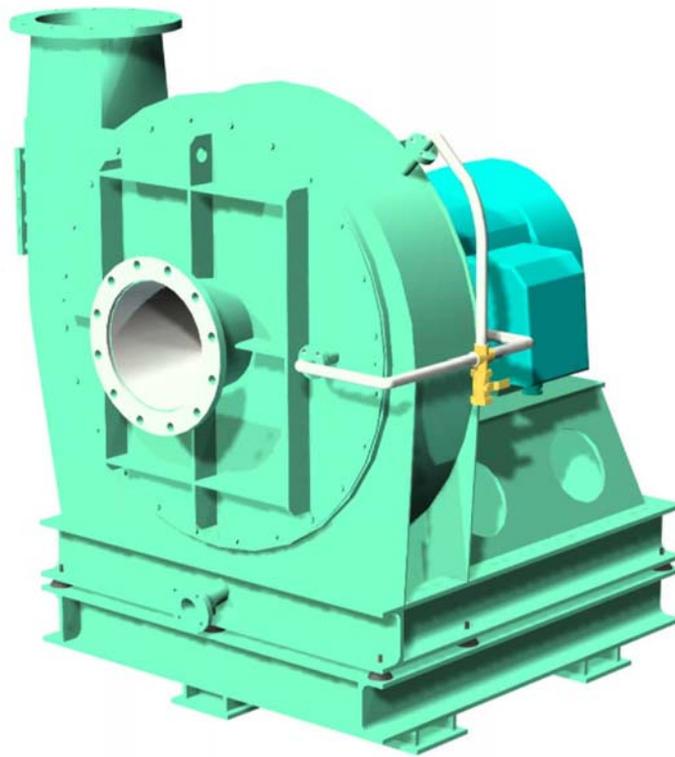


# INSTRUCTION MANUAL FOR INERT GAS FAN



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## 1. OPERATION MANUAL

### 1-1 Cautions prior to Operation

Treatment, transportation, installation, operation, and maintenance of the all devices should be performed carefully in the right sequence.

When disassembling and inspecting the fan, no one except the related personnels should be admitted, since rotating the impeller by hands can cause injuries.

- 1) Make sure that every part is thoroughly equipped, clear around the machine, and make sure that there is no foreign matter around the inlet opening or in the suction line piping.
- 2) Confirm that the power source is normal.
- 3) Lubricating Oil

Inspect the bearing grease. Excessive filling of grease will cause excessive heat in bearings. The amount of grease required for the lubrication of bearing is sufficient when filled and approximately 1/3 for in the bearing case.

If the pillow type inlet is applied, with Shell Alvania grease No. 2 or Equivalent is already filled, there is no need for further feeding.

#### 4) Turning by Hand

Make sure there is no unreasonable or forced arrangement in the suction and discharge of ducts or air leakage. Also make sure there are no remainders of material used during installation work. After confirming no irregularity, turn the blower by hand to check abnormal contact in the interior.

#### 5) Starting

Start the blower with the air control damper closed. Sudden increase of speed should be prohibited. Check the bearing, noise in the casing inside, vibration and temperature, then increase the speed gradually to the speed.

#### 1-2 Start-Up

During the start-up of the trial operation, the bearing temperature, vibration and contact with the rotating member require special attention.

- 1) Check the direction of rotation of the fan.
- 2) Carefully observe the variation of the current during the start, and if any abnormality is found, immediately stop the motor.
- 3) Pay attention the vibration and sound during the start. If any abnormality is noticed, stop the fan to check for causes.

Since the abnormal vibration of casing is usually caused by the seal packing at the center of boss insertion touching the boss strongly, recheck them.

- 4) While carefully observing the variation of the current, gradually adjust the opening of the suction and/or discharge valve to set the current predetermined value.
- 5) If the operation condition is smooth thus far, the bearing temperature becomes constant after half an hour to an hour. Therefore, operate the fan at least for one hour to check the operational condition such as the bearing temperature and vibration.
- In case of the rapid temperature rise of the motor, check the followings.
- ① Check whether there is any flaw or crack on the outer and inner wheel or driving part.
  - ② Check whether the packing materials are in strong contact with the boss.

### 1-3 Operation

#### 1) Temperature of the Bearing

Confirm the circulation of oil after full speed has been attained and measure the temperature increase in bearing. This should be under 40°C and the bearing temperature should be kept under 70°C under any condition.

The temperature will become constant after one hour from starting.

It is considered safe if you can keep your palm on the bearing for more than 10 seconds. For the blower which is provided with a gland, pay attention so as not to tighten the gland unbalancedly. Then, operate the motor for a moment to ascertain the revolving direction and inner contact.

If the bearing temperature is 70°C or below, it is normal, however, should the temperature exceed that value, carry out an inspection of oil, bearings and the shaft alignment.

(Refer to the paragraph under Inspection and Maintenance.)

Damage in the bearing or oil shortage causes a small metallic noise.

#### 2) Treatment of Gases of other Temperature than Normal

In the case where the gas has a smaller specific gravity than that of a normal temperature air treated under normal temperature, it sometimes develops an overload.

Pay attention not to commit such an irregularity.

#### 3) Measurement of the Bearing Vibration

Measure the bearing vibration and its amplitude of the fan at the centermost position of each bearing horizontally, vertically and in an axial direction. Use 1/1000 mm as the unit, and express the vibration in total amplitude. Check the reading of the instrument whether it is in half amplitude or in total amplitude.

For everyday inspection, touching by hand may be applied. However, when the vibration becomes big, measure it with a vibration gauge. If it exceeds the permissible value of the bearing vibration, stop operation without delay to inspect and adjust.

When vibration starts and keeps of going, it becomes impossible to operate continuously.

Therefore the imbalance should be rectified immediately.

For a reference for permissible vibration, Fig 2 can be used as a guide.

e.g. the limit of permissible vibration is 70  $\mu\text{m}$  with 3570 rpm.

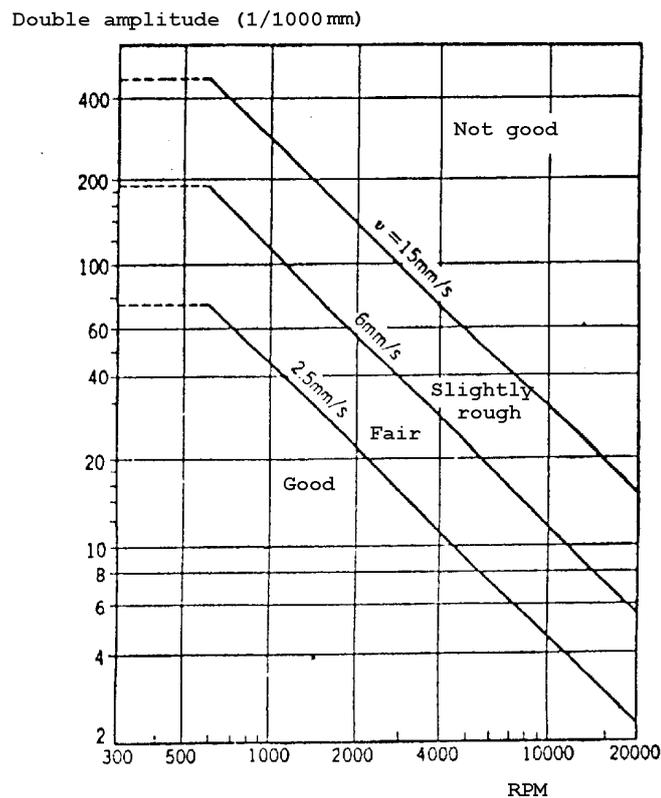


Fig. 2 Vibration Tolerance

## 1-4 Stopping & Shut Down

After the complete closing of air control damper, stop the main electric motor. Make sure that any abnormal sound is not heard, and that the drop of the number of revolution is not abnormally fast until the rotor is completely stopped.

For a shut down of a long period, drain thoroughly the water such as the cooling water in the bearing housing every part, and also the machine thoroughly. Coat the finished faces of each section of the machine with appropriate corrosion inhibitor. Provide cover over the necessary places to prevent dust, rain, etc., settling in the machine.

Pay special attention to the motor.

## 2. MAINTENANCE MANUAL

It is important to perform regular maintenance according the right plan for the long life expectancy and the safe operation. Although basic maintenance items are the lubrication and cleaning of the bearing, and regular vibration checking, frequent measurement of the discharge pressure, air temperature, current, and etc can prevent the accidents in advance, since the operation of the fan in worse conditions than specified conditions can causes the accidents. Since the operating conditions or surroundings other than designed specifications can affect the performance of the fan, adjust the operating conditions and perform the regular check-up as early as possible after the first operation.

### 2-1 Daily Check Points

Pay attention to the following points everyday and carry out the inspection of the blower.

- 1) Is there any abnormal noise ?
- 2) Are the bearing temperature and vibration normal ?
- 3) Is the value shown by the ammeter normal ?
- 4) Is the oil quantity proper when using oil bath or oil ring lubrication ?  
(Check by means of oil level gauge.)

## 2-2 Suspension of Operation

- 1) When the operation of the fan is to be suspended, pay much attention in cleaning, rust prevention of the blower, and be cautious in preventing dust, dirt and water getting into bearings.
- 2) Pay attention to prevent humidity against all electrical parts such as the motor and other parts.
- 3) Remove water completely from the bearing cooling water piping and bearing cases.

## 2-3 Periodical Inspection

Carry out periodical inspection at least once a year, and inspect the following items:

- 1) Clean disassembled parts thoroughly.
- 2) Replace lubricating oil (or grease) with fresh ones
- 3) Examine the contacting surfaces of the rotating elements and the static sections.
- 4) Examine the condition of play at fitting sections.
- 5) Recheck the alignment.

## 2-4. Operation Diary

Inasmuch as the operation diary is the data for making a diagnosis of the fan, keep a meticulous entry for present and future reference. If the operating record is kept, it is possible to find abnormality in the early stage, and even if trouble occurs, it is easy to find the cause of trouble.

## 2-5 Cleaning of impeller (4-3 DWG. of Water nozzle system)

To prevent corrosive particles to damage the impeller, the impeller should be immediately after each running period.

This fan is equipped with a fresh water nozzle system, which is used when cleaning the impeller.

### \* Cleaning procedure:

- A. Stop the fan and before the cleaning procedure make sure that undesired starting up will not be possible. This is done by activating the repair switch or by removing the safety fuses.
- B. Open the fresh water tap and let water run for app. 2~3 minutes.
- C. Make sure the impeller is running – otherwise the impeller must be rotated by hand.
- D. Close the fresh water tap.
- E. Remove the clean out door, and inspect the impeller.  
Dust is most like to be caught at the reverse side of the impeller blades (according to rotation direction), and in the area around suction port and the side plate.
- F. Use a wire brush and a spatula for complete removal of ,dusty/corrosive particles.
- G. If cleaning isn't sufficient connect fresh water again.
- H. Check for static balance by gently rotating the impeller by hand, as to whether the position where the impeller stops of itself is not same.
- I. if cleaning is considered sufficient mount clean out door again.

Before restarting the fan it is important to make sure that impeller is entirely clean and the dismantled parts have been remounted and there are no unauthorised persons close to the fan.

The hose from the shaft sealing should be drained before starting up again.

NB. If the impeller has not been carefully cleaned all over residual coatings might bring about lack of balance. This lack of balance may cause vibrations and thus exceed the maximum level of 11 mm/sec., which may result in breakdown of bearings and fan.

Therefore it is important to take precautions by inspecting the impeller before starting up.

#### 2-6 Shaft sealing (4-5 DWG. OF Shaft sealing)

- 1) The shaft sealing is fitted with a carbon ring, which is supposed to prevent aggressive gasses to leak from the casing hole, which could cause severe damage to the front motor bearing.
- 2) The shaft sealing does not require any special kind of maintenance, but it is strongly recommended to drain the hose after using the water nozzle system.
- 3) The lifetime of the carbon ring depends upon how well dusty particles are kept away from the sealing shaft and hole. The impeller is fitted with fins at the back to prevent any dusty particles to run through the casing hole. and further the sealing is fitted with a tight PTFE sealing which should minimize the risk for dusty particles to reach the carbon ring.

If the sealing is leaking more than acceptable, it is recommended to change to the carbon ring.

\* Changing of carbon ring

1) Dismounting of carbon ring:

- A, Loosen the bolts and push the cover towards the slinger ring.
- B, Pull out the carbon ring from the seal housing.
- C, Unlock the spiral spring on the carbon ring and remove the carbon ring.

2) Mounting of carbon ring:

- A. Note that the carbon ring is marked from the manufacturer and that the carbon ring is assembled in the same way when mounted.
- B. Unlock the spiral spring.
- C. Mount the three parts of the carbon ring (with the hole for the guide pin towards the seal housing) on the fan hub and lock the spiral spring.
- D. push the carbon ring into the seal housing making sure that the hole for the guide pin is aligned with the guide pin.
- E. Push the cover to the seal housing and fasten the bolts.
- F. When restarting the fan make sure that there are no leaking from the shaft seal.

## ● Regular check point table ●

Item	Description	Period		Cleaning	Repair	Exchange
		6 months	12 months			
CASING	(1) Foreign substance	○		○		
	(2) Corrosion and wear		○	○	○	
	(3) Stagnant drainage	○		○	○	
	(4) Loosened bolts		○		○	
	(5) Damaged packings		○		○	
IMPELLER	(1) Dust attachment			○		
	(2) Corrosion and wear		○		○	○
	(3) Deformation and side plate cone contact		○		○	○
	(4) Loosened bolts & nuts for the attachment of the hub to the main plate		○		○	
	(5) Unbalance	○		○	○	

## 2-7 Causes of Troubles and Their Countermeasures

Even under the strictest observation, there may be a discrepancy the operator may have never expected, which may lead to trouble. We will find out its causes and take proper countermeasure for you provided that you supply us with history of operation since the beginning and current situation of the problem.

See Table 1 where causes of troubles and their countermeasure are listed.

Table 1. Causes of Troubles &amp; Their Countermeasures

Troubles	Causes	Inspection Point	Countermeasures
High Bearing Temperature	1. Surplus or short filling of grease	Bearing	Make the filling quantity proper
	2. Defective fitting of inner ring of roller bearing and shaft	Bearing & Shaft	Adjust shaft
	3. Defective fitting of outer ring of roller bearing and shaft	Bearing & Shaft	Replace bearing case
	4. Damage of roller bearing	Bearing	Replace bearing
	5. Oil deterioration or water blend	Bearing	Replacement or regeneration of oil
	6. Excessively small clearance of metal	Metal	Machining for adjustment
	7. Cooling water for bearing is short	B'rg Housing & Piping	Add cooling water
	8. Defective turn of oil ring	B'rg Housing	Repair or replacement

Troubles	Causes	Inspection Point	Countermeasures
High Bearing Temperature	9. Overheat of bearing 10. Defective alignment of coupling 11. Excessive tightening of V-belt 12. Vibration	Coupling  V-belt  Bearing	Replacement of Metal Additional tightening of bolts and nuts Correct the tension  Refer to "Vibration"
Excessive Vibration	1. Unbalance of impeller  2. Defective fitting of impeller boss and shaft 3. Unbalance of shaft coupling 4. Bending of shaft 5. Defective centering 6. Excessively large clearance in metal 7. Contact of rotor and Casing 8. Abnormal contact of gland packing 9. Defective foundation 10. Defective tightening of fitting belts 11. Surging 12. Concurrence with critical speed	Rotor  Rotor  Coupling  Shaft Coupling B'rg Housing  Casing interior Gland packing  Common bed V-belt	Correct balance & clean adhered matters Replace boss or shaft  Replacement of coupling & check alignment Repair or replacement Repair Repair or replacement  Re-installation of casing  Repair  Reinforcement of foundation Additional tightening of bolts and nuts
Abnormal Noise	1. Contact with static section  2. Existence of foreign matter 3. Damage of roller bearing	Bearing	Alter the position of oil thrower collar, adjust the contact of impeller & suction cone. Remove foreign matter  Overhaul inspection

Troubles	Causes	Inspection Point	Countermeasures
Abnormal Noise	<ol style="list-style-type: none"> <li>4. Vane control device</li> <li>5. Damper</li> </ol>		<p>Inspection of lever and connecting rod, inspection of wear of the pin of sliding ring</p> <p>Inspection of the play between lever and connecting rod.</p>
Deterioration in performance	<ol style="list-style-type: none"> <li>1. Drop in rpm, drop in power cycle</li> <li>2. Reverse revolution</li> <li>3. Adherence of foreign matters to impeller, wear and corrosion</li> <li>4. Clogging of suction filter</li> <li>5. Defective opening / closing of suction &amp; discharge valves</li> <li>6. Accumulation of dust in casing duct</li> <li>7. Leakage through drain hole &amp; other sections</li> <li>8. Difference in the gas specific gravity</li> <li>9. Excessively large actual resistance</li> </ol>		<p>Adjustment required</p> <p>Change the motor wiring</p> <p>Cleaning, repair or replacement</p> <p>Repair</p> <p>Repair</p> <p>Cleaning</p> <p>Repair</p> <p>Measurement of the specific gravity of gas and analysis of gas</p> <p>Planing of gas booster</p> <p>replacement of impeller</p>
Vane control device	<ol style="list-style-type: none"> <li>1. Rusting of sliding ring</li> <li>2. Rusting of lever pin</li> </ol>		<p>Disassemble, feed grease and repair</p> <p>Disassemble, feed grease and repair</p>

Troubles	Causes	Inspection Point	Countermeasures
Suction damper	<ol style="list-style-type: none"><li>1. Rusting of lever</li><li>2. Rusting of bearing</li><li>3. Contacting of blades</li></ol>		<p>Disassemble, feed grease and repair</p> <p>Disassemble, feed grease and repair</p> <p>Repair the distortion of blades, inspect its contact duct</p>

### 3. Disassembly and repair

#### 3-1. Precaution when disassembling

- 1) The inner structure of the fan and the disassembling procedure should be well identified through sectional drawings before disassembling, and for the easy reassembly later, match marks should be recorded.
- 2) Take good care of the disassembled parts not to be damaged, and wrap them with vinyl cover not to be attached by water, dust and sand.
- 3) Record the installation dimension for the fan and clearance dimension of the inlet cone for the later reassembly.
- 4) Perform regular maintenance job to each part. Foregoing consideration concerning the treatment method can make reassembly procedure faster.

#### 3-2. Precautions when reassembling.

- 1) Assembly procedure is the reverse of the disassembly procedure, and match mark should be always confirmed before assembling.
- 2) If there is damage, color change, or scratch of paint, repaint the rust resisting paint.
- 3) Packing material should be inserted into the contact surface of the casing for the sealing purpose.
- 4) Check loosened bolts, and tighten them if any. Paint the bolts and nuts with the rust resisting paint.
- 5) After assembling parts, check whether any part remains, and measure the clearance dimension between the impeller and the suction cone. Check the operation by manual rotation, and perform the test operation.
- 6) The test operation should be performed before the real operation.

### 3-3. Checking the impeller

1) If the impeller is damaged by corrosion, wear, or dust attachment, it causes the unbalance, which becomes the source of the abnormal vibration.

Therefore, the impeller should be checked regularly. In case of the abnormal vibration due to the foreign matter attachment, attached matter should be cleaned completely, but in case of the corrosion or wear, it should be repaired or exchanged. Since the repair or balance weight welding can cause cracks on the materials, it should be performed by an expert.

#### 2) Dismounting of impeller

A. Stop the fan and secure it against undesirable starting up before dismounting it.

B. Dismount the nuts which are tightening the front plate.

C. Remove the front plate by the help of lifting device or a tackle.

D. Dismount the end bolt of the shaft. Replace the end bolt by a similar short bolt.

E. Mount a wheel-puller (the impeller is equipped with threaded holes M12, placed on the hub plate.)

Now tighten the wheel-puller until the impeller gets loose.

F. Then dismount the wheel-puller and bolt. Finally the impeller can be pulled out from the spiral casing.

4. DRAWING OF INERT GAS FAN

4-1 DEVELOPMENT DWG. OF INERT GAS FAN

23	INSPECTION DOOR	SS400	1		
22	DRAIN	SUS316L	1		
21	CLEANING HOSE	RUBBER	1		
20	VALVE	BC2	1		
19	BED	SS400	1		
18	LEG SUPPORT	SS400	7		
17	ISOLATOR BED	SS400	1		
16	ISOLATOR	RUBBER	8		
15	PIN	SUS316	3		
14	CARBON RING	CARBON	1		
13	C/B SPRING	SUS316	1		
12	FLANGE	SUS316	1		
11	BOLT, S/W	SUS316L	6		
10	SEAL PLATE	SS400	1		
9	BOLT, S/W	SUS316L	4		
8	MOTOR	SS400	1		
7	O-RING	TEFLON	2		
6	BOLT, S/W	SUS316L	2		
5	BOSS CAP	SUS316L	1		
4	IMPELLER	SUS316L	1		
3	BOLT, S/W	SUS316L	-		
2	SUCTION CONE	SS400	1		
1	FAN CASING	SS400	1		
NO.	DESCRIPTION	MAT'L	QTY	SPECIFICATION	REMARKS
QTY	SCALE	PART DRAWING OF INERT GAS FAN WITH MOTOR			
N/S		SERIP NO.		3RD ANGLE	
DWG. NO. H-IGS2006-P				HMMCO	

DATE	CDR	M E M O	SIGN

4-2 DWG. OF WATER NOZZLE SYSTEM

