

Direct Fired Gas Heated Make Up Air Unit Operation/Installation Manual



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.

FOR YOUR SAFETY

If you smell gas:

- 1. Open windows.
- 2. Don't touch electrical switches.
- 3. Extinguish any open flame.
- 4. Immediately call your gas supplier.

FOR YOUR SAFETY

The use and storage of gasoline or other flammable vapors and liquids in open containers in the vicinity of this appliance is hazardous.



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I. GENERAL INFORMATION

Receiving Equipment

Inspect for damage upon receipt of equipment. The manufacturer thoroughly inspects and tests all units before shipping. When a freight carrier signs for a shipment, they are acknowledging receipt of the shipment and the number of pieces contained in the shipment as compared to the freight bill. When you receive the shipment, carefully read the freight bill and verify that all pieces are received. Note at this time any damaged or missing items on the freight bill before signing. You should get the driver's signature to confirm any damaged or missing pieces (a photograph is a sure way to document this).

Most heaters have options that need to be field installed. Be sure all these are accounted for

before the delivering carrier leaves. Check all items received with the packing list enclosed with the unit.

Inspection for any internal damage should also be made. Any missing parts or damage discovered at a later date may prevent you from having a valid claim with the carrier. If the equipment is not going to be installed immediately, proper storage will prevent damage.

Direct Fired Heating

This Direct Fired Heater is a make up air unit. It is only to be used for installations requiring frequent air changes. Some examples are commercial kitchens, factories, foundries, and paint booths. This unit is NOT designed for space heating. All units can be used with either natural gas or LP gas. Read this manual before beginning installation. Direct fired heaters are designed to operate in a fresh flowing air stream. If the airflow stops or is different from the factory settings, the unit will shut down or perform below its design capability. It is important to follow the installation and start-up procedures to maximize the heater's performance. The manufacturer has designed a unit that is easy to install, start up and service. If you have any questions, call the Service Department at 1-800-334-9256.

II. INTRODUCTION AND OVERVIEW

There are many types of heaters available for commercial use. We will concern ourselves with 100% fresh air (make up air) Direct Fired Gas units for commercial kitchen and industrial use. The advantages of direct fired gas heaters include:

- Low cost per BTU of heating
- Readily available
- Most efficient heat transfer

There are two general types of gas-fired heaters, direct and indirect. *Indirect fired heaters*, like a residential furnace, burn gas inside a metal tube called a heat exchanger. The air that is used to heat the application is heated indirectly when it is passed around the tubes. This air never comes in contact with the flame. The combustion products from the flame inside the tubes are exhausted through a flue pipe to the atmosphere. A *direct fired heater* burns the gas directly in the air stream. The products of combustion are included in the air that is used to heat the application.

III. APPLICATIONS

These direct fired heaters are well suited for a wide range of uses in the commercial and industrial field. For kitchen ventilation, where heated make up air is needed in large volume in cool climates, the direct fired unit is a prime choice. It is able to handle large volumes of air with substantial temperature rise at minimal expense. The units are reliable, and most replacement parts are readily available in the field.

Industrial plants and processes where there is a large amount of air being exhausted are excellent candidates for direct fired units. Where welding hoods and plasma tables are used, the direct fired unit can provide fresh outside air at a comfortable temperature for occupants. Today the trend is toward less user interaction with the heater units. Most customers prefer the unit to sit on the roof, turn on, and run by itself with no user interaction (temperature selection, summer-winter selection, etc.). This means that the field installation has to be done properly; no user interaction can cover up installation problems. Now, more than ever, installation and start up is critical to customer satisfaction and product operation.

IV. THEORY

Energy (heat) must be added to a specific volume of air in order to change its temperature. Direct fired gas heaters create heat by burning gas. Heat is measured in BTU's (British Thermal Units), which is a measure of heat, not temperature.

Temperature vs. Heat

The temperature changes when the energy of a specific volume of air increases or decreases. Energy (in the form of heat) is added to a volume of air and changes the temperature. When this energy is added to different volumes of air, different temperatures are achieved. To further illustrate this point, let's look at how to calculate temperature rise, i.e., the difference between the air temperature after it is heated and before it is heated.

This equation shows that if the CFM's **increase** and the BTU's remain constant, the temperature rise will **decrease**. Conversely, if the CFM's **decrease** and the BTU's remain constant, the temperature rise will **increase**. (See following examples).

Example 1

A heater rated at 200,000 BTU's is currently supplying 3000 CFM of air with a 62° F temperature rise. The heater needs adjustment to supply 4500 CFM of air. What is the temperature rise for this heater (assuming 200,000 maximum available BTU's)?

Using the equation to determine the temperature rise:

 $\Delta T = 200,000/(4500 \times 1.08)$ $\Delta T = 41^{\circ}$

Static Pressure vs. HP

Construction of the ductwork connected to a heater unit is another element in understanding heater operation. Some of the essential elements in understanding ductwork are static pressure, blower curves and motor amperage. Static pressure is the pressure created in the duct by the flow of air. As air is forced through a section of duct, it exerts forces on the walls of the ductwork containing it. The measurement of this force is static pressure and is commonly measured in inches water column using a device called a manometer. As a rule, air travels easily in a straight line and does not like to turn. When we force air in a duct to turn or transition, the air exerts even more force on the walls of the duct and we create more static pressure. As the static pressure increases, the blower moves less air due to the resistance in pushing (or pulling) the air through the duct. This decreases the amount of current that the motor is using to turn the blower wheel (lowers the motor amperage). This relation can be seen on a blower curve, which plots CFM's vs. static pressure as a function of blower RPM and motor horsepower. Looking at the blower curve, pick a given CFM and static pressure to determine the blower RPMs and motor horsepower. Example 2 illustrates the use of the blower curve.

Example 2

A unit with a 15" wheel is set to run at 4000 CFM with 0.125" of static pressure. What was the factory RPM setting and motor HP? During the installation, however, turns were added to the ductwork to avoid interference with some of the building structure, bringing the static pressure up to 0.25". What do the new RPM's need to be, and do we need a different motor?



15" Blower Curve

First we can determine what size motor and what blower RPM has been set by the factory based on the initial static pressure numbers. By looking on the 15" Blower Curve, we pick the intersection of 0.125" (from the left axis) and 4000 CFM (from the bottom axis). This point is just below the 700 RPM line indicating a blower speed of approximately 690 RPM. This point is also to the left of the 1.5 horsepower line, indicating a 1.5 horsepower motor was probably supplied. Next, we can determine the new blower RPM and what motor will be needed. By looking at the 15" Blower Curve again, pick the intersection of the 0.25" static pressure at 4000 CFM's. This point is halfway between the 700 and 800 RPM curves, indicating that approximately 750 RPM's will be required from the blower. The correct motor for this situation would NOT be the 1.5 horsepower. because the point is to the right of the 1.5 horsepower curve. The correct choice would be a V. OPERATION PRINCIPLES 2 horsepower (it is to the left of the 2 horsepower line).

Gas Flow

Another critical element in understanding heater operation is gas flow. Gas pressure changes based on flow rates. A simple example of this is shown in example 3, where a portion of the plumbing is smaller in the middle. This could represent a device in the line such as a gas valve. Note in the first illustration, with no gas flow, there is equal pressure in both sections of the pipe (P1 and P2). In the second illustration, where the gas is flowing, the second section of pipe has much less pressure than the first (P2 is less than P1).

Example 3



Illustration 1: No gas flow. P1 = P2



Illustration 2: Gas flow from left to right. P1 > P2

This is important because the incoming gas pressure is often measured when the heater is not running. Even though the line may appear to have the appropriate pressure, the pressure will drop when the heater is operating. If the gas supply system is sized properly, the upstream regulator will compensate for the drop, and increase the pressure to the heater.

Another important part of heater performance relates to the heating value of the fuel. Natural gas has Methane as its main constituent, while LP consists of Propane. The same heater is capable of burning both of these fuels, however, the volume required for LP is roughly half the volume required for natural gas for the same BTU's. This is because natural gas (-380,000 BTU/lbmol) has a heating value that is approximately half the heating value of Propane (-955,000 BTU/lbmol).

The direct-fired heater is most easily understood when broken down into smaller individual systems. There are two main systems, a make-up air fan and a heater. The make-up air fan consists of a heavy-duty blower and motor. The heater may be further broken down into two control systems, the Flame Safety Control (FSC) and the Modulating Gas System (MGS). The burner mixes air with the gas (Natural or Propane) which heats the air.



Fireye 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 an ultraviolet (UV) sensor mounted on top of the burner assembly to view the flame in the burner. The FSC is also wired into an airflow switch, which tells it whether there is proper airflow through the unit (not just any airflow, but proper airflow). The FSC controls the opening of the redundant solenoid gas valves and the operation of the spark ignitor to initiate a pilot flame upon start-up. When there is a call for heat, the OPR CTRL light will turn on indicating that the unit has power. Next, the airflow light will come on if there is proper airflow through the unit. Third, the unit will pause ten (10) seconds to purge any gasses or combustible vapors before attempting flame ignition. Then, there is a Pilot Trial for Ignition (PTFI) and the PTFI light comes on. During PTFI, the FSC opens the redundant gas valves and allows gas to bypass to the modulating valve (part of the Maxitrol system). The Maxitrol valve is not yet energized, so there is a minimal amount of gas passing through it (called "low fire"). At the same moment, the spark igniter is started, causing the spark plug in the burner to ignite the gas. This results in a low fire or pilot flame. When the UV sensor detects the flame it turns on the flame light, turns off the PTFI light, and powers the modulating gas system. This is the normal operating mode. The FSC continues to monitor the flame and airflow.

The **airflow switch** is a single pole double throw (one common contact, one normally open contact, and one normally closed contact) switch that is "switched" by air pressure. There are two opposing airflow tubes in the heater, located near the burner and profile plate assembly (profile plates surround the burner and channel air into the burner section). With the differential pressure created in the airflow switch by suction on one tube and velocity pressure on the other, the switch



Airflow Switch With Cover Removed

will change state, indicating airflow. In the case of clogged filters or a blocked intake, a differential pressure is not achieved, not allowing the airflow switch to close. With high static pressure or lack of blower movement, no suction is placed on the rearward-facing port and a differential pressure is again not achieved. The airflow switch may need to be adjusted for different pressures that occur at different CFM's.

The other system, **the Maxitrol modulating gas system**, consists of a temperature selector dial, a discharge air sensor, an amplifier, and a modulating gas valve. The two types of Maxitrol systems found on these units are the Maxitrol 14 and the Maxitrol 44. The Maxitrol 14 utilizes a discharge air sensor and modulates the discharge air to the selected temperature on the temperature selector dial. The Maxitrol 44 utilizes a room temperature sensor as well as a discharge air sensor in order to control the room temperature. The modulating gas valve controls the amount of gas to the burner based on the temperature rise needed. When the modulating gas valve is all the way open and achieving the maximum BTU's and temperature rise of the unit, it is called "high fire".



Maxitrol 14 Amplifier

One back up safety device is the **high temperature limit** switch. This switch is a mechanical thermostat that measures the temperature inside the unit directly above the burner. If the factory set temperature is exceeded, it will shut down the power to the FSC. This requires a manual reset. The pre-set temperature that the factory uses is based on the temperature above the burner when the outlet temperature is 185° F. The settings are as follows:



Honeywell High Temperature Limit

#1 Size	160° F
#2 Size	150° F
#3 Size	225° F
#4 Size	245° F
#5 Size	150° F

ALL HEATERS BY THIS MANUFACTURER HAVE REDUNDANT GAS VALVES.

Heaters set for less than 700,000 BTU's use a combination gas valve. The combination gas valve has redundant solenoids and a regulator built into one body. Larger heaters use a regulator and two separate solenoid valves. The redundant gas valves shut gas flow off to the burner in case of a malfunction, no call for heat, or power outage. They are normally closed, and are energized by the Fireye FSC. The regulator controls the gas pressure going into the gas train from the supply line. The "high fire" setting for the heater unit (maximum temperature rise) is adjusted by the regulator before the two redundant solenoid valves or on the combination gas valve (whichever the case may be).

The following is a summary of a normal start for a direct fired gas heater:

- With the blower already running
 - ✓ The summer-winter switch is set to winter OR
 - ✓ The outside air temperature falls below the setting of the outside air override
- The FSC is energized and the following occurs:
 - ✓ Indicates that it has power by turning on the "Opr Ctrl" light
 - ✓ Verifies airflow and turns on the "Airflow" light
 - ✓ Pauses 10 seconds to purge the air in the heater
 - ✓ Begins Pilot Trial for Ignition and turns on the "PTFI" light
 - ✓ The redundant gas solenoid valves are opened, the Honeywell spark igniter begins sparking and the UV sensor watches for flame initiation
 - ✓ When flame is established, the "PTFI" light turns off and the "Flame" light turns on
 - ✓ The Maxitrol system is powered and the unit begins heating
 - ✓ The FSC monitors the flame while the Maxitrol system adjusts to the selected temperature
- The Maxitrol system checks the discharge air temperature (and the room temperature for the Maxitrol 44) and regulates the gas going to the burner to satisfy the temperature setting.
- The last light on the Fireye is the "Alarm" light. This will turn on when the Fireye determines an unsafe condition, and won't allow the unit to recycle for heat until it has been properly reset. Anytime the Fireye flame safety has gone into "Alarm" mode, the problem must be diagnosed and corrected to avoid future lockouts after resetting. To begin troubleshooting, or to reset the Fireye, the following procedure must be used (just pushing the reset button does NOT reset the unit)
- With the power to the unit
 - ✓ Push the reset button on the Fireye
 - ✓ Turn power off (the 5 Amp circuit breaker is convenient for this)
 - \checkmark Turn power back on and allow the heater to start up

VI. HEATER COMPONENTS



 Freeze-Stat Timer (Optional) Allows heater to run long enough so that it won't shut off before reaching operating temperature. Must be used with the thermostat below. The settings should be on the yellow scale: Time sector - 30m

Time value - 10m Red Switch to Right

- 2. **Freeze-Stat Thermostat** (Optional) This turns the heater off if the discharge air temperature falls below the set point. The recommended set point is 40 deg. Must be used with the timer above.
- 3. **Starter/Overload** A contractor with overload protection installed as an option in units not used with a prewired control package.
- 4. Transformer Provides 24V AC power to Maxitrol system.
- 5. Fireye Flame Safety Control (FSC) Initiates flame and monitors it for safety.
- 6. Transformer Provides 24V AC power to combination gas valve.
- 7. Temperature Selector Allows the selection of the discharge air temperature.
- 8. Maxitrol Modulating Amplifier Regulates temperature by modulating gas valve.
- 9. Ignition Module Produces high voltage spark to ignite burner.
- 10. **High Temperature Limit Control** Shuts off burner control when temperature of discharge air exceeds safe operating levels.
- 11. **Airflow Switch** A safety device to insure proper air flow during burner operation. Burner will shut off if air flow is lost.
- 12. **Outside Air Override** This will automatically turn heater circuit on when the outside air temperature falls below its set point.
- 13. **Combination Gas Valve** A combination of redundant solenoid valves and gas regulator built into one unit. This valve opens when the Burner Control is in the PTFI mode.
- 14. **Modulating Gas Valve** After a successful pilot, this valve is opened and modulates to provide the desired discharge air temperature.
- 15. Inlet Gas Pressure Tap Inlet gas pressure should be measured here when the heater is locked in high fire.

VII. HEATER INSTALLATION PROCEDURE

When separate technicians perform these installations, please leave this manual for the next technician to perform their installation. When the final start-up is completed, you must return the Warranty form to **activate** the warranty.

Service Department 117 Franklin Park Ave Youngsville, NC 27596 919-554-4605 Fax

It is imperative that this unit is operated with the designed airflow, electrical and gas supply in accordance with the following installation sections. If there are any questions about any items, please call the service department at 1-800-334-9256 before performing them.

Mechanical Installation

The following tools are necessary for installation and start-up:

- Manometer Volt/Ohm Meter Amp Meter
- Tachometer
- Thermometer
- Standard Hand Tools

The label for this unit specifies the tested CFM and static pressure. For the gas and electrical components to function properly it is important that the unit produce the designed airflow. The ductwork attached to this unit will significantly affect the airflow performance. DO NOT use flexible ductwork, square turns, and plenum boxes. These will increase the static pressure and reduce airflow. Carefully raise the unit to its installation point. The unit should be installed on a curb and/or rail elevated not less than 14" above any surface. Make sure the unit is mounted level, and all attachments are properly sealed with silicone caulking. If there is a motorized damper make sure any wires are routed for the job site electrician.





Plumbing Installation

This unit is designed for a constant 7" W.C. Natural gas supply, (LP should be 11") when the unit is in high fire. If the gas supply exceeds 14" W.C. it will damage the internal components and if it is below 7" W.C. it may not perform to specifications. Insure that all connections are well sealed, and the factory supplied external ball valve is installed to shut down the gas supply. The incoming pipe should be sized to match the connections on the outside of the unit. Avoid multiple taps in the gas supply so the unit has a steady supply of gas at all times. Blow out the gas line to remove debris before making connections. Purge line to remove air before attempting to start unit.

Pipe sizes are listed below:

Model	Pipe Size (NPT)
#1	3/4"
#2	1"
#3	1"
#4	11/4"
#5	11/4"

Electrical Installation

This unit uses two separate circuits. The controls are run from a dedicated 120V circuit. The 120V circuit only requires 5 Amps of service, however, a dedicated 20 Amp service is recommended. The motor circuit should be supplied by a dedicated branch circuit with short circuit protection according to the National Electric Code. Two flexible conduits are provided exiting the floor of the unit inside the curb. One contains the motor circuit wires and the other the control circuit wires. Refer to the performance label for incoming power requirements. Make sure the interior of the heater is free of loose debris or shipping materials. Verify that the blower is rotating in the right direction. For 3 Phase motors, interchange any two leads to reverse rotation. For single phase motors refer to instructions on motor.

N	DIACK White	IZUV ⊟UL 120V/ Neutral
1	Blue	120V Supply to remote starter and/or heat shut off switch
2	Brown	120V Return wire from remote heat shut off switch.
he H and N res the hear mote starter	wires are require t function will no or heat shut off	ed for all units to supply power to the control circuit. Without these t work! Wires 1 and 2 should be individually capped off if there is no ⁵ switch.
ere may be	some additiona	I option wires with this unit. They are as follows:
8	Gray	120V Airflow indication (may be used for exhaust interlock)
11	Red	120V Burner on indication
33	Yellow	120V Safety lockout indication
T4 & T5	Red/Black	DC shielded cable for remote temperature control
I the previou	us wires are for t	he control circuit and are located in the control conduit.
	are the designa	tions for the motor wires
e following		Motor line voltage
e following	Black	
e following	Black White	120V Neutral (It single Phase)
ne following	Black White Green	Earth ground

VIII.START-UP PROCEDURE



NOTE: The start up procedure should be followed in the order outlined at left. Failure to do so may result in unit not performing properly. Follow procedures to make adjustments. These adjustments should be made after Ventilation System has been balanced.

To Adjust Air Flow Switch:

With heater in HEAT mode, slowly turn air flow switch adjustment until air flow light goes out on FSC. Then turn back one half turn.

Setting Incoming Pressure:

Pressure must be measured at first "T" in supply gas line before the first gas valve.

Adjusting High Fire:

Remove wire #4 from the Maxitrol amplifier. This will drive the valve into its full open position. Adjust high fire with the regulator inside the unit. Turn clockwise to increase.

Adjusting Low Fire:

Remove terminal #5 from the Maxitrol amplifier. This will drive the valve into its lowest position. Adjust the low fire by turning the low fire bypass on the side of the modulating valve for M511 and M611 models. For MR212D, the low and high fire are both inside the valve. Refer to the included Maxitrol literature.

IX. TROUBLE SHOOTING CHART









Typical Wiring Diagram for Heater with Remote Starters

X. ELECTRICAL DIAGRAMS



Typical Pre-Wire for Exhaust Fan and Make Up Air Heater







Typical Heater Wiring Diagram With Starter/Overload in Unit

XI. OPERATION AND INSTALLATION NOTES FOR CANADIAN UNITS ONLY

- Keep this owners manual in an accessible place to answer questions about the unit.
- A low temperature limit control is needed for areas where the ambient air temperature is below -40° F at the controls (Freeze-Stat)
- The unit shall be installed in accordance with the installation code for gas burning appliances and equipment, CGA B149, and applicable provincial regulations for the class; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.
- The unit shall be installed such that no source of flammable vapor gasses or dust shall be within 20 ft horizontally of any unit unless that source is separated from the unit by an enclosure of fire and vapor resistive materials.
- The unit shall be installed to prevent snow, rain or deleterious material from entering the unit.
- All air shall be brought directly from the outdoors.
- The total air discharge capacity of the unit shall not exceed by more than 10% the total discharge capacity of the exhaust system(s) in conjunction with which it is used. Where the tempered air is discharged directly

XII. MAINTENANCE

- Monthly
 - Remove and clean the filters using a mild degreaser and water.
 - ✓ Check belt tension and pulley alignment.
- Yearly
 - ✓ Check for gas leaks and repair as needed.
 - ✓ Check all controls for proper operation.
 - ✓ Clean flame sensor (for an ultraviolet sensor, wipe the lense with a damp cloth. For a flame rod, rub with steel wool to remove any rust build-up.
 - ✓ Clean burner with a wire brush and ensure the burner ports are free of debris. Then wipe down with a clean rag.

FILTER SIZES									
UNIT	STAND	ALONE	ROOF T	OP PKG					
	QTY	SIZE	QTY	SIZE					
#1	2	16 X 20	1	20 X 25					
#2	3	16 X 25	2	20 X 25					
#3	6	16 X 20	6	16 X 20					
#4	8	20 X 25	8	20 X 25					
#5	10	20 X 25							

into a booth, the total air discharge capacity shall not exceed the exhaust capacity of that booth.

- The unit shall be installed such that in the event the unit creates a hazard to other fuel burning equipment in the building, the unit shall be interlocked to open balancing inlet air dampers.
- The unit shall be electrically interlocked such that it will operate only when the associated exhaust system(s) is energized. An exhaust flow proving device must be installed, except on multiple exhaust systems where a measuring device electrically interlocked with the unit may perform both functions.
- The unit shall be installed such that the content of toxic vapors and gasses in the tempered air at the point of discharge into the building will not cause irritating effects during normal operation, and the installation shall not be considered acceptable if the discharged toxic products are known to exceed the limits listed below:

Acetaldehyde -10 ppm	Formaldehyde25 ppm
Carbon dioxide- 2500 ppm	Nitrogen dioxide - 1 ppm
Carbon monoxide- 10 ppm	Sulfur dioxide5 ppm

- The unit shall be used solely for replacing exhausted inside air with heated outside air.
- The unit shall be installed such that the temperature of any adjacent combustible materials shall not exceed 90° F above an ambient temperature of 77° F.

• Re-Setting of the Unit If the flame safety control is locked out (alarm light on), reset the unit by:

1. Pressing the reset button on the FIREYE BURNER control.

- 2. Turn off power to unit.
- 3. Wait 10 seconds and turn power back on.
- Emergency Shut-Down

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

- 1. Turn power off the unit from downstairs.
- 2. At the unit, turn the external disconnect switch to the off position.
- 3. At the unit, close the inlet gas valve located on the heater.
- Prolonged shut down of the unit

For prolonged shutdown, the following steps should be done:

- 1. At the unit, turn the external disconnect switch to the off position.
- 2. At the unit, close the inlet gas valve located on the heater.
- To restart the unit, the following steps should be done:
 - 1. At the unit, turn the external disconnect switch to the on position.
 - 2. At the unit, open the gas valve located on the heater.

XIII.PULLEY SELECTION CHART

- 1. Choose the motor pulley based on the HP of the motor.
- 2. Look up the RPMs needed in the white area as close to the center as possible.
- 3. Read the blower pulley from the left column.

4. Read the number of turns to set the motor pulley for the desired RPMs. (0 turns is when the motor pulley is adjusted clockwise until it is tight.

0 to 2 HP		МОТО	R PULL	EY P	d1	Pd2							
Us	ing A Belts	IVL40			2.4	3.4							
					Т	urns on	Motor I	Pulley					
	Blower Pulley	Pd	0	1/2	1	1½	2	2 ½	3	3 ½	4	4 ½	5
	AK32	3	2012	1953	1893	1834	1775	1716	1657	1598	1538	1479	1420
	AK39	3.5	1724	1674	1623	1572	1521	1471	1420	1369	1319	1268	1217
	AK46	4.2	1437	1395	1352	1310	1268	1226	1183	1141	1099	1057	1014
	AK54	5	1207	1172	1136	1101	1065	1030	994	959	923	888	852
	AK66	6.2	973	945	916	888	859	830	802	773	744	716	687
	AK79	7.5	805	781	757	734	710	686	663	639	615	592	568
	AK94	9	671	651	631	611	592	572	552	533	513	493	473
	AK114	11	549	533	516	500	484	468	452	436	420	403	387

3 to 20 HP	MOTOR PULLEY	Pd1	Pd2
Using BX Belts	2VP60	4.3	5.5

rums on Motor Pulley												
Blower Pulley	Pd	0	1/2	1	1½	2	2 ½	3	3 ½	4	4 ½	5
2BK36H	3.4	2871	2809	2746	2683	2621	2558	2495	2433	2370	2308	2245
2BK40H	3.6	2712	2653	2593	2534	2475	2416	2357	2298	2238	2179	2120
2BK45H	3.9	2503	2449	2394	2339	2285	2230	2176	2121	2066	2012	1957
2BK50H	4.4	2219	2170	2122	2074	2025	1977	1928	1880	1831	1783	1735
2BK55H	4.9	1992	1949	1905	1862	1818	1775	1732	1688	1645	1601	1558
2BK60H	5.4	1808	1768	1729	1690	1650	1611	1571	1532	1492	1453	1413
2BK65H	5.9	1655	1619	1582	1546	1510	1474	1438	1402	1366	1330	1294
2BK70H	6.4	1525	1492	1459	1426	1392	1359	1326	1292	1259	1226	1193
2BK80H	7.4	1319	1290	1262	1233	1204	1175	1147	1118	1089	1060	1031
2BK90H	8.4	1162	1137	1111	1086	1061	1035	1010	985	959	934	909
2BK100H	9.4	1039	1016	993	971	948	925	903	880	857	835	812
2BK110H	10.4	939	918	898	877	857	836	816	795	775	754	734
2BK120H	11.4	856	838	819	800	782	763	744	726	707	688	670
2BK130H	12.4	787	770	753	736	719	701	684	667	650	633	616
2BK140H	13.4	729	713	697	681	665	649	633	617	601	585	570
2BK160H	15.4	634	620	606	592	579	565	551	537	523	509	496

Irps on Motor Pullov

DESIGN CHANGES Acme reserves the right to make changes in design, improvements and additions in and to its products any time without imposing any liability or obligations to itself to apply or install the same in any product manufactured by it.

TITLE The title and right of possession of the equipment sold herein shall remain with the Company and such equipment shall remain personal property until all payments herein (in-

TERMS AND CONDITIONS

cluding deferred payments whether evidenced by notes or otherwise) shall have been made in full in cash and the Purchaser agrees to do all acts necessary to perfect and maintain such right and title in the Company.

SAFETY ACCESSORIES The Company manufactures equipment designed to serve multiple applications and offers a wide range of safety equipment, including guards and other devices, as may be required to meet customer specifications. Without exception, the Company recommends that all orders include applicable safety devices. Equipment ordered without applicable safety devices is clearly the responsibility of the Purchaser. Further, the Purchaser warrants that he has determined and acquired any and all safety devices required for equipment sold by the Company. Weather covers and guards for motor and V-belt drives, couplings, shafts and bearings, along with inlet and outlet screens, are optional accessories noted in the price list.

These instructions cover the usual installation, operation and maintenance methods for which the product(s) was designed. They do not purport to cover all details or variations in the product(s) nor to provide for every possible contingency that might be met in connection with the installation, operation and maintenance. For any departures from these instructions, or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the Company.

WARNING Acme products are designed and manufactured to provide reliable performance but they are not guaranteed to be 100% free of defects. Even reliable products will experience occasional failures and this possibility should be recognized by the User. If these products are used in a life support ventilation system where failure could result in loss or injury, the User should provide adequate back-up ventilation, supplementary natural ventilation or failure alarm system, or acknowledge willingness to accept the risk of such loss or injury.

WARNING DO NOT use in HAZARDOUS ENVIRONMENTS where fan's electrical system could provide ignition to combustible or flammable materials unless unit is specifically built for hazardous environments.

CAUTION Guards must be installed when fan is within reach of personnel or within seven (7) feet (2.134 m) of working level or when deemed advisable for safety.

DISCLAIMER The Company has made a diligent effort to illustrate and describe the products in this literature accurately; however, such illustrations and descriptions are for the sole purpose of identification, and do not express or imply a warranty that the products are merchantable, or fit for a particular purpose, or that the products will necessarily conform to the illustrations or descriptions or dimensions.

WARRANTY AND DISCLAIMER: The Company extends this limited warranty to the original buyer and warrants that products manufactured by the Company shall be free from original defects in workmanship and mate-rials for one year from date of shipment, provided same have been properly stored, installed, serviced, maintained and operated Warranty Start-Up sheet must be returned within 30 days of start-up. This warranty shall not apply to products which have been altered or repaired without the Company's express authorization, or altered or repaired in any way so as, in the Company's judgment, to affect its performance or reliability, nor which have been improperly installed or subjected to misuse, negligence, or accident, or incorrectly used in combination with other substances. The Buyer assumes all risks and liability for results of use of the products. Warranties on purchased parts, such as but not limited to bearings, sheaves, belts, couplings, electric motors, pumps and controls are limited to the terms of warranty extended by our supplier.

Polyethylene tubing and cooling pads are warranted to be free of defects in material and workmanship for a period of 90 days from date of shipment and a like warranty applies to the cross fluted cellular type cooling cells for a period of two years from date of shipment provided same have been properly handled, stored, installed, serviced, maintained and operated. And further, not subjected to excessive heat, corrosive agents or chemicals, or mechanical abuse that may cause tearing, crushing or undue deterioration nor used on a system or in a manner other than that for which it was designed as explained in the product literature.



ACME ENGINEERING AND MANUFACTURING CORPORATION P.O. Box 978 Muskogee, Oklahoma 74402 918/682-7791 Fax: 918/682-0134 acmefan@acmefan.com www.acmefan.com

LIMITED WARRANTY

LIMITATION OF REMEDY AND DAMAGES: All claims under this warranty must be made in writing and delivered to P. O. Box 978, Muskogee, Oklahoma, 74402, within 15 days after discovery of the defect and prior to the expiration of one year from the date of shipment by the Company of the product claimed defective, and Buyer shall be barred from any remedy if Buyer fails to make such claim within such period.

Within 30 days after receipt of a timely claim, the Company shall have the option either to inspect the product while in Buyer's possession or to request Buyer to return the product to the Company at Buyer's expense for inspection by the Company. The Company shall replace, or at its option repair, free of charge, any product it determines to be defective, and it shall ship the repaired or replacement product to Buyer F.O.B. point of shipment; provided, however, if circumstances are such as in the Company's judgment to prohibit repair or replacement to remedy the warranted defects, the Buyer's sole and exclusive remedy shall be a refund to the Buyer of any part of the invoice price, paid to the Company, for the defective product or part.

The Company is not responsible for the cost of removal of the defective product or part, damages due to removal, or any expenses incurred in shipping the product or part to or from the Company's plant, or the installation of the repaired or replaced product or part.

Implied warranties, when applicable, shall commence upon the same date as the express warranty provided above, and shall, except for warranties of title, extend only for the duration of the express warranty. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to

you. The only remedy provided to you under an applicable implied warranty and the express warranty shall be the remedy provided under the express warranty, subject to the terms and conditions contained therein. The Company shall not be liable for incidental and consequential losses and damages under the express warranty, any applicable implied warranty, or claims for negligence, except to the extent that this limitation is found to be unenforceable under applicable state law. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

No employee, agent, dealer, or other person is authorized to give any warranties on behalf of the Company or to assume for the Company any other liability in connection with any of its products except in writing and signed by an officer of the Company.

REPLACEMENT PARTS If replacement parts are ordered, buyer warrants that the original components in which these replacement parts will be placed are in satisfactory working condition, and when said replacement parts are installed, the resultant installation will operate in a safe manner, at speeds and temperatures for which the original equipment was purchased.

TECHNICAL ADVICE AND RECOMMENDA-TIONS, DISCLAIMER: Notwithstanding any past practice or dealings or any custom of the trade, sales shall not include the furnishing of technical advice or assistance or system design. Any such assistance shall be at the Company's sole option and may be subject to additional charge.

The Company assumes no obligation or liability on account of any recommendations, opinions or advice as to the choice, installation or use of products. Any such recommendations, opinions or advice are given and shall be accepted at your own risk and shall not constitute any warranty or guarantee of such products or their performance.

GENERAL In no event shall any claim for consequential damages be made by either party. The Company will comply with all applicable Federal, State, and local laws.