

FanInst-01
1101



Fan and Blower Manual

- Installation
- Operation
- Maintenance

How to Use This Manual

This manual provides general guidelines and recommendations for the installation, operation and maintenance of Alloy Engineering fans and blowers. The information is general in nature and pertains to a variety of fan and blower models and configurations manufactured by Alloy Engineering.

In addition, recommended procedures are provided for start-up, run-in, operation, maintenance, and troubleshooting of Alloy Engineering fans and blowers, as well as part ordering and repair procedures.

Information on the proper installation, operation and maintenance of specific components—such as bearings, couplings, V-belts, motors, and motor starters—should be obtained from their manufacturers.

General safety considerations and important recommended practices are bold and italicized for emphasis. However, it is the user's responsibility to follow approved safety practices when installing, operating and maintaining air-handling equipment. Current safety standards should be followed and operations supervised by personnel experienced in moving heavy equipment.

Do not hesitate to contact Alloy Engineering for additional information and clarification of installation, operation and maintenance recommendations and/or guidelines.

Contents

How to Use This Manual	1
Before Installation	2
Receiving.....	2
Handling.....	2
Storage.....	2
General Installation Guidelines	2
Foundations.....	2
Structural Steel Supports.....	3
Factory-Assembled Fans.....	3
Field-Assembled Fans.....	3
Rotor/Shaft Assembly.....	3
Bearing Replacement.....	4
Sleeve bearings:.....	4
Split-roller bearings:.....	4
Solid pillow block:.....	5
Final assembly:.....	5
Lubrication.....	5
Component Alignment.....	6
Final Assembly and Alignment	6
Drives.....	6
Duct Connections.....	7
Grouting.....	7
Accessories.....	7
Cooling wheels.....	7
Shaft seals.....	8
Variable inlet vanes.....	8
Inlet box dampers.....	8
Outlet dampers.....	8
Axial-Flow Fan Guidelines.....	8
High-Temperature Fan Guidelines	8
Shaft and Bearing Cooling Media.....	9
Water-cooled fans:.....	9
Air-cooled fans:.....	9
General installation guidelines.....	10
Direct-Driven, Pressurized Blower Guidelines ..	10
Blower Operation.....	11
Start-Up/Run-In Guidelines	11
Safety Labeling.....	12
Inspection & Maintenance	13
Troubleshooting Checklist.....	14
Air capacity:.....	14
Noise:.....	14
Vibration:.....	14
Motor:.....	15
Drive:.....	15
Ordering	15
Fan Repairs and Spare Parts	15
Limitation of Warranties and Claims	15

Before Installation

Receiving

All Alloy Engineering fans and blowers are carefully constructed and inspected before shipment to ensure the highest standards of quality and performance. When receiving an Alloy Engineering shipment, first compare all components with the bill of lading or packing list to verify that the proper order was received.

Check each unit for damage and, if damaged in transit, report the situation to the carrier and to Alloy Engineering.

Electrically isolate the drive motor and fan. Then, before starting, rotate the fan shaft by hand to be sure that there are no restrictions to its free turning.

Handling

Do not lift complete fans by the lifting ring on the motor. Do not lift a housing-type fan or blower by casing outlet or inlet flange connections, as they are not designed for the heavy loads produced by lifting the entire fan or blower structure.

Factory assembled units and housings should be lifted by the housing lifting lugs provided, or by pallets.

Unassembled units should be lifted by slings using spreader bars and padding.

Whenever possible, shaft assemblies should be lifted at areas that avoid any contact with the wheel, bearing seats, or coupling.

Storage

If the fan or blower is not put into service immediately, proper storage methods should be used. Bearings, drive motor and exposed metal should be protected from moisture or exposure to foreign materials. Store in a clean, dry location. For long-term storage (over 60 days), bearings should be filled and all machined surfaces coated with grease. Cover all inlets and outlets with lids.

During both short and long-term storage, the fan or blower shaft should be periodically rotated (minimum of 180 deg) to prevent corrosion of the internal parts

of the bearings. The unit should be run for 15 min. every two weeks, if possible. Be sure that the bearings are aligned and lubricated. All ducts must be connected and access sections securely closed.

General Installation Guidelines

These guidelines and recommendations are general and pertain to a variety of Alloy Engineering fans. Contact Alloy Engineering for specific unit installation questions not covered in this manual.

Foundations

Sound foundations are essential for proper operation of all fans. They must be rigid, flat, level, and designed to prevent settling. Mounting provides uniform support of the fan and provision must always be made for proper leveling.

A reinforced concrete slab with a minimum mass of three times the total assembled weight of the fan and driver is the preferred mounting method for all fans. The edges of the foundation should be beveled to prevent chipping and should extend at least 6 in. beyond the fan. A minimum allowance of 1 in. should be made for shimming or grouting (with a non-shrinking grout) when determining the height of the foundation. J-type anchor bolts, tied into the reinforcing bar, should be used. A sleeve around the bolt to allow alignment adjustments at installation is suggested.

Structural Steel Supports

If the fan is to be mounted on structured steel, the structure must be designed to carry the static weight of the fan, as well as the loads imposed by the centrifugal force of the rotor and driver. Fan structures should be analyzed to ensure that no natural frequencies occur within 30% of fan speed. This is especially critical when more than one fan is located on the same structure.

A concrete-filled steel inertia-block base with coil-spring supports is an excellent method of mounting fans on structural steel and eliminating transmitted vibrations.

Factory-Assembled Fans

Level the complete fan assembly (check on the shaft) on the foundation by using stainless steel shims or non-shrinking grout on either side of each anchor bolt.

Check the bearing alignment. If incorrect, shim or reposition the bearings to compensate.

Sheaves on belt-driven fans are generally provided with taper lock bushings. The sheaves can be cocked if bushing bolts are not tightened uniformly (use progressive tightening procedure when tightening these bolts). Motor and fan sheave faces must be aligned when checked with a straight-edge or stringline. Check belts for proper tension.

Factory mounted couplings on direct-driven fans, usually shrunk fit on the fan and motor shafts, are subject to misalignment during shipment.

Coupling alignment must be checked and realigned if required. Note that most couplings require lubrication.

4

Check to make sure that the wheel is tight on the shaft, and foundation bolts, motor bolts, sheaves and bearings are tightly secured. Check to make sure there is no rubbing or binding, and that the wheel-to-inlet cone clearances are correct. **If rubbing or binding is found, it must be eliminated prior to operation of the fan.**

Check to be sure the bearings are lubricated. For non-circulating oil-lube systems, check to be sure the oil level is correct. Recommended oil type is specified on the General Arrangement drawing.

If any accessories were shipped loose, they should be installed at this time. Refer to the Accessories section of this manual for details.

Field-Assembled Fans

If the housing was shipped disassembled, begin installation by placing the bottom half of the housing onto the foundation. If the housing was shipped assembled, disassemble it so the rotor can be installed after the housing has been set on the foundation.

The housing should be lifted from as many points as possible, and spreader bars should be used to minimize distortion. When the housing is properly positioned over the anchor bolts, it should be carefully lowered on to the foundation. The housing can be preliminarily leveled with adjusting nuts on the anchor bolts.

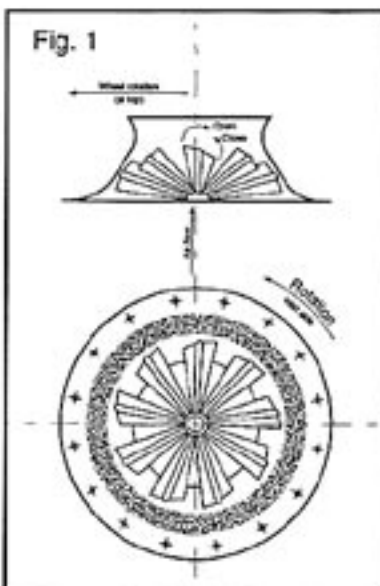
Set the bearing pedestals in place. Adjusting nuts on the anchor bolts can be used to establish a preliminary level. Do not tighten anchor bolts at this point.

Rotor/Shaft Assembly

If the rotor and shaft have not been factory assembled, install the shaft in the wheel.

Remove any protective coatings from the shaft and wheel hub bore. Check all surfaces for rust, corrosion and nicks. If cleanup is necessary, use nothing rougher than crocus cloth. Remove all keys and loosen set screws. Oil mating surfaces and assemble the shaft into the wheel. Check the assembly drawings to insure the shaft is correctly installed in the wheel. **Note that the rotation of the fan is always determined by viewing from the drive side.** Install keys and tighten set screws.

On pre-assembled rotors, remove any protective coatings and check for nicks and corrosion as previously noted. Oil the shaft at the bearing journal locations.



Before placing the rotor assembly into position in the housing, be sure the inlet cone, inlet ring, and/or variable inlet vanes (VIVs) of Arrangement 3 fans can be mounted with the rotor assembly into the housing. If VIVs are provided, check for proper rotation, Fig. 1.

Inlet vanes in the half-closed position must pre-spin the air in direction of wheel rotation. On a double-width, double-inlet (DWDI) fan, one inlet vane is clockwise and the other counter-clockwise; be careful not to install them reversed. **Do not allow vane center mechanism to damage the shaft.**

Bearing Replacement

When installing bearings, always check the assembly drawing to determine the location of the fixed and expansion bearings. These bearings cannot be interchanged.

Bearings should be square to the shaft. Alignment of split-roller or sleeve bearings to the shaft can be checked by measuring the bearing-seal-to-bearing-housing gap. This gap should be constant entirely around the shaft.

Sleeve bearings:

1. Disassemble the bearings and clean with appropriate solvent. Do not mix parts between bearings as they are not interchangeable.
2. Always handle bearings with clean hands and great care. Even slight damage to the bearing liner surface can cause the bearing to fail prematurely. Oil all bearing liner surfaces at assembly.
3. Always be sure to install oil slinger rings in the correct location andpeen the ring screws in place.
4. Bearing housings may be tapped with a number of holes. Be sure all equipment is installed in the proper location.
5. Bolt the lower halves of the bearing housings loosely in place on the pedestal(s), and place the lower bearing half in the housing.
6. Oil the lower liner in accordance with the manufacturer's instructions, and cover to avoid contamination.
7. Sling the rotor assembly into place. **Always use great care not to damage the bearing liners.**
8. Oil journals and set bearing and housing top halves in place. Install bolts loosely.

Split-roller bearings:

1. Disassemble the bearings and clean with appropriate solvent. Do not mix parts between bearings as they are not interchangeable.
2. Bolt the lower halves of the bearing housings loosely in place on the pedestal(s). Cover to avoid contamination.
3. Place the seals, bearing and adaptor sleeve loosely on the shaft.
4. Sling the rotor assembly over the fan and position the seals and bearing over the bearing housing.
5. Set the rotor assembly in place.
6. Install the bearing housing caps and bolts. Leave the bolts loose.

Solid pillow block:

1. Slip the bearing assembly over the shaft of the rotor assembly.
2. Sling the rotor assembly into place and bolt the bearings onto the pedestal(s).

Final assembly:

1. With ball and roller bearings, adapter-sleeve adjustments affect internal bearing clearance and preload. Set according to manufacturer's recommendations.
2. Always be sure to bend down a tang on the bearing sleeve lockout (split pillow block) or tighten the set collar screws (solid pillow block).
3. Oil or grease type is specified on the fan assembly drawing. Never substitute lubricants as premature failure can result.
4. According to manufacturers' instructions, torque cap bolts, liner screws, thrust collar screws, set screws and plunger to recommended levels.

Annually, check torque of all set screws and collars according to manufacturers' recommendations and adjust, if necessary, to ensure tightness on shaft.

For doweled bearings, the fan should be allowed to run for at least 30 days prior to doweled. Alignment of all components must be rechecked prior to doweled. Always use dowel pins of an appropriate size and never drill through a highly stressed portion of the bearing.

Lubrication

Ball and roller bearings are factory pre-lubricated with high quality grease, Table 1. The re-lubrication interval depends on the bearing operating conditions: speed, temperature, and environment, Table 2.

Manufacturer	Grease
Citgo	Mystik JT6
Shell Oil Company	Alvania 2 or 3
	Alvania EP 2
Exxon Oil	Unirex N2 or N3
Texaco	Premium RB
Mobil Oil	Mobilith 22
	Mobil 532

Speed (rpm)	Temp. (°F)	Cleanliness	Interval
100	Up to 120	Clean	6 to 12 mo
500	Up to 150	Clean	2 to 6 mo
1000	Up to 210	Clean	3 wks to 2 mo
1500	Over 211	Clean	Weekly
Any	Up to 150	Dirty	1 wk to 1 mo
Any	Over 150	Dirty	Daily to 2 wk
Any	Any	Very dirty	Daily to 1 wk
Any	Any	Extremely Dirty	Daily to 1 wk

Normal service is considered as operation in a clean, dry atmosphere at temperatures between 20°F and 180°F and at shaft surface speeds up to 1900 fpm. This corresponds to a 1-in. shaft at 7300 rpm, a 2-in. shaft at 3600 rpm or a 3in. shaft at 2400 rpm.

Where service is abnormal with respect to speed, temperature, exposure to moisture, dirt or corrosive chemicals, or where extremely long life is required, more frequent re-lubrication may be advisable. Follow bearing manufacturer's advice on suitable greases for abnormal service.

Bearings can be re-lubricated either while stationary or running. However, for safety, re-lubrication is suggested while the units are stationary (when the fan is shut-down).

Always follow plant safety procedures and OSHA requirements.

Component Alignment

The rotor must now be leveled and aligned to the housing. Using a machinist's level, level the shaft by using adjusting nuts on the anchor bolts. Verify rotor alignment to the housing by setting an equal distance from the rotor backplate to the housing side sheet. (Refer to the assembly drawing for position in the housing.) Align housing to wheel as required.

Next, assemble the top half of the fan housing, or housing split section, to the fan unit. Always use the appropriate gasket material for split flanges. Check rotor alignment to housing top half as previously stated.

The inlet cone must now be aligned to the wheel. Wheel-to-cone alignment details are included on the assembly drawing provided with each fan. The drawing gives dimensions for the inlet cone-to-wheel backplate distance and radial cone-to-wheel clearances.

High temperature fans may require special wheel and cone alignments to allow for expansion due to temperature. The settings given on the assembly drawing reflect cold settings.

Always check that there is no rubbing or binding of the wheel cone.

With the preliminary level, alignment, and inlet-cone clearances set, the fan is ready for final shimming and tightening of the anchor bolts.

Shims are necessary for proper support and attachment of the fan to the foundation. Shims should be placed on either side of each anchor bolt and should be approximately 4-in. wide (Fig. 1).

With shims in place, tighten all anchor bolts. **Remember to loosen the adjusting nuts.**

An epoxy grout can be used in place of shims if the following procedure is employed. **However, do not grout fan until all alignments have been checked. See Page 7 regarding grouting.**

1. Drill and tap soleplates and housing mounting flanges (or weld nuts to each corner) for jack bolts.

2. Level with jack bolts, keeping anchor bolt nuts snug.
3. Tighten anchor bolts, check alignment.
4. Fill *entire* space beneath housing and sole-plates with epoxy grout. Only epoxy grouts can be used since masonry grout will not flow to fill entire space.

Final Assembly and Alignment

With fan shimmed and anchor bolts tight, the final alignments and assembly can be made.

Drives

Next, connect the fan drive. For direct-drive fans, check to see that both coupling halves have been mounted. If fan half coupling has not been mounted at Alloy Engineering, follow the coupling manufacturer's instructions to mount and align the coupling. Couplings normally have a slight interference (approximately 0.001-in. interference per inch of bore) to obtain a shrink fit on the shaft. This fitting will require heating the coupling to slip it onto the shaft.

Always check to be sure the shaft and coupling bore are free of burrs, grit, and any foreign material.

Follow the coupling manufacturer's instructions for proper heating recommendations. Use of a good quality high-temperature assembly lubricant is recommended to prevent locking the coupling onto the shaft before it is in the proper position. Proper expansion of the coupling hub during heating can be determined by the use of temperature sticks or inside calipers.

The hub should be mounted and the key inserted before the hub has cooled. Mounting the driver half coupling is accomplished in a similar fashion. Check the assembly drawing for the proper gap between coupling halves.

Don't forget to place the coupling outer housing onto the shaft before shrinking the coupling on.

Extreme care must be used when aligning the coupling. Incorrectly aligned couplings can cause bearing overheating, high vibration, and excessive wear or failure of the coupling and/or bearings. Follow the coupling manufacturer's instructions when making the alignment. Use of a dial gauge or laser alignment tool is recommended.

Turbines and motors expand as they come up to operating temperature. The driver side of the coupling should be set low by a few thousandths-of-an-inch to allow for expansion during operation. Install the gasket, bolt the coupling halves together, and lubricate in accordance with coupling manufacturer's instructions.

For belt driven fans, install the driver and driven sheaves (be careful to get them on the correct shafts). Install the belts and align with straightedge or string.

After final assembly and alignment of the rotor and drives is complete, recheck the inlet cone clearances to ensure proper clearances have been held. If supplied, install the VIV linkage(s) at this time. Details of linkage arrangement are supplied on the fan assembly drawing.

Recheck the tightness of all fasteners in foundation, pedestals, etc. Install shaft seals if not already installed. Turn rotor by hand to make sure it turns freely with no binding or rubbing.

Other accessories that were shipped loose can be installed at this time. Refer to the Accessories section of this manual for details.

Duct Connections

The fan is now ready to be connected to its duct work. ***Dead weight of flues, ducts, silencers, or other associated equipment must not be carried by the fan.*** Subjecting the fan to external loads can cause distortion of the housing and will adversely affect wheel/cone clearances and bearing alignments. Flexible connections at the inlet and outlet are recommended and are required for high-temperature operation.

Grouting

The final fan installation step is grouting of the foundation. If you have contacted Alloy Engineering for a start up check-out, do not grout the fan until after the Alloy Engineering field service engineer has inspected the installation. After verification of alignment, grouting can be completed. A good, commercial quality, non-shrinking grout should be used. Epoxy grouts are recommended for areas where their ability to flow can be useful, such as under large soleplates.

Accessories

The following is a guide to installation of fan accessories including cooling wheels, shaft seals, variable inlet vanes, inlet box dampers, and outlet dampers.

Cooling wheels

Cooling wheels consist of split aluminum radial-bladed wheels that are designed to interrupt heat conduction along the shaft and into the bearing(s). The two wheel halves are bolted together around the shaft with the backplate toward the fan housing and the cooling fins facing away from the housing. (The opposite may be true on oil-lubricated bearings, since the fan action of the disc can draw oil out of the bearing). Consult the assembly drawing for proper location and orientation. A guard must be used over the cooling wheel.

Shaft seals

Shaft seals are furnished as standard on most high-temperature and induced-draft (exhaust) fans. Typical seals use an air dam membrane or a stuffing box.

Variable inlet vanes

Variable inlet vanes (VIVs) are inlet cones with variable vanes mounted in them for airflow volume control and power savings. VIV assemblies can also be supplied as a flanged bolt-on accessory. In either case, the unit itself will be factory assembled. (See Pg. 4 for installation instructions.)

Linkage assembly details are provided on the fan assembly drawing. VIVs are available for either manual operation with locking handle, or automatic operation using a powered operator. When

installing powered operators, follow the manufacturer's instructions packed with the unit.

Inlet box dampers

Inlet box dampers provide regulation of volume and power similar to that of VIVs. Most dampers are supplied completely assembled in a unitary channel frame and should be installed with damper axles parallel to the fan shaft. For units shipped knocked down, or for DWDI linkage mounting, consult the damper manufacturer's directions. After installation, check that the damper(s) pre-spin the air in the direction of wheel rotation.

Outlet dampers

Outlet dampers, like inlet dampers, are usually supplied completely assembled and mounted in a unitary channel frame. The outlet damper is bolted to the outlet of the fan for volume control.

Axial-Flow Fan Guidelines

In addition to the general installation recommendations for all Alloy Engineering fans, several considerations relate to the installation of Alloy Engineering axial-flow fans.

- Minimum distance behind fan wheel:
For type FA-06 (six-bladed), FA-07 (seven bladed) and FA-10 (ten-bladed), see Alloy Engineering Axial Fan Catalog.
- Catalog performance data is based on fans with shrouds. Fans without shrouds produce less pressure with some reduction in capacity. Horsepower remains constant.
- Fan shrouds are recommended on installations where the high-velocity air jet must penetrate a distance in excess of one wheel diameter per 1,000 fpm of velocity.
- Avoid a corner or other similar component at the fan inlet as a non-symmetrical inlet-velocity distribution may occur, reducing performance.
- On installations where more than one axial fan is used and located close to each other, fans should be installed to be counter rotating or a baffle plate should be installed between fan wheels to prevent air-flow interference between fans.

High-Temperature Fan Guidelines

Do not subject the fan to abrupt temperature change. The average rate of temperature change should not exceed 15-deg F/min. Consult Alloy Engineering when the average rate of temperature change exceeds this value.

The fan should not make contact with a burner flame. Do not mount the fan close to radiant tubes or heating elements.

Shaft and Bearing Cooling Media

Several methods of cooling media can be used with Alloy Engineering fans. The appropriate method is dictated by the furnace design. The following information will aid in the selection of the required cooling arrangement.

Water-cooled fans:

Standard water-cooled fan units, where a bearing housing is used, are sealed by the bearing seals. On standard water-cooled fan units where an independent bearing pedestal is used with pillow block bearings, a stuffing box packing gland is used. On both types of standard water-cooled fans small amounts of gas may pass through the seals. An atmosphere purge of inert gas may be placed between the bearings to make the standard water-cooled arrangement a gas-tight seal.

When the furnace contains toxic, corrosive (including steam & high water vapor), combustible or explosive atmospheres, or atmospheres where air infiltration into the furnace is critical (such as annealing), a special shaft seal is required. Please consult Alloy Engineering when any of these atmospheres are present.

On water-cooled fan units, the fan shaft and bearings are cooled by maintaining the flow of water through the unit. The cooling water should be kept on at all times when the internal furnace temperature exceeds 200°F. The temperature differential between water inlet and water outlet should not exceed 15 deg F.

It is important to use an adequate pressure-relief valve (75 psi, or lower) directly connected to the water inlet or outlet pipe on a closed water system. Confined water, exposed to heat, could result in a dangerous condition.

When water-cooled fan units are to be mounted outdoors in areas that may be subjected to temperatures below 32°F, an antifreeze solution (non-alcohol base) must be added to the water re-circulating system.

Cooling water inlet temperature should not exceed 85°F or damage to bearings may result. Water should be free from sludge or foreign matter that may cause blockage in the water-cooled plug and could cause damage to the fan and/or create a dangerous condition.

Water-cooled fan units and air-cooled fan units are not interchangeable. Contact Alloy Engineering for more information.

Shaft Diameter, at inner bearing (in.)	Flow Rate* (gpm)
1 ¹ / ₄	10
1 ⁷ / ₁₆	12
1 ¹¹ / ₁₆	15
1 ¹³ / ₁₆	17
2 ³ / ₁₆	20
2 ⁷ / ₁₆	25
2 ¹¹ / ₁₆	30
2 ¹⁵ / ₁₆	35
3 ³ / ₁₆	43
3 ⁷ / ₁₆	50
3 ¹¹ / ₁₆	55
3 ¹⁵ / ₁₆	60

* Flow rates are for temperatures below 600°F. Multipliers for flow rates for furnace temperatures above 600°F are shown in Table 4. Maximum water temperature at water inlet not to exceed 80°F. Maximum temperature differential between water inlet and water outlet not to exceed 15 deg F. The above flow rates may need to be adjusted to maintain required temperature differential.

Table 4-Flow Rate Multipliers
(for use with furnaces above 600°F)

Temperature Range (°F)	Multiplier
601 to 800	1.15
801 to 1100	1.30
1100 to 1350	1.50
1351 to 1500	1.70
1501 to 1650	2.10
1651 to 1800	2.30
1801 to 2000	2.60

Air-cooled fans:

Standard air cooling is the most effective method of air cooling at temperatures to 2250°F.

Air-cooled fans are suitable for toxic, combustible or explosive atmospheres. Air-cooled fans are sealed and gas will not flow either into or out of the furnace along the fan shaft.

General guidelines for standard air-cooled fans include:

- The air-cooling efficiency of this type of cooling arrangement depends solely on the specially designed Alloy Engineering cooling package.
- On air-cooled fan units, the fan shaft and bearings are cooled by the operation of the fan. To avoid bearing and shaft damage, standard air-cooled fans must rotate at normal operating speed at all times when the furnace temperature exceeds 200°F.
- To avoid bearing or shaft damage, do not stop the fan shaft from rotating at normal operating speed for at least three hours after furnace heat is turned off. This allows the cooling mechanism to dissipate the heat absorbed by the fan wheel and shaft during operation.
- Air-cooling ports must never be obstructed as bearing damage could result.
- If the ambient air temperature in the area where the fan is to be mounted exceeds 120°F, consult Alloy Engineering's engineering department.

Air-cooled fans should be installed at a maximum of 200°F and gradually ramped up to operating temperature at a rate not to exceed 100°F/hr.

External heat slinger arrangement uses an impeller made of heat-conducting material mounted on the exterior of the fan. An insulated gasket material surrounding the shaft and located between the top of the fan plug and the heat slinger acts as a heat shield. This method of cooling is effective for temperatures to 2250°F.

General installation guidelines

When mounting the fan, all mounting holes must be used.

Customer must provide a suitable fan mounting-flange gasket on sealed applications. On vacuum applications, Alloy Engineering will provide an O-ring seal for mounting flange to customer-machined flat surface.

Fan housing inlet and outlet connections require a slip connection or expansion joint to allow for thermal expansion. Inlet and outlet connections are not designed to support duct work.

Un-insulated fans should be insulated or guarded by customer to prevent physical contact with hot surfaces that could cause injury or a dangerous condition.

If the fan is to be belt driven and the fan and motor sheaves are not Alloy Engineering factory mounted, the fan sheave and motor sheave must be balanced and, when mounted, must be in alignment with matched, properly tensioned V-belts. Improper alignment or belt tension can cause excessive power (high amperage) consumption as well as damage to the drive belts and bearings.

All electrical connections and electrical grounding of the fan equipment must be in accordance with local and national-UL and National Electrical Code (NEC)-codes.

Direct-Driven, Pressurized Blower Guidelines

When mounting the blower, all mounting holes must be used.

During installation, cover the inlet and outlet to keep foreign materials from entering the blower casing.

The blower inlet and outlet are not designed for supporting piping. All piping should be independently supported.

Do not obstruct the blower intake on a free-inlet installation. A minimum of three (3) inlet diameters open-area radius is recommended within 180 deg of the inlet.

The blower must handle clean air only. Prevent dirt and other foreign material from being drawn into the intake. If adverse conditions exist, mount an air intake filter-available from Alloy Engineering-on the blower.

If the blower is exposed to moisture, drill a 1/4-in. hole in the bottom of the casing for drainage.

All electrical connections or electrical grounding of the blower equipment must conform to local and national-UL and National Electrical Codes (NEC)-codes.

Blower Operation

Alloy Engineering blowers are constructed for a special purpose. It is important not to exceed their recommended operational limits as a dangerous condition may result. Do not operate Alloy Engineering blowers if not equipped with safety guards as required by OSHA regulations. OSHA-conforming guards are available for Alloy Engineering blowers and are furnished upon request.

Blowers should never be operated with the air outlet wide open or without the proper restrictions in the air outlet delivery line, as motor would be overloaded and probably damaged.

Check motor leads for proper voltage hook-up before wiring. Check for proper rotation.

Check to make sure that the proper heater elements are in the starter. When the blower is at full speed, check the motor load draw and compare with motor nameplate specifications.

All blowers are carefully balanced as a complete unit before shipment. Do not operate blower if vibration from an out-of-balance condition is evident. An unbalanced wheel will cause premature failure of the blower and/or could create a dangerous condition. It is recommended that the amplitude of vibration, Table 5, be checked on a periodic basis and the balance corrected as required.

Speed (rpm)	Smooth	Fair	Rough	Very rough
				Danger: correction required
3600	0.4	0.7	1.5	3 to 5

Due to the high blower wheel speeds necessary in pressure blower design, noise levels could exceed OSHA. specification 1910.95 and all applicable revisions. If noise levels are of concern, blower silencers-available from Alloy Engineering-are recommended.

Start-Up/Run-In Guidelines

Alloy Engineering fans and blowers are constructed for a special purpose. It is important not to exceed their limitations as a dangerous condition may result. Do not operate fans or blowers if not equipped with safety guards as require by OSHA regulations. OSHA-conforming guards are available for all Alloy Engineering fans and blowers and are furnished upon request.

Only trained personnel should be used during fan (and blower) start-up. Always make a final safety check to prevent injury to personnel or damage to the equipment. If start-up service has not been

requested from Alloy Engineering, the following start-up checklist should be followed:

1. Lock out power source.
2. Check bearings for alignment, lubrication, tightness of locking collars, cleanliness, and cooling water or lubrication flow, if applicable.
3. Check wheel set screws for tightness. Check tightness of housing and foundation bolts.
4. Check inlet cone clearances.
5. Turn wheel by hand to ensure that it rotates freely without rubbing.
6. Check housing and duct work for foreign matter and debris. Close all access doors.
7. Close all inlet vanes or dampers.
8. Turn on power.
9. Jog fan with starter, check for proper rotation.
10. Start fan and allow unit to reach full speed and run for several minutes. Check for excessive vibration or unusual noise.

Always start the driving equipment in accordance with motor and/or starter manufacturer's recommendations. Most motors are limited to one or two starts per hour. Be aware of the time span between starts to prevent overheating the motor. Turn fan off and allow to coast to a stop.

11. Lock out power source.

12. Recheck tightness of bolts and set screws, which may have loosened during start-up.

If satisfactory operation is obtained, re-start and operate the fan for a run-in period. During this period, check bearing temperature approximately every hour. Bearing temperatures should not exceed 160°F for ball bearings or 180°F for sleeve or roller bearings.

If the fan has sleeve bearings, check to see that the oil rings are rotating and carrying oil by removing the ring inspection caps on the bearing housings.

Monitor equipment vibration levels. If vibrations levels are excessive, (see Table 6) stop fan and determine the cause. Do not operate the fan until the problem has been corrected. Fan should be rechecked weekly for the first two to three months, and periodically thereafter.

Safety Labeling

The following labels are applied to all units, where appropriate, to ensure safe operation do not remove and replace if damaged and/or unreadable.

CAUTION	CAUTION
THIS IS A SPECIAL PURPOSE FAN, DO NOT EXCEED ITS LIMITATIONS.	ALL UNITS DESIGNED FOR USE IN SPECIAL SEALED ATMOSPHERES MUST BE PURGED OF OXYGEN A MINIMUM OF 5 TIMES PRIOR TO OPERATING.
CAUTION	CAUTION
KEEP CLEAR OF FAN WHEN IN OPERATION	WHEN PREPARING OR HANDLING, SEE OUR INSTRUCTION MANUAL.
CAUTION	CAUTION
DO NOT OPERATE FAN WITHOUT GUARDS FOR ALL MOVING PARTS, INCLUDING FAN WHEELS, BELTS, PULLEYS AND SHAFTS, CONFORMING TO O.S.H.A. STANDARD 1910.219	THIS UNIT CONTAINS A MINERAL WOOL OR CERAMIC FIBER PRODUCT. <u>NO ASBESTOS.</u>
CAUTION	CAUTION
ONLY OUR FACTORY REPAIRS OR ALTERATIONS ARE AUTHORIZED ON THIS EQUIPMENT.	THE AFE AIR COOLED SEALED FAN SHAFT MUST ALWAYS BE ROTATING AT ITS NORMAL OPERATING SPEED AT ANY TIME WHEN THE FURNACE TEMPERATURE IS ABOVE 200 DEGREES F. IF THE SHAFT IS SLOWED OR STOPPED AT ANY TIME WHILE HEAT IS PRESENT BEARING AND SHAFT DAMAGE COULD OCCUR.
CAUTION	CAUTION
DO NOT EVER STOP THE FAN SHAFT FROM ROTATING, AT ITS NORMAL OPERATING SPEED, FOR A PERIOD OF AT LEAST 3 HOURS AFTER THE FURNACE HEAT IS TURNED OFF IN ORDER TO ALLOW THE COOLING MECHANISM TO DISIPATE THE HEAT ALREADY ABSORBED BY THE FAN WHEEL AND SHAFT DURING ITS OPERATION OR BEARING AND SHAFT DAMAGE COULD OCCUR.	

Inspection & Maintenance

It is necessary to shut down and stop the unit before inspecting the fan or the system. The fan system must be electrically isolated and adequately grounded according to the National Electrical Codes. Disconnect switches; other controls must be locked in the Off position. Precautions must be taken to prevent electrical power to be accidentally applied to the fan system.

When inspecting the fan, all materials and welds should be checked for wear, corrosion or cracking that may reduce material strength and could cause failure damage and/or a dangerous condition.

For maximum life and trouble-free service, a periodic fan maintenance schedule is recommended. Inspect all parts for wear at regular intervals, and not less than four times each year. In material or dust-handling applications, internal parts should be checked frequently for erosion and/or abrasive wear.

Table 6-Fan Vibration Amplitude Levels (mils, peak-to-peak)				
Speed (rpm)	Smooth	Fair	Rough	Very rough
600	2.0	4.0	8.0	12 to 20
900	1.5	2.75	6.0	8 to 10
1200	1.0	2.0	4.5	6 to 8
1800	0.75	1.5	3.5	5 to 7

Lubrication: The bearings furnished with this fan have been lubricated at the factory for the initial run-in period. Lubrication intervals and lubricant selection, as recommended by the bearing manufacturer, are described in the attached bearing manufacturer instruction tags. If a lubricant other than shown on these tags is to be used, it is advisable to consult the bearing manufacturer. **Do not over grease.** Note that sleeve bearings require periodic flush/refill of oil.

Fan drives: If fan or blower is belt driven, the belt tension should be checked eight hours after initial start up and adjusted accordingly. It is important that proper belt tension be maintained. High belt tension can cause fan and motor-bearing failure. Loose belts can slip causing wear and problems with sheaves, bear-

ings, shafts and motors. Belts should be tensioned according to the belt manufacturer's recommendations. Replace worn belts with a new, matched set.

All Alloy Engineering fans are carefully balanced as a complete unit before shipment. Do not operate if vibration from an out-of-balance condition is evident. An unbalanced wheel will cause premature failure of the unit and/or could create a dangerous condition. The amplitude of vibration, Table 6, should be periodically checked at the fan bearings and the balance corrected as required.

Should excessive vibration develop, check the following:

- Build up of material on the wheel
- Mounting bolt and set-screw tightness
- Improper V-belt alignment or tension
- Improper bearing clearance or alignment, or bearing loose on the shaft
- Improper coupling alignment
- Wheel loose on the shaft
- Damage to wheel, shaft or bearings from foreign objects passing thru the fan
- Vibration coming from a source other than the fan. (Stop the fan and determine if the vibration still exists. Disconnect the driver from the fan and operate by itself to determine if this produces vibration.)
- Improper clearance between the wheel and inlet
- Erosion or corrosion of the wheel

Avoid physical contact with any fan member or component as these surfaces may be hot and cause injury.

Fan should not exceed design temperature or speed limitations and should not be subjected to abrupt temperature change as damage from thermal shock may result.

Troubleshooting Checklist

In most cases, problems with air delivery, noise, vibration, motors and drives can be traced to one of the following causes.

Air capacity:

- Resistance of system not at design rating. If resistance is lower than expected, both air flow and horsepower may be up. If resistance is higher than expected, air volume will be down.
- Fan speed is not at design speed.
- Air density not at design values. Also check air performance measurement techniques/procedures.
- Devices for air modulation are plugged or closed. Also check filters.
- Wheel mounted improperly or is rotating in reverse.
- Parts of system or fan have been damaged or need cleaning.

Noise:

- Fan forced to operate in an unstable flow region.
- Bearing failure. Check bearings (lubrication).
- Supply voltage high or inconsistent supply frequency.
- Objects in a high-velocity air stream, such as flow sensors and turning vanes, can generate noise.
- Poor fan inlet conditions.
- Incorrect acoustics or sound measurement procedures.

Vibration:

- Misalignment of drive components.
- Poor foundations or mounting structure (operation at system resonances).
- Foreign material attached to rotating components.
- Damaged rotating components (bearings, shaft, fan, wheel, sheaves).
- Broken, loose or missing set screws.
- Loose bolts.
- Vibration transmitted by another source.
- Water accumulating in airfoil blades.
- Fan operating in stall or unstable flow region.

Motor:

- Incorrect wiring.
- Fan speed too high.
- Parts improperly installed (binding).
- Bearing improperly lubricated.
- Inertia capability (WR³) of motor too low for application.
- Protection devices improperly sized.

Drive:

- Belts improperly tensioned.
- Poor drive alignment.

Ordering

All orders should specify fan rotation direction as viewed from the drive side. All orders should specify whether the fan is roof, base, or side-wall mounted.

On orders where Alloy Engineering is not supplying the motor or drives, the order should state the intended fan speed. This will enable Alloy Engineering to dynamically balance the fan unit for that speed. All Alloy Engineering fan wheels are statically and dynamically balanced.

Fan Repairs and Spare Parts

Only Alloy Engineering factory repairs or alterations are authorized on this equipment to avoid a dangerous condition that could result if repairs or alterations are made elsewhere.

Alloy Engineering has complete repair facilities and replacement parts are available for all of its fan and blower equipment on an economical and prompt basis.

Limitation of Warranties and Claims

See reverse side of Alloy Engineering Order Acknowledgement for details.