YORK®

Maintaining Air Handling Units for Long Term Health

Wisconsin Healthcare Engineering Association

Presenters: Mark Miller and Rob Tanner

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The power behind **your mission**

Johnson Controls

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Life-Sustaining Care for
Healthcare Facility Air Handling Units (AHU's)

The AHU caretaker's "Hippocratic Oath"

- I respect the knowledge of those who have done this (successfully) before me
- I will apply all known best practices and procedures
- I will remember that the care of AHU equipment is a combination of art and science
- I will not be ashamed to say, "I don't know" and will seek out those who do know
- I respect that the AHU is important to the health and wellness of all who enter the facility
- I will remember that I do not merely fix or repair a component but that I am fixing or repairing a system
- I will practice preventative maintenance to minimize the need for a catastrophic repair
- I will remember that I am not the only person doing this and that I am part of a larger community of people who also take care of AHU's

Maintaining Air Handling Units for Long Term Health

1. Safety First!
2. What's in the air path?
3. Air mixing section
4. Filters (and other air cleaning devices)
5. Coils (and other things that change the condition of the air)
6. Fan Systems
7. Control devices
8. Unit casing/housing

Safety First

Shut Off Power
at the
Main Disconnect

- Power to the unit must be de-energized during maintenance
- Always use a trusted meter for verification

Shut Off
the
Disconnect Switch
and
Lock It Out

Lock Out / Tag Out

The control of hazardous energy sources prior to starting work by placing a lock and tag on the system or equipment. A lockout device must be used when an employee could be injured due to unexpected energization of equipment or machinery.

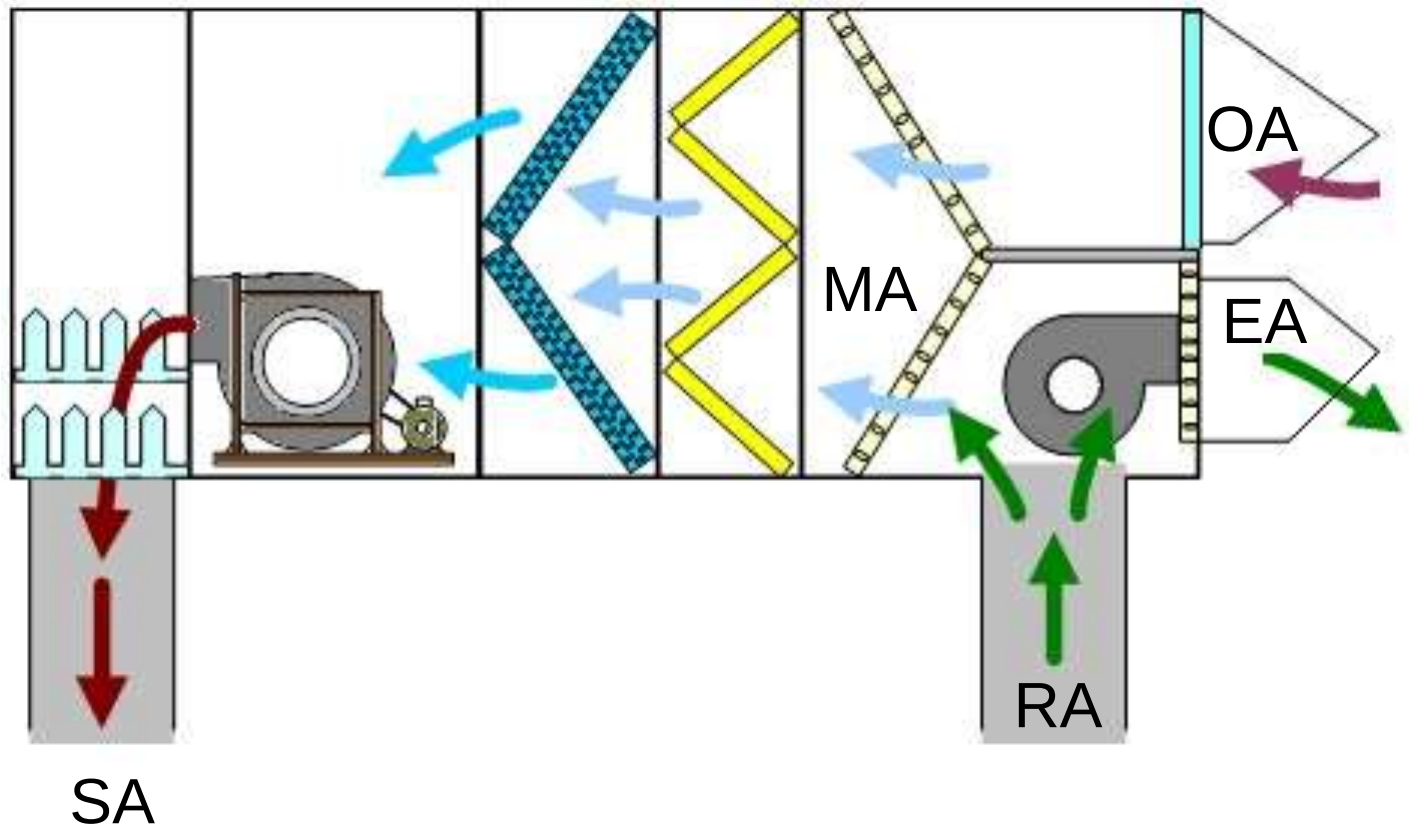
"Typical" Air Handler

Air Paths

- OA = Outside Air
- RA = Return Air
- EA = Exhaust/Relief Air
- MA = Mixed Air
- SA = Supply Air

Common Components

- Return / Exhaust Fan
- Dampers
- Filters
- Coils (Water, DX)
- Supply Fan



Air Mixing Section

The power behind **your mission**

Damper Checks

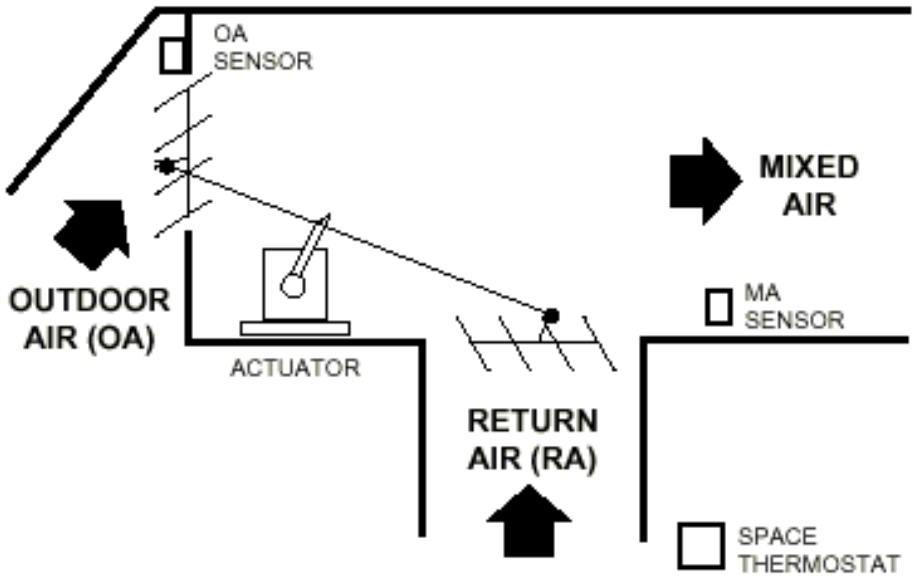
Damper Maintenance

- Observe damper motors and actuators
- Check / tighten mounting bolts
- Adjust actuator linkages
- Check blades in closed position – adjust, clean or replace as necessary
- Check pins, straps, brushings
- Lubricate moving parts
- Check caulking

Economizer Checks

Economizer Maintenance

- Observe economizer when filters are changed
- Check:
  - Damper linkages
  - Minimum air requirement
  - Outside air temp
  - Return air temp
- Verify mixed air temperature



Economizer Checks

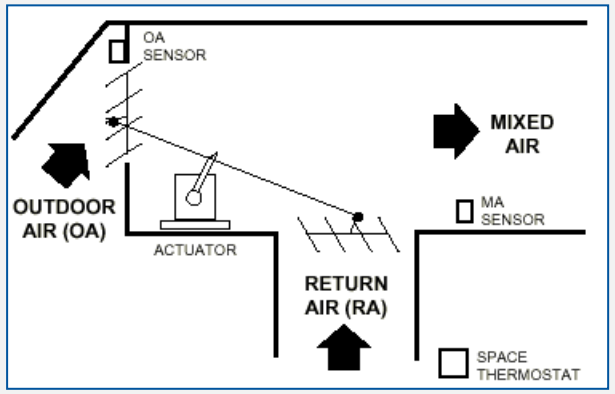
Verify Mixed Air Temperature – Example

Conditions:

Building requires 15% Outside Air

Outside Air = 50°F

Return Air = 78°F



Calculation:

50°F Outside Air x 15% = 7.5°F

78°F Return Air x 85% = 66.3°F

7.5°F + 66.3°F = 73.9°F (rounded to 74°F)

With the minimum position damper set for 15%, the Mixed Air temperature is 74°F

Filters (and other air cleaning devices)

Filters

MERV 5-8

- 30% efficient
- Trap particles as small as 3* microns
- Residential and light commercial applications

MERV 9-12

- 30% efficient
- trap particles in the 1 to 3 micron* range
- Commercial and industrial applications

Maintenance: replace at 1.25” W.G. pressure drop at 500 FPM

Filters

Bag Filter

- 65%, 85%, 95% efficient (MERV 11-15)
- Trap particles as small as 0.3* microns
- Holds lots of particles

Activated Carbon Filter

- Efficiency and depends on partnered filters
- Trap particles as small as 0.5* microns
- Gas-phase filtration – typically odor control

Rigid Filter

- 60-65% efficient, 90-95% efficient (MERV 11-14)
- Trap particles as small as 0.3* microns
- Holds more particles than panel-type

Filters

2” MERV 8 Pre-Filter with 12” MERV 14 65% Rigid Metal Filter

Single Headered with Pre-Filter or Double Headered with Pre-Filter

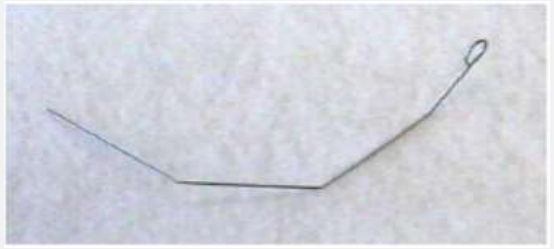
Filters

HEPA Filter

- **H**igh **E**fficiency **P**articulate **A**ir Filter
- 99.97% efficient
- 99.99% efficient
- 99.999% efficient
- Trap particles as small as 0.02* microns
- Critical contaminant control applications

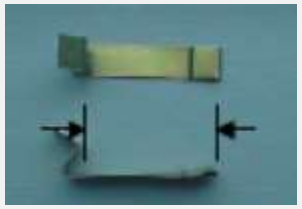
Filters Clips Vary by Style and Application

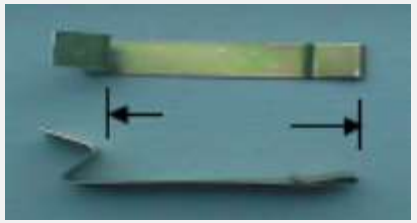
2” Pre-Filter and Single Headered Final Filter



2” Pre-Filter with 4” Final Filter

2” or 4” Pre-Filter and Double Headered Final Filter





2” or 4” Pre-Filter and Single Headered Final Filter

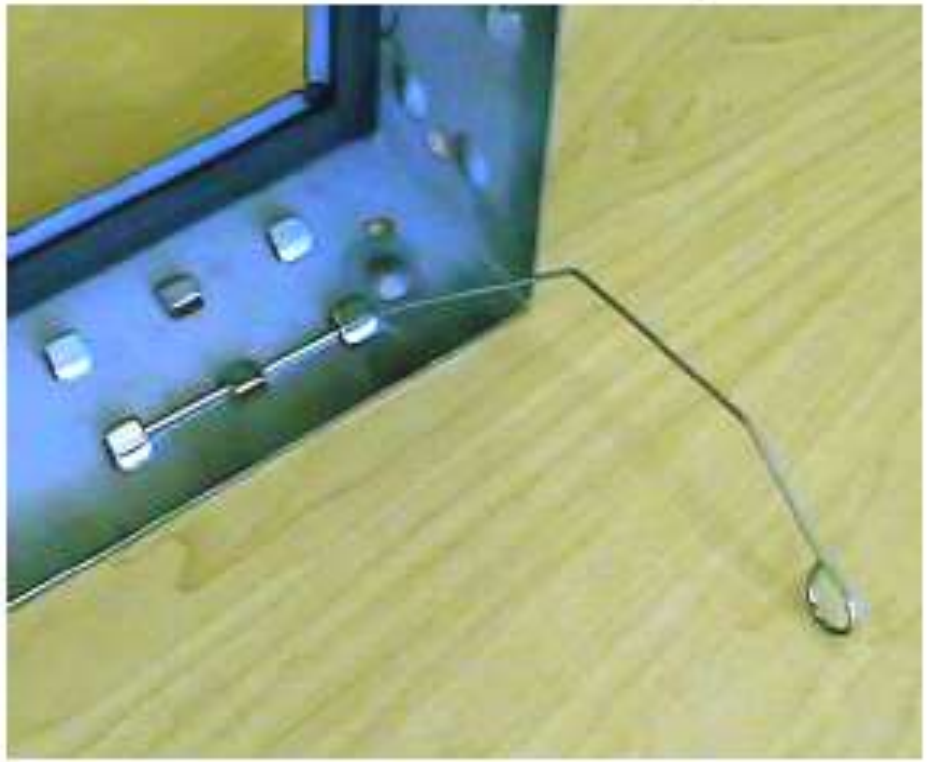
2” or 4” Pre-Filter and Double Headered Final Filter

HEPA Filter

Filters Clips Vary by Style and Application

C70 Clip

Type 8 frame w/C70 Clip



C86 Clip

Ultraviolet (UV) Lights

UV Light Safety

- Control Panel serves as 120V disconnect
- Reset selector knob of doors are opened without UV lights turned off

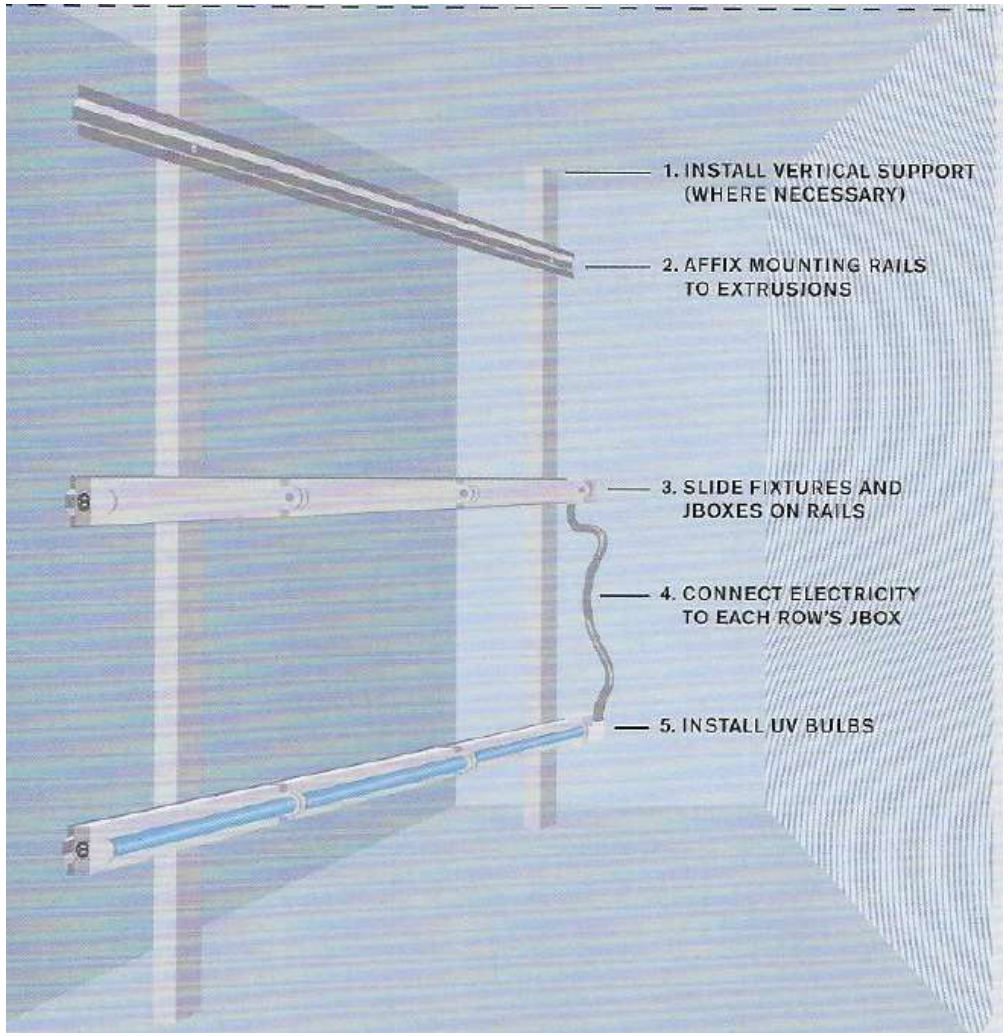
- Door safety switches interrupts power to UV lights when door is open

UV LIGHT AND LAMP BURN HAZARD

- Can cause severe burns
- Temporary or permanent loss of vision
- Never look at lamps when illuminated

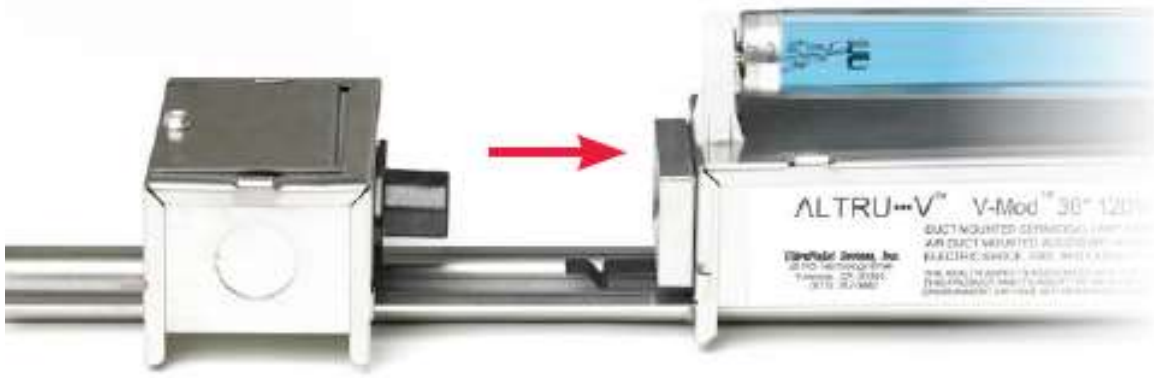
- Power supply must be disconnected before opening or servicing the unit
- Access panels and doors must be interlocked to disconnect

Ultraviolet (UV) Lights



UV Light Installation

- Field or factory installed
- Keep lamp surface clean
- Use clean dry cloth – not bare hands – or clean the lamp with alcohol after handling



Easily Plugs in

Ultraviolet (UV) Lights

Radiometer

- Shows life remaining for UV light installations
- Blinking function of the LED indicates a possible malfunction
  - Sensor cable broken
  - UV lamp off
  - UV intensity below 10% of nominal

Ultraviolet (UV) Lights

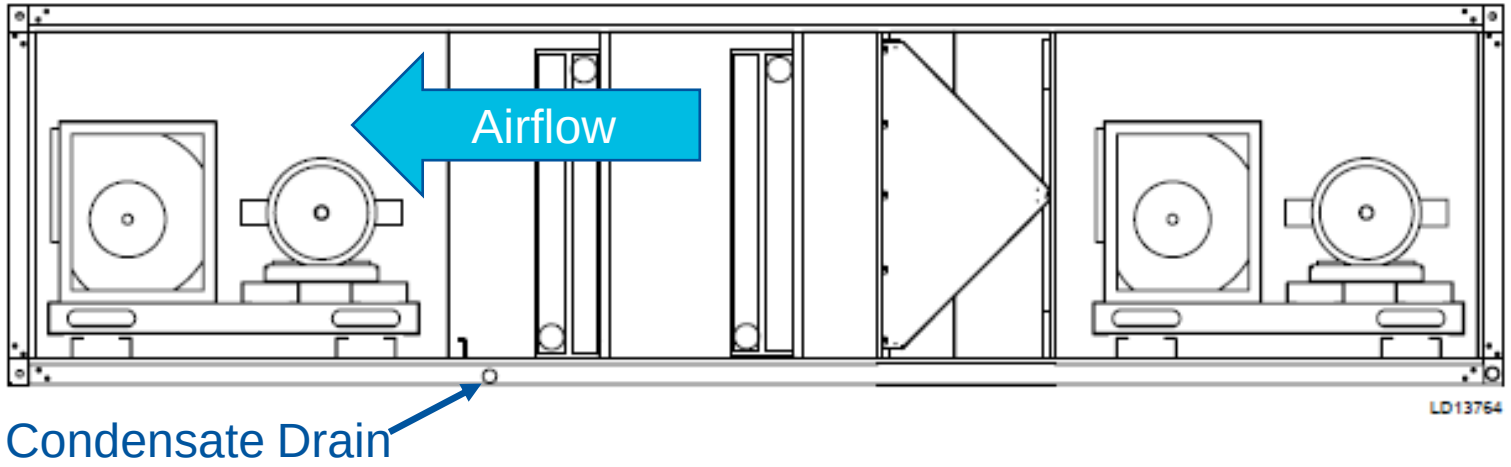
Maintenance

- Intensity drops to 70% after 9000 hours ~ 1 year
- Replace lamps after 9000 hours of use
  - Verify power has been disconnected
  - Disconnect supply cable
  - Remove clips from lamp
  - Inset replacement lamp into clips
  - Secure lamp supply cable connector to lamp
- Connect lamps and reset ballasts if lamps are not installed prior to turning on power

Coils
(and other things that change the condition of the air)

Condensate Drain Piping

Condensate from the Cooling Coils must be removed from the air handler to prevent water carryover into the air stream



Draw-Thru

- Fan located downstream of coil
- Coil and condensate pan located in negative pressure
- Condensate does not flow freely out of pan
- Water trap prevents air from flowing through the trap (outside to inside)

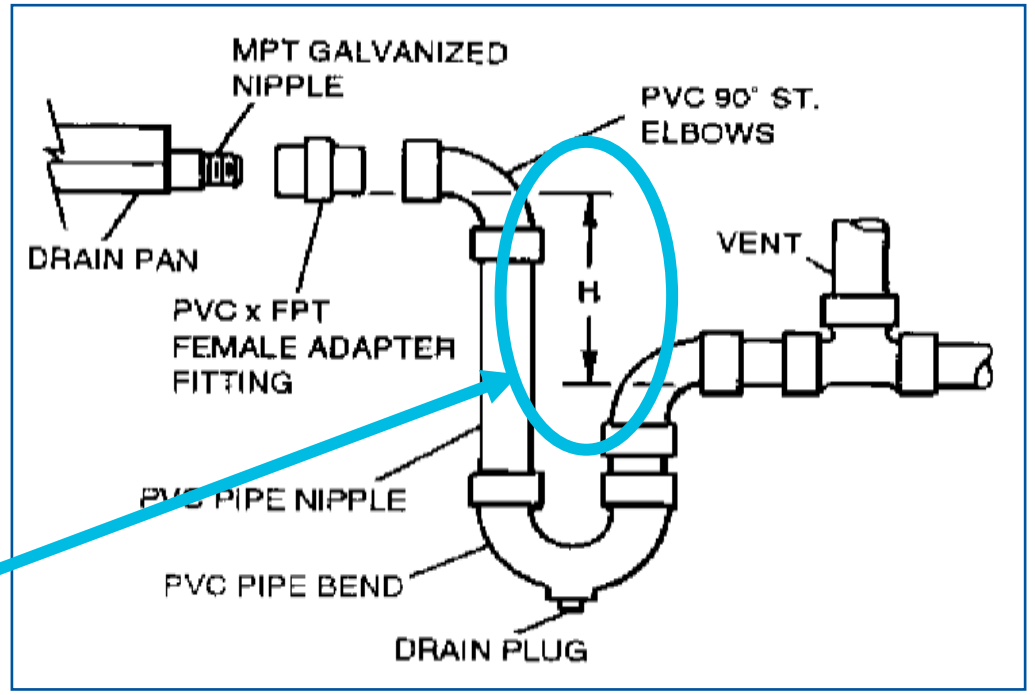
Blow-Thru

- Fan located upstream of coil
- Coil and condensate pan located in positive pressure
- Water trap acts as a seal

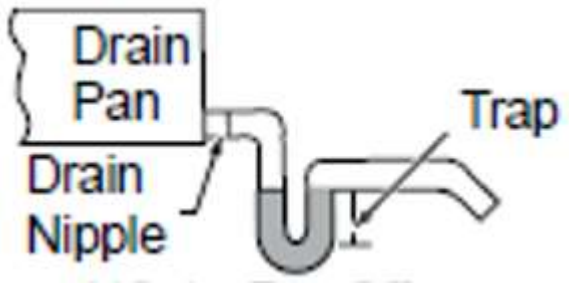
Condensate Drain Draw-Thru Example

"H" dimension must be ≥ 1" negative static pressure of the drain pan area

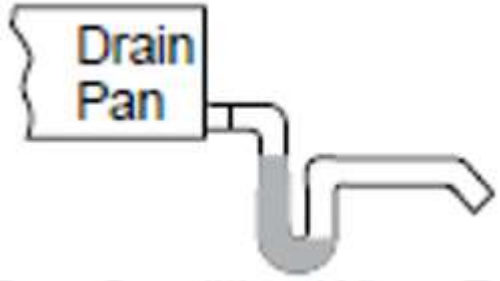
Example: Negative static pressure = 4.5"
Minimum of ½" = 1.0"
4.5" + 1.0" = **"H" Dimension = 5.5"**



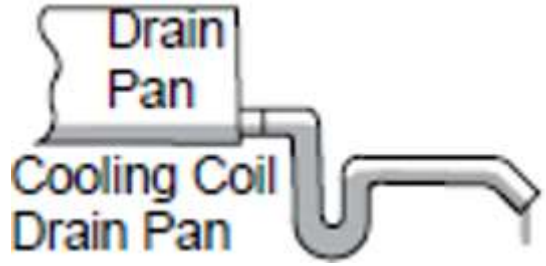
Fan off



Fan starts



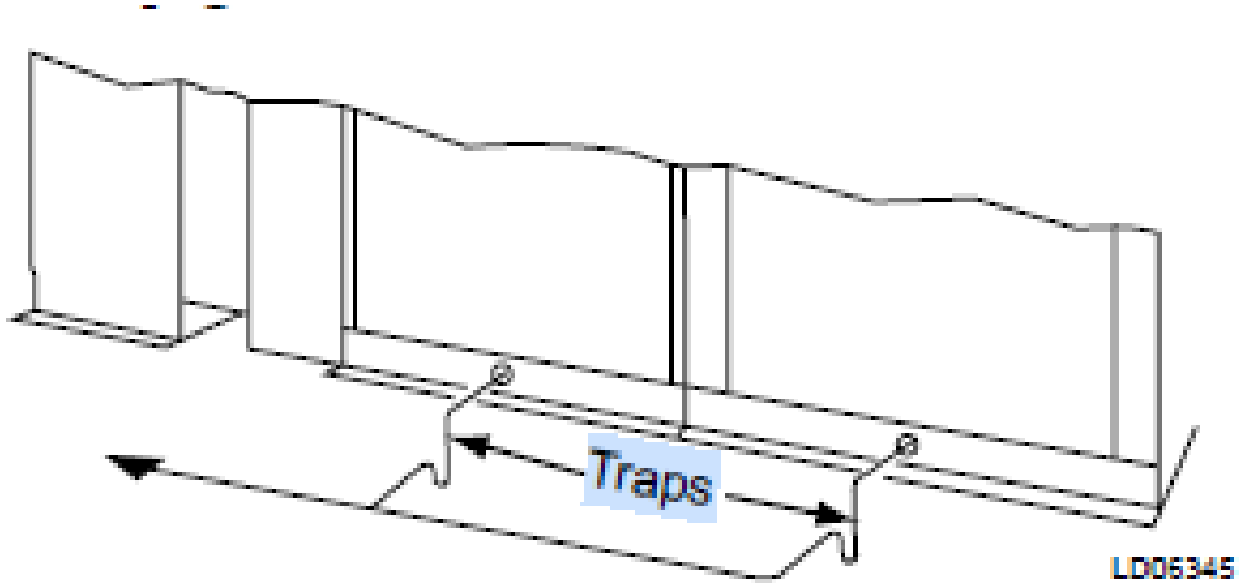
Fan running and condensate



Condensate Drain Piping

Combining Drain Lines

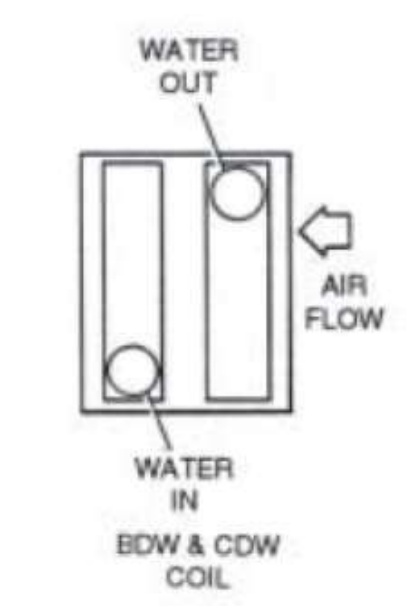
- Multiple traps on a single air handler can use a common condensate line
- Drains must be trapped individually before lines can be combines



Coils

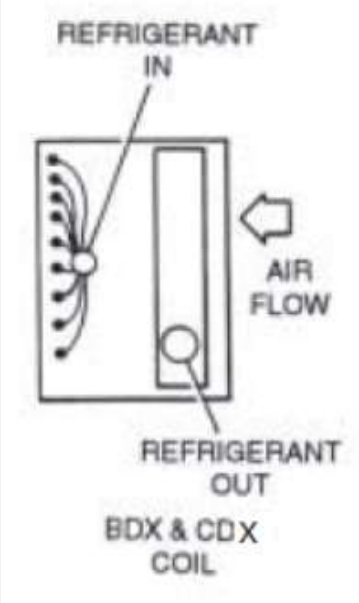
Water Coil

- Water in on bottom
- Water out on top
- Water flows opposite direction of air



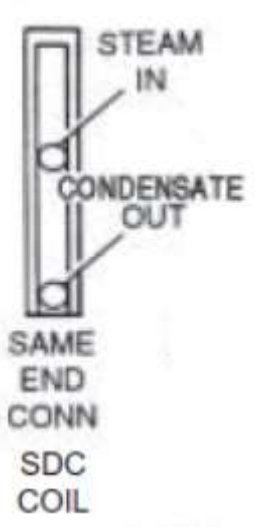
Refrigerant (DX) Coil

- Suction (outlet) on bottom
- Refrigerant flows opposite of air



Steam Coil

- Top/middle steam inlet
- Bottom condensate outlet
- Tube-in-tube non-freeze design
- Sloping tubes



Coils

Coil Freeze Protection

- Installed if coil is subjected to temperatures 32°F or lower
- Antifreeze solution options
- When not in use, coil must be drained and blown dry inside with compressed air

Coils

Coil Cleaning

- Recommended annually

- Clean coils using oil-free pressurized air
- Look for potential leak spots
- Do not use extreme high-pressured air
- Do not bend coil fins during cleaning
- Straighten fins with a fin comb

- A safe commercial grade coil cleaner can be used on heavily soiled coils
- Spray from the leaving air side of the coil
- Direct water and cleaner into the drain pan and safely out of the drain line

Coils

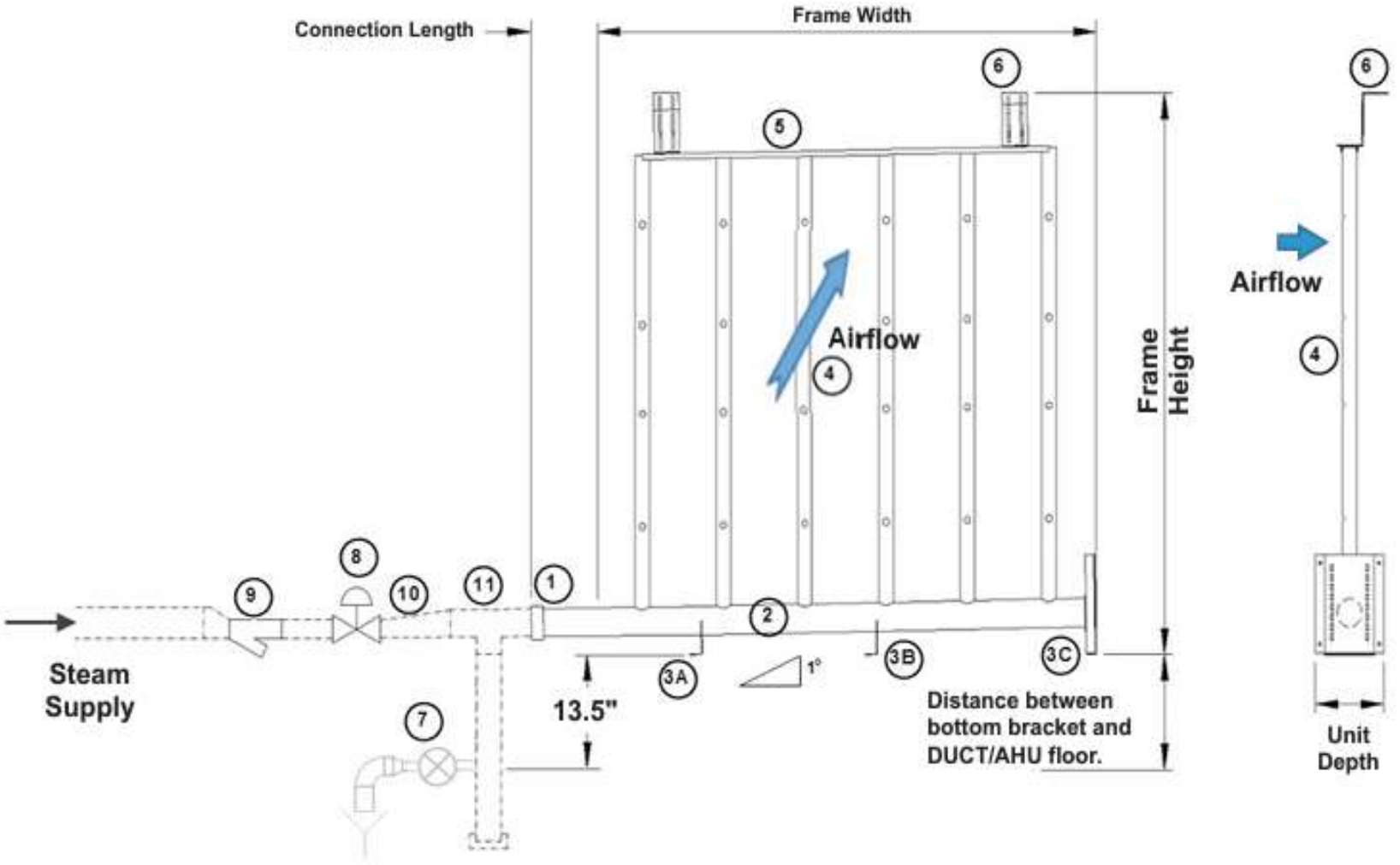
Coil Stacking Racks

- Ease of coil removal/replacement in stacked coil configurations
- Top or bottom coil can slide out of the rack while the other coil remains in place

Steam Humidifier Manifold

Components

1. Manifold Inlet
2. Grid Main Header
3. Bottom Brackets
4. Distribution Tubes
5. Upper Bracket
6. Top Support Bracket
7. Steam Trap
8. Valve/Actuator
9. “Y” Strainer
10. Steam Pipe Reducer
11. Tee and Vertical Piping to Steam Trap



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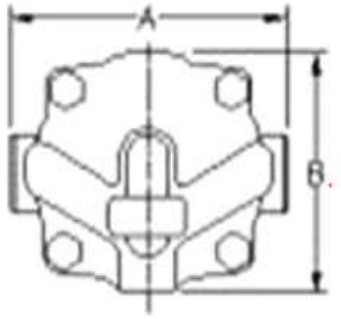
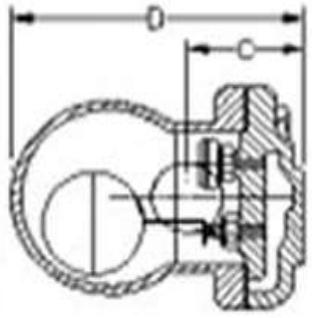
Float and Thermostatic Steam Traps

- Continuously discharge steam condensate at specific temperature
- Non-condensable gases are released through air vent
- Periodically disassemble for cleaning of valve head and seat
- Isolate trap on both sides before disassembly
- Damaged parts should be replaced using a complete Capsule an Seat Assembly Set





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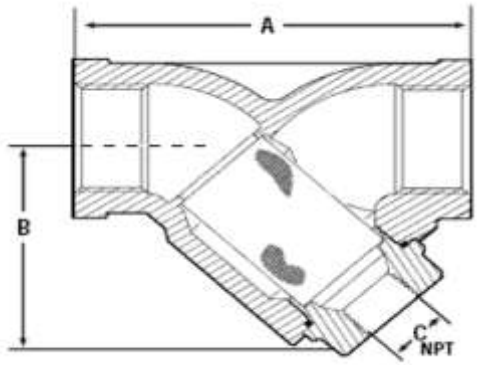
Valve / Actuator

Cast Iron Strainer



Electric Heat

Cutouts

- Provided with both automatic and manual reset thermal cut-outs

Maintenance Checks

- Check all electric connections for tightness annually
  - Factory and field made connections
- Keep filters clean to ensure adequate airflow

Gas Heat Components

Gas Heat Control and Safeties

- Pressure Tap
- System Ignition Control Module
- Rollout Switch (manual reset)High Limit Switch
- Induced Draft – Air Pressure Switch
- Auxiliary Limit and Airflow Proving Switch

Gas Heat Components

Gas Heat Control and Safeties

- **Pressure Tap**
- System Ignition Control Module
- Rollout Switch (manual reset)High Limit Switch
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- Auxiliary Limit and Airflow Proving Switch

Figure 5A – On / Off (1 Stage) Gas Valve

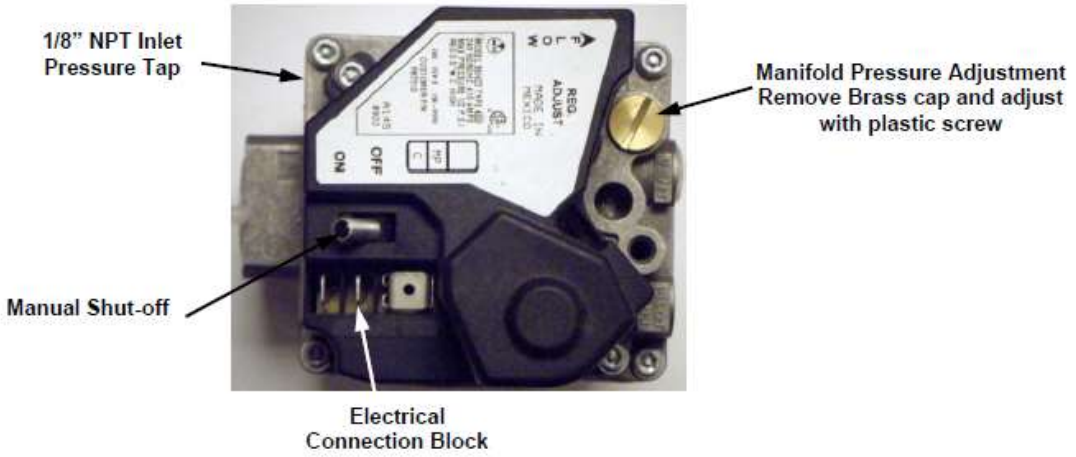
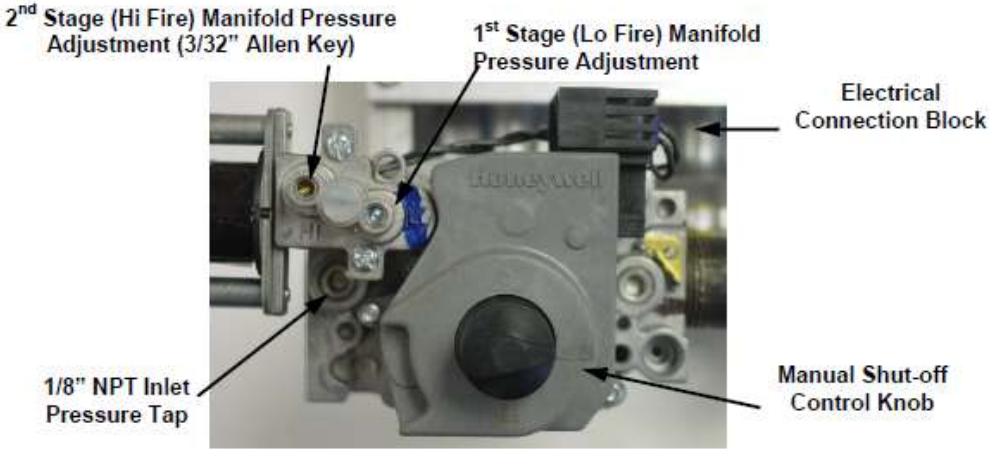
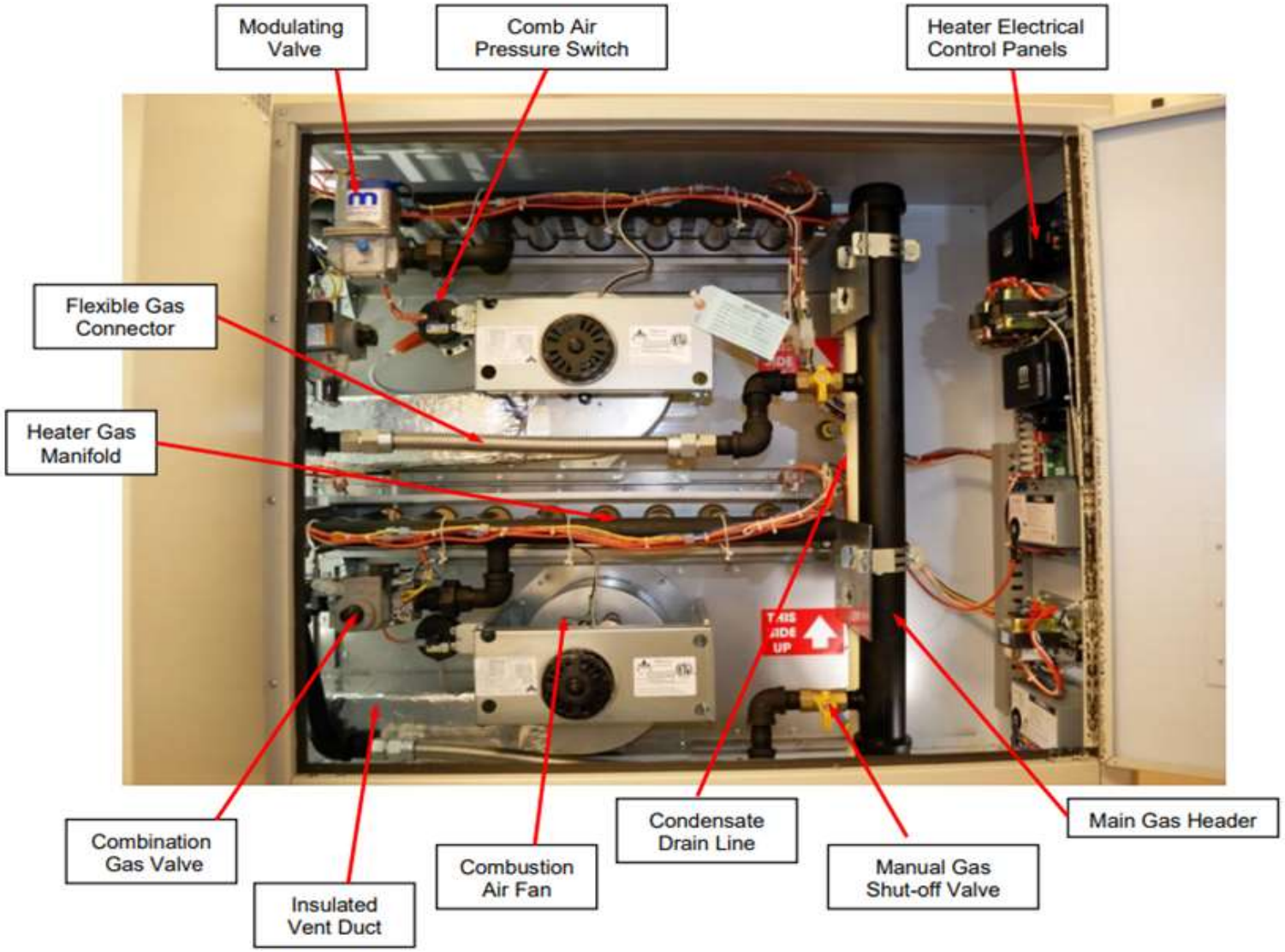


Figure 5B – 2 Stage Gas Valve



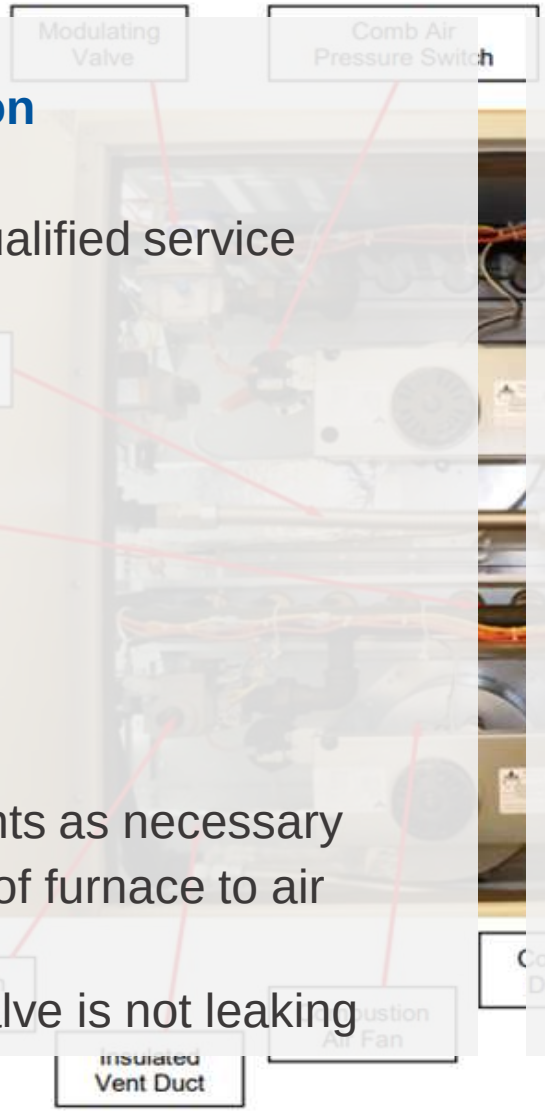
Gas Heat Component Identification



Gas Heat Components – Maintenance Checks

Furnace Module Inspection

- Inspected annually by qualified service agency
- Determine condition of:
  - Burners
  - Heat Exchanger
  - Draft Inducer
  - Vent System
  - Operating Controls
  - Wiring
- Clean/replace components as necessary
- Check attachment point of furnace to air handler or duct
- Ensure automatic gas valve is not leaking



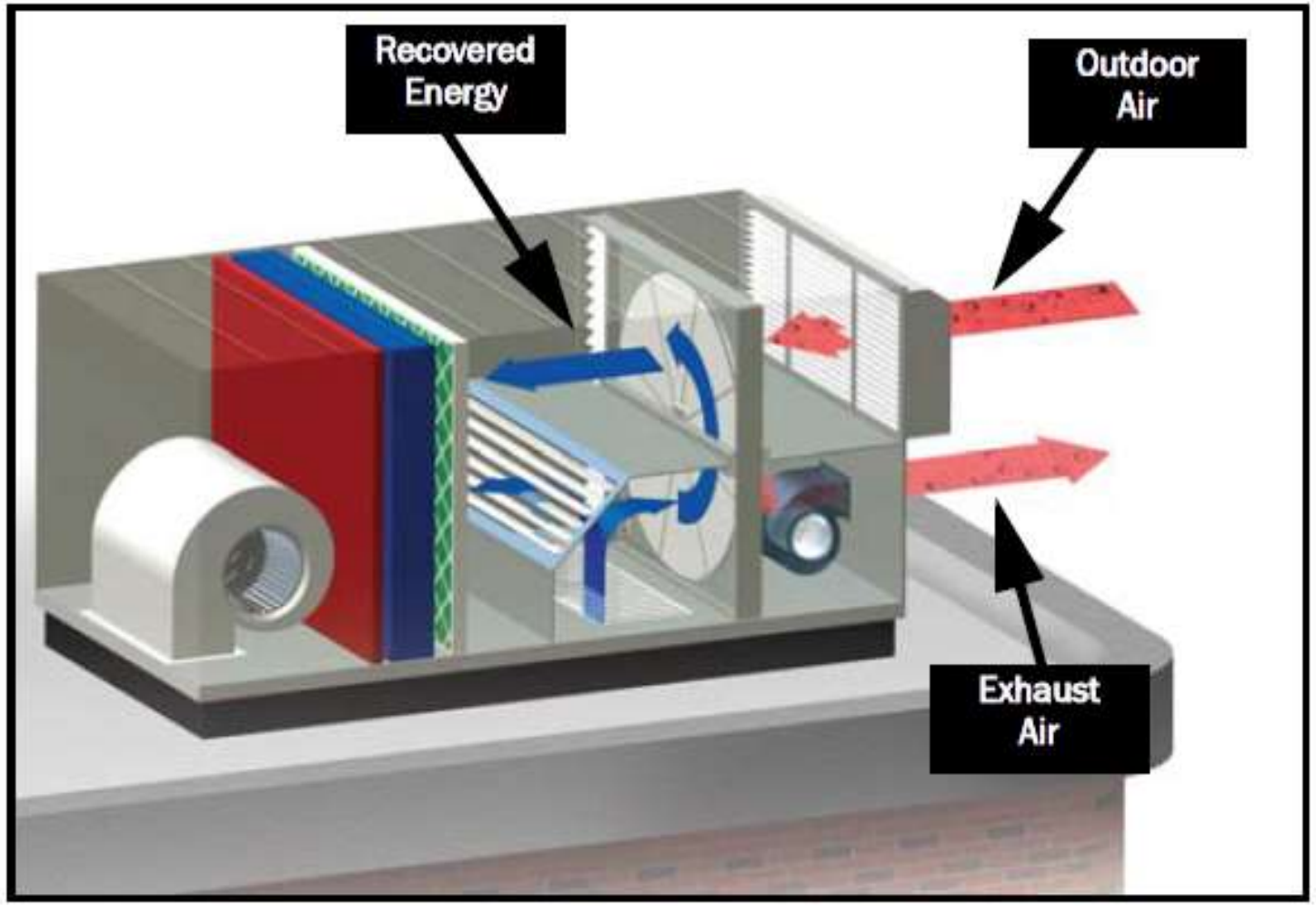
Furnace Module Operation Check

- Turn on Power to the unit
- Set heat controller to call for heat
- Allow heater module to operate
- Check for proper start-up and ignition of each furnace as outlined in the Sequence of Operations
- Check appearance of burner flame
  - Blue in color, well defined and centered at tube entry
- Return heat controller to normal setting

Energy Recovery Wheels

Technology

- Energy wheel rotates between the incoming outdoor air steam and a buildings exhaust air stream
- Exhaust energy is used to condition the incoming outside air
  - Pre-heat
  - Pre-cool
  - Humidify
  - Dehumidify



Energy Recovery Wheels

Maintenance Checks

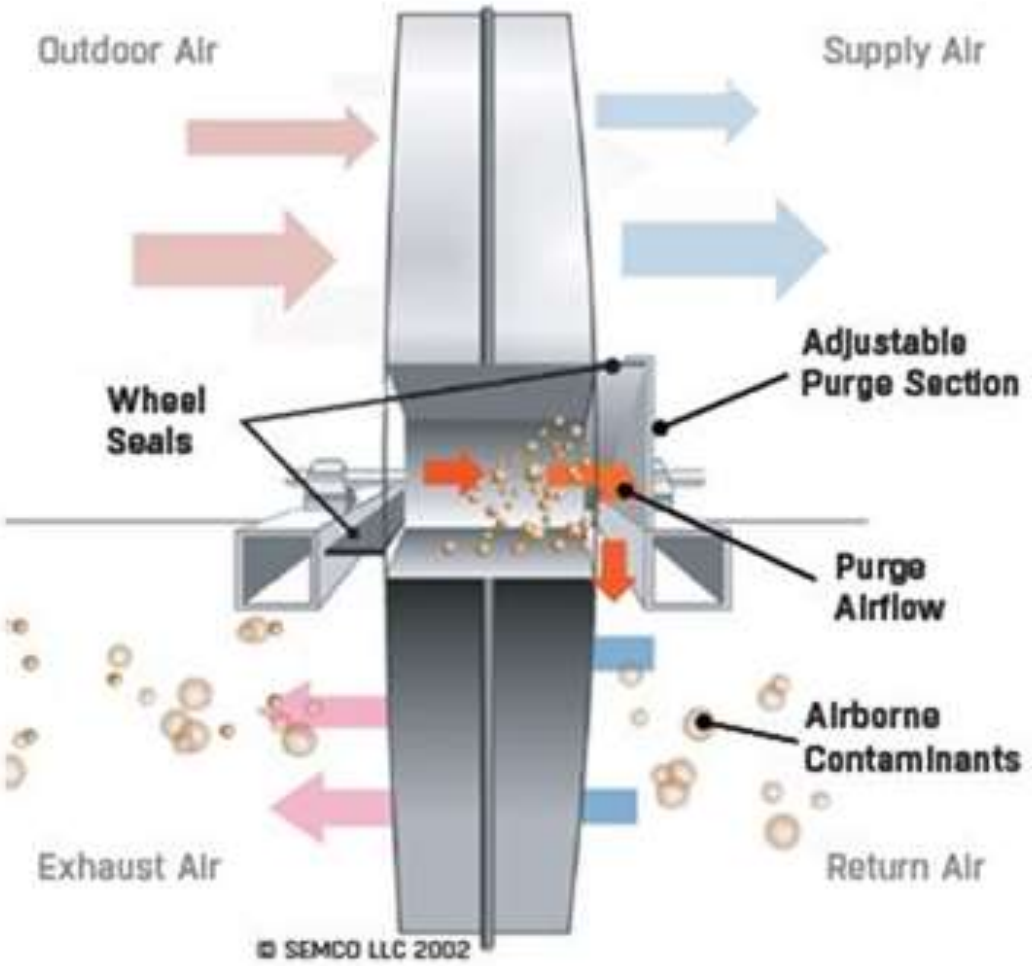
- Verify wheel rotates clockwise when viewed from pully side
- Verify wheel rotation 40-50 RPM
- Inspection of belts, pulleys, bearings, wheel seals and motors

- Wheels are typically self cleaning
- Brush or vacuum dry contaminants off both wheel sides
- Refer to manufacturer recommended procedure for deep cleaning
- Protect bearings if deep cleaning is required with water or liquid cleaner

Energy Recovery Wheels

Purge Section

- Allows for strategic leakage of unconditioned outdoor air into the Return Air stream
- Purge airflow is driven by system static pressures around the Energy Recovery Wheel and through the purge angle



Energy Recovery Wheel – Bearing Lubricant

Energy Recovery Wheel Bearings

- White lithium-based grease
- NLGI Grade #2

YORK®

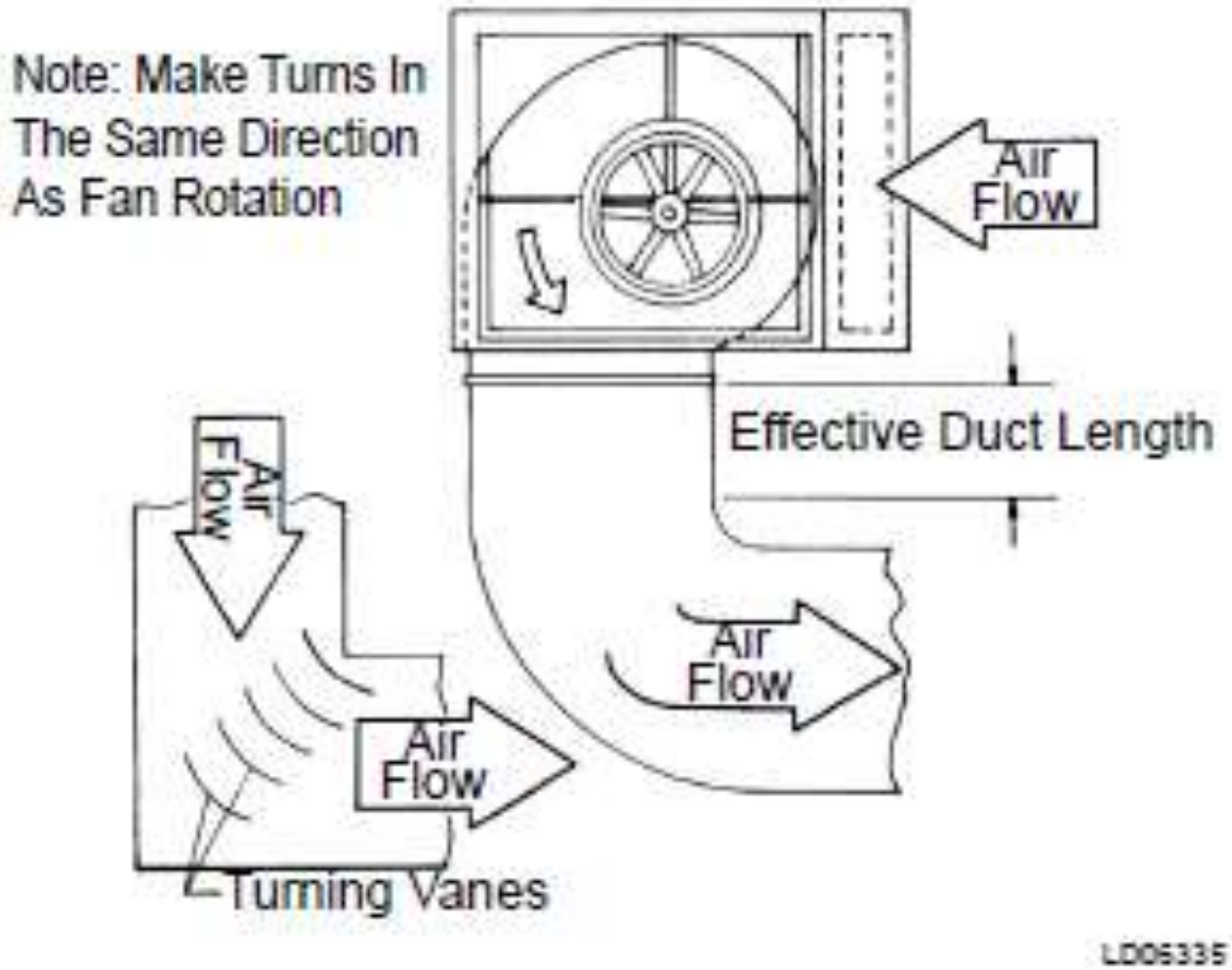
Fan Systems

The power behind **your mission**

Johnson Controls

Fan Ductwork

- A duct should turn in the same direction as the fan rotation
- A good traverse of readings of a duct is 10 ft away in a straight duct run



Fan Types

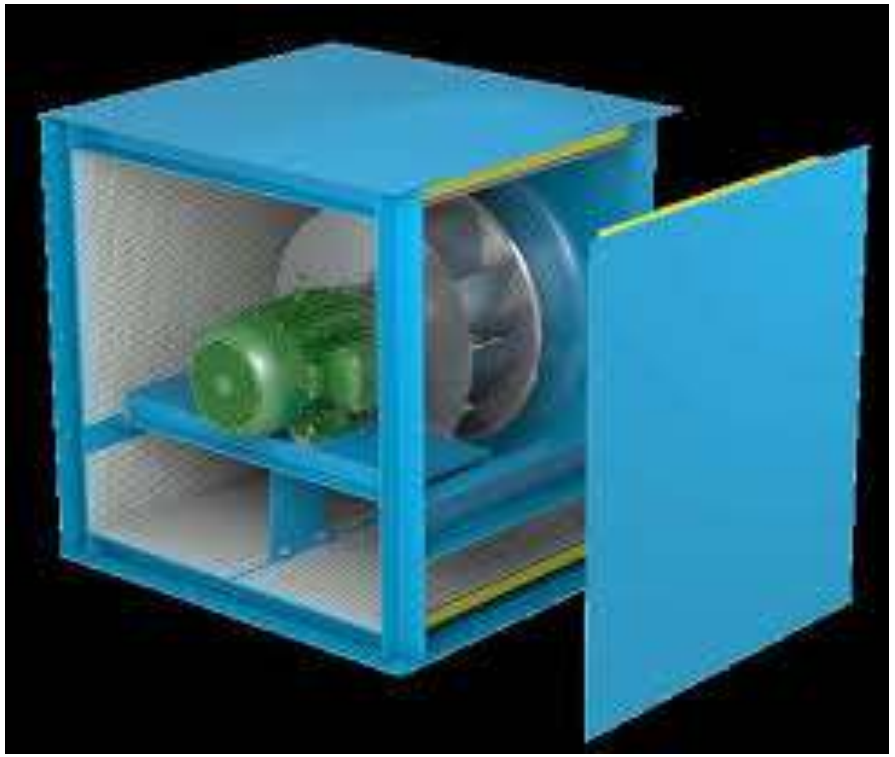
Double Inlet Airfoil Bladed Backward Curved Centrifugal Fan

Double Inlet Forward Curved Centrifugal Fan

Fan Types

Plenum Fan

Plenum Fan with Insulated Perf Panel for Sound Attenuation



Fan Types

Modular Plenum Fans
Stackable on Rubber Gaskets

Fan Types

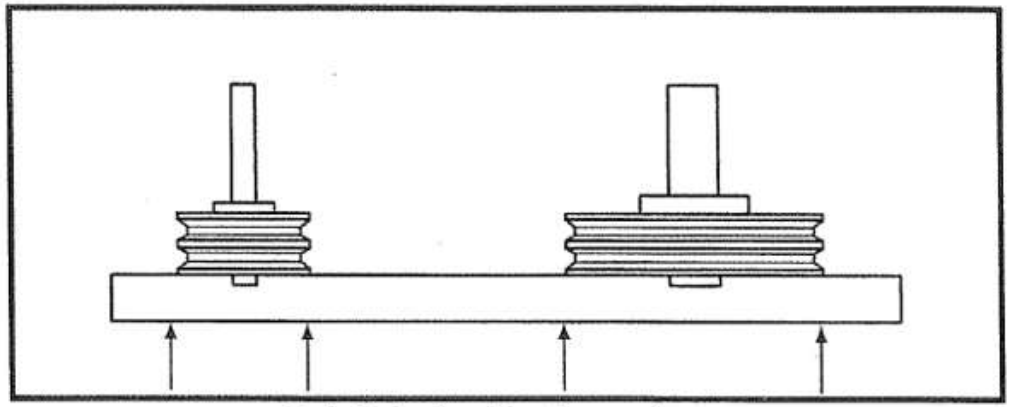
Belt Driven Fans

- Inspect the blower and motor pulleys to insure they are parallel with the belts
- Buy replacement belts from same brand
- Check set screws on both pulleys for tightness
- Requires sheave adjustment and alignment

- Alignment methods:
  - Straight Edge
  - String
  - Laser

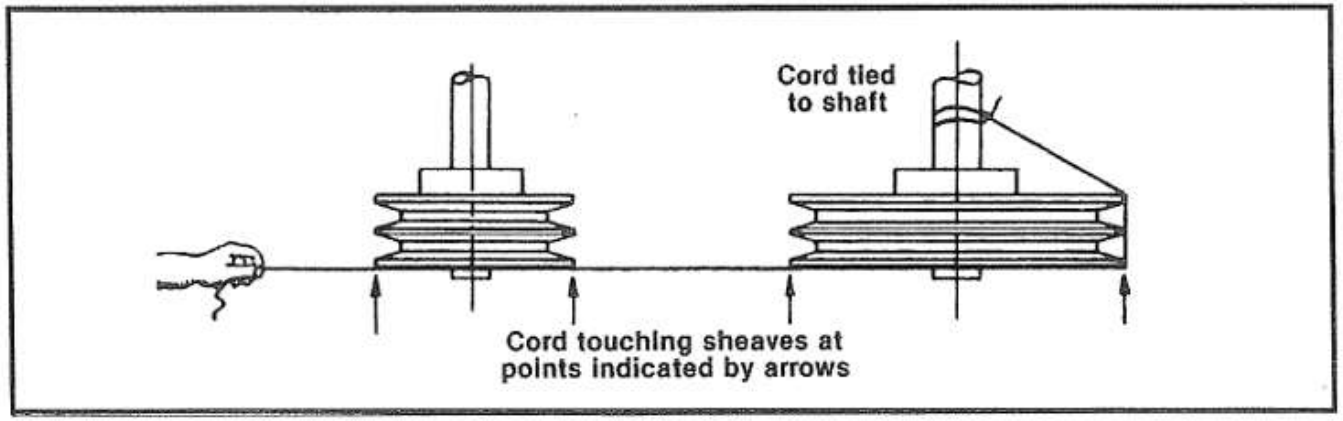
Belt Driven Fan – Alignment Methods

Alignment Using Straightedge



Straightedge touching sheaves at points indicated by arrows

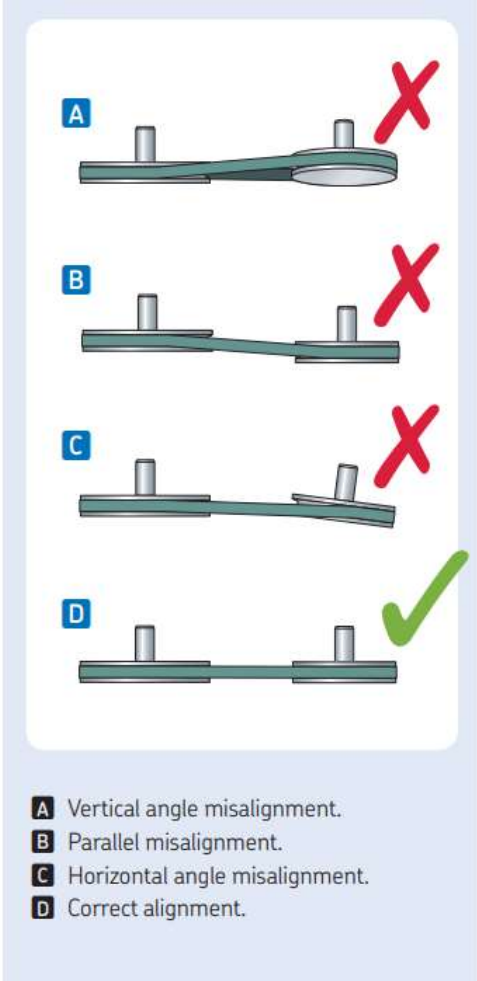
Alignment Using Strings



(B) ALIGNMENT USING STRING

Belt Driven Fan – Alignment Methods

Alignment Using Lasers

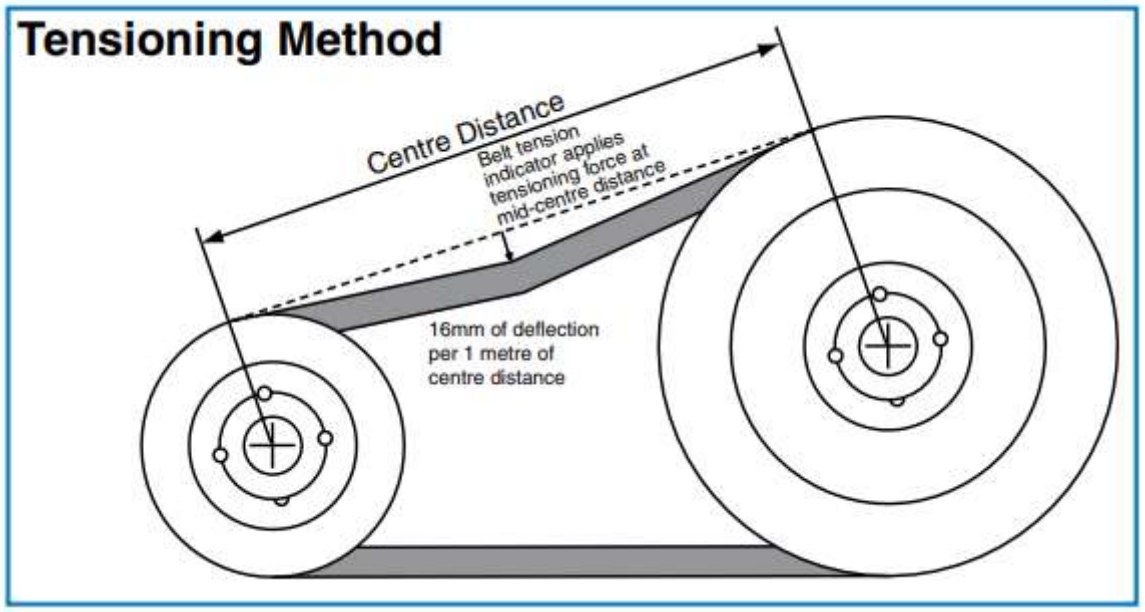


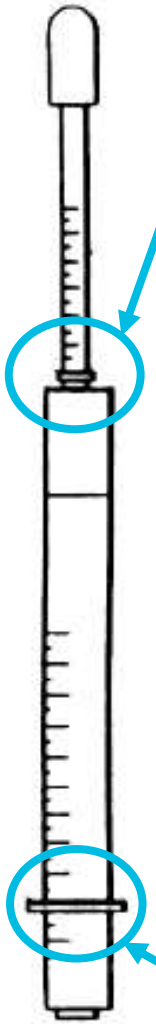
A Vertical angle misalignment.
B Parallel misalignment.
C Horizontal angle misalignment.
D Correct alignment.

Fan Belt Tensioning Method

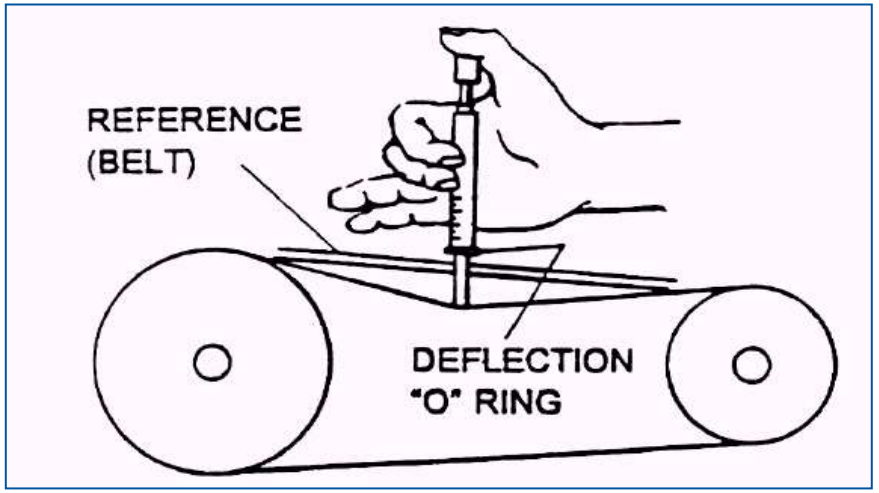
Fan Belt Tension

- Squealing belts during start-up is caused by slipping belts that are not tensioned properly





Load "O" Ring

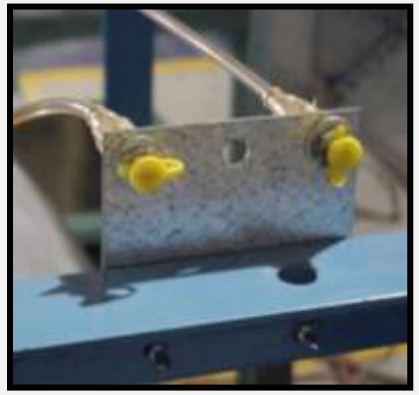


Deflection "O" Ring

Fan Bearing Maintenance

Fan Bearing Lubrication Intervals

- Size and speed will determine frequency of greasing
- Refer to the fan and/or bearing IOM for true schedule
- Lubrication maintenance every week to six months
- NOTE: Class I fans have permanently lubricated bearings



RELUBRICATION SCHEDULE (MONTHS) BALL BEARING PILLOW BLOCKS									
SPEED (RPM)	500	1000	1500	2000	2500	3000	3500	4000	4500
SHAFT DIA									
1/2" THRU 1-11/16"	6	6	5	3	3	2	2	2	1
1-15/16" THRU 2-7/16"	6	5	4	2	2	1	1/2	1/4	1/4
2-11/16" THRU 2-15/16"	5	4	3	2	1	1/2	1/2		
3-7/16" THRU 3-15/16"	4	3	2	1	1/2	1/2			

Fan Bearing Maintenance

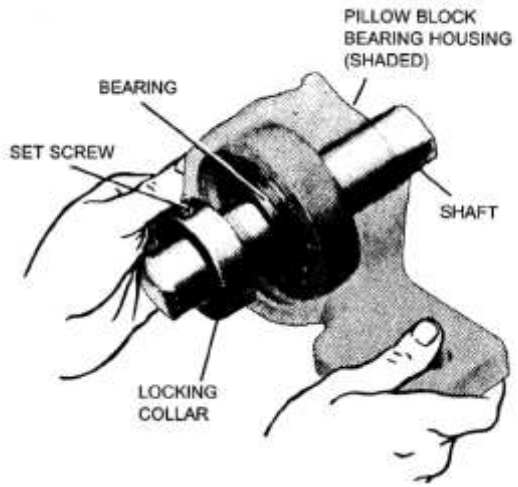
Lubricants Differ……..

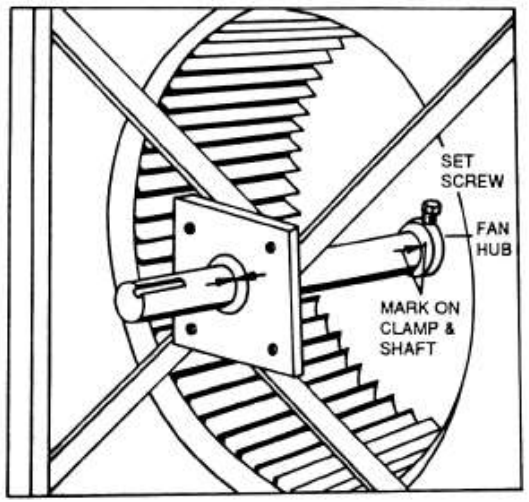
- Use a white Lithium Based Grease
- NLGI Grade #2
- Light Viscosity
- Low Torque
- Free from rust, dust and abrasive material
- -30°F to 200°F

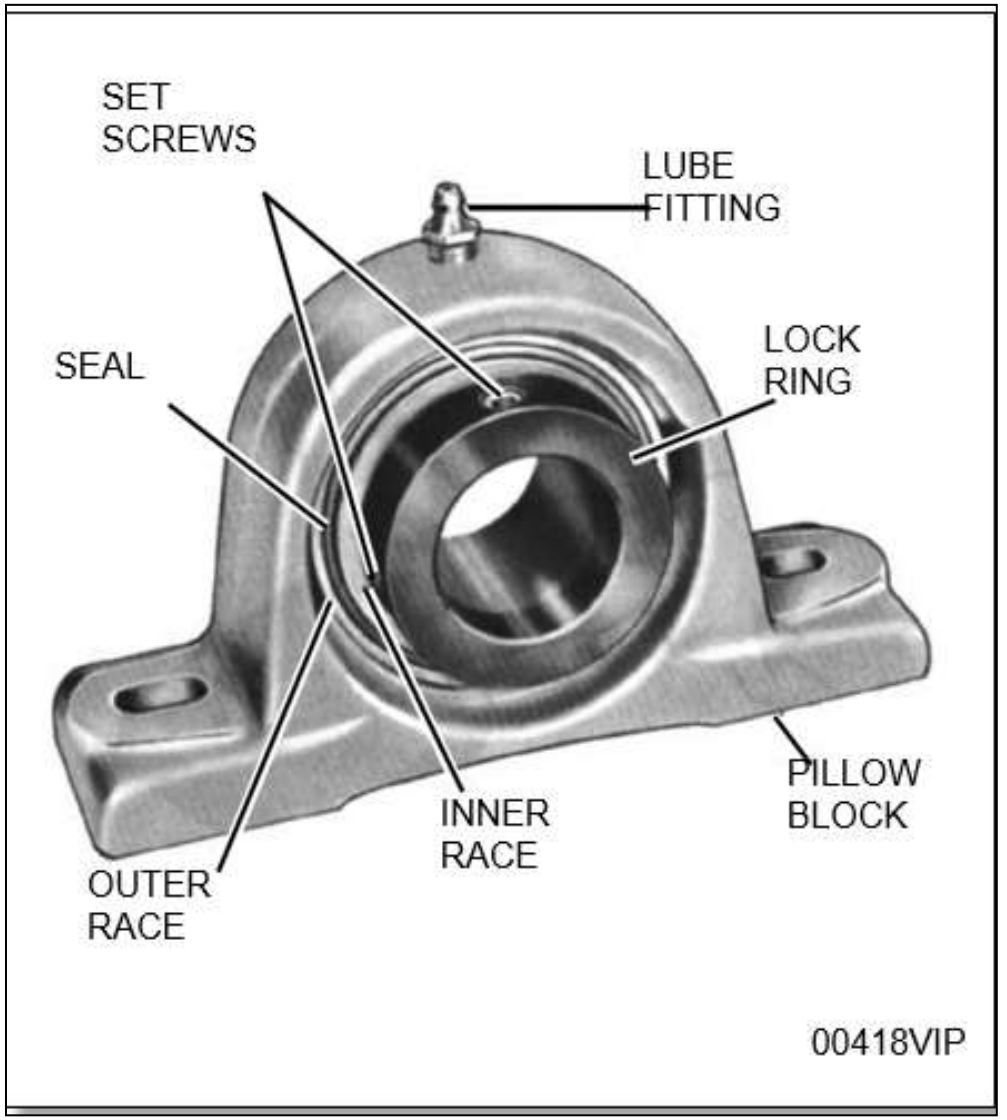
Fan Bearing Locking Device

Locking Device Replacement

- Follow step-by-step procedure recommended by the replacement bearing manufacturer
- NOTE: Direct Drive fans do not have bearings on the fan – only on the motor



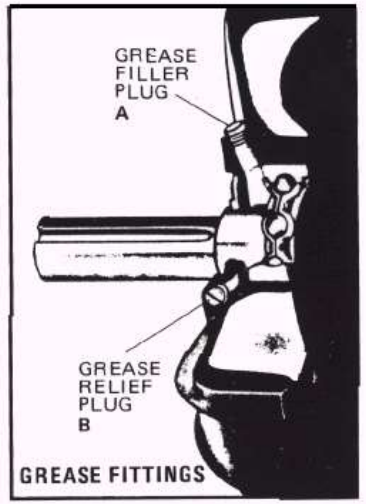




Fan Motor Maintenance

Motor Bearing Service

- High grade ball or roller bearing grease
- Recommended: Polyrex EM
- Zerk Fittings typical
- NOTE: do not over-grease – grease could get into the windings and cause motor issues



NEMA / (IEC) FRAM SIZE	RATED SPEED - RPM					
	10000	6000	3600	1800	1200	900
UP TO 210 INCL. (132)	**	2700 HRS.	5500 HRS.	12000 HRS.	18000 HRS.	22000 HRS.
OVER 210 TO 280 INCL. (180)			3600 HRS.	9500 HRS.	15000 HRS.	18000 HRS.
OVER 280 TO 360 INCL. (180)			*2200 HRS.	7400 HRS.	12000 HRS.	15000 HRS.
OVER 360 TO 5800 INCL. (180)			*2200 HRS.	3500 HRS.	7400 HRS.	10500 HRS.

ECM Motors / Fans – Electronically Commutated Motor

Maintenance Checks

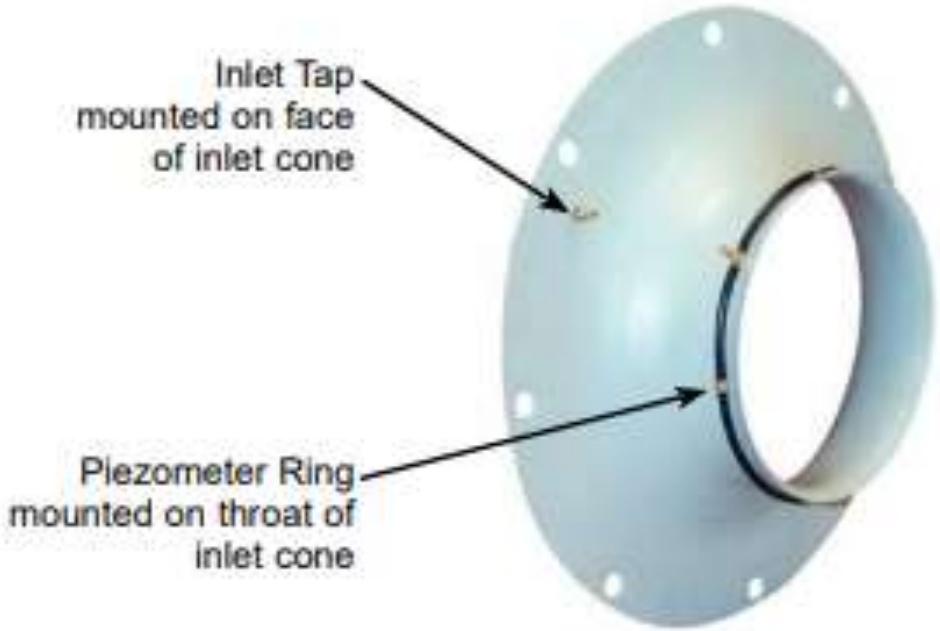
- If motor is continuously blowing fuses, there is an internal short and blower needs replacing
- If fuses are not blown:
  - follow manufacturer recommendations and safeties
  - confirm correct motor voltage
  - confirm resistances
  - confirm fan speed
  - possible fan replacement

Fan – Airflow Measurement

Piezometer Ring

- Flow is calculated by measuring the static pressure drop trough the inlet cone
- Inlet tap is connected to high-pressure side of transducer
- Piezometer ring is connected to low-pressure side
- Accuracy +/- 5%
- K-factor based on size of fan and inlet cone is used to calculate fan CFM

- **Maintenance:** remove dirt build-up by blowing compressed air through fittings and hoses



Fan – Variable Inlet Guide Vanes

Maintenance

- Inspect the linkages
- Clean all bearings
- Lubricate the bearings (SAE 30 oil)

- NOTE: control actuator is field installed to a single shaft extending outside of the drive end for synchronous vane control

Fan Motor Removal Rails

Rails with Legs

Motor removal rail is designed for the weight of one motor and/or fan-motor combo.

Rigger. Contractor or Service Technician to provide the sling, chain, strap, chain fall, ratchet straps in accordance with their safety and jobsite safety requirements.

Bolt-Thru Option

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Control Devices

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Johnson Controls

Protective Air Handler Controls

Low Temperature Limit

Maintenance Checks

- Cap tube is not kinked or cracked
- Cap tube is strung properly and secure
- Trip setting works and is adjustable
- Terminals for tightness

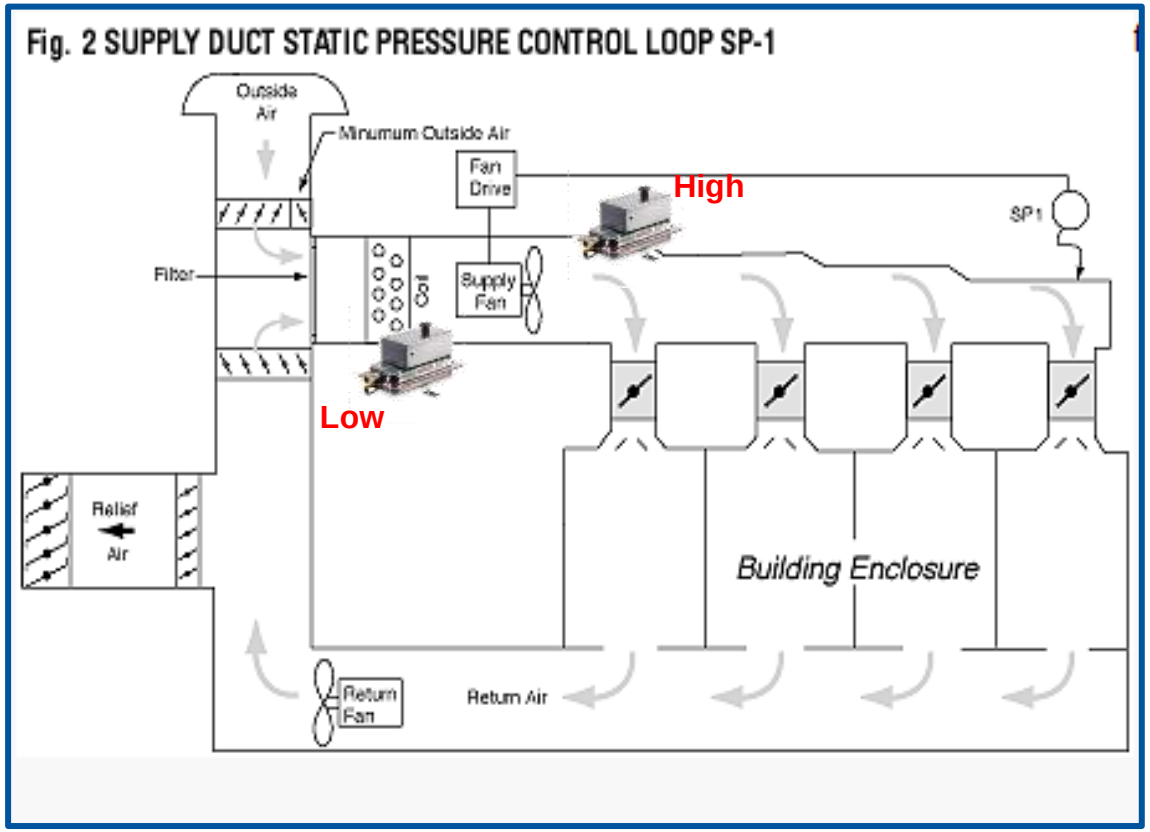
Airflow Paddle Switch

Airflow Pressure Sensing

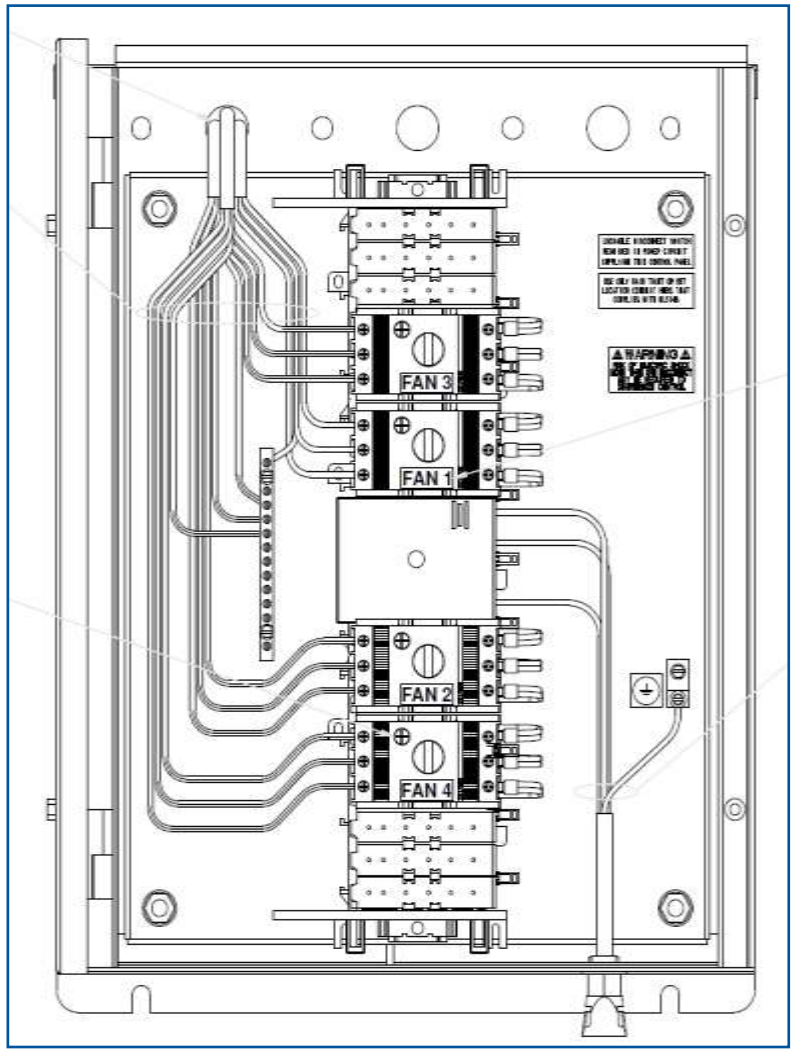
Protective Air Handler Controls

Manual Reset Air Pressure Switch

- Monitor duct static pressure
- Shut down the fan when excess high and/or low pressure occurs
- Manually reset switch before system re-start



Manual Motor Protector (MMP) Panels



- Used on multi-fan arrays
- Overload protection for each motor
- Field adjustable (typical) with dial in amp range size for motors.
- Can act as a manual shut-off
- Power comes from VSD to MPP then out to motors

Control and Electrical Panels

Maintenance Checks

- Check terminals for tightness
  - Torque
  - Snugging up terminals with screwdriver
- Check fuse holders for tightness
- Check fuses, volts and amp readings

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Unit Casing/Housing

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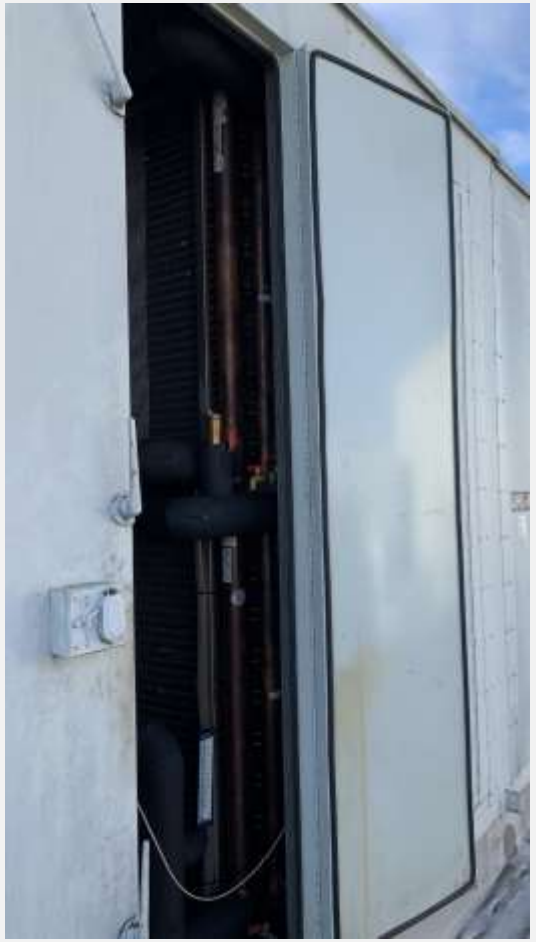
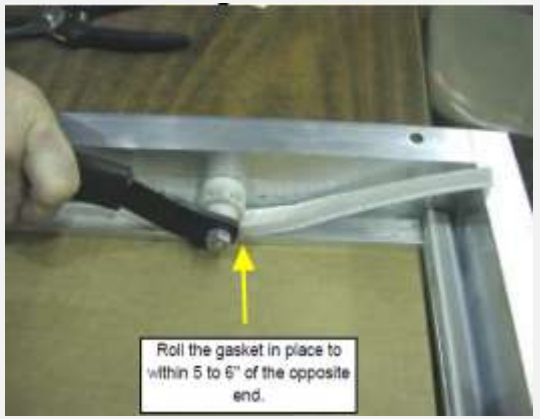
Access Door and Panel Gasketing

Sticky Back Closed Cell Neoprene Gasket



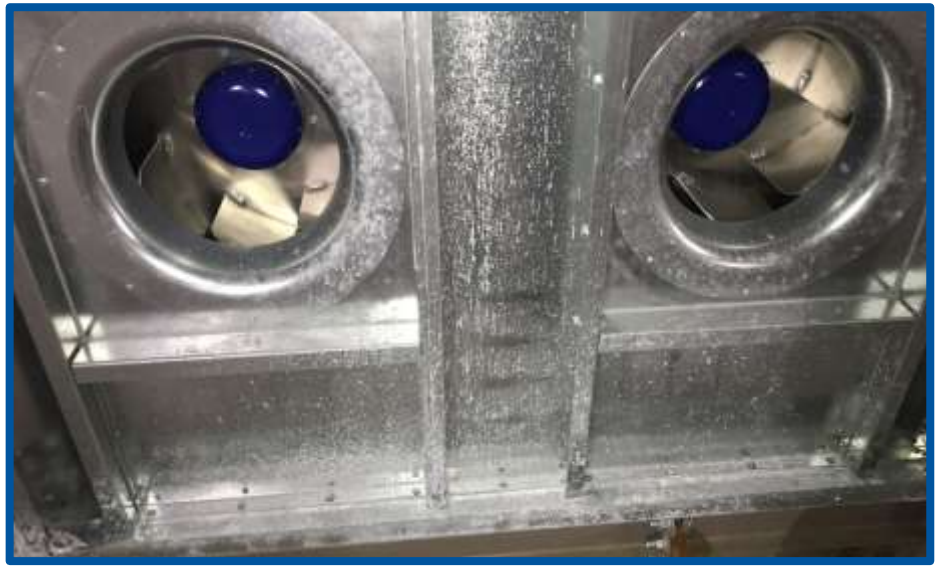
Sticky Back Closed Cell Gasket – Glue Corners and Splices



Galvanized Metal Corrosion Cleaner

Inspection, Prevention and Repair

- Corrosion (White Rust) on Galvanized Metal
- 3M Adhesive Remover
  - Water Leaks
  - Insulation
  - Rust
  - Door Gasket
  - Sealant
  - Roof Coating



Questions?

1. Safety First!
2. What's in the air path?
3. Air mixing section
4. Filters (and other air cleaning devices)
5. Coils (and other things that change the condition of the air)
6. Fan Systems
7. Control devices
8. Unit casing/housing

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Questions?

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Thank You!

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Appendix