OPERATION & MAINTENANCE MANUAL

SAVAGE RANGE SYSTEMS

SHOOTING RANGES AND BULLET TRAPS

Model 800W with Drag Conveyor

www.SavageRangeSystems.com
Tel: 413-642-4185
Fax: 413-562-1152
info@savagerangesystems.com

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ATTACHMENT 1

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EXCLUSIVE LIMITED WARRANTY

PAYMENT REQUIRED: This Exclusive Limited Warranty will become effective and binding only upon timely receipt of payment in full to Savage Range Systems, Inc. ("SRS") for all amounts agreed to be paid to SRS for all services, or goods received or to be received, and will last for a period of one year from installation or delivery. Upon this Exclusive Limited Warranty becoming effective as set forth herein, SRS warrants that materials, equipment, goods, or services provided under this contract shall remain free from defects for a period of one (1) year. If within said 1-year period, SRS determines that a defect exists, then SRS will, at no charge to the customer, repair or replace materials and/or perform services so as to correct any defect covered under this warranty. Any claim made or submitted under this warranty must be issued or confirmed via a written notice received by SRS prior to the expiration of the 1-year period from the date of delivery or commissioning of the equipment. In the event warranty service, repair or replacement is requested, claimant shall (1) timely deliver written notice to SRS within the warranty period; (2) maintain a receipt of delivery of such timely notice; (3) fully cooperate with providing complete information necessary or as requested by SRS; and, (4) Upon request by SRS, provide access upon the premises as necessary to enable to SRS or its agent(s), to inspect, investigate or service the equipment.

SRS's obligations, and customer rights under this warranty, **shall become null and void** should customer fail to comply as set forth above or should the defect occur as the result of customer's failure to maintain the equipment as recommended herein. Additionally, this warranty **shall become null and void upon** misuse, abuse, usage of weapons or ammunition or procedures which exceed or differ from the specifications and parameters set forth in SRS product manuals, failure to timely deliver payment, or failure to timely provide written notice to SRS of a claim for warranty service, repair, or replacement, failure to take appropriate action under the circumstances so as to mitigate the damages or potential damages or injury. SRS accepts no liability for, and hereby specifically disclaims any direct, indirect, incidental, consequential or other damages incurred by the customer as a result of use or ownership of the equipment covered hereunder. The remedies detailed in this warranty shall represent SRS's sole and exclusive obligation and the customer's sole and exclusive rights under this warranty. No other warranties expressed or implied, INCLUDING BUT NOT LIMITED TO WARRANTY FOR FITNESS FOR A PARTICULAR PURPOSE OR WARRANTY OF MERCHANTABILITY shall apply to this contract, or the goods or services sold, performed or delivered.

I. INTRODUCTION

Congratulations on the purchase of your new Wet Snail™ Trap. The Snail Trap is the safest, cleanest, most cost effective method for capturing bullets available. Following the simple Operation & Maintenance procedures described herein will ensure that your Snail Trap will provide you with many years of trouble free, safe, containment of the ammunition used in your range.

The spent bullets from the Wet Snail Trap do not contain lead dust particles and can be sold directly to a metal salvage company. With the automatic conveyor system, you have eliminated the necessity for your range or maintenance personnel to physically handle the spent rounds.

The range equipment you have purchased will safely contain all ammunition rated up to 8100 Foot Pounds Energy (at Muzzle) excluding steel core, ceramic tipped or AP / API ammunition. Using ammunition which exceeds the above specification may result in damage to the Snail Trap and could result in injury to the Range Users.

In the unlikely event that a warranty issue arises, you may contact Savage Range Systems Customer Service at (800) 370 0712. Working with you, we will evaluate the problem and agree a solution. Failure to comply with the terms of any Express Limited Warranty, such as failure to timely contact Savage Range Systems, Inc. prior to taking corrective action, may limit or eliminate our responsibilities under the warranty.

II. SAFEGUARDS & WARNINGS

WARNING!!! SEVERE INJURY OR DEATH MAY RESULT

THE OPERATION, HANDLING, MAINTANENCE AND USE OF FIREARMS ARE DANGEROUS AND THE NATURAL CONSEQUENCE FOR MISUSE IS SEVERE INJURY OR DEATH.

RANGE EQUIPMENT PROVIDED BY SAVAGE RANGE SYSTEMS ("SRS") IS RATED FOR CONTAINMENT OF AMMUNITION RATED UP TO 8100 FOOT POUNDS ENERGY (AT MUZZLE), EXCLUDING STEEL CORE, CERAMIC TIPPED OR AP/API AMMUNITION. USING AMMUNITION OR FIREARMS EXCEEDING THIS SPECIFICATION OR WHICH IS ARMOR PIERCING, INCENDIARY, CERAMIC TIPPED OR STEEL CORE **CAN CAUSE INJURY OR DEATH** TO THE RANGE USERS, VOIDS ANY AND ALL WARRANTIES INCLUDING ANY EXPRESS, IMPLIED, OR LIMITED WARRANTIES, IS AT YOUR OWN RISK AND PERIL, AND MAY RESULT IN DAMAGE TO THE SNAIL TRAP.

IMPORTANT SAFEGUARDS

SRS accepts no responsibility for the manner in which this range is used and maintained. Buyer, any user and any operator completely accept all risk and responsibility for the use of this range, and shall take every precaution necessary to operate the range in a safe manner. The Buyer, any user and any operator of the range must ensure that all applicable safety rules and regulations are followed. The range should only be used in a manner in conformity with this manual and should be operated only by personnel trained in the safe use of firearms. The safety procedures in this manual do not replace, excuse or relieve you of your obligation to comply with your local law, assert good independent judgment, and/or follow all other safety procedures as are prudent and necessary to operate a firing range or firearms in your community.

- Read all instructions, Manuals and precautions contained herein, and those supplied with firearms, ammunition and all products to be used. **BUYERS USERS AND OPERATORS are responsible for assuring that products and specifications are compatible for safe use!**
- **ASSURE FIREARMS OR LIVE AMMUNITION IS NOT AVAILABLE FOR USE OR HANDLING DURING MAINTAINANCE OR INSPECTION AND ALL USERS ARE REMOVED FROM RANGE!**
- Wear proper clothing and personal protective equipment (PPE") including, gloves, properly rated eye and ear protection when using or maintaining and operating the range or equipment. Do not wear loose clothing or dangling strings, and secure long hair that may become entangled or catch in moving parts. Wash hands after each use or maintenance procedure.
- Discard all bullets and bullet material in proper containers, as required by law and local ordinances.
- Only use manufacturer's recommended products with this unit.
- Read all pump & conveyor manufacturer's Instructions (Section IX).
- Isolate all power supplies to the pumps and conveyor, prior to performing any maintenance on the Snail Trap unless otherwise instructed in this manual.
- Do not exceed the ammunition rating as printed in these instructions and on the nameplate on the bullet trap.
- Do not store materials on the back of the upper ramps. It should not be used as a storage area or as a means of accessing high level items (HVAC, power, etc.) above the bullet trap.

III. EQUIPMENT

SPECIFICATIONS & RATINGS

Model & Description	Rating
Snail™ Trap	
Model 800W Complete with Automatic Bullet Collection System	All ammunition rated up to 8100 FPE at muzzle excluding: - • Steel Shot / Steel Slug • Steel Core (including NATO M855 / SS109) • Ceramic Tipped • Armor Piercing / Armor Piercing Incendiary • Fully automatic weapon fire • Proof loads

IV. OPERATION

Snail™ Trap

WARNING - Do not exceed the ammunition rating for the Bullet Trap.

1. Turn on pumps and conveyor. Allow the pumps to run for several minutes prior to commencing training. This allows the ramps and deceleration chamber to be thoroughly wetted, ensuring optimum performance.
2. Upon completion of the training sessions, operate the pumps for several minutes to absorb the gases and airborne materials within the trap.
3. Switch off the pumps and conveyor.
4. Remove all litter / debris from the front trough and lower ramps.
5. Check the level of the spent bullets in the collection drum. Replace the drum before the level reaches the top.

V. ROUTINE & PREVENTIVE MAINTENANCE

AFTER APPROXIMATELY 4 WEEKS OF OPERATION, THE TENSION ON THE CONVEYOR CHAIN BELT MUST BE CHECKED AND ADJUSTED AS NECESSARY. PLEASE REFER TO THE MAYFRAN INSTALLATION OPERATION AND MAINTENANCE MANUAL IN SECTION IX.

Daily

- Check water level in tank. Water should be above pump housing. Top up with clean water as necessary.
- Ensure that all edge protectors are in place. Replace / reinstall any missing deflectors.

Weekly

Bullet Trap

- Check Snail Oil concentration using the refractometer provided. See Section VIII for proper use of the refractometer. Oil concentration should be between 2% & 3%. Add oil as necessary. To raise oil concentration 1% add 1 gallon Snail Oil for each 8' section of trap.
- Clean T-strainers
- Check level of spent bullets in the collection drum.
- Remove any debris (target backing, shot gun wads, etc.) from the front trough.
- Check edge protectors for sharpness. Replace / Reinstall any missing deflectors.
- Inspect the trap for signs of damage or excessive wear. If any damage is noted, stop use of the trap and call Savage Range Systems (1-800-370-0712) immediately and speak to Range Product Support.

Monthly

In addition to Weekly Maintenance items: -

Bullet Trap

- Inspect: -
  - Deceleration Chamber, Upper And Lower Ramps - check for dents, gouges, scoring or other signs of wear or misuse.
  - Front Trough - check for wear, sludge build up and blockage of return pipes.
  - Spraybar - check for blockage, proper alignment and general flow, adjust bolts if necessary. (See Section VIII for procedures for cleaning spraybars.)
  - Edge Protectors - check for sharpness of leading edge, dents, gouges, scoring or other signs of wear or misuse; proper alignment and tightness.
  - Sidewall Plates - check for tightness and wear.
  - Reservoir - for corrosion, dents, liquid level and concentration, leaks, pumps, bullet trays, blockage of return pipe, deterioration of pump hoses, tightness of connections and positioning of splash shields.
  - All Trap Components - for corrosion of plates, supports, and nuts and bolts.

Conveyor

- Refer to Section IX for complete maintenance procedures
- Check steel belt tension and adjust as necessary. Lubricate where required.
- Check Reducer oil level and add oil if required.

Quarterly

In addition to Monthly Maintenance items: -

Conveyor

- Lubricate bearings
- Check limit switch operation

Semi-annually

In addition to Quarterly Maintenance items: -

Conveyor

- Check Roller Chain adjustment / lubrication
- Check V-belt tension
- Check Sheave lubricant
- Change Gear Reducer oil

Annually

In addition to Semi-Annual Maintenance items: -

Bullet Trap

- Remove sludge from Reservoir and Front Trough (depending on volume of frangible rounds being used, it may be necessary to reduce the interval between cleanings)
- Check Pump condition and operation

VI. REPLACEMENT OF PARTS / COMPONENTS

Replacement or repair of parts can be ordered directly from Savage Range Systems, Inc. Call (800) 370 0712, Range Product Support, for assistance or visit our website at www.snailtraps.com.

Item	Part No.	Manufacturer / Supplier
Bullet Collection Tray		Savage Range Systems
Pump	215101	Zoeller Pumps
T-Strainer - Housing	215180	Savage Range Systems
T-Strainer - Filter	215103	Savage Range Systems
Spraybar	501004	Savage Range Systems
Front Trough Screen		Savage Range Systems
Edge Protector	215123	Savage Range Systems
Snail Oil		Savage Range Systems
1-gallon	191160	
5-gallon	191170	
55-gallon	191130	
Splash Guards	191240	Savage Range Systems
Ball Valve	215050	Savage Range Systems
Deleading Handwash	501022	Savage Range Systems
Refractometer	190121	
Conveyor Components - See Manufacturer's literature in Section IX		Mayfran
Spent Bullet Containers		

VII. TROUBLESHOOTING

Problem	Probable Cause	Possible Solution
No water flow	Pumps not turned on	Switch on pumps
	No power to pumps	Ensure pumps are plugged in
		Check circuit breaker
Poor water coverage	Pump is not working	Check power supply
		Plug pump into socket
		Reset pump - See Manufacturer's manual (Section IX)
		Replace pump
	Spraybar is blocked	Clean spraybar - See Section VIII
	T-Strainer is dirty	Clean filter screen
		Replace filter screen
Pump is not working	No power to pump	Check plug
		Check circuit breaker
	Pump has overheated and tripped out	Reset pump
		Low water level - bring water level to top of pump
		Excessive sludge around pump - remove sludge
	Faulty pump	Replace pump
Conveyor not functioning	Not turned on	Switch conveyor on
	No power	Check supply / circuit breaker
	Refer also to Conveyor Manufacturer's literature	
Conveyor Won't Start from Remote Panel	Control Panel in "Local" Mode	Ensure that main panel behind trap is switched to "Remote" and Penta-Drive is set to Automatic
Pumps Start BUT Conveyor Alarms When Started from Remote Station	Power was lost to Main Control Panel OR E-stop was hit	Refer to Maintenance Procedures.
Lubricating fluid is foaming	Insufficient foaming retardant	Add anti-foaming agent - contact SRS
	Excessive Snail Oil Concentration	Add water to dilute the Snail Oil concentration. Should be between 2 - 3%

VIII. MAINTENANCE PROCEDURES

- Starting Conveyor After Loss of Power
- Cleaning / Adjusting Spraybars
- Checking Oil Concentration
- Removing the Sludge from the Fluid Tank
- Replacing Edge Protector
- Cleaning / Replacing Filter Screen
- Replacing a Pump
- Welding Procedures for Leak Repair

Starting Conveyor After Loss of Power

If power is lost to the conveyor variable frequency drive (VFD) either through complete loss of power to the facility, pushing the E-Stop or opening the disconnect at either panel, it will be necessary to follow the following start up sequence in order to be able to control the conveyor from the Remote Operators Station. The pumps will start from the Remote Station but the conveyor will go into an alarm condition.

1. Turn on / close the trap control panel disconnect switch.
2. Reset E-stop on the control panel if necessary.
3. Select desired control (LOCAL or REMOTE) on the trap control panel.
4. Turn on / close the conveyor disconnect switch.
5. At the conveyor control:
   - Turn on Power Toggle Switch
   - Set the AUTO / MANUAL switch to AUTO
   - Set the FORWARD / OFF / REVERSE switch to FORWARD

At this point the 'power on' light on the conveyor drive control should be illuminated and the STATUS LED should be slow flashing GREEN at a 1 second on/off rate. This indicates that the drive control mode is in RUN and is waiting for the RUN COMMAND from the trap control panel. If the STATUS LED is not flashing GREEN as described above, refer to Table 5 in the VFD manual for Status Indication.

Cleaning / Adjusting Spraybars

The spraybar should be producing a uniform sheet of water that covers the entire wet ramp while spraying the inside of the deceleration chamber. Before removing the spraybar, check the water level and the bottom of the pump to verify that there are no obstructions or lead sediment restricting the impeller from spinning freely. Check the T-Strainer screen, to make sure it's clean. If the screen requires cleaning refer to the procedure later in this section. Verify that the ball valve is in the full open position. If no obvious obstructions / problems are discovered, the spraybar should be removed and cleaned.

1. Unplug the pump to ensure that it cannot be switched on while the spraybar is removed.
2. Remove the hose clamps on the 90° barb fittings and disconnect the 1" vinyl tubing.
3. Loosen the two bolts that hold the bar in place. Remove the spraybar from the deceleration chamber.
4. Check the spray holes in the bar for any obvious blockage. Use a piece of wire to clear any obstructions.

5. To flush the debris from the inside the spraybar, remove the plugs from each end of the spraybar. Using a garden hose, flush with clean water until all foreign material is removed.
6. Replace the plugs.
7. To re-install the spraybar, reverse the sequence on Steps 1 - 3 above.

Checking Snail Oil Concentration

For an accurate reading, run the system for at least 5 minutes to mix the water and Snail Oil.

1. Remove the refractometer from the bag along with the dropper that is in a small Velcro pouch inside.
2. With the dropper, collect a sample of the fluid from the tank.
3. Open the clear plastic flap on the refractometer and apply a few drops to the glass portion that was covered by the plastic flap.
4. Keeping the drops centered on the glass, close the clear plastic flap.
5. Hold the refractometer to the light and read the concentration percentage in the viewfinder. Adjust the focus by turning the rubber section at the eyecup.
6. Additional oil should be added if the concentration is below 2%. The recommended concentration is between 2% and 3%. One gallon of Snail Oil per 8 ft. section will increase the concentration approximately 1%.
7. After testing the oil level, rinse off the end of the refractometer, dry and return to the bag.

Removing the Sludge from the Fluid Tank

Recommended tools for removing the sludge from the tank are flat head shovel, trowel and pump for transferring the fluid. We recommend that you wear rubber / latex gloves when handling the sludge. As the sludge is wet, inhalation exposure is not an immediate concern.

1. Remove the spent bullets from the bullet collection tray.
2. Remove the trays from the tank and set aside. Take this opportunity to inspect the condition of the tray and make any necessary repairs.
3. Either using a separate sump pump or one of the existing pumps in the tank, transfer the fluid from the tank to 55-gallon, open top drums. If you use one of the trap pumps, it will be necessary to disconnect it from the filter & spray bar assembly. It will also be necessary to move the pump from section to section. We recommend using a separate sump pump (similar to a Little Giant Model 5-MSP) with a 1" discharge. This is usually more convenient than using one of the existing pumps. Pump as much fluid from the tank as possible.
4. After the fluid has been removed from the tank, use the flat head shovel to remove the sludge from the tank. The sludge should be placed in containers appropriate for disposal of lead waste. It may be necessary to use a trowel to get the sludge from in the corners of the tank and along the edges.
5. After the sludge has been removed, using the pump from Step 3, transfer the fluid from the holding barrels / drums back to the tank. Top up the water level as necessary. Check the Snail Oil Concentration and add oil as necessary to obtain the correct concentration.
6. Reinstall the bullet collection trays.
7. Turn on the pumps to ensure proper operation of all units.

Inspecting / Re-sharpening / Replacing the Edge Protector

The edge protector is shaped like an axe head and is designed to prevent bullets hitting the welded seam of the deceleration chamber endplates. This eliminates the hazard of bullet fragments returning towards the firing line while protecting the weld from damage. If the edge protector starts to have any more of a flat face measuring more than 3/16" across, it must be sharpened.

If the edge protectors are subjected to frequent bullet strikes, the set screw may loosen and the unit could fall off. IT MUST BE **IMMEDIATELY** REPLACED / REINSTALLED. TREAT THIS AS A MATTER OF URGENCY!

1. Remove the edge protector by grinding the welds and use a hammer to loosen the protector.
2. Using a hard disc grinder, re-shape the edge protector to provide a sharp edge to the unit. **Proper PPE should always be worn when using grinding / rotating equipment.**
3. If there is insufficient material remaining to enable you to re-shape the unit, a new edge protector must be installed.
4. Re-install the edge protector by welding the tab to the deceleration chamber endplate and the top edge of the protector to the upper ramp. Maintain approximately 1/8" clearance between the bottom of the edge protector and the bottom ramp.

Cleaning / Replacing Filter Screen

1. Unplug / isolate the pump to ensure that it cannot be inadvertently started while the T-strainer is disassembled.
2. Turn the clear cup counter clockwise to loosen. Care should be taken when removing the housing to ensure that the orange gasket is not lost or damaged.
3. Using a stiff bristle nylon brush and warm water, clean the screen filter element.
4. Rinse the clear housing to remove any sediment. Check the gasket to ensure that there is no sediment on it that could cause a leak.
5. Re-install the screen filter and clear housing, turning clockwise to tighten.
6. Plug the pump cord into socket and switch on.
7. Check for leaks. If there are leaks, tighten the housing. If this does not stop the leak, turn off the pump and isolate as in Step 1. Remove the clear housing and inspect the gasket for damage or sediment. Clean the gasket, re-install the housing and re-test.

Replacing a Pump

1. Unplug / isolate the electrical supply to the pump.
2. Remove the bullet collection tray if a conveyor is not present. If necessary, remove the spent bullets from the tray as described previously.
3. Remove the pump from the tank.
4. Loosen the hose clamp securing the vinyl tubing to the barb fitting.
5. Remove the vinyl tubing from the fitting. It may be necessary to use a pair of channel locks to loosen the tubing on the fitting. Care should be taken not to damage the tubing.
6. Remove the barb fitting from the old pump.
7. Install the barb fitting removed above into the new pump. Attached the vinyl tubing to the fitting using the hose clamp to secure it.

8. Place the pump into the tank. Run the pump to verify that the proper flow rate is obtained.
9. Replace the bullet collection tray if there is no conveyor.

Welding Procedures for Leak Repair

1. Use Ledizolv (or similar) to clean the work area.
2. Heat the area to be repaired with a heating torch to dry thoroughly and remove all Snail Oil and Ledizolv residues.
3. Clean the area with a wire wheel or grinder.
4. Groove out the crack in the weld. This assures good penetration for the repair.
5. After the repair area is cleaned, weld the crack using 7018 welding rods.
6. Allow the weld to cool before leak testing.
7. Dry the area using the heating torch and touch up with gray primer.

IX. MANUFACTURER'S LITERATURE

- Conveyor - Mayfran International
- Zoeller Pump
- Snail Oil (MSDS)

Documents can be downloaded from our website.

OPERATION AND MAINTENANCE MANUAL

BULLET TRAP DRAG CONVEYOR INFORMATION
MAYFRAN 2 1/2" Pitch Drag Conveyor

Mayfran International, Incorporated
P.O. Box 43038
6650 Beta Drive
Cleveland, Ohio 44143
(440) 461-4100 tel.
(440) 461-5565 fax

ATTACHMENT 2

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BULLET TRAP DRAG CONVEYOR INFORMATION

MACHINE INFO

Customer:

Mfg. Year: Serial No:

Voltage/Phase Cycle:

Inspected by: _____

YOUR WARRANTY PERIOD

Mayfran's Warranty is given on the following page.

Your Warranty period: _____ through _____

CUSTOMER SERVICE / PARTS ORDERS

If you have any questions or need to order parts, please contact Mayfran International at:
(440) 461-4100 Fax: (440) 461-5565 8:00 a.m. to 5:00 p.m. (EST)

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Mayfran International, Incorporated
P. O. Box 43038
Cleveland, OH 44143

Information in this manual is subject to change and is furnished to supplement, not modify the terms and conditions of Mayfran's order acknowledgment and/or signed contract with the customer.

SAFETY INFORMATION

DO NOT operate any machinery without reading and understanding this manual completely.

DO NOT operate any machinery unless fully trained and qualified by the owner or end user.

DO NOT operate any machinery (or any portion of this machinery) unless all personnel are clear of any rotating or moving parts (or parts that may potentially move or rotate).

DO NOT operate any machinery unless all guards and/or emergency stops are in place and functioning as designed by Mayfran.

DO NOT operate any machinery in applications other than the specific application for which the machinery was designed.

DO NOT perform any maintenance, repairs or adjustments on this machinery without first locking out all electrical controls.

DO NOT lubricate any machinery without first locking out all electrical controls.

DO NOT clean this machinery or the areas adjacent to or below the machinery without first locking out all electrical controls.

DO NOT remove any covers or guards without locking out all electrical controls.

DO NOT perform any maintenance or repairs on power lines feeding this machinery without first locking out power at the source.

DO NOT remove or cover any warning labels.

Adjustment, maintenance, cleaning and lubrication should be carried out only by personnel trained by the owner or end user in the operation of all associated conveyors and process equipment. Personnel should be trained in OSHA compliant lock-out / tag-out and electrical safety procedures. Records of training should be maintained by the owner or end user. Records of training for the safe operation of this machinery must also be maintained. Never should adjustment, maintenance, cleaning or lubrication be performed without following proper safety procedures.

Operators should be instructed to report any impairment of guards, emergency stop, or safety switches to their supervisors.

THE SAFETY INFORMATION CONTAINED HEREIN MUST BE COMMUNICATED BY THE CUSTOMER, OWNER, OR END USER TO ALL PERSONNEL WHO WILL ACTUALLY OPERATE, MAINTAIN, REPAIR, OR ADJUST THIS MACHINERY, OR WHO ARE ASSIGNED TO WORK IN THE VICINITY OF THIS MACHINERY.

SAFETY INFORMATION, continued

- **Chip Processing Equipment should be used to process only the material for which it was specifically designed.**
- **Casings, guards and other safety devices shall not be removed, bypassed, or disengaged during system operation.**
- **Personnel should not climb on the components of a system unless the equipment is expressly designed to support people and function as a work area.**
- **Only trained operators should be permitted to operate the Chip Processing Equipment.**
- **All necessary guards, switches and other safety devices shall be installed so that a loss of power to the equipment shall not render the guards, switches or safety devices inoperative.**
- **Emergency controls shall be installed so that they cannot be overridden from other locations.**
- **Guards shall be kept in place at all times unless the electrical power is off and the system is locked out.**
- **All repairs and services shall be performed by qualified personnel. Before repairs, tests or services are begun, all power controls shall be locked out in accordance with OSHA compliant procedures.**
- **After a machine has been repaired, tested or serviced, it shall not be operated until all guards and safety devices have been reinstalled, all maintenance equipment has been removed and a visual inspection of the machine and immediate area has been completed.**
- **Material should not be discharged onto a screw feed conveyor that is not operating. Material accumulations may inhibit the equipments safe operation.**
- **When working on the Chip Processing Equipment, be sure to turn the electrical disconnect OFF and LOCK OUT the power to the equipment.**

MAYFRAN INTERNATIONAL, INCORPORATED WILL NOT BE RESPONSIBLE FOR ANY WORK PERFORMED, OR ALTERATIONS MADE TO ANY OF ITS PRODUCTS UNLESS PRIOR APPROVAL HAS BEEN GRANTED BY AN AUTHORIZED MAYFRAN REPRESENTATIVE. ANY SUCH WORK PERFORMED WILL VOID ANY AND ALL WARRANTIES AND LIABILITIES. ALL WARRANTIES AND LIABILITIES SHALL ALSO BE VOID IF PARTS UNIQUE TO MAYFRAN INTERNATIONAL ARE PURCHASED FROM A SOURCE OTHER THAN MAYFRAN INTERNATIONAL.

START UP

Before the conveyor is started, the following items should be checked to ensure proper operation of the conveyor.

1.) Check the interior of the conveyor for obstructions such as wooden shipping braces etc. that may have gotten in during shipment. Remove all obstructions.

2.) Check for proper belt adjustment. See the " **BELT ADJUSTMENT** " section of this manual for tensioning requirements and adjustment instructions.

3.) Check belt direction. The lower strand of belt should be moving in a direction that is towards the head shaft. Conversely, the upper strand will be moving away from the head shaft , or towards the tail shaft. If the belt is traveling in the wrong direction, reversing any two leads on the motor will reverse its direction. See figure #1.

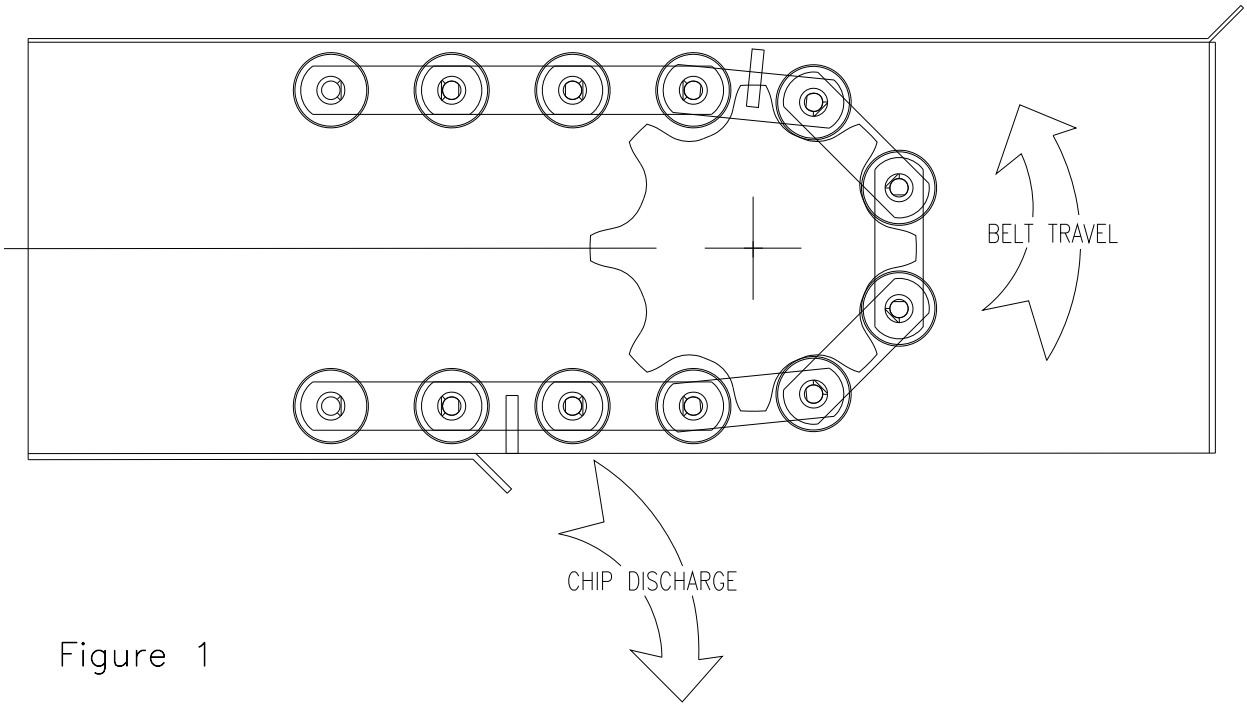

Figure 1

4.) Check for the breather plug in the gear reducer drive. It should be in the upper most port on the reducer and it should be open to atmosphere.

All information provided in this manual is for the purpose of customer education only, and is subject to change without notice.

MAINTENANCE & ADJUSTMENTS

MAINTENANCE SCHEDULE

By far, the most important maintenance activity is to keep the conveyor clean. Cleaning the conveyor on a regular basis will ensure that the reducer, motor and electronic motion sensor will perform as they were designed. It is recommended that the end users maintenance manager produce their own preventative maintenance schedule based on the following chart. Accurate records of any maintenance performed must be kept. This table is not all inclusive, and should be used as a general guideline only. It should be adjusted for shift usage, and environmental conditions.

MAINTENANCE OPERATION	INTERVAL
Inspect drag cleats/wipers for wear or damage	Weekly
Check for proper belt adjustment	Monthly
Oil drive chain and sprockets	Monthly
Check belt tracks for material build-up	Quarterly
Grease headshaft bearings	Semi-Annually (no.2 lithium based grease)
Check reducer oil level-change if required*	Semi-Annually, change every 2500 hrs of operation

*Note: Change oil in reducer after initial 40 hrs. of operation

LUBRICATION

A vital maintenance item is to ensure that the drive components are kept well lubricated. This will help prevent unneccessary down time due to early failure.

GENERAL LUBRICATION GUIDELINES

1. Use grease from tightly sealed containers. Grease should be free from impurities such as dirt, metal particulate or moisture.
2. Wipe grease fittings clean before adding grease.
3. A small amount of grease at frequent intervals is more preferable than a large amount at longer intervals. However, the proper amount and interval can only be determined by experience.
4. Bearings should be greased with a white lithium based grease such as Mobilux EP-2, Texaco Molytex 2 or equal. Do not mix different types of grease. Mixing grease may cause chemical reactions that diminish the greases ability to lubricate the bearings. Use one manufacturer and stay with that brand.

All information provided in this manual is for the purpose of customer education only, and is subject to change without notice.

GEAR REDUCER

LUBRICATION

The reducers will be filled to the proper level with lubricant when shipped from the factory. However, the oil level should be checked periodically. Also, when checking the oil level, make sure that the vent plug is clean and functioning properly. The lubricant should be changed every 6 months or 2500 hours of operation. In unusually severe or harsh environments, the lubricant should be changed on a more frequent basis. The unit holds approximately ½ pint of oil.

REDUCER LUBRICATION CHART

MANUFACTURER	AMBIENT TEMPERATURE 15°- 60°F AGMA Compound No.7	AMBIENT TEMPERATURE 50°-125°F AGMA COMPOUND NO.8
Amoco Oil Co.	Worm Gear Oil	Cylinder Oil #680
Chevron Usa, Inc.	Cylinder Oil #460x	Cylinder Oil #680x
Exxon Co. Usa	Cylesstic Tk-460	Cylesstic Tk-680
Gulf Oil Co.	Senate 460	Senate 680d
Mobil Oil Corp.	600w Super	Extra Hecia Super
Shell Oil Co.	Valvata Oil J460	Valvata Oil J680
Sun Oil Co.	Gear Oil 7c	Gear Oil 8c
Texaco	Honor Cylinder Oil	650t Cylinder Oil
Union Oil of California	Steaval A	Worm Gear Lube 140

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ADJUSTMENTS

The drag conveyor requires only a few simple adjustments to keep it operating at peak performance.

BELT CHAIN ADJUSTMENT

Proper belt chain tension is critical to the reliable operation of this conveyor. The belt chains will loosen up after the initial run-in period, and after long periods of continued use as components begin to wear. A sure sign of an improperly tensioned belt chain is an observed jerking motion of the chains or cleats while running. Loose belt chains may jam and cause damage to the conveyor. Over-tightened belt chains may cause excessive wear to the belt components, and create overloads on the drive.

To determine if the belt chains are properly adjusted, do the following:

1.) Position a cleat several inches prior to the headshaft in the direction of belt travel.

2.) Disconnect and lockout all power to the equipment.

3.) Press up from the underside of the conveyor firmly on the center of the cleat. Observe one of the following conditions:

3a.) If the cleat and chains collapse and stay collapsed, the chains are too loose.

3b.) If the cleat and chains spring back to their original position, the tension is correct.

3c.) If the cleat is unable to be depressed, the chains are to tight.

TIGHTENING THE BELT CHAINS

1.) Remove the chain guard cover from the drive. Loosen the chain guard back plate to allow for movement.

2.) Loosen the motor base mounting and adjustment bolts, and slide the base back to put some slack in the drive chain.

3.) Loosen the bearing mounting bolts slightly. Do not remove.

4.) Loosen the jam nuts on the take up bolts. Adjust the bolts inward to push on the bearing plates to tighten the belt chains. Adjust the bolts evenly on each side until condition “3b” is met above.

5.) Check headshaft for squareness to the machine. To do this, measure from the headshaft to the end of the head frame on each side. The dimensions should match.

6.) Tighten jam nuts on the take up bolts, and the bearing mounting bolts.

7.) Adjust the drive chain.

8.) Adjust the chain guard back plate so the sheave is centered in the large opening, and the reducer shaft is centered in the slot. Tighten in place.

9.) Replace the chain guard.

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LOOSENING THE BELT CHAINS

Follow the above steps except step (4) four should read:

4.) Loosen the jam nuts on the take up bolts. Adjust the bolts outward to relieve pressure from the bearing plates to loosen the belt chains. Adjust the bolts evenly on each side until condition “3b” is met above.

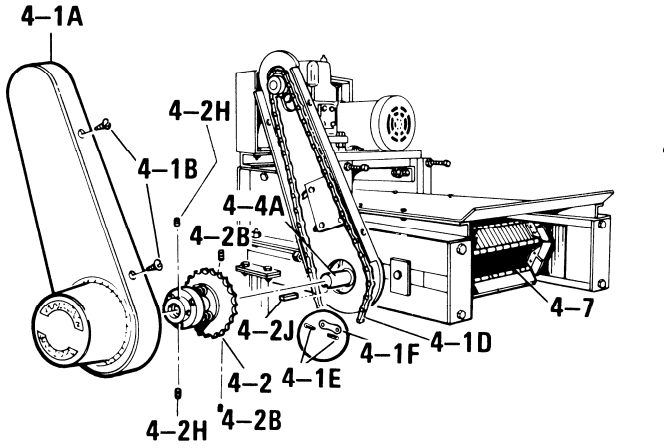
3.) Loosen the belt chains slightly. Remove the cotterpin from the belt pin. Using a punch of less than 3/8" dia., carefully tap the pin from the chain. Perform this same procedure on the opposite side belt chain. Chains should now be separated.

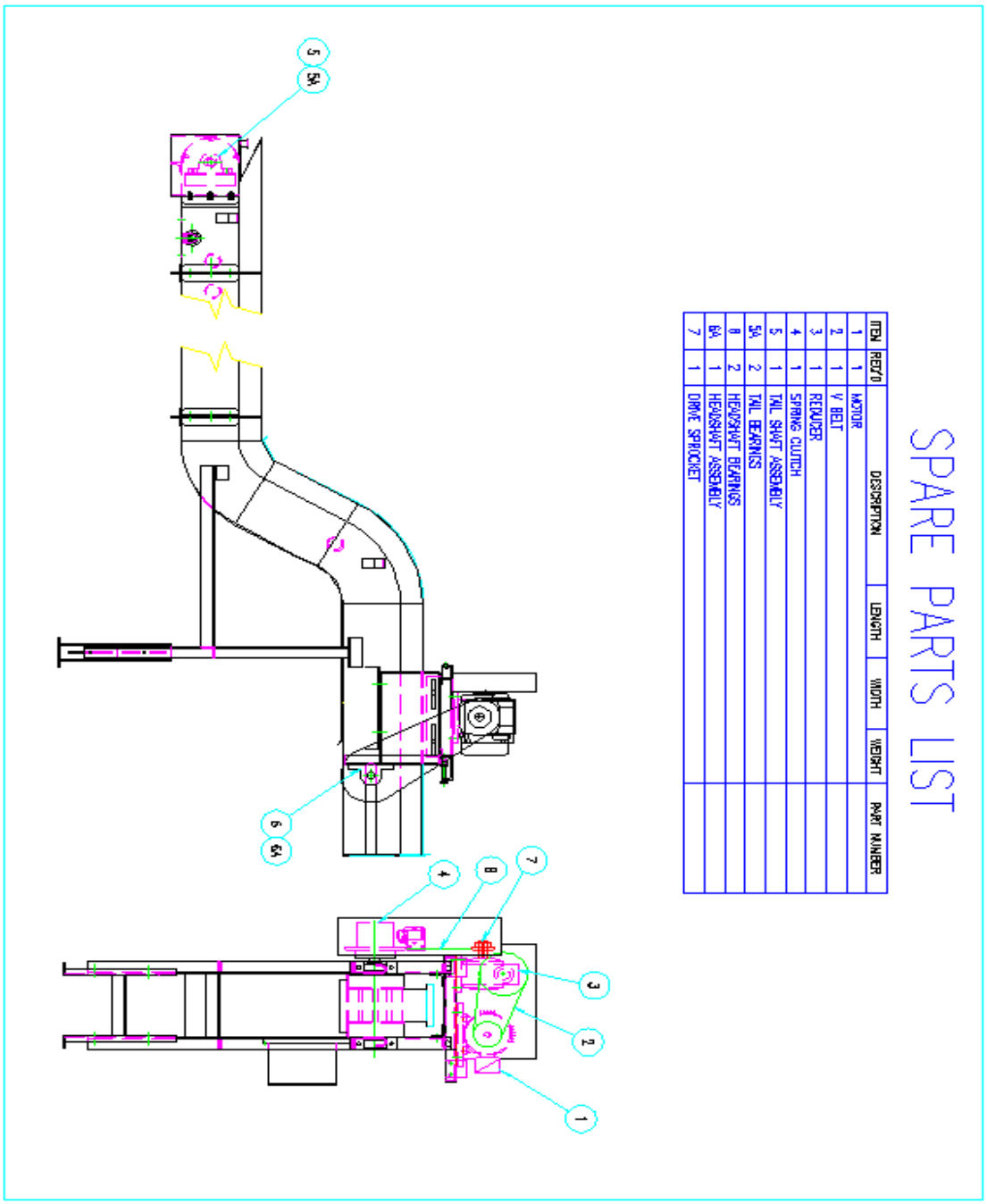
4.) Remove the chain guard cover. Locate drive chain masterlink and separate chain.

5.) Loosen the two set screws holding the sheave onto the head shaft. Pull sheave from shaft.

6.) Remove the mounting bolts holding the headshaft assembly to the slotted take up angles. Headshaft can now be removed from the take up slots. Do not lose the bearing push plates.

7.) Install new head shaft assembly, and reassemble the conveyor in reverse order.





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VARIALBLE SPEED INVERTER OPERATION

Mayfran conveyor is supplied with a variable speed motor inverter with electronic jam. Review KB Penta KBAC operation manual from web sight www.kbelectronics.com/manuals/kbac_manual.pdf

LOCAL JOG OPERATION

Power up inverter. Select "MANUAL" on KB Penta inverter. Push upward momentary "START" select which enables the jog "FORWARD/REVERSE" select. Manually select jog "FORWARD/REVERSE" to clear jam.

REMOTE AUTO START OPERATION

Power up inverter. Select "AUTO" on KB Penta inverter. Push upward momentary "START" select which enables a remote auto start. A remote auto start signal will start the conveyor. In some applications the remote auto start input is jumpered to start automatically when selected to "AUTO".

SPEED REFERENCE

Conveyor speed reference is factory set at 50% (3FPM). It is preferred to increase speed if necessary. Slower speed could cause overloading of conveyor or potential jams.

INVERTER ELECTRONIC JAM FAULT

"CL" parameter inside inverter is factory set at 100%. If overload or jam occurs, motor current will exceed the "CL" set point and inverter will fault, signaled by a flashing red LED. Do not increase "CL" without factory approval. A run status contact interlock is available t indicate conveyor running. Scrap material should not be feed into conveyor unless the conveyor is running.

TROUBLESHOOTING

OVERVIEW

Mayfran drag conveyors are designed to be the most reliable in the industry. However, problems may arise from time to time. Problems are normally discovered in one of two ways:

A fault is indicated on the main control panel.

The second indication that a problem exists is simply by the operator noticing that there is something different about the way the conveyor is operating; usually some sort of unusual noise or vibration. The only way to correct this problem is to examine the conveyor and determine the source.

It is imperative that any unusual noises or situations are identified, diagnosed, and corrected immediately to prevent serious damage from occurring.

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OVERLOAD FAULTS

An electronic jam fault is caused by overloading or jam in the conveyor belt. After the motor inverter device is reset, and any obvious cause corrected, the component should be run in manual mode, and the amperage draw on the motor checked. Check the current setting "CL" on the motor inverter is set to 100%.

PROBLEM	POSSIBLE CAUSE	SOLUTION
Motor does not start	Main power switch is not connected	Connect power
	Emergency stop button is working	Reset emergency stop button
	Circuit breaker/overload is working	Reset circuit breaker. Find cause of overload
Inverter electronic jam fault	Inverter jam fault caused by material build up in the conveyor	Remove excess material. Reset inverter fault, restart.
	Loose belt chains jammed causing clutch overload	Retension belt chains
	Drive component failure	Investigate drive components for defective part(s)
Excessive amperage draw or motor inverter fault	Belt chains to tight	Retension belt chains
	Excessive material jammed in belt chain or chain path	Clean chain and/or chain path
Excessive jams without material blockage	Loose belt chains	Retension belt chains

All information provided in this manual is for the purpose of customer education only, and is subject to change without notice.

Installation & Operation Guide

Industrial Non Re-circulating Direct-Fired Heaters

Horizontal / Vertical and Single / Twin Blowers

FOR YOUR SAFETY	**FOR YOUR SAFETY**
If You smell gas: 1. Open windows 2. Don't touch electrical switches 3. Extinguish any open flames 4. Immediately call your gas supplier	The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous!

WARNING!!

Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment. ALWAYS disconnect power and gas before working on heater.

RECEIVING AND INSPECTION

Upon receiving unit, check for any interior or exterior damage, and if found, report it immediately to the carrier. Also check that all accessory items are accounted for and are damage free. Turn the blower wheel by hand to verify free rotation and check the damper (if supplied) for free operation.

NOTE TO INSTALLER	**NOTE TO INSTALLER**
Please complete and return the Start-UP Checklist on the back of this manual to validate warranty	This manual should be reviewed with the customer and left with the equipment user

Revision 12 – 11.19.2013

ATTACHMENT 3

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WARRANTY

This equipment is warranted to be free from defects in materials and workmanship, under normal use and service, for a period of 12 months from date of shipment. This warranty shall not apply if:

- the equipment is not installed by a qualified installer per the manufacturer's installation instructions shipped with the product
- the equipment is not installed in accordance with federal, state and local codes and regulations
- the equipment is misused or neglected
- the equipment is not operated within its published capacity
- the invoice is not paid within the terms of the sales agreement
- the Start-Up Checklist has not been filled in by a qualified technician and returned to the Factory Service Department

The manufacturer shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 12-month warranty period, upon examination by the manufacturer, such part will be repaired or replaced by manufacturer at no charge. The buyer shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without manufacturer's prior authorization and all returned equipment shall be shipped by the buyer, freight prepaid to a destination determined by the manufacturer.

NOTE TO INSTALLER

Please complete and return the
Start-UP Checklist on the back of this manual to validate warranty

INSTALLATION

It is imperative that this unit is installed and operated with the designed airflow, gas, and electrical supply in accordance with this manual. Any variance to these instructions may cause the unit to not perform to specifications and may cause severe damage to the unit or jobsite. Please call the service department at **866-784-6900** for assistance on warranty issues and technical support.

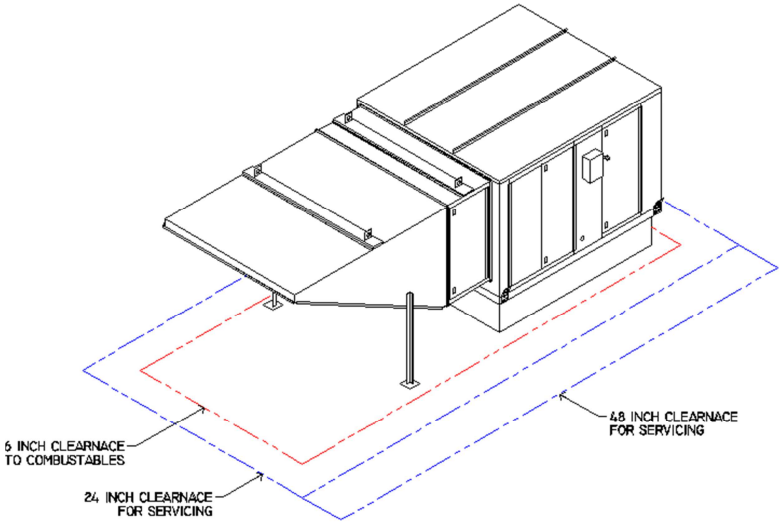
Inspection on Arrival

1. Inspect unit on delivery
2. Photograph any visible damage
3. Report any damage to the delivery carrier
4. Request a written inspection report from the Claims Inspector to substantiate claim
5. File claims with delivery carrier
6. Check unit's rating plate to verify proper electric and fuel type to meet job requirements
7. Compare unit received with description of product ordered

Unit Location

1. Do not locate any gas-fired equipment near corrosive or explosive vapors such as chlorinated or acid vapors
2. Avoid overhead power lines, or other utility access to prevent accidental contact or damage.
3. Provide clearance around installation site to safely rig and lift the equipment into its final position onto adequate supports. Refer to the manufacturer's estimated weights.
4. Consider general service and installation space when locating the unit.
5. Locate the unit close to the space it will serve to reduce long, twisted duct runs.
6. Do not allow air intake to face prevailing winds. Air flow switch may trip in high winds.

7. Situate the unit above ground or at roof level high enough to prevent precipitation from being drawn into its inlet.
8. The inlet must also be located at least 10 feet away from any exhaust vents.
9. The heater inlet must be located in accordance with the applicable building code provisions for ventilation air.
10. All air to the heater must be ducted from the outdoors.
11. Recirculation of room air is not permitted. If in doubt regarding the application, consult the manufacturer.
12. The unit must have adequate structural support or the equipment or building could be damaged.
13. Do not alter or otherwise restrict combustion or ventilation openings.
14. Direct-fired units should not be installed downstream from cooling systems which use refrigerants for cooling.



COMBUSTABLE CLEARANCES

The top, back, and front surfaces of this heater may not be installed less than 6 inches from combustible materials. The heater base may be installed on combustible surfaces.

SERVICE CLEARANCES

Allow 24 inches or greater minimum service clearance on all sides of this heater. Allow 48 inches or greater on the vestibule and blower door side.

Rigging

1. Horizontal units are supplied with four lifting lugs on the bottom corners of the casing.
2. Vertical units are supplied with four lifting lugs at the top corners of the casings.
3. Lift the unit and accessories separately, attach the accessories to the unit once the unit is in place.
4. The following diagrams represent the proper methods for lifting the unit and accessories.
5. Always use spreader bars to prevent damage to the unit casing.

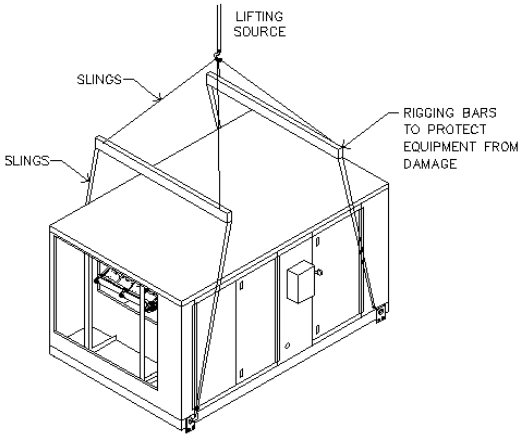


FIGURE 1: SIZE 10, 12, 15, & 18

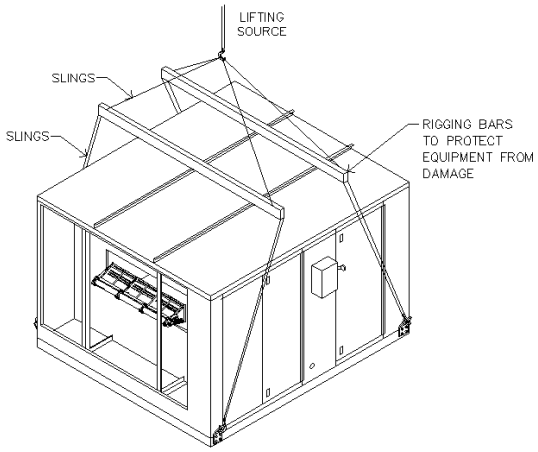


FIGURE 2: NO SPREADER BARS

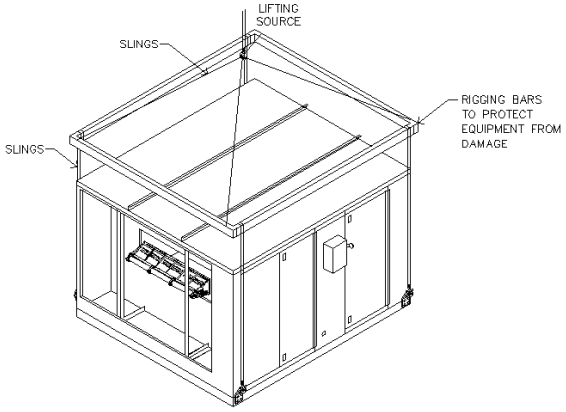


FIGURE 3: WITH SPREADER BARS

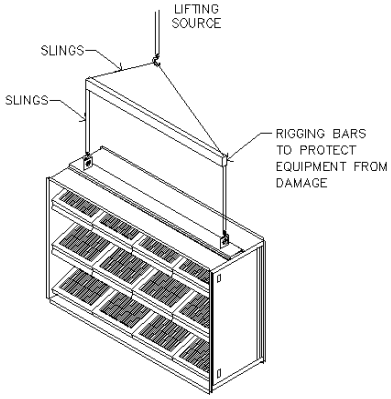


FIGURE 4: ACCESSORIES

CAUTION!!

These are unbalanced loads
Lift equipment gently
Do not jerk

WARNING!!

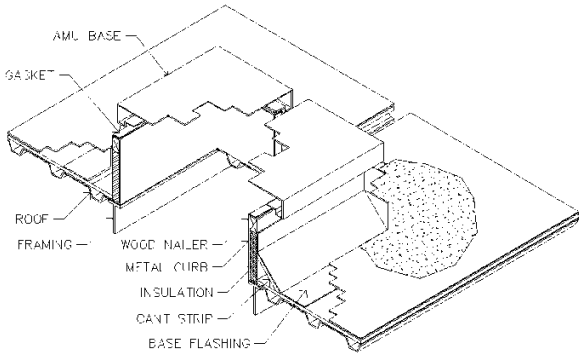
Spreader bars must be used and should extend past the edges of the equipment to avoid damage to the casing. Not using spreader bars may cause damage to the casing

WARNING!!

Damage will result if the equipment is raised by the intake hood, blower, motor shaft, or bearings
Use the provided lifting eyes and brackets on the unit

Curbs

The unit must have adequate structural support or the equipment or building could be damaged. The curb and unit must be leveled or the unit may leak or be damaged. Use gasket and caulk between the curb and unit. Use shims if necessary to level the unit. Screw or weld the unit's base to the curb to avoid damage to the equipment.



WARNING!!

The unit must have adequate structural support or the equipment or building could be damaged.

WARNING!!

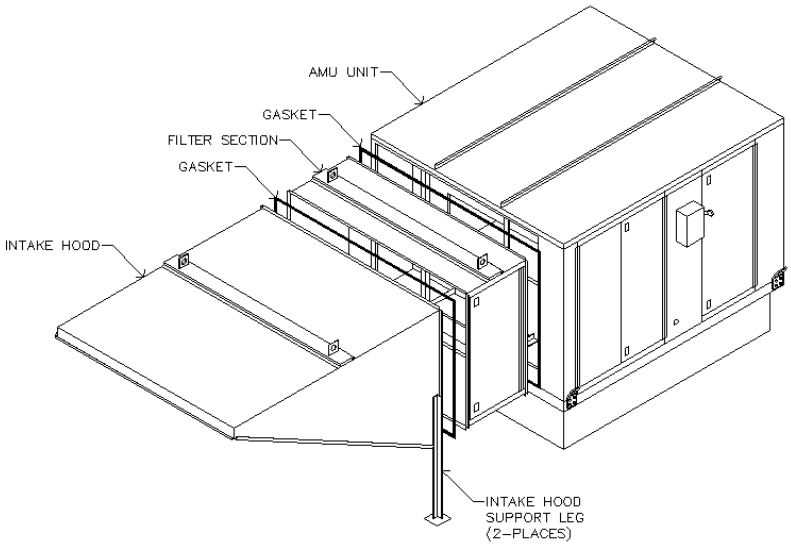
Screw or weld the unit's base to the curb to avoid damage to the equipment.

WARNING!!

The curb and unit must be leveled or the unit may leak or be damaged.

Accessories

Intake and discharge accessories are shipped loose and unassembled. When attaching the accessories to the unit use gasket, caulk, and #10 sheet metal screws on all seams. All accessories must be level.



WARNING!!

Use gasket, caulk, and #10 sheet metal screws on all component intersections. Leaking may result if the intersections are not completed properly.

WARNING!!

The accessories must be level and support legs attached to the hood and solid part of the roof. Equipment that is not level or properly supported may leak or be damaged.

Split Units

1. Apply weather-proof gasket to the seam of the vertical or horizontal unit
2. Use provided fasteners to secure the seam of the unit using the provided pre-punched holes
    a. Horizontal units internal channels and a formed frame
    b. Vertical units have angles on the outside of the casing
3. Apply silicone to the outside edge of the seam
4. Field wire the discharge air sensor using a minimum 22 gauge wire
5. Mount the high temperature limit bulb to the blower housing
6. Mount the (optional) freeze control sensor to the blower housing

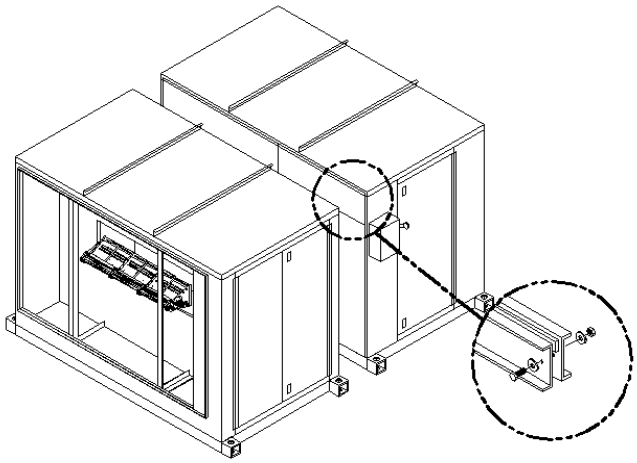


FIGURE 1: HORIZONTAL SPLIT ASSEMBLY

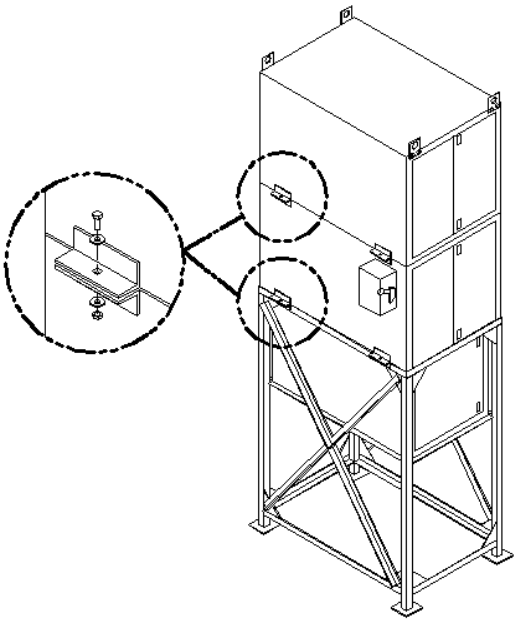
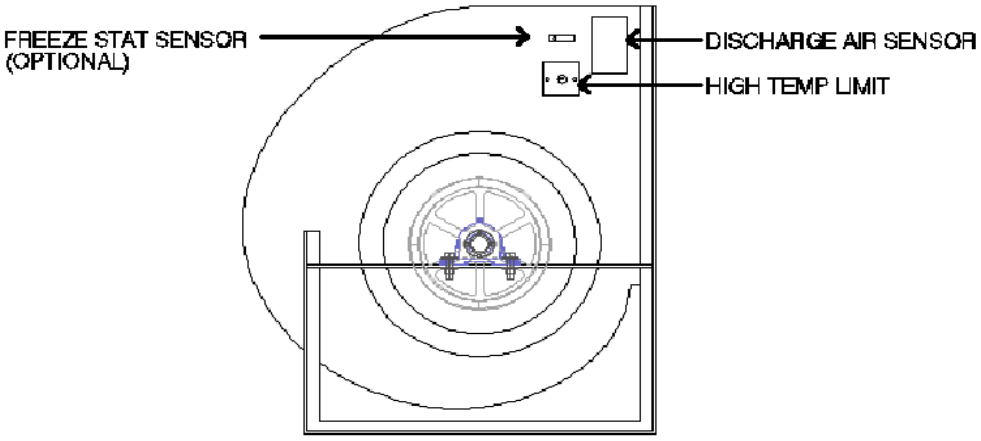


FIGURE 2: VERTICAL SPLIT ASSEMBLY



Shipped Loose Intake or Discharge Dampers

In some cases an intake or discharge damper may be shipped loose. This may be requested by the customer or can be required because of larger units shipping size restrictions. Follow these instructions to attach and wire the shipped loose damper. Factory mounted dampers may be attached on the unit and will not require assembly or field wiring.

1. Attach the damper to the intake or discharge using gasket, caulk, and #10 sheet metal screws
2. Field wire the damper using the as built wiring schematic for the specific unit. Wiring may be different depending on the model and options selected.
3. Refer to the factory supplied wiring print to verify the field wiring terminals.

Ductwork

This fan was specified for a specific CFM and static pressure. The ductwork attached to this unit will significantly affect the airflow performance.

WARNING!!

- Flexible ductwork and square elbows should not be used
- Transitions and turns in ductwork near the fan outlet will cause system effect and will drastically increase the static pressure and reduce airflow
- The Ductwork Sizing Chart shows the minimum fan outlet duct sizes and straight lengths recommended for optimal fan performance
- Units with twin blower must have a common discharge plenum

Follow SMACNA guides and recommendations for the remaining duct run. Fans designed for rooftop installation should be installed on a prefabricated or factory-built roof curb. Follow curb manufacturer's instructions for proper curb installation. It is recommended an outdoor unit be installed on a curb and/or rail elevated so intake is not less than 20" above any surface. Be sure the duct connection and fan outlet are properly aligned and sealed.

Adequate building relief is necessary in order to prevent over-pressurizing the building when the heater is operating at capacity. This can be accomplished by establishing properly-sized relief openings, an interlocked exhaust system, or both.

Heaters installed with intake ductwork must be purged to replace at least four air changes of the volume of the intake duct.

In order to avoid hazards to other fuel-burning equipment in the building (i.e., when the heater is providing make-up air to a boiler room), the unit should be interlocked to open inlet air dampers or other such devices.

On outdoor installations, it is recommended that the discharge duct be insulated to prevent condensation during the "OFF" cycle in cold weather.

Units being installed in **airplane hangars** should be installed in accordance with the Standard for Aircraft Hangars, ANSI/NFPA 409. Units being installed in **public garages** should be installed in accordance with the Standard for Parking Structures, ANSI/NFPA 88A, or the Standard for Repair Garages, ANSI/NFPA 88B, and with CAN/CGA B149 Installation Codes.

Flexible connectors should be employed on all ductwork connections. Vibration isolators are optional and can be supplied in the loose parts package.

Ductwork Sizing Chart Single Blower		
Blower Size	Duct Size (Inches)	Duct Length (Inches)

Ductwork Sizing Chart Dual Blowers		
Blower Size	Duct Size (Inches)	Duct Length (Inches)

10	14 x 14	30
12	16 x 16	36
15	20 x 20	45
18	24 x 24	54
20	26 x 26	60
22	30 x 30	66
25	32 x 32	75
27	36 x 36	81
30	38 x 38	90
33	44 x 44	99
36	44 x 44	108

222	77 x 28	66
225	88 x 32	75
227	96 x 36	81
230	104 x 38	90
233	116 x 44	99
236	122 x 44	108

WARNING!!

Failure to undersize ductwork size or length may cause system affect and reduce the performance of the equipment.
Using the unit to support the ductwork may cause damage to the units casing.

Installation Examples

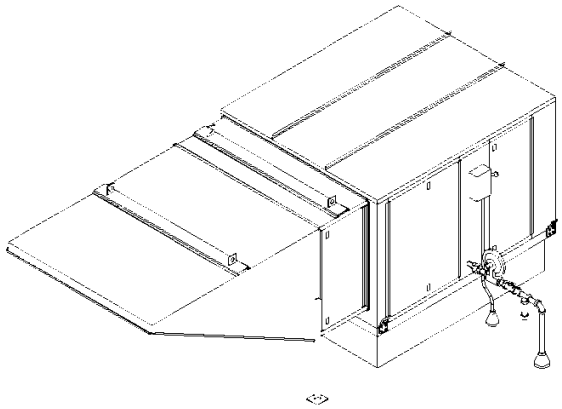


Figure 1: Horizontal Roof Top Installation

- □ Down discharge AMU reduces ductwork
- □ Hood weight supported by support legs
- □ Union, regulator, and shut-off
- □ Roof curb supports unit
- □ Intake facing away from prevailing winds

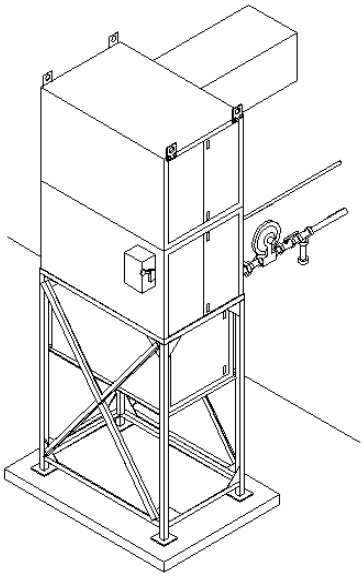


Figure 2: Vertical Outdoor Ground Installation

- □ Side discharge AMU reduces ductwork
- □ Support stand on concrete pad
- □ Union, regulator, and shut-off
- □ Filter section inside support stand
- □ Ease of serviceability on ground

Gas

Gas piping must be installed to conform with local building codes, or in the absence of local codes, the National Fuel Gas Code, ANSI Z223.1 (NFPA 54) – latest edition. In Canada, gas piping must be installed in accordance with CAN/CGA-B149.1 for natural gas units and CAN/CGA-B149.2 for propane units.

WARNING

Inlet gas pressure must not exceed pressure indicated on name plate.

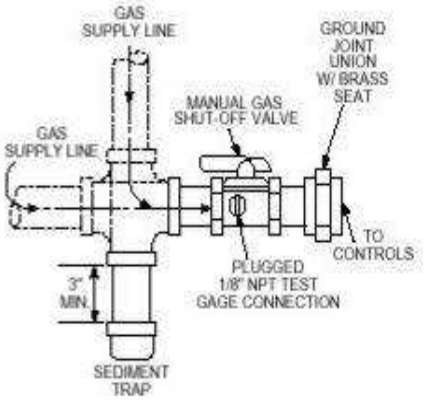
Refer to the heater rating plate for determining the minimum gas supply pressure for obtaining the maximum gas capacity for which this heater is specified.

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power-up.
2. Piping to the unit should conform to local and national requirements for type and volume of gas handled, and pressure drop allowed in the line. Refer to the Gas Engineer's Handbook for gas line capacities.
3. The incoming pipe near the heater should be sized to match the connection on the outside of the unit. Unit inlet sizes are shown in the table to the right. Avoid multiple taps in the gas supply so the unit has a steady supply of gas at all times.
4. Install a ground joint union with brass seat and a manual shut-off valve external to the unit casing, as shown below, adjacent to the unit for emergency shut-off and easy servicing of controls.
5. Provide a sediment trap, as shown below, before each unit and where low spots in the pipe line cannot be avoided.
6. Blow out the gas line to remove debris before making connections. Before starting the unit, purge line to remove air. Purge air from gas lines according to ANSI Z223.1-latest edition "National Fuel Gas Code," or in Canada: CAN/CGA-B149.
7. All field gas piping must be pressure/leak tested prior to operating the unit. Use a soap solution or equivalent for leak testing. The heater and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of ½ PSI. During any pressure testing of the gas supply piping system at test pressures equal to or less than ½ PSI, the heater must be isolated from the gas supply piping system and its individual manual shutoff valve closed.
8. This unit requires the gas pressure to be within the unit's minimum and maximum gas pressure ratings. If the pressure is greater than the maximum, the internal valve components will be damaged. If the pressure is below the minimum, the heater will not perform to specifications.
9. If installing on a paint booth application, a manual shutoff should be located for access in case of a fire or explosion at the heater.

Gas Connection Sizes

	Gas Pressure (Inches W.C. & PSI)		
BTU Input	7" – 14"	15" – 1#	1# - 5#
158,000	½	½	½
275,000	¾	½	½
549,999	¾	¾	¾
1,099,999	1	¾	¾
1,374,999	1 ¼	¾	¾
1,649,999	1 ½	1	1
1,924,999	2	1	1
2,474,999	2	1 ¼	1
2,749,999	2	1 ½	1
3,574,999	2	2	1 ¼
4,124,999	2	2	1 ½
5,224,999	2 ½	2	2
5,774,999	2 ½	2	2
7,974,999		2	2
8,524,999		2 ½	2
9,624,999		2 ½	2
11,274,999		2 ½	2
11,824,999		3	2
12,924,999		3	2 ½
16,847,999			3

Gas Connection Diagram



Electrical

Before connecting power to the heater, read and understand this entire section. Wiring diagrams are furnished with each fan by the factory, and are attached to the door of the unit.

WARNING!!

Disconnect power before installing or servicing fan. High voltage electrical input is needed for this equipment. This work should be performed by a qualified electrician.

Electrical wiring must be done in accordance with local ordinances and the National Electric Code, ANSI/NFPA70. Be sure the voltage and phase of the power supply and the wire amperage capacity conform to those listed on the motor nameplate. For additional safety information, refer to AMCA publication 410-96, "Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans."

1. Always **disconnect power** before working on or near a heater. Lock and tag the disconnect switch or breaker to prevent accidental power-up.
2. A dedicated circuit should supply the units electrical disconnect with circuit protection, according to the National Electric Code.
3. Make certain that the power source is compatible with the requirements of your equipment. The heater nameplate identifies the **proper phase and voltage** of the motor.
4. Units shipped with an optional remote panel have two electrical circuit. It is important to run the motor wires in a conduit separate from the remote control wiring. The DC wires from the unit temperature controller, located in the control drop, should be either in shielded cable or run in a separate conduit.
5. Before connecting the heater to the building power source, verify the power line wiring is de-energized.
6. Secure the power cables to prevent contact with sharp objects.
7. Do not kink power cable and never allow the cable to come in contact with oil, grease, hot surfaces or chemicals.
8. Before powering up the heater, check fan wheel for free rotation and make sure that the interior of the heater is free of loose debris or shipping materials.

Copper Wire Ampacity

Wire Size AWG	Maximum Amps
14	20
12	25
10	30
8	40
6	55
4	70

9. If necessary, the original wire supplied with the heater may be replaced with type TW wire or the equivalent.

Remote Control Panel

For units with the remote control panel, **a terminal strip inside the panel matches the terminals in the heater unit.** Consult the as built wiring print supplied with the equipment. Most remote panels and VAV applications have signal wiring which needs to be shielded cable or in a separate conduit to avoid voltage interference.

Power Supply Wiring

The units input power supply is listed on the unit nameplate. If the units power supply does not match the unit nameplate contact the service department for a new wiring print and parts.

Paint Booth Applications

If a low temperature control is not an integral part of the heater, it is recommended that one be installed in areas where freeze protection is needed in the event of a burner shutdown. The space should be ventilated following a bake cycle to purge any contaminants and cool product prior to personnel entering the space. If the unit was supplied with paint booth controls from the factory, refer to the schematic for installation of the interlock to disable spraying equipment unless the heater is operating in ventilation mode. Refer to electrical schematic for interlock to disable facility lighting within the process space during the bake cycle.

SEQUENCE OF OPERATIONS

Description of Operation

Designed for indoor or outdoor installation, the Direct Fired Gas Heater draws fresh outside air over a gas-fired burner. The unit is equipped to fire with natural or propane gas. Units are designed for modulated firing of the burner, based on the discharge-air temperature or room temperature requirement.

Standard Sequence of Operation

1. With disconnect in ON position and the remote control panel (or other device) calling for unit operation, power is supplied to the damper motor, if equipped.
2. When the damper motor approaches the OPEN position, the damper-end switch closes, energizing the motor contactor and powering the blower motor or enabling the VFD if equipped.
3. Power is supplied to the damper motor through the low-temperature limit control, if equipped. After ten minutes, the low-temperature limit control disables the unit if discharge temperature is continually below the temperature setting on the low limit control.
4. When the low airflow switch and high airflow switch (VFD only) are proven, the flame safety relay is energized through the high-temperature limit control, the optional low and/or high gas pressure switches, and the burner on/off intake air thermostat. The pilot valve opens, and the ignition transformer energizes.
5. After the flame rod detects flame, the main valves are energized and the ignition transformer de-energizes.
6. The temperature control system monitors the discharge air and modulates DC voltage to the

modulating valve to maintain desired discharge temperature.

Additional Sequence of Operation – All VFD Motor Control

1. During lower speeds, the low-speed potentiometer increases the resistance going to the modulating valve to limit temperature rise.
2. VFD contacts are included in the burner control circuit to disable the burner should a fault condition occur in the VFD.

VFD by Others and VAV Choke Off Profile Bypass Damper

As the VFD increases and decreases speed the profile air flow switch modulates the VAV bypass damper motor to maintain proper pressure drop across the burner profile.

Factory VFD Profile Bypass Damper

The VFD produces a 0-10vdc or a 4-20ma signal to the profile damper motor which modulates the profile damper's opening to maintain the burner profile pressure drop. The range of this modulation must coincide with the VFD operating range.

VFD Preset Speeds

1. Inputs are made to the VFD to engage programmable pre-set speeds. A factory-supplied VFD wiring and programming instruction sheet comes with every unit. Consult the as-built schematics and the VFD manual for additional information.

Manual Potentiometer Adjustment – VFD and Choke-Off Dampers

1. A 10k-15k ohm potentiometer may be field supplied and installed if remote manual control is required for the VFD. See VFD manual for proper installation.
2. A 135 ohm potentiometer is used for remote manual control of choke-off vav dampers.

Static Pressure Control (Photohelic) – VFD and Choke-Off Dampers

The VFD or Choke-off dampers can be controlled by a building static pressure control. This controller will sense the difference between pressure inside the building, and pressure outside the building and will control the operating speed of the VFD or position of choke-off dampers to maintain the pressure setting on the controller. The controller has two set points and an indicator. The two set points are a minimum desired static pressure point, and a maximum static pressure point.

When building static pressure is below the minimum setting, the VFD will increase the blower RPM or choke-off damper will open to increase airflow. If the building static is above maximum setting, the VFD will decrease the blower RPM or close choke-off dampers. When building static pressure is between the minimum and maximum settings, no signal is given to change VFD speed or choke-off damper position.

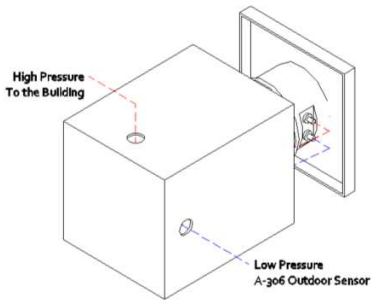
See additional wiring and installation information on the static pressure controller and outdoor sensor. The static pressure controller can be ordered to be shipped loose or mounted inside the unit to reduce field wiring and assembly.

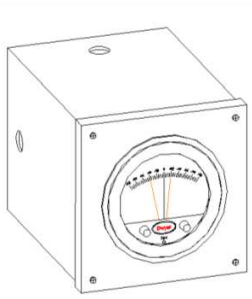
Static Pressure Controller Installation Instructions

Avoid locating the front of the static pressure controller in sun light or other areas with high ambient light or corrosive levels. Bright light shining on the photocells can cause false actuation of the load relays.

The static pressure controller should be zeroed out before attaching the low and high pressure hoses. The zero adjustment is located between the minimum and maximum dials.

Using the supplied rubber tubing the high side of the static pressure controller should be plumbed to the inside of the building. The low side of the static pressure controller should be plumbed to the inside of the building. The low side of the static pressure controller should be plumbed to an outdoor sensor.





Outdoor Sensor

Use the installation instructions shipped with the outdoor sensor.

START-UP PROCEDURE

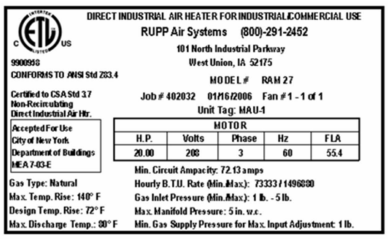
- □ Check for signs of damage. Do not operate if damage exists and contact your manufactures sales representative. Units are easier to fix before the equipment is installed.
- □ Check all installation clearances.

Clearance from Combustibles	Clearance for Serviceability
Top: 6” Sides: 6” Base: 0”	Unit: 24” Service Accesses: 48”

- □ Check that the unit has been set level and secured.
  - □ Unit must have adequate structural support or the equipment or building may be damaged.
  - □ Curb and unit must be leveled or the unit may leak or be damaged.
  - □ Gasket and caulk the seam between the curb and unit base
  - □ Screw or weld the unit’s base to the curb to avoid damage to the equipment.
- □ Check that the accessories are set level and secured.
  - □ Accessories must have adequate structural support or the equipment or building may be damaged
  - □ Gasket, caulk, and screw each accessory to unit seam
- □ Check that the unit’s intake and discharge are free of debris
- □ Check that the filter are installed in the (optional) filter section or intake hood in accordance to the air flow direction
- □ Check that the unit’s ductwork size and length match the minimum ductwork size chart
- □ Check that all field wiring has been completed in accordance to the factory supplied wiring diagram
  - □ Field wires are shown as dashed lines on the wiring prints

- □ Check that all terminal screws are tight and that wires are in place
- □ Check pulley alignment. Correct if necessary

- □ Check that the power supply matches the nameplate voltage, phase, and amperage
  - □ Record the voltage on the Start-Up Sheet
- □ Check that the gas type and pressure matches the nameplate type and pressure
  - □ Check that the gas type and pressure matches the nameplate type and pressure
  - □ Contact the service department is the power or gas supply needs to be changed in the field. Different parts might be necessary for the change
- □ Turn the remote panel switch to OFF if blower and burner service switches were supplied
- □ Set the temperature set point dial to the maximum
- □ Turn the main power disconnect ON
  - □ Bump the blower motor starter to check the blower wheel rotation
  - □ The decal is located on the blower housing
  - □ If the rotation is backwards turn off the power and correct the wiring
  - □ The rotation can be corrected by interchanging two legs of 3 phase (must be between vfd and motor on vav units)


DIRECT INDUSTRIAL AIR HEATER FOR INDUSTRIAL/COMMERCIAL USE

RUPP Air Systems (800)-291-2452

101 North Industrial Parkway

West Union, IA 52175

9900950

CONFORMS TO ANSI Std Z83.4

MODEL # RAH 27

Certified to CSA Std 3.7

Non-Recirculating

Direct Industrial Air Htr.

Job # 402032 01/16/2006 Fan # 1 - 1 of 1

Unit Tag: MAU-1

Accepted For Use

City of New York

Department of Buildings

MEA 7-03-E

MOTOR				
H.P.	Volts	Phase	Hz	FLA
20.00	208	3	60	55.4

Min. Circuit Ampacity: 72.13 amps

Gas Type: Natural

Hourly B.T.U. Rate (Min./Max.): 73333 / 1496830

Max. Temp. Rise: 140° F

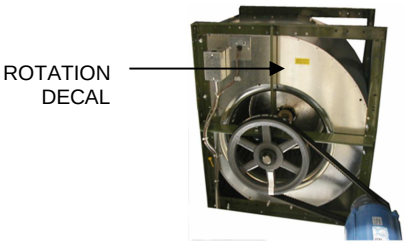
Gas Inlet Pressure (Min./Max.): 1 lb. - 5 lb.

Design Temp. Rise: 72° F

Max. Manifold Pressure: 5 in. w.c.

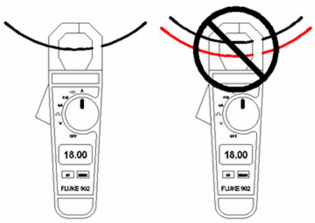
Max. Discharge Temp.: 80° F

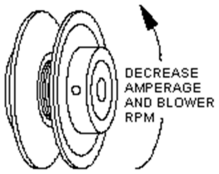
Min. Gas Supply Pressure for Max. Input Adjustment: 1 lb.

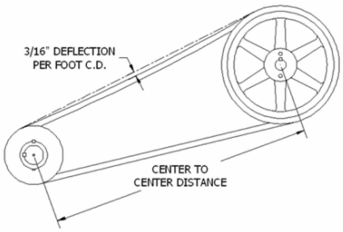


- □ Turn the blower service switch or remote control device to ON. The (optional) intake or discharge damper motor will start to open. Once the damper is 90% open the damper motor internal end switch will close and energize the blower motor starter.
- □ Check that the motor amp draw is less than the FLA (full load amps) of the blower motor.
  - □ The fan RPM may need to be reduced to decrease motor amps.
  - □ Opening the driver (motor) pulley decreases RPM and motor amps.
  - □ Closing the driver pulley increases RPM and motor amps.
  - □ Record the motor amps on the Start-Up Sheet.
- □ If the RPM was adjusted in the field use a tachometer to record the new RPM on the Start-Up Sheet.
- □ Check the belt tension after any RPM adjustments. See the belt tension detail.

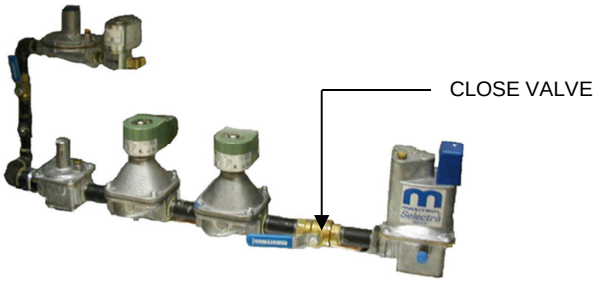
BLOWER SERVICE SWITCH →







- □ Check the air flow pressure drop.
  - □ The air flow switch on single speed units is a low air flow switch only and opens below 0.15 in w.c.
  - □ The target pressure drop range for the single speed unit is 0.40 – 0.50 in w.c.
  - □ **Do not adjust airflow switches**
  - □ Use the profile plates or blower RPM to increase or decrease the pressure drop.
  - □ Record the pressure drop on the Start-Up Sheet.
- □ Close the burner gas shut off valve
  - □ This will allow the unit to fire the pilot only and will be opened at a later time

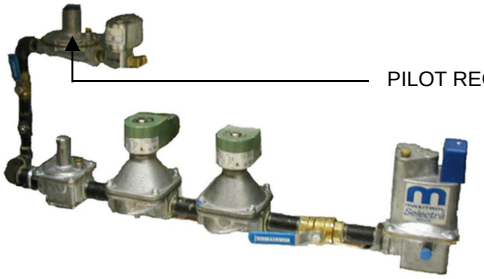


- □ Set the Burner Intake On Off Switch is set above the outside air temperature

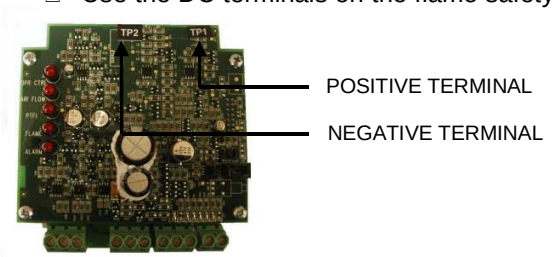
SET DIAL 10 DEGREES ABOVE OUTDOOR TEMP →

- □ Turn the burner service switch or remote control to ON

- □ The Fireye Flame Safety Control energizes the ignition transformer and pilot gas valve
- □ After the pilot flame is established, the main gas valves will open
  - □ At this time the pilot will be the only flame in the burner
- □ The pilot regulator should be adjusted so the pilot flame signal is stable 6-18 VDC



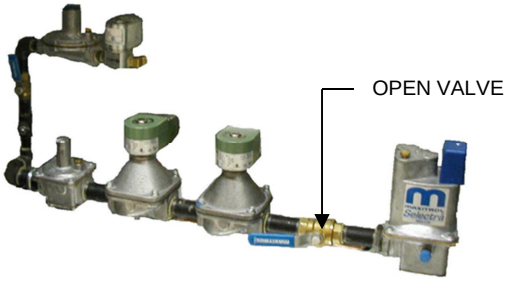
□ Use the DC terminals on the flame safety to read the pilot flame signal



□ Record the pilot flame signal in the Start-Up Sheet
□ Record the low and high fire flame signal on the Start-Up Sheet

Setting High Fire

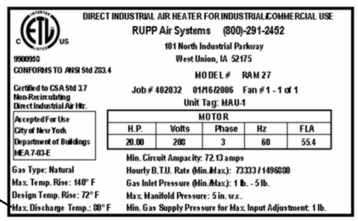
□ Open the Burner Gas Shut Off Valve



□ Measure the intake air temperature.
□ Add the intake air temperature to the units nameplate design temperature rise.
□ This result will be the desired high fire discharge temperature.

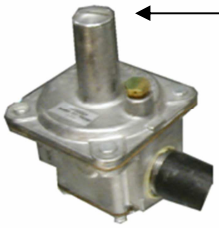
Example: Intake Temp 70 F
Design Temp Rise 72 F
Discharge Temp **142 F**

GAS TYPE: NATURAL
MAX. TEMP. RISE: 140 F
DESIGN TEMP. RISE: **72 F**
MAX. DISCHARGE TEMP.: 80



- □ Use the Amplifier to override the heater into high fire.
  - □ On discharge temperature control amplifier remove the #4 wire
  - □ On the space temperature control amplifier remove the #2 and #4 wire
  - □ On the M-Series adjust the set-point to be 160 F
- □ Adjust the manifold gas pressure to achieve the desired discharge air temperature.
  - □ See the details for the high fire pressure adjustment locations.
  - □ On manifolds with an MR212 modulation valve, adjust the small regulator inside the MR212 modulation valve
  - □ On manifolds with either an M511 or M611 modulation valve, adjust the regulator located before the main gas valves
  - □ On manifolds with a combination gas valve, adjust the regulator under the brass cap on the combination gas valve.
- □ Measure the discharge temperature using a thermometer. Laser thermometers are not as accurate as a thermocouple type.
- □ If the discharge ductwork outlet is hard to reach, you may feed a thermocouple into the mixing tube inside the blower discharge.

MR212



M511 & M611

36C68

Setting High Fire – Manifold Pressure Method

- □ Turn the burner service switch OFF
- □ Measure the manifold pressure with the burner in high fire as described above
- □ Adjust to match design manifold pressure on nameplate
- □ Measure discharge temperature and calculate temperature rise as described above to account for variances in airflow from design

GAS TYPE: NATURAL
MAX. TEMP. RISE: 140 F
DESIGN TEMP. RISE: **72 F**
MAX. DISCHARGE TEMP.: 80

DIRECT INDUSTRIAL AIR HEATER FOR INDUSTRIAL/COMMERCIAL USE
RUPP Air Systems (800)-291-2452
101 North Industrial Parkway
West Union, IA 52175
MODEL # RAH 27
Job # 402032 01/16/2006 Fan # 1 - 1 of 1
Unit Tag: MAU-1

MOTOR				
H.P.	Volts	Phase	Hz	FLA
20.00	208	3	60	55.4

Setting Low Fire

- □ Disconnect power to the amplifier or modulating valve
- □ Adjust the low fire setting on the modulation valve so the flame is full length of burner without dark spots
  - □ See the details for the low fire pressure adjustment locations
  - □ Use the burner observation port on the end of the unit to view the flame size
- □ Replace all amplifier wires in the place they were removed to set high and low fire
- □ Additional capacity is provided via a low fire bypass when MR212 low fire capacity is insufficient. Additional adjustment is made via the R400S regulator installed in the low fire bypass.

LOW FIRE →

MR212

M511 & M611

LOW FIRE →

Final Start-Up

- □ Set the Burner Intake On-Off Thermostat to the desired temperature to disable burner
  - □ This will automatically open the burner circuit when the outside air is above the selected temperature
- □ Turn the blower and burner service switches OFF
  - □ Now the unit will be operated from the control panel only
- □ Operate the unit from the remote panel checking the lights, switches, set-points, and optional thermostats or timers
- □ Review the proper operation and sequence of operation with the customer to ensure that the unit is operated properly and that the customer does not misuse the equipment
- □ Complete the Start-Up Sheet and fax it to the service department to validate the warranty

START-UP PROCEDURE VARIABLE AIR VOLUME

The Start-Up procedure for variable air volume units is the same as the single speed unit except there are additional steps for checking burner pressure drop and setting high/low fire. Use the single speed procedure along with these additional steps for the vav start-up procedure.

- □ Check the air flow pressure drop through entire airflow range.
  - □ The air flow switch on vav units is a low (0.15) and (0.65) high switch
  - □ **Do not adjust airflow switches**
  - □ Use the profile plates, choke-off dampers or VFD to increase or decrease the pressure drop.
  - □ Record the pressure drops on the Start-Up Sheet.
  - □ Verify the flame limiting device is functioning properly in low speed on units with a vfd.
  - □ Verify low fire setting at minimum flow rate as well.

PROFILE ADJUSTMENTS

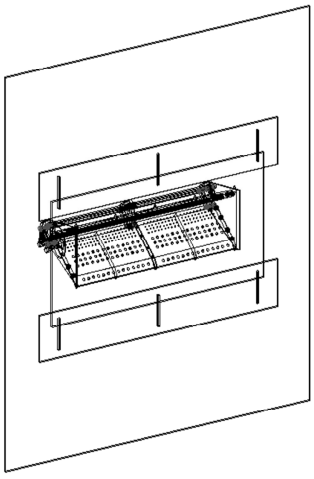
The Direct-Fired Gas, make-up heater requires the correct air flow velocity across the burner. The air flow switch monitors the profile pressure differential, and will open the burner circuit if pressure difference is not within the allowed range. The air flow switches have low and high pressure settings for variable air volume units. The pressure drop should not be near the minimum and maximum of the air flow switch. Profile adjustment may be required to fine tune the burner profile pressure drop. See the specifications and instructions below on air balancing a 100% fresh air heater.

Single-Speed Profile

The pressure drop should be checked with the burner OFF if ambient temperature is greater than 60 degrees Fahrenheit. If the ambient temperature is lower than 60 degrees Fahrenheit, the burner should be operating and discharging approximately 70 degrees Fahrenheit. An extra set of airflow probes have been installed to ease in checking profile differential.

WARNING!!

Disconnect power and close all gas valves before and while making burner profile adjustments.

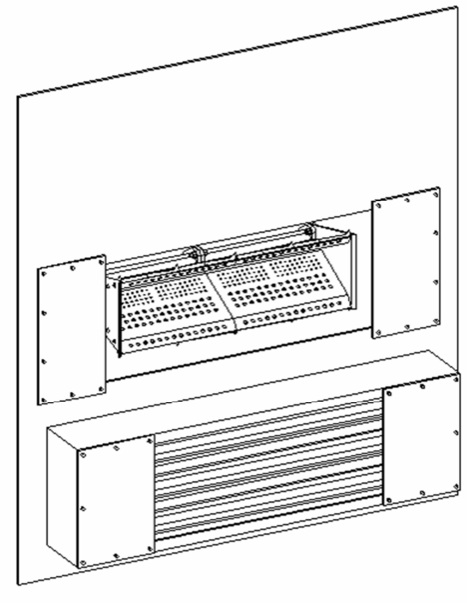


Single-Speed Profile

If the pressure drop is too low, adjust the profile opening to be smaller, which will increase the pressure drop.

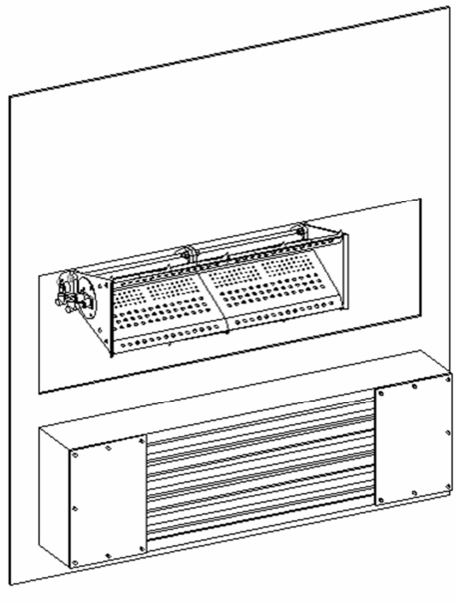
If the pressure drop is too high, adjust the profile opening to be larger, which will decrease the pressure drop.

Variable Air Volume Profile



VAV Profile

In low speed, adjust the burner profile opening smaller to increase pressure drop or larger to lower pressure drop.



VAV Profile

In high speed adjust the bypass damper opening larger to decrease the pressure drop and smaller to increase the pressure drop.

VFD Drive Installation & Programming Instructions

WARNING!!

-Before installing the VFD drive, ensure the input power supply to the drive is OFF
-The power supply and motor wiring of the VFD must be completed by a qualified electrician
-The programming of the VFD must be completed by a qualified HVAC technician

Consult the VFD manual and all documentation shipped with the unit for proper installation and wiring of the VFD.

The VFD has been programmed by the factory with order specific parameters.

Check Installation:

√	Check
	The installation environment conforms to the VFD manual.
	The drive is mounted securely.
	Space around the drive meets the drive's specification for cooling.
	The motor and driven equipment are ready for start.
	The drive is properly grounded.
	The input power voltage matches the drive's nominal input voltage.
	The input power connections at U1, V2, and W1 are connected and tight.
	The input power protection is installed.
	The motor power connection at U2, V2, and W2 are connected and tight.
	The input, motor, and control wiring are run in separate conduit runs.
	The control wiring is connected and tight.
	NO tools or foreign objects (such as drill shavings) are in the drive.
	NO alternative power source for the motor (such as a bypass connection) is connected - NO voltage is applied to the output of the drive.

TEMPERATURE CONTROL SYSTEMS

401M

- The 401M replaces building-exhaust air with tempered make-up air.
- A discharge-sensing controller that compensates for intake air temperature changes modulates the burner flame.
- A manual, remote selector switch controls the unit's operation.

402M

- The 402M is used primarily in door-heater applications. The space override thermostat increases the discharge-air temperature when needed to maintain temperature.
- The amount of override temperature is controlled via a 0-40 degree potentiometer on the side of the temperature set point dial.
- A manual, remote selector switch may control the unit's operation.

403M

- The 403M maintains a constant space temperature.
- A modulating space thermostat adjusts the burner to maintain the supply-air temperature necessary to compensate for changes in the building's heat requirement.
- The amplifier limits the maximum and minimum temperature of the supply air the unit delivers.
- A manual, remote selector switch may control the unit's operation.

404M

- The 404M maintains a constant space temperature, day or night. During day operation, a modulating-space thermostat adjusts the burner to maintain the supply-air temperature necessary to compensate for changes in building's heat requirements.
- The amplifier limits the maximum and minimum temperature of the supply air the unit delivers.
- During night operation, a space thermostat cycles the unit ON or OFF to maintain the space temperature.
- A manual remote selector switch may control unit operation.
- The DAY/NIGHT mode is automatically controlled via a programmable thermostat or time clock.

Signal Conditioner

- When computer of other process controls are specified, the signal conditioner provides compatibility with modulator / modulator-regulator valves.
- This system requires a field supplied 4 to 20 milliamp or 0 to 10 DC voltage signal.

OTHER UNIT COMPONENTS

Flame Safety Control

The first system to understand is the **Flame Safety Control**. The FSC is there ***only*** to monitor the flame, NOT to control temperature. The FSC uses a flame rectification sensor (flame rod) mounted on the pilot assembly to detect the presence of flame in the burner. Flame strength and presence can be measured at the FSC by reading the rectified flame signal using a DC voltage meter in the test jacks. Flame is present when the DC voltage reads between **6 and 18 VDC**. Ideal flame intensity produces a signal of **12 VDC** or greater. The FSC controls the opening of the main and pilot gas valves and the operation of the spark igniter to initiate a pilot flame upon start-up.

Flame Safety Controller

The **OPR CTRL** LED indicates that there is power to the FSC. Next, the **AIRFLOW** LED will come on if there is proper airflow through the unit. Third, the unit will pause to purge any gasses or combustible vapors before attempting flame ignition. Then, there is a Pilot Trial For Ignition (PTFI) and the **PTFI** LED comes on. During PTFI, the FSC opens the pilot gas valve and allows gas to flow to the pilot assembly. At the same moment, the spark igniter is started, causing the spark to ignite the pilot gas. When the flamerod sensor detects the flame, it turns on the **FLAME** LED, turns off the PTFI LED. This is the normal operating mode. The last LED on the FSC is the **ALARM** LED. This will turn on when the FSC determines an unsafe condition has occurred, and will not allow the unit to recycle for heat until it has been properly reset. Anytime the FSC has gone into “Alarm” mode, the problem must be diagnosed and corrected to avoid future lockouts after resetting. To reset the FSC, cycle power to the control. This will clear the alarm from the flame safety.

DC Flame Signal

DC Voltage	Flame Status
0 to 5 VDC	No Flame
6 to 11 VDC	Weak Flame
12 to 18 VDC	Strong Flame

High Temperature Limit

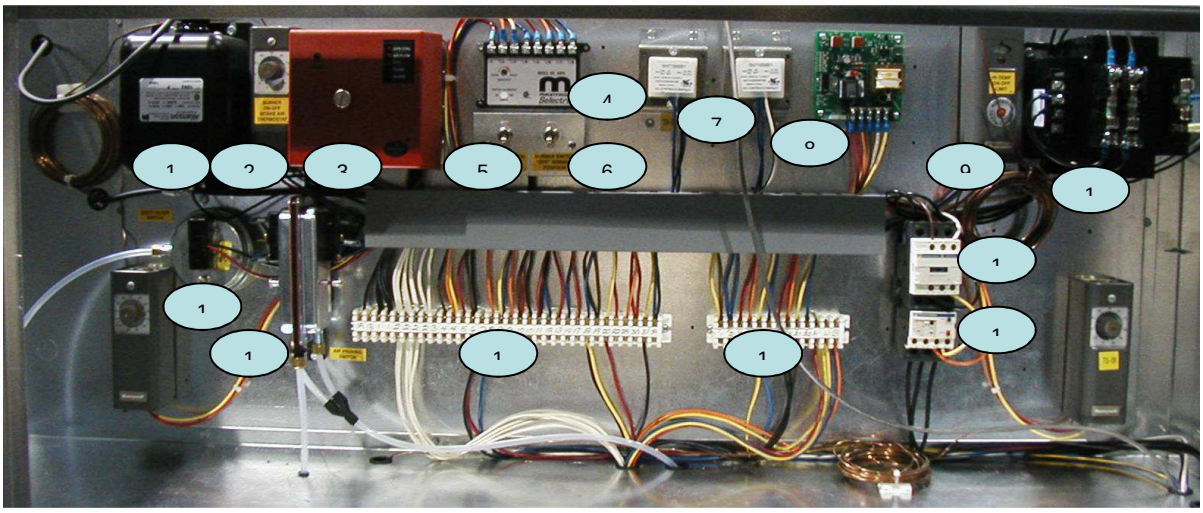
One of the safety device is the **high temperature limit** switch. This switch is a mechanical thermostat that measures the temperature inside the unit downstream of the burner. If the factory-set temperature is exceeded, it will disable the burner. This requires a manual reset of the high temperature limit.

High Temperature Limit

Electric Cabinet Heater

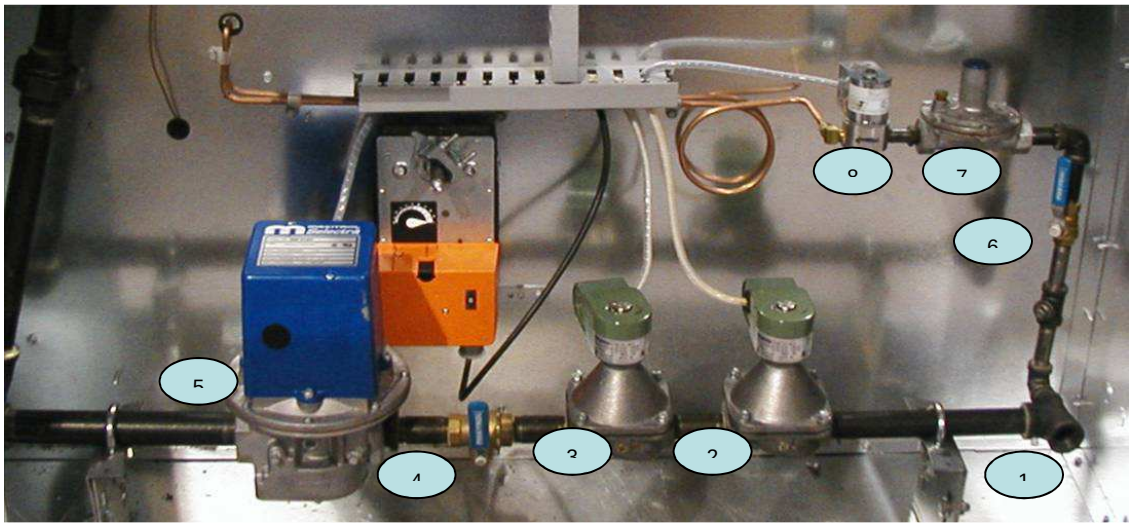
On units shipped with an optional electric cabinet heater, ensure that the heater is wired to a **separate** 120V, 15 amp input, the thermostat sensing bulb is mounted correctly in the control vestibule where the heater is located, and the **thermostat set to 0 Degrees Fahrenheit.**

ELECTRICAL VESTIBULE



1. IGNITION TRANSFORMER
2. INTAKE AIR THERMOSTAT
3. FLAME SFAETY CONTROL
4. MODULATING AMPLIFIER
5. BLOWER SERVICE SWITCH
6. BURNER SERVICE SWITCH
7. CONTROL TRANSFORMER
8. FREEZE CONTROL
9. HIGH TEMPERATURE LIMIT
10. POWER TRANSFORMER
11. MOTOR STARTER
12. MOTOT OVERLOAD
13. CLOGGED FILTER SWITCH
14. AIR FLOW PROVING SWITCH
15. 120 VOLT TERMINALS
16. 24 VOLT TERMINALS

MANIFOLD VESTIBULE



1. GAS INLET
2. 1ST MAIN GAS VALVE
3. 2ND MAIN GAS VALVE
4. BURNER SHUT OFF VALVE
5. MODULATING GAS VALVE
6. PILOT SHUT OFF VALVE
7. PILOT REGULATOR
8. PILOT GAS VALVE

TROUBLESHOOTING

The following tables list causes and corrective actions for possible problems with direct fired heater units. Review these lists prior to consulting the manufacturer.

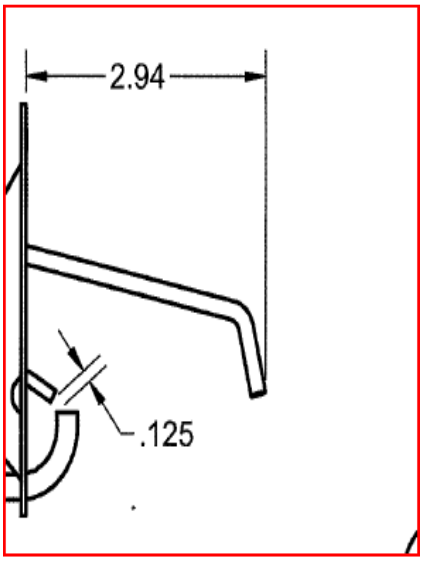
Airflow Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Fan inoperative	Blown fuse or open circuit breaker	Replace fuse or reset circuit breaker and check amps
	Disconnect switch in “OFF” position	Turn to “ON” position
	Motor wired incorrectly	Check motor wiring against wiring diagram located on fan motor
	Broken fan belt	Replace belt
	Motor starter overloaded	Reset starter and check amps
	Remote panel set to “OFF” position	Set Remote Panel to “MANUAL” or “AUTO” Position
Motor overload	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Fan speed is too high	Reduce fan RPM
	Motor wired incorrectly	Check motor wiring against wiring diagram located on fan motor
	Overload in starter set too low	Set overload to motor FLA value
	Motor HP too low	Determine if HP is sufficient for job
	Duct static pressure lower than design	Reduce fan RPM
Insufficient airflow	Fan rotating in the wrong direction	Be sure fan is rotating in the direction shown on rotation label
	Poor outlet conditions	There should be a straight, clear duct at the outlet
	Intake damper not fully open	Inspect damper linkage and replace damper motor if needed
	Duct static pressure higher than design	Improve ductwork to eliminate or reduce duct losses
	Blower speed too low	Increase fan RPM. Do not overload motor
	Supply grills or registers closed	Open and adjust
	Dirty or clogged filters	Clean and/or replace
	Belt slippage	Adjust belt tension
Excessive airflow	Blower speed to high	Reduce fan RPM
	Filters not installed	Install filters
	Duct static pressure lower than design	Reduce fan RPM
Excessive vibration and noise	Misaligned pulleys	Align pulleys
	Damaged or unbalanced wheel	Replace wheel
	Fan is operating in the unstable region of the fan curve	Refer to performance curve for fan
	Bearings need lubrication or replacement	Lubricate or replace
	Fan speed is too high	Reduce fan RPM
	Belts too loose, worn, or oily	Inspect and replace if needed

Burner Troubleshooting Chart

Problem	Potential Cause	Corrective Action
Pilot does not light/stay lit	Main gas is off	Open main gas valve.
	Air in gas line	Purge gas line.
	Dirt in pilot orifice	Clean orifice with compressed air.
	Gas pressure out of range	Adjust to proper gas pressure.
	Pilot valve is off	Turn pilot valve on.
	Leaking pilot orifice fitting	Tighten pilot orifice.
	Excessive drafts	Re-direct draft away from unit.
	Safety device has cut power	Check limits and airflow switch.
	Dirty flame sensor	Clean flame sensor.
	Remote panel in “Vent” mode	Change to “Heat” mode.
	No spark at igniter	Check wiring, sensor, and ignition controller. Check spark gap as shown below.
Main burner does not light (Pilot is lit)	Defective valve	Replace combination valve.
	Loose valve wiring	Check wiring to valve.
	Defective pilot sensor	Replace pilot sensor.
	Shut-off valve closed	Open shut off valve.
	Defective flame safety controller	Replace flame safety controller.
	Pilot fails as main gas valves open and main gas begins to flow	Plug the first burner port next to the pilot gas tube with burner cement.
Not enough heat	Main gas pressure too low	Increase main gas pressure – do not exceed 14 in. w.c. inlet pressure (5 psi. on size 4-5 heater).
	Too much airflow	Decrease airflow if possible.
	Burner undersized	Check design conditions.
	Gas controls not wired properly	Check wiring.
	Thermostat setting too low	Increase thermostat setting.
	Thermostat malfunction	Check/replace thermostat.
	Unit locked into low fire	Check wiring.
Too much heat	Defective modulating gas valve	Check/replace modulating valve.
	Thermostat setting too high	Decrease thermostat setting.
	Unit locked into high fire	Check wiring.
	Thermostat wired incorrectly	Check thermostat wiring.

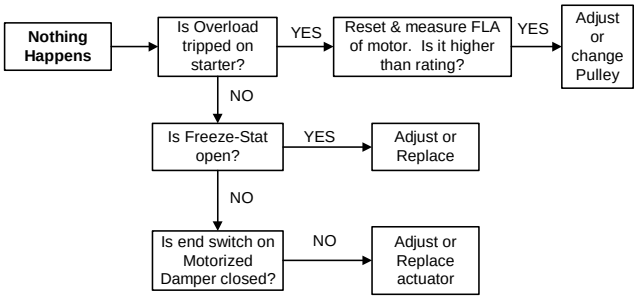
Proper Spark Gap

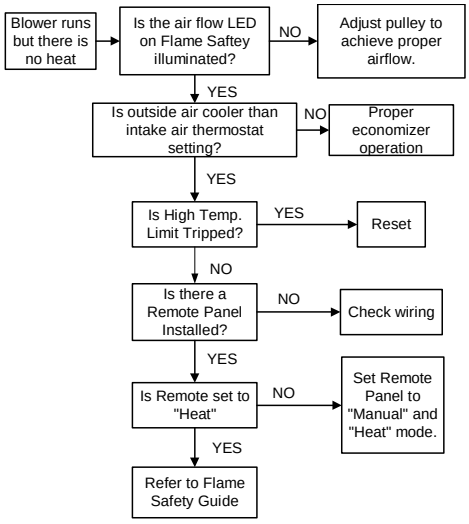


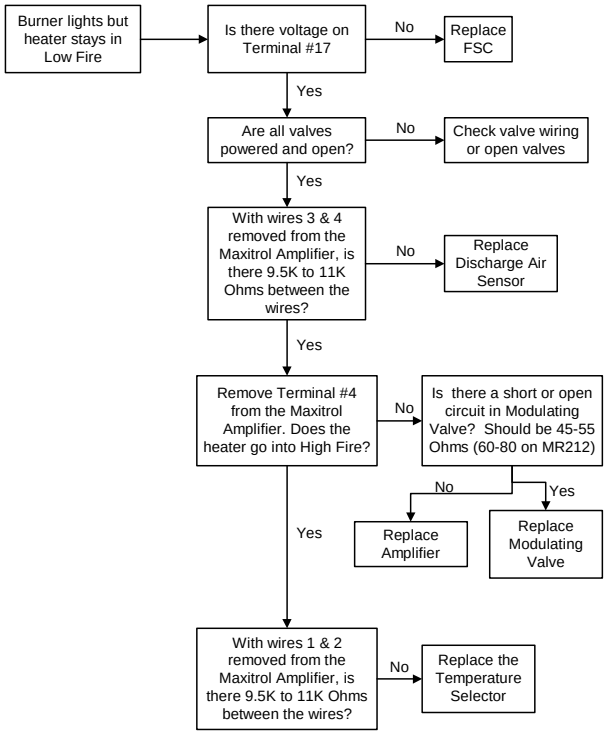
Remote Panel Troubleshooting Chart

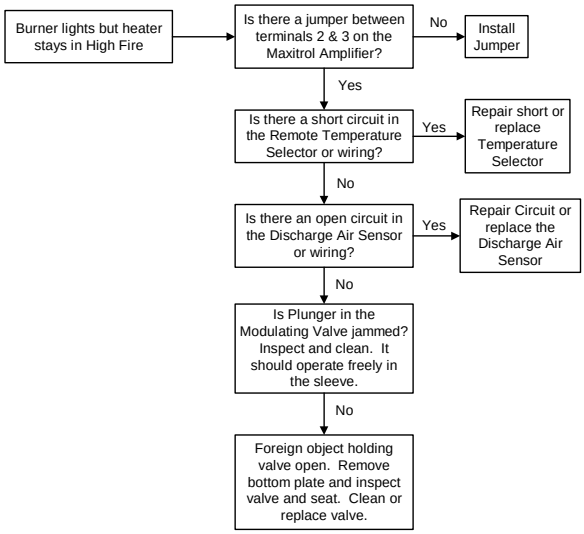
Light Indication	Condition	Possible Cause
No lights	Power not available to Remote Panel	Bad voltage to unit
		Main Disconnect in “OFF” position
		Circuit breaker tripped
		Bad main transformer
POWER light only	Proper unit Off Operation	No problem
	No power to motor starter	Manual/Off/Auto switch in “OFF” position (3-position Remote Panels only)
		Improper damper function
		Low Temperature Thermostat timed out (option)
POWER light and BLOWER ON light	Proper ventilation operation	No problem
	No power to flame safety controller	Manual/Off/Auto switch in “OFF” position (2-position Remote Panels only)
		Heat/Vent switch in “VENT” position
		Gas pressure switch Tripped (option)
		High Temperature Limit Thermostat tripped
		Manual/Off/Auto Switch in “AUTO” position and Intake Air Thermostat not satisfied
	Improper airflow	Insufficient airflow
		Excessive airflow
		Bad airflow switch
		Problem with air probes
		Problem with airflow tubing
		Broken belt
POWER light and BLOWER ON light and BURNER ON light	Proper heating operation	No problem
CLOGGED FILTER light on (optional)	Filters clogged	Filters dirty or need replacement
FLAME FAILURE light on	Flame safety alarm activated	Combination valve in “OFF” position (Unit sizes 1-3)
	No flame detected during pilot establishment period	Stuck closed gas valve
		No or low gas pressure
		Bad spark electrode
		Bad ignition transformer
		Flames sensor malfunction
		Clogged pilot orifices

Troubleshooting Flowcharts









Maxitrol Preliminary Circuit Analysis Series 14 System

The basic Series 14 system consists of an amplifier, a discharge-air sensor and mixing tube, a remote-temperature selector, and a modulating valve or a modulator-regulator valve.

Series 14 Preliminary Wiring Testing Procedures:

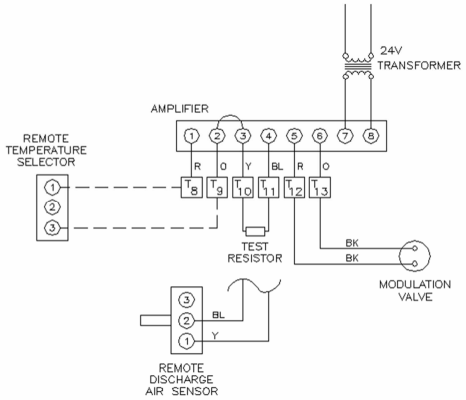
- Disconnect the discharge-air sensor and replace with a 10,000-Ohm, 1/4-watt test resistor at Terminals 3 & 4.
- Connect a dc-volt meter on the modulator-regulator or modulator-valve terminals.
- Set the temperature to 55° F. Voltage should read 0-V.
- Rotate dial to 90° F. Voltage should gradually increase to a minimum of 20-V.
- If these voltages are obtained, the valve function can now be checked out.
- In the event proper voltages are obtained, and the valve responds correctly to these voltages, the problem could be in the wiring to the discharge-air sensor or the discharge-air sensor itself.
- If the proper voltages are not obtained when wired as shown above, the problem can be isolated to the electronics.

After these preliminary tests are completed, remove the test resistor and reconnect the discharge air sensor to Terminals 3 and 4 and continue checking system, following the Series 14 Troubleshooting Steps.

The operation of the modulating-valve regarding voltage is as follows:

o	0 to 5-V	The heater should be at bypass or low.
o	5 to 15-V	The heater should respond to various input rates.
o	15-V and up	The heater is at maximum input.

- If the voltage is obtained on the valve terminals, but the heater does not respond as described, the problem can be isolated to the valve itself or to the gas-control manifold of the heater.



Maxitrol Series 14 Troubleshooting

Symptom	Possible Cause	Field Test	Remedy
No Gas Flow	Modulating valve improperly installed	Arrow on side of valve should point in direction of gas flow	Install properly
Continuous low fire (electronics problem)	Short circuit or no voltage to the amplifier	Check for 24-V at amplifier terminals 7 & 8	Prove power source
	Open circuit in TD114 remote temperature selector or wiring	Check wire connections between amplifier terminals 1 and 2 and remote temperature selector terminals 1 and 3	Tighten connections or replace wiring
	Short circuit in TS114 remote temperature circuit or wiring	Follow test procedures as outlined in the preliminary testing section of this manual	If modulating voltages are obtained, check TS114 if necessary. If these items check out and modulating voltages are still not obtained, amplifier may be assumed defective. Install replacement.
Continuous low fire (electronics OK)	Faulty amplifier Open circuit in modulator coil	Check Td114 for internal open circuits. Maximum 11,500 ohms across terminals 1 and 3 with external wiring disconnected. Measure resistance across modulator terminals with interconnecting wires disconnected.	Replace modulator head if not approximately 45 to 55 ohms for the M611 and M511 and 60 to 80 ohms for the MR212.
	Plunger missing, jammed, or improperly installed	Inspect: Plunger should operate freely in solenoid sleeve.	Clean or replace plunger if necessary.
Incorrect minimum fire	Incorrect by-pass metering valve adjustment	Re-set low fire (see start-up instructions)	Adjust to proper low fire
	Excessive negative burner pressure	Close main-gas supply and measure manifold pressure with blower opening. Reading should be less than 1.5-in wc negative pressure.	If reading is greater than 1.5-in wc negative pressure, check for clogged filters or other inlet air restrictions.
Continuous high fire (electronics problem)	Short circuit in remote temperature selector circuit	Inspect for shorts at or between amplifier terminals 1 and 2 and at TD114 terminals 1 and 3.	Correct wiring if a short is present. Replace TD114 if defective.
	Open Circuit in the TS114 discharge air sensor circuit	Check TS114 for terminal shorts, minimum 8,000 ohms across terminals 1 and 3 with external wiring disconnected.	If modulating voltages are obtained, check TS114 circuit for shorts. Replace TS114 if necessary.
	Jumper not connected across amplifier terminals 2 and 3	Connect test resistor as described in the preliminary circuit test.	Correct if necessary.

Symptom	Possible Cause	Field Test	Remedy
Continuous high fire (electronics OK)	Foreign object holding valve open or plunger jammed	Inspect: plunger should be smooth and clean, and operate freely in the solenoid valve.	Clean or, if necessary, replace plunger
Incorrect maximum fire	Inlet pressure too low	Read pressure at inlet to modulating valve using a manometer with unit operating at high fire. Pressure should be equal to the sum of the outlet pressure setting plus pressure drop of the valve.	Increase inlet pressure, if possible.
	Incorrect outlet pressure adjustment of pressure regulator	Read manifold pressure using manometer and compare with recommendation of the heater manufacturer.	
	Hunting	Adjust sensitivity control counter clockwise.	If flame stabilizes, adjust sensitivity control to maintain an even flame
Erratic or pulsating flame	Erratic air patterns or improper TS114 location	Connect test resistor as described in the preliminary circuit analysis section. Turn TS114 selector dial so heater goes though its entire modulating range.	If the flame is steady thought-out the entire modulating range, the TS114 must be relocated.
	TD114 wiring is run next to high voltage switching circuits causing induced voltages	Temporarily remove TD114 from its remote locating and reconnect at valve location. Observe heater observation.	If smooth operation results, isolate TD114 wiring from source of induced voltage.
	Faulty amplifier or erratic voltage supply	With test resistor connected as described in the preliminary tests, and TD114 locally connected as described above, turn TD114 selector dial though entire modulating range. Observe voltage across modulator terminals.	If erratic or unstable voltages are obtained throughout the modulating range, the amplifier may be assumed defective. Replace. If erratic operation is noted only over a small range, the voltage source may contain surges.
Incorrect discharge air temperature	Incorrect wiring	Check installation according to the diagram in the preliminary circuit analysis section.	Correct wiring
	Improper TS114 location	Sensed temperature does not represent average discharge air temperature.	Move TS114 to location where average representative temperature can be sensed.

Maxitrol Preliminary Circuit Analysis *Series 44 System*

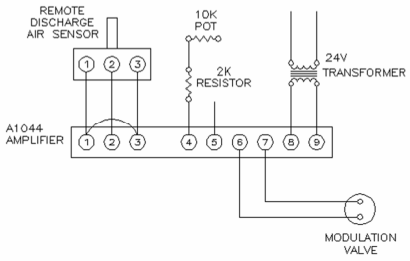
The basic Series 44 system consists of an amplifier, a discharge-air monitor with mixing tube, a selectrastat, and a modulating valve or a modulator-regulator valve.

Series 44 Wiring for Preliminary Testing Procedures:

- Turn the test potentiometer to 2,000-Ohm minimum resistance. The dc voltage should read 0-V. Slowly turn the test potentiometer to maximum resistance or 12,000-Ohms. The dc voltage should gradually increase to at least 18-V.
- If proper voltages are observed, continue with the following test procedures.
- If proper voltages are not observed, the problem is identified with the amplifier, the 24-V ac power supply, or the circuit connected to Terminals 6 and 7.
- Turn power OFF. Wire system as shown. Turn power back ON.
- Turn the test potentiometer to minimum resistance. The dc voltage should read 0-V. Slowly turn the test potentiometer to maximum resistance. The dc voltage should gradually increase to at least 18-V.
- If proper voltages are observed, continue with the following test procedures.
- If proper voltages are not observed, the problem is identified with the amplifier, the 24-V ac power supply, or the circuit connected to Terminals 6 and 7.
- Observe burner flame and burner pressure as test potentiometer is turned through full range.
    - o 0 to 5-V The heater should be at bypass or low.
    - o 5 to 15-V The heater should respond to various input rates.
    - o 15-V and up The heater is at maximum input.

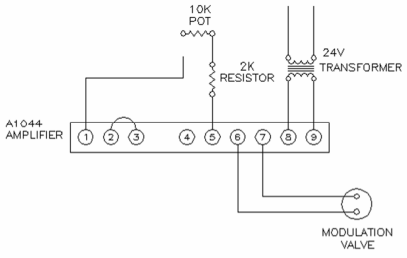
- If proper voltages are observed, continue procedures to check operation of sensing and selecting components.

- If proper voltages are not observed, see checklist on the following page to test the MR212 or M611 modulating valve and connecting wiring.



- With proper voltages present and modulator responding correctly, return to the wiring configuration as shown below, except have the TS144 discharge-air monitor connected in place of the jumper. Set minimum-temperature selector at least 10° F above outdoor temperature. Set maximum-temperature selector at mid-range. Heater is now under control of the discharge-air monitor.

- Turn test potentiometer to maximum resistance. Air temperature should be at maximum-temperature setting. Turn test potentiometer to minimum resistance. Delivered air temperature should be at minimum temperature setting.



- If proper voltages are not observed, check calibration. See checklist on the following page.

- If proper voltages are observed, the problem is identified with the space temperature sensing and temperature selecting components and circuits.

- After these preliminary test procedures are completed, remove all test equipment and reconnect components.

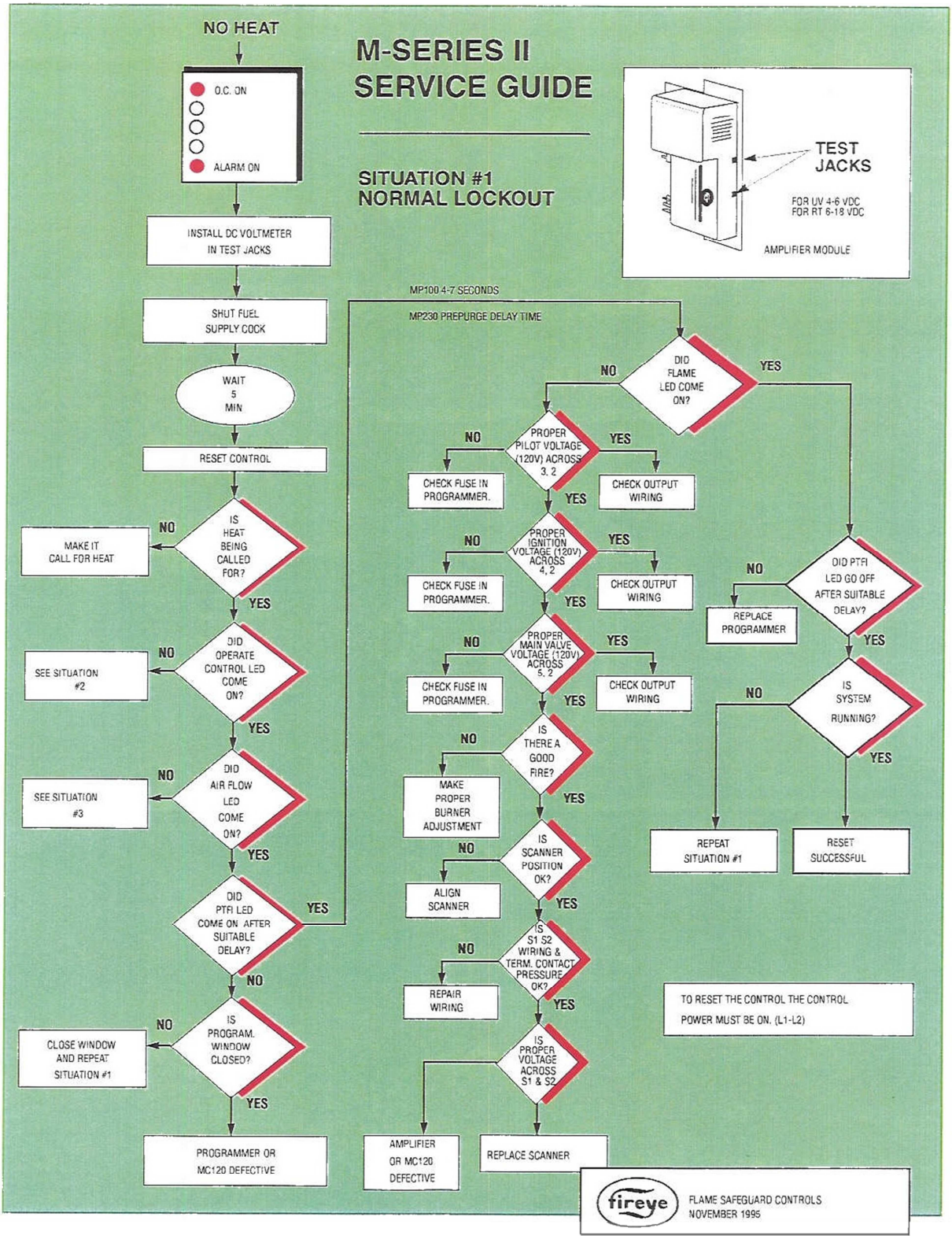
Maxitrol Series 44 Troubleshooting

Symptom	Possible Cause	Field Test	Remedy
No gas flow	Modulating valve installed improperly	Arrow in side of valve should point in direction of gas flow.	Install properly
Continuous low fire (electronics problem)	No voltage to amplifier	Check for 24-v ac at amplifier terminals 8 and 9	Provide 24-v ac to amplifier
	Short in modulator coil circuit	Remove wires connected to amplifier terminals 6 and 7; measure resistance MR212: 60 – 80 ohms M611 & M511: 45 to 55 ohms	If proper resistance values are not observed; replace modulator head or repair wiring.
	Short in TS144 circuit	Remove wires connected to amplifier terminals 1, 2, and 3. Measure resistance across wires 1 and 3, then across 2 and 3. Meter should read greater than 2500 ohms.	If readings are incorrect, replace the TS114 or repair wiring.
	Defective amplifier	Follow procedures in the preliminary circuit analysis section	After following the preliminary circuit analysis test without satisfactory results, the amplifier can be assumed defective. Install replacement.
Continuous low fire (electronics OK)	Open in modulator coil circuit	Remove wires connected to amplifier terminals 6 and 7 measure resistance MR212: 60 – 80 ohms M611 & M511: 45 to 55 ohms	If proper resistance values are not observed, replace modulator head or repair wiring
	Plunger missing, jammed or improperly installed	Inspect: plunger should operate freely in solenoid sleeve.	Clean or replace plunger if necessary
Incorrect minimum fire	Incorrect by-pass metering valve adjustment	Re-set low fire (see start-up instructions)	Adjust to proper low fire
	Excessive negative burner pressure	Close main-gas supply and measure manifold pressure with blower opening. Reading should be less than 1.5-in wc negative pressure.	If reading is greater than 1.5-in wc negative pressure, check for clogged filters or other inlet air restrictions.
Continuous minimum discharge temperature	Defective amplifier	Refer to the preliminary circuit analysis section	If amplifier is proven defective, install replacement
	Short in T244 or TS244/TD244 circuit	Remove wires to amplifier terminals 4 and 5. Set T244 or TD244 to maximum setting. Measure resistance across wires. Meter should read 6000 ohms +- 1000 ohms. If TS244/TD244 are used, meter should read 4500 ohms +- 1000 (TS244) and 2100 ohms +- 150 (TD2440)	If reading is incorrect, replace T244, TS244/TD244 or repair wiring

Symptom	Possible Cause	Field Test	Remedy
Incorrect minimum or maximum discharge air temperature	Improper TS144 location	Compare sensed temperature at TS144 with average discharge air temperature	Move TS144 to location where average temperature can be sensed
	Incorrect discharge air temperature control calibration	Refer to the preliminary circuit analysis section	If proper temperatures are not observed, refer to control calibration of this manual
Continuous high fire (electronics problem)	Open in TS144 circuit	Remove wires to amplifier terminals 1, 2, and 3. Measure resistance between terminals 1 and 3, then between terminals 2 and 3. Meter should read greater than 2500 ohms	If readings are incorrect, replace TS114 or repair wiring
Continuous high fire (electronics OK)	Foreign material holding valve open	Remove bottom plate and inspect valve and seat	Clean and replace valve and seat. Replace if necessary
	Plunger jammed	Inspect: plunger should be smooth and clean, and operate freely in solenoid valve	Clean, or if necessary, replace plunger
Incorrect high fire	Inlet pressure too low	With heater operating at full fire, take pressure reading at inlet to modulation valve. Pressure should meet or exceed the units minimum gas pressure	Increase inlet pressure if possible, or change to a larger modulation valve. Contact manufacturer for increasing valve size.
	Incorrect outlet pressure adjustment	Read outlet pressure using a manometer and compare with recommendation of unit capacities	See control calibration of this manual
Continuous maximum discharge air temperature	Defective amplifier	Refer to the preliminary circuit analysis section	Replace amplifier if defective
	Open in T244 or TS244/TD244	Remove wires to amplifier terminals 4 and 5. Set T244 or TD244 to maximum setting. Measure resistance across wires. Meter should read 6000 ohms +- 1000 ohms. If TS244/TD244 are used, meter should read 4500 ohms +- 1000 (TS244) and 2100 ohms +- 150 (TD2440)	If reading is incorrect, replace T244, TS244/TD244 or repair wiring
	Incorrect space temperature control calibration	See control calibration section of this manual	If proper action is obtained, see calibration section of this manual

Flame Safety Service Guide

(Airflow LED may or may not be illuminated)



Flame Safety Service Guide (continued)

(Airflow LED may or may not be illuminated)

MAINTENANCE

To guarantee trouble free operation of this heater, the manufacturer suggests following these guidelines. Most problems associated with fan failures are directly related to poor service and maintenance.

WARNING!!

DO NOT ATTEMPT MAINTENANCE ON THE HEATER UNTIL THE ELECTRICAL SUPPLY HAS BEEN COMPLETELY DISCONNECTED AND THE MAIN GAS SUPPLY VALVE HAS BEEN TURNED OFF.

General Maintenance

1. Fan inlet and approaches to ventilator should be kept clean and free of any obstructions.
2. Motors are normally permanently lubricated. Check bearings periodically. If they have grease fittings, lubricate each season. Use caution when lubricating bearings. Wipe the fittings clean. The unit should be rotated by hand while lubricating. **Caution: Use care when touching the exterior of an operating motor. Motors normally run hot and may be hot enough to be painful or cause injury.**
3. Before starting a unit after maintenance checks, check all fasteners for tightness.
4. Blowers require very little attention when moving clean air. Occasionally oil and dust may accumulate, causing imbalance. If the fan is installed in a corrosive or dirty atmosphere, periodically inspect and clean the wheel, inlet and other moving parts to ensure smooth and safe operation.

Re-Setting Of The Unit

If the flame safety control is locked out (alarm light on), reset the unit by:

1. Turn OFF power to the unit.
2. Turn power to the unit back ON.

Emergency shutdown of unit

To shut down the unit in the event of an emergency do the following:

1. Turn power OFF to the unit from main building disconnect.
2. Turn the external disconnect switch to the OFF position.
3. Close the inlet gas valve located on the heater.

Prolonged shutdown of the unit

For prolonged shutdown the following steps should be done:

1. Turn the external disconnect switch to the OFF position.
2. CLOSE the inlet gas valve located on the heater.

To re-start the unit the following steps should be done:

1. Turn the external disconnect switch to the ON position.
2. OPEN the inlet gas valve located on the heater.

Lubricating Blower Bearings

Blower bearings require little lubrication. A general rule is one half pump from a grease gun for ½" to 1 7/16" shaft diameters and one pump for 1 11/16" and large diameter shafts for every 1500 to 3000 hours of operation. A lithium based grease should be used. Bearings should be rotated as they are lubricated to evenly distribute the grease, either by hand or via extended grease lines. Do not attempt to grease bearings from inside the enclosure while the motor is energized.

2 Weeks after Start-Up

1. Belt tension should be checked after the first two weeks of fan operation. Belts tend to stretch and settle into pulleys after an initial start-up sequence. **Do not tighten the belts by changing the setting of the motor pulley**. This will change the fan speed and may damage the motor.

   To re-tension belts, turn disconnect OFF. Loosen the fasteners that hold the blower scroll plate to the blower. Rotate the motor to the left or right to adjust the belt tension. Belt tension should be adjusted to allow 1/64" of deflection per inch of belt span. Exercise extreme care when adjusting V-belts as not to misalign pulleys. Any misalignment will cause a sharp reduction in belt life and produce squeaky noises. Over-tightening will cause excessive belt and bearing wear as well as noise. Too little tension will cause slippage at startup and uneven wear. **Whenever belts are removed or installed, never force belts over pulleys without loosening motor first to relieve belt tension.** Use the same type belt as originally supplied by the manufacturer when replacements are needed. On units shipped with double groove pulleys, matched belts should always be used.

2. Before restarting a unit after maintenance checks, all fasteners on blower housings, bearings, motors and sheaves should be checked for tightness.

Every 3 months

1. Belt tension should be checked quarterly. See instructions in the previous maintenance section. Over-tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at startup and uneven wear.
2. Filters need to be cleaned and/or replaced quarterly, and more often in severe conditions. Washable filters can be washed in warm soapy water. When re-installing filters, be sure to install with the **airflow in the correct direction** as indicated on the filter.

Yearly

1. Inspect bearings for wear and deterioration. Replace if necessary.
2. Inspect belt wear and replace torn or worn belts.
3. Inspect bolts and set screws for tightness. Tighten as necessary.
4. Inspect motor for cleanliness. Clean exterior surfaces only. Remove dust and grease from the motor housing to ensure proper motor cooling. Remove dirt and grease from the wheel and housing to prevent imbalance and damage.
5. Check for gas leaks and repair if present.
6. Clean flame sensor by rubbing with steel wool to remove any rust build-up,
7. Clean burner with a wire brush and insure burner ports are free of debris. Then wipe the burner with a clean rag.

Burner Orifice Drill Size

Orifice	Drill Size
Gas Port	31
Air Port	43

START-UP CHECKLIST

WARNING!!

-The Start-Up must be completed after all field wiring and air balancing has been completed
-The Start-Up must be completed by a qualified HVAC technician
-The Start-Up Check list must be faxed into the Service Department to validate the product warranty

JOB INFORMATION	
Job Name	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Purchase Date	

TECHNICIAN INFORMATION	
Service Company	
Address	
City	
State	
Zip	
Phone Number	
Fax Number	
Contact	
Start-Up Date	

Refer to the start-up procedure in this manual to complete this section.

Name Plate and Unit Information	
Model Number	
Serial Number	
Motor Volts	
Motor Hertz	
Motor Phase	
Motor FLA	
Motor HP	
Blower Pulley	
Motor Pulley	
Belt Number	
Gas Type	
Min. Btu/Hr	
Max. Btu/Hr	

Field Measured Information		
Motor Voltage		
Motor Amperage*		
Low Speed RPM **		
High Speed RPM		
Low Speed Differential Pressure **		in. w.c.
High Speed Differential Pressure		in. w.c.
Pilot Flame Signal		VDC
Low Fire Flame Signal		VDC
High Fire Flame Signal		VDC
Gas Type	Natural	
	Propane	
High Fire Inlet Gas Pressure		in. w.c.
Low Fire Manifold Gas Pressure		in. w.c.
High Fire Manifold Gas Pressure		in. w.c.
Temperature Control	Discharge	
	Space	
Airflow Direction	Correct	
	Incorrect	

*****If measured amps exceed the FLA rating on the nameplate, fan RPM must be reduced to decrease the measured amps below the nameplate FLA rating.
**Low speed readings used on variable air volume units.

Factory Service Department
Phone: 866-784-6900
Fax: 919-554-9374

COOK

CA/CF/CP

Centrifugal Blowers

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

This publication contains the installation, operation and maintenance instructions for standard units of the CA, CF, and CP Centrifugal Blowers.

- CA / CF SWSI
- CA-4 SWSI
- CPFD
- CAF-DW
- CPA / CPA-A / CPS / CPS-A / CPV
- CA DWDI
- CA-4 DWDI
- CPFB

Carefully read this publication and any supplemental documents prior to any installation or maintenance procedure.

Loren Cook Company's catalog *CA/CF & CP* provides additional information describing the equipment, fan performance, available accessories, and specification data.

For additional safety information, refer to AMCA publication 410-96, *Safety Practices for Users and Installers of Industrial and Commercial Fans*.

All of the publications listed above can be obtained from Loren Cook Company by phoning (417)869-6474, extension 166; by FAX at (417)832-9431; or by e-mail at info@lorencook.com.

For information on special equipment, contact Loren Cook Company Customer Service Department at (417)869-6474.

⚠WARNING

Rotating Parts & Electrical Shock Hazard:
Disconnect electric power before working on unit.

Follow proper lockout / tagout procedures to ensure the unit cannot be energized while being installed or serviced.

A disconnect switch should be placed near the fan in order that the power can be swiftly cut off, in case of an emergency and in order that maintenance personnel are provided complete control of the power source.

Grounding is required. All field-installed wiring must be completed by qualified personnel. All field-installed wiring must comply with National Electric Code (NFPA 70) and all applicable local codes.

Failure to follow these instructions could result in death or serious injury.

Receiving and Inspection

Carefully inspect the fan and accessories for any damage and shortage immediately upon receipt of the fan.

- Turn the wheel by hand to ensure it turns freely and does not bind.
- Inspect dampers (if supplied) for free operation of all moving parts.
- Record on the delivery receipt any visible sign of damage.

Handling

Lift the fan by the base or lifting eyes. **NOTICE! Never lift by the shaft, motor, or housing.**

Storage

If the fan is stored for any length of time prior to installation, completely fill the bearings with grease or moisture-inhibiting oil (refer to Lubricants on page 6). Rotate the wheel several revolutions every three to five days to keep a coating of grease on all internal bearing parts.

Store the fan in its original crate and protect it from dust, debris and the weather.

To maintain good working condition of the fan when it is stored outdoors, follow the additional instructions below.

- Coat the shaft with grease or a rust preventative compound.
- Wrap bearings for weather protection.
- Cover the inlet and outlet to prevent the accumulation of dirt and moisture in the housing.
- Periodically rotate the wheel and operate dampers (if supplied).
- Periodically inspect the unit to prevent damaging conditions.

Installation

Motor Installation

Most motors are shipped mounted on the fans with belts and drives installed. However, extremely heavy motors and drives are shipped separately. These motors and drives will require field installation.

CA SWSI

ATTACHMENT 4

⚠WARNING

The attachment of roof mounted fans to the roof curb as well as the attachment of roof curbs to the building structure must exceed the structural requirements based on the environmental loading derived from the applicable building code for the site. The local code official may require variations from the recognized code based on local data. The licensed engineer of record will be responsible for prescribing the correct attachment based on construction materials, code requirements and environmental effects specific to the installation.

Failure to follow these instructions could result in death or serious injury.

Foundation

This fan requires a strong, level foundation of reinforced poured concrete. A correctly designed concrete foundation provides the best means for mounting floor units. The foundation's size is determined by fan size and arrangement, motor size and position, and the specific location of the installation.

Use the following guidelines to calculate foundation size:

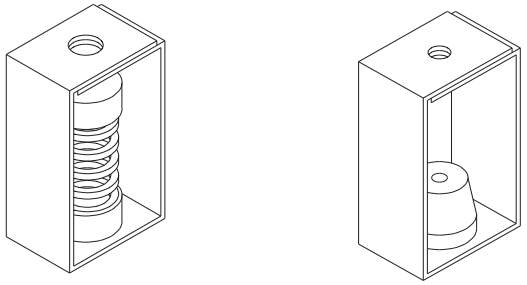
- The overall dimensions of the foundation should extend at least 6 inches beyond the outline of the fan and its motor.
- The weight of the foundation should be 2 to 3 times the weight of the unit and its motor.

Isolation

NOTICE! Although a certain amount of vibration is inherent in operating centrifugal fans, extreme vibration is a serious problem that may cause structural and mechanical failure.

Isolation Base: To prevent vibration and noise from being transferred to the building isolators are recommended. Arrangement 1, 2, & 3 (CA or CF) fans require an isolation base to effectively isolate the fan system which includes the fan, base, motor, drive, guards, etc. Bases must have sufficient rigidity to resist belt pull and prevent drive distortion which can lead to excessive belt and bearing wear; its perimeter should contain all base angles and rotating parts. Arrangement 9 or 10 fans (CA, CF, and CP) above size 270 require isolation rails. Please consult factory for isolation of arrangement 9 fans due to the potential of uneven loading caused by the motors and drives. Isolators should be located between the fan system and the support structure.

Ceiling Mounted Isolators: Some applications require fan systems designed for floor mounting to be suspended from ceiling supports. In such cases, all CA, CF, or CP fans of all arrangements should be installed on either rails or bases in the classical orientation. Typically, these systems are hung from the corners by rods, which include isolation hangers of either spring or rubber-in-shear design. **NOTICE! Under no circumstances is the fan to be inverted and hung by its base angles.**

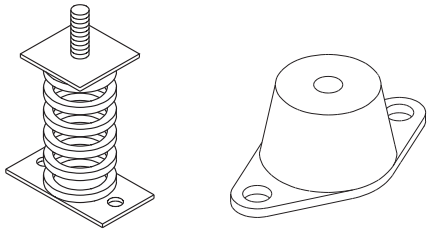


Ceiling Mounted Spring Isolator — Rubber-In-Shear Ceiling Isolators

Figure 1 - Ceiling Mount Isolators

Floor Mounted Spring Isolators

1. Mount fan and motor on isolation base (if supplied).
2. Elevate fan (or isolation base) to operating height and insert blocks to hold in position.
3. Position isolators under the fan and vertically align by inserting leveling bolt through mounting holes in the fan or the base. The isolator must be installed on a level surface.
4. Adjust the isolators by turning the leveling nut counter clockwise several turns at a time alternately on each isolator until the fan weight is transferred onto the isolators and the fan raises uniformly off the blocks. Then remove the blocks.
5. Turn lock nut onto leveling bolt and secure firmly in place against the top of the mounting flange or frame.
6. Secure isolators to mounting surface.



Spring Isolator — Rubber-In-Shear Isolator

Figure 2 -Floor Mount Isolators

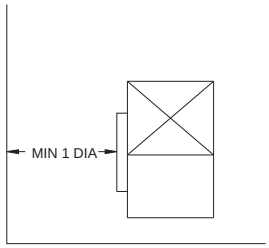
Floor Mounted Rubber-In-Shear (RIS) Isolators

1. Mount fan and motor on an isolation base (if supplied).
2. Elevate fan to provide room to insert isolators between the base and foundation and block in position.
3. Position isolators under fan and secure bolts.
4. Remove blocks and allow fan to rest on floor. Isolators must be installed on a level surface (leveling should not be required).
5. Secure isolators to mounting surface.

Duct Installation

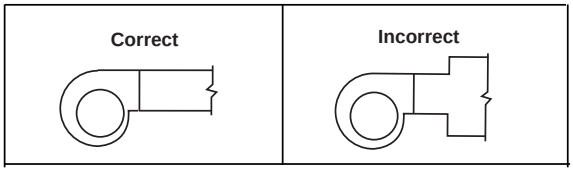
Efficient fan performance relies on the proper installation of inlet and discharge ducts. Be sure your fan conforms to the following guidelines.

Non-Ducted Inlet Clearance: If your fan has an open inlet (no duct work), the fan must be placed 1 fan wheel diameter away from walls and bulkheads.



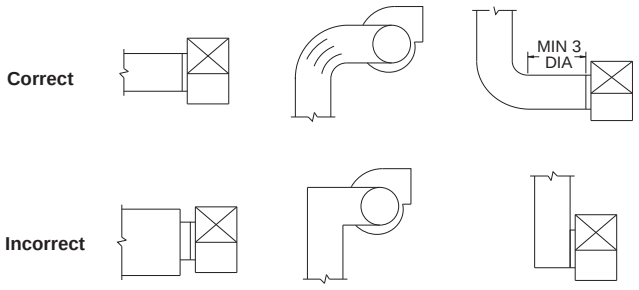
Non-ducted Inlet Clearance

Free Discharge: Avoid a free discharge into the plenum. This will result in lost efficiency because it doesn't allow for a static regain.



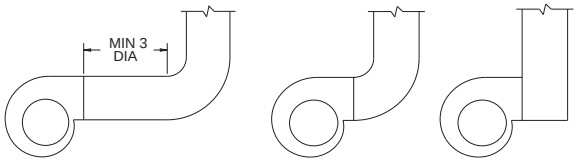
Free Discharge

Inlet Duct Turns: For ducted inlets, allow at least 3 fan wheel diameters between duct turns or elbows and the fan inlet.



Inlet Duct Turns

Discharge Duct Turns: Where possible, allow 3 duct diameters between duct turns or elbows and the fan outlet. Refer to figure above.

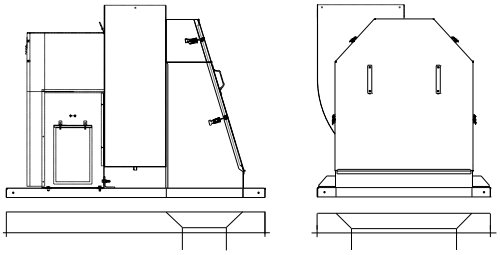


Discharge Duct Turns

CP with Optional Curb Cap & Inlet Box

UL 762 / NFPA96 and local codes may dictate additional or modifications to this installation.

The installation diagram below has a solid curb cap duct adapter placed over the top of the curb. The welded grease duct with recommended transition is either welded or sealed with UL recognized fire caulk to both the curb cap duct adapter and the bottom of the fan. A minimum of two separate outlines of caulk is recommended at the outer portion of the curb cap duct adapter.



Wheel-to-Inlet Clearance

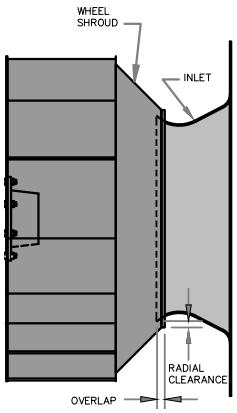
The correct wheel-to-inlet clearance is critical to proper fan performance. This clearance should be verified before initial start-up since rough handling during shipment could cause a shift in fan components. Refer to wheel/inlet drawing for correct overlap.

Adjust the overlap by loosening the wheel hub and moving the wheel along the shaft to obtain the correct value.

A uniform radial gap (space between the edge of the cone and the edge of the inlet) is obtained by loosening the inlet cone bolts and repositioning the inlet cone.

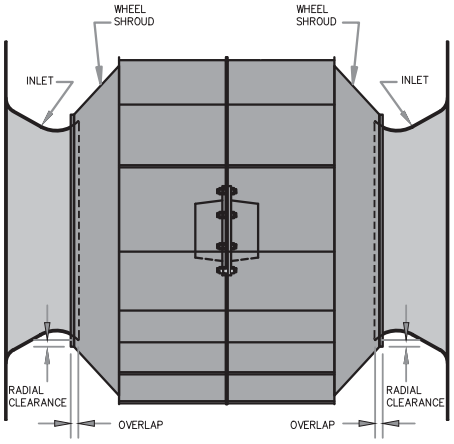
CA, CF, & CP

Size	Overlap
60 - 165	3/16”
180 - 245	1/4”
270 - 300	5/16”
330 - 365	3/8”
402	7/16”
445 - 490	1/2”
540 - 730	13/16”



CAF-DW

Size	Overlap
120	1/8”
135 - 165	5/32”
180	1/4”
195	5/32”
210	1/4”
225	5/32”
245	9/32”
270 - 445	1/4”
490	17/32”
540 - 600	27/32”
660 - 730	25/32”



Wiring Installation

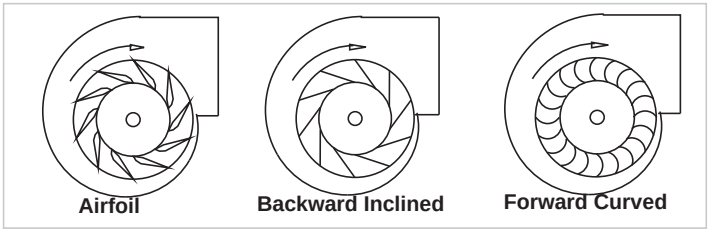
NOTICE! All wiring should be in accordance with local ordinances and the National Electrical Code, NFPA 70. Ensure the power supply (voltage, frequency, and current carrying capacity of wires) is in accordance with the motor nameplate.

(See page 5 for diagram)

Leave enough slack in the wiring to allow for motor movement when adjusting belt tension. Some fractional motors have to be removed in order to make the connection with the terminal box at the end of the motor. To remove motor, remove bolts securing motor base to power assembly. Do not remove motor mounting bolts.

Units with Arrangement 10 have a hole provided at the base of the bearing pedestal to accommodate wiring.

Follow the wiring diagram in the disconnect switch and the wiring diagram provided with the motor. Correctly label the circuit on the main power box and always identify a closed switch to promote safety (i.e., red tape over a closed switch).



Wheel Rotation

Test the fan to ensure the rotation of the wheel is the same as indicated by the arrow marked Rotation.

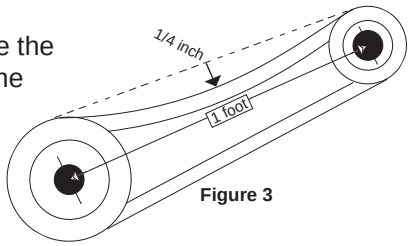


Figure 3

For 115 and 230 Single Phase Motors: Fan wheel rotation is set correctly at the factory. Changing the rotation of this type of motor should only be attempted by a qualified electrician.

For 208, 230, and 460, 3 Phase Motors: These motors are electrically reversible by switching two of the supply leads. For this reason, the rotation of the fan cannot be restricted to one direction at the factory. See Wiring Diagrams above for specific information on reversing wheel direction.

NOTICE! Do not allow the fan to run in the wrong direction. This will overheat the motor and cause serious damage. For 3-phase motors, if the fan is running in the wrong direction, check the control switch. It is possible to interchange two leads at this location so that the fan is operating in the correct direction.

Belt and Pulley Installation

Belt tension is determined by the sound the belts make when the fan is first started. Belts will produce a loud squeal which dissipates after the fan is operating at full capacity. If the belt tension is too tight or too loose, lost efficiency and possible damage can occur.

Do not change the pulley pitch diameter to change tension. This will result in a different fan speed than desired.

1. Loosen motor plate adjustment nuts on L-bolts and move motor plate in order that the belts can easily slip into the grooves on the pulleys. Never pry, roll, or force the belts over the rim of the pulley.
2. Slide the motor plate back until proper tension is reached. For proper tension a deflection of approximately 1/4" per foot of center distance should be obtained by firmly pressing the belt. Refer to *Figure 3*.
3. Lock the motor plate adjustment nuts in place.
4. Ensure pulleys are properly aligned. Refer to *Figure 4*.

Tolerance	
Center Distance	Maximum Gap
Up thru 12"	1/16"
12" up through 48	1/8"
Over 48"	1/4"

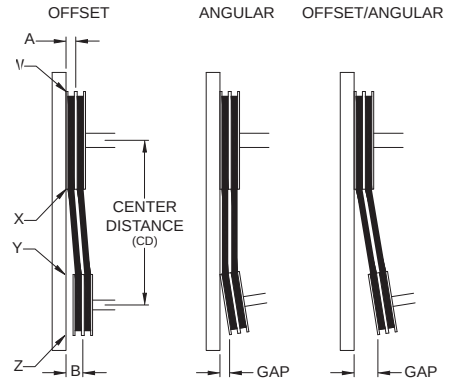


Figure 4

Pulley Alignment

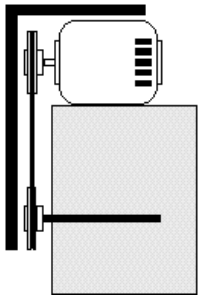


Figure 5

Pulley alignment is adjusted by loosening the motor pulley setscrew and by moving the motor pulley on the motor shaft.

Figure 4 indicates where to measure the allowable gap for the drive alignment tolerance. All contact points (indicated by WXYZ) are to have a gap less than the tolerance shown in the table. When the pulleys are not the same width, the allowable gap must be adjusted by half of the difference in width (As shown in A & B of Figure 4). *Figure 5* illustrates using a carpenter's square to adjust the position of the motor pulley until the belt is parallel to the longer leg of the square.

Final Installation Steps

1. Inspect fasteners and setscrews, particularly fan mounting and bearing fasteners, and tighten according to the recommended torque shown in the following table.
2. Inspect for correct voltage with voltmeter.
3. Ensure all accessories are installed.

Recommended Torque for Setscrews & Hold Down Bolts

Setscrews				Hold Down Bolts	
Size	Key Hex Across Flats	Recommended Torque (inch/lbs)		Size	Wrench Torque (inch/lbs)
		Min.	Max.		
No.10	3/32"	28	33	3/8"-16	240
1/4"	1/8"	66	80	1/2"-13	600
5/16"	5/32"	126	156	5/8"-11	1200
3/8"	3/16"	228	275	3/4"-10	2100
7/16"	7/32"	348	384	7/8"- 9	2040
1/2"	1/4"	504	600	1"- 8	3000
5/8"	5/16"	1104	1200	1-1/8" - 7	4200
3/4"	3/8"	1440	1800	1-1/4" - 7	6000

Operation

Pre-Start Checks

1. Lock out all the primary and secondary power sources.
2. Ensure fasteners and setscrews, particularly those used for mounting the fan, are tightened.
3. Inspect belt tension and pulley alignment.
4. Inspect motor wiring.
5. Ensure belt touches only the pulleys.
6. Ensure fan and ductwork are clean and free of debris.
7. Inspect wheel-to-inlet clearance. The correct wheel-to-inlet clearance is critical to proper fan performance.
8. Close and secure all access doors.
9. Restore power to the fan.

Start Up

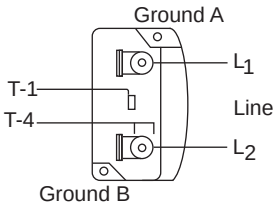
Turn the fan on. In variable speed units, set the fan to its lowest speed and inspect for the following:

- Direction of rotation.
- Excessive vibration.
- Unusual noise.
- Bearing noise.
- Improper belt alignment or tension (listen for squealing).
- Improper motor amperage or voltage.

NOTICE! If a problem is discovered, immediately shut the fan off. Lock out all electrical power and check for the cause of the trouble. See Troubleshooting.

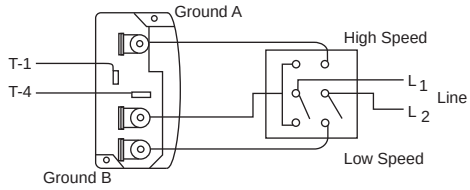
Wiring Diagrams

Single Speed, Single Phase Motor



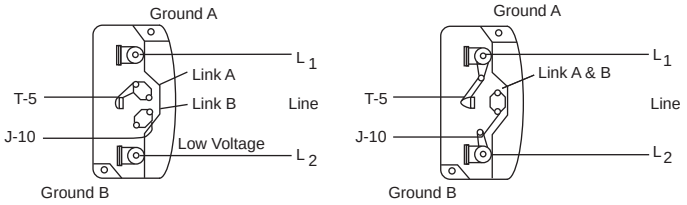
When ground is required, attach to ground A or B with no. 6 thread forming screw. To reverse, interchange T-1 and T-4.

2 Speed, 2 Winding, Single Phase Motor



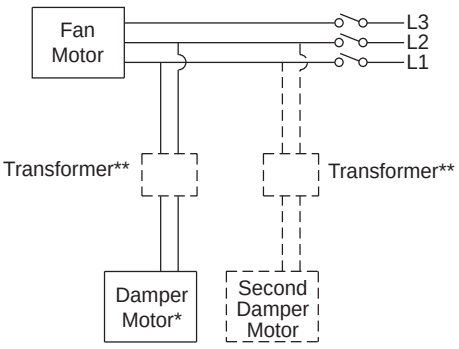
When ground required, attach to ground A or B with No. 6 thread forming screw. To reverse, interchange T-1 and T-4 leads.

Single Speed, Single Phase, Dual Voltage



When ground required, attach to ground A or B with No. 6 thread forming screw. To reverse, interchange T-5 and J-10 leads.

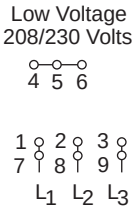
Typical Damper Motor Schematic



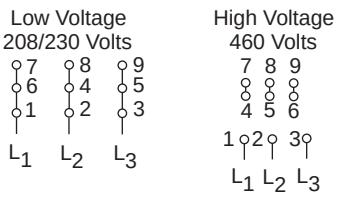
For 3 phase, damper motor voltage should be the same between L_1 and L_2. For single phase application, disregard L_3. *Damper motors may be available in 115, 230 and 460 volt models. The damper motor nameplate voltage should be verified prior to connection. ** A transformer may be provided in some installations to correct the damper motor voltage to the specified voltage.

Wiring Diagrams

3 Phase, 9 Lead Motor Y-Connection

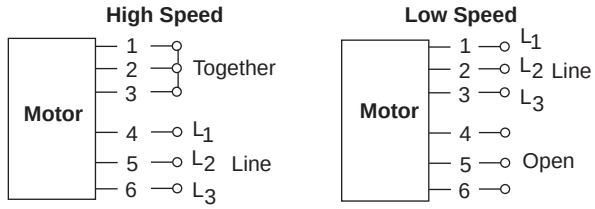


3 Phase, 9 Lead Motor Delta-Connection



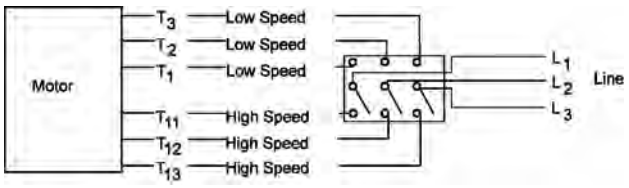
To reverse, interchange any 2 line leads.

2 Speed, 1 Winding, 3 Phase Motor



To reverse, interchange any 2 line leads. Motors require magnetic control.

2 Speed, 2 Winding, 3 Phase



To reverse: High Speed-interchange leads T_{11} and T_{12}.
Low Speed-interchange leads T_1 and T_2. Both Speeds-interchange any 2 line leads.

Use of Variable Frequency Drives

Motors

Motors that are to be operated using a Variable Frequency Drive (VFD) must be VFD compatible. At a minimum, this must be a Premium Efficiency motor with Class F insulation. Motors that are not supplied by Loren Cook Company should have the recommendation of the motor manufacturer for use with a VFD.

Grounding

The fan frame, motor and VFD must be connected to a common earth ground to prevent transient voltages from damaging rotating elements.

Wiring

Line reactors may be required to reduce over-voltage spikes in the motors. The motor manufacturer should be consulted for recommended line impedence and usage of line reactors or filters, if the lead length between the VFD and the motor exceeds 10 feet (3m).

Fan

It is the responsibility of the installing body to perform coast-down tests and identify any resonant frequencies after the equipment is fully installed. These resonant frequencies are to be removed from the operating range of the fan by using the “skip frequency” function in the VFD programming. Failure to remove resonant frequencies from the operating range will decrease the operating life of the fan and void the warranty.

Inspection

Inspection of the fan should be conducted at the first 30 minute, 8 hour and 24 hour intervals of satisfactory operation. During the inspections, stop the fan and inspect as per the Conditions Chart.

30 Minute Interval

Inspect bolts, setscrews, and motor mounting bolts. Adjust and tighten as necessary.

8 Hour Interval

Inspect belt alignment and tension. Adjust and tighten as necessary.

24 Hour Interval

Inspect belt tension, bolts, setscrews, and motor mounting bolts. Adjust and tighten as necessary.

Maintenance

Establish a schedule for inspecting all parts of the fan. The frequency of inspection depends on the operating conditions and location of the fan.

Inspect fans exhausting corrosive or contaminated air within the first month of operation. Fans exhausting contaminated air (airborne abrasives) should be inspected every three months.

Regular inspections are recommended for fans exhausting non-contaminated air.

It is recommended the following inspection be conducted twice per year.

- Inspect bolts and setscrews for tightness. Tighten as necessary. Worn setscrews should be replaced immediately.
- Inspect belt wear and alignment. Replace worn belts with new belts and adjust alignment as needed. See the Belt and Pulley Installation.
- Bearings should be inspected as recommended in the Lubrication Conditions Chart.• Inspect variable inlet vanes for freedom of operation and excessive wear. The vane position should agree with the position of the control arm. As the variable inlet vanes close, the entering air should spin in the same direction as the wheel.
- Inspect springs and rubber isolators for deterioration and replace as needed.
- Inspect for cleanliness. Clean exterior surfaces only. Removing dust and grease on motor housing assures proper motor cooling. Removing dirt from the wheel and housing prevent imbalance and damage.

Lubrication - Fan Bearings

Greasable fan bearings are lubricated through a grease fitting on the bearing.

Lubrication Conditions Chart

Fan Class	Fan Status	Shaft Size	Maximum Interval (operational hrs)
Centrifugal Blower Class I	Normal Conditions (Clean, Dry & Smooth)	> 1-1/2”	10,000
		< 1-1/2”	2,000
	Extreme Conditions (Dirty/Wet/Rough)	> 1-1/2”	2,000
		< 1-1/2”	400
Centrifugal Blower Class II	Normal Conditions (Clean, Dry & Smooth)	> 2”	7,500
		< 2”	1,000
	Extreme Conditions (Dirty/Wet/Rough)	> 2”	1,500
		< 2”	200
Centrifugal Blower Class III	Normal Conditions (Clean, Dry & Smooth)	> 2”	3,000
		< 2”	500
	Extreme Conditions (Dirty/Wet/Rough)	> 2”	500
		< 2”	100

Exceptions to the greasing interval chart:

1. Periodic Applications (any break of one week or more): it is recommended that full lubrication be performed prior to each break in operation.
2. Higher Temperature: it is recommended to halve the intervals for every 30°F increase in operating temperature above 120°F not to exceed 230°F for standard bearings; High Temperature bearings (optional) can operate up to 400°F.
3. Vertical Shaft: it is recommended that the intervals should be halved.

For best results, lubricate the bearing while the fan is in operation. Pump grease in slowly until a slight bead forms around the bearing seals. Excessive grease can burst seals thus reducing bearing life.

Before lubricating, the grease nipple and immediate vicinity should be thoroughly cleaned without the use of high pressure equipment. The grease should be supplied slowly as the bearing rotates until fresh grease slips past the seal. Excessive pressure should be avoided to prevent seal damage.

In the event the bearing cannot be seen, use no more than three injections with a hand-operated grease gun.

NOTICE! Loren Cook Company uses petroleum lubricant in a lithium base. Other types of grease should not be used unless the bearings and lines have been flushed clean. If another type of grease is used, it should be a lithium-based grease conforming to NLGI grade 2 consistency. A NLGI grade 2 grease is a light viscosity, low-torque, rust-inhibiting lubricant that is water resistant. Its temperature range is from -30°F to

+200°F and capable of intermittent highs of +250°F. For temperatures above 250°F Mobiltemp SHC 32 is recommended.

Lubrication - Motor Bearings

Motors are provided with prelubricated bearings. Any lubrication instructions shown on the motor nameplate supersede instructions below.

Motor bearings without provisions for relubrication will operate up to 10 years under normal conditions with no maintenance. In severe applications, high temperatures or excessive contaminates, it is advisable to have the maintenance department disassemble and lubricate the bearings after 3 years of operation to prevent interruption of service.

For motors with provisions for relubrication, follow intervals of the following table.

Relubrication Intervals

Service Conditions	NEMA Frame Size					
	Up to and including 184T		213T-365T		404T and larger	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 months

Motors are provided with a polyurea mineral oil NGLI #2 grease. All additions to the motor bearings are to be with a compatable grease such as Exxon Mobil Polyrex EM and Chevron SRI.

The above intervals should be reduced to half for vertical shaft installations.

Motor Services

Should the motor prove defective within a one-year period, contact your local Loren Cook representative or your nearest authorized electric motor service representative.

Changing Shaft Speed

All belt driven fans with motors up to and including 5 HP (184T max.) are equipped with variable pitch pulleys. To change the fan speed, perform the following:

1. Loosen setscrew on driver (motor) pulley and remove key, if equipped.
2. Turn the pulley rim to open or close the groove facing. If the pulley has multiple grooves, all must be adjusted to the same width.
3. After adjustment, inspect for proper belt tension.

Speed Reduction: Open the pulley in order that the belt rides deeper in the groove (smaller pitch diameter).

Speed Increase: Close the pulley in order that the belt rides higher in the groove (larger pitch diameter). Ensure that the RPM limits of the fan and the horsepower limits of the motor are maintained.

Maximum RPM

CA SWSI, CPS-A, CPA-A, Size	Maximum RPM		
	Class I	Class II	Class III
120	3348	4368	5503
135	2976	3883	4892
150	2678	3494	4403
165	2435	3177	4002
180	2114	2757	3474
195	1951	2545	3207
210	1812	2363	2978
225	1691	2206	2779
245	1553	2026	2553
270	1419	1851	2332
300	1277	1666	2099
330	1161	1514	1908
365	1064	1388	1749
402	965	1259	1586
445	873	1138	1434
490	793	1034	1303
540	719	938	1182
600	647	844	1064
660	588	768	967
730	532	694	874

CA & CAF DWDI Size	Maximum RPM		
	Class I	Class II	Class III
120	3714	4846	6105
135	3307	4315	5436
150	2575	3357	4230
165	2374	3095	3901
180	2176	2839	3577
195	2009	2621	3302
210	1865	2434	3066
225	1741	2271	2862
245	1631	2128	2681
270	1443	1883	2372
300	1262	1647	2074
330	1147	1496	1885
365	1038	1354	1706
402	941	1228	1547
445	851	1110	1399
490	773	1009	1271
540	702	916	1164
600	631	823	1037
660	574	749	944
730	519	677	853

CF SWSI, CPS, CPA, Size	Maximum RPM		
	Class I	Class II	Class III
60-100*	4230	5519	6953
120	3404	4441	5595
135	3026	3948	4974
150	2723	3553	4476
165	2476	3230	4069
180	2269	2961	3730
195	2095	2733	3443
210	1795	2341	2950
225	1675	2185	2753
245	1539	2007	2529
300	1257	1639	2065
330	1142	1490	1877
365	1023	1334	1681
402	939	1225	1543
445	849	1108	1396
490	771	1006	1268
540	700	913	1150
600	630	822	1035
660	573	747	941
730	518	675	851

*Sizes 60 through 100 only applies to CPS and CPA.

CPV Size	Maximum RPM	
	Standard	Reinforced
60-100	2719	--
120	2527	
135	2093	
150	2035	
165	1766	
180	1588	
195	1429	1571
210	1277	1407
225	1152	1265
245	1015	1260
270	876	1091
300	837	1006
330	716	869
365	624	805
402	539	701
445	463	660
490	360	576

RPM Derating Factor

Temperature (°F)	RPM Factor	
	Steel	Aluminum
70	1.00	1.00
200	0.98	0.93
300	0.96	0.79
400	0.94	-
500	0.91	
600	0.87	
700	0.81	
800	0.75	

For elevated airstream temperatures, the maximum fan speed limits must be derated by the factors above.

Pulley and Belt Replacement

1. Remove pulleys from their respective shafts.
2. Clean the motor and fan shafts.
3. Clean bores of pulleys and coat the bores with heavy oil.
4. Remove grease, rust, or burrs from the pulleys and shafts.
5. Remove burrs from shaft by sanding.
6. Place fan pulley on fan shaft and motor pulley on its shaft. Damage to the pulleys can occur when excessive force is used in placing the pulleys on their respective shafts.
7. Tighten in place.
8. Install belts on pulleys and align as described in the Belt and Pulley Installation section.

Bearing Replacement

The fan bearings are pillow block ball bearings. An emery cloth or file may be needed to remove imperfections in the shaft left by the setscrews.

For Arrangement 1,2, 9 and 10:

1. Mark the position on the shaft of both bearing races, setscrews, and the wheel and pulley. Mark the location and orientation of the inlet cone. Note the clearance between the wheel and inlet cone.
2. Remove the fan pulley.
3. Remove the inlet cone.d. Remove the wheel from the shaft. A 2-jaw puller may be needed.
4. Remove bearing hold-down bolts. Remove shaft and bearings as one unit.
5. Remove the anti-corrosion coating from the shaft with a suitable degreaser.
6. Remove the bearing from the shaft using a bearing puller. If a bearing puller is not available, tap on the bearing with a wood block and hammer to remove it.
7. Smooth and clean the shaft and bearing bore thoroughly.
8. Place the bearings into position making sure they are not on a worn section of the shaft. Tapping the inner ring face with a soft driver may be required. **NOTICE! Do not hammer on the housing.**
9. The outer ring of the bearing is spherical and swivels in the housing to compensate for misalignment. Secure hold-down bolts, but do not fully tighten.
10. Align the setscrews on the bearings and tighten one setscrew on each bearing.
11. Rotate the shaft to allow the bearing outer rings to find their center of free movement.
12. Install the wheel on the shaft. Install the inlet cone in its original location. And adjust bearing position and inlet cone to center the wheel in the inlet cone.
13. Tighten hold-down bolts to proper torque.
14. Turn the shaft by hand. Resistance should be the same as it was before hold-down bolts were fully tightened.
15. Tighten bearing setscrews to specified torque. Refer to the Torque chart.
16. Re-install the pulley and adjust the belt tension.
17. Test run and retighten all setscrews and bolts; trim balance as necessary (.0785 in/sec max.).

After 24 hours of operation, retighten the setscrews to the appropriate torque. This assures full locking of the inner race to the shaft. Make sure the socket key or driver is in good condition with no rounded corners. The key should be fully engaged in the setscrew and held squarely to prevent rounding out of the setscrew socket when applying maximum torque.

For Arrangement 3: Bearings should be replaced individually for each side of fan.

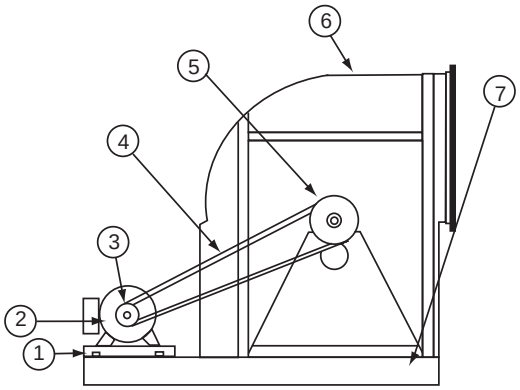
1. Loosen and remove belts.
2. If replacing drive side bearing, mark location of pulley and then remove.
3. Mark bearing location on bearing support and loosen bearing hold down bolts.
4. Support shaft to remove weight from bearing.
5. Remove anti-corrosion coating from the shaft with a suitable de-greaser.
6. Remove bearing from the shaft using a bearing puller. If a bearing puller is not available, tap on the bearing with a wood block and hammer to remove it.
7. Smooth and clean the shaft and bearing bore thoroughly.
8. Place the bearing into position making sure it is not on a worn section of the shaft. Tapping the inner ring face with a soft driver may be required. Do not hammer on the housing.
9. The outer ring of the bearing is spherical and swivels in the housing to compensate for misalignment. Secure hold-down bolts, but do not fully tighten.
10. Align setscrews on the bearings and tighten one setscrew on bearing.
11. Rotate the shaft to allow the bearing outer ring to find its center of free movement.
12. Tighten hold-down bolts to proper torque. Refer to Torque chart.
13. Turn the shaft by hand. Resistance should be the same as it was before hold-down bolts were fully tightened.
14. Tighten bearing setscrews to specified torque.
15. Re-install the pulley if required.
16. Repeat process for opposite bearing.
17. Adjust the belt tension.
18. Test run and retighten all setscrews and bolts; trim balance as necessary (.0785 in/sec max.).

After 24 hours of operation, retighten the setscrews to the appropriate torque. This assures full locking of the inner race to the shaft. Make sure the socket key or driver is in good condition with no rounded corners. The key should be fully engaged in the setscrew and held squarely to prevent rounding out of the setscrew socket when applying maximum torque.

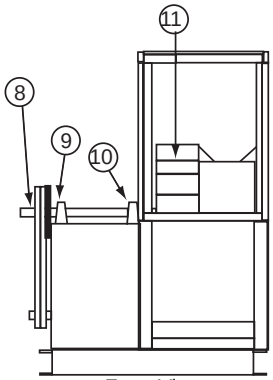
Troubleshooting

Problem and Potential Cause
Low Capacity or Pressure: • Incorrect direction of rotation. Make sure the fan rotates in same direction as the arrows on the motor or belt drive assembly. • Poor fan inlet conditions. There should be a straight clear duct at the inlet. • Improper wheel alignment.
Excessive Vibration and Noise: • Damaged or unbalanced wheel. • Belts too loose; worn or oily belts. • Speed too high. • Incorrect direction of rotation. Make sure the fan rotates in same direction as the arrows on the motor or belt drive assembly. • Bearings need lubrication or replacement. • Fan surge or incorrect inlet or outlet condition.
Overheated Motor: • Motor improperly wired. • Incorrect direction of rotation. Make sure the fan rotates in same direction as the arrows on the motor or belt drive assembly. • Cooling air diverted or blocked. • Improper inlet clearance. • Incorrect fan RPMs. •Incorrect voltage.
Overheated Bearings: • Improper bearing lubrication • Excessive belt tension.

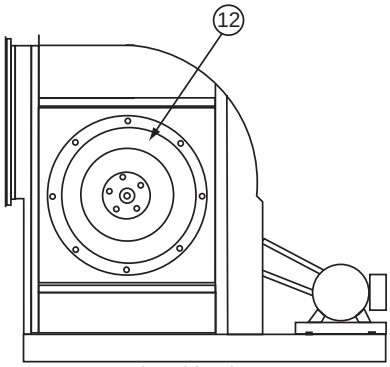
CA/CF SWSI Arrangement 1 Parts List



Drive Side View



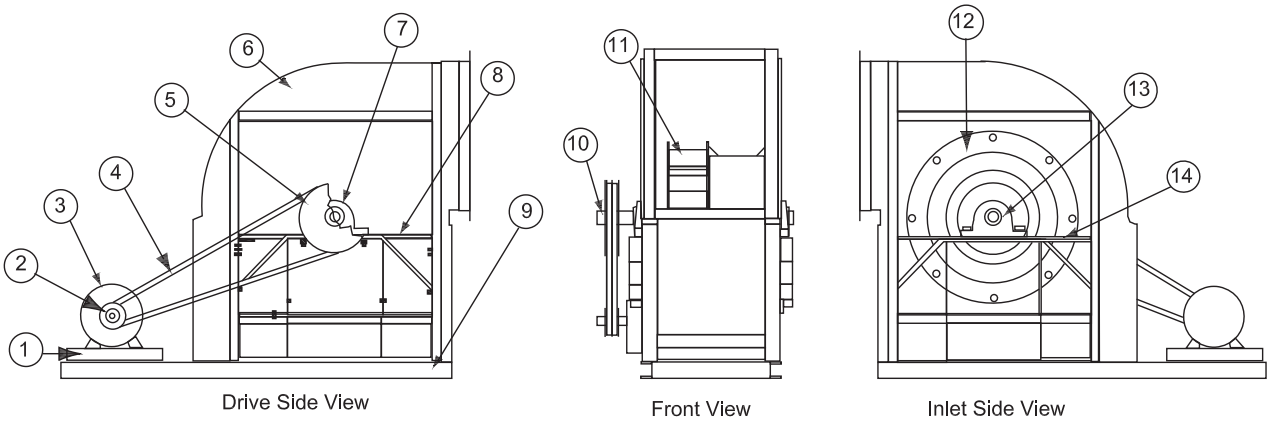
Front View



Inlet Side View

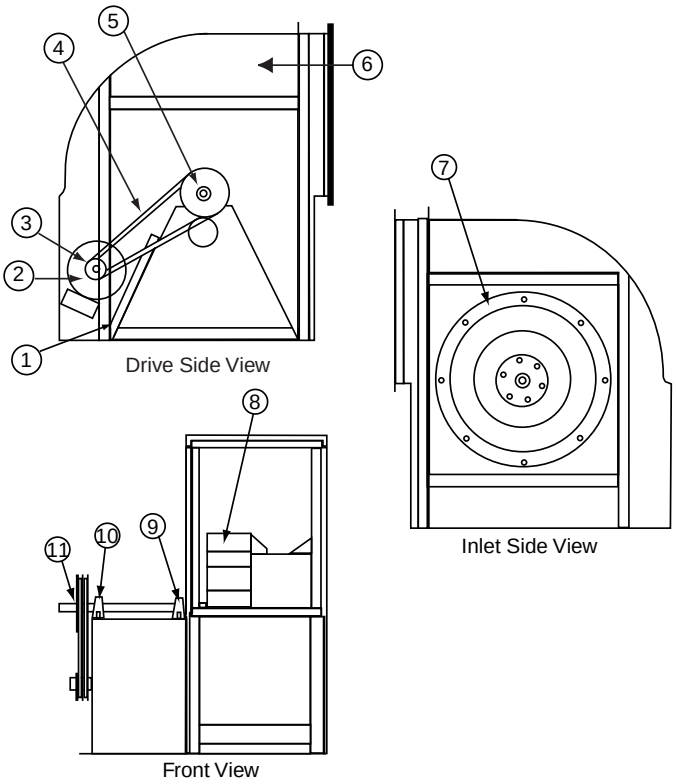
Part No.	Description Sizes 120 - 730
1	Motor Slide Base
2	Motor
3	Motor Sheave
4	Belt Set
5	Fan Sheave
6	Housing
7	Isolation Base (optional)
8	Shaft
9	Outboard Bearing
10	Inboard Bearing
11	Wheel
12	Inlet Cone

CA/CF SWSI Arrangement 3 Parts List



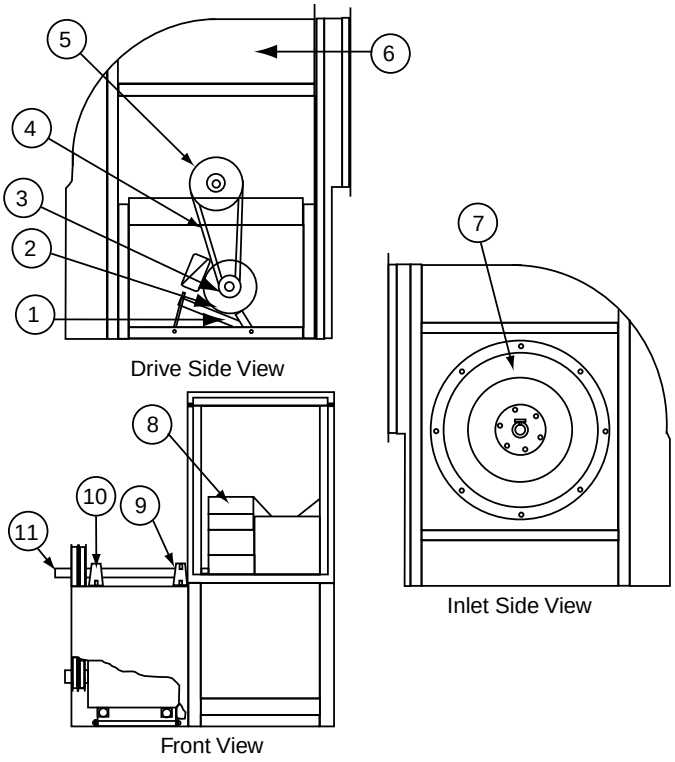
Part No.	Description Sizes 120 - 730
1	Motor Slide Base
2	Motor Sheave
3	Motor
4	Belt Set
5	Fan Sheave
6	Housing
7	Drive Side Bearing
8	Drive Side Bearing Support
9	Isolation Base (optional)
10	Shaft
11	Wheel
12	Inlet Cone
13	Free Side Bearing
14	Free Side Bearing Support

CA/CF SWSI Arrangement 9 Parts List



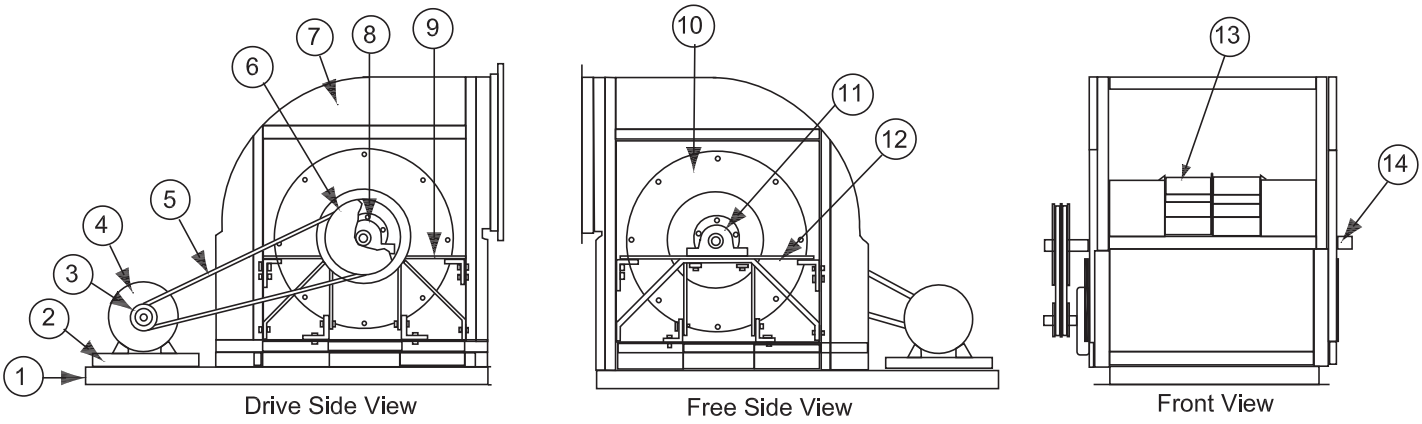
Part No.	Description Sizes 120 - 730
1	Motor Slide Base
2	Motor
3	Motor Sheave
4	Belt Set
5	Fan Sheave
6	Housing
7	Inlet Cone
8	Wheel
9	Inboard Bearing
10	Outboard Bearing
11	Shaft

CA/CF SWSI Arrangement 10 Parts List



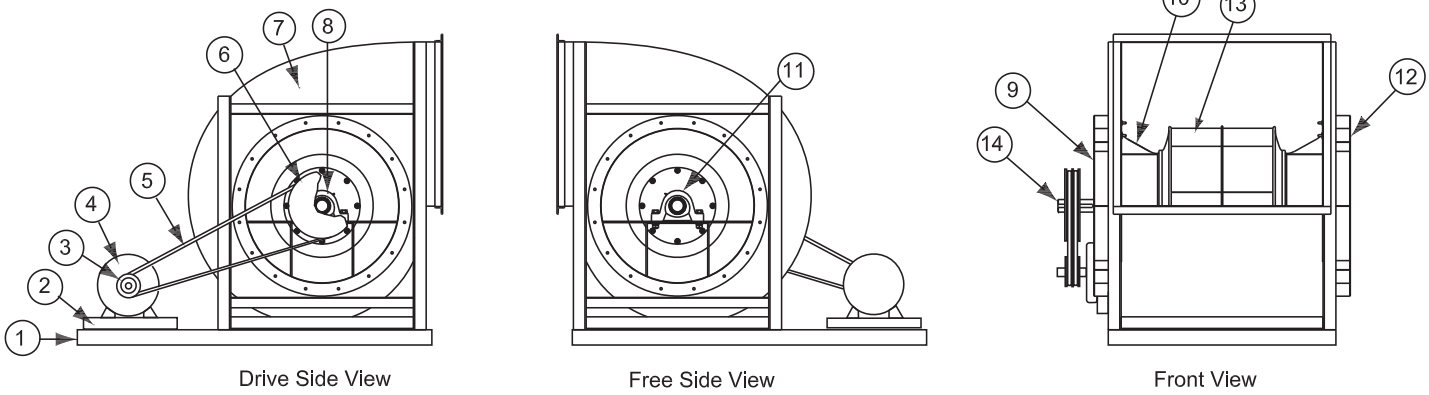
Part No.	Description Sizes 120 - 730
1	Motor Base
2	Motor
3	Motor Sheave
4	Belt Set
5	Fan Sheave
6	Housing
7	Inlet Cone
8	Wheel
9	Inboard Bearing
10	Outboard Bearing
11	Shaft

CA DWDI Parts List



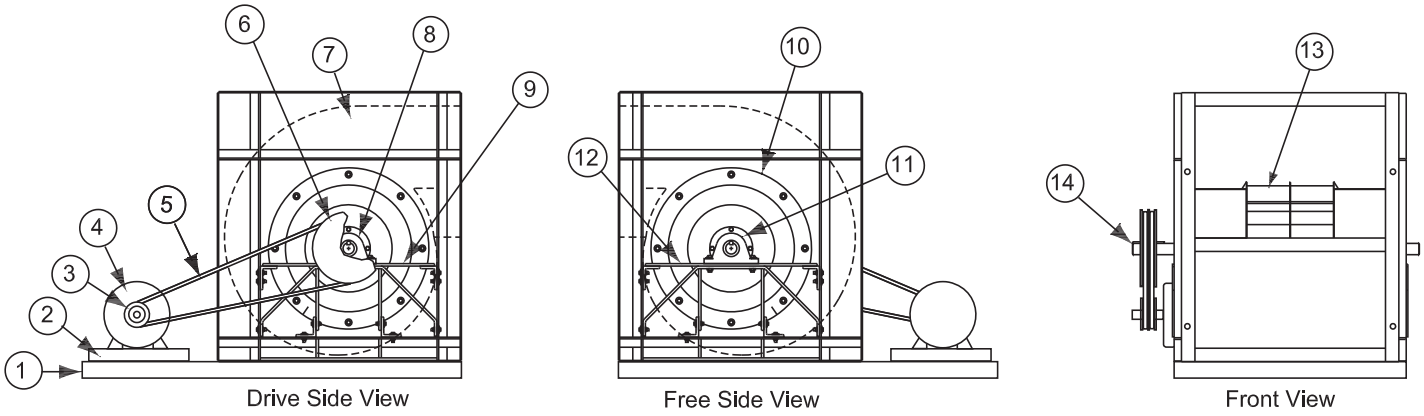
Part No.	Description Sizes 120 - 730
1	Isolation Base (optional)
2	Motor Slide Base
3	Motor Sheave
4	Motor
5	Belt Set
6	Fan Sheave
7	Housing
8	Drive Side Bearing
9	Drive Side Bearing Support
10	Inlet Cone (2)
11	Free Side Bearing
12	Free Side Bearing Support
13	Wheel Assembly
14	Shaft

CAF-DW Parts List



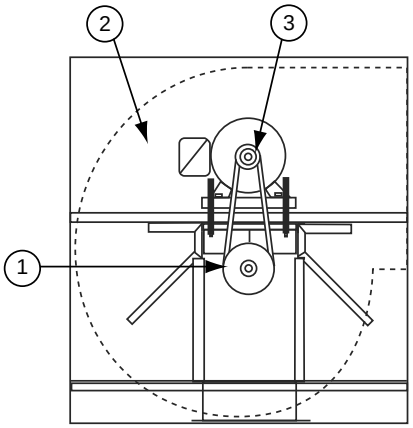
Part No.	Description
	Sizes 120 - 730
1	Isolation Base (optional)
2	Motor Slide Base
3	Motor Sheave
4	Motor
5	Belt Set
6	Fan Sheave
7	Housing
8	Drive Side Bearing
9	Drive Side Bearing Support
10	Inlet Cone (2)
11	Free Side Bearing
12	Free Side Bearing Support
13	Wheel Assembly
14	Shaft

CA-4 DWDI Parts List

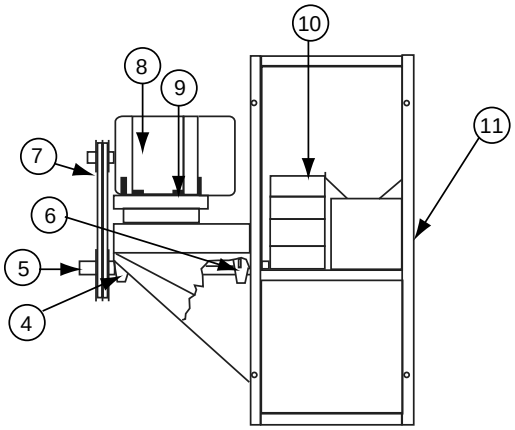


Part No.	Description
	Sizes 120 - 730
1	Isolation Base (optional)
2	Motor Slide Base
3	Motor Sheave
4	Motor
5	Belt Set
6	Fan Sheave
7	Housing
8	Drive Side Bearing
9	Drive Side Bearing Support
10	Inlet Cone (2)
11	Free Side Bearing
12	Free Side Bearing Support
13	Wheel Assembly
14	Shaft

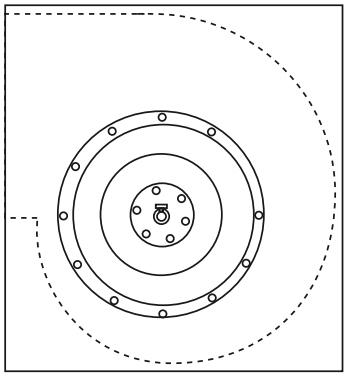
CA-4 SWSI/CF-4 SWSI Parts List



Drive Side View

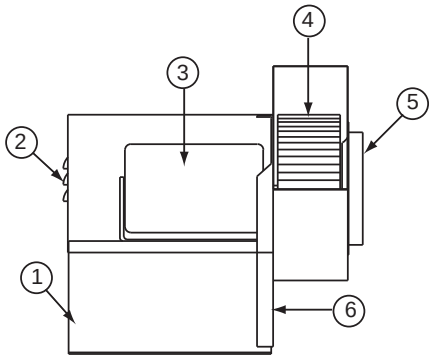


Front View

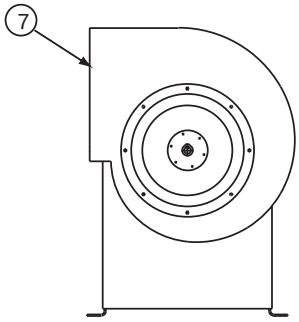

Inlet Side View

Part No.	Description
	Sizes 120 - 600
1	Fan Sheave
2	Housing
3	Motor Sheave
4	Outboard Bearing
5	Shaft
6	Inboard Bearing
7	Belt Set
8	Motor
9	Motor Base
10	Wheel
11	Inlet Cone

CPFD Parts List



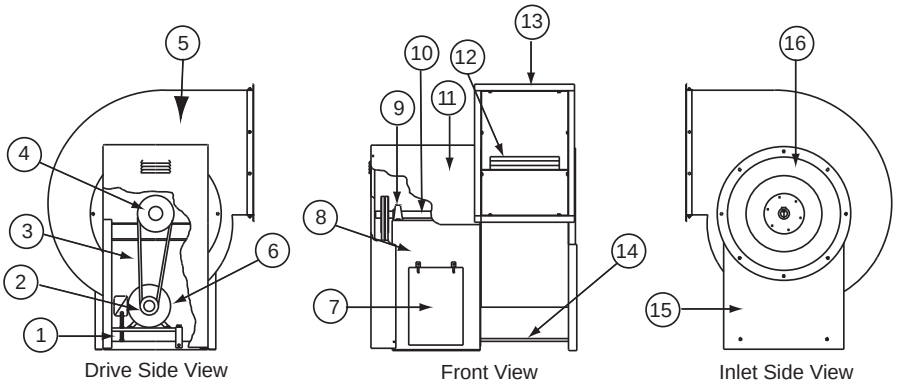
Front View



Inlet Side View

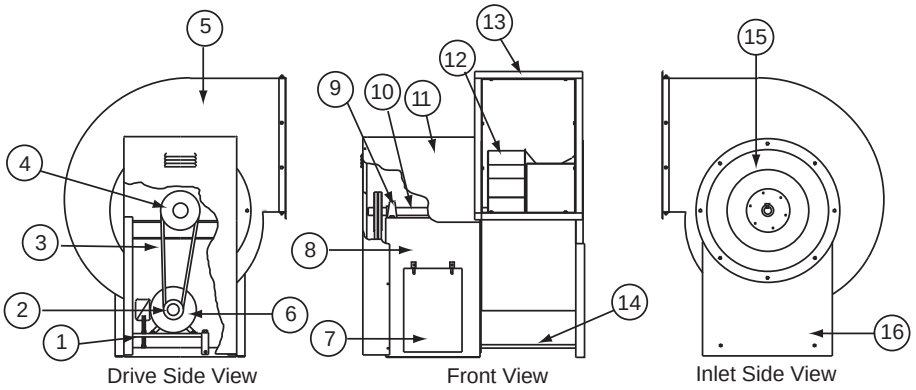
Part No.	Description
	Sizes 6 - 10
1	Motor Base
2	Weather Cover (Optional)
3	Motor
4	Wheel
5	Inlet Cone
6	Blower Mounting Plate
7	Scroll

CPFB Parts List



Part No.	Description
	Sizes 100 - 300
1	Motor Mount
2	Motor Sheave
3	Belt Set
4	Fan Sheave
5	Housing
6	Motor
7	Optional Side Cover (2)
8	Pedestal
9	Bearings (2)
10	Shaft
11	Optional Weather Cover
12	Wheel Assembly
13	Discharge Flange
14	Spreader Bar (2)
15	Inlet Side Support
16	Inlet Cone

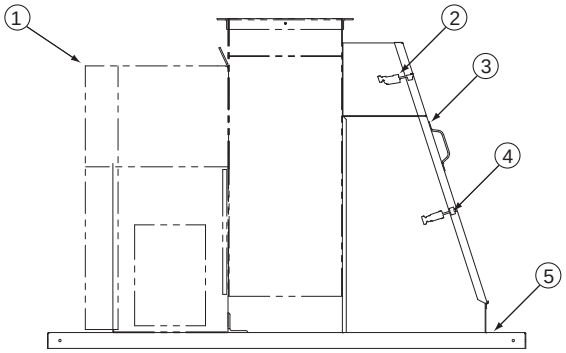
CPA/CPA-A/CPS/CPS-A/CPV Parts List



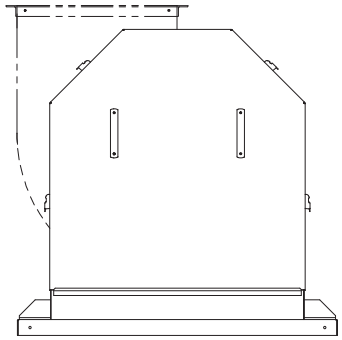
Part No.	Description				
	CPA Size 60-490	CPA-A Size 120-490	CPS Size 60-490	CPS-A Size 120-490	CPV Size 60- 490
1	Motor Mount	Motor Mount	Motor Mount	Motor Mount	Motor Mount
2	Motor Sheave	Motor Sheave	Motor Sheave	Motor Sheave	Motor Sheave
3	Belt Set	Belt Set	Belt Set	Belt Set	Belt Set
4	Fan Sheave	Fan Sheave	Fan Sheave	Fan Sheave	Fan Sheave
5	Housing	Housing	Housing	Housing	Housing
6	Motor	Motor	Motor	Motor	Motor
7	Optional Side Cover (2)	Optional Side Cover (2)	Optional Side Cover (2)	Optional Side Cover (2)	Optional Side Cover (2)
8	Pedestal	Pedestal	Pedestal	Pedestal	Pedestal
9	Bearings (2)	Bearings (2)	Bearings (2)	Bearings (2)	Bearings (2)
10	Shaft	Shaft	Shaft	Shaft	Shaft
11	Optional Weather Cover	Optional Weather Cover	Optional Weather Cover	Optional Weather Cover	Optional Weather Cover
12	Wheel Assembly	Wheel Assembly	Wheel Assembly	Wheel Assembly	Wheel Assembly
13	Discharge Flange	Discharge Flange	Discharge Flange	Discharge Flange	Discharge Flange
14*	Spreader Bar (2)	Spreader Bar (2)	Spreader Bar (2)	Spreader Bar (2)	Spreader Bar (2)
15	Inlet Cone	Inlet Cone	Inlet Cone	Inlet Cone	Inlet Cone
16*	Inlet Side Support	Inlet Side Support	Inlet Side Support	Inlet Side Support	Inlet Side Support

*For units adapted to curb/plenums, the removal of spreader bars and inlet side support are required.

CPA/CPA-A/CPS/CPS-A/CPV
w/Optional Curb Cap and Inlet Box Accessory Parts List



Side View



Front View

Part No.	Description
1	CP Vent Set
2	Adjustable Draw Latch
3	Access Door Assembly
4	Latch Keeper
5	Curb Cap/Plenum Box Assembly
6	Foam Tape (Not Shown)

Limited Warranty

Loren Cook Company warrants that your Loren Cook fan was manufactured free of defects in materials and workmanship, to the extent stated herein. For a period of one (1) year after date of shipment, we will replace any parts found to be defective without charge, except for shipping costs which will be paid by you.

This warranty is granted only to the original purchaser placing the fan in service.

This warranty is void if the fan or any part thereof has been altered or modified from its original design or has been abused, misused, damaged or is in worn condition or if the fan has been used other than for the uses described in the company manual. This warranty does not cover defects resulting from normal wear and tear.

To make a warranty claim, notify Loren Cook Company, General Offices, 2015 East Dale Street, Springfield, Missouri 65803-4637, explaining in writing, in detail, your complaint and referring to the specific model and serial numbers of your fan. Upon receipt by Loren Cook Company of your written complaint, you will be notified, within thirty (30) days of our receipt of your complaint, in writing, as to the manner in which your claim will be handled. If you are entitled to warranty relief, a warranty adjustment will be completed within sixty (60) business days of the receipt of your written complaint by Loren Cook Company.

This warranty gives only the original purchaser placing the fan in service specifically the right. You may have other legal rights which vary from state to state.

For fans provided with motors, the motor manufacturer warrants motors for a designated period stated in the manufacturer's warranty. Warranty periods vary from manufacturer to manufacturer. Should motors furnished by Loren Cook Company prove defective during the designated period, they should be returned to the nearest authorized motor service station. Loren Cook Company will not be responsible for any removal or installation costs.

LOREN COOK COMPANY

Corporate Offices: 2015 E. Dale Street Springfield, MO 65803 417.869.6474

lorencook.com

Bay Oil Company, 38 Plainfield Street , Chicopee, Ma. 01013
Tel.413-737-7728 Fax 413-737-7730

Material Safety Data Sheet

Product Name: **Snail Lube Concentrate** Effective Date: 10/25/11 Date Printed: 10/25/11

HMIS Rating: H=1, F=0, R=0

1) INGREDIENTS: (% wt., unless otherwise noted)

CHEMICAL NAME	CAS #	%
Triethanolamine	102-71-6	10-15

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not "Hazardous" per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2) PHYSICAL DATA:

Boiling Point:	215° F.
Vapor Pressure:	20
Vapor Density:	1
Solubility In Water:	Soluble
Sp. Gravity:	1.12 0.01
Appearance:	Clear green liquid
Odor:	Bland

3) FIRE AND EXPLOSION HAZARD DATA:

Flash Point:	None
Method Used:	PMCC

FLAMMABLE LIMITS:

LFL:	None
UFL:	None

EXTINGUISHING MEDIA: Water, carbon dioxide, dry chemical
FIRE & EXPLOSION HAZARDS: Intense heat may cause unopened drums to rupture. Cool fire-exposed surfaces with water.
FIRE-FIGHTING EQUIPMENT: Use NIOSH-approved self-contained breathing apparatus.

4) REACTIVITY DATA:

STABILITY: (conditions to avoid) Stable under normal storage and use conditions
INCOMPATIBILITY: (specific materials to avoid) Do not mix with strong acids or bases.
HAZARDOUS DECOMPOSITION PRODUCTS: Thermal decomposition may produce asphyxiants.
HAZARDOUS POLYMERIZATION: Will not occur

ATTACHMENT 5

Bay Oil Company, 38 Plainfield Street , Chicopee, Ma. 01013
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5) ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Contain spill. Use wet/dry vacuum, squeegee or mop to pick up material. Flush residue down drain, mop dry. Treat slippery surfaces with absorbents.
DISPOSAL METHOD: Dispose of in accordance with federal, state and local regulations.

6) HEALTH HAZARD DATA:

EYE: Contact may cause irritation.
SKIN CONTACT: Prolonged or repeated contact may cause mild irritation of the skin.
SKIN ABSORPTION: Not likely to occur
INGESTION: Small amounts ingested incidental to normal handling are not likely to cause injury; Larger amounts ingested may cause injury.
INHALATION: May cause respiratory irritation if mists are generated.
SYSTEMIC (other target organ) EFFECTS: None known
TERATOLOGY (birth defects): No adverse effects expected
REPRODUCTIVE EFFECTS: No adverse effects expected
MUTAGENICITY (effects on genetic material): No adverse effects expected
CARCINOGENICITY: IARC: NO NTP: NO OSHA: NO

7) FIRST AID:

EYES: Flush with large amounts of water for 15 minutes. If irritation persists, contact a physician.
SKIN: Wash with soap and water.
INGESTION: Give milk or water. Consult a physician.
INHALATION: Remove to fresh air. If symptoms persist, consult a physician.
NOTE TO PHYSICIAN: Treatment of overexposure should be directed toward the control of symptoms and the clinical condition.

8) HANDLING PRECAUTIONS :

EXPOSURE GUIDELINE: Triethanolamine: ACGIH TLV: 5 mg/m^3

VENTILATION: General room ventilation should be satisfactory. Local exhaust ventilation may be necessary if misting is generated.
RESPIRATORY PROTECTION: None normally required
SKIN PROTECTION: Protective rubber gloves
EYE PROTECTION: Safety glasses

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9) ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
Launder contaminated clothes before reuse. Avoid prolonged breathing of mist and vapors. Use as directed. Normal precautions common to good manufacturing practices should be followed in handling and storing. Store
away from food in a cool, dry area. Wash hands before eating, drinking or smoking and after handling.

REGULATORY INFORMATION: (Not meant to be all-inclusive--selected regulations represented).

NOTICE: The information herein is presented in good faith and believed to be accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

TOXIC SUBSTANCES CONTROL ACT (TSCA):
The components of this product are listed on the TSCA inventory.

This product contains the toxic chemical or chemicals listed below, which are subject to the supplier notification requirements of Section 313 of the Superfund Amendments and Reauthorization Act of 1986 ("SARA") and the requirements of 40 CFR part 372. None

This notice must not be detached from the foregoing MSDS. If the MSDS is copied for any reason, including distribution, this notice must also be copied and accompany all redistributed MSDS'. Failure to do so may subject you to penalties under law.
This product contains the following ingredient(s) which are regulated under the Clean Air Act Section 112 hazardous air pollutants and is subject to all reporting requirements of CERCLA (Superfund). None

10) TRANSPORTATION INFORMATION:

PROPER SHIPPING NAME: Non-regulated

DOT HAZARD CLASS: Non-regulated