrified for 1~2 seconds, immediately cut off power supply, carefully study the faults reason and eliminate the faults, then re-start the motor.

When the motor is found with abnormal conditions, it should be stopped immediately. Work of inspection and dealing measures is carried out according to item 11.

7 Start and shutdown of wound-rotor type motor

7.1 Wound rotor motor should be started with a rheostatic starter connected to the rotor circuit, starting measures are as follows:

7.1.1 Check the rheostatic starter that its handle should be in "START" position with all resistances in.

7.1.2 Close stator circuit breaker or magnetic contactor.

7.1.3 Advance the handle of starter gradually from "START" to "RUN" position depending on motor speed up. During this, observe that the stator current should not be higher than two times of rated current and rotor current not higher than the carrying capacity of the rheostat.

7.1.4 Whenever the rated speed is reached, however, the starting arm must be stayed at "RUN" position so as to cut all of starting resistances out of the rotor circuit.

7.2 Shutdown procedure for motor as follows:

7.2.1 Open breaker or trip magnetic contactor.

7.2.2 Turn back the handle of starter to "START" position. Connect all the starting resistors to rotor circuit.

7.3 For the water-air cooler type motor, the cooler should be supplied with cooling water prior to start.

8 Start and shutdown of squirrel-cage motor

8.1 Squirrel-cage motor is started with on-line full voltage or through an autotransformer or reactor.

8.2 For direct-on-line full voltage starting, a breaker or magnetic contactor may be used to connect the power line into stator circuit and make the motor on and off.

9 Starting time, number of consecutive starts and starting current

9.1 Whenever the voltage is impressed on the rotor, it will rotate up to its rated speed for which the starting time depends on starting torques of the motor, load torque on shaft and moment inertia of the rotating body (i.e. the combination of rotor and driven machine).

9.2 In order to prolong the service life of a squirrel-cage motor, in general, two consecutive cold starts with interrupting interval of 5 min. or hot start for once are permissible.

Provided that the motor will not speed up at the first start, it may be restarted after 5 min.



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at rest. If the motor fails to start again, the third start ought to come after as late as 2 hours; and if starting failure still occurring, no further starting is permissible unless the causes have been detected and removed, work refer to item 11.5.

10 Checks in service

Check in motor service at regular intervals as follows:

10.1 Motors should be periodically checked as per following measures.

10.1.1 Cautions must be taken for cleanliness in motor service, particular to windings. To be dirty is not allowable for neither interior nor exterior of a motor, water or oil dropping into the motor not allowed also.

10.1.2 The motor should be inspected and cleaned of dust, dirt at regular intervals depending on local conditions, sliprings, brushes and conductors must be in a good cleanliness. Keep the motor area in the clear to prevent foreign matters falling into the interior of the motor.

10.2 Checks for end shield bearings:

10.2.1 Leakage of endshield bearing is not permitted because of contaminating to sliprings and coils due to splashing grease, which is harmful to both conductive performance and insulation.

10.2.2 Take care of the bearings for with a smooth running. If any abnormal noise is present, shut down the motor immediately and remedy it on time.

10.2.3 Pick up grease sample for analysis at regular. Grease with dark color or moisture composition, dirty bearing or overheat in running should be replaced immediately. During this, bearings must be washed up with petrol and wiped for drying.

10.2.4 The regreasing intervals of rolling bearing indicated on the instruction plate located at the motor frame, it may be done while the motor is running by means of using a grease gun to inject the fresh grease into a grease nipple and the spent grease being displaced by a grease drainer.

10.2.5 Rolling bearing inner and outer rings should be in tight fit condition at normal, any loosened up not permitted in service. If any of relative movements between outer ring and end shield bearing house or between inner ring and shaft must be repaired immediately. The former results from loose bolts of bearing cap, and the latter results from loose catch bolt of labyrinth ring or splashing disk or from loose of check collar nut. Any severely damaged parts (bearing, shaft or end shield) be found should be replaced.

10.2.6 Check seal rings and seal liner of possible wear, burn-out, aging and deterioration etc., if any, replace them to ensure the complete bearing set having a good seal. The surface of felt seal should be greased also so that it would not be damaged by wear and burn-out.

10.2.7 When a motor after a longer shutdown is to be placed into operation, bearings of which should be through washed up with petrol and then added with grease in 1/2~2/3 bearing house.



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Overgreasing is very likely to cause not only leakage grease but also grease solvent due to the bearing overheating in the running. After greasing the rotor should be rotated freely by hand.

10.2.8 Sliding bearings should be checked as per following measures:

10.2.8.1 Renewing lubricating oil intervals is subject to the impurity degree and the motor's specifications, but it should be renewed every half an year at least or follow the document attached.

10.2.8.2 The cycling oil with pressure should be kept necessary volume, and the temperature of which should not be less than 50°C. While motors operating at cold zone, the viscosity of lubricating oil should be checked for according with the standard specified in outline drawing.

10.2.8.3 For the lubricating system of combination of bearings, oil level should be kept in a certain position which is subject to the central position of oil observing hole while the motor is shutdown and the oil is in a state of supplying. At this time, oil supplying volume and pressure are the rated values, if oil level alternates because of motor operation, change oil volume and keep oil pressure to assure the oil level in central position.

10.2.8.4 Volume and pressure of oil is subject to the condition that the temperature of bearings is stable, the value of which specified in outline drawing is the theoretically calculating data and for closing matching equipment.

10.2.8.5 Motors after a long shutdown are going to be used, the shaft journal and bearing bushes should be washed out by petrol, and the insulation bearing shims on bearing bracket should be secured on their positions.

10.2.8.6 Check the lubricant brand for confirming to those specified in the outline drawing, check the lubricating oil for deteriorating cleanliness if there is any, it should be renewed.

10.2.8.7 For the self-lubricating bearing, check the oil level for ending the control position of observing hole; for the bearing with pressure oil lubrication, check the oil pipe connected to bearing for good insulation (to prevent shaft current) and check the oil supplying system for blocking.

10.2.8.8 Check the oil ring of bearing for good operation, and take care to keep the temperature of bearing less than 80°C, bearing without abnormal noise, vibration and hot spots. Check the oil tank for its normal operation when no oil ring used.

10.3 Brushes and sliprings

10.3.1 The sliprings should be maintained smooth and true surface with which brushes should make good contact. If necessary, grind new brushes with glass sandpaper for graphite brushes or with sandpaper for carbon graphite brushes. For doing this, cut out the sandpaper (or glass sandpaper) into narrow tape, put it under brush with pressing against the contour of the slipring (arc form). The sandpaper should be pulled in the direction of rotation, and the brush to be



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pressed down firmly only by the normal pressure of the brush finger, not by hand.

10.3.2 Overheating of brush or sparks beneath brush, especially for brushes of stationary set, 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; if too high (or low) a value of brush tension; whether the grade of brush agrees with; if any fault detected, remedy it promptly.

10.3.3 To avoid a brush to be grind in a flanged shape, the brush extending over the slipring should not be allowed. Brushes should be renewed as per the identical grade with same size when the height of brush have been worn-out less than 30 mm, or the wiring part of brushes contacts with slipring, or brushes are immersed in oil, or brushes are damaged by foreign materials.

10.3.4 To ensure brushes are tightly fitted with their boxes but still being a freely sliding body. Brush boxes are kept to about 2-5mm off the slipring surface.

10.4 Air gap

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

10.4.2 The non-uniform air gap of motor does not greater than 10%, i.e. the difference between max.(or min.)air gap value and its average value no more than 10% of the latter.

10.4.3 While thoroughly disassemble the motor for inspection, remove all bolts retaining the stator and the frame, but do not loosen the position fixing ones.

10.5 Bolts

The tightness of all bolts should frequently be checked up. Adequate precautions must be taken for those of fixing the insulations and the rotating parts.

10.6 Checks for air-to-air cooler

10.6.1 The cooler interior should be frequently inspected to make sure that no foreign materials and no dust accumulated, if any, clear up them or by which the heat dissipation, ventilation and cooling affectiveness could be influenced greatly, in addition dust could corrode the cooling pipes and shorten the service life of the cooler.

10.6.2 While cleaning up the cooler, only woolen (not steel wool) brush should be used.

10.6.3 Inspect and clear of dust or foreign materials periodically from the external fan and its housing.

10.6.4 Periodically check the sealing shims for good seal, if the scaling shims aged, damaged, they should be renewed in time.

10.7 Checks for water-to-air cooler

10.7.1 The pressure of cooling water at cooler inlet is checked daily to ascertain that the water pressure is normally in the range of 0.1~0.2MPa (with the maximum not more than 0.3MPa) so



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as to make the water flow (meet the stipulation on outline drawing) enough in the cooling pipe for carrying away the heat dissipated by motor. Pressure of cooling water exceeding a certain value will damage the cooler and shorten the operating life of cooler.

10.7.2 The cooling water supplied to cooler should be checked regularly to keep clean (meet the requirement of industrial water standard), temperature of inlet water should be not over 33°C, and not less than 5°C.

10.7.3 The cooler should be cleaned up at regular intervals (once a year). Clean up the scale and sediment deposit from the cooling pipes (with a round woolen brush as mentioned above), thus to constitute a better heat conductive ability and to enable sufficient water flow passing through cooling pipes for carrying away the heat dissipated, it is capable to reduce the corrosive effect and to prolong the service life of the cooling pipes.

10.7.4 Periodically check the sealing shims for good seal, if the sealing shims aged, damaged, they should be renewed in time.

10.7.5 Check cooler of leakage water frequently, if any (indicated by the appearance of drops from two small holes in the lateral side of the cooler), remedy it promptly or which may cause deterioration for the insulation and even faults.

10.8 Temperature measurement

10.8.1 During running, the temperature of stator winding should be frequently measured (it is well to do once a day). When doing this, screw out the bolt set at center of the hood lateral side where without terminal box, and then insert an alcohol thermometer carefully into the frame for making a good contact with the stator winding, take out the steady temperature reading which should be in normal with the temperature rise not exceed the specified value shown in Table 1. If existing any abnormal appearance or outside the limits, shut down the motor for checking, otherwise which may influence on motor service life and even cause faults. After measuring, screw down the bolt to avoid the entrance of dust or foreign matter.

10.8.2 During running, the temperature of bearings should be frequently measured (it is well to do once a day). Measurements can be performed with a contact thermometer contacting with the bearing outer cap or pad (or with a generally used thermometer gummed up on the bearing outer cap or pad). The temperature measured should not exceed the specified value shown in table 1, otherwise, stop for checking.

10.8.3 During running, the temperature of sliprings should be frequently measured also. For safety and exactitude, readings by contact thermometer shall be commenced as soon as possible after shutdown. The temperature rise of each slipring does not exceed the appropriate value given in table 1, otherwise, it needs determining the cause of, and remedying the abnormal conditions. Only after which should the motor be put into operation continuously.



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10.8.4 If the stator and the bearings are equipped with thermodetector elements, shutdown temperature for windings is the temperature rise limits value specified in table 1 for the according insulation grade pulsing the ambient temperature specified in rating plate, and the warning temperature is 5°C lower than the shutdown temperature, the shutdown temperature for rolling bearing is 95°C and the warning temperature is 85°C, the shutdown temperature for sliding bearing is 80°C and warning temperature is 70°C.

Table 1

Part	Type	Class B			Class F			Class H		
		A	B	C	A	B	C	A	B	C
Winding (temp. rise K)	General	70	80	80	85	105	110	105	125	130
	TH	70	80	80	85	105	110	105	125	130
	TA	65	75	75	80	100	105	100	120	125
Stator core (temp. rise K)	General	80	/	/	100	/	/	125	/	/
	TH	80	/	/	100	/	/	125	/	/
	TA	75	/	/	95	/	/	100	/	/
Part	Type	Class B			Class F			Class H		
		A	B	C	A	B	C	A	B	C
Sliprings (temp. rise K)	General	80			90			100		
	TH	80			90			100		
	TA	70			85			95		
Rolling bearing (temp. deg. °C)	General	95								
	TH	95								
	TA	95								
Sliding bearing (temp. deg. °C)	General	80								
	TH	80								
	TA	80								

Note: 1 A --- Thermometer method B --- Resistance method

C --- Thermodetector method

2 TH --- humid-tropical zone type TA --- dry-tropical zone type

Ambient temperature: 40°C for general and type TH, 45°C for type TA

3 Unless otherwise specific ordered, the permissible temperature rises shall be subjected to the insulation classes given in the nameplate.



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10.9 Service condition

10.9.1 Often check the ambient air (or cooling air) if that is dry and its relative humidity does not exceed 70% for general purpose motors; 95% for TH type motors.

10.9.2 The ambient air (or cooling air) does not contain excessive amounts of dust, which may cause blockage of the ventilating ducts and pollution of the windings, thus reduced the effects of ventilating and heat dissipating so as to result in faults or shorten the service life of motor.

Take steps to clear up dust as possible, although enclosed motors are permitted to use in dirty places.

10.9.3 The temperature of ambient air (or cooling air) should be no more than +40°C for general purpose and type TH motors, or within $-5^{\circ} \sim +45^{\circ}\text{C}$ for type TA. In case of a too low temperature heater is in need of; on the other hand, if the temperature exceeding the limits mentioned above, it is necessary to reduce the temperature of cooling air or derate the load of motor until the temperature rise of stator winding or iron core lies inside these limits given in Table 1.

10.9.4 Often check whether the ambient air contains dangerous, corrosive gases and salty fog, if any, those should be instantly clear up as possible, otherwise the service life of the motor, as it is severely corroded away, would be shorten to a considerable degree, particularly with regard to motors with degrees of protection lower than IP44. Take steps to reduce the corrosive gases and salty fog contents of the ambient air as possible, although special protected motors are permitted to use in polluted ambient air. Any dangerous gases existing is forbidden.

10.9.5 Often check whether white ants exist inside and outside the machinery room, if any, eliminate them instantly.

10.9.6 In case of forced ventilated motors in which the air is expelled through ducting or filters, the flow of air should be checked with reference to the outline drawing furnished with the motor at delivery. The filter through which air is expelled should be frequently inspected to ensure for providing sufficient air without any possible restriction of the entry of air into the motor.

10.10 Terminal box

10.10.1 Check seals of terminal box at regular intervals. Seal rings and liners should be renewed in time if they come to lose their sealing function due to aging or deterioration.

10.10.2 Often check the seal and fixation of the supply cable entry to the terminal box. If there exists any poor sealing or loose fitting, it is necessary to tighten the looseness and replace the seal rings in time.

10.10.3 Check the quality of contacting between power cable joint and terminal studs. The presence of any appreciable burn-out of which should be promptly replaced. Treat it refer to clause 5.2.



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10.11 Frequently check the earth terminal of the motor for good condition, special lightening arrester and current transformer being in a good condition.

10.12 Measure the insulation resistance of windings usually. The measured insulation resistance of any phase below the value given in subclause 6.2.17 is an indication of needing to clean up dirt and dust. If necessary dry it.

10.13 Power supply

10.13.1 In general, the motor is guaranteed for successful operation at rated voltage specified in the nameplate. If the supply voltage variation over $\pm 5\%$, the motor should be stopped, but permissible for running at instantaneous overvoltage or under-voltage, voltage variation over $\pm 10\%$ is not allowed.

10.13.2 In general, the motor is running successfully at the rated frequency specified in the nameplate. If the supply frequency is deviated from the rated value by over $\pm 1\%$, the motor needs to shut down, but permissible for running at instantaneous a little higher or lower frequency, frequency variation in comparison with the rated value over $\pm 3\%$ is not allowed.

10.13.3 The voltage and current wave of the power supply subject to satisfy the requirements of a preferable sine wave.

10.14 Load

10.14.1 During motor's running, the continuous current does not exceed the limits specified in the nameplate rating. It is well known overcurrent tending to produce a considerably high temperature rise which may cause to shorten the service life of motor.

If it is impossible to adjust the input power of the driven machine as to make the motor current within the nameplate value, a motor with larger capacity should be safely used.

10.14.2 The load torque of the driven machine can't exceed scope specified in IEC standard, because of too high a moment of inertia to be driven it will result in a severe starting and it is harmful to motor service life.

10.15 Space heater

10.15.1 Check whether the supply voltage of the space heater follows as the nameplate.

10.15.2 Check insulation resistance of the space heater usually to make sure there is no current leakage which may cause an alive enclosure and even the danger of electric shock.

10.15.3 When current goes through the heater until the temperature of air inside the motor become steady, the temperature near by coils can't exceed 70% of the temperature allowed by insulating class specified in nameplate.

10.16 Motor service record

10.16.1 Record various instrument readings systematically:

- a. The supply voltage;



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- b. The motor's load current;
- c. The supply frequency;
- d. Power input and output of the motor;
- e. Inlet pressure and flow of the cooling water;
- f. Oil flow and pressure of sliding bearing.

10.16.2 Record the involved temperature readings:

- a. The stator coils;
- b. The bearings;
- c. The cooling water at inlet;
- d. The cooling water at outlet;
- e. The motor interior after making the space heater on;
- f. The ambient air.
- g. Inlet oil temperature for sliding bearing.

10.16.3 Other recording contents

- a. The motor starting time and times;
- b. The motor stopping time, times and cause;
- c. The abnormal phenomenon of the motor in running;
- d. The inspection items of the motor;
- e. The repair items of the motor;
- f. The abnormal appearances of the driven machine in running;
- g. The inspection contents for ambient environment.

11 Troubles and the resulting causes occurring in running and method of repair

It is probable that in motor running troubles would occur in one way or another due to varieties of causes, if any, take steps instantly to dispel those troubles otherwise, which may induce a danger of breakdown. Any power source should be cut off before the disposal of the fault troubles. The most common are as follows:

11.1 Bearing overheating, abnormal sound

For the causes and remedies for bearing overheating and abnormal sound please refer to Table 2.



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Table 2

Faults	Causes	Remedies
Bearing overheating and abnormal sound.	Overgreasing or undergreasing.	Add an amount of grease or to drain off excessive grease.
	Grease, oil deteriorated or containing impurity contents.	Washing the bearing or bushes, shaft journal thoroughly and renewing the grease, oil.
	Over wear or burn-out bearings or bushes.	Renew the bearing or bushes, the type of which specified on the outline drawing furnished with the motor.
	Bent shaft resulting from overload.	Check the axial line for aligning, whether there is axial thrust load, correct shaft, reduce load.
	Insulation shims for sleeve bearings aged or damaged, inlet oil temperature is too high.	Renew insulation shims, lower inlet oil temperature.
	Loose inner/outer race of the bearing or bush.	Tighten bolts, stop crews or round nuts up. The bearing sleeve, shaft, end shield or bushes worn out, renew or repair them.

11.2 Bearing leakage

For the causes and remedies to bearing leakage please refer to table 3.

Table 3

Faults	Causes	Remedies
Bearing leakage.	Sealing devices deteriorate or any damaged, space between sealing devices is enlarged.	Make the sealing devices thicker or renew the sealing devices.
	Overgreasing, excessive oil.	Clean out excessive oil or grease.
	Grease deteriorate, thin down.	Wash out bearing, renew grease.
	Pressure or volume of oil with pressure is too much.	Adjust the oil pressure or volume.
	Bearings overheat.	Eliminate the causes leading to overheating.

11.3 Excessive vibration and noise of motor

For the causes and remedies to vibration and noise of motor refer to table 4.



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Table 4

Faults	Causes	Remedies
Excessive vibration, noise of motor.	Rotor unbalanced.	Disconnect motor from driven machine, rotor is balanced dynamically.
	Installation is not rigid or the base is not good enough.	Re -twist bolts tightly, check insulation shims, strengthen the installation base.
	Shaft is bent, shaft journal vibrate excessively.	Correct the shaft distortion, align shaft extension bumper, bearing bumper and rotor core bumper, correct out-of-roundness of shaft journal.
	Broken bar or cracked end ring of the cage rotor.	Replace rotor bars, end rings even the complete rotor assembly.
	Coupling poorly fitted or balanced.	Coupling to be balanced dynamically, correct the fit of coupling.
	Shafts not in control line.	Re-position and re-align the motor and its driven machine.
	Vibration frequencies of the bedplate coincided with the motor (set).	Adjust the vibration frequency of bed plate so as to differ from the motor set.
	Bearing or bushes damaged.	Renew the damaged bearings or bushes.
	Non-uniform bedplate dropping.	Make the foundation rigid enough.
	Bedplate is not rigid enough.	Strengthen the rigidity of the bedplate.
	Non-satisfactory operation of the driven machine.	Repair the driven machine by aid of its operating instruction for getting a satisfactory operation.
	Excessive end play.	Repair or renew the damaged or worn out shaft, bearing device.

11.4 Broken shaft

For the causes and remedies to the broken shaft refer to Table 5.



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Table 5

Faults	Causes	Remedies
Shaft broken.	Misalignment of the motor set	Renew shaft and damaged parts, align motor set in central line.
	Impulse load exceed the allowable maximum torque value which can be seen on the outline drawing furnished with the motor.	Renew shaft and damaged parts, reduce the impulse load, take remedies to avoid excessive impulse load.
	Motor reverse abruptly.	Renew the shaft and damaged parts take remedies to avoid accidents.
	Excessive service time of motor, shaft broken for fatigue.	Renew the shaft and damaged parts or even the complete motor.

11.5 Abnormal starting

For the causes and remedies of the abnormal starting refer to Table 6.

Table 6

Faults	Causes	Remedies
Motor doesn't operate.	At least two inlet cables break off.	Check up the fuse, inlet cables and loading in terminals, connect circuit.
	No. voltage, wrong wirings.	Check up the inlet cables.
hum noise of motor, but rotor doesn't start.	Stator or rotor open circuit one phase at least.	Check up the inlet cables, and repair the circuit breaker. If there is not open circuit outside motor, check stator windings, stator wiring wire and rotor windings for open circuit position. If stator wiring wires break, connect them, If stator or rotor windings open circuit, renew the stator or rotor windings by the manufacturer so as to assure quality.
Motor couldn't start with load, but where is normal magnetic noise.	Excessive load torque or static torque, exceeding the value specified in ordering standard.	Repair the driven machine, disconnect motor and check it for the no-load operating if both are with good condition, reorder new motor with large output.
	Abnormally low supply voltage.	Increase the supply voltage with an allowance no more than $\pm 5\%$ of the rated value.
	Open circuit of wound rotor, broken bar or cracked end ring in the cage rotor.	Check rotor circuit, repair start rheostat, connect rotor circuit, renew cage rotor.
Motor operate with no-load, but couldn't operate with load.	After starting, one of supply cables breaks off.	Check the supply cables and connect it.



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11.6 Overheating of motor

For the causes and remedies to overheating of motor refer to Table 7.

Table 7

Faults	Causes	Remedies
Overheating of motor with no load.	Incorrectly wiring of stator windings (Delta connection connected with "Y" connection).	Correctly re-wiring as per drawing.
	Supply voltage exceeds rated value excessively.	Check the supply voltage and the no-load current, regulate the supply voltage variation to the rated value not over $\pm 5\%$.
	Ventilation pipe blocked	Clean up the ventilation pipe
	Cooling fan rotates wrongly.	Correct its rotating direction.
Overheating during motor's operating with load.	Overload.	Check up the rated current, reduce the load so as to get the rated current, when the practical load exceeds the former, select a new motor with larger rated output.
	Too high flow a value of supply voltage.	Check up the voltage, to make the supply voltage not to deviate from the rated value over $\pm 5\%$.
	Motor operates with one phase.	Find out the open circuit of supply cables or of stator wiring and remedy it.
	Cooler is blocked or dirty.	Clean up cooler according to item 10.6 or item 10.7.
	The temperature of inlet cooling water is too high.	Lower the temperature of cooling water below 33°C .
	The temperature of cooling air or surrounding air is so high as to exceed the nameplate limits.	Lower the temperature of cooling air or surrounding air.
	The pressure or volume of cooling water is not big enough.	Increase the pressure or volume of cooling water to the specified value in outline drawing.
Heatspots in stator, some of the windings overheats and with buzzing noise.	Short circuit occurs between turn-to-turn of stator windings.	Renew the burn-out windings or the complete stator assembly by the manufacturer so as to assure quality.
Heatspots in rotor.	Short circuit in wound-rotor windings or the welding sealing-off, there are air holes in cage rotor bars or broken bar in cage rotor.	Carefully check rotor for welding sealing-off and re-weld, renew the burn-out windings or renew the complete rotor assembly.



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11.7 Insulation breakdown

11.7.1 Causes

- a. Too high a value of supply voltage;
- b. Corrosive gases or salty fog existing in the surrounding air;
- c. A great deal of dust, dirt etc. deposited on exposed insulation layer without thoroughly cleaning up for long period of time;
- d. The motor running with overload results in coil excessive heating beyond the permissible temperature rise given in Table 2;
- e. Loose coil bands combined with vibration from which bands wear and tear resulted;
- f. The ambient relative humidity exceeds the specified value in item 5.1.3;
- g. Mechanical damage;
- h. Cooler leakage, water penetrating into some insulation layer;
- i. The temperature of storing room below 3°C.

11.7.2 Remedies

- a. If a defect develops on the connector, it can be repaired by carefully stripping off the injured insulation layer, then applying with fresh insulation layer and protective coating baked for drying;
- b. If a defect develops in the coil, it must be replaced, except for those of the breakdown and of the mechanical damaged coil end connector which may be repaired as mentioned above;
- c. Take off the source of insulation breakdown at the same time of repairing.

11.8 Low insulation resistance

For the causes and remedies to low insulation resistance refer to Table 8.

Table 8

Faults	Causes	Remedies
Low insulation resistance	Humidity of surrounding air is too large.	Improve ventilation conditions. Lower the humidity of surrounding air.
	Insulation materials surface is dirty.	Clean off the deposited dirt and dust from insulation surface.
	Condensate results from greatly varied ambient temperature.	For drying process, the drying temperature should not be over the nameplate permissible value of the given insulation class.
	Insulation breakdown or aged.	Renew the stator assembly.
	Cooler leakage, water penetrating into some insulation.	According to item 11.9 repair the cooler to dispose of water leakage.
	Without proper protection from moisture while the motor is in stand-by.	When motor is shutdown, take necessary measures to prevent moisture.
	Defect occurs in the space heater.	Repair or renew the space heater.



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11.9 Water leakage of water-air cooler

For the causes and remedies to water-air cooler refer to Table 9 (After repairing, water pressure test should be carried out under 250kPa without the presence of water leakage).

Table 9

Faults	Causes	Remedies
Water leakage of water-air cooler.	The quality of cooling water is not qualified, cooling pipes are destroyed by corrosive water.	Clean the cooling water so as to meet the quality requirement as industrial water, and renew the damaged cooling pipe.
	Too high a value of the cooling water pressure.	Control the pressure of cooling water in the range of 100~200 kPa.
	Faulty seal liner inside the cooler.	Renew the sealing liner.
	Bolts come loose resulting in poor seal.	Twist bolts to tightly press the sealing liner.
	Cooling pipes are damaged.	Renew the damaged cooling pipes, or renew the complete cooler.
	Looseness of cooling pipes.	Extrude the opening of cooling pipes to make a close contact with the end plate.

11.10 Brushes with excessive spark

Sparking under brush is sure to burn out both brush and slipring which is followed by the burning and its result is severe then reaction turn about. Therefore excessive spark under brushes should be eliminated by remedies at the beginning of detecting out of it.

For the causes and remedies to bushes' sparking refer to Table 10.

Table 10

Faults	Causes	Remedies
Sparking under brushes.	Contact face area between brushes and slipring is too small.	Regind the brushes in accordance with item 10.3.1 to guarantee the contacting surfaces between brushes and slipring not less than 80%.
	Brushes sticking in holders.	Relocate the brush in box to enable the brush to follow the ring more freely.
	Dirt on surface of slipring and brushes.	Clean up dirt from the surfaces of brushes and sliprings to make a better contact.
	Run-out value of slipring is too high.	Correct the out-of-roundness of slipring and properly align slipring with bearing bumper, turn off the surface of slipring to guarantee the run-out value less than 0.2mm.



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Table 10 Continued

Faults	Causes	Remedies
Sparking under brushes.	Insufficient brush tension.	Pressure of each brush to be adjusted in the range of 0.0143 to 0.0255MPa.
	Wrong brand of brush.	Replace the brush.
	Poor contact between the brush connecting wires and conduction plate.	Tightly twist the bolts of brush connecting wires.
	Less numbers or insufficient current-carrying capacity of brushes.	Increase the numbers of brushes.
	Roughness of the slipring surface.	Lightly polish the dirt on the slipring's surface with No.00 fine sand cloth, even to turn off the surface.
	Excessive vibration of the motor.	Work carried out according to item 11.3.

11.11 Flashover between sliprings

For the causes and remedies to flashover between sliprings refer to Table 11.

Table 11

Faults	Causes	Remedies
Flashover between sliprings	Sliprings and brush holders dirtied with carbon dust.	Clean up carbon dust from the sliprings and brush holders.
	The ambient relative humidity exceeds the specified value given in item 5.1.3.	Make the relative humidity conform to the specifications of item 5.1.3 by enhancing the ventilation.
	The ambient air is materially polluted by corrosive gases as acid or alkaline and salty fog.	Keep clear of corrosive gases and salty fog from the ambient air.
	An insulation breakdown between sliprings.	Renew the insulation between sliprings.
	Rotor circuit broken.	Check the rotor for broken circuit position, connect the circuit.
	Rheostatic device circuit broken.	Check the rheostatic device for broken circuit position, connect the circuit.

11.12 Open joint of the rotor coil connectors

The wound-rotor coils with soldered end connectors often fail in running because of open



OPERATION INSTRUCTIONS FOR IH355~630 3-PHASE ASYNCHRONOUS MOTOR

joint.

For the causes and remedies to open joint of the rotor coil connectors refer to Table 12.

Table 12

Faults	Causes	Remedies
Open joint of rotor coil connectors	Overload in running.	Reduce the load to an appropriate value given in the nameplate, resolder it.
	Abnormal starting.	According to item 11.5.2 remove the failure in starting.
	Poor quality of soldering.	Find out the poorly soldered end connectors, if any, repair it.
	Dirt and dust deposited on the end connectors.	Keep end connectors always free of dirt and grease, so as to stop a hidden danger of open joint or short circuit.

11.13 Rub between the stator and the rotor

The causes and remedies to rub between the stator and the rotor can be seen in following table 13.

Table 13

Faults	Causes	Remedies
Rub between stator and rotor	The bearing heat leads to the damage of the bearing and the bush.	Check and mend according to 11.1 item.
	The motor's vibration isn't mended well in time.	Check and mend according to 11.3 item.
	The axis of rotation is broken.	Check and mend according to 11.4 item.
	The motor is too hot and it isn't repaired well in time.	Check and mend according to 11.6 item.
	The air gap isn't equability	Check the airgap and disposal the fault.
	There are some chip and foreign material etc. This leads to rub.	Clean out the foreign materials inside of the motor.

12 Drying up the motor

If the insulation resistance is less than the least permitting value, one of the following methods can keep moisture out, so the insulation resistance can satisfy with the requirement of item 6.2.17.

12.1 Drying the motor by space heater.

13.2 Dry up the motor in air of near to 80° C, the hot air must be dry.



OPERATION INSTRUCTIONS FOR H355-630 3-PHASE ASYNCHRONOUS MOTOR

13.3 Energize the motor with near to 60% of DC rated current.

13.4 The rotor blocked, let current passes the stator winding when the voltage is near to 10% rating voltage.

Permit increasing the value of current until the stator coil's temperature reaches 90° C, don't allow over this value or increase voltage enough to make the rotor running. Heating course must be careful when the rotor is blocked in order to avoid damaging the stator, keep the temperature at 90° C until the insulation resistance is stable in fact.

Pay more attention, heating course must be slow in order to let the steam pass the insulation and run out evenly, slowly and naturally. Fast heating may make steam pressure of the partial place strong enough to let the steam pass the insulation and run out. This damages the insulation permanently. It usually takes 15~20 hours to make the temperature increase to the needing value. After two or three hours, measure the insulation resistance again, if the effect of the temperature is thought about and the insulation resistance early reaches the least permitting value, the dry course of the motor can be finished and the motor can work.

13 Disassembling the motor

Write down the disassembling process on the form of schedule, it is reference of reassembling, the followings are usually process.

13.1 Disconnect all the cables of the power, the monitor device, the earthed system and lead wire.

13.2 In the case of sliding bearing, the oil should be discharged from the two bearings. If the bearing has other oil-feed system, cut it and its oil return pipe off.

13.3 Water-cooling type motor's cooled water should be discharged first, and the connection with feed piping should be disassembled. The oil filling pipe and the exhaust oil pipe should be disassembled first for the air-air cooling type motor. The slipring should be disassembled first, then the end shield should be disassembled for wound type motor.

13.4 Disassembling the whole top cover or cooler, the outer protective cap, if any, should be disassembled first for outdoor motor.

13.5 Disassemble the cover plate, mantle, window shutter or pipe.

13.6 Disassemble the base bolt and positioning pin and decouple the coupled shaft.

13.7 Take the coupler or the hydrodynamic coupler off from the shaft extension.

13.8 Disassemble the lead wire cables of the stator and additional device's lead wires of heater, temperature detector etc. from terminal box.

13.9 Disassemble the outer bearing cover and temperature relay, temperature detector etc. in all the bearing, then disassemble the upper cover plate and upper half bush (sliding bearing), or bearing's sleeve (rolling bearing).



OPERATION INSTRUCTIONS FOR H355-630 3-PHASE ASYNCHRONOUS MOTOR

For air-air cooling type motor disassemble the outer fan and fan frame first.

13.10 Unclench the lead wires between the slipring and the rotor terminal box for wound rotor, dismantle the brush from brush holder.

13.11 Insert the bakelite plate or hard paper plate in the interior circle of the stator, place the rotor in the interior circle of the stator.

13.12 Disassemble the bolt from the end shield, disassemble the end shield by the aid of the screw hole.

13.13 Disassemble the fan shrouds of both ends.

13.14 If the rolling bearing isn't damaged or needn't replacing, don't disassemble the bearing in order to avoid damaging the rotating shaft.

13.15 Jacket the shaft extension with protective jacket, draw the rotor out with special tool.

13.16 When the no-shaft extension end needs bearing replacement, but there isn't any special tools, draw the rotor out on following method after disassembling the bearing cover inside bearing and the fan.

13.16.1 Mount a steel pipe which has suitable inside diameter, length and strength at the rotor no-coupler end, place the steel pipe in the shaft near the rotor core, not in journal, if this can't be satisfied, a suitable diameter copper ring which is mounted in the steel pipe can be used as a bush.

13.16.2 Sleeve the suspension cable round the steel pipe and near the shaft extension, the shaft extension must be sleeved with protective sleeve.

13.16.3 Lift the rotor near the center position of the air gap carefully, axially draw the rotor from the shaft extension end slowly or from the no-shaft extension end (in special conditions) out of the stator, doing this must be careful, don't let the rotor slip or rub the interior circle of stator or stator winding.

13.16.4 When passing through the interior circle of the stator, the rotor is drawn out of the frame, sleeve the third suspension cable around the shaft at the non-shaft extension end or the rotor core, and regulate the suspension cable in order to bear the weight beared previously by the steel pipe.

13.16.5 Disassemble the steel pipe sleeved and the suspension cable carefully. Don't damage the stator winding.

13.16.6 After drawing the rotor from the interior circle of the stator, place it in suitable position and pad it well with a big piece of thick hard paper plate or other suitable material, block the rotor in suitable position, the stator and rotor inside can be checked and repaired at this time.

13.17 After checking or repairing the motor, keep dust, oil and fat away from motor inside and



OPERATION INSTRUCTIONS FOR H355-630 3-PHASE ASYNCHRONOUS MOTOR

outside. Oil vapor, generation, flying dust, chemicals' or textile can make ventilation bad resulting in winding overheating. The conducting dust can shorten the creepage distance. The sharp powder may damage insulation of stator and shorten its using life under the drive of rotor fan or air duct. Especially Magnetic dust is harmful to insulation. Blow the light and harmless dust off with dry air of equal or less 0.2MPa (2kg/cm²) pressure, the dust of sand grains, metallic and magnetic dust or carbon powder should be absorbed, the equipment must have a non-metallic attraction nipple.

14 Reassembly of motor

The motor should be reassembled according to the reverse sequence to the described disassembling procedure, and be secured all the inner bolts to be tightened and recover all the locking devices. For the outdoor (open-air) motor, all the external joint faces should be coated with D05RTV silicon rubber seal agent.



OPERATION INSTRUCTIONS FOR H355-630 3-PHASE ASYNCHRONOUS MOTOR

Special Note

According to description of application, when motor is under the state of operation, or maintenance, it will make noises and solid waster matter such as odd parts, discarded insulation material, waster rubber, bakelite, waster cotton silk, discarded lubricating grease and some liquefied waster matter such as disused lubricating oil, disused engine oil, fuel oil, all these factors will result in certain impact on you and environment around you, in accordance with related law and regulation of region, profession, or state, protection on equipment should be strengthened, the solid waster material and waster liquefied material should also be classified, stored, recovered, reused and disposed in concentration, to avoid causing pollution to environment.



Note: If the technical item related to this instruction is modified,our corporation reserves the right not to issue a separate notice.

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NO:0EB.460.818DW



15. Drawing list

15.1 PA Fan

No.	Drawing No.	Drawing Description
1	TB2-SDC.VP101-00100-M-M1A-MAN-9037	PA Fan Assembling DRAWING
2	TB2-SDC.VP101-00100-M-M1A-MAN-9038	PA FAN ASSEMBLY BLADE ACTUATING SECTION
3	TB2-SDC.VP101-00100-M-M1A-MAN-9039	PA Fan Outline Drawing

15.2 Motor

No.	Drawing No.	Drawing Description
1	Page.37~45	Typical Assembly of YRKK Motor

15.3 Lubrication system

No.	Drawing No.	Drawing Description
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 equipment					
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			



THAI BINH 2 THERMAL POWER PLANT 2 x 600MW

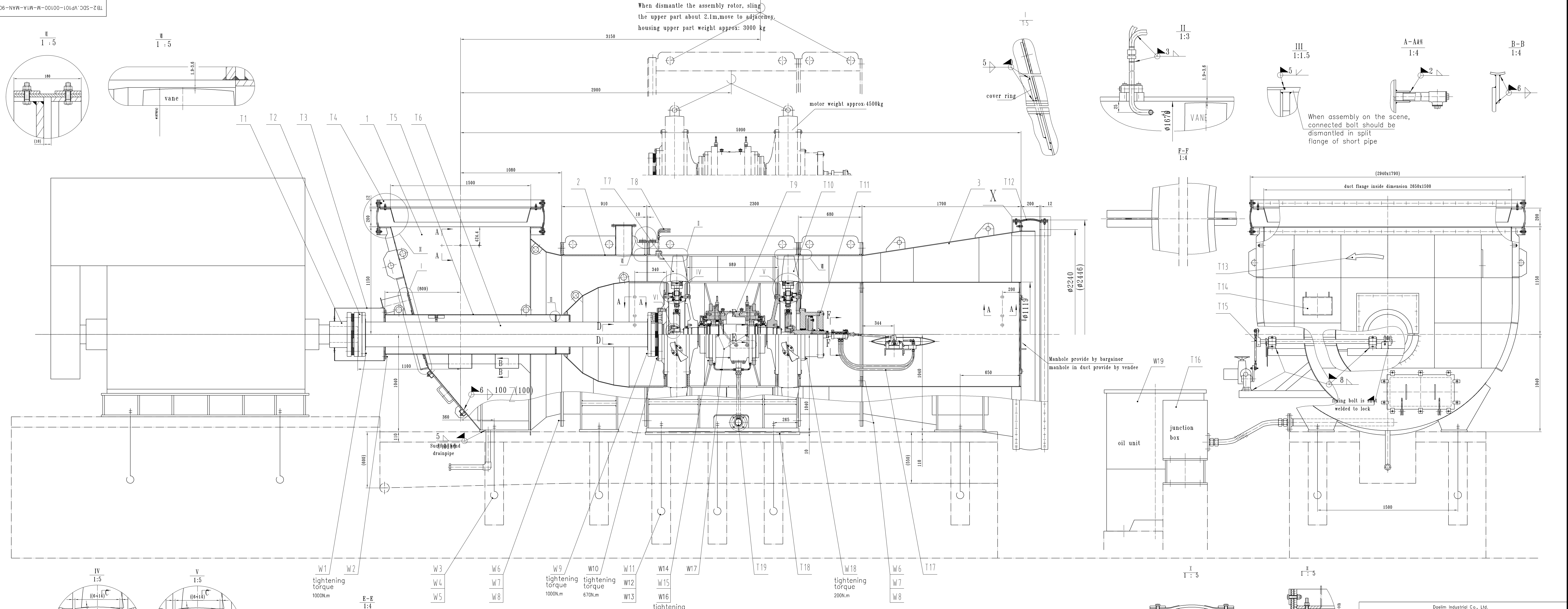
4	vibration monitoring system for fan				Shenke	
4.1	horizontal direction sensor	2		Bearing Housing		
5	Actuator	1			ROTORK	
6	Key phase measurement				Shenke	
6.1	Key phase probe	1				
7	thermometer for motor					
7.1	Motor Bearing temperature device	2	Pt100	Motor Bearing Housing		supplied by motor 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 corrossions 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 PT thermalresistor; one set vibration monitoring system; and one set unstable range indicating unit;
3. Adjustable mode is that actuator subp 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 $|r| < 0.1\text{mm}$; Angle displacement for installment: $|\alpha| < 0.25^\circ$;
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 keeping appropriate in water proof store room before assembled insite;
8. As assembled, the most heaviest units (casing assembly+bearing assembly+impeller assembly+servo-control system) are lifted about 14000 kg, 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 cord, 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 $600\text{kg}\cdot\text{m}^2$

W14		VIBRATION MONITOR							
W13		WASHER 36	6						
W12		NUT M36	12						
W11		FOUNDATION BOLT M36x1000	6						
W10		BOLT M24x80	12	8.8 GRADE					
W9		BOLT M30x80	12	8.8 GRADE					
W8		WASHER 16	80						
W7		NUT M16	80						
W6		BOLT M16x80	80						
W5		WASHER 30	6						
W4		NUT M30	12						
W3		FOUNDATION BOLT M30x800	6						
W2		BOLT M16x35	8						
W1		BOLT M30x110	12	8.8 GRADE					
T20	TY900300	MEASURING BRANCH ARRANGEMENT	1						
T19	TY9900	LUBRICATION PIPE	1						
T18	U236201	PEDESTAL FOR HOUSING	2						
T17	TY9200	CONTROL OIL-WAY	1						
T16	TU55030(G)	LOCAL CONNECTION BOX	1						
T15	U234100	ASSEMBLY BLADE ACTUATING SECTION	1						
T14		ROTATING SCUTCHION	1						
T13		FAN NAME PLATE	1						
T12	U234P20	OUTLET EXPANSION JOINT	1						
T11	SFG190X127D129	ASSEMBLY SERVO MOTOR	1						
T10	U234Y200	IMPELLER	1						
T9	U236D00	ASSEMBLY MAIN BEARING	1						
T8	U138S010A	UNSTABLE RANGE INDICATING UNIT	1						
T7	U234Y100	IMPELLER	1						
T6	U234N00	ASSEMBLY INTERMEDIATE SHAFT	1						
T5	U234C00	GUARDING PIPE	1						
T4	U134P10	INLET EXPANSION JOINT	1						
T3	U234Z010	COUPLING GUARD	1						
T2	Form13 2501	Form01 COUPLING	1						
T1	U236D01	clapboard	1						
3	U234K00fffH	ASSEMBLY HOUSING	1						
2	U234L00fffH	DIFFUSER	1						
1	U234J00fffH	SUCTION BOX	1						

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NOTE: Attachment

[illegible]

REV	DATE	DESCRIPTION	DRWN	CHKD	REVD	APRD
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OWNER	 PETROVIETNAM VIETNAM OIL AND GAS GROUP (PTG)	OWNER'S CONSULTANT FICHTNER Cable & Co. IG FICHTNER	 PETROVIETNAM PV Power PCC PV POWER PCC
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<p>EPC CONTRACTOR</p> <div data-bbox="2490 1675 2522 1682"> </div> <p>PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVIC)</p>	<p>EPC CONSTRUCTOR'S CONSULTANT</p> <div data-bbox="2706 1675 2825 1682"> </div> <p>WORLEYPARSONS</p>
--	---

POWER ISLAND PACKAGE SUPPLIER		
	SOJITZ CORPORATION	DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE	THAI BINH2 THERMAL POWER PLANT 2 x 600MW
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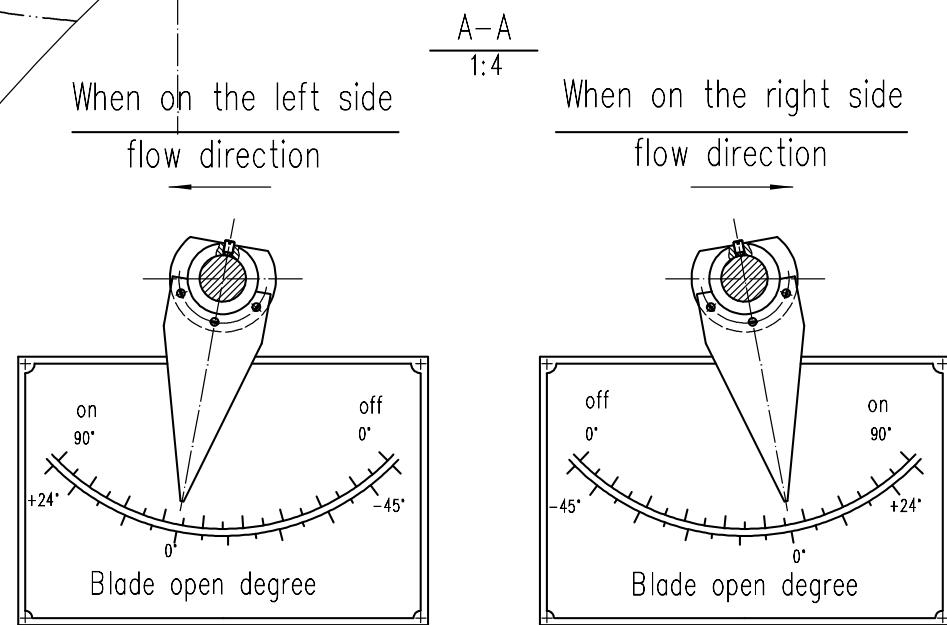
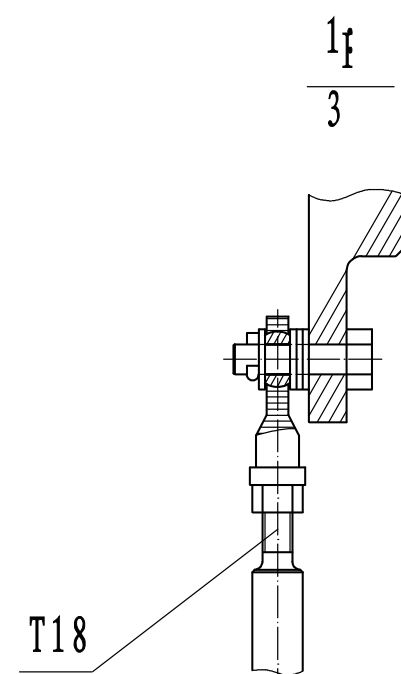
DRAWING TITLE	PA Fan Assembling DRAWING
---------------	---------------------------

BIP SUPPLIER  BABCOCK & WILCOX BEIJING CO., LTD.	FUNCTION	NAME	SIGN	DATE
	DRWN	Shuai fu		24 Mar.2015

 BIP SUB-SUPPLIER	CHKD	Chen Huarin		24 Mar.2015
	REVD			

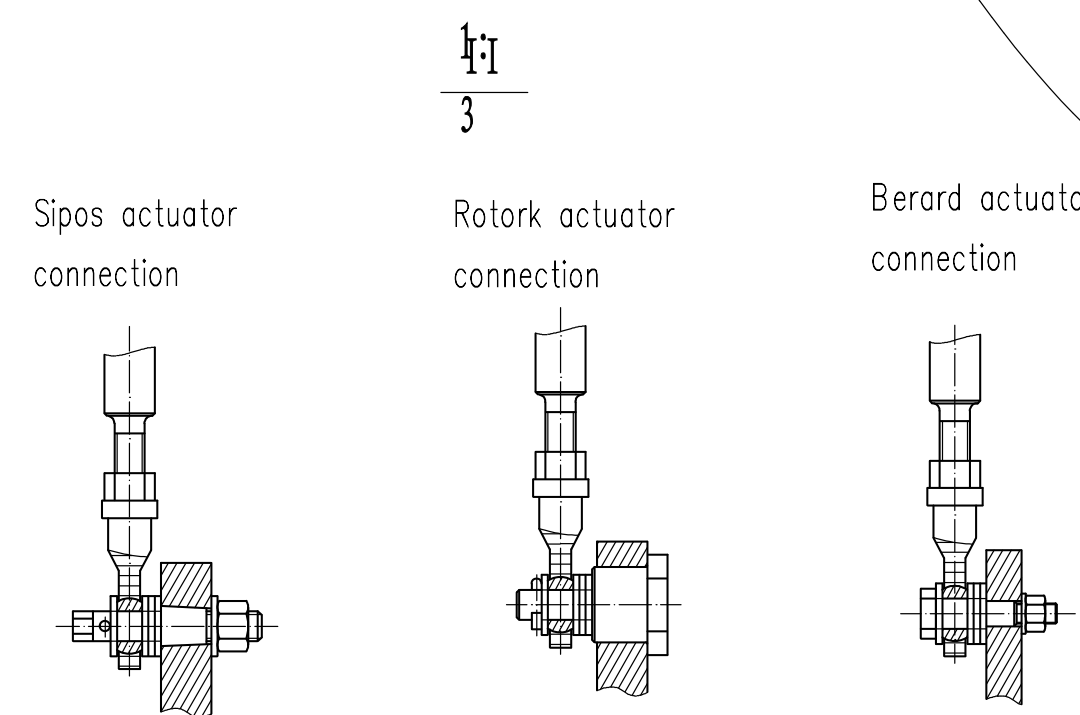
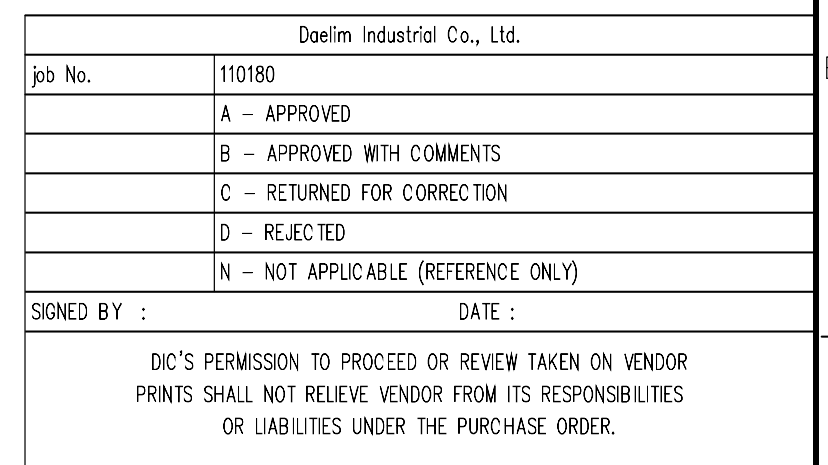
中国能建 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE		APPD	Wang Jun	24	24 Mar.2015
DRAWING NO.	TR2-SDC VP101-00100-M-M14-MAN-9037	JOB NO.	11A10A	SCALE	REV. NO.

MAJOR	CO-SIGNER	DATE
DESIGN STAGE	DETAIL DESIGN	



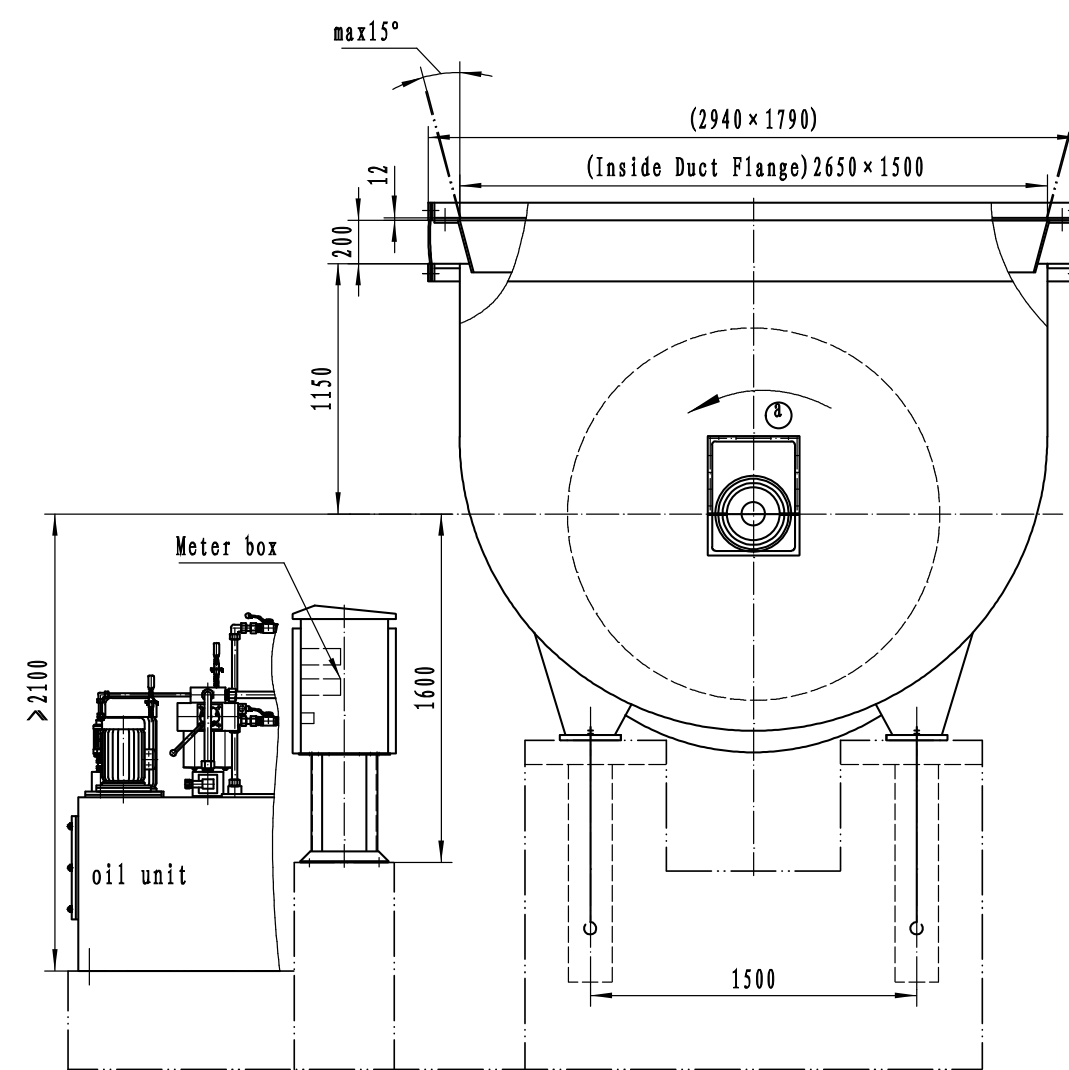
T19	U23401	Drive shaft	1			0.06	
T18	TY96020	Actuator Pole	1		1	2	
T17	TY9618	Connected pin Ø12x45	1		0.15	0.3	
T16	TY9617	Key 80x12x8	1			0.07	
T15	TY9616	Stop block	2			0.04	
T14	TY9615	Stud M16x80	2			1.3	
T13	TY9614	Connected pin Ø12x75	1			2.2	
T12	TY96010	Oil cylinder pole	1			2	
T11	TY9613	Tie-in	1			4	
T10	TY9612	Execute pedestal	1			0.1	
T9	TY9611	Rotate arm	1			0.45	
T8	TY9610	Needle pointer	1			0.1	
T7	TY9609	Needle pointer pedestal	1			1.5	
T6	TY9608	Diolo	1		2	4	
T5	TY9607	Soleplate	1		0.01	0.02	
T4	TY9604	Bearing housing pedestal	2			1	
T3	TY9603	Distanced ring	2			14.1	
T2	TY9602	Bearing housing pedestal	1			23.5	
T1	TY9601	Distanced ring	1			6.6	
3	U23401	H beam III	1			29	
2	U23401	H beam II	1			2	
1	U23401	H beam I	1			50.5	
No.	DWG.NO.	DESCRIPTION	QTY.	MATERIAL	single WEIGHT	total	REMARK

1. It is for which the execute part arranges at the left side (view form air flow). The right one is opposite.
2. Welding after beam, angle steel and distribution pipe base adjusted in assembling.
3. The dimensions in the bracket are only for reference.

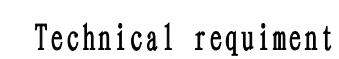


NOTE: [Redacted]

BWBC drawing No.



FOUNDATION



1. Temperature measuring device is in the surface thermal; Vibration measuring monitor system have one set.
 2. When the fan is installed, the max lifting weight is about 10000kg; when examined and repaired , it is about 4500kg.
 3. Accommodation of this fan is to regulate hydraulic pressure by actuator to adjust movable blade.
 4. The revising requirement of coupling of motor and impeller side: radial displacement $|r| < 0.1mm$, 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 $0.02mm$.
 6. When assembled and overhauled, all the bolt should be fastened according to the moment which required on the instruction book and drawing .
- Note: 1. The dimensions within brackets in the base iconography are reference for base construction.
2. The dimension of oil unit and motor 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;

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DOCUMENT SUBMISSION STATUS: FF

NOTE:

Attachment 3.

	24 Mar 2015	FOR FINAL	Shou fu	Chen Huan		Wang Lin
REV	DATE	DESCRIPTION	DRWN	CHKD	REV'D	APRD

<p>OWNER</p> <div style="text-align: center;">  PETROVIETNAM VIETNAM OIL AND GAS GROUP (VNG) </div>	<p>OWNER'S CONSULTANT</p> <div style="text-align: center;">  FICHTNER GmbH & Co. KG FICHTNER PY POWER PCC </div>
<p>EPC CONTRACTOR</p> <div style="text-align: center;">  PCC PETROVIETNAM CONSTRUCTION JOINT STOCK CORPORATION (PVC) </div>	<p>EPC CONTRACTOR'S CONSULTANT</p> <div style="text-align: center;">  WorleyParsons <small>INTEGRATION & INNOVATION</small> WORLEYPARSONS </div>

POWER ISLAND PACKAGE SUPPLIER



sojitz
SOJITZ CORPORATION

DAELIM

DAELIM INDUSTRIAL CO., LTD.

PROJECT TITLE	THAI BINH2 THERMAL POWER PLANT 2 × 600MW
---------------	--

DRAWING TITLE	PA Fan Outline Drawing				
DATE	BY	CHECKED	APPROVED	SCALE	NOTES

BIP SUPPLIER  BABCOCK & WILCOX BEIJING CO., LTD.	FUNCTION	NAME	SIGN	DATE
	DRWN	Shuai fu		24 Mar. 2015

BIP SUB-SUPPLIER	CHKD	Chen Huamin		24 Mar. 2015
	REVD			

CCDC 广东省电力设计研究院

中国能建 GUANGDONG ELECTRIC POWER DESIGN INSTITUTE		APPD	Wang Jun	24 Mar. 2015
DRAWING NO.	TB2-SDC.VP101-00100-M-M1A-MAN-9039	JOB NO.	110180	SCALE
				REV. NO. 

Motor Detail List

No.	Type	Power kW	Voltage kV	Rotary weight kg	Standard dynamic load(kg/1000 h)	Transmit dynamic load(kg/1000 h)	Electric load (single h)	Dimension																Anchor hole Drawing No.	TTF	Vendor	Nail coupling Type	User
								A	A1	B	B1	B2	P	C	U	H	h1	HD	L	N1	N2							
1	YXL30-40	1500	10	1492	10400	8.6	17.2	25.5	1120	1600	1450	2290	630	630	300	2570	1300	1310	1310	M42 x 1250	4	Xiang Tan motor		Miss Dink + Thomas Power Plant, Vietnam				