VAV VARIABLE AIR VOLUME FANS

OPERATION & MAINTENANCE INSTRUCTIONS CONTROLLABLE PITCH VANE AXIAL FANS

DESIGN 47

CPP

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A. DESCRIPTION OF EQUIPMENT

General

Chicago Blower Corporation Controllable Pitch Pneumatic (CPP) fans are high performance, variable pitch, van axial fans. They are quality products which, with proper care, will provide many years of satisfactory operation.

CPP fan wheels have cast aluminum hubs and cast aluminum airfoil blades. CPP wheels are mounted on the motor shafts by use of straight bore adaptor bushings.

Fan casings are steel, formed with integrally formed inlet and outlet flanges. Casings are complete with welded steel guide vanes, and welded steel inner fairing rings. Steel motor mounting bulkheads are welded to the inner fairing rings and are recessed to accept NEMA, "C" face flange, TEAO electric motors.

Controllable Pitch Operation

CAUTION: Blade pitch changes are made while the fan is running. To check blade settings, stop fan, lock out switch. Blade position veneers are stamped at each hub blade socket and each blade has a cast-in position pointer to indicate its pitch setting on the hub veneers.

CAUTION: Blade settings greater than those stamped on fan nameplates (located on fan casing) may overload the motors.

CPP center mounted pitch changing mechanisms are mated to fan wheels through the same straight bore adaptor bushings used to mount fan wheels to motor shafts.

The pitch changing mechanism consists of an internally mounted pneumatic actuator with spring return, connected to individual blade crankarms. Air is supplied to the actuator through a rotating union from an externally mounted pilot positioner, complete with a cable connected feedback.

Electric Option

The Electric option includes an electric/pneumatic transducer, for translation of user electric signals to the pneumatic signals required by the external pilot positioner.

Compressed air for the Electric option is furnished either by the user or by the auxiliary pneumatic power pressure system available from Chicago Blower Corporation. The auxiliary system consisting of an air compressor, receiver, gauges, filters drains, and air lines, is mounted to the fan casing or furnished loose for user mounting.

In this bulletin, information specific to the Electric option will generally appear near the end of its appropriate section, accentuated by the phrase "Electric Option".

NOTE: Please refer to the individual rotating union and pilot positioner safety, installation, operating and maintenance instructions, furnished by their manufacturers and provided with the fan, for details on those items.

Controllable Pitch Operation - Electric Option

Please refer to the individual transducer component and compressor safety, installation, operating, and maintenance instructions, furnished by their manufacturers and provided with the fan, for details on those items.

Controllable Pitch Related Accessories

Various accessories are available for CPP fans. Those pertinent to fan performance, controllable pitch operation, or installation are discussed here.

CPP fans with open inlets require the use of inlet bells or inlet cones. Published fan performances are based on the use of inlet bells and operation of units with bare, open inlets will result in decreased performances and increased noise levels. Chicago Blower Corporation CPP fans are dynamically balanced, but it is recommended that they be supported by vibration isolators. Either spring or rubber-in-shear isolators are suitable. Do not use large deflection isolators.

NOTE: When CPP fans are energized, they generate thrust forces which cause the fans to be displaced opposite the direction of air flow. These forces must be resisted to maintain duct alignment and protect flexible connections. Some installations, particularly horizontal units with long hanging rods, may require 'snubbers' to limit fan movement.

CPP fans are inherently high velocity air moving devices and it is quite common to utilize outlet cones on fan discharges to minimize velocity pressure losses and regain static pressure. Inlet casing extensions or spool pieces are necessary when inlet bells or inlet cones are not specified.

B. RECEIVING, HANDLING, AND STORAGE

Receiving

Chicago Blower Corporation CPP fans are prepared for shipment in accordance with the Uniform Freight Classification. They are thoroughly inspected at the factory and, barring damage in transit, will be in perfect condition upon arrival. When a carrier signs a Chicago Blower Corporation bill of lading, the carrier accepts responsibility for any subsequent shortage or damage, evident or concealed, and any claim must be made against the carrier by the purchaser. Evident shortage or damage should be noted on the carrier's delivery document before signature of acceptance. Inspection by the carrier, of damage evident or concealed, must be requested. After inspection, issue a purchase order for necessary parts or arrange for return of the equipment to the Chicago Blower Corporation factory for repair.

NOTE: Do not remove the plastic plugs used to fill the empty blade sockets in wheel hubs on fans supplied with six-bladed wheels.

Handling

Chicago Blower Corporation CPP fans are shipped completely assembled and skidded. The should be handled with good rigging techniques and care to avoid concentrated stresses that would distort any parts.

Safety Precautions

This pamphlet contains general recommendations. Specific requirements, such as those outlined in federal, state, and local safety codes, may apply to individual installations. Strict compliance with those codes and strict adherence to these installation instructions are the responsibility of the user.

Chicago Blower Corporation CPP fans are rotating pieces of equipment and can become sources of danger to life or cause injury if not properly applied. The

maximum operating temperatures and speeds for which these fans are designed must not be exceeded. These limits are given in Chicago Blower Corporation catalogs, or on Chicago Blower Corporation order forms, or on Chicago Blower Corporation drawings. Personnel who will operate or maintain these fans should be given this pamphlet to read and be warned of the potential hazards of the equipment.

Storage

If not installed immediately, the fans should be protected to remain dry at all times.

Extended Storage

1. Store the fans in a dry area, protected from low temperature, rapid and extreme changes in humidity, and free from vibration. Block the fan wheels to prevent wind-milling.
2. Every ninety days; turn the fan wheels several revolutions by hand. Energize the actuators and cycle them six to eight times.
3. Every six months; lubricate the motor bearings.
   See Section **D. MAINTENANCE, Lubrication, Motor Bearings.**
4. Make space heaters operable on motors so equipped.
5. Motor windings should be megged at the time of storage, and again when removed from storage. Resistance readings at removal must not be less than fifty-percent of the initial readings. Removal readings less than fifty-percent of the initial readings mean the motors must be dried, electrically or mechanically.
6. Upon removal from storage, lubricate the motor bearings.
   See Section **D. MAINTENANCE, Lubrication, Motor Bearings.**

C. INSTALLATION AND START-UP

Inlet/Outlet Connections

Ducts should be closely aligned with fan casings and flexible connections should be provided between the fan casings and ducts to prevent structure borne noises and vibrations from being transmitted through the duct work. Vane axial fans require the air to enter the wheels unobstructed and special care is required in the installation of flexible inlet connections. The inlet ends of the fans are under negative pressure and flexible connection materials tend to be sucked inward, disrupting the flow of air to the wheels and causing reduced fan performances. The thrust of the fans aggravates this situation in that the fans tend to move forward, against the direction of air flow, when they are operating. Flexible connections at the large diameter of inlet bells and/or cones eliminate this problem.

Fan Mounting Hardware

All hardware used for support or connection of CPP fans should be Grade 5 strength.

Electrical

Motor leads terminate in the conduit boxes mounted on the exteriors of the fan casings. Rigid conduit should be run from motor starters to the fans with short sections of flexible conduit at the conduit boxes to provide for fan movement. Wire sizes and motor overloads should be sized in accordance with the motor nameplates electrical data. Motor nameplates are located on the casings, adjacent to the Chicago Blower Corporation nameplates.

The WR^2 values for CPP fans are quite low in comparison with equivalent centrifugal fans and usually result in start-up times of three to six seconds. CPP

fans and motors are capable of across-the-line starts, however reduced voltage starting may be required by local conditions or limitations.

Actuator

The actuators require eighty PSIG supply air. The pilot positioners accept three-to fifteen PSIG control air.

Calibration of Pilot Positioner

A cable feedback is used from the actuators to position them in accordance with control air signals. Before disconnecting the feedback cable, note and record the location of the cable clamp assembly on the pilot positioner lever arm. Make sure the clamp assembly remains in that position during calibration.

NOTE: Refer to the pilot positioner manufacturers installation instructions for additional detail.

1. Remove the pilot positioner side cover. Align the scribe mark on the cam plate with the cam roller.
2. With the actuator at mid-stroke, the fan blades at the mid-point of the blade setting range, and the scribe mark aligned, pull the cable taut and tighten the set screw in the cable clamp assembly. Check that the cable passes through the center of the hole in the fan casing.
3. Connect an air line from the rotating union to the 'SUPPLY' port in the pilot positioner.
4. Block the "VALUE' port of the positioner with a suitable pipe plug.
5. Connect a supply air line to the air filter mounted on the positioner.
6. Connect a control air line to the "INSTR' port in the pilot positioner.
7. Apply nine PSIG to the 'INSTR' port. This should put the scribe mark in line with the cam roller. If it does not, turn the knurled spring adjustment nut located to the left of the can roller. When the scribe mark is in line, the positioner is calibrated.
8. The instrument pressure range is from three PSIG to fifteen PSIG. Check that the actuator and blade settings are; at their minimum position at three PSIG; at their mid position at nine PSIG; and at their maximum position at fifteen PSIG. If they are not, adjust the cable clamp on the positioner lever arm.
9. Replace the positioner side cover.

Electric Option: Calibration of Electric/Pneumatic Transducer

1. Set pressure from source (i.e., CBC furnished compressor or user air) to seventy PSIG. Adjustments can be made on filter regulator if ordered with fan. Chicago Blower Corporation presets regulator at seventy PSIG.
2. In conjunction with pilot positioner calibration, remove pipe plug from transducer port and install a three-to-fifteen PSIG range, ¼ NPT, pressure gauge.
3. Apply a twelve milliamp signal to transducer. This should correspond to a nine PSIG air signal and middle blade setting. If it does not, change to a four milliamp signal and zero out transducer using adjustment screw located on side of transducer, while reading pressure gauge and blade setting (zero point is three PSIG and minimum blade setting).
4. Apply a twenty milliamp signal and set span of operation using adjustment screw next to zero adjustment while reading pressure gauge and blade setting (a twenty milliamp signal will correspond to a fifteen PSIG air signal and maximum blade setting).
5. Repeat steps three and four as often as necessary.
6. If there is a large discrepancy at the zero point then repeat calibration of pilot positioner by applying a twelve milliamp signal to transducer and adjust knurled

spring adjustment nut in pilot positioner until pressure gauge on transducer reads nine PSIG. Repeat steps three and four.

Start-up Check List

With the fans correctly installed and checks made for mounting bolt and other hardware tightness, the following, final safety checks are required to prevent injury to personnel or damage to the equipment:

1. Check for correct supply voltages and motor overloads.
2. Remove all material from fan casings, ducts, and areas in front of inlets.
3. Check blade pitch control assemblies for freedom of operation and integrity of all hardware. Check that control assemblies do not move blades to settings that exceed the maximum settings on the fan nameplates, and that the control assemblies return blades to minimum settings upon disconnect of actuator power.
4. 'Bump' motors to check fan rotations. Rotations are counter-clock-wise (CCW) looking into the fan inlet.
5. Start fans. Check motor amperages in each phase for balance and correct motor loads.
6. Check vibration levels (see *CHART 1*) and for unusual sounds.

CHART 1: VIBRATION LIMITS		
FAN RPM	Vibration Displacement in Mils Measured Peak to Peak	
	ALARM LEVEL	SHUT DOWN LEVEL
900	4.8	10.8
1200	3.5	7.8
1800	2.3	5.3

D. MAINTENANCE

General

The basic design and precision construction of Chicago Blower Corporation CPP fans is intended to provide a long, trouble-free life. The wheels are statically and dynamically balanced after assembly. Completely assembled fans are given running balances during final inspection before shipment. To insure long life and trouble-free service, routine inspections and maintenance should be observed. Maintenance personnel should be alert for excessive vibration or unusual sounds.

Lubrication

NOTE: Fan wheels and blade control mechanisms contain a number of self lubricated bearings.

CAUTION: Mixing of lubricants is not recommended.

Cleanliness is important in lubrication. Lubricants should be fresh and free from contamination, and care should be taken to properly clean the areas around grease inlets to prevent contamination.

During factory assembly, Chicago Blower Corporation CPP fan bearings requiring lubricants are provided with an adequate supply, however, following start of operation those bearings must be re-lubricated in accordance with the proper schedule. Chicago Blower Corporation's recommended re-lubrication schedules for specific CPP fan parts are listed below. Motor, rotating union, and pilot positioner manufacturers' recommended schedules are included with the fans.

Actuator

The life of the piston 'O' ring is such that, under normal operating conditions, replacement will seldom be necessary. If disassembly is necessary, follow the lubrication procedure in Section **F. REASSEMBLY, Wheel Reassembly**.

Blade Thrust Bearings

Blade assemblies are complete with blade thrust bearings located between the blade crankarms and blade skirts. A grease fitting is provided, in the wheel hubs, for each bearing. These bearings are packed with **DARMEX 123** lubricant during manufacture with additional **DARMEX 123** lubricant added during assembly at the Chicago Blower Corporation factory, until each bearing is one-hundred percent full.

NOTE: Based on results of extensive tests, DARMEX 123 and SENTINEL 123 are the only Chicago Blower Corporation approved lubricants for these bearings in this application.

Blade thrust bearings should be re-lubricated every two years as follows:

1. Run unit for five to ten minutes.
2. Stop unit. Lock out switch and remove wheel nose spinning.
3. Add **DARMEX 123** or **SENTINEL 123** grease to each blade bearing through the fittings provided until a one-thirty-second inch wide ring of grease appears around the bearing outside diameter inside the wheel hub.
4. Replace wheel nose spinning.

Motor Bearings

1. Stop unit. Lock out switch.
2. Locate the grease inlet fittings. Clean the area thoroughly and remove the protective plastic caps from the grease fittings.
3. Refer to the motor manufacturer's instructions. Add the recommended type and volume of lubricant using a hand operated grease gun. If possible, rotate the fan by hand during lubrication.

E. DISASSEMBLY

WARNING: Disconnect all power sources from fan to avoid electrical shock and personal injury from rotating parts.

Wheel Removal

NOTE: The actuator and wheel are balanced as a unit. To maintain proper parts relationships and balance; note and use the factory imprinted match marks, or otherwise match mark the parts, before disassembly and keep all hardware in its original location.

1. Disconnect the pilot positioner feedback cable clamp at the pilot positioner.
2. Disconnect the air line at the rotating union and the air line union located at the pilot positioner end of the cable pulley support member.
3. Remove the cable pulley support member.
4. Remove the wheel nose spinning.
5. Disassemble and remove the actuator:
    A. Remove the piston housing end plate (eight hex socket cap screws and lock washers). Check the condition of the end plate 'O' ring. Replace if necessary.
    B. Remove the piston assembly (one hex socket cap screw, flat washer, and 'O' ring in the center).
    CAUTION: The piston is under spring pressure.

Make sure the springs are removed as part of the piston assembly. Check the condition of the piston and retaining bolt 'O' rings. Replace if necessary.

C. Rotate the blade crankarm rollers out of the piston housing groove through the slots provided in the piston housing flange.

D. Slide the piston housing assembly off of the straight bore adaptor bushing. Check that the six, plastic return spring guide rod, bushings remained captured in the counter bored holes in the inner wall of the housing.

6. Remove the three hex socket cap screws and lock washers that attach the wheel to the straight bore adaptor bushing and thread the cap screws into the holes provided, adjacent to the mounting holes, in the wheel hub.
7. Tighten the cap screws slowly and evenly against the straight bore bushing flange to loosen and remove the wheel hub-and-blade assembly.
8. To remove the straight bore adaptor bushing, loosen its four set screws and slide the bushing from the motor shaft. A puller may be required.

Motor Removal

NOTE: To remove the motor, it is necessary to have access to both the inlet and the discharge ends of the unit.

1. Remove the pitch changing mechanism, wheel hub and blade assembly, and straight bore adaptor bushing.
   See Section ***E. DISASSEMBLY, Wheel Removal.***
2. Remove the conduit box cover and disconnect all wiring.
3. Remove the conduit box from the fan casing.
4. Disconnect and remove the conduit running from the motor to the fan casing.
   CAUTION: Remove the conduit with care so the motor electrical leads are not damage.
5. Disconnect the motor bearing lubrication lines at the fan casing.
6. Larger motors have tie rods from the motor to the casing, opposite the shaft end of the motor. Remove the tie rods.
7. Support the motor securely so it is not damaged when the motor mounting bolts are removed.
8. The motor mounting bolts extend through the motor mounting bulk head into the 'C' face flange of the motor. Remove the motor mounting bolts from the inlet side of the motor mounting bulk head.
9. Remove the motor through the discharge end of the casing.

F. REASSEMBLY

Motor Installation

1. Place the motor into the fan casing from the discharge end.
2. Fit the motor 'C' face flange into the recess provided in the motor mounting bulk head. Secure the motor to the bulk head with the motor mounting bolts. The motor mounting bolts are inserted through the bulk head and extend into the motor's 'C' face flange. Tighten the motor mounting bolts evenly and torque to; thirty foot pounds for one-half inch diameter bolts; sixty-five foot pounds for five-eighths diameter bolts.
   NOTES: If the original motor mounting bolts are not used, make sure the replacement bolts are Grade 5 strength.
3. Replace the tie rods if so equipped.
4. Connect the motor bearing lubrication lines to the casing.
5. Guide the motor electrical leads through the conduit and connect the conduit to the motor and the fan casing.
6. Replace the conduit box and reconnect all wiring.

7. Replace the conduit box cover.
8. Replace the straight bore adaptor bushing, hub and blade assembly, and pitch changing mechanism.
   See Section **F. REASSEMBLY, Wheel Reassembly.**
9. Follow the start-up check list procedure.
   See Section **C. INSTALLATION AND START-UP, Start-up Check List.**

Wheel Reassembly

NOTE: If the wheel was previously assembled, the straight bore adapter bushing, wheel hub-and-blade assembly, and actuator parts will be match marked. Maintain that alignment when reassembling to retain proper dynamic balance.

1. Install the straight bore adapter bushing and wheel to the motor shaft:
   A. Place the key in the motor shaft keyway.
   B. Align the keyway in the straight bore adapter bushing with the motor shaft key.
   C. Slide the straight bore adapter bushing onto the motor shaft until the snap ring in the straight bore adapter bushing contacts the end of the motor shaft.
   D. Tighten the four straight bore adapter set screws (tighten the two set screws over the key first).
   E. Torque the four set screws to the value shown in **CHART 1**.
   F. Slide the fan wheel onto the straight bore adapter bushing. If the fan wheel was previously assembled, align the wheel-to-straight bore adapter bushing match marks. Align the untapped wheel hub holes with tapped holes in the straight bore adapter bushing.
   G. Install the three socket head cap screws and lock washers and tighten evenly.
   H. Torque the three socket head cap screws to the value shown in **CHART 2**.

CHART 2: WHEEL MOUNTING TIGHTENING TORQUES

FAN MODEL	SET SCREW TORQUE [FT-LB]	CAP SCREW TORQUE [FT-LB]
'B' HUB	9.0	75.0
'C' HUB	30.0	100.00

2. Check that the six plastic bushings are inserted into the piston housing guide rod relief holes.
3. Apply a thin coat of white lithium grease to a cleaned straight bore adapter bushing surface which contacts the piston housing Teflon strip.
4. Slide the piston housing onto the straight bore adapter bushing.
5. Align one crankarm roller with the slot in the piston housing. Rotate the blade crankarm until the crankarm roller passes through the slot into the piston housing groove. Repeat the step for the crankarm roller located opposite the first. Hold the wheel stationary and rotate the piston housing until the next pair of crankarm rollers align with the slots. Repeat until all the crankarm rollers are in the piston housing groove.
6. Rotate the piston housing until the slots in the piston housing are centered between two crankarm rollers and the balancing match marks are aligned.

7. Install an 'O' ring in the 'O' ring groove in the piston
8. Install an 'O' ring in the 'O' ring groove in the piston housing end plate.
9. Apply a thin coat of white lithium grease to a cleaned piston housing inside diameter; a cleaned piston 'O' ring; cleaned piston guide rods; and a cleaned end plate 'O' ring.
10. Place the six springs onto the piston guide rods.
11. Slide the piston assembly into the piston housing and align the balancing match marks.

    NOTE: Align the 'keyway' on the end of the piston hub with the 'key' on the end of the straight bore adapter bushing.

    The piston guide rods must pass through the piston housing guide rod bushings.
12. Place the flat washer and 'O' ring onto the hex socket head cap screw. Apply Loctite #271 to the hex socket head cap screw threads.
13. Insert the hex socket head cap screw through the center hole in the piston. Thread the hex socket head cap screw into the tapped hole in the end of the motor shaft. Check that the piston assembly is properly seated. Tighten and torque the hex socket head cap screw to sixty-five foot-pounds.
14. Install the piston housing end plate to the piston housing. Secure the end plate with the eight hex socket head cap screws. Tighten and torque to five foot-pounds.
15. Apply Loctite #271 to the rotating union threads. Install the rotating union to the piston housing end plate. Tighten and torque the rotating union to seven foot-pounds.
16. Check the blade settings:
    A. With the supply air disconnected from the actuator, check that the actuator is positioned at its minimum position.
    B. Calibrate the pilot positioner per the instructions in Section **C. INSTALLATION AND START-UP, Calibration of Pilot Positioner.**
    C. Activate the actuator. Check that the maximum actuator travel results in the original maximum blade setting and that the minimum actuator travel results in the original minimum blade setting.
    D. If necessary, adjust the blade settings:
        a. Loosen the crankarm set screws and clamp screws to allow blade rotation inside the crankarms.

        NOTE: Crankarm **SET** screws should **NOT** be retightened until last.

        * b. One at a time, rotate the blades until the index marks are set to the original maximum blade settings, PLUS one-half a setting. Repeat **'C'** above.
    E. Tighten the crankarm clamp screws evenly and torque to the value shown in **CHART 3**. Tighten the crankarm set screws and torque to the value shown in **CHART 3**.

CHART 3: BLADE CRANKARM TIGHTENING TORQUES

FAN MODEL	CLAMP SCREW TORQUE [FT-LB]	SET SCREW TORQUE [FT-LB]
'B' HUB	10.0	10.0
'C' HUB	15.0	15.0

17. Attach nose spinning.

* Allows for piston-housing-groove-to-crankarm-roller clearance and in-motion blade air load.

THE FOLLOWING INSTRUCTIONS APPLY FOR RUN TESTING ONLY:

NOTE: See Also Section C. INSTALLATION AND START-UP, Start-up Check List.

1. Run fan. Touch-up balance as required.
2. Run fan. Actuate blades full travel several times as final check of operation.
3. Following run test, remove nose spinning. If necessary, add ***DARMEX 123*** grease to each blade bearing through fittings provided until a one-thirty-second inch ring of grease appears around bearing O.D., inside hub.
4. Attach nose spinning.

G. INSTALLED FANS

1. Chicago Blower requires that all appurtenances, including ductwork or stacks, which are attached to the fan inlet or outlet, be independently supported, unless prior approval has been obtained from Chicago Blower. Excess dead lo wind loads can distort the fan housing causing misalignment and possible failure. Flexible connections are also necessary to prevent duct expansion or movement from adding loads to the fan.