WELLESLEY MUNICIPAL

MUNICIPAL LIGHT PLANT & DEPARTMENT OF PUBLIC WORKS

O&M MANUAL

WELLESLEY MUNICIPAL

INDEX

USER'S INFORMATION MANUAL

ACCU-3D

R-410A OUTDOOR SPLIT-SYSTEM AIR CONDITIONING OR HEAT PUMP

MODELS: 13 SEER
CZB / AC3B / AL3B / YZB / HC3B / HL3B SERIES
1-1/2 TO 5 TONS

ARI Standard 210/240 Unitary Heat Pumps

C UL US LISTED

ISO 9001 Certified Quality Management System

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CONTACT INFORMATION

- Go to website at www.york.com click on "contact", then click on "contact form" and follow the instructions.
- Contact us by mail:

York International
Consumer Relations
5005 York Drive
Norman, OK 73069

SECTION I: SAFETY

⚠WARNING

This product must be installed and serviced by a qualified installer or service agency. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage.

SECTION II: THERMOSTATS

YOUR KEY TO COMFORT

Though thermostats may vary widely in appearance they are all designed to perform the same basic function, to control the operation of your air conditioning or heat pump system. Regardless of size or shape, each thermostat will feature a temperature indicator; a dial, arm or push button for selection of the desired temperature; a fan switch to choose the indoor fan operation; and a comfort switch for you to select the system mode of operation.

Only approved thermostats have been tested and are fully compatible with this equipment. *Please be aware that many different thermostats operate on batteries or "power stealing" principals. These types of thermostats can not be supported as trouble free when used with this product.*

The following illustrations and discussion will aid you to determine which type of thermostat you have for your system.

A complete operating instruction is provided by the manufacturer for each thermostat. Familiarize yourself with its proper operation to obtain the maximum comfort with a minimum of energy consumption.

COOLING ONLY

If your air conditioning system is designed to provide cooling only (AC), with no capability for heating operation (heat pump), a one-stage cooling only thermostat, with a manual, one-position "Cool" and "Off" comfort switch is all that is required for system operation.

NOTE: If you have an independent heating system (with a separate thermostat), always be sure the heating control is turned "Off" before turning on the cooling system.

COOLING AND HEATING (HEAT PUMP)

If your system has been designed to allow both cooling and heating operation, you may have either a manual change-over type, or a programmable electronic type thermostat.

MANUAL CHANGE-OVER

Manual change-over simply means that the comfort switch must be manually positioned every time you wish to switch from the cooling to heating or heating to cooling modes of operation.

SECTION III: PROGRAMMABLE ELECTRONIC THERMOSTATS

The computerized electronic thermostat is actually a sophisticated electronic version of a manual change-over type. This thermostat includes features which allow "set-back" temperature variations for periods of sleep, or while you are away during the day, and means energy savings for you. The thermostat also features a digital clock.

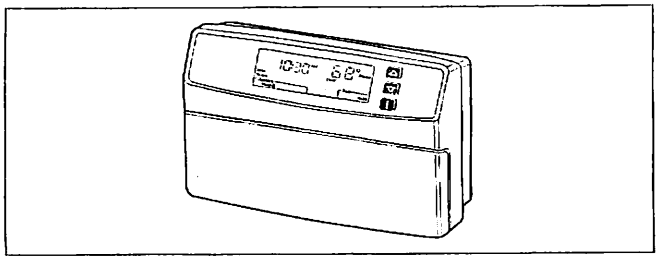


FIGURE 1: PROGRAMMABLE ELECTRONIC THERMOSTAT

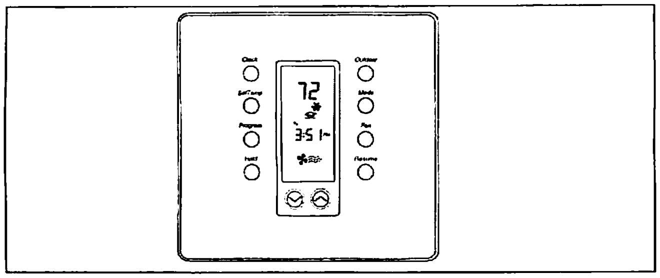


FIGURE 2: PROGRAMMABLE ELECTRONIC THERMOSTAT

FAN OPERATION SELECTION

A multi-position fan switch allows you to choose the type of fan operation of the indoor fan.

AUTO

With the thermostat fan switch set to "AUTO", the fan will run intermittently as required for either heating or cooling. This position will provide the lowest operating cost. If you purchased one of our thermostats, they have an Intelligent fan mode which continually circulates the air during occupied modes or when you are at home, and can cycle the fan during unoccupied mode or during the night while you sleep to further conserve energy.

ON

CONTINUOUS FAN OPERATION: With the thermostat fan switch set to "ON", the indoor fan will not shut off. However, the cooling (AC) or heating (heat pump) systems will still operate as required by room temperatures. This provides continuous air filtering and more even temperature distribution to all conditioned spaces.

FAN ONLY OPERATION: On moderate days, usually during spring and fall, when neither heating nor cooling is required, you may want to run only the fan to ventilate, circulate and filter the air in your home or building. Set the comfort control switch to "OFF" and the fan switch to "ON". Be sure to return the switches to their original positions for normal operation.

SECTION IV: START-UP

The maximum and minimum conditions for operation must be observed to assure a system that will give maximum performance with minimum service.

TABLE 1: APPLICATION LIMITATIONS

Air Temperature DB at Outdoor Coil, °F				Air Temperature DB at Indoor Coil, °F			
Min.		Max.		Min.		Max.	
Cool	Heat	Cool	Heat	°WB Cool	°DB Heat	°WB Cool	°DB Heat
50	-10	115	75	57	50[1]	72	80

1. Operation below this temperature is permissible for a short period of time, during morning warm-up.

The comfort control switch is assumed to be in the "OFF" position. If the main power supply to the outdoor and indoor units is off, turn the appropriate disconnects to the "ON" position. Place the system into operation as follows:

1. Set temperature adjustment to the desired temperature on your thermostat.

COOLING - The higher the setting, the lower the amount of energy consumed. Federal Guidelines recommend a setting of 78 °F.

HEATING - The lower the setting, the lower the amount of *energy consumed*. Federal guidelines recommend a setting of 65 °F or lower.

NOTE: If your cooling and heating temperature adjustments are separate, be sure to set both.

2. After considering "Fan Operation Selection" above, select and set the fan operation mode you desire.
3. Move the comfort control switch to the desired mode of operation (Cooling or Heating) found on your particular thermostat.

POWER FAILURE

When accidents, wind storms, etc. disrupt electrical power supply to your house, switch thermostat to "OFF" position.

SECTION V: SYSTEM OPERATION

MANUAL CHANGE-OVER THERMOSTAT

COOLING YOUR HOME: With the comfort control switch in the "COOL" position, the system will operate as follows: When the indoor temperature rises above the level indicated by the temperature adjustment setting, the system will start. The outdoor unit will operate and the indoor fan will circulate the cooled, filtered air. When the room temperature is lowered to the setting selected, the system will shut off.

HEATING YOUR HOME: If your system includes a heating unit and the comfort control switch is in the "HEAT" position, the system will operate as follows: When the indoor temperature drops below the level indicated by the temperature adjustment setting, the system will start. The heating system will operate and the indoor fan will circulate the filtered air. When the room temperature rises to the setting selected, the system will shut off. Whether heating or cooling, the fan will continue to operate if the fan switch was set in the "ON or Intelligent" position. The "AUTO" setting on the fan switch will allow the fan to shut off when your system does.

ELECTRONIC THERMOSTAT

The computerized electronic thermostat, when programmed, will function automatically to operate the system as follows: When the indoor temperature rises above the higher (COOL) setting, the outdoor unit will operate and the indoor fan will circulate the cooled, filtered air. When the room temperature is lowered to the selected level, the system will shut off. The indoor fan will either shut off or run continuously, depending upon your choice of fan switch setting. When the indoor temperature drops below the lower (HEAT) setting, the heating system will operate, and the indoor fan will circulate the heated, filtered air. When the indoor temperature rises to the selected setting, the system will shut off.

The indoor fan will either shut off or run continuously, depending upon your choice of fan switch setting.

SECTION VI: CARE OF SYSTEM

It is strongly recommended that regular periodic preventative maintenance be performed on this equipment. The person most familiar with the equipment in your H.V.A.C. system is a dealer. The dealer can ensure your maintenance program meets the conditions of the Warranty", maximize the efficiency of the equipment, and service your unit within the federally mandated guidelines with regard to unlawful discharge of refrigerants into the atmosphere.

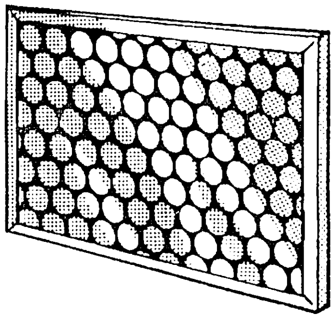
COIL CARE

Keep the outdoor unit free of foliage, grass clippings, leaves, paper, and any other material which could restrict the proper air flow in and out of the unit. The coil may be vacuumed to remove any debris from between the fins. If the coil becomes excessively dirty, turn the main disconnect switch to "Off" and wash the coil with your garden hose. Avoid getting water into the fan motor and control box. Flush dirt from base pan after cleaning the coil.

SERVICE CALLS

There are a few instances where the user can avoid unnecessary service calls. If unit stops functioning properly check the following items before calling your servicing dealer:

1. Indoor section for dirty filter.



2. Outdoor section for leaf or debris blockage. Eliminate problem, turn off the thermostat for 10 seconds and attempt start. Wait 5 minutes. If system does not start, call your servicing dealer.

⚠WARNING

Your system contains environmentally friendly refrigerant R-410A, which operates at high pressures. You may be in danger if you try to make an attempt to repair your unit. Please contact your local dealer.

FILTER CARE

Inspect the air filter(s) at least once a month. If they are dirty, wash reusable filters with a mild detergent per manufacturer's recommendations. Replace disposable filters with new filters. Install the clean filters with "air flow" arrow in the same direction as the air flow in your duct. Filters should be clean to assure maximum efficiency and adequate air circulation.

CLEARANCES

The minimum clearances shown below must be maintained should any patio or yard improvements be done around the outdoor unit.

TOP 48"	SIDES* 24"
SIDES, REAR 12"	FRONT 12"

* Service Access Panel

PARTS INFORMATION

Replacement parts are available from local contractor/dealer or the nearest distribution center.

EXTENDED WARRANTY

Special warranty packages are available through your contractor. These packages reduce the potential cost of service calls following the first year of operation on your cooling (or heating/cooling) system.

SECTION VII: SOME EFFICIENCY DO'S & DON'TS

DON'T heat or cool unused household area. Reduce supply and return air flow to a minimum in areas which are not living spaces (storage rooms, garages, basements, etc).

DON'T be a "thermostat jiggler". Moving your thermostat setting will not make your system heat or cool any faster. Adjust your thermostat to a comfortable setting and leave it there.

DON'T restrict air circulation. Placing furniture, rugs, etc. in such a way that they interfere with air vents will make your system work harder to achieve a comfortable temperature level. This requires more energy, which means greater cost to you.

DON'T heat or cool when you are away. If you are going to be away for a day or more, re-adjust your thermostat accordingly. Your furniture is far less demanding than you are when it comes to comfort levels. However, don't expect the system to restore comfort conditions immediately upon returning home. It will take a little time.

DON'T locate lamps or other heat-producing appliances (radios, TV's, heaters, etc.) near your thermostat. The heat from these items will give your thermostat "false information" about the temperature in the room.

DO select a comfortable thermostat setting, but keep in mind that moderation in temperature selection will save energy.

DO turn on your kitchen exhaust fan when cooking and your bathroom exhaust fan when showering. Also, make sure your clothes dryer is properly vented. If these items are neglected, an excess heat and humidity condition may be created, causing your air conditioning system to run longer.

DO set your thermostat a few degrees lower than normal several hours before entertaining a large group of people in a relatively small area. People give off a considerable amount of heat and moisture in a closed area.

DO keep drapes and venetian blinds closed when practical. These items provide insulation against heat loss/gain.

DO contact a qualified service person to make repairs or adjustments to your system. He has been trained to perform this service.

Limited Warranty

UPG warrants this product to be free from defects in factory workmanship and material under normal use and service and will, at its option, repair or replace any parts that prove to have such defects according to the terms outlined on this warranty. This warranty covers only the equipment described by the Product Model Number and Serial Number listed on the Warranty Registration Card.

For your benefit and protection, return the Warranty Registration Card to UPG promptly after installation. This will initiate the warranty period and allow us to contact you, should it become necessary. In the absence of a recorded Warranty Registration Card, the warranty period will begin upon product shipment from UPG.

This warranty extends only to the original consumer purchaser and is non-transferable. For this warranty to apply, the product must be installed according to UPG recommendations and specifications, and in accordance with all local, state, and national codes; and the product must not be removed from its place of original installation. The warranty period for repair or replacement parts provided hereunder shall not extend beyond the warranty period stated below.

CONDENSING UNITS			
CONDENSING UNITS		COMPRESSOR	PARTS
13 SEER	CZB, AC3B, AL3B, YZB, HC3B, HL3B	10 yrs	5 yrs

UPG strongly recommends regular periodic preventative maintenance on this equipment. The person most familiar with the equipment in your HVAC system is a UPG dealer. The UPG dealer can ensure your maintenance program meets the conditions of the "UPG Warranty", maximize the efficiency of the equipment, and service your unit within the mandated guidelines with regard to unlawful discharge of refrigerants into the atmosphere.

This warranty applies only to products installed in the United States and Canada.

EXCLUSIONS

This warranty does not cover any:

1. Shipping, labor, or material charges.
2. Damages resulting from transportation, installation, or servicing.
3. Damages resulting from accident, abuse, fire, flood, alteration, or acts of God (tampering, altering, defacing or removing the product serial number will serve to void this warranty).
4. Damages resulting from use of the product in a corrosive atmosphere.
5. Damages resulting from inadequacy or interruption of electrical service or fuel supply, improper voltage conditions, blown fuses, or other like damages.
6. Cleaning or replacement of filters.
7. Damages resulting from failure to properly and regularly clean air and/or water side of condenser and evaporator.
8. Damages resulting from: (I) freezing of condenser water or condensate; (II) inadequate or interrupted water supply; (III) use of corrosive water; (IV) fouling or restriction of the water circuit by foreign material or like causes.
9. Damages resulting from operation with inadequate supply of air or water.
10. Damages resulting from use of components or accessories not approved by UPG (vent dampers, etc.).
11. Increase in fuel or electric cost.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

SOME STATES DO NOT ALLOW THE DISCLAIMER OF IMPLIED WARRANTY, SO THAT THE ABOVE DISCLAIMER MAY NOT APPLY TO YOU.

SOME STATES ALLOW ONLY A PARTIAL LIMITATION ON IMPLIED WARRANTIES TO LIMIT THE DURATION OF IMPLIED WARRANTIES TO THE DURATION OF THE EXPRESS WARRANTY. IN SUCH STATES, THE DURATION OF IMPLIED WARRANTIES IS HEREBY EXPRESSLY LIMITED TO THE DURATION OF THE EXPRESS WARRANTY ON THE FACE HEREOF.

IN NO EVENT, WHETHER AS A RESULT OF BREACH OF WARRANTY OR CONTRACT, TORT (INCLUDING NEGLIGENCE) STRICT LIABILITY OR OTHERWISE, SHALL UPG BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF USE OF THE EQUIPMENT OR ASSOCIATED EQUIPMENT, LOST REVENUES OR PROFITS, COST OF SUBSTITUTE EQUIPMENT OR COST OF FUEL OR ELECTRICITY. THE ABOVE LIMITATIONS SHALL INURE TO THE BENEFIT OF UPG'S SUPPLIERS AND SUBCONTRACTORS. THE ABOVE LIMITATION ON CONSEQUENTIAL DAMAGES SHALL NOT APPLY TO INJURIES TO PERSONS IN THE CASE OF CONSUMER GOODS.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES, OR FOR STRICT LIABILITY IN TORT, SO THAT THE ABOVE EXCLUSIONS AND LIMITATIONS MAY NOT APPLY TO YOU.

UPG DOES NOT ASSUME, OR AUTHORIZE ANY OTHER PERSON TO ASSUME FOR UPG, ANY OTHER LIABILITY FOR THE SALE OF THIS PRODUCT.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

For Owner's Information:

PRODUCT MODEL. NO. ____________________ INSTALLATION DATE ______________________________
UNIT SERIAL NO. ________________________ INSTALLING DEALER ______________________________

Unitary Products Group
5005 York Drive
Norman OK 73069

Limited Warranty

UPG warrants this product to be free from defects in factory workmanship and material under normal use and service and will, at its option, repair or replace any parts that prove to have such defects according to the terms outlined on this warranty. This warranty covers only the equipment described by the Product Model Number and Serial Number listed on the Warranty Registration Card.

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CONDENSING UNITS[1]		
CONDENSING UNITS	**COMPRESSOR**	**PARTS**
E*RD, E*BD, ERHS, HP13, E*ZD, CPBD, LPBD, THGD, GHGD	5 yrs	5 yrs
YHJD, CHJD, LHJD	10 yrs	5 yrs
E*RE, FRHS, E*BE	10 yrs	5 yrs

1. All 3 phase condensing units have 5-year compressor and 1-year parts (Model Numbers with 25/46 or T/W voltage codes).

UPG strongly recommends regular periodic preventative maintenance on this equipment. The person most familiar with the equipment in your HVAC system is a UPG dealer. The UPG dealer can ensure your maintenance program meets the conditions of the "UPG Warranty", maximize the efficiency of the equipment, and service your unit within the mandated guidelines with regard to unlawful discharge of refrigerants into the atmosphere.

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4. Damages resulting from use of the product in a corrosive atmosphere.
5. Damages resulting from inadequacy or interruption of electrical service or fuel supply, improper voltage conditions, blown fuses, or other like damages.
6. Cleaning or replacement of filters.
7. Damages resulting from failure to properly and regularly clean air and/or water side of condenser and evaporator.
8. Damages resulting from: (I) freezing of condenser water or condensate; (II) inadequate or interrupted water supply; (III) use of corrosive water; (IV) fouling or restriction of the water circuit by foreign material or like causes.
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IN NO EVENT, WHETHER AS A RESULT OF BREACH OF WARRANTY OR CONTRACT, TORT (INCLUDING NEGLIGENCE) STRICT LIABILITY OR OTHERWISE, SHALL UPG BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF USE OF THE EQUIPMENT OR ASSOCIATED EQUIPMENT, LOST REVENUES OR PROFITS, COST OF SUBSTITUTE EQUIPMENT OR COST OF FUEL OR ELECTRICITY. THE ABOVE LIMITATIONS SHALL INURE TO THE BENEFIT OF UPG'S SUPPLIERS AND SUBCONTRACTORS. THE ABOVE LIMITATION ON CONSEQUENTIAL DAMAGES SHALL NOT APPLY TO INJURIES TO PERSONS IN THE CASE OF CONSUMER GOODS.

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For Owner's Information:

PRODUCT MODEL. NO. ____________________ INSTALLATION DATE ____________________

UNIT SERIAL NO. ____________________ INSTALLING DEALER ____________________

126874-UUM-G-0408
Supersedes: 126874-UUM-F-0208

Johnson Controls Unitary Products
5005 York Drive
Norman, OK 7306

USER'S INFORMATION MANUAL

ACCU-1M;2M;3M

OUTDOOR SPLIT-SYSTEM HEAT PUMP

MODELS: 13 & 14 SEER SERIES - 1 & 3 PHASE 1.5 TO 5 TONS

ARI PERFORMANCE CERTIFIED™
ARI Standard 210/240
Unitary Heat Pumps

c UL us LISTED

ISO 9000 REGISTRATION
ISO 9001
Certified Quality
Management System

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- Contact us by mail:

Johnson Controls Unitary Products
Consumer Relations
5005 York Drive
Norman, OK 73069

This Heat Pump has been specially developed and built as a heat pump to meet the dual needs of heating and cooling. It's not just an air conditioner with extra parts. That's why you can rely on efficient, trouble-free operation.

Your system is fully automatic. Set the thermostat and forget it. And it's automatically protected from damage by voltage fluctuations or excessive heating or cooling demands.

Your split system heat pump consists of two units - one installed outdoors and one installed indoors. The indoor unit may be installed in a basement, attic, or crawl space.

HOW YOUR HEAT PUMP WORKS

If your hand is wet and you blow on it, it feels cool because some of the moisture is evaporating and becoming a vapor. This process requires heat. The heat is being taken from your hand, so your hand feels cool.

That's what happens with a heat pump. During the cooling cycle, your system will remove heat and humidity from your home and will transfer this heat to the outdoor air.

During the heating cycle, your system will remove heat and humidity from the outdoor air and will transfer this heat to your home. This is possible because even 0°F outdoor air contains a great deal of heat. Remember that your heat pump doesn't generate much heat, it merely transfers it from one place to another.

SYSTEM OPERATION

Your thermostat puts full control of the comfort level in your home at your fingertips. DO NOT switch your thermostat rapidly "On" and "Off" or between "Heat" to "Cool" This could damage your equipment. Always allow at least 5 minutes between changes.

SETTING THE THERMOSTAT

Although thermostats may vary widely in appearance, they are all designed to perform the same basic function: to control the operation of your air conditioning or heat pump system. Regardless of size or shape, each thermostat will feature a temperature indicator; a dial, arm, or push button for selection of the desired temperature; a fan switch to choose the indoor fan operation; and a comfort switch for you to select the system mode of operation.

Only approved thermostats have been tested and are fully compatible with this equipment. *Please be aware that many different thermostats operate on batteries or "power stealing" principals. These types of thermostats can not be supported as trouble free when used with this product.*

A complete operating instruction is provided by the manufacturer for each thermostat. Familiarize yourself with its proper operation to obtain the maximum comfort with minimum energy consumption.

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Manual change-over simply means that the comfort switch must be manually positioned every time you wish to switch from the cooling to heating or heating to cooling modes of operation.

The computerized electronic thermostat is actually a sophisticated electronic version of a manual change-over type. This thermostat includes features which allow "set-back" temperature variations for periods of sleep, or while you are away during the day, and means energy savings for you. The thermostat also features a digital clock.

⚠ CAUTION

The main power to the system must be kept "ON" at all times to prevent damage to the outdoor unit compressor. If necessary, the thermostat control switch should be used to turn the system "OFF". Should the main power be disconnected or interrupted for 8 hours or longer, DO NOT attempt to start the system for 8 hours after the power has been restored to the outdoor unit. If heat is needed during this 8 hour period, use emergency heat.

Fan Operation Selection

A multi-position fan switch allows you to choose the type of fan operation of the indoor fan.

AUTO - With the thermostat fan switch set to "AUTO", the fan will run intermittently as required for either heating or cooling. This position will provide the lowest operating cost. If you purchased one of our thermostats, they have an Intelligent fan mode which continually circulates the air during occupied modes or when you are at home, and can cycle the fan during unoccupied mode or during the night while you sleep to further conserve energy.

ON - If the fan switch is set to "ON", the indoor fan will not shut off. However, the system will still operate as required by room temperatures. This provides continuous air filtering and more even temperature distribution throughout the house, which is especially useful in houses with basements.

Usually during spring and fall, when neither heating nor cooling is required, you may want to run only the fan to ventilate, circulate, and filter the air in your home or building. Set the comfort control switch to "OFF" and the fan switch to "ON". Be sure to return the switches to their original positions for normal operation.

Heating Cycle

With the thermostat in the heating position, and the outdoor temperature in the range of 20 to 30° or below, the outdoor unit will generally run 100%of the time.

All systems can be equipped with balance point control to provide even more efficient operation. This control will prevent the electric heater from being energized when the outdoor air is above some predetermined temperature setting (0 to 45°F). At higher temperatures, your system will provide all the heat your home will ever need. At lower temperatures, the auxiliary heat will be energized to keep your home comfortable.

When the outdoor air is cool and moist, frost may form on the surface of your outdoor coil. When this frost builds to a certain point, your system will switch to a defrost cycle. Although you may feel cooler air coming from your registers, DO NOT adjust your thermostat. The frost will melt quickly, and your system will return to normal operation automatically.

Cooling Cycle

Switch your thermostat to cool.Select a comfortable thermostat temperature setting, typically between 75 and 80°. Comfort sensations vary with individuals. The lower the indoor temperature desired, the greater will be the number of hours your unit must operate.

Set your thermostat 2 or 3°F below normal several hours before entertaining large groups during hot weather. People give off considerable heat and moisture.

On an extremely hot day, the indoor temperature may rise 3 to 6°F above the thermostat setting. Properly selected equipment does not have the capacity to maintain a constant indoor temperature during the peak load. Over-sizing your system to handle this peak load is not practical because the oversized system would operate much less efficiently at all other conditions.

TO MAXIMIZE OPERATING EFFICIENCY

HEATING CONSERVATION

For the most efficient operation, keep storm windows and doors closed all year long. They not only help insulate against heat and cold, but they also keep out dirt, pollen and noise.

Closing drapes at night, keeping fireplace dampers closed when not in use, and running exhaust fans only when necessary will help you to retain the air you have already paid to heat.

Keep lamps, televisions, or other heat producing sources away from the thermostat. The thermostat will sense this extra heat and will not be able to maintain the inside temperature to the desired comfort level.

COOLING CONSERVATION

To comfortably cool your home, your heat pump must remove both heat and humidity. Don't turn your system off even though you will be away all day. On a hot day, your system may have to operate between 8 to 12 hours to reduce the temperature in your home to a normal comfort level.

Keep windows closed after sundown. While the outdoor temperature at night may be lower than indoors, the air is generally loaded with moisture which is soaked up by furniture, carpets, and fabrics. This moisture must be removed when you restart your system.

The hotter the outside temperature, the greater the load on your system. Therefore do not be alarmed when your system continues to run after the sun has set on a hot day. Heat is stored in your outside walls during the day and will continue to flow into your home for several hours after sunset.

Use your kitchen exhaust fan when cooking. One surface burner on "HIGH" requires one ton of cooling. Turn on your bathroom exhaust fan while showering to remove humidity. However, exhaust fans should not be run excessively. It would decrease efficiency by removing conditioned air.

You can also help your system in the summer by closing drapes or blinds and by lowering awnings on windows that get direct sunlight.

CARE OF SYSTEM

IMPORTANT: The Owner/user should not attempt to disassemble the equipment nor perform the periodic maintenance unless they are experienced and qualified to do so.

A periodic inspection, cleaning, lubrication and adjustment of your heat pump is available from your dealer. Be sure to ask him about this service.

For those who prefer to do-it-yourself, follow the instructions below to care for your system.

COIL CARE

Keep the outdoor unit free of loose snow, foliage, grass clippings, leaves, paper, and any other material which could restrict the proper air flow in and out of the unit. The coil may be vacuumed to remove any debris from between the fins. However, don't knock ice off the outdoor unit's coil surface following an ice or severe snowstorm. The blows could mash the coil fins shut (blocking air passage), or break the refrigerant tubing allowing the refrigerant to escape.

If the coil becomes excessively dirty, turn the main disconnect switch to "OFF" and wash the coil with your garden hose. Avoid getting water into the fan motor and control box. Flush dirt from base pan after cleaning the coil.

CARE OF FAN MOTORS

Some fan motors are provided with lubrication ports. Inspect your indoor and outdoor units to determine whether or not lubrication ports are provided.

The fan motor is shipped with an oil supply which will last for several years under normal operating conditions. After this time, each motor bearing should be oiled with 10-15 drops (approximately 1/4 teaspoon) of SAE 20 non-detergent electric motor oil or automobile oil. DO NOT use definite purpose oils such as sewing machine, cleaning, rust preventative, cutting, household, etc.

SCHEDULE FOR RELUBRICATION		
Running Hours Per Day	Environment	
	Normal	Dirty
0-8	Every 5 Yrs.	Every 4 Yrs.
9-16	Every 4 Yrs.	Every 3 Yrs.
17-24	Every 3 Yrs.	Every 2 Yrs.
Do not over oil		

If your system is an Add-on type, (installed in conjunction with a standard furnace) inspect your furnace blower motor and care for it in the same way.

FILTER CARE

Inspect the air filter(s) at least once a month. If they are dirty, wash reusable filters with a mild detergent per manufacturer's recommendations. Replace disposable filters with new filters.

Install the clean filters with "air flow" arrow in the same direction as the air flow in your duct. Filters should be clean to assure maximum efficiency and adequate air circulation. Drapes, furniture or other obstructions blocking your supply and return air grilles will also decrease efficiency.

OUTDOOR UNIT FINISH

If you wish to maintain the finish of the outdoor unit, it can be polished with car wax. It is recommended the unit be cleaned with soap and water prior to waxing.

TROUBLESHOOTING GUIDE			
PROBLEM	CHECK	ACTION TO TAKE	FAULT CODE
No Heat or Cooling	1. Thermostat for proper settings.	Set thermostat to proper setting.	-
	2. Circuit breakers and fuses.	Reset circuit breakers - Replace blown fuses.	-
	3. Check outdoor unit for dirty coil (Cooling).	Clean coil, see "COIL CARE" section.	2
	4. Outdoor unit for snow accumulation. (Heating).	Remove loose snow only.	3
	5. Indoor unit for dirty filter (Heating).	Clean or replace, see "FILTER CARE" section.	2
	6. Emergency heat light status on thermostat.	Check 1 - 5, call qualified service person.	2
	Light on = Malfunction	Check 1 - 5, call qualified service person.	-
	Light flashing = Malfunction	Check 1 - 5, call qualified service person with fault code.	-
Wet on Floor or in Furnace	Condensate drain and "P" trap	Remove blockage, usually mold or fungus.	-

CLEARANCES

The minimum clearances shown below must be maintained should any patio or yard improvements be done around the outdoor unit.

Top 60"	Sides 12"
Rear 12"	Front* 24"

* Service access panel

POWER INTERRUPTION

When ice, snow, wind storms, etc. disrupt electrical power supply to your house, proceed as follows:

Heating Season

1. Switch thermostat to emergency heat.

NOTE: There will be no heat available until power is re-established.

2. Leave on emergency heat for at least 8 hours after electrical power is re-established if the power was off more than 8 hours.
3. Switch thermostat back to heating or auto.

Cooling Season

1. Switch thermostat to OFF position.
2. Do not switch to cooling or auto until electrical power has been re-established for 8 hours if the power was off more than 8 hours.

SERVICE CALLS

There are a few instances where you can avoid unnecessary service calls. (See Troubleshooting Guide above). Some models provide fault codes. The flashing light on the system thermostat is capable of providing you with time and money saving information. The fault code numbers listed can be handled by taking the corrective action indicated. Call qualified service person if displaying fault code numbers not listed.

PARTS INFORMATION

Replacement parts are available from local contractor/dealers or the nearest distribution center.

CHARACTERISTICS OF HEAT PUMPS

A CONSTANT HEAT

Heat pumps have a noticeable cooler supply air temperature than furnaces. The common practice of over-sizing furnaces contributes to an "off-and-on again" operation with short blasts of hot supply air. The heat pump system is sized more closely to the heating needs of your home. Heat is supplied at a lower temperature over a longer period of time to provide a more constant heat, and it may give you the impression that your system "never stops running".

WATER RUN-OFF

During the heating cycle, in mild weather you may notice water running off the outdoor coil. Moisture from the air is condensed on the outside surface of the coil where it gathers and runs off. No need for alarm, your unit has not sprung a leak!

OUTDOOR COIL DEFROSTING

At certain outdoor conditions (low temperature, high humidity), frost may build up on the coil of the outdoor unit. In order to maintain heating efficiency, the system will automatically defrost itself. Steam rising from the outdoor unit is normal and is an indication of proper operation. The vapor cloud will only last for a few minutes. When the defrost cycle is completed, the system will automatically switch back to heating. Auxiliary heat is automatically energized to maintain comfort during defrost.

USER'S INFORMATION MANUAL

AIR HANDLERS AHU-1M; 2M; 3M; AHU-3D

MODELS: ALL

ISO 9001
Certified Quality
Management System

TABLE OF CONTENTS

CONTACT INFORMATION

- Go to website at www.york.com click on "contact", then click on "contact form" and follow the instructions.
- Contact us by mail:

York International
Consumer Relations
5005 York Drive
Norman, OK 73069

This high efficiency Air Handling system has been precision engineered, manufactured of high quality materials, and passed many rigorous tests and inspections to ensure years of satisfactory service. That's why you can rely on efficient, trouble-free operation. Your system is fully automatic. Set the thermostat and forget it. And it's automatically protected from damage by voltage fluctuations or excessive heating or cooling demands. Your Air Handler is actually two units – the indoor air blower and the indoor refrigeration coil, part of the outdoor AC or Heat Pump system installed with this Air Handler. You may also have an Electric Resistance Heater kit installed in this air handler.

⚠WARNING

FIRE OR ELECTRICAL HAZARD
Failure to follow the safety warnings exactly could result in serious injury, death or property damage.
A fire or electrical hazard may result causing property damage, personal injury or loss of life.

SECTION I: HOW YOUR AIR HANDLER WORKS

If your hand is wet and you blow on it, it feels cool because some of the moisture is evaporating and becoming a vapor. This process requires heat. The heat is being taken from your hand, so your hand feels cool. That's what happens with a heat pump. During the cooling cycle, your system will remove heat and humidity from your home and will transfer this heat to the outdoor air. During the heating cycle, your system will remove heat and humidity from the outdoor air and will transfer this heat to your home. This is possible because even 0°F outdoor air contains a great deal of heat.

Remember that your heat pump doesn't generate much heat, it merely transfers it from one place to another.

SECTION II: SYSTEM OPERATION

Your thermostat puts full control of the comfort level in your home at your fingertips. DO NOT switch your thermostat rapidly "On" and "Off" or between "Heat" to "Cool" This could damage your equipment. Always allow at least 5 minutes between changes.

SETTING THE THERMOSTAT

Although thermostats may vary widely in appearance, they are all designed to perform the same basic function: to control the operation of your air conditioning or heat pump system. Regardless of size or shape, each thermostat will feature a temperature indicator; a dial, arm, or push button for selection of the desired temperature; a fan switch to choose the indoor fan operation; and a comfort switch for you to select the system mode of operation.

Only approved thermostats have been tested and are fully compatible with this equipment. *Please be aware that many different thermostats operate on batteries or "power stealing" principals. These types of thermostats can not be supported as trouble free when used with this product.*

A complete operating instruction is provided by the manufacturer for each thermostat. Familiarize yourself with its proper operation to obtain the maximum comfort with minimum energy consumption.

If your system has been designed to allow both cooling and heating operation, you may have either a manual change-over type, or a programmable electronic type thermostat.

Manual change-over simply means that the comfort switch must be manually positioned every time you wish to switch from the cooling to heating or heating to cooling modes of operation.

The computerized electronic thermostat is actually a sophisticated electronic version of a manual change-over type. This thermostat includes features which allow "set-back" temperature variations for periods of sleep, or while you are away during the day, and means energy savings for you. The thermostat also features a digital clock.

Fan Operation Selection

A multi-position fan switch allows you to choose the type of fan operation of the indoor fan.

AUTO - With the thermostat fan switch set to "AUTO", the fan will run intermittently as required for either heating or cooling. This position will provide the lowest operating cost. If you purchased one of our thermostats, they have an Intelligent fan mode which continually circulates the air during occupied modes or when you are at home, and can cycle the fan during unoccupied mode or during the night while you sleep to further conserve energy.

ON - If the fan switch is set to "ON", the indoor fan will not shut off. However, the system will still operate as required by room temperatures. This provides continuous air filtering and more even temperature distribution throughout the house, which is especially useful in houses with basements.

Usually during spring and fall, when neither heating nor cooling is required, you may want to run only the fan to ventilate, circulate, and filter the air in your home or building. Set the comfort control switch to "OFF" and the fan switch to "ON". Be sure to return the switches to their original positions for normal operation.

Heating Cycle

With the thermostat in the heating position, and the outdoor temperature in the range of 20 to 30° or below, the outdoor unit will generally run 100%of the time.

All systems can be equipped with balance point control to provide even more efficient operation. This control will prevent the electric heater from being energized when the outdoor air is above some predetermined temperature setting (0 to 45°F). At higher temperatures, your system will provide all the heat your home will ever need. At lower temperatures, the auxiliary heat will be energized to keep your home comfortable.

When the outdoor air is cool and moist, frost may form on the surface of your outdoor coil. When this frost builds to a certain point, your system will switch to a defrost cycle. Although you may feel cooler air coming from your registers, DO NOT adjust your thermostat. The frost will melt quickly, and your system will return to normal operation automatically.

Cooling Cycle

Switch your thermostat to cool.Select a comfortable thermostat temperature setting, typically between 75 and 80°. Comfort sensations vary with individuals. The lower the indoor temperature desired, the greater will be the number of hours your unit must operate.

Set your thermostat 2 or 3°F below normal several hours before entertaining large groups during hot weather. People give off considerable heat and moisture.

On an extremely hot day, the indoor temperature may rise 3 to 6°F above the thermostat setting. Properly selected equipment does not have the capacity to maintain a constant indoor temperature during the peak load. Over-sizing your system to handle this peak load is not practical because the oversized system would operate much less efficiently at all other conditions.

MANUAL CHANGE-OVER THERMOSTAT

COOLING YOUR HOME: With the comfort control switch in the "COOL" position, the system will operate as follows: When the indoor temperature rises above the level indicated by the temperature adjustment setting, the system will start. The outdoor unit will operate and the indoor fan will circulate cool, filtered air. When the room temperature is lowered to the setting selected, the system will shut off.

HEATING YOUR HOME: If your system includes a heating unit and the comfort control switch is in the "HEAT" position, the system will operate as follows: When the indoor temperature drops below the level indicated by the temperature adjustment setting, the system will start. The heating system will operate and the indoor fan will circulate warm, filtered air. When the room temperature rises to the setting selected, the system will shut off.

Whether heating or cooling, the fan will continue to operate if the fan switch was set in the "ON or Intelligent" position. The "AUTO" setting on the fan switch will allow the fan to shut off when your system does.

ELECTRONIC THERMOSTAT

The computerized electronic thermostat, when programmed, will function automatically to operate the system as follows: When the indoor temperature rises above the higher (COOL) setting, the outdoor unit will operate and the indoor fan will circulate cool, filtered air. When the room temperature is lowered to the selected level, the system will shut off. When the indoor temperature drops below the lower (HEAT) setting, the heating system will operate, and the indoor fan will circulate the warm, filtered air. When the indoor temperature rises to the selected setting, the system will shut off. The indoor fan will either shut off or run continuously, depending upon your choice of fan switch setting.

SECTION III: TO MAXIMIZE OPERATING EFFICIENCY

HEATING CONSERVATION

For the most efficient operation, keep storm windows and doors closed all year long. They not only help insulate against heat and cold, but they also keep out dirt, pollen, and noise.

Closing drapes at night, keeping fireplace dampers closed when not in use, and running exhaust fans only when necessary will help you to retain the air you have already paid to heat.

Keep lamps, televisions, or other heat producing sources away from the thermostat. The thermostat will sense this extra heat and will not be able to maintain the inside temperature to the desired comfort level.

COOLING CONSERVATION

To comfortably cool your home, your air conditioner must remove both heat and humidity. Don't turn your system off even though you will be away all day. On a hot day, your system may have to operate between 8 to 12 hours to reduce the temperature in your home to a normal comfort level.

Keep windows closed after sundown. While the outdoor temperature at night may be lower than indoors, the air is generally loaded with moisture which is soaked up by furniture, carpets, and fabrics. This moisture must be removed when you restart your system.

The hotter the outside temperature, the greater the load on your system. Therefore do not be alarmed when your system continues to run after the sun has set on a hot day. Heat is stored in your outside walls during the day and will continue to flow into your home for several hours after sunset.

Use your kitchen exhaust fan when cooking. One surface burner on "HIGH" requires one ton of cooling. Turn on your bathroom exhaust fan while showering to remove humidity. However, exhaust fans should not be run excessively. It would decrease efficiency by removing conditioned air.

You can also help your system in the summer by closing drapes or blinds and by lowering awnings on windows that get direct sunlight.

SECTION IV: CARE OF SYSTEM

IMPORTANT: The owner/user should not attempt to disassemble the equipment nor perform periodic maintenance unless they are experienced and qualified to do so.

A periodic inspection, cleaning, lubrication, and adjustment of your heat pump is available from your dealer. Be sure to ask him about this service.

For those who prefer to do-it-yourself, follow the instructions below to care for your system.

MOTOR LUBRICATION

The motors in these Air Handlers are permanently lubricated, and do not require periodic oiling.

PERIODIC INSPECTION

Periodic Inspection

⚠WARNING

Electric Shock and Moving Parts Hazards are present behind the Blower & Coil access panels. Presenting risk of Personal Injury and/or Fire or Electric Shock, potentially causing property damage, personal injury, and/or loss of life. The only owner serviceable part is the filter behind the bottom filter access panel

Every time the filters are changed, the following items should be visually inspected:

- Check unit exterior to be sure it is in good condition and that there are no obvious signs of deterioration.
- Check the drain lines to make sure there are no cracks, leaks or blockages.
- Check the area around the unit and all registers and grilles – to maintain good air flow.

Periodic inspection by a qualified service technician is highly recommended.

Cleaning & maintenance of the Air Handler interior and its components must only be done by a qualified service professional.

For more information, or if you have questions about the operation of your Air Handler, Or if you suspect your unit is malfunctioning or in need of service or repair

- Call a certified dealer or servicing contractor to check and/or clean your Air Handler.

AIR FILTERS

Air filters maybe internally or externally mounted. Dirty filters greatly restrict the flow of air and may cause damage to the moving parts. If the filters become clogged the Electric Heaters and blower motor could overheat resulting in a potentially dangerous situation. The filters should be checked every month. On new construction, check the filters every week for the first four weeks and every three weeks after that, especially if the indoor fan is running continuously. When replacing the filter(s) you must use filters that are the same size as those recommended in Table 1. Never operate your Air Handler without a suitable air filter.

Filter Care

Inspect the air filter every month. If dirty, wash reusable filters with a mild detergent per manufacturer's recommendations. Replace disposable filters with new filters. Filters should be clean to assure maximum efficiency and adequate air circulation. Drapes, furniture or other obstructions blocking your supply and return air grilles will also decrease efficiency.

An air filter was supplied by your dealer with you new Air Handler. A 1" filter rack compartment was built-in on your new Air Handler and may use either a 1" disposable filter or a permanent washable filter media per Table 1.

TABLE 1:

Cabinet Size	Disposable Filter Size for Built-in Filter Compartment
B	16"x20"x1"
C	20"x20"x1"
D	22"x20"x1"
Cabinet Size	Permanent Washable Filter Part Numbers for Built-in Filter Compartment
B	S1-1PF0601BK
C	S1-1PF0602BK
D	S1-1PF0603BK

⚠CAUTION

Equipment should never to operated without filters

Removing Internally Mounted Air Filters

This Air Handler may have a filter located on bottom of the unit behind the filter access panel.

1. Remove filter access panel by flipping the levers on each side of the cabinet outward, to release the panel.
2. Install the clean filters with "air flow" arrow in the same direction as the air flow in your duct.
3. Replace the panel and push levers in to secure the panel.

For Externally Mounted Air Filters

This air filter should be located in a rack attached to the casing of the Air Handler or placed in the return air duct, or wall mounted filter grille.

Replace throw away filter(s) with the same size new filter(s).

Throw away filter(s) may be replaced with cleanable filter(s) at this time.

Cleanable filter(s) may be cleaned as described in the Manufacturer instructions

How to Clean your Filter

Permanent type, washable, High-velocity filters may be cleaned with a vacuum cleaner or taken away from the unit & washed with a garden hose. Be sure to shake off excess water and allow filter to completely dry before re-installing the filter.

CONDENSATE DRAIN LINES

Coils maybe included in the air handler or separately mounted. During the cooling season check the condensate drain lines to be sure that condensate is flowing from the primary drain but not from the secondary drain. If condensate ever flows from the secondary drain the unit should be promptly shut off and the condensate pan and drains cleaned by a qualified sevice technican to insure a free flowing primary drain.

COIL CLEANING

If an inspection by a qualified sevice technician indicates the coil needs to be cleaned, it should be washed with Calgon Coilclean (mix one part Coilclean to seven parts water). Allow solution to remain on coil for 30 minutes before rinsing with clean water. Solution should not be permitted to come in contact with painted surfaces.

⚠CAUTION

*Coil cleaning solutions must be diluted according to the manufacturer's instructions. The use of undiluted coil cleaning solutions on the coil **WILL** damage the coil coating.*

BLOWER CARE

Even with good filters properly in place, blower wheels and motors will become dust laden after long months of operation. The entire blower assembly should be inspected annually. If the motor and wheel are heavily coated with dust, they can be brushed and cleaned with a vacuum cleaner. If the blower cannot be properly cleaned without removing it from the furnace, then this service must be performed by a qualified service agency.

⚠WARNING

Make sure you DO NOT move the clip on weight on the indoor fan wheel when cleaning the wheel. This weight is used to balance the wheel. Moving the weight will cause the fan wheel to vibrate.

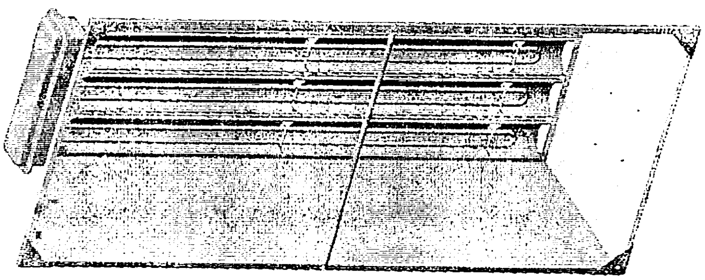
TROUBLESHOOTING GUIDE

PROBLEM	CHECK	ACTION TO TAKE	FAULT CODE
No Heat or Cooling	1. Thermostat for proper settings.	Set thermostat to proper setting.	-
	2. Circuit breakers and fuses.	Reset circuit breakers - Replace blown fuses.	-
	3. Check outdoor unit for dirty coil (Cooling).	Clean coil, see "COIL CARE" section.	2
	4. Outdoor unit for snow accumulation. (Heating).	Remove loose snow only.	3
	5. Indoor unit for dirty filter (Heating).	Clean or replace, see "FILTER CARE" section.	2
	6. Emergency heat light status on thermostat.	Check 1 - 5, call qualified service person.	2
	Light on = Malfunction	Check 1 - 5, call qualified service person.	-
	Light flashing = Malfunction	Check 1 - 5, call qualified service person with fault code.	-
Wet on Floor or in Furnace	Condensate drain and "P" trap	Remove blockage, usually mold or fungus.	-

160619-UUM-C-1106
Supersedes: 160619-UUM-B-0206

Unitary Products Group
5005 York Drive
Norman OK 73069

Marley
Engineered Products
An SPX Company



M Series
Fixed Overhead Radiant Heaters

Installation & Maintenance Instructions

Dear Owner,

Congratulations! Thank you for purchasing this new heater by Marley Engineered Products. You have made a wise investment selecting the highest quality product in the heating industry. Please carefully read the installation and maintenance instructions shown in this manual. You should enjoy years of efficient heating comfort with this product from Marley Engineered Products... the industry's leader in design, manufacturing, quality and service.

... The Employees of Marley Engineered Products

⚠ WARNING ⚠

Read Carefully - These instructions are written to help you prevent difficulties that might arise during installation of heaters. Studying the instructions first may save you considerable time and money later. Observe the following procedures and cut your installation time to a minimum. To reduce risk of fire, electric shock or falling:

1. Read all instructions before using the heater.
2. Do NOT use this heater as a residential or household heater.
3. This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces. Keep combustible materials, such as furniture and papers at least 5 feet from the front of the heater.
4. Always disconnect the heater when not in use.
5. To prevent possible electrical shock, disconnect ALL power coming to heater at main service panel before wiring or servicing.
6. All wiring must be in accordance with the National and Local Electrical Codes and the heater must be grounded as a precaution against possible electrical shock.
7. Verify the power supply voltage coming to the heater matches the ratings printed on the heater nameplate before energizing.
8. This heater is NOT suitable for use in hazardous locations as described by the National Fire Protection Association (NFPA). This heater has hot and arcing or sparking parts inside. DO NOT use in areas where gasoline, paint or other flammable liquids are used or stored.
9. This heater is intended for Ceiling Installation ONLY (except as noted below.). The following clearances MUST be maintained:
   a) Top of heater to ceiling - 24" (640 mm)
   b) Bottom of heater to floor - 10' (3048 mm)
   c) Side of heater to wall - 36" (914 mm)
   d) End of heater to wall - 36" (914 mm)
   e) Side of heater to side of adjacent heater - 36" (914 mm)
   f) End of heater to end of adjacent heater - 36" (914 mm)
10. Under special controlled conditions this heater may be converted for use as a movable heater by installation of the optional Portable Cart Kit, Cord Kits, Grille Kit and Tip Over Kits. **Extreme care must be taken when using this heater as a movable unit! The heater operates at very high temperatures and could cause a fire if placed too close to combustible materials.** <u>NEVER OPERATE THIS HEATER AS A MOVABLE UNIT WHILE UNATTENDED</u>. Always maintain at least the minimum clearances as stated above. If the Tip Over Kit is not provided, the heater could cause a fire if it falls over.
11. Heater MUST be securely fastened to the building structure to prevent it from falling.
12. DO NOT stack or store combustible materials in the radiation path under the heater. At least 5' (1524 mm) clearance MUST be maintained between bottom of heater and combustibles.
13. If used as a cord connected movable heater, always make sure the outlet or power source to which the heater is connected is properly grounded. Use of the heater with an extension cord is not recommended. If one must be used, it must be provided with a grounding conductor and must be rated to handle a load of at least 125% of the maximum heater ampere load. Always inspect the cord for damage before each use and do not use if damaged. Route cord so it is not subject to being damaged during use.
14. In order to prevent equipment damage, protect with a ground fault device such as Marley Engineered Products WMGF240 for 240V heaters and WMGF480 for 480 volt heaters.
15. Use this heater only as described in this manual. Any other use not recommended by the manufacturer may cause fire, electric shock or injury to persons.

SAVE THESE INSTRUCTIONS

INSTALLATION

The Marley Engineered Products radiant heater is shipped fully assembled. The heater can be hung from the ceiling with 4 chains or rigid angle brackets attached to the heater brackets located on the back of the heater, for 2 and 4.5 kW heaters, chains can be attached to the four holes in the corners of the back reflector. Optional hanging chain kits are available for these heaters that will allow for installations 2 to 6 feet from the ceiling. (Model **MHK**) (See Figure 1.) Minimum spacings:

Ceiling to top of heater is 2 feet.

Wall to sides of heater is 3 feet.

Floor to bottom of heater is 10 feet.

NOTE: Installer should consult state and local codes and meet any applicable requirements regarding this installation.

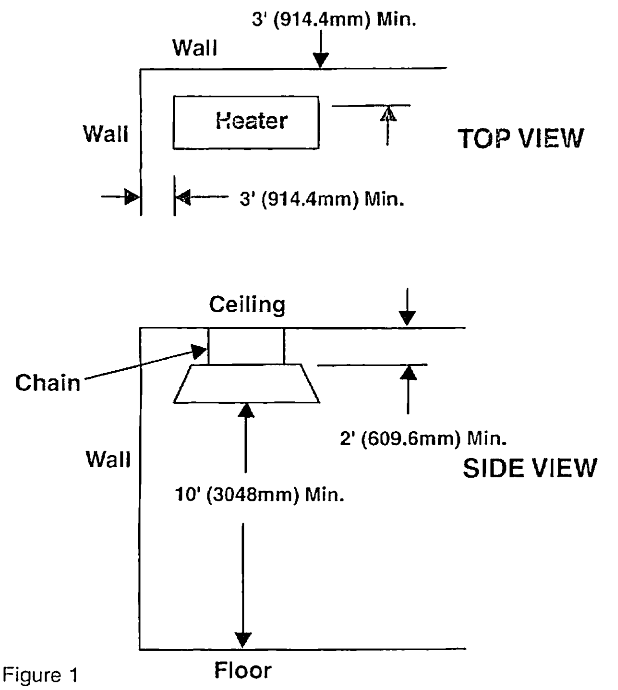


Figure 1

WIRING

⚠ WARNING ⚠

ELECTRIC SHOCK HAZARD. Disconnect all power before installing or servicing heater. Failure to do so could result in personal injury or property damage. Heater must be effectively grounded in accordance with the National Electrical Code, NFPA 70.

All electrical wiring must be done by a qualified person in accordance with National Electrical Code (NEC) and meet all state and local regulations.

1. Use heater only at the voltage specified on the nameplate.
2. Branch circuit wire for connection to heater must be at least 90°C wire. Use copper conductors only.
3. Heater can be wired with rigid or flexible conduit.
4. Refer to Table 1 for proper supply wiring size.
5. The heater connection points are located in the gasketed terminal enclosure. To remove cover, remove 4 screws on the cover. Remove the cover to expose wiring connection points.
6. A green ground terminal is provided in the bottom of the enclosure. The ground wire should be connected before other connections are made.
7. Attach power to pigtail leads L1 and L2 (or L1, L2 & L3 on 3 phase models) using appropriate listed connectors.

NOTE: All 3 element heaters are factory pre-wired for 3-phase delta operation. Some units can be converted to single phase operation by changing the wiring. Refer to Table 1 for those heaters that can be converted to single phase. The appropriate wiring diagram (Figure 2) is also located on the bottom of the enclosure.

INSTRUCTIONS FOR FIELD CONVERSION FOR 3 PHASE TO 1 PHASE

1. Remove nuts from all terminals.
2. Remove all pigtail leads and hat shaped buss bar.
3. Remove end of lead wire on terminal 5 and slip onto terminal 4.
4. Remove lead wire attached to instruction sheet and connect between terminals 4 and 6.
5. Install hat shaped buss bar between terminals 3 and 5.
6. Place pigtail lead marked "L1" on to terminal 2 and pigtail lead marked "L2" on to terminal 6.
7. Install nuts and tighten.
8. Connect entrance wiring to pigtail leads "L1" and "L2". Connect ground to screw provided.
9. Inspect to make sure wiring is per "Single Phase Wiring" above.

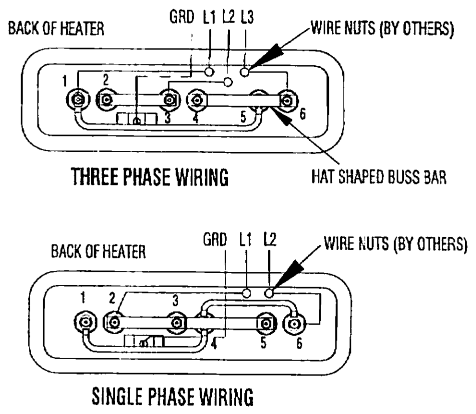


Figure 2

OPTIONAL ACCESSORIES

Marley Engineered Product M series radiant heaters can be field modified by adding optional kits. Refer to Figure 3 to select the proper kit.

Portable Cart Kit

The portable cart kit can be used to convert a fixed overhead unit into a portable heating device where a fixed installation is not required. This kit includes wheels, legs, handle, grill(s), baffle (if req'd) and all of the necessary hardware to complete the modification. See instruction sheet 5200-2648-###. for details.

"CAUTION - Use of this kit presents certain hazards including risks for fire or burns. Extreme care must be taken when use of any Marley Engineered Products heater with this kit. See Warnings in front of this manual for additional details. As an added safety precaution, we strongly recommend the Tip Over Kit and Grille Kit be used in conjunction with the Portable Cart Kit. It will help reduce the risk of fire if the heater and cart happen to fall over or if something happens to fall against the heater."

Grill Kit

The grill kit consists of one (1.5, 2, 4.5 and 6 kW) or 2 grill sections (13.5kW) and hardware to protect personnel from coming into contact with hot radiant heating elements.
See instruction sheet 5200-2646-### for details.

Disconnect Kit

The disconnect kit consists of a complete assembly consisting of a disconnect switch (3 Pole), power terminal block and all hardware to complete the installation. This kit can be mounted to both the fixed, overhead heater or the portable heater;
see instruction sheet 5200-2652-### for details.

Hanger Kit

Hanger kit model MHK include 24 feet of chain and four S hooks to mount the unit in a fixed overhead position using the universal mounting brackets included on the heater. This kit allows installation distances from the ceiling of 2 feet to 6 feet. See installation diagram Fig. 1 on page 2.

Cord Kits (Portable Only)

Cord kits consist of 25 feet of 90°C cable and a right angle cord fitting which can connect directly to the heater terminal box or disconnect switch (if used). See instruction sheet 5200-2647-### for details

Tip Over and Ground Fault Kits

TOS240 Series Kit attaches to portable heater and de-energizes the heater in the event it is tipped over.

WMGF240 Series Kit mounts to wall that de-energizes heater prior to element failure.

See instruction sheet 5200-2652-###.

Figure 3 – Optional Accessory Selection Guide

Model	Grill Kit	Disconnect Kit	Wall Mount Ground Fault	Portable Cart Kit**
M2081B			Notify Factory	
M2021B	WG2		WMGF240	NA
M2041B			WMGF480	
M2061B			Notify Factory	
M4581B			Notify Factory	
M4521B	WG45		WMGF240	M45
M4541B			WMGF480	
M4561B		PDS60050	Notify Factory	
M6083B			Notify Factory	
M6023B			WMGF240	
M6071B	WG60		Notify Factory	M60
M6043B			WMGF480	
M6063B			Notify Factory	
M13583B			Notify Factory	
M13523B			WMGF240	
M13571B	WG135		Notify Factory	M135
M13543B			WMGF480	
M13563B			Notify Factory	

Note: Order model MHK Hanging Kit to mount M Series and N Series infrared heaters. This kit comes complete with chain and hooks.

MAINTENANCE

WARNING

ELECTRIC SHOCK HAZARD. Disconnect all power before servicing or replacing heating elements.

The heater requires no special maintenance other than occasional cleaning to prevent excess accumulation of dust and lint on surfaces. It is important for the reflectors to be kept clean to obtain the maximum radiant output. If used as a movable unit, the cart and cord should be checked periodically to make sure the hardware remains tight and cart and cord are not damaged. Do not continue to use the heater if damaged.

Element Replacement

1. Remove Terminal Box Cover.
2. Disconnect lead wires from heater terminals.
3. Remove safety grills (if installed).
4. Remove retainer screw located on the reflector at the terminal end.
5. Loosen (2), 3/8" nuts from the terminal box bracket located on the back of the heater and slide the entire heating element assembly out of the reflector assembly.
6. Remove wires and jumper straps as required to replace the failed heating element(s).
7. Remove bulkhead fitting nuts and washers.
8. Remove failed element and replace with a new element. Replace only with genuine Chromalox "Arctic End" elements. Use of other elements will cause excess temperatures inside terminal box.
9. Place gasket on the bulkhead fitting and insert terminals and fittings into the element holes in the terminal box.
10. Place washers and nuts on bulkhead fittings and tighten.
11. Replace wiring and jumper straps.
12. Reassemble by following the reverse procedures (steps 5 through 1).

Table 1 – HEATER SELECTION CHART

Model	Watts	Volts	Phase	Reflector Angle	Element Type	Ship Wt.	Avail.	Wire Ga. (Min.) 1 Ph	Wire Ga. (Min.) 3 Ph
M2081B		208					NS	14	NA
M2021B	2000	240	1			18 lbs.	S	14	NA
M2041B		480					NS	14	NA
M2061B		600					NS	14	NA
M4581B		208					NS	12	NA
M4521B	4500	240	1			18 lbs.	S	12	NA
M4541B		480					S	14	NA
M4561B		600					NS	14	NA
M6083B		240	1 & 3	90° Symm	Metal Sheath		NS	10	12
M6023B		208	1 & 3				S	10	12
M6071B	6000	240	1			25 lbs.	NS	10	-
M6043B		480	1 & 3				S	12	12
M6063B		600	1 & 3				NS	12	12
M13583B		208	3				NS	NR	10
M13523B		240	3				S	NR	10
M13571B	13500	277	1			55 lbs.	NS	8	-
M13543B		480	1 & 3				S	12	12
M13563B		600	1 & 3				NS	12	12

DIMENSIONS

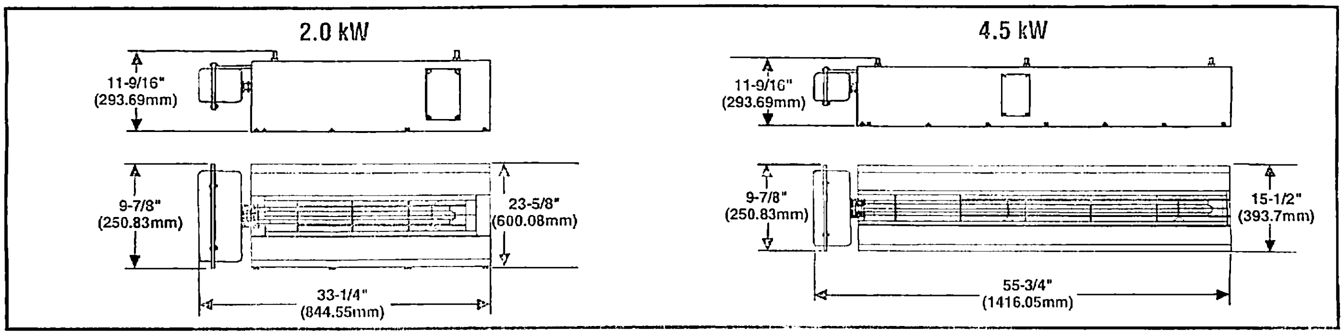


Figure 3

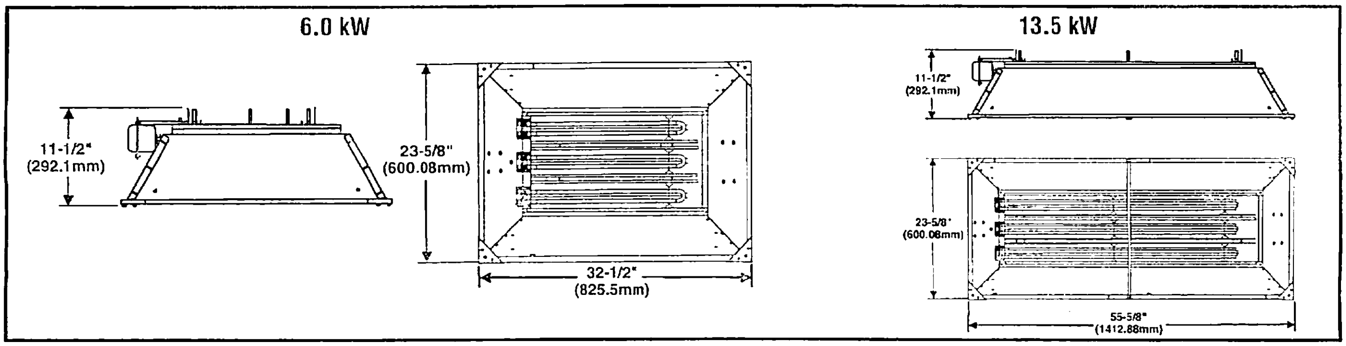


Figure 4

LIMITED WARRANTY

All products manufactured by Marley Engineered Products are warranted against defects in workmanship and materials for one year from date of installation, except heating elements which are warranted against defects in workmanship and materials for five years from date of installation. This warranty does not apply to damage from accident, misuse, or alteration; nor where the connected voltage is more than 5% above the nameplate voltage; nor to equipment improperly installed or wired or maintained in violation of the product's installation instructions. All claims for warranty work must be accompanied by proof of the date of installation.

The customer shall be responsible for all costs incurred in the removal or reinstallation of products, including labor costs, and shipping costs incurred to return products to Marley Engineered Products Service Center. Within the limitations of this warranty, inoperative units should be returned to the nearest Marley authorized service center or the Marley Engineered Products Service Center, and we will repair or replace, at our option, at no charge to you with return freight paid by Marley. It is agreed that such repair or replacement is the exclusive remedy available from Marley Engineered Products.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT. MARLEY ENGINEERED PRODUCTS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES ARISING WITH RESPECT TO THE PRODUCT, WHETHER BASED UPON NEGLIGENCE, TORT, STRICT LIABILITY, OR CONTRACT.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation 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.

For the address of your nearest authorized service center, contact Marley Engineered Products in Bennettsville, SC, at 1-800-642-4328. Merchandise returned to the factory must be accompanied by a return authorization and service identification tag, both available from Marley Engineered Products. When requesting return authorization, include all catalog numbers shown on the products.

HOW TO OBTAIN WARRANTY SERVICE AND WARRANTY PARTS PLUS GENERAL INFORMATION

1. Warranty Service or Parts 1-800-642-4328
2. Purchase Replacement Parts 1-800-654-3545
3. General Product Information www.marleymep.com

Note: When obtaining service always have the following:
1. Model number of the product
2. Date of manufacture
3. Part number or description

Marley Engineered Products
An SPX Company
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

Marley Engineered Products
An SPX Company

Installation Instructions
and
RENEWAL PARTS IDENTIFICATION

"F" Series
Ceiling Mounted Fan-Forced Heater

CONTRACTOR
PLEASE READ AND FOLLOW THESE INSTRUCTIONS. LEAVE INSTALLATION INSTRUCTIONS FOR USER TO READ.

Specifications

Cat. No.	Volts	Watts	BTU/Hr.	Amps
F-1500	120	1500	51,195	12.5
F-2008	208	2000	6826	9.8
F-2004	240/208	2000/1500	6826/5120	8.3/7.2
F-2007	277/240	2000/1500	6826/5120	7.2/8.2
F-1507	277	1500	5120	5.4
F-4008	208	4000	13,652	19.2
F-4004	240/208	4000/3000	13,652/10,239	16.7/14.4
F-4007	277/240	4000/3000	13,652/10,239	14.4/12.5
F-3007	277	3000	10,239	10.8
F-4804	240/208	4800/3600	16,382/12,287	20.0/17.3
F-4807	277/240	4800/3600	16,382/12,287	17.3/15.0

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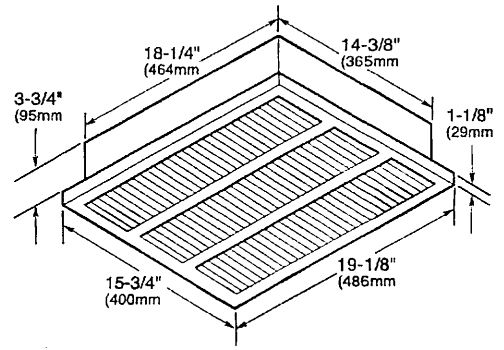


Accessories

Cat. No.	Description
F-PE	Pneumatic/Electric Switch. Factory set at 10 psig (69 kPa) to "make" on pressure drop. May be field wired to "break" on pressure drop. Pressure set point adjustable to 30 psig (207 kPa).
F-R2 (24V) F-R12 (120V)	Time Delay Relay. 45-60 seconds to close when energized. Uses 120V or 24V power supply from remote source.
F-TBF	T-Bar Frame Kit.
FF-SM	Surface Mounting Frame for surface installations. Painted White.
F-T1	Single pole built-in thermostat kit.
FF-T2	Double pole built-in thermostat kit.
F-TR4	208/240V Primary Transformer/24V Sec. and 24V Holding Coil Control Relay.
F-TR7	277V Primary Transformer/24V Sec. and 24V Holding Coil Control Relay.

FAN DELAY NOTE: A fan delay is standard on all units. In order to have the fan delay operate correctly, separate wiring is required between the heater and the wall thermostat. See warning, page 2.

WARNING
THIS INSTRUCTION SHEET CONTAINS VITAL INFORMATION FOR THE PROPER INSTALLATION, USE, AND EFFICIENT OPERATION OF THE HEATER. CAREFULLY READ THE MANUAL BEFORE INSTALLATION, OPERATION, OR CLEANING OF THE HEATER. FAILURE TO ADHERE TO THE INSTRUCTIONS COULD RESULT IN FIRE, ELECTRICAL SHOCK, DEATH, SERIOUS PERSONAL INJURY OR PROPERTY DAMAGE. SAVE THESE INSTRUCTIONS AND REVIEW FREQUENTLY FOR CONTINUING SAFE OPERATION AND INSTRUCTING FUTURE USERS.

1. To prevent a possible electrical shock, disconnect all power coming to heater at main service panel before wiring or servicing.
2. All wiring must be in accordance with the National and Local Electrical Codes and the heater must be grounded as a precaution against possible electrical shock.
3. Verify the power supply voltage coming to the heater matches the ratings printed on the heater nameplate before energizing.
4. Do not install the heater closer than 12 inches (305mm) to any wall.
5. Do not operate heater without front cover installed.
6. This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces.
7. Do not insert or allow foreign objects to enter any ventilation or exhaust openings as this may cause an electric shock, fire, or damage to the heater.
8. To prevent a possible fire, do not block air intakes or exhaust in any manner. Keep combustible materials, such as boxes, crates, etc., away from heater.
9. A heater has hot and arcing or sparking parts inside. Do not use it in areas where gasoline, paint or flammable liquids are used or stored.
10. Use this heater only as described in this manual. Any other use not recommenced by the manufacturer may cause fire, electric shock, or injury to persons.
11. This heater is not approved for use in corrosive atmospheres such as marine, green house or chemical storage areas.

Installation of Recessed Mounted Heater in Plaster Ceiling

WARNING
RISK OF FIRE - DO NOT INSTALL HEATER CLOSER THAN 12 INCHES (305mm) FROM ANY WALL.
RISK OF FALLING - THE HEATER BACK BOX MUST BE SECURELY MOUNTED TO THE BUILDING STRUCTURE AND THE BUILDING STRUCTURE MUST BE CAPABLE OF SUPPORTING THE HEATER WITH ALL ACCESSORIES. THE HEATER WEIGHT IS AT LEAST 20 POUNDS (9 kg).

1. Determine the desired mounting location of the heater.
2. Cut a 14-1/2 inch (368mm) by 18-3/8 inch (467mm) hole in the ceiling for the recessed back box, maintain 12 inch (305mm) minimum distance between edge of hole and adjacent wall.

3. Bring the power supply cable to the heater location providing at least 12 inches (305mm) of cable for wiring.

4. Remove front cover and heater assembly from carton.

NOTE: Screws to mount the front cover are packed separately in an envelope. The kit contains four standard cross recess screws and four spanner head screws in case tamper resistance is required.

5. Remove the heater assembly and disconnect switch assembly from the back box.

6. Remove the desired knockout from the back box in the area behind the disconnect switch, install cable clamp and bring power supply cable into box leaving at least six inches of cable in box for wiring.

7. Fit heater back box into hole in ceiling and secure in position using mounting holes in side of back box with four fasteners (not provided). See WARNING at beginning of this section.

8. If there are any accessories to be installed with this heater, these should be installed at this time. Refer to the instructions provided with the accessories.

9. Remove the wiring compartment cover from heater assembly by removing two screws. Mount the heater to the back box using four screws previously removed in step 5.

10. Attach the supply ground conductor to the green colored screw in the heater back box.

11. Connect the power supply lead wires to the blue colored lead wires on the disconnect switch using appropriately sized wire connectors. See Wiring Diagram, Figure 1.

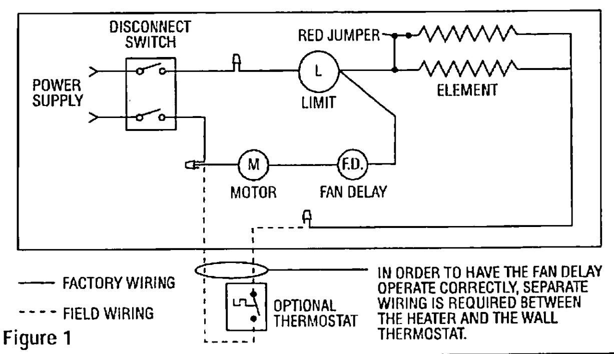


Figure 1

WARNING

TO REDUCE RISK OF FIRE OR PERMANENT DAMAGE TO HEATER, THERMOSTAT MUST NOT CUT POWER TO FAN. THERMOSTAT MUST BE WIRED AS SHOWN IN WIRING DIAGRAM SO THAT IT CYCLES HEATING ELEMENTS ONLY.

12. Feed the heater (or accessory if provided) lead wires through the smooth hole in the disconnect switch bracket and connect these leads to the black colored lead wires from the disconnect switch using appropriately sized wire connectors.

13. Carefully bundle lead wires under disconnect switch bracket and secure bracket to back box using two screws removed in step 5.

14. Install the wiring compartment cover removed in step 9. Push the disconnect switch to the "ON" position.

15. Install the front cover using the four standard cross recess or the spanner tamper resistant screws provided with the heater.

Installation of Heater Using the Cat. No. F-SM Surface Mounting Frame

WARNING

RISK OF FIRE - DO NOT INSTALL HEATER CLOSER THAN 12 INCHES (305mm) FROM ANY WALL.

RISK OF FALLING - THE HEATER BACK BOX MUST BE SECURELY MOUNTED TO THE BUILDING STRUCTURE AND THE BUILDING STRUCTURE MUST BE CAPABLE OF SUPPORTING THE HEATER WITH ALL ACCESSORIES. THE HEATER WEIGHT IS AT LEAST 20 POUNDS (9 kg).

1. Determine the desired location for the heater.

2. Follow steps 3, 4, 5, and 6 of the "Installation of Recessed Mounted Heater in Plaster Ceiling" instructions.

NOTE: The power supply cable must be routed between the heater back box and the surface mounting frame.

3. Mount the back box to the ceiling using mounting holes in the back of the back box and four fasteners (not provided). See WARNING above.

4. Fit the Cat. No. F-SM Surface Mounting Frame over the back box and secure in place with the two screws provided in kit.

5. Complete the installation by following steps 8 through 15 of the "Installation of Recessed Mounted Heater in Plaster Ceiling" instructions.

WARNING

RISK OF FIRE - DO NOT INSTALL HEATER CLOSER THAN 12 INCHES (305mm) FROM ANY WALL.

RISK OF FALLING - THE HEATER BACK BOX MUST BE SECURELY MOUNTED TO THE BUILDING STRUCTURE AND THE BUILDING STRUCTURE MUST BE CAPABLE OF SUPPORTING THE HEATER WITH ALL ACCESSORIES. THE HEATER WEIGHT IS AT LEAST 20 POUNDS (9 kg).

Installation of Heater in T-Bar Ceiling Using the Cat. No. F-TBF Kit

1. Determine the desired location for the heater.

2. Remove heater from carton, remove front cover, heater assembly and disconnect switch from back box as described in steps 4 and 5 of the "Installation of Recessed Mounted Heater in Plaster Ceiling" instructions.

3. Mount the heater back box to the F-TBF kit frame using the four screws provided with kit. See Figure 2.

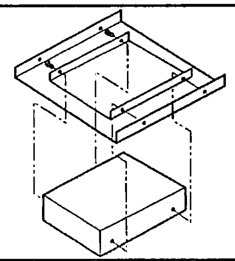


Figure 2

4. Place the F-TBF frame with heater back box installed in ceiling framing and secure in position. Secure the frame to the building structure as necessary using appropriate wire to prevent the heater and frame from falling.

5. Bring power supply cable to heater location, remove the desired knockout in back box and install cable using an appropriate cable clamp, leaving at least six inches (150mm) of wire in box for connections.

NOTE: Power supply cable must enter back box in location behind the disconnect switch assembly.

6. Complete the installation by following steps 8 through 15 of the "Installation of Recessed Mounted Heater in Plaster Ceiling" instructions.

Heater Check-Out and Operation

1. Turn the thermostat that is provided to control the heater to the full counter-clockwise direction (LO or OFF setting).
2. Turn power to heater ON at main service panel.
3. Check heater to confirm it is not operating.
4. Turn thermostat to the full clockwise positon (HI setting). This should energize the heater. In a short time, the fan should come on and warm air should flow from the heater.

NOTE: This heater is provided with a fan delay control that allows the heating element to warm prior to the fan coming on. This delay will also allow the fan to operate for a short period after the heating element has been turned off to remove the residual heat from the heater.

5. After the room has reached the desired temperature, adjust the thermostat back to the desired temperature setting. In a short time, the fan should turn off.

NOTE: For the best results, the heater should be left "ON" constantly during the heating season as the thermostat, when properly set, will maintain the desired temperature.

Maintenance and Cleaning

Maintenance

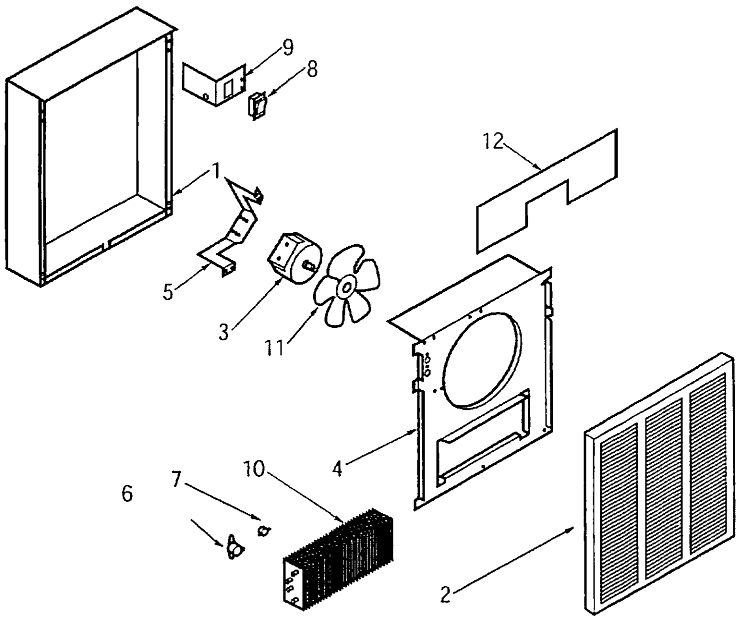
Your heater is designed for years of trouble-free operation and requires no special maintenance other than occasional cleaning. The motor is permanently lubricated.

Cleaning

Once each year, the heater should be cleaned to remove dust and other foreign material which has collected during the heating season, as follows:

1. Turn power off at main switch.
2. Remove grille by removing four screws and turn disconnect switch to the "OFF" position.
3. Use vacuum cleaner with brush attachment to remove dust and dirt that has accumulated in heater (especially around heating element and fan blade). Do not use water or any cleaners to clean heater components.
4. After cleaning, turn disconnect switch to the "ON" position.
5. Replace grille.
6. Wipe grille clean with a damp cloth. DO NOT use waxes or any cleaners that leave a residue since these may discolor during heater operaton.
7. Turn the main line switch on at the switch panel to restore power to heater. The heater is now ready for another season of operation.

Renewal Part Indentificaiton



Ref. No.	Description	Part Number
1	Back Box	1203-2015-000
2	Front Cover	1402-2149-000
3	Motor, 208V	3900-2010-000
3	Motor, 240/277V	3900-2010-001
3	Motor, 120V	3900-2010-003
4	Fan Panel	4513-2042-000
5	Motor Mount	310914002
6	High Limit	410169001
7	Fan Delay	410074000
8	Disconnect Switch	410170001
9	Disconnect Switch Bracket	1215-2058-000
10	Element-1500W, 120V	302012827

Ref. No.	Description	Part Number
10	Element-1500W, 277V	302015006
10	Element- 2000W, 208V	302015001
10	Element- 2000W, 240V	302015002
10	Element- 2000W, 277V	302015003
10	Element- 3000W, 277V	302012006
10	Element- 4000W, 208V	302012007
10	Element- 4000W, 240V	302012008
10	Element- 4000W, 277V	302012009
10	Element- 4800W, 240V	302012010
10	Element- 4800W, 277V	302012011
11	Fan Blade	490030103
12	Wire Compartment Cover	4513-2037-000

NOTE: Always order by "Part Number", never by "Ref. No."

LIMITED WARRANTY

All products covered by this instruction sheet are warranted against defects in workmanship and materials for one year from date of installation, except heating elements which are warranted against defect in workmanship and material for five years from date of installation. This warranty does not apply to damage from accident, misuse, or alteration; nor where the connected voltage is more than 5% above the nameplate voltage; nor to equipment improperly installed or wired or maintained in violation of this instruction sheet. All claims for warranty work must be accompanied by proof of the date of installation.

The customer shall be responsible for all costs incurred in the removal or reinstallation of products, including labor costs, and shipping costs incurred to return products to a Marley Engineered Products Service Center. Within the limitations of this warranty, inoperative units should be returned to the nearest Marley authorized service center, or the Marley Engineered Products Service Center, and we will repair or replace; at our option, at no charge to you with return freight paid by Marley. It is agreed that such repair or replacement is the exclusive remedy available from Marley Engineered Products.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT. MARLEY ENGINEERED PRODUCTS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES ARISING WITH RESPECT TO THE PRODUCT, WHETHER BASED UPON NEGLIGENCE, TORT, STRICT LIABILITY OR CONTRACT.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation 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.

For the address of your nearest authorized service center contact Marley Engineered Products, 470 Beauty Spot Road East, Bennettsville, South Carolina 29512 USA. Merchandise returned to the factory must be accompanied by a return authorization and service identification tag, both available from the above location. When requesting return authorization, include all catalog numbers shown on the products.

HOW TO OBTAIN WARRANTY SERVICE AND WARRANTY PARTS PLUS GENERAL INFORMATION

1. Warranty Service or Parts	1-800-642-4328
2. Purchase Replacement Parts	1-800-654-3545
3. General Product Information	www.marleymep.com

Note: When obtaining service always have the following:

1. Model number of the product
2. Date of manufacture
3. Part number or description

Marley
Engineered Products
An SPX Company
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

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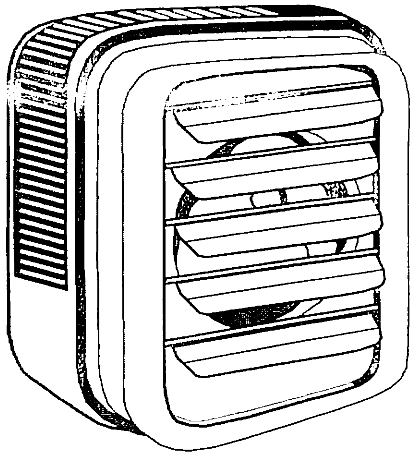


MUH Series
Modular Unit Heaters

c UL us
FILE #E21609

Installation & Maintenance Instructions

Dear Owner,

Congratulations! Thank you for purchasing this new heater manufactured by Marley Engineered Products. You have made a wise investment selecting the highest quality product in the heating industry. Please carefully read and follow the installation and maintenance directions shown in this manual. You should enjoy years of efficient heating comfort with this product from Marley Engineered Products... the industry's leader in design, manufacturing, quality and service.

... The Employees of
Marley Engineered Products

⚠ WARNING ⚠

Read Carefully - These instructions are written to help you prevent difficulties that might arise during installation of heaters. Studying the instructions first may save you considerable time and money later. Observe the following procedures, and cut your mounting time to a minimum.

To reduce risk of fire or electric shock:

1. To prevent electrical shock, disconnect all power coming to heater at main service panel before wiring or servicing.
2. All wiring must be in accordance with the National and Local Electrical Codes and the heater must be grounded as a precaution against possible electric shock.
3. Verify the power supply voltage coming to heater matches the ratings printed on the heater name plate before energizing.
4. This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces.
5. Do not insert or allow foreign objects to enter any ventilation or exhaust opening as this may cause an electric shock, fire,or damage to the heater.
6. To prevent a possible fire, do not block air intakes or exhaust in any manner. Keep combustible materials, such as crates, drapes, etc., away from heater. Do not install behind door, furniture, towels, or boxes.
7. A heater has hot and arcing or sparking parts inside. Do not use it in areas where gasoline, paint or flammable liquids are stored.
8. Use this heater only as described in this manual. Any other use not recommended by the manufacturer may cause fire, electric shock, or injury to persons.
9. This heater is not approved for use in corrosive atmospheres such as marine, green house or chemical storage areas.

SAVE THESE INSTRUCTIONS

IMPORTANT⚠

CAUTION⚠

THE HEATER MUST BE MOUNTED AT LEAST 7' (2134mm) ABOVE THE FLOOR TO PREVENT ACCIDENTAL CONTACT WITH THE FAN BLADE WHICH COULD CAUSE INJURY.

CAUTION⚠

THE CEILING MOUNTING STRUCTURE AND THE ANCHORING PROVISIONS MUST BE OF SUFFICIENT STRENGTH TO SUPPORT THE COMBINED WEIGHT OF THE HEATER AND MOUNTING BRACKET. (SEE TABLE 4).

CAUTION⚠

ALL BUILT-IN THERMOSTATS: IF THE HEATER IS USED TO PREVENT PIPING OR LIQUIDS FROM FREEZING, AND IF THE THERMOSTAT IS SET BELOW 45° F (7°C), THE FAN MUST RUN CONTINUOUSLY.

CAUTION⚠

TO PREVENT POSSIBLE OVERHEATING OR DAMAGE DUE TO OVERHEATING, KEEP AT LEAST 5' (1524mm) CLEARANCE IN FRONT OF HEATER. REFER TO TABLE 1 FOR SIDE, TOP, AND BACK CLEARANCE REQUIREMENTS.

DO NOT MOUNT MERCURY TYPE THERMOSTAT DIRECTLY ON UNIT. VIBRATION COULD CAUSE HEATER TO MALFUNCTION.

MANUAL RESET LIMIT (FACTORY INSTALLED OPTION ONLY.) THE LIMIT SWITCH IS LOCATED INTERNALLY ON THE REAR OF THE HEATER. ON THE MUH03 AND MUH05 MODELS, THE ACCESS TO THE RESET BUTTON IS ON THE RIGHT SIDE (WHEN FACING REAR OF HEATER); ON ALL OTHER MODELS IT IS NEAR THE TOP REAR OF THE HEATER.

THE MANUAL RESET LIMIT IS IN SERIES WITH THE AUTOMATIC RECYCLING PROTECTOR (LIMIT). THE MANUAL RESET LIMIT WILL NOT RESET UNTIL THE HEATER HAS COOLED AND THE BUTTON IS PUSHED IN.

HEATER LOCATION INSTRUCTIONS

Arrange units so their discharge air streams:

- **a.** are subjected to a minimum of interference from columns, machinery and partitions;
- **b.** wipe exposed walls without blowing directly at them;
- **c.** are directed away from room occupants in comfort heating;
- **d.** are directed along the windward side when installed in a building exposed to a prevailing wind.

Locate thermostats approximately 5' (1524mm) above the floor on interior partition walls or post away from cold drafts, internal heat sources and away from heater discharge air streams.

Small rooms can be heated by one unit heater.

Large rooms require multi-unit installations. Number and capacity of units will be determined by volume of building and square feet of floor area to be heated. Arrange units to provide perimeter air circulation where each unit supports the air stream from another.

MOUNTING THE HEATER

GENERAL

The heater may be mounted to discharge the heated air either horizontally or vertically. When the heater is mounted for vertical discharge, it is recommended that the heater be positioned so that the access door will open away from the wall to provide greater access to the wiring and control compartment. If the heater is to be mounted with the access door facing a wall, the heater must be mounted far enough from that wall to allow full opening of the access door (a distance approximately equal to the width of the heater ... check clearance before installing). Refer to Table 1 for wall and ceiling clearances before mounting heater.

The heater may be mounted for either vertical or horizontal discharge by the use of threaded rods. (Refer to Table 2 for threaded rod sizes required.) Observe the detailed procedures in the following installation instructions.

The heater may also be suspended from the wall or ceiling by means of an optional mounting bracket (type MMB or MCMB) which permits horizontal pivoting of the heater.

After the heater is installed, the louvers may be positioned to direct the heated air in the desired direction. When the heater is installed for horizontal discharge, the louvers should direct the air either straight ahead or downward. Directing the air upward may cause the heated air to remain in the ceiling area and waste energy.

HORIZONTAL DISCHARGE (Rod-mount from Ceiling)

1. Install four threaded mounting rods in the threaded holes and secure in place using lock nuts. (See Table 2).
2. Securely attach the four mounting rods to the ceiling. (Refer to Table 1 for wall and ceiling clearances, and Table 2 for mounting rod spacing).

Table 1. Wall and Ceiling Clearance, inches (mm)

Unit	Discharge	Ceiling	Side Wall	Back Wall
3 & 5 kW	Horiz.	2 (50.8)	6 (152.4)	9 (228.6)
	Vert.	6 (152.4)	18 (457.2)	18 (457.2)
7.5 to 10 kW	Horiz.	6 (152.4)	6 (152.4)	13 (330.2)
	Vert.	6 (152.4)	24 (609.6)	24 (609.6)
15 to 10 kW	Horiz.	6 (152.4)	9 (228.6)	$12\frac{1}{2}$ (317.5)
	Vert	6 (152.4)	24 (609.6)	24 (609.6)
25 to 50 kW	Horiz.	16 (406.4)	12 (304.8)	$18\frac{1}{2}$ (470.0)
	Vert.	12 (304.8)	39 (914.4)	39 (914.4)

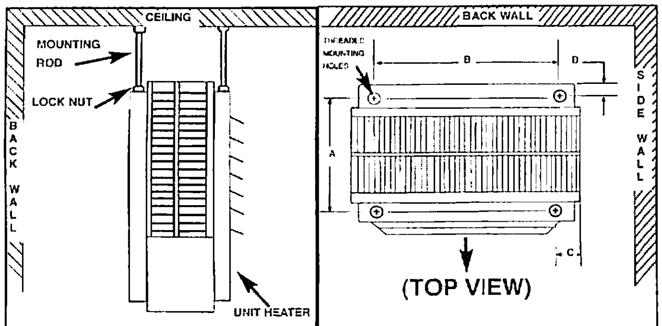


Figure 1. Horizontal Discharge Mounting and Spacing.

Table 2. Rod Thread and Spacing Dimensions, inches (mm) for Horizontal Discharge

Unit	Rod Thread Type	A	B	C	D
3 - 5 kW	$\frac{5}{16}$ - 18	$6\frac{1}{16}$ (153.9)	6 (152.4)	$4\frac{1}{16}$ (103.1)	$\frac{3}{4}$ (19.0)
7.5 - 10 kW			$8\frac{7}{8}$ (225.6)	$5\frac{1}{8}$ (130.3)	$\frac{3}{4}$ (19.0)
15 - 20 kW		$11\frac{3}{8}$ (289.0)			
25 - 30 kW	$\frac{3}{8}$ - 16	$10\frac{9}{16}$ (268.2)	14 - 12 (368.3)	$6\frac{3}{16}$ (157.2)	$\frac{5}{8}$ (16.0)
40 - 50 kW		$15\frac{15}{16}$ (404.9)	14 - 12 (368.3)	$6\frac{3}{16}$ (157.2)	$\frac{5}{8}$ (16.0)

VERTICAL DISCHARGE (Rod-Mount from Ceiling)

1. Remove bolts from the threaded holes in the back of the heater.
2. Install four threaded mounting rods in the threaded holes and and secure in place using lock nuts.
3. Securely attach the four mounting rods to the ceiling. (Refer to Table 1 for wall and ceiling clearances, and Table 3 for mounting rod spacing dimensions.)

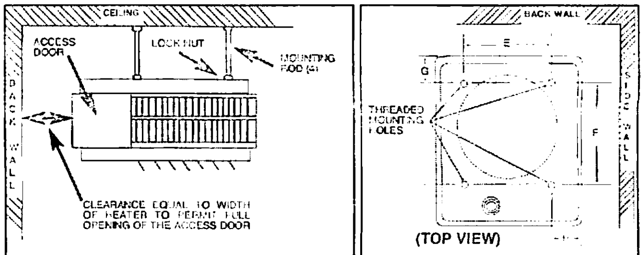


Figure 2. Vertical Discharge Mounting and Rod Spacing

Table 3. Rod Thread Type and Spacing Dimensions, inches (mm) for Vertical Discharge

Unit	Rod Thread Type	E	F	G	H
3 - 5 kW	$\frac{5}{16}$ - 18	6 (152.4)	$9\frac{3}{4}$ 247.7)	2 (50.8)	$4\frac{1}{16}$ (103.1)
7.5 - 20 kW		$8\frac{7}{8}$ (225.6)	$14\frac{5}{8}$ (371.6)	2 (50.8)	$5\frac{1}{8}$ (130.3)
25 - 30 kW	$\frac{3}{8}$ - 16	$14\frac{1}{2}$ (368.3)	$21\frac{1}{4}$ (539.8)	$2\frac{3}{16}$ (56.0)	$6\frac{3}{16}$ (157.2)

WIRING

BRANCH CIRCUIT (POWER)

1. Connect heater only to the voltage, amperage and frequency specified on the nameplate.
2. Field wiring must be properly sized to carry the amperage in accordance with the NEC.
3. The access door is hinged. There are either one or two screws accessible from the side that must be loosened to gain access. These screws are the captive type; do not try to remove them.
4. A knockout is provided in the back of the heater close to the power terminal block and the control terminal board. The control terminal board knockout is 1/2 inch (12.7 mm) conduit size. The power terminal block knockout is multiple diameter. Use the diameter that fits the required conduit size.
5. A ground terminal is provided near the power terminal board. The ground wire should be connected before other connections are made.
6. The power terminal block is equipped with box terminals sized to accept the correct size power supply wire. Branch circuit wire rated min 600V, 60° C is acceptable for heaters rated up to 80 amps. For heaters rated more than 80 amps, branch circuit wire must be rated at least 75°C. Either aluminum or copper wire is satisfactory for connection to the heater power terminal block box terminal. Copper wire is recommended and must be used with built-in disconnect switch.

7. Each heater has a wiring diagram affixed to the inside of the access door. Consult this diagram before making any field connections.
8. Single or three-phase power connections may be used with heater models MUH0521, MUH0581, MUH072, MUH078, MUH102, MUH108, and MUH158. These units are factory wired for single-phase operation. If these heaters are for use with three-phased power, reconnect the wires as indicated in the wiring diagram attached to the heater. Additional information can be found by looking at the wiring illustrations in Figures 3a and 3b and following the directions shown below.

On models MUH0521,MUH0581, MUH072, MUH078, MUH102, and MUH108 (Figure 3a), move only the two wires marked "A1" and marked "B1"; do not move or change any other wiring. The element lead wire marked "B1" which is factory connected to the power terminal block (terminal located closest to the elements) must be moved to terminal "B" on the three-phase terminal block.

The relay (contactor) lead wire "A1" must be moved from the end terminal of the power terminal block (terminal closest to the contactor or control terminal board) to the "A" terminal of the lower terminal block (center terminal).

Model MUH158 (Figure 3b) has two three-phase terminal blocks located adjacent to the relays (contactors). Move only the two wires marked "C1" and "D1" on each of these two three-phase terminal blocks to terminal "B". Do not move or change any other wires.

9. Electrical Accessories, either kits or factory-installed options, are shown connected by a dash line on the heater wiring diagram.
10. **208/240 VOLT HEATER.** Interchange transformer red and black primary leads (see wiring diagram) when the heater is to be connected to 208 volts supply.

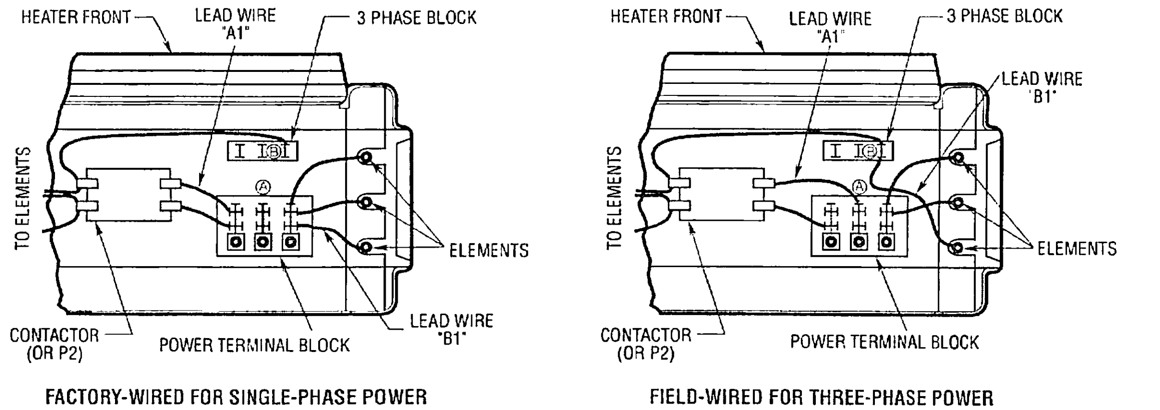


Figure 3a. Wiring Connections for Single-Phase and Three -Phase Power(MUH0521, MUH0581, MUH072, MUH078, MUH102 and MUH108)

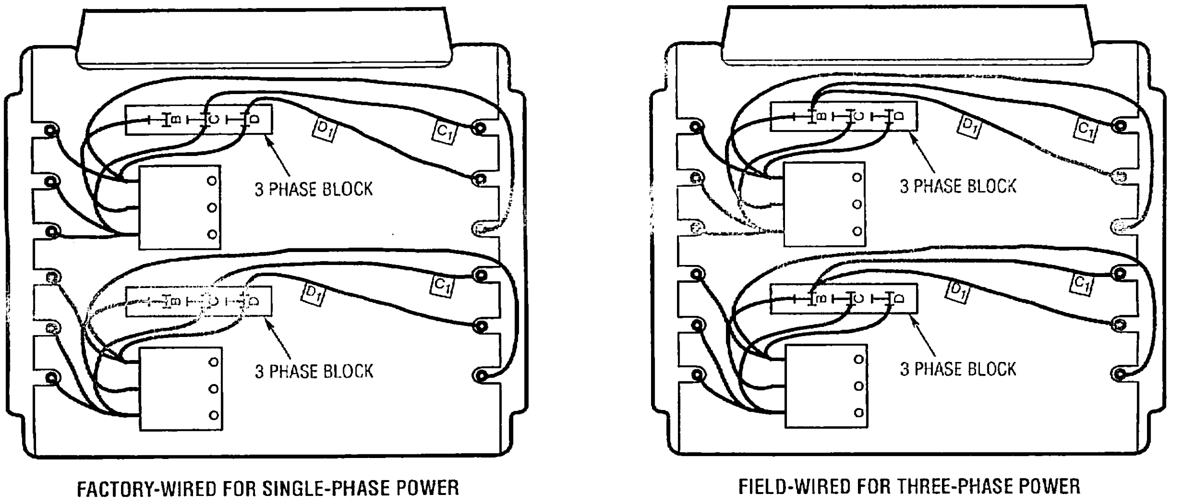


Figure 3b. Wiring Connections for Single-Phase and Three -Phase Power (MUH158)

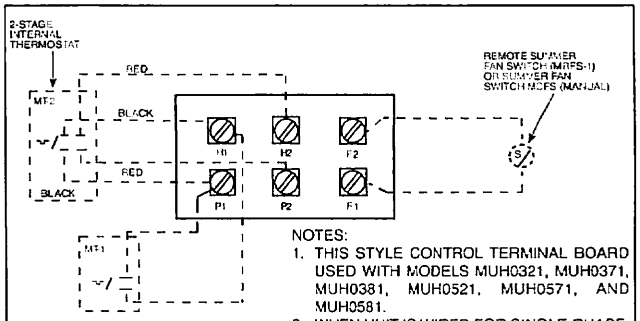
CONTROL WIRING

⚠ WARNING ⚠

LINE VOLTAGE IS PRESENT ON SOME OF THE TERMINALS ON THE CONTROL TERMINAL BOARD. ALWAYS DISCONNECT THE POWER FROM THE HEATER BEFORE MAKING ANY CONNECTIONS TO THE CONTROL BOARD TO PREVENT ELECTRIC SHOCK HAZARD.

1. Use min. 600 volts, NEC Class 1 insulated wire for all control circuit wiring.
2. Use a crimp-on type fork terminal on the wire ends that attach to the control terminal board if more than one connection is to be made under the terminal screw.
3. On units <u>not provided with internal contactor</u> (3 & 5 KW), refer to Figure 4 for wiring diagram.

   Note: Thermostat and control circuit wiring must be suitable to handle the full load of the heater (example MUH0581 is rated 24 amps)
4. On units <u>provided with internal contactor</u> (units rated 7 KW and higher) refer to Figure 5 for wiring diagram. Control wiring must be rated minimum 18 AWG.



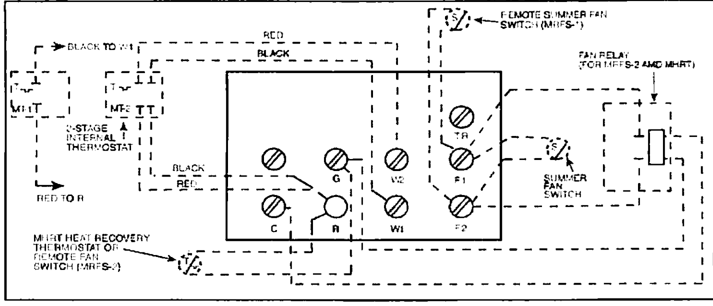
NOTES:

1. THIS STYLE CONTROL TERMINAL BOARD USED WITH MODELS MUH0321, MUH0371, MUH0381, MUH0521, MUH0571, AND MUH0581.
2. WHEN UNIT IS WIRED FOR SINGLE-PHASE, JUMPER H1 TO H2. IF SINGLE-POLE THERMOSTAT IS USED WITH SINGLE-PHASE UNIT, CONNECT THERMOSTAT LEADS TO P1 AND H1.
3. EXTERNAL LINE VOLTAGE THERMOSTATS SHOULD BE TREATED AS SINGLE STAGE ONLY.

Figure 4. Control Terminal Board (for Heaters Without Contactors)

Table 4. Specifications

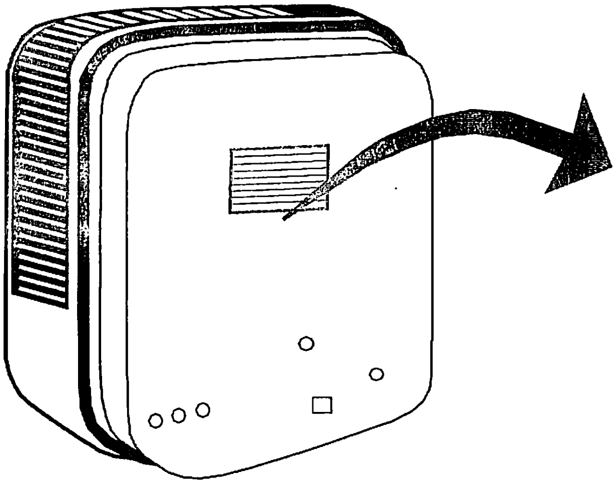
Basic Model No.	Height in (mm)	Width in. (mm)	Depth in. (mm)	Mounting Weight lbs. (kg)	Wiring Compartment Volume
MUH0381	16 (406.4)	14 (355.6)	$7\frac{1}{2}$ (190.5)	27 (12.2)	90 in^3 (14.70 cm^3)
MUH0321				27 (12.2)	
MUH0371				27 (12.2)	
MUH0341				30 (13.6)	
MUH0581				27 (12.2)	
MUH0521				27 (12.2)	
MUH0571				27 (12.2)	
MUH0541				30 (13.6)	
MUH0331				30 (13.6)	
MUH0361				30 (13.6)	
MUH0531				30 (13.6)	
MUH0561				30 (13.6)	
MUH078	$21\frac{3}{4}$ (552.5)	19 (482.6)	$7\frac{1}{2}$ (190.5)	38 (17.2)	100 in^3 (1639 cm^3)
MUH072				38 (17.2)	
MUH077				38 (17.2)	
MUH074				38 (17.2)	
MUH108				38 (17.2)	
MUH102				38 (17.2)	
MUH107				38 (17.2)	
MUH104				38 (17.2)	
MUH073				38 (17.2)	
MUH076				38 (17.2)	
MUH103				38 (17.2)	
MUH106				38 (17.2)	
MUH158	$21\frac{3}{4}$ (552.5)	19 (482.6)	$12\frac{3}{4}$ (323.9)	54 (24.5)	140 in^3 (2295 cm^3)
MUH152				50 (22.7)	
MUH154				50 (22.7)	
MUH208				60 (27.2)	
MUH202				55 (24.9)	
MUH204				55 (24.9)	
MUH156				55 (24.9)	
MUH206				55 (24.9)	
MUH252	30 (76.2)	$26\frac{5}{8}$ 676.4)	$11\frac{3}{4}$ (298.5)	89 (40.4)	504 in^3 (8260 cm^3)
MUH254				89 (40.4)	
MUH308				89 (40.4)	
MUH302				89 (40.4)	
MUH304				89 (40.4)	
MUH256				89 (40.4)	
MUH306				89 (40.4)	
MUH402	30 (76.2)	$26\frac{5}{8}$ 676.4)	$17\frac{1}{4}$ (435.1)	119 (54.0)	648 in^3 (10620 cm^3)
MUH404				119 (54.0)	
MUH508				119 (54.0)	
MUH502				119 (54.0)	
MUH504				119 (54.0)	
MUH406				119 (54.0)	
MUH506				119 (54.0)	



NOTES:

1. THIS STYLE CONTROL TERMINAL BOARD USED WITH MODELS EXCEPT MUH0321, MUH0371, MUH0381, MUH0521, MUH0571, AND MUH0581.
2. REMOVE JUMPER W1 TO W2 WHEN 2-STAGE THERMOSTAT IS USED.
3. *ONLY ONE OF THESE ACCESSORIES MAY BE INSTALLED IN A SINGLE HEATER.
4. EXTERNAL LINE VOLTAGE THERMOSTATS SHOULD BE TREATED AS SINGLE STAGE ONLY.

Figure 5. Control Terminal Board (for Heaters With Contactors)



NAMEPLATE

MODEL NO. / MFG. NO. MUH0321 — DATE CODE 0395

VOLTS AC 60 HZ	KILOWATTS	PHASE	MIN. SUPPLY CIR. AMPACITY
208 / 240	2.2 /3	1	

MAX. FUSE	MOTOR VAC	MOTOR AMP	CONTROLS VAC	CUSTOMER NO
	208/240	.25	208/240	

AIR FLOW	MINIMUM MOUNTING CLEARANCE SIDE	BACK	CEILING	FLOOR
HORIZ.	6"	9.5"	2"	7'
VERT.	18"	18"	6"	7'

WARNING: DO NOT TURN LOUVERS ABOVE LEVEL OF THE UNIT. DISCONNECT POWER BEFORE SERVICING. IF EXTERNAL CONTROL IS USED, ALSO DISCONNECT EXTERNAL POWER SUPPLY.

NE PAS RELEVER LES LAMES AU-DELÀ DU NIVEAU PREVU DE L'APPAREIL. METTRE HORS TENSION AVANT DE PROCEDER A L'ENTRETIEN. SI UNE COMMANDE EXTERNE EST UTILISEE, COUPER AUSSE L'ALIMENTATION EXTERNE. ASSURER UN DEGAGEMENT D'AU MOINS 6 PI ENTRE L'APPAREIL DE CHAUFFAGE ET LEPLANCHER.

774G LISTED AIR HEATER

c UL us

MARLEY ENGINEERED PRODUCTS
BENNETTSVILLE, SC 29512

4104-0275-036

LIMITED WARRANTY

All products manufactured by Marley Engineered Products are warranted against defects in workmanship and materials for one year from date of installation, except heating elements which are warranted against defects in workmanship and materials for five years from date of installation. This warranty does not apply to damage from accident, misuse, or alteration; nor where the connected voltage is more than 5% above the nameplate voltage; nor to equipment improperly installed or wired or maintained in violation of the product's installation instructions. All claims for warranty work must be accompanied by proof of the date of installation.

The customer shall be responsible for all costs incurred in the removal or reinstallation of products, including labor costs, and shipping costs incurred to return products to Marley Engineered Products Service Center.Within the limitations of this warranty, inoperative units should be returned to the nearest Marley authorized service center or the Marley Engineered Products Service Center, and we will repair or replace, at our option, at no charge to you with return freight paid by Marley. It is agreed that such repair or replacement is the exclusive remedy available from Marley Engineered Products.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEED THE AFORESAID EXPRESSED WARRANTIES ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT. MARLEY ENGINEERED PRODUCTS SHALL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES ARISING WITH RESPECT TO THE PRODUCT, WHETHER BASED UPON NEGLIGENCE, TORT, STRICT LIABILITY, OR CONTRACT.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation 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.

For the address of your nearest authorized service center, contact Marley Engineered Products in Bennettsville, SC, at 1-800-642-4328. Merchandise returned to the factory must be accompanied by a return authorization and service identification tag, both available from Marley Engineered Products. When requesting return authorization, include all catalog numbers shown on the products.

HOW TO OBTAIN WARRANTY SERVICE AND WARRANTY PARTS PLUS GENERAL INFORMATION

1. Warranty Service or Parts **1-800-642-4328**
2. Purchase Replacement Parts **1-800-654-3545**
3. General Product Information **www.marleymep.com**

Note: When obtaining service always have the following:

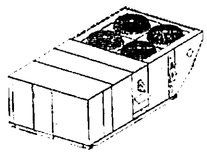
1. Model number of the product
2. Date of manufacture
3. Part number or description

Marley Engineered Products
An SPX Company
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

ECR 36699
Part No. 5200-0722-011
9/06

INSTALLATION MANUAL

R-410A
ZJ SERIES #ZJ210
15 - 25 Ton RTU-1DA
60 Hertz



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General

YORK® Model ZJ units are either single package air conditions equipped with optional factory installed electric heaters, or single package gas-fired central heating furnaces with cooling unit. Both are designed for outdoor installation on a rooftop or slab.

The units are completely assembled on rigid, permanently attached base rails. All piping, refrigerant charge, and electrical wiring is factory installed and tested. The units require electric power, gas connection, duct connections, installation of combustion air inlet hood, flue gas outlet hoods and fixed outdoor air intake damper (units without economizer or motorized damper option only) at the point of installation.

The supplemental electric heaters have nickel-chrome elements and utilize single point power connection.

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot. All gas heaters are shipped from the factory equipped for natural gas use, but can be field converted to L.P./Propane with Kit Model # 1NP0418. See Gas Heat Application Data Table.

Safety Considerations

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention the signal words **DANGER, WARNING** or **CAUTION.**

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury.**

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury.**

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state and national codes including, but not limited to building, electrical, and mechanical codes.

WARNING

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock could cause personal injury. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system. Gage sets, hoses, refrigerant containers and recovery systems must be designed to handle R-410A. If you are unsure, consult the equipment manufacturer. Failure to use R-410A compatible servicing equipment may result in property damage or injury.

WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

a. Do not try to light any appliance.
b. Do not touch any electrical switch; do not use any phone in your building.
c. Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
d. If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Due to system pressure, moving parts, and electrical components, installation and servicing of air conditioning equipment can be hazardous. Only qualified, trained service personnel should install, repair, or service this equipment. Untrained personnel can perform basic maintenance functions of cleaning coils and filters and replacing filters.

Observe all precautions in the literature, labels, and tags accompanying the equipment whenever working on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including ANSI Z223.1 or CSA-B149.1- latest edition.

Wear safety glasses and work gloves. Use quenching cloth and have a fire extinguisher available during brazing operations.

Inspection

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing.

CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state and national codes including, but not limited to, building, electrical, and mechanical codes.

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

Reference

Additional information is available in the following reference forms:

- Technical Guide - ZJ180-300, 251934
- General Installation - ZJ180-300, 284810

Renewal Parts

Contact your local York® parts distribution center for authorized replacement parts.

Approvals

Design certified by CSA as follows:

1. For use as a cooling only unit, cooling unit with supplemental electric heat or a forced air furnace.
2. For outdoor installation only.
3. For installation on combustible material.
4. For use with natural gas (convertible to LP with kit).

CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state, and national codes including, but not limited to, building, electrical, and mechanical codes.

WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

Nomenclature

15-25 Ton Sunline Magnum™ Model Number Nomenclature

Z	J	180	N24	A	2	A	AA	1	0	1	2	4	A

Product Category

Z = A/C, Single Pkg., R-410A

Product Identifier

J = 11.0+ EER A/C

Nominal Cooling Capacity

180 = 15 Ton
210 = 17.5 Ton
240 = 20 Ton
300 = 25 Ton

Heat Type and Nominal Heat Capacity

C00 = Cooling Only. No field installed electric heat

Gas Heat Options

N24 = 240 MBH Output Aluminized Steel
N32 = 320 MBH Output Aluminized Steel
S24 = 240 MBH Output Stainless Steel
S32 = 320 MBH Output Stainless Steel

Electric Heat Options

E18 = 18 KW
E36 = 36 KW
E54 = 54 KW
E72 = 72 KW

Airflow

A = Std. Motor
B = Std. Motor/Economizer
C = Std. Motor/Economizer/Power Exhaust (Downflow Only)
D = Std. Motor/Motorized Damper
E = Std. Motor/Motorized Damper/Barometric Relief
J = Std. Motor/Economizer/Barometric Relief
N = Hi Static
P = Hi Static/Economizer
Q = Hi Static/Economizer/Power Exhaust (Downflow Only)
R = Hi Static/Motorized Damper
K = Hi Static/Motorized Damper/Barometric Relief
S = Hi Static/Economizer/Barometric Relief
2 = Low Static
3 = Low Static/Economizer
4 = Low Static/Economizer/Power Exhaust (Downflow Only)
5 = Low Static/Motorized Damper
6 = Low Static/Motorized Damper/Barometric Relief
7 = Low Static/Economizer/Barometric Relief

Voltage

2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60

Installation Options

A = No Options Installed	N = Options 2 & 3
B = Option 1	P = Options 2 & 4
C = Option 2	Q = Options 2, 3, & 4
D = Options 1 & 2	R = Options 3 & 4
E = Option 3	S = Option 5
F = Option 4	T = Options 1 & 5
G = Options 1 & 3	U = Options 1, 3, & 5
H = Options 1 & 4	V = Options 1, 4, & 5
J = Options 1, 2 & 3	W = Options 1, 3, 4, & 5
K = Options 1, 2, & 4	X = Options 3 & 5
L = Options 1,3 & 4	Y = Options 4 & 5
M = Options 1, 2, 3, & 4	Z = Options 3, 4 & 5

Options

1 = Disconnect	4 = Smoke Detector R.A.
2 = Non-Pwr'd Conv. Outlet	5 = Pwr'd Conv. Outlet
3 = Smoke Detector S.A.	

Additional Options

Standard Cabinet	Hinged Filter Door & Tool Free Access Cabinet
AA = None	BA = Hinged Filter Door & Tool Free Access Panels
AB = Phase Monitor	BB = Phase Monitor, Hinged Filter Door & Tool Free Access Panels
AC = Coil Guard	BC = Coil Guard, Hinged Filter Door & Tool Free Access Panels
AD = Dirty Filter Switch	BD = Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels
AE = Phase Monitor & Coil Guard	BE = Phase Monitor & Coil Guard, Hinged Filter Door & Tool Free Access Panels
AF = Phase Monitor & Dirty Filter Switch	BF = Phase Monitor & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels
AG = Coil Guard & Dirty Filter Switch	BG = Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels
AH = Phase Monitor, Coil Guard & Dirty Filter Switch	BH = Phase Monitor, Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels
RC = Coil Guard & American Flag	
TA = Technicoat Condenser Coil	
TJ = Technicoat Evaporator Coil	
TS = Technicoat Evaporator & Condenser Coils	

ZZ = If desired option combination is not listed above, ZZ will be assigned and configuration options will be located in digits 15-18.

Product Generation

1 = First Generation

Configuration Options (not required for all units)
These four digits will not be assigned until a quote is requested, or an order placed.

- SS Drain Pan
- CPC Controller, DFS, APS
- Johnson Controller UNT 1126 (N2 protocol), DFS, APS
- Honeywell Controller, DFS, APS
- Novar Controller, DFS, APS
- Simplicity IntelliComfort Controller
- Simplicity IntelliComfort Controller w/ModLinc
- York Commercial Comfort System (YCCS) Rtu Controller
- Hot Gas Bypass (Standard on VAV, Optional on CV)
- Variable Air Volume, VFD (not available with factory installed BAS options)
- Variable Air Volume, VFD with ModLINC (not available with factory installed BAS options)
- Variable Air Volume, VFD and Manual Bypass (not available with factory installed BAS options)
- Variable Air Volume, VFD and Manual Bypass with ModLINC (not available with factory installed BAS options)
- Variable Air Volume, VFD (BAS ready)
- Variable Air Volume, VFD and Manual Bypass (BAS ready)
- Variable Air Volume, VFD Ready (for customer provided, field installed drive)
- Variable Air Volume, VFD Ready with ModLINC (for customer-provided, field-installed drive)
- 2" Pleated filters
- 4" Pleated filters
- BAS Ready Economizer (2-10 V.D.C. Actuator without a controller)
- Double Wall Construction
- Any Combination of Additional Options that Don't Have an Option Code Pre-assigned

Product Style

A = Style A

Installation

Installation Safety Information

Read these instructions before continuing this appliance installation. This is an outdoor combination heating and cooling unit. The installer must assure that these instructions are made available to the consumer and with instructions to retain them for future reference.

1. Refer to the unit rating plate for the approved type of gas for this product.
2. Install this unit only in a location and position as specified on Page 7 of these instructions.
3. Never test for gas leaks with an open flame. Use commercially available soap solution made specifically for the detection of leaks when checking all connections, as specified on Pages 5, 28 and 52 of these instructions.
4. Always install furnace to operate within the furnace's intended temperature-rise range with the duct system and within the allowable external static pressure range, as specified on the unit name/rating plate, specified on Page 27 of these instructions.
5. This equipment is not to be used for temporary heating of buildings or structures under construction.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Limitations

These units must be installed in accordance with the following:

In U.S.A.:

1. National Electrical Code, ANSI/NFPA No. 70 - Latest Edition
2. National Fuel Gas Code, ANSI Z223.1 - Latest Edition
3. Gas-Fired Central Furnace Standard, ANSI Z21.47a. - Latest Edition
4. Local building codes, and
5. Local gas utility requirements

In Canada:

1. Canadian Electrical Code, CSA C22.1
2. Installation Codes, CSA - B149.1.
3. Local plumbing and waste water codes, and
4. Other applicable local codes.

Refer to unit application data found in this document.

After installation, gas fired units must be adjusted to obtain a temperature rise within the range specified on the unit rating plate.

If components are to be added to a unit to meet local codes, they are to be installed at the dealer's and/or customer's expense.

Size of unit for proposed installation should be based on heat loss/heat gain calculation made according to the methods of Air Conditioning Contractors of America (ACCA).

This furnace is not to be used for temporary heating of buildings or structures under construction.

⚠ CAUTION

The Simplicity® control board used in this product will effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When applying this product for process cooling applications (computer rooms, switchgear, etc.), please reference applications bulletin AE-011-07 or call the applications department for Unitary Products @ 1-877-UPG-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.

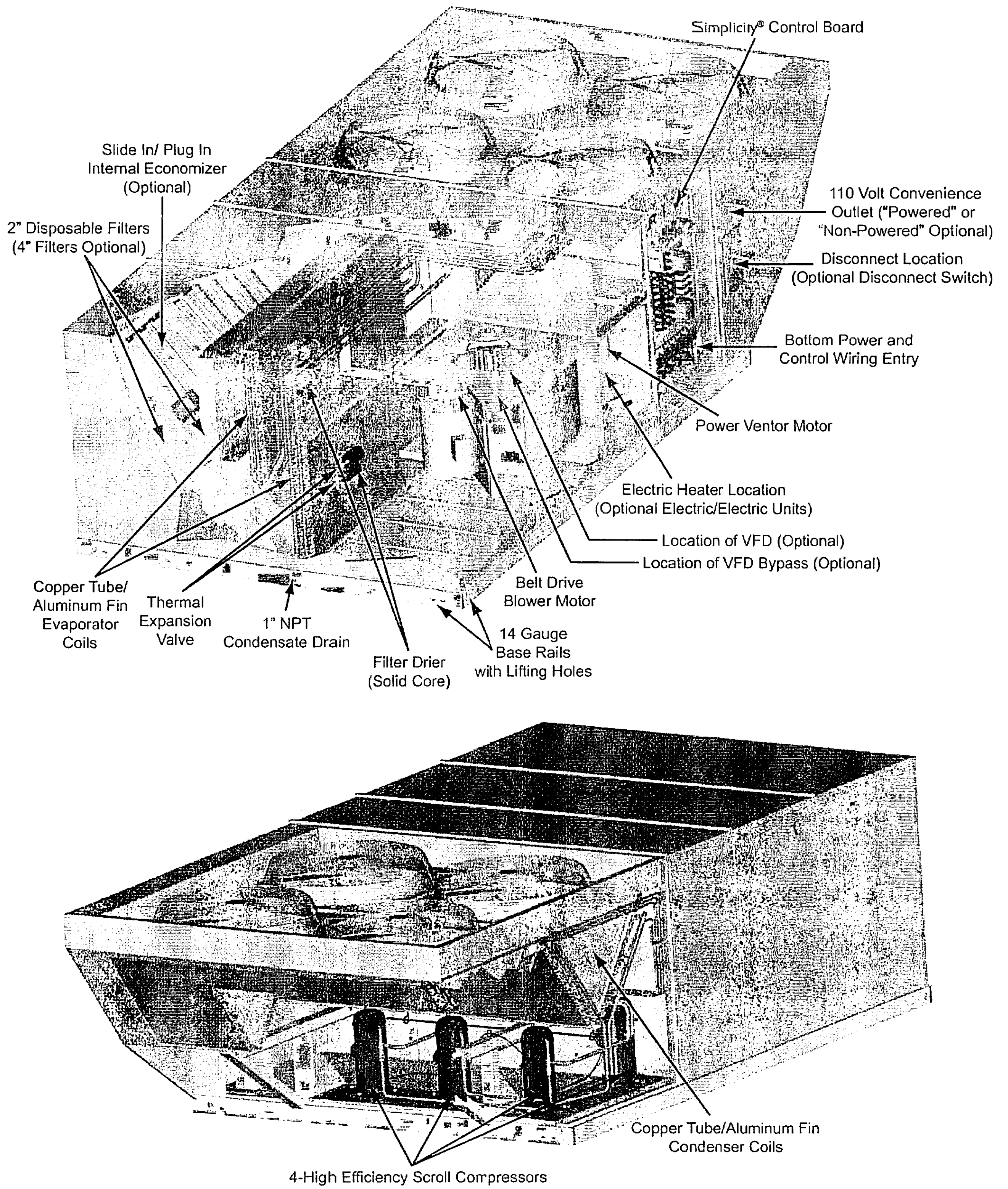


Figure 1: ZJ180-300 Component Location

Table 1: ZJ180-300 Unit Limitations

Size (Tons)	Unit Voltage	Unit Limitations		
		Applied Voltage		Outdoor DB Temp
		Min	Max	Max (°F)
180 (15)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
210 (17.5)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
240 (20)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
300 (25)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125

Location

Use the following guidelines to select a suitable location for these units:

1. Unit is designed for *outdoor installation only.*
2. Condenser coils must have an unlimited supply of air. Where a choice of location is possible, position the unit on either north or east side of building.
3. Suitable for mounting on roof curb.
4. For ground level installation, use a level concrete slab with a minimum thickness of 4 inches. The length and width should be at least 6 inches greater than the unit base rails. Do not tie slab to the building foundation.
5. Roof structures must be able to support the weight of the unit and its options/accessories. Unit must be installed on a solid, level roof curb or appropriate angle iron frame.
6. Maintain level tolerance to 1/2" across the entire width and length of unit.

⚠WARNING

Excessive exposure of this furnace to contaminated combustion air may result in equipment damage or personal injury. Typical contaminates include: permanent wave solution, chlorinated waxes and cleaners, chlorine based swimming pool chemicals, water softening chemicals, carbon tetrachloride, Halogen type refrigerants, cleaning solvents (e.g. perchloroethylene), printing inks, paint removers, varnishes, hydrochloric acid, cements and glues, antistatic fabric softeners for clothes dryers, masonry acid washing materials.

Clearances

All units require particular clearances for proper operation and service. Installer must make provisions for adequate combustion and ventilation air in accordance with section 5.3 of Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 – Latest Edition (in U.S.A.), or Sections 7.2, 7.3, or 7.4 of Gas Installation Codes, CSA-B149.1 (in Canada) - Latest Edition, and/or applicable provisions of the local building codes. Refer to Table 6 for clearances required for combustible construction, servicing, and proper unit operation.

⚠WARNING

Do not permit overhanging structures or shrubs to obstruct condenser air discharge outlet, combustion air inlet or vent outlets.

Rigging And Handling

Exercise care when moving the unit. Do not remove any packaging until the unit is near the place of installation. Rig the unit by attaching chain or cable slings to the lifting holes provided in the base rails. Spreader bars, whose length exceeds the largest dimension across the unit, **MUST** be used across the top of the unit.

⚠ CAUTION

If a unit is to be installed on a roof curb other than a York® roof curb, gasketing must be applied to all surfaces that come in contact with the unit underside.

⚠ CAUTION

Before lifting, make sure the unit weight is distributed equally on the rigging cables so it will lift evenly.

Units may be moved or lifted with a forklift. Slotted openings in the base rails are provided for this purpose.

LENGTH OF FORKS MUST BE A MINIMUM OF 90 INCHES.

⚠ CAUTION

All panels must be secured in place when the unit is lifted.

The condenser coils should be protected from rigging cable damage with plywood or other suitable material.

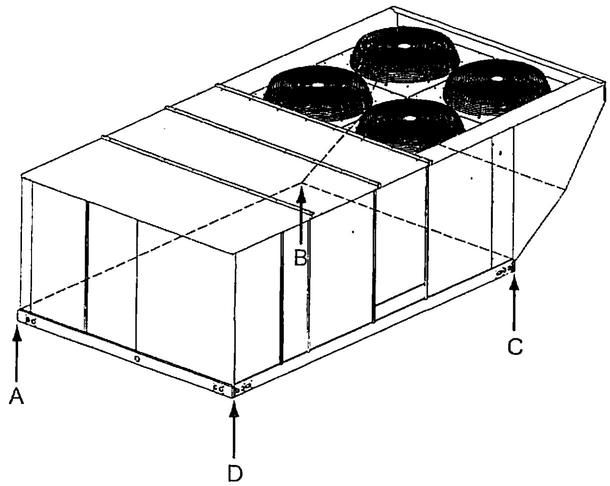


Figure 2: Unit 4 Point Load Weight

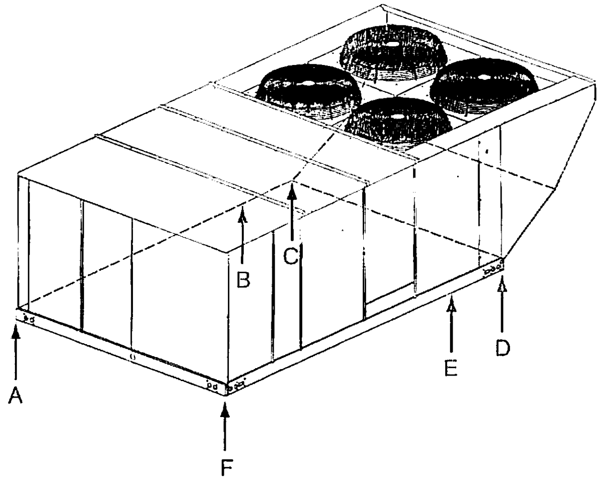


Figure 3: Unit 6 Point Load Weight

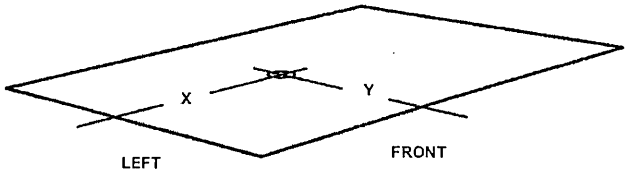


Figure 4: Center of Gravity

Table 2: Weights and Dimensions

Size	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
(Tons)	Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
180 (15)	2614	2609	85.25	44	467	781	852	510	287	392	568	620	428	313
210 (17.5)	2670	2665	85.25	44	477	797	870	520	293	401	580	633	437	320
240 (20)	2702	2697	85.05	44	485	805	878	529	298	406	585	638	443	326
300 (25)	2788	2783	85.25	44	498	833	908	544	306	419	606	661	457	334

Table 3: ZJ180-300 Unit Accessory Weights

Unit Accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	165	160
Power Exhaust	250	245
Electric Heat[1]	40	40
Gas Heat[2]	240	240
Double Wall	260	260
Motorized Damper	150	150
Barometric Damper	50	45
Econ./Motorized Damper Rain Hood	60	55
Econ./Power Exhaust Rain Hood	95	90
Wood Skid	220	220
Roof Curb	190	185
Hot Gas Bypass	10	10
Supply Fan VFD	See Table 5	

1. Weight given is for the maximum heater size available (54KW).
2. Weight given is for the maximum number of tube heat exchangers available (8 tube).

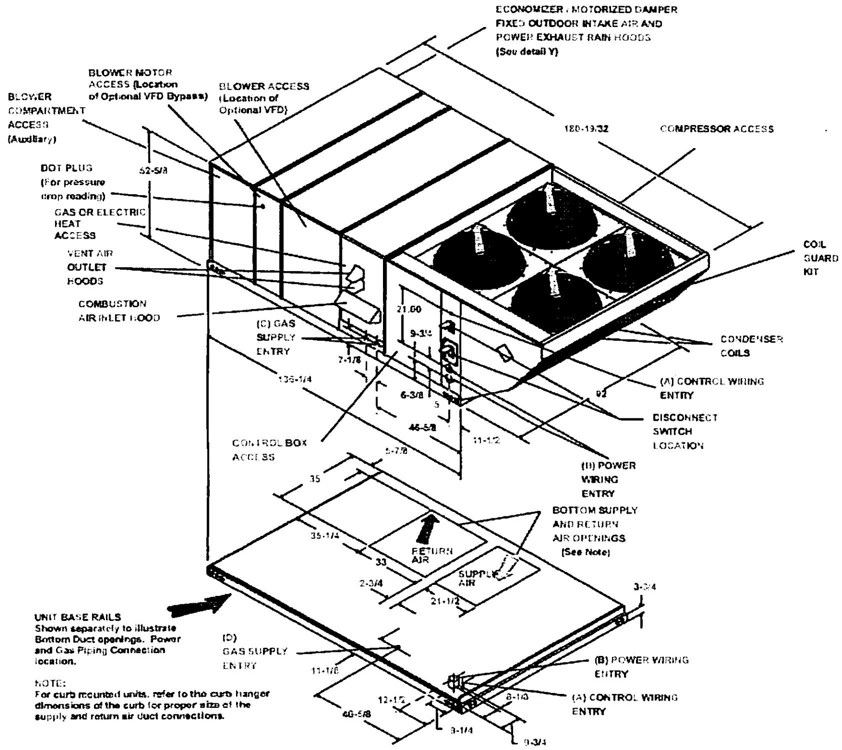


Figure 5: ZJ180-300 Unit Dimensions Front View

Table 4: Utilities Entry

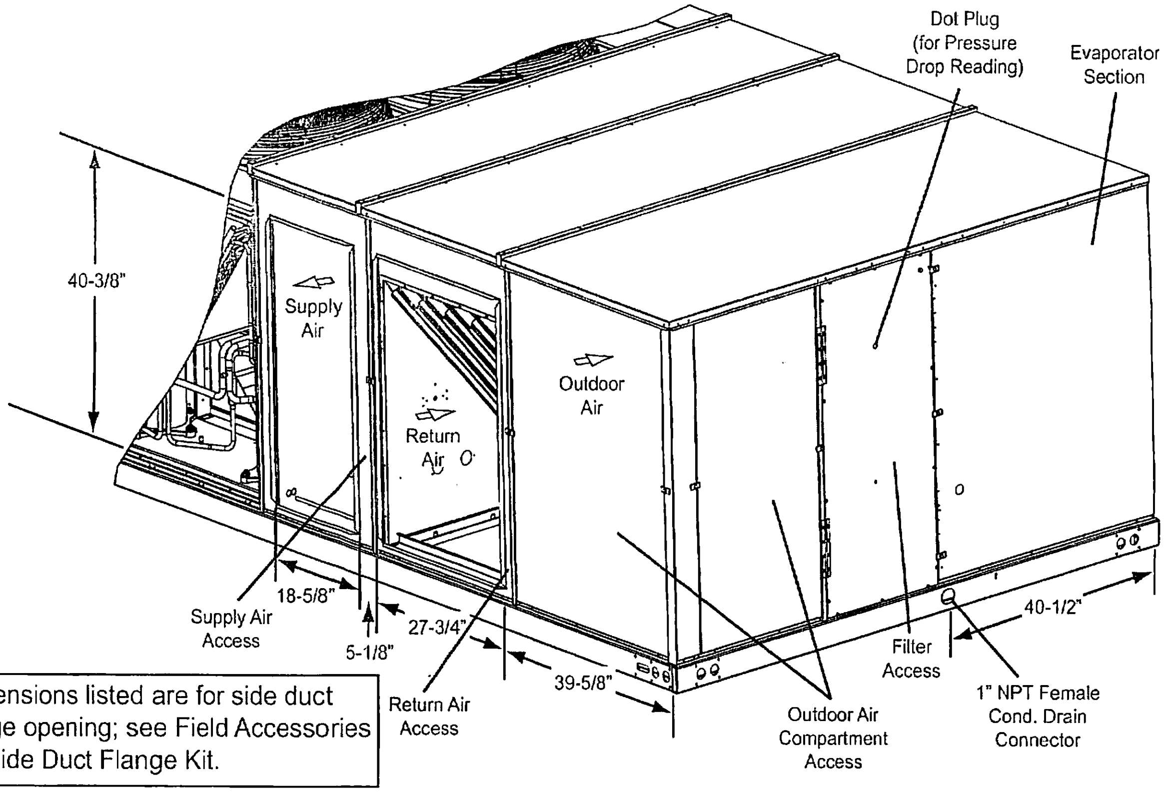
Hole	Opening Size Diameter	Used For	
A	1-1/8" KO	Control Wiring	Front
	3/4" NPS (Fem.)		Bottom
B	3-5/8" KO	Power Wiring	Front
	3" NPS (Fem.)		Bottom
C	2-3/8" KO	Gas Piping (Front)[1]	
D	1-11/16" Hole	Gas Piping (Bottom)[1,2]	

1. One-inch Gas Piping NPT Required.
2. Opening in the bottom to the unit can be located by the slice in the insulation.

Note: All entry holes should be sealed to prevent rain water entry into building.

Table 5: Supply Fan VFD Weights, In Lbs.

Supply Fan Motor	230V	460V	575V
W/O Manual Bypass			
5.0 hp	25	25	30
7.5 hp	30	30	30
10.0 hp	30	30	35
15.0 hp	30	30	40
W/Manual Bypass			
5.0 hp	30	30	35
7.5 hp	35	35	35
10.0 hp	35	35	40
15.0 hp	40	35	45



Dimensions listed are for side duct flange opening; see Field Accessories for Side Duct Flange Kit.

Figure 6: ZJ180-300 Unit Dimensions Rear View

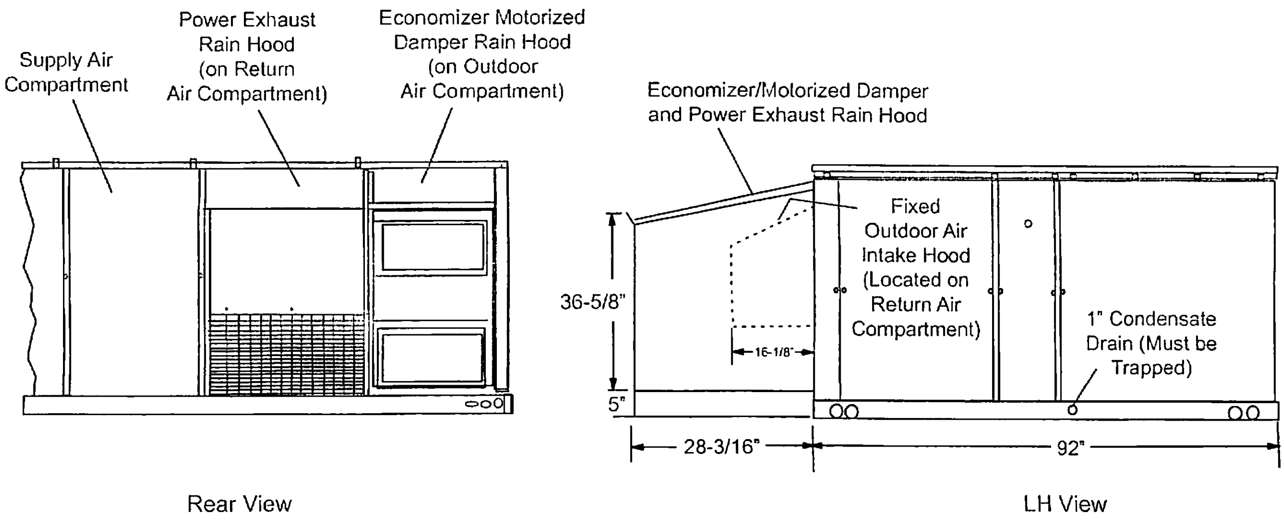
NOTE: Units are shipped with the bottom duct openings covered. An accessory flange kit is available for connecting side ducts.

For <u>bottom</u> duct applications:

1. Remove the side panels from the supply and return air compartments to gain access to the bottom supply and return air duct covers.
2. Remove and discard the bottom duct covers. Duct openings are closed with sheet metal covers except when the unit includes a power exhaust option. The covering consists of a heavy black paper composition.
3. Replace the side supply and return air compartment panels.

For <u>side</u> duct applications:

1. Replace the side panels on the supply and return air compartments with the accessory flange kit panels.
2. Connect ductwork to the flanges on those panels.



Detail "Y"
Unit with Rain Hoods

Figure 7: ZJ180-300 Unit Dimensions Rain Hood

Table 6: ZJ180-300 Unit Clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72 With 36 Maximum Horizontal Overhang (For Condenser Air Discharge)	Right	36
Front	36	Bottom[2]	0
Rear	24 (W/O Economizer)	Left	24 (W/O Economizer)
	49 (W/Economizer)		36 (W/Economizer)[3]

1. Units must be installed outdoors. Over hanging structure or shrubs should not obscure condenser air discharge outlet.
2. Units may be installed on combustable floors made from wood or class A, B or C roof covering materials.
3. If economizer is factory installed, the unassembled rain hood must be removed from its ride along position in front of the evaporator coil, or in the outdoor air compartment, prior to final installation.

Note: ELEC/ELEC Models: Units and ductwork are approved for zero clearance to combustible material when equipped with electric heaters.

GAS/ELEC Models: A 1" clearance must be provided between any combustible material and the supply air ductwork for a distance of 3 feet from the unit.

The products of combustion must not be allowed to accumulate within a confined space and recirculate.

Locate unit so that the vent air outlet hood is at least:

- Three (3) feet above any force air inlet located within 10 horizontal feet (excluding those integral to the unit).
- Four (4) feet below, four horizontal feet from, or one foot above any door or gravity air inlet into the building.
- Four (4) feet from electric and gas meters, regulators and relief equipment.

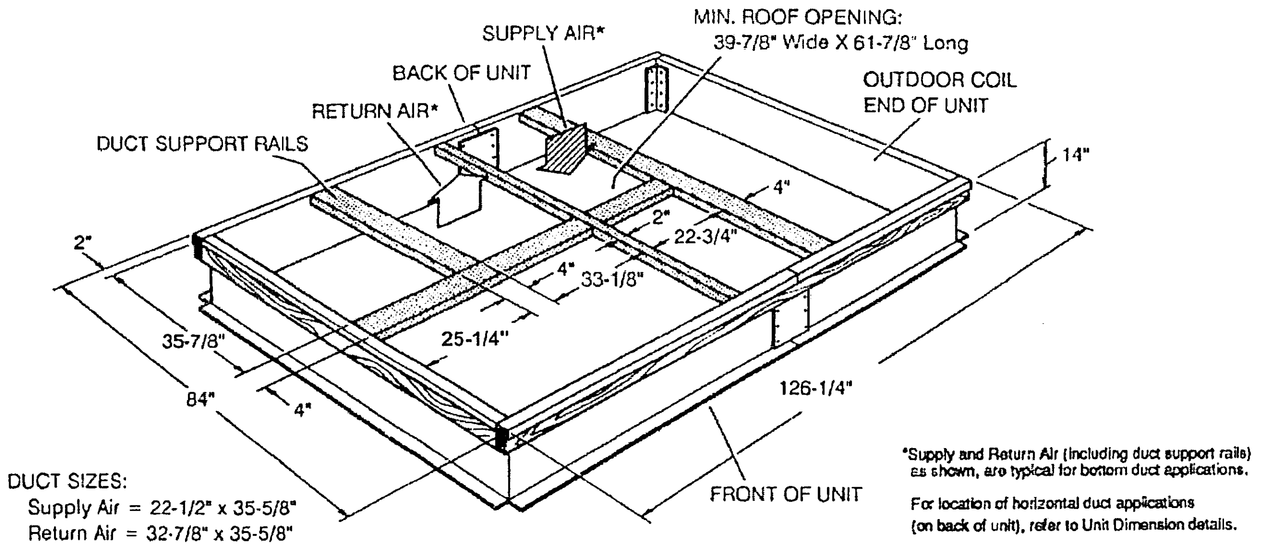


Figure 8: ZJ180-300 Roof Curb

Ductwork

Ductwork should be designed and sized according to the methods in Manual D of the Air Conditioning Contractors of America (ACCA) or as recommended by any other recognized authority such as ASHRAE or SMACNA.

A closed return duct system should be used. This will not preclude use of economizers or outdoor fresh air intake. The supply and return air duct connections at the unit should be made with flexible joints to minimize noise.

The supply and return air duct systems should be designed for the CFM and static pressure requirements of the job. They should NOT be sized to match the dimensions of the duct connections on the unit.

Refer to Figure 5 for bottom air duct openings. Refer to Figure 6 for side air duct openings.

NOTE: It is recommended that, in Canada, the outlet duct be provided with a removable access panel. It is recommended that this opening be accessible when the unit is installed in service, and of a size such that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The cover should be attached in a manner adequate to prevent leakage.

Fixed Outdoor Air Intake Damper

This damper is shipped inside the return air compartment. It is completely assembled and ready for installation. A damper baffle inside of the hood is adjustable to provide variable amounts of outdoor air intake on units that are not provided with an economizer or a motorized damper option. Refer to the Fixed Outdoor Damper Figure 9.

Gasketing and mounting screws are provided in a parts bag attached to the hood assembly. Apply gasketing to the three flange surfaces on the hood prior to installing the hood. Extend gasketing 1/4 inch beyond the top and bottom of the two side flanges to insure adequate sealing.

Adjusting the damper to the desired air flow may be done before mounting the hood into position or after installation by removing the front hood panel or the screen on the bottom of the hood. Damper baffle in position 1 will allow approximately 10% outdoor air flow, position 2 approximately 15% and, to allow approximately 25%, remove the damper baffle.

On units with bottom return air application install the damper assembly over the opening in the side return air access panel. Remove and discard the opening cover and the covering over the hood mounting holes (used for shipping) before installing. Secure with the screws provided.

On units with side return air applications, install the damper assembly on the return air ductwork as close to the unit as possible. Cut an opening 16 inches high by 18 inches wide in the ductwork to accommodate the damper. Using the holes in the hood flanges as a template, drill 9/64 inch diameter (#26 drill) holes into the ductwork and secure with the screws provided.

⚠ CAUTION

If outdoor air intake will not be required on units with bottom return air applications, the damper assembly should still be mounted on the side return air access panel, per the instructions above, to insure moisture is not drawn into the unit during operation. The covering over the mounting holes only need be removed. Do not remove the opening cover.

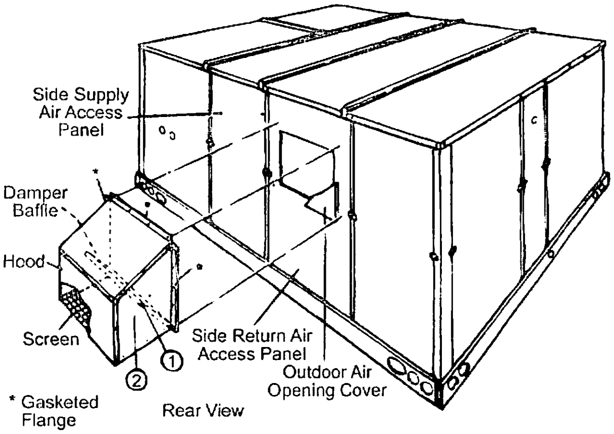


Figure 9: Fixed Outdoor Air Damper

Condensate Drain

Plumbing must conform to local codes. Use a sealing compound on male pipe threads. Install a condensate drain line from the one-inch NPT female connection on the unit to an open drain.

NOTE: The condensate drain operates in a negative pressure in the cabinet. The condensate drain line MUST be trapped to provide proper drainage. See Figure 10.

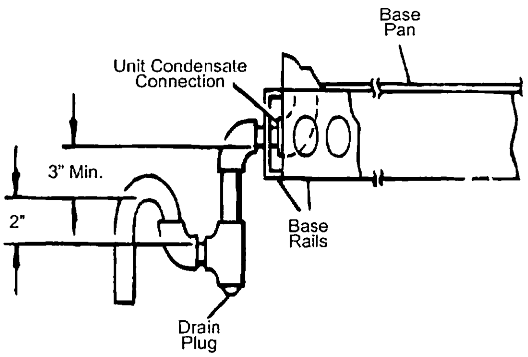


Figure 10: Condensate Drain

Compressors

The scroll compressor used in this product is specifically designed to operate with R-410A Refrigerant and cannot be interchanged.

> **⚠ CAUTION**
>
> This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

The compressor also uses a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oil can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. Take all necessary precautions to avoid exposure of the oil to the atmosphere.

> **⚠ CAUTION**
>
> Do not leave the system open to the atmosphere. Unit damage could occur due to moisture being absorbed by the **POE oil** in the system. This type of oil is highly susceptible to moisture absorption

POE (polyolester) compressor lubricants are known to cause long term damage to some synthetic roofing materials.

> **⚠ CAUTION**
>
> Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When performing any service that may risk exposure of compressor oil to the roof, take precautions to protect roofing.

Procedures which risk oil leakage include, but are not limited to, compressor replacement, repairing refrigerant leaks, replacing refrigerant components such as filter drier, pressure switch, metering device or coil.

Units are shipped with compressor mountings which are factory-adjusted and ready for operation.

> **⚠ CAUTION**
>
> Do not loosen compressor mounting bolts.

Filters

Two-inch filters are supplied with each unit, but units can be converted easily to four-inch filters. Filters must always be installed ahead of the evaporator coil and must be kept clean or replaced with same size and type. Dirty filters will reduce the capacity of the unit and will result in frosted coils or safety shutdown. Minimum filter area and required sizes are shown in Physical Data Table 9.

> **⚠ CAUTION**
>
> Make sure that panel latches are properly positioned on the unit to maintain an airtight seal.

Power And Control Wiring

Field wiring to the unit, fuses, and disconnects must conform to provisions of National Electrical Code (NEC), ANSI/NFPA No. 70 – Latest Edition (in U.S.A.), current Canadian Electrical Code C221, and/or local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified above and/or local codes.

Voltage tolerances which must be maintained at the compressor terminals during starting and running conditions are indicated on the unit Rating Plate and Table 1.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. Field alteration to comply with electrical codes should not be required. If any of the wire supplied with the unit must be replaced, replacement wire must be of the type shown on the wiring diagram and the same minimum gauge as the replaced wire.

A disconnect must be utilized for these units. Factory installed disconnects are available. If installing a disconnect (field supplied or York International® supplied accessory), refer to Figure 1 for the recommended mounting location.

⚠ CAUTION

Avoid damage to internal components if drilling holes for disconnect mounting.

NOTE: Since not all local codes allow the mounting of a disconnect on the unit, please confirm compliance with local code before mounting a disconnect on the unit.

Electrical line must be sized properly to carry the load. USE COPPER CONDUCTORS ONLY. Each unit must be wired with a separate branch circuit fed directly from the meter panel and properly fused.

Refer to Figures 11 and 12 for typical field wiring and to the appropriate unit wiring diagram mounted inside control doors for control circuit and power wiring information.

⚠ CAUTION

When connecting electrical power and control wiring to the unit, water-proof connectors must be used so that water or moisture cannot be drawn into the unit during normal operation. The above water-proofing conditions will also apply when installing a field supplied disconnect switch.

Power Wiring Detail

Units are factory wired for the voltage shown on the unit nameplate. Refer to Electrical Data Table 8 to size power wiring, fuses, and disconnect switch.

Power wiring is brought into the unit through the side of the unit or the basepan inside the curb.

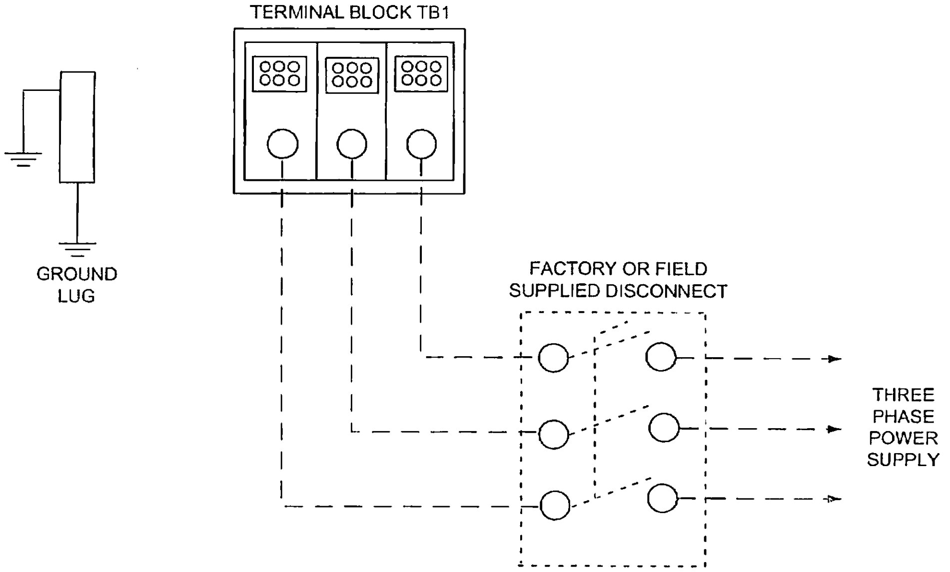


Figure 11: Field Wiring Disconnect - Cooling Unit With/Without Electric Heat

Thermostat Wiring

The thermostat should be located on an inside wall approximately 56 inch above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow the manufacturer's instructions enclosed with thermostat for general installation procedure. Seven (7) color-coded, insulated wires should be used to connect the thermostat to the unit. Refer to Table 7 for control wire sizing and maximum length.

Space Sensor

The space sensor, if used, should be located on an inside wall approximately 56 inches above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow manufacturer's instructions enclosed with sensor for general installation procedure.

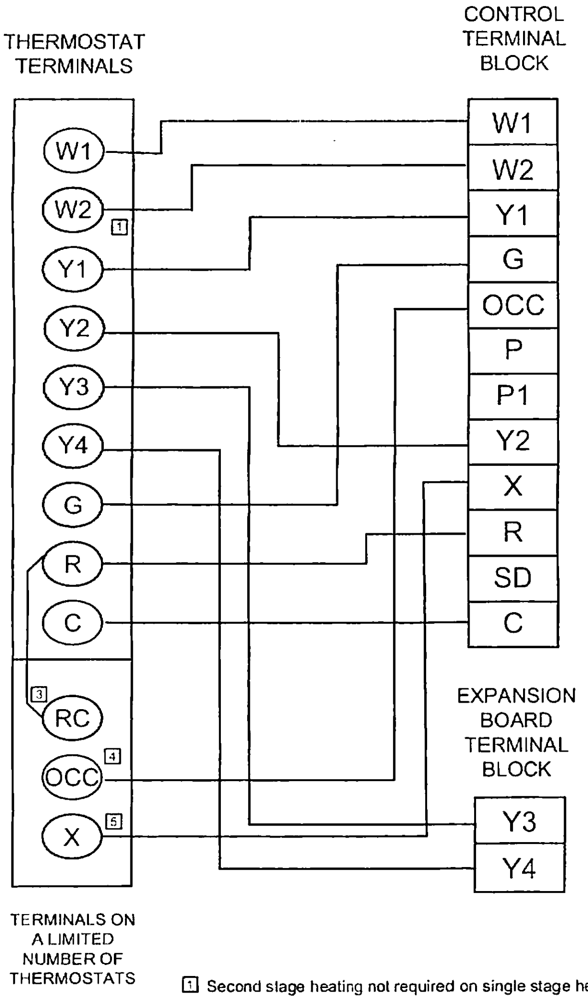
Table 7: Control Wire Sizes

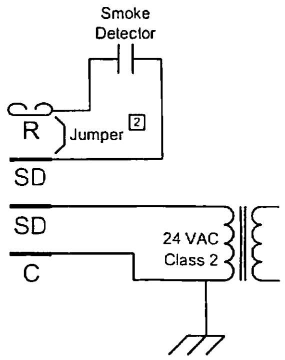
Wire Size	Maximum Length[1]
18 AWG	150 Feet

1. From the unit to the thermostat and back to the unit.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.





1 Second stage heating not required on single stage heating units.

2 Jumper is required if there is no Smoke Detector circuit.

3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

5 X is an input to the thermostat to display Error Status conditions.

Figure 12: Typical Field Wiring 24 Volt Thermostat

Table 8: Electrical Data

ZJ180-300 - Standard Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	14.7	115	23.0	2.1	15.4	0.0	None	-	-	-	86.5	100
								E18	13.5	1	37.5	86.5	100
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	14.7	115	23.0	2.1	14.4	0.0	None	-	-	-	85.3	90
								E18	18.0	1	43.3	85.3	90
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	7.7	50	12.0	1.1	7.2	0.0	None	-	-	-	44.3	50
								E18	18.0	1	21.7	44.3	50
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	6.4	40	10.0	0.9	5.9	0.0	None	-	-	-	36.7	40
								E18	18.0	1	17.3	36.7	40
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
210 (17.5)	208-3-60	16.7	120	26.0	2.1	15.4	0.0	None	-	-	-	94.8	110
								E18	13.5	1	37.5	94.8	110
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	16.7	120	26.0	2.1	14.4	0.0	None	-	-	-	93.8	110
								E18	18.0	1	43.3	93.8	110
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	8.7	60	15.5	1.1	7.2	0.0	None	-	-	-	48.6	50
								E18	18.0	1	21.7	48.6	50
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	6.7	42	10.5	0.9	5.9	0.0	None	-	-	-	38.0	40
								E18	18.0	1	17.3	38.0	40
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
240 (20)	208-3-60	17.9	120	28.0	3.7	15.4	0.0	None	-	-	-	106.3	110
								E18	13.5	1	37.5	106.3	110
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	17.9	120	28.0	3.7	14.4	0.0	None	-	-	-	105.3	110
								E18	18.0	1	43.3	105.3	110
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	9.6	70	15.0	1.9	7.2	0.0	None	-	-	-	55.6	60
								E18	18.0	1	21.7	55.6	60
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	7.4	53	11.5	1.5	5.9	0.0	None	-	-	-	43.4	50
								E18	18.0	1	17.3	43.4	50
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90

ZJ180-300 - Standard Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	23.0	160	31.5	3.7	28.0	0.0	None	-	-	-	141.8	150
								E18	13.5	1	37.5	141.8	150
								E36	27.0	2	74.9	141.8	150
								E54	40.6	2	112.7	175.9	200
								E72	54.1	2	150.2	185.2	200
	230-3-60	23.0	160	31.5	3.7	26.0	0.0	None	-	-	-	139.3	150
								E18	18.0	1	43.3	139.3	150
								E36	36.0	2	86.6	140.8	150
								E54	54.0	2	129.9	162.4	175
								E72	72.0	2	173.2	205.7	225
	460-3-60	12.2	87	17.1	1.9	13.0	0.0	None	-	-	-	72.7	80
								E18	18.0	1	21.7	72.7	80
								E36	36.0	2	43.3	72.7	80
								E54	54.0	2	65.0	81.2	90
								E72	72.0	2	86.6	102.9	110
	575-3-60	8.7	62	13.5	1.5	10.3	0.0	None	-	-	-	53.7	60
								E18	18.0	1	17.3	53.7	60
								E36	36.0	2	34.6	56.2	60
								E54	54.0	2	52.0	64.8	70
								E72	72.0	2	69.3	82.2	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ180-300 - Standard Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	14.7	115	23.0	2.1	15.4	10.0	None	-	-	-	96.5	110
								E18	13.5	1	37.5	96.5	110
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	14.7	115	23.0	2.1	14.4	10.0	None	-	-	-	95.3	100
								E18	18.0	1	43.3	95.3	100
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	7.7	50	12.0	1.1	7.2	5.0	None	-	-	-	49.3	50
								E18	18.0	1	21.7	49.3	50
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	6.4	40	10.0	0.9	5.9	4.0	None	-	-	-	40.7	45
								E18	18.0	1	17.3	40.7	45
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
210 (17.5)	208-3-60	16.7	120	26.0	2.1	15.4	10.0	None	-	-	-	104.8	110
								E18	13.5	1	37.5	104.8	110
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	16.7	120	26.0	2.1	14.4	10.0	None	-	-	-	103.8	110
								E18	18.0	1	43.3	103.8	110
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	8.7	60	15.5	1.1	7.2	5.0	None	-	-	-	53.6	60
								E18	18.0	1	21.7	53.6	60
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	6.7	42	10.5	0.9	5.9	4.0	None	-	-	-	42.0	45
								E18	18.0	1	17.3	42.0	45
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
240 (20)	208-3-60	17.9	120	28.0	3.7	15.4	10.0	None	-	-	-	116.3	125
								E18	13.5	1	37.5	116.3	125
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	17.9	120	28.0	3.7	14.4	10.0	None	-	-	-	115.3	125
								E18	18.0	1	43.3	115.3	125
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	9.6	70	15.0	1.9	7.2	5.0	None	-	-	-	60.6	70
								E18	18.0	1	21.7	60.6	70
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	7.4	53	11.5	1.5	5.9	4.0	None	-	-	-	47.4	50
								E18	18.0	1	17.3	47.4	50
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90

ZJ180-300 - Standard Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	23.0	160	31.5	3.7	28.0	10.0	None	-	-	-	151.8	175
								E18	13.5	1	37.5	151.8	175
								E36	27.0	2	74.9	151.8	175
								E54	40.6	2	112.7	188.4	200
								E72	54.1	2	150.2	197.7	200
	230-3-60	23.0	160	31.5	3.7	26.0	10.0	None	-	-	-	149.3	175
								E18	18.0	1	43.3	149.3	175
								E36	36.0	2	86.6	153.3	175
								E54	54.0	2	129.9	174.9	175
								E72	72.0	2	173.2	218.2	225
	460-3-60	12.2	87	17.1	1.9	13.0	5.0	None	-	-	-	77.7	90
								E18	18.0	1	21.7	77.7	90
								E36	36.0	2	43.3	77.7	90
								E54	54.0	2	65.0	87.5	90
								E72	72.0	2	86.6	109.1	110
	575-3-60	8.7	62	13.5	1.5	10.3	4.0	None	-	-	-	57.7	60
								E18	18.0	1	17.3	57.7	60
								E36	36.0	2	34.6	61.2	70
								E54	54.0	2	52.0	69.8	70
								E72	72.0	2	69.3	87.2	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ180-300 - High Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	14.7	115	23.0	2.1	15.4	0.0	None	-	-	-	86.5	100
								E18	13.5	1	37.5	86.5	100
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	14.7	115	23.0	2.1	14.4	0.0	None	-	-	-	85.3	90
								E18	18.0	1	43.3	85.3	90
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	7.7	50	12.0	1.1	7.2	0.0	None	-	-	-	44.3	50
								E18	18.0	1	21.7	44.3	50
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	6.4	40	10.0	0.9	5.9	0.0	None	-	-	-	36.7	40
								E18	18.0	1	17.3	36.7	40
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
210 (17.5)	208-3-60	16.7	120	26.0	2.1	20.0	0.0	None	-	-	-	100.2	110
								E18	13.5	1	37.5	100.2	110
								E36	27.0	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	16.7	120	26.0	2.1	20.0	0.0	None	-	-	-	100.2	110
								E18	18.0	1	43.3	100.2	110
								E36	36.0	2	86.6	133.3	150
								E54	54.0	2	129.9	154.9	175
								E72	72.0	2	173.2	198.2	225
	460-3-60	8.7	60	15.5	1.1	10.0	0.0	None	-	-	-	51.7	60
								E18	18.0	1	21.7	51.7	60
								E36	36.0	2	43.3	66.6	70
								E54	54.0	2	65.0	77.5	90
								E72	72.0	2	86.6	99.1	110
	575-3-60	6.7	42	10.5	0.9	8.2	0.0	None	-	-	-	40.7	45
								E18	18.0	1	17.3	40.7	45
								E36	36.0	2	34.6	53.6	60
								E54	54.0	2	52.0	62.2	70
								E72	72.0	2	69.3	79.5	90
240 (20)	208-3-60	17.9	120	28.0	3.7	15.4	0.0	None	-	-	-	106.3	110
								E18	13.5	1	37.5	106.3	110
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	17.9	120	28.0	3.7	14.4	0.0	None	-	-	-	105.3	110
								E18	18.0	1	43.3	105.3	110
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	9.6	70	15.0	1.9	7.2	0.0	None	-	-	-	55.6	60
								E18	18.0	1	21.7	55.6	60
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	7.4	53	11.5	1.5	5.9	0.0	None	-	-	-	43.4	50
								E18	18.0	1	17.3	43.4	50
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90

ZJ180-300 - High Static Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	23.0	160	31.5	3.7	38.6	0.0	None	-	-	-	155.1	175
								E18	13.5	1	37.5	155.1	175
								E36	27.0	2	74.9	155.1	175
								E54	40.6	2	112.7	189.1	200
								E72	54.1	2	150.2	198.4	225
	230-3-60	23.0	160	31.5	3.7	38.6	0.0	None	-	-	-	155.1	175
								E18	18.0	1	43.3	155.1	175
								E36	36.0	2	86.6	156.5	175
								E54	54.0	2	129.9	178.2	200
								E72	72.0	2	173.2	221.5	250
	460-3-60	12.2	87	17.1	1.9	19.3	0.0	None	-	-	-	80.5	90
								E18	18.0	1	21.7	80.5	90
								E36	36.0	2	43.3	80.5	90
								E54	54.0	2	65.0	89.1	100
								E72	72.0	2	86.6	110.7	125
	575-3-60	8.7	62	13.5	1.5	15.4	0.0	None	-	-	-	60.1	70
								E18	18.0	1	17.3	60.1	70
								E36	36.0	2	34.6	62.6	70
								E54	54.0	2	52.0	71.2	80
								E72	72.0	2	69.3	88.5	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ180-300 - High Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
180 (15)	208-3-60	14.7	115	23.0	2.1	15.4	10.0	None	-	-	-	96.5	110
								E18	13.5	1	37.5	96.5	110
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	14.7	115	23.0	2.1	14.4	10.0	None	-	-	-	95.3	100
								E18	18.0	1	43.3	95.3	100
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	7.7	50	12.0	1.1	7.2	5.0	None	-	-	-	49.3	50
								E18	18.0	1	21.7	49.3	50
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	6.4	40	10.0	0.9	5.9	4.0	None	-	-	-	40.7	45
								E18	18.0	1	17.3	40.7	45
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
210 (17.5)	208-3-60	16.7	120	26.0	2.1	20.0	10.0	None	-	-	-	110.2	125
								E18	13.5	1	37.5	110.2	125
								E36	27.0	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	16.7	120	26.0	2.1	20.0	10.0	None	-	-	-	110.2	125
								E18	18.0	1	43.3	110.2	125
								E36	36.0	2	86.6	145.8	150
								E54	54.0	2	129.9	167.4	175
								E72	72.0	2	173.2	210.7	225
	460-3-60	8.7	60	15.5	1.1	10.0	5.0	None	-	-	-	56.7	60
								E18	18.0	1	21.7	56.7	60
								E36	36.0	2	43.3	72.9	80
								E54	54.0	2	65.0	83.7	90
								E72	72.0	2	86.6	105.4	110
	575-3-60	6.7	42	10.5	0.9	8.2	4.0	None	-	-	-	44.7	50
								E18	18.0	1	17.3	44.7	50
								E36	36.0	2	34.6	58.6	60
								E54	54.0	2	52.0	67.2	70
								E72	72.0	2	69.3	84.5	90
240 (20)	208-3-60	17.9	120	28.0	3.7	15.4	10.0	None	-	-	-	116.3	125
								E18	13.5	1	37.5	116.3	125
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	17.9	120	28.0	3.7	14.4	10.0	None	-	-	-	115.3	125
								E18	18.0	1	43.3	115.3	125
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	9.6	70	15.0	1.9	7.2	5.0	None	-	-	-	60.6	70
								E18	18.0	1	21.7	60.6	70
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	7.4	53	11.5	1.5	5.9	4.0	None	-	-	-	47.4	50
								E18	18.0	1	17.3	47.4	50
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90

ZJ180-300 - High Static Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	23.0	160	31.5	3.7	38.6	10.0	None	-	-	-	165.1	200
								E18	13.5	1	37.5	165.1	200
								E36	27.0	2	74.9	165.1	200
								E54	40.6	2	112.7	201.6	225
								E72	54.1	2	150.2	210.9	225
	230-3-60	23.0	160	31.5	3.7	38.6	10.0	None	-	-	-	165.1	200
								E18	18.0	1	43.3	165.1	200
								E36	36.0	2	86.6	169.0	200
								E54	54.0	2	129.9	190.7	225
								E72	72.0	2	173.2	234.0	250
	460-3-60	12.2	87	17.1	1.9	19.3	5.0	None	-	-	-	85.5	100
								E18	18.0	1	21.7	85.5	100
								E36	36.0	2	43.3	85.5	100
								E54	54.0	2	65.0	95.3	110
								E72	72.0	2	86.6	117.0	125
	575-3-60	8.7	62	13.5	1.5	15.4	4.0	None	-	-	-	64.1	70
								E18	18.0	1	17.3	64.1	70
								E36	36.0	2	34.6	67.6	70
								E54	54.0	2	52.0	76.2	90
								E72	72.0	2	69.3	93.5	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ300 - Low Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	23.0	160	31.5	3.7	20.0	0.0	None	-	-	-	132.6	150
								E18	13.5	1	37.5	132.6	150
								E36	27.0	2	74.9	132.6	150
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	23.0	160	31.5	3.7	20.0	0.0	None	-	-	-	132.6	150
								E18	18.0	1	43.3	132.6	150
								E36	36.0	2	86.6	133.3	150
								E54	54.0	2	129.9	154.9	175
								E72	72.0	2	173.2	198.2	225
	460-3-60	12.2	87	17.1	1.9	10.0	0.0	None	-	-	-	69.5	80
								E18	18.0	1	21.7	69.5	80
								E36	36.0	2	43.3	69.5	80
								E54	54.0	2	65.0	77.5	90
								E72	72.0	2	86.6	99.1	110
	575-3-60	8.7	62	13.5	1.5	8.2	0.0	None	-	-	-	51.2	60
								E18	18.0	1	17.3	51.2	60
								E36	36.0	2	34.6	53.6	60
								E54	54.0	2	52.0	62.2	70
								E72	72.0	2	69.3	79.5	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

ZJ300 - Low Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
300 (25)	208-3-60	23.0	160	31.5	3.7	20.0	10.0	None	-	-	-	142.6	150
								E18	13.5	1	37.5	142.6	150
								E36	27.0	2	74.9	142.6	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	23.0	160	31.5	3.7	20.0	10.0	None	-	-	-	142.6	150
								E18	18.0	1	43.3	142.6	150
								E36	36.0	2	86.6	145.8	150
								E54	54.0	2	129.9	167.4	175
								E72	72.0	2	173.2	210.7	225
	460-3-60	12.2	87	17.1	1.9	10.0	5.0	None	-	-	-	74.5	80
								E18	18.0	1	21.7	74.5	80
								E36	36.0	2	43.3	74.5	80
								E54	54.0	2	65.0	83.7	90
								E72	72.0	2	86.6	105.4	110
	575-3-60	8.7	62	13.5	1.5	8.2	4.0	None	-	-	-	55.2	60
								E18	18.0	1	17.3	55.2	60
								E36	36.0	2	34.6	58.6	60
								E54	54.0	2	52.0	67.2	70
								E72	72.0	2	69.3	84.5	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Table 9: ZJ180-300 Physical Data

Component	Models							
	ZJ180		ZJ210		ZJ240		ZJ300	
Nominal Tonnage	15		17.5		20		25	
ARI COOLING PERFORMANCE								
Gross Capacity @ ARI A point (Btu)	183500		213700		242000		312000	
ARI net capacity (Btu)	178500		206000		235000		295000	
EER	12.4		12.1		11.6		10.4	
SEER	-		-		-		-	
IPLV	13.9		13.2		12.9		10.6	
Nominal CFM	6000		7000		8000		10000	
System power (KW)	14.40		17.10		20.10		28.50	
Refrigerant type	R-410a		R-410a		R-410a		R-410a	
Refrigerant charge (lb-oz)								
System 1	12-8		12-8		12-0		12-8	
System 2	12-8		13-8		12-0		13-8	
System 3	12-8		12-8		12-0		13-0	
System 4	12-8		12-8		12-0		12-8	
ARI HEATING PERFORMANCE								
Heating model	24	32	24	32	24	32	24	32
Heat input (K Btu)	300	400	300	400	300	400	300	400
Heat output (K Btu)	240	320	240	320	240	320	240	320
AFUE%	-	-	-	-	-	-	-	-
Steady state efficiency (%)	80	80	80	80	80	80	80	80
No. burners	6	8	6	8	6	8	6	8
No. stages	2	2	2	2	2	2	2	2
Temperature Rise Range (°F)	20-50	30-60	20-50	30-60	20-50	30-60	20-50	30-60
Gas Limit Setting (°F)	195	195	195	195	195	195	195	195
Gas piping connection (in.)	1	1	1	1	1	1	1	1
DIMENSIONS (inches)								
Length	180-19/32							
Width	92							
Height	52-5/8							
OPERATING WT. (lbs.)	2609		2665		2697		2783	
COMPRESSORS								
Type	Scroll		Scroll		Scroll		Scroll	
Quantity	4		4		4		4	
Unit Capacity Steps (%)	25 / 50 / 75 / 100		25 / 50 / 75 / 100		25 / 50 / 75 / 100		25 / 50 / 75 / 100	
CONDENSER COIL DATA								
Face area (Sq. Ft.)	63.8		63.8		63.8		63.8	
Rows	2		2		2		2	
Fins per inch	20		20		20		20	
Tube diameter (in.)	3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face	
EVAPORATOR COIL DATA								
Face area (Sq. Ft.)	25		25		25		25	
Rows	4		4		4		4	
Fins per inch	13.5		13.5		13.5		13.5	
Tube diameter	3/8		3/8		3/8		3/8	
Circuitry Type	Split-face		Split-face		Split-face		Split-face	
Refrigerant control	TXV		TXV		TXV		TXV	

Table 9: ZJ180-300 Physical Data (Continued)

Component	Models								
	ZJ180		ZJ210		ZJ240		ZJ300		
Nominal Tonnage	15		17.5		20		25		
CONDENSER FAN DATA									
Quantity	4		4		4		4		
Fan diameter (Inch)	24		24		30		30		
Type	Prop		Prop		Prop		Prop		
Drive type	Direct		Direct		Direct		Direct		
No. speeds	1		1		1		1		
Number of motors	2		2		2		2		
Motor HP each	1/3		1/3		1/3		1/3		
RPM	850		850		870		870		
Nominal total CFM	4000		4000		5000		5000		
BELT DRIVE EVAP FAN DATA									
Quantity	1		1		1		1		
Fan Size (Inch)	15 X 15		18 X 15		18 X 15		18 X 15		
Type	Centrifugal		Centrifugal		Centrifugal		Centrifugal		
Motor Sheave	1VP65	1VP65	1VP60	1VP60	1VP60	1VP60	1VP60	1VP75X	1VP75X
Blower Sheave	BK110	BK090	BK110	BK090	BK110	BK090	1B5V94	1B5V110	1B5V94
Belt	BX85	BX81	BX78	BX75	BX78	BX75	BX78	5VX840	5VX860
Motor HP each	5	5	5	7.5	5	7.5	7.5	10	15
RPM	1725	1725	1725	1725	1725	1725	1725	1725	1725
Frame size	184T	184T	184T	213T	184T	213T	213T	215T	254T
FILTERS									
Quantity - Size	12 - 12 x 24 x 2		12 - 12 x 24 x 2		12 - 12 x 24 x 2		12 - 12 x 24 x 2		

Optional Electric Heat

The factory-installed heaters are wired for single point power supply. Power supply need only be brought into the single point terminal block.

These CSA approved heaters are located within the central compartment of the unit with the heater elements extending in to the supply air chamber.

Fuses are supplied, where required, by the factory. Some kW sizes require fuses and others do not. refer to Table 10 for minimum CFM limitations and to Table 8 for electrical data.

Table 10: Electric Heat Minimum Supply Air

Size (Tons)	Voltage	Minimum Supply Air (CFM) Heater kW			
		9	18	54	72
180 (15)	208/230-3-60	4500	4500	5000	5000
	460-3-60	4500	4500	5000	4500
	600-3-60	4500	4500	4500	4500
210 (17.5)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
240 (20)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
300 (25)	208/230-3-60	7500	7500	7500	7500
	460-3-60	7500	7500	7500	7500
	600-3-60	7500	7500	7500	7500

Optional Gas Heat

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot.

Table 11: Gas Application Data

Unit Size	Unit Opt.	Input (MBH)	Output (MBH)	Temp Rise (°F)[1]
180	24	300	240	20-50
	32	400	320	30-60
210	24	300	240	20-50
	32	400	320	30-60
240	24	300	240	20-50
	32	400	320	30-60
300	24	300	240	20-50
	32	400	320	30-60

1. On VAV units, individual VAV boxes must be full open in heating mode to insure airflow falls within temperature rise range.

Gas Piping

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas and the length of run. "National Fuel Gas Code" Z223.1 (in U.S.A.) or the current Gas Installation Codes CSA-B149.1 (in Canada) should be followed in all cases unless superseded by local codes or gas utility requirements. Refer to the Pipe Sizing Table 12. The heating value of the gas may differ with locality. The value should be checked with the local gas utility.

NOTE: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a one-inch pipe connection at the entrance fitting.

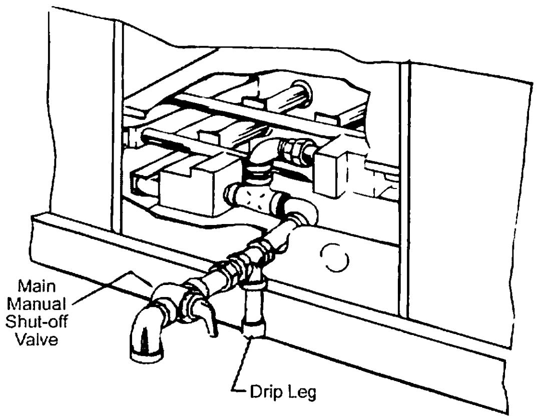


Figure 13: External Supply Connection External Shut-Off

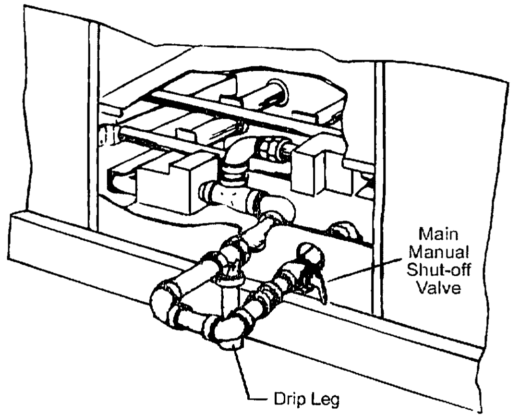


Figure 14: Bottom Supply Connection External Shut-Off

Table 12: Gas Pipe Sizing - Capacity of Pipe

Length of Pipe (ft.)	Nominal Iron Pipe Size 1 in.	Nominal Iron Pipe Size 1-1/4 in.
10	520	1050
20	350	730
30	285	590
40	245	500
50	215	440
60	195	400
70	180	370
80	170	350
90	160	320
100	150	305

NOTE: Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 inch W.C. and 0.6 specific gravity gas.

Table 13: Gas Heat Minimum Supply Air

Size (Tons)	Heat Size	Supply Air (CFM) Cooling Min	Cooling Max	Heating Min	Heating Max
180	24	4500	7000	4500	7000
(15)	32	4500	7000	4500	7000
210	24	6000	8750	6000	8750
(17.5)	32	6000	8750	6000	8750
240	24	6000	9400	6000	9400
(20)	32	6000	9400	6000	9400
300	24	7500	12500	7500	12500
(25)	32	7500	12500	7500	12500

Gas Connection

The gas supply line can be routed within the space and roof curb, exiting through the unit's basepan. Refer to Figure 5 for the gas piping inlet location. Typical supply piping arrangements are shown in Figures 13 and 14. All pipe nipples, fittings, and the gas cock are field supplied.

Gas piping recommendations:

1. A drip leg and a ground joint union must be installed in the gas piping.
2. Where required by local codes, a manual shut-off valve must be installed outside of the unit.
3. Use wrought iron or steel pipe for all gas lines. Pipe dope should be applied sparingly to male threads only.

WARNING

Natural gas may contain some propane. Propane is an excellent solvent and will quickly dissolve white lead and most standard *commercial* compounds. A special pipe dope must be used when assembling wrought iron or steel pipe. Shellac based compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clydes's or John Crane may be used.

4. All piping should be cleaned of dirt and scale by hammering on the outside of the pipe and blowing out loose particles. Before initial start-up, be sure that all gas lines external to the unit have been purged of air.
5. The gas supply should be a separate line and installed in accordance with all safety codes as prescribed under "Limitations".
6. A 1/8-inch NPT plugged tapping, accessible for test gage connection, must be installed immediately upstream of the gas supply connection to the unit.
7. After the gas connections have been completed, open the main shut-off valve admitting *normal gas pressure* to the mains. *Check all joints for leaks with soap solution or other material suitable for the purpose.* **NEVER USE A FLAME.**

WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

CAUTION

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

WARNING

Threaded joints should be coated with a sealing compound that is resistant to the action of liquefied petroleum gases. **Do not use Teflon tape.**

Lp Units, Tanks And Piping

All gas heat units are shipped from the factory equipped for natural gas use only. The unit may be converted in the field for use with LP gas with accessory kit model number 1NP0418.

All LP gas equipment must conform to the safety standards of the National Fire Protection Association.

For satisfactory operation, LP gas pressure must be 10.0 inch W.C. at the unit under full load. Maintaining proper gas pressure depends on three main factors:

1. The vaporization rate which depends on the temperature of the liquid and the "wetted surface" area of the container(s).
2. The proper pressure regulation. (Two-stage regulation is recommended).
3. The pressure drop in the lines between regulators and between the second stage regulator and the appliance. Pipe size required will depend on the length of the pipe run and the total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and LP gas suppliers.

WARNING

LP gas is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe for LP. Shellac base compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clyde's, or John Crane may be used.

Check all connections for leaks when piping is completed using a soap solution. **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Vent And Combustion Air

Two vent hoods and a combustion air hood (with screens) are shipped attached to the blower housing in the blower compartment. For units with factory installed VFD option, the hoods and accompanying hardware are shipped inside the gas heat section. These hoods must be installed to assure proper unit function. All hoods must be fastened to the outside of the gas heat access panel with the screws provided in the bag also attached to the blower housing.

The screen for the combustion air intake hood is secured to the inside of the access panel opening with four fasteners and the screws used for mounting the hood to the panel. The top flange of this hood slips in under the top of the access panel opening when installing. Refer to Vent and Combustion Air Hood Figure 15.

Each vent hood is installed by inserting the top flange of the hood into the slotted opening in the access panel and securing in place.

The products of combustion are discharged horizontally through these two screened, hooded vent openings on the upper gas heat access panel.

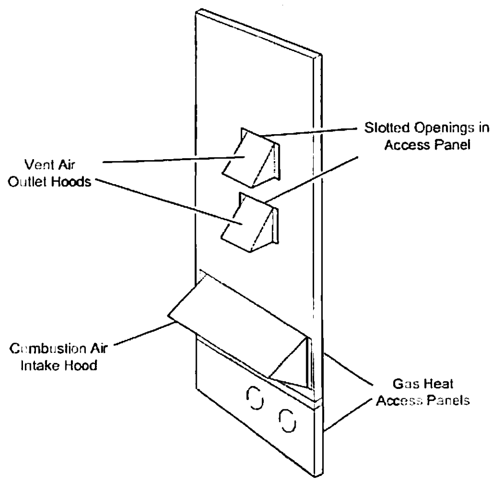


Figure 15: Vent and Combustion Air Hood

Options/Accessories

Electric Heat

Electric heaters are available as a factory-installed option. These heaters mount in the heat compartment with the heating elements extending into the supply air chamber. All electric heaters are fused and intended for use with single point power supply.

Economizer/Motorized Outdoor Damper Rain Hood

The instruction for the optional economizer/motorized damper rain hood can be found in the rain hood kit. Use these instructions when field assembling an economizer rain hood onto a unit. The outdoor and return air dampers, the damper actuator, the damper linkage, the outdoor and return air divider baffles, and all the control sensors are factory mounted as part of the "Factory installed" economizer option.

Power Exhaust/Barometric Relief Damper and Rain Hood

The instructions for the power exhaust/barometric relief damper and rain hood can be found in the rain hood kit. The exhaust fan, all supporting brackets, angles, and the wiring are factory installed as part of the power exhaust option.

Economizer And Power Exhaust Set Point Adjustments

Remove the top rear access panel from the unit. Locate the economizer control module, where the following adjustments will be made.

⚠ CAUTION

Extreme care must be exercised in turning all set point, maximum and minimum damper positioning adjustment screws to prevent twisting them off.

Minimum Position Adjustment

- Check that the damper blades move smoothly without binding; carefully turn the Minimum Position Adjust screw (found on the damper control module) fully clockwise and then set the thermostat indoor fan switch to the ON position and then OFF or energize and de-energize terminals "R" to "G".
- With the thermostat set to the indoor fan ON position or terminals "R" to "G" energized, turn the Minimum Position Adjusting screw (located on the damper control module) counterclockwise until the desired minimum damper position has been attained.

Enthalpy Set Point Adjustment

- The enthalpy set point may now be set by selecting the desired set point shown in the Enthalpy Set Point Adjustment Figure 16. Adjust as follows:
- For a single enthalpy operation carefully turn the set point adjusting screw (found on the damper control module) to the "A", "B", "C" or "D" setting corresponding

to the lettered curve of the Enthalpy Set Point Adjustment Figure 17.

- For a dual enthalpy operation, carefully turn the set point adjusting screw fully clockwise past the "D" setting.

Power Exhaust Damper Set Point

With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer damper position (Percent Open). The Exhaust Air Adjustment Screw should be set at the Percent Open of the economizer damper at which the power exhaust is needed. It can be set from 0 to 100% damper open.

Indoor Air Quality AQ

Indoor Air Quality (indoor sensor input): Terminal AQ accepts a +2 to +10 Vdc signal with respect to the (AQ1) terminal. When the signal is below it's set point, the actuator is allowed to modulate normally in accordance with the enthalpy and mixed air sensor inputs. When the AQ signal exceeds it's set point setting and there is no call for free cooling, the actuator is proportionately modulated from the 2 to 10 Vdc signal, with 2 Vdc corresponding to full closed and 10 Vdc corresponding to full open. When there is no call for free cooling, the damper position is limited by the IAQ Max damper position setting. When the signal exceeds it's set point (Demand Control Ventilation Set Point) setting and there is a call for free cooling, the actuator modulates from the minimum position to the full open position based on the highest call from either the mixed air sensor input or the AQ voltage input.

- Optional CO_2 Space Sensor Kit Part # 2AQ04700324
- Optional CO_2 Sensor Kit Part # 2AQ04700424

Replace the top rear access panel on the unit.

Optional BAS-Ready Economizer Power Exhaust Damper Set Point Adjustment

Remove the economizer access panel from the unit. Loosen, but do not remove the two panel latches. Locate the economizer actuator, where the following adjustment can be made.

With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer's outdoor damper position. The actuator's auxiliary switch adjustment screw should be set at the damper position at which the power exhaust is needed. The adjustment screw can be set between 25 to 85 degrees open.

Replace the economizer access panel.

Optional Variable Air Volume (VAV)

A variable air volume (VAV) option using a variable frequency drive (VFD) is available for applications requiring a constant supply duct static pressure. A differential pressure transducer is used to monitor supply duct static pressure and return a speed reference signal to the VFD to control the output of the indoor blower motor.

Duct Static Pressure Transducer

A 0-5" WC pressure transducer, located in the control box compartment, is used to sense static (gauge) pressure in the supply air duct and convert this pressure measurement to a proportional 0-5 VDC electrical output.

Pressure-transmitting plastic tubing (1/4" diameter) must be field supplied and installed from the transducer to both the ductwork and to the atmosphere. Connect the tubing from the 'HIGH' pressure tap of the transducer to a static pressure tap (field supplied) in the supply duct located at a point where constant pressure is expected. To prevent an unstable signal due to air turbulence, there should be no obstructions, turns or VAV terminal boxes up- or down-stream of the sensing tube location for at least a distance of 6-10 times the duct diameter. Tubing must also be run between the 'LOW' pressure tap of the transducer and atmospheric pressure (outside of the unit).

⚠ CAUTION

Do not run plastic tubing in the supply or return air ducts as air movement could cause erroneous pressure measurements. If the tubing penetrates through the bottom of the unit be sure openings are sealed to prevent air and water leakage.

VAV Control Board

A VAV control board, located in the top-left corner of the control box, is used to convert the pressure transducer input signal into a speed reference signal that the drive uses to control the speed of the blower motor. This modulating speed reference signal is generated using an internal algorithm which continuously calculates an output value.

A brief description of the VAV board's I/O terminals that are used follows:

Inputs:

- **DUCT PRES** - a 0-5 VDC analog input provided by a factory-installed duct static pressure transducer located in the unit's control box.
- **SAT** - analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the unit's supply air compartment.
- **RAT** - analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the unit's return air compartment.
- **OAT** - analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the outdoor air compartment or mounted within the evaporator base rail for units without the installed economizer option.
- **ST** - analog input provided by field-installed space temperature sensor.

- **OH** - a 0-10 VDC analog input provided by a field-installed outdoor air relative humidity sensor for single enthalpy economizer configuration.
- **RH** - a 0-10 VDC analog input provided by a field-installed return air relative humidity sensor for dual enthalpy economizer configuration (used with OH).
- **IAQ** - a 0-10 VDC analog input provided by a field-installed carbon dioxide sensor which monitors indoor air quality (CO2 concentration) and enables call for Demand Ventilation mode for units installed with economizer option.
- **OAQ** - a 0-10 VDC analog input provided by a field-installed carbon dioxide sensor which monitors outdoor air quality (CO2 concentration) and, along with IAQ, enables call for Differential Demand Ventilation mode for units installed with economizer option.
- **APS** - a 24 VAC binary input provided by a field-installed air proving switch which monitors the pressure difference across the indoor blower.
- **PUR** - a 24 VAC binary input for building purge calls from an external source.
- **OCC** - a 24 VAC binary input used to set the building occupancy status for the control.
- **LIMIT 2** - a 24 VAC binary input which either confirms 2nd-stage gas heat operation or receives an error signal from the variable frequency drive.

Outputs:

- **FAN** - a 2-10 VDC analog output signal sent to the VFD to modulate the speed of the indoor blower motor.
- **ECON** - a 2-10 VDC analog output signal sent to the economizer actuator to modulate position of the return air and outdoor air dampers (optional).
- **EXH ~** - a 24 VAC binary output signal used to turn on/off the power exhaust relay (optional).
- **VAV BOX (gas/electric heat only)** - a normally open relay contact connected to a terminal block, used to drive the building's VAV boxes to full-open during heating operation.

Programmable set points:

The *duct static set point* is the pressure that the drive will maintain when operating the unit in VAV mode. The set-point is adjustable between 0" WC and 5" WC with the default setting of 1.5" WC.

The *duct static high-limit set point* is the maximum allowable duct pressure to prevent damage from over-pressurization of the ductwork in the event of either a drive or damper failure. The high-limit set-point is adjustable between 0" WC and 5" WC with the factory default setting of 4.5" WC. If the duct static pressure reaches the high-limit set point, then the supply fan motor will be shutdown.

NOTE: Either of the set points described above can be changed through the unit control board (UCB) with the use of a USB-to-RS485 converter, personal computer or PDA and a down-loaded copy of the Simplicity® software available at the UPGnet Commercial Product Catalog website.

⚠ CAUTION

The customer must be aware of the duct pressure design limit, and what the duct pressure sensor is reading when the peak pressure is reached (i.e. the pressure transducer sensing tube may not be located at the place of highest pressure in the system).

Factory-installed VFD

The factory-installed VFD is mounted in the Blower Access Compartment above the blower assembly. The drive comes wired from the factory to include both 3-phase power and control connections (run permit signal, speed reference signal & fault signal).

All required drive parameters are pre-programmed at the factory, except in the case of 208-volt applications, in which the parameter that defines motor nameplate voltage must be changed to a value of 208.00 and the parameter that defines motor-rated current must be changed to the appropriate value appearing on the motor's nameplate. Refer to the enclosed drive material or access the UPGnet Commercial Product Catalog website for instructions on changing parameter settings.

For units also equipped with gas/electric heat, a terminal block located in the unit's control box and connected to the VAV board's "VAV BOX" terminal, must be field wired to the building's VAV boxes to ensure fully open dampers during heating operation.

Manual Bypass

An optional, factory-installed manual bypass switch available with factory-installed VFD can be found in the Blower Motor Access compartment and has the following three positions:

- **DRIVE** - routes power through the VFD for modulating control of the indoor blower motor.
- **LINE** (or BYPASS) - routes power directly to the motor which provides full-speed motor operation and complete electrical isolation of the drive.
- **TEST** - routes power to the VFD but not to the motor to allow for drive programming and/or diagnostics.

If a drive failure occurs, the unit does not automatically switch to bypass mode. The LINE/DRIVE/TEST switch must be manually switched to the LINE (BYPASS) position. If there is a call for the fan, the indoor blower motor will run at full-speed while in the bypass mode.

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

⚠ WARNING

Before beginning any service, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

BAS-Ready VFD

Factory-installed VFD is also available with 'BAS-ready' models. Terminal blocks are provided in the control box (in place of the VAV control board) for field wiring of a customer-installed BAS to receive 24 VAC power and to connect to the following control signals:

- a duct static pressure transducer input signal (0-5 VDC)
- an economizer actuator input signal (2-10 VDC)
- an economizer actuator output signal (2-10 VDC)
- a VFD speed reference output signal (2-10 VDC)

The use of shielded cable is recommended for the above control wiring connections.

NOTE: Factory-installed VFD is not available with factory-installed BAS options due to space limitations in the control box.

A solid-state, lock-out relay (LR) and 100-µF, 50 VDC capacitor must be field-supplied and installed to provide a means to transmit a potential fault signal back to the BAS controller. The specific relay part number required will depend upon the need for either AC-output or DC-output. See price pages for further details.

Once the appropriate relay and capacitor are obtained, install the capacitor across LR terminals '3' & '4' and make the following wiring connections:

- LR '1' to BAS controller
- LR '2' to BAS controller
- LR '3' to UCB 'X'
- LR '4' to UCB 'C'

'VFD-Ready' For Customer-installation

Units configured as 'VFD-ready' provide provisions for a customer-installed drive. The physical dimensions of VFDs can vary greatly among manufacturers, horsepower ratings and voltage requirements. Keep in mind that drive manufacturers also require various minimum clearances to allow for adequate internal cooling of the drive during operation.

The unit comes with a mounting bracket installed in the Blower Access compartment which may accommodate other vendor's drives depending on their size. In order to utilize the unit's mounting bracket, the maximum recommended drive dimensions are as follows:

For 5-hp motor applications ....13" H x 6" W x 7" D
For 7.5 thru 15-hp motor applications ....13" H x 8" W x 8" D

If the drive will not fit in the allotted space, then it will need to be mounted elsewhere; either within the building on a perpendicular wall which is not subjected to excessive temperature, vibration, humidity, dust, corrosive gas, explosive gas, etc., or within an appropriate enclosure rated for outside installation to safeguard against moisture, dust and excessive heat.

The power leads to the drive (L1, L2, L3) and from the motor (T1, T2, T3) along with the respective ground wires are supplied with the unit and need to be connected after the drive is installed.

⚠ CAUTION

Do not connect AC power to the T1, T2, T3 drive terminals to prevent damage to the VFD.

A terminal block located in the control box is provided for field connection of the VFD speed reference signal (2-10 VDC) and to the normally-open, run-permit auxiliary contact. The use of shielded cable is recommended for the above control wiring connections.

For VFD-ready units also equipped with gas/electric heat, a terminal block located in the unit's control box and connected to the VAV board's "VAV BOX" terminal, must be field wired to the building's VAV boxes to ensure fully open dampers during heating operation.

Optional Hot Gas Bypass (HGBP)

To allow for low cooling load operation, a direct-acting, pressure-modulating bypass control valve installed on the system #1 discharge line is used to divert high temperature, high pressure refrigerant around the TXV in order to maintain a desired minimum evaporator pressure.

The opening pressure of the bypass valve is fully adjustable between 0 and 80 psig with a factory-setting of 60 psig. HGBP is standard on all units with VAV and optional with CV units.

CONTROL CURVE	CONTROL POINT APPROX. °F (°C) AT 50% RH
A	73 (23)
B	70 (21)
C	67 (19)
D	63 (17)

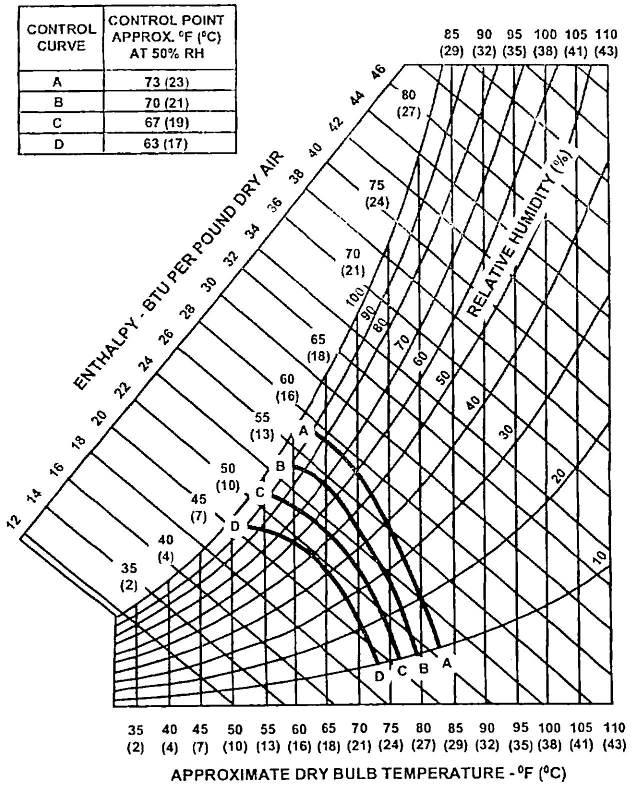


Figure 16: Enthalpy Set Point Chart

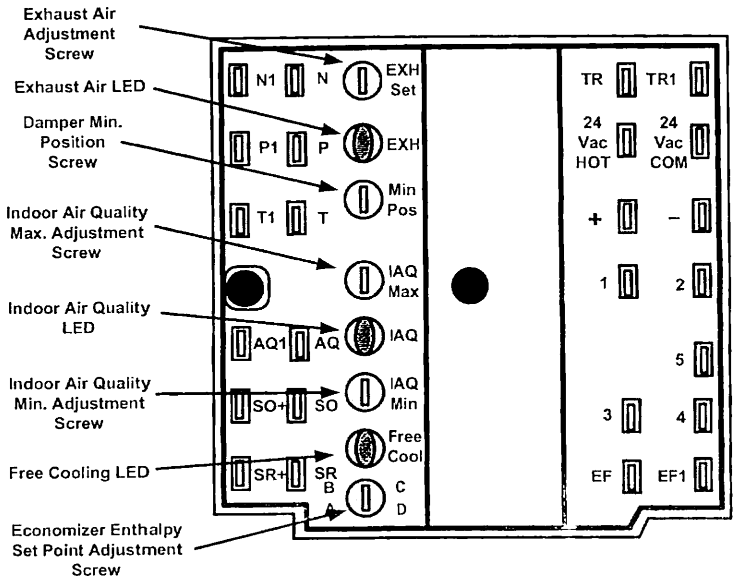


Figure 17: Honeywell Economizer Control W7212

Phasing

York® Model ZJ units are properly phased at the factory. Check for proper compressor rotation. If the blower or compressors rotate in the wrong direction at start-up, the electrical connection to the unit is misphased. Change the phasing of the **Field Line Connection at the factory or field supplied disconnect** to obtain proper rotation. (Scroll compressors operate in only one direction. If the scroll is drawing low amperage, has similar suction and discharge pressures, or producing a high noise level, the scroll is misphased.)

> **⚠ CAUTION**
>
> Scroll compressors require proper rotation to operate correctly. Units are properly phased at the factory. Do not change the internal wiring to make the blower condenser fans, or compressor rotate correctly.

Blower Rotation

Check for proper supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased (See 'PHASING').

Belt Tension

The tension on the belt should be adjusted as shown in Figure 18.

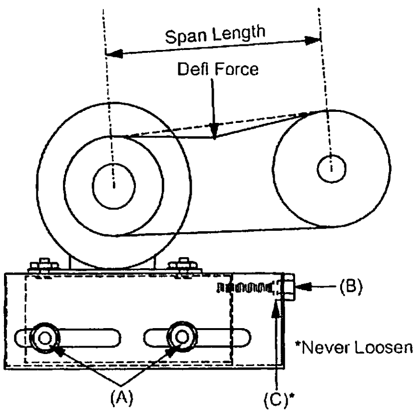


Figure 18: Belt Adjustment

> **⚠ CAUTION**
>
> Procedure for adjusting belt tension:
> 1. Loosen six nuts (top and bottom) A.
> 2. Adjust by turning (B).
> 3. Never loosen nuts (C).
> 4. Use belt tension checker to apply a perpendicular force to one belt at the midpoint of the span as shown. Deflection distance of 4mm (5/32") is obtained.
>
> To determine the deflection distance from normal position, use a straight edge from sheave to sheave as reference line. The recommended deflection force is as follows:
>
> Tension new belts at the max. deflection force recommended for the belt section. Check the belt tension at least two times during the first 24 hours of operation. Any retensioning should fall between the min. and max. deflection force values.
>
> 5. After adjusting retighten nuts (A).

CFM Static Pressure and Power-Altitude and Temperature Corrections

The information below should be used to assist in application of product when being applied at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a "constant volume" device. This means that, if the rpm remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure will be generated and less power will be required than a similar application at sea level. Air density correction factors are shown in Table 14 and Figure 19.

Table 14: Altitude/Temperature Correction Factors

Air Temp.	Altitude (Ft.) 0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651

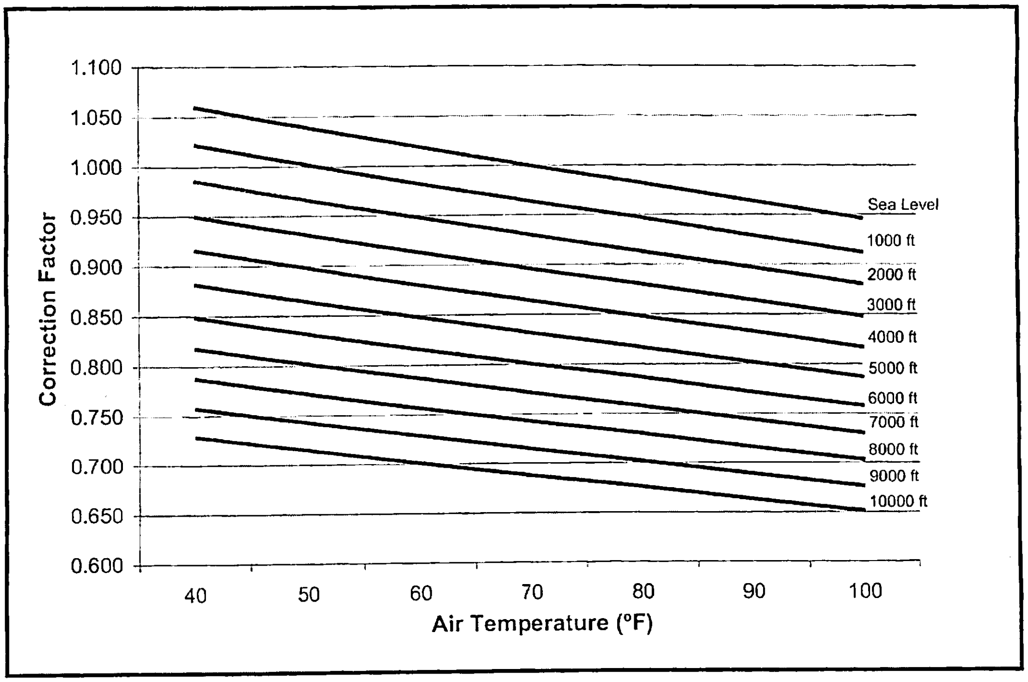


Figure 19: Altitude/Temperature Correction Factors

The examples below will assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 6,000 CFM, 1.5 IWC and 4.0 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 6,000 CFM if the rpm is unchanged. However, Table 14 must be used to determine the static pressure and BHP. Since no temperature data is given, we will assume an air temperature of 70°F. Table 14 shows the correction factor to be 0.832.

Corrected static pressure = 1.5 x 0.832 = 1.248 IWC

Corrected BHP = 4.0 x 0.832 = 3.328

Example 2: A system, located at 5,000 feet of elevation, is to deliver 6,000 CFM at a static pressure of 1.5". Use the unit blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5" static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

Sea level static pressure = 1.5 / .832 = 1.80"

Enter the blower table at 6000 sCFM and static pressure of 1.8". The rpm listed will be the same rpm needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 3.2. This value must be corrected for elevation.

BHP at 5,000 ft. = 3.2 x .832 = 2.66

Drive Selection

1. Determine side or bottom supply duct application.
2. Determine desired airflow
3. Calculate or measure the amount of external static pressure.
4. Using the operating point determined from steps 1, 2 & 3, locate this point on the appropriate supply air blower performance table. (Linear interpolation may be necessary.)
5. Noting the RPM and BHP from step 4, locate the appropriate motor and/or drive on the RPM selection table.
6. Review the BHP compared to the motor options available. Select the appropriate motor and/or drive.
7. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
8. Determine turns open to obtain the desired operation point.

Example

1. 6800 CFM
2. 2.0 iwg
3. Using the supply air blower performance table below, the following data point was located: 1020 RPM & 5.92 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 5.92 BHP exceeds the maximum continuous BHP rating of the 5.0 HP motor. The 7.5 HP motor is required.
6. 1020 RPM is within the range of the 7.5 HP drives.
7. Using the 7.5 HP motor and drive, 3.5 turns open will achieve 1020 RPM.

Example Supply Air Blower Performance

Air Flow (CFM)	Available External Static Pressure - IWG																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive										High Static 7.5 HP & Drive											
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
																					7.5 HP & Field Supplied Drive			

Table X: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
X	Y	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A

Table 15: Air Flow Performance - Side Duct Application

ZJ180 (15 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive								High Static 5 HP & Drive									
4000	727	1.14	765	1.47	806	1.77	848	2.04	891	2.29	934	2.52	977	2.73	1020	2.93	1061	3.12	1101	3.30	1138	3.48	1174	3.67
4400	753	1.51	792	1.84	832	2.14	874	2.41	917	2.66	960	2.88	1004	3.09	1046	3.29	1087	3.48	1127	3.67	1165	3.85	1200	4.03
4800	781	1.92	820	2.25	861	2.55	903	2.82	946	3.06	989	3.29	1032	3.50	1074	3.70	1116	3.89	1155	4.08	1193	4.26	1228	4.44
5200	812	2.37	850	2.70	891	3.00	933	3.27	976	3.52	1019	3.74	1062	3.95	1105	4.15	1146	4.34	1186	4.53	1223	4.71	1259	4.89
5600	844	2.86	882	3.19	923	3.49	965	3.76	1008	4.01	1051	4.23	1094	4.45	1137	4.64	1178	4.83	1218	5.02	1255	5.20	1291	5.39
6000	877	3.39	916	3.72	957	4.02	999	4.29	1042	4.54	1085	4.76	1128	4.98	1170	5.17	1212	5.36	1251	5.55	1289	5.73	-	-
6400	912	3.96	951	4.29	992	4.59	1034	4.86	1077	5.10	1120	5.33	1163	5.54	1205	5.74	-	-	-	-	-	-	-	-
6800	949	4.56	988	4.89	1028	5.19	1070	5.46	1113	5.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	986	5.20	1025	5.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

ZJ210 (17.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive										High Static 7.5 HP & Drive							
4400	636	0.65	672	1.14	709	1.60	745	2.03	780	2.43	815	2.78	849	3.09	882	3.35	914	3.55	944	3.70	973	3.78	999	3.79
4800	649	0.99	685	1.48	721	1.94	757	2.37	793	2.77	828	3.12	862	3.43	895	3.69	927	3.89	957	4.04	985	4.12	1012	4.13
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ240 (20 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive										High Static 7.5 HP & Drive									
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
9200	905	6.85	941	7.33	977	7.79	1014	8.22	1049	8.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	936	7.65	973	8.13	1009	8.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10000	969	8.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ300 (25 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive				Low Static 7.5 HP & Drive											
6600	760	2.51	793	3.11	824	3.68	856	4.23	887	4.74	919	5.23	950	5.70	983	6.15
7000	775	2.99	808	3.60	839	4.17	871	4.71	902	5.22	934	5.72	966	6.19	998	6.64
7400	792	3.51	824	4.11	856	4.69	887	5.23	918	5.74	950	6.24	982	6.70	1014	7.16
7800	809	4.07	841	4.67	873	5.24	904	5.78	935	6.30	967	6.79	999	7.26	1031	7.71
8200	826	4.66	859	5.27	890	5.84	922	6.38	953	6.89	985	7.39	1016	7.86	1049	8.31
8600	845	5.30	877	5.90	909	6.47	940	7.01	972	7.53	1003	8.02	1035	8.49	1067	8.94
9000	864	5.97	896	6.57	928	7.14	960	7.69	991	8.20	1022	8.69	1054	9.16	1087	9.61
9400	884	6.68	916	7.28	948	7.86	980	8.40	1011	8.91	1042	9.41	1074	9.88	1107	10.33
9800	905	7.43	937	8.04	969	8.61	1000	9.15	1032	9.67	1063	10.16	1095	10.63	1127	11.08
10200	926	8.22	958	8.83	990	9.40	1021	9.94	1053	10.46	1084	10.95	1116	11.42	1148	11.87
10600	948	9.05	980	9.66	1012	10.23	1043	10.77	1075	11.29	1106	11.78	1138	12.25	1170	12.70
11000	970	9.92	1003	10.52	1034	11.09	1066	11.64	1097	12.15	1128	12.64	1160	13.11	1193	13.56
11400	993	10.82	1025	11.43	1057	12.00	1089	12.54	1120	13.06	1151	13.55	1183	14.02	1216	14.47
11800	1017	11.76	1049	12.37	1081	12.94	1112	13.48	1143	14.00	1175	14.49	1207	14.96	1239	15.41
12200	1040	12.74	1073	13.34	1104	13.91	1136	14.46	1167	14.97	1199	15.46	1231	15.93	1263	16.38
12600	1065	13.75	1097	14.35	1129	14.92	1160	15.47	1192	15.98	1223	16.47	1255	16.94	-	-
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive					
6600	1016	6.59	1050	7.00	1086	7.41	1123	7.81	1161	8.19	1202	8.58	1244	8.95	1289	9.33
7000	1031	7.07	1065	7.49	1101	7.89	1138	8.29	1176	8.68	1217	9.06	1259	9.44	1304	9.82
7400	1047	7.59	1081	8.01	1117	8.41	1154	8.81	1192	9.20	1233	9.58	1275	9.96	1320	10.34
7800	1064	8.14	1098	8.56	1134	8.97	1171	9.36	1209	9.75	1250	10.13	1292	10.51	1337	10.89
8200	1082	8.74	1116	9.16	1152	9.56	1189	9.96	1227	10.35	1268	10.73	1310	11.11	1355	11.49
8600	1101	9.37	1135	9.79	1170	10.20	1207	10.59	1246	10.98	1286	11.36	1329	11.74	1374	12.12
9000	1120	10.05	1154	10.46	1189	10.87	1226	11.27	1265	11.65	1305	12.04	1348	12.41	1393	12.79
9400	1140	10.76	1174	11.18	1209	11.58	1246	11.98	1285	12.37	1325	12.75	1368	13.13	1413	13.51
9800	1160	11.51	1195	11.93	1230	12.33	1267	12.73	1306	13.12	1346	13.50	1389	13.88	1434	14.26
10200	1182	12.30	1216	12.72	1251	13.12	1288	13.52	1327	13.91	1367	14.29	1410	14.67	1455	15.05
10600	1204	13.13	1238	13.55	1273	13.95	1310	14.35	1349	14.74	1389	15.12	1432	15.50	1477	15.88
11000	1226	14.00	1260	14.41	1296	14.82	1332	15.22	1371	15.60	1412	15.99	1454	16.36	1499	16.74
11400	1249	14.90	1283	15.32	1318	15.72	1355	16.12	1394	16.51	1434	16.89	-	-	-	-
11800	1272	15.84	1306	16.26	1342	16.66	1379	17.06	-	-	-	-	-	-	-	-
12200	1296	16.82	1330	17.23	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
							15 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

Table 16: Air Flow Performance - Bottom Duct Application

ZJ180 (15 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive								High Static 5 HP & Drive											
4000	768	1.24	806	1.55	846	1.83	888	2.09	930	2.32	972	2.53	1015	2.73	1056	2.91	1097	3.09	1136	3.27	1173	3.44	1208	3.61
4400	797	1.65	835	1.96	875	2.24	916	2.49	959	2.72	1001	2.93	1043	3.13	1085	3.32	1126	3.50	1165	3.67	1202	3.84	1237	4.02
4800	828	2.09	866	2.40	906	2.68	947	2.93	989	3.16	1032	3.38	1074	3.58	1116	3.76	1157	3.94	1196	4.11	1233	4.28	1267	4.46
5200	860	2.57	898	2.88	938	3.16	980	3.41	1022	3.65	1064	3.86	1107	4.06	1148	4.24	1189	4.42	1228	4.59	1265	4.77	1300	4.94
5600	894	3.09	932	3.40	972	3.68	1014	3.93	1056	4.16	1098	4.38	1141	4.57	1182	4.76	1223	4.94	1262	5.11	1299	5.28	1334	5.46
6000	930	3.64	968	3.95	1008	4.23	1049	4.48	1091	4.71	1134	4.93	1176	5.12	1218	5.31	1259	5.49	1298	5.66	-	-	-	-
6400	966	4.22	1005	4.53	1045	4.81	1086	5.06	1128	5.30	1171	5.51	1213	5.71	-	-	-	-	-	-	-	-	-	-
6800	1005	4.84	1043	5.14	1083	5.42	1124	5.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	1044	5.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																	5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

ZJ210 (17.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive												High Static 7.5 HP & Drive							
4400	661	0.74	697	1.19	733	1.62	768	2.03	803	2.40	838	2.73	871	3.02	904	3.26	935	3.45	964	3.59	992	3.66	1018	3.67
4800	677	1.07	712	1.53	748	1.96	784	2.36	819	2.73	853	3.06	887	3.35	919	3.59	950	3.79	980	3.92	1008	4.00	1034	4.01
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
															7.5 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ240 (20 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive												High Static 7.5 HP & Drive									
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
9200	955	7.23	991	7.68	1026	8.11	1062	8.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	988	8.05	1024	8.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
															7.5 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

ZJ300 (25 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]													
	0.4		0.6		0.8		1.0		1.2		1.4		1.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive		Low Static 7.5 HP & Drive											
6600	787	2.67	819	3.23	850	3.76	881	4.27	912	4.75	943	5.21	974	5.65
7000	804	3.18	835	3.74	867	4.27	898	4.78	928	5.26	959	5.72	991	6.16
7400	821	3.72	853	4.28	884	4.82	915	5.32	946	5.80	977	6.26	1008	6.70
7800	839	4.30	871	4.86	902	5.40	933	5.90	964	6.39	995	6.85	1026	7.28
8200	858	4.92	890	5.48	921	6.02	952	6.52	983	7.01	1013	7.47	1045	7.90
8600	877	5.58	909	6.14	940	6.68	971	7.18	1002	7.66	1033	8.12	1064	8.56
9000	898	6.28	929	6.84	960	7.37	991	7.88	1022	8.36	1053	8.82	1084	9.26
9400	918	7.01	950	7.57	981	8.10	1012	8.61	1043	9.09	1074	9.55	1105	9.99
9800	940	7.78	972	8.34	1003	8.87	1034	9.38	1064	9.86	1095	10.32	1127	10.76
10200	962	8.58	994	9.14	1025	9.68	1056	10.18	1086	10.67	1117	11.13	1149	11.56
10600	984	9.42	1016	9.98	1047	10.52	1078	11.02	1109	11.51	1140	11.96	1171	12.40
11000	1007	10.30	1039	10.86	1070	11.39	1101	11.90	1132	12.38	1163	12.84	1194	13.28
11400	1031	11.20	1063	11.76	1094	12.30	1125	12.80	1156	13.29	1187	13.75	1218	14.18
11800	1055	12.14	1087	12.70	1118	13.24	1149	13.74	1180	14.23	1211	14.69	1242	15.12
12200	1080	13.11	1111	13.68	1142	14.21	1173	14.72	1204	15.20	1235	15.66	1266	16.10
12600	1104	14.12	1136	14.68	1167	15.21	1198	15.72	1229	16.20	1260	16.66	1291	17.10
	High Static 15 HP & Drive													

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	1.8		2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive							
6600	1006	6.07	1039	6.48	1072	6.87	1107	7.25	1144	7.62	1182	7.98	1221	8.33	1263	8.68	1307	9.04
7000	1023	6.58	1055	6.98	1089	7.37	1124	7.75	1160	8.12	1198	8.48	1238	8.84	1280	9.19	1324	9.54
7400	1040	7.12	1072	7.53	1106	7.92	1141	8.30	1177	8.67	1215	9.03	1255	9.38	1297	9.74	1341	10.09
7800	1058	7.71	1090	8.11	1124	8.50	1159	8.88	1195	9.25	1233	9.61	1273	9.97	1315	10.32	1359	10.67
8200	1077	8.33	1109	8.73	1143	9.12	1178	9.50	1214	9.87	1252	10.23	1292	10.59	1334	10.94	1378	11.29
8600	1096	8.98	1129	9.39	1162	9.78	1197	10.16	1234	10.53	1272	10.89	1311	11.24	1353	11.60	1397	11.95
9000	1116	9.68	1149	10.08	1183	10.47	1218	10.85	1254	11.22	1292	11.58	1332	11.94	1373	12.29	1418	12.64
9400	1137	10.41	1170	10.82	1203	11.21	1238	11.59	1275	11.95	1313	12.32	1352	12.67	1394	13.02	1438	13.37
9800	1159	11.18	1191	11.59	1225	11.98	1260	12.35	1296	12.72	1334	13.09	1374	13.44	1416	13.79	1460	14.14
10200	1181	11.99	1213	12.39	1247	12.78	1282	13.16	1318	13.53	1356	13.89	1396	14.25	1438	14.60	1482	14.95
10600	1203	12.82	1236	13.23	1269	13.62	1304	14.00	1341	14.37	1379	14.73	1418	15.08	1460	15.44	1504	15.79
11000	1226	13.70	1259	14.10	1293	14.49	1327	14.87	1364	15.24	1402	15.60	1441	15.96	1483	16.31	1528	16.66
11400	1250	14.61	1282	15.01	1316	15.40	1351	15.78	1387	16.15	1425	16.51	1465	16.87	1507	17.22	-	-
11800	1274	15.55	1307	15.95	1340	16.34	1375	16.72	1411	17.09	-	-	-	-	-	-	-	-
12200	1298	16.52	1331	16.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

Table 17: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
180 (15)	ZJ	5	5.75	1VP65	BK110	815	850	885	920	950	985	N/A
		5	5.75	1VP65	BK090	1010	1055	1095	1135	1180	1220	N/A
210 (17.5)	ZJ	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
240 (20)	ZJ	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
300 (25)	ZJ	7.5	8.63	1VP60	1B5V94	810	850	885	920	960	1000	N/A
		10	11.50	1VP75X	1B5V110	975	1005	1040	1070	1100	1135	1165
		15	17.25	1VP75X	1B5V94	1140	1180	1215	1255	1290	1330	1365

Table 18: Indoor Blower Specifications

Size (Tons)	Model	Motor					Motor Sheave			Blower Sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum Dia. (in.)	Bore (in.)	Model	Datum Dia. (in.)	Bore (in.)	Model	
180 (15)	ZJ	5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	10.4	1	BK110	BX85
		5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	8.4	1	BK090	BX81
210 (17.5)	ZJ	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
240 (20)	ZJ	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
300 (25)	ZJ	7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	9.5	1 7/16	1B5V94	BX78
		10	1725	0.89	1.15	215T	5.8 - 7.0	1 3/8	1VP75X	11.1	1 7/16	1B5V110	5VX840
		15	1725	0.91	1.15	254T	6.2 - 7.4	1 5/8	1VP75X	9.5	1 7/16	1B5V94	5VX860

Table 19: Power Exhaust Specifications

Voltage	Motor			Motor			CFM @ 0.1 ESP
	HP	RPM[1]	QTY	LRA	FLA	MCA	
208/230-1-60	3/4	1075	1	7.7	5.0	6.25	5250
460-1-60	3/4	1075	1	4.1	2.2	2.75	5250
575-1-60	3/4	1050	1	2.84	1.5	1.875	5250

1. Motors are multi-tapped and factory wired for high speed.

Air Balance

⚠ CAUTION

On VAV units be certain that the VFD drive is set to maximum output, exhaust dampers are closed and individual space damper boxes are full open.

VFD units with bypass must not be in bypass mode ('LINE' position) unless all individual space dampers are full open.

Start the supply air blower motor. Adjust the resistances in both the supply and the return air duct systems to balance the air distribution throughout the conditioned space. The job specifications may require that this balancing be done by someone other than the equipment installer.

To check the supply air CFM after the initial balancing has been completed:

1. Remove the two 5/16" dot plugs from the blower motor and the filter access panels shown in the Unit Dimensions and Rear View Clearances Figure 6.
2. Insert at least 8" of 1/4 inch tubing into each of these holes for sufficient penetration into the air flow on both sides of the indoor coil.

NOTE: The tubes must be inserted and held in a position perpendicular to the air flow so that velocity pressure will not affect the static pressure readings.

3. Using an inclined manometer, determine the pressure drop across a dry evaporator coil. Since the moisture on an evaporator coil may vary greatly, measuring the pressure drop across a wet coil under field conditions would be inaccurate. To assure a dry coil, the compressors should be deactivated while the test is being run.

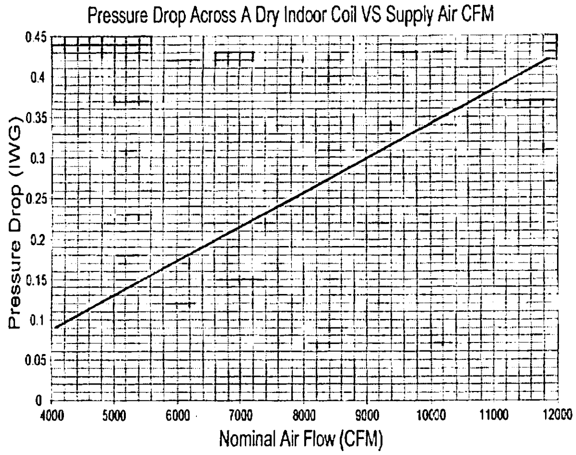


Figure 20: Pressure Drop Across A Dry Indoor Coil Vs. Supply Air CFM For All Unit Tonnages

4. Knowing the pressure drop across a dry coil, the actual CFM through the unit can be determined from the curve in Pressure Drop vs. Supply Air CFM Figure 20.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

After readings have been obtained, remove the tubes and reinstall the two 5/16" dot plugs that were removed in Step 1.

NOTE: De-energize the compressors before taking any test measurements to assure a dry indoor coil.

Supply Air Drive Adjustment

The RPM of the supply air blower will depend on the required CFM, the unit accessories or options and the static resistances of both the supply and the return air duct systems. With this information, the RPM for the supply air blower and the motor pulley adjustment (turns open) can be determined from the Blower Performance Data Tables.

⚠ CAUTION

Belt drive blower systems MUST be adjusted to the specific static and CFM requirements for the application. The belt drive blowers are NOT set at the factory for any specific static or CFM. Adjustments of the blower speed and belt tension are REQUIRED. Tighten blower pulley and motor sheave set screws after these adjustments. Re-checking set screws after 10-12 hours run time is recommended.

High speed drive accessories (containing a smaller blower pulley and a shorter belt) are available for applications requiring the supply air blower to produce higher CFM's and/or higher static pressures. Use Model 1LD0460 for 15 ton units, Model 1LD0417 for 17.5 and 20 ton units, and Model 1LD0435 for 25 ton units. Refer to the Blower Motor and Drive Data Table 18.

Note the following:

1. The supply air CFM must be within the limitations shown in the Blower Performance Tables 15 and 16.
2. Pulleys can be adjusted in half turn increments.
3. The tension on the belt should be adjusted as shown in the Bet Adjustment, Figure 18.
4. Tighten blower pulley and motor sheave set screws after any adjustments. Re-check set screws after 10-12 hours run time recommended.

Additional Static Resistance

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	Electric Heat kW[2]			
					18	36	54	72
180 (15)	ZJ	4500	0.10	0.10	0.10	0.10	0.20	0.20
		6000	0.10	0.10	0.10	0.20	0.30	0.40
		7500	0.10	0.10	0.10	0.30	0.40	0.60
210 (17.5) 240 (20) 300 (25)	ZJ	6000	0.10	0.10	0.10	0.10	0.20	0.20
		7500	0.10	0.10	0.10	0.20	0.30	0.40
		9000	0.15	0.15	0.10	0.30	0.40	0.60
		10500	0.15	0.15	0.20	0.40	0.60	0.80
		12000	0.20	0.20	0.30	0.50	0.70	0.90

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Operation

Cooling Sequence Of Operation

For ZJ units, the thermostat makes a circuit between "R" and "Y1" for the first stage of cooling.

The call is passed to the **Unit Control Board (UCB)**, which then determines whether the requested operation is available and, if so, which components to energize.

For gas heating, the UCB monitors the "W1" call but does not handle the operation of the gas furnace. An ignition control board controls the gas heater operation. For electric heat units, the UCB passes the call to the electric heater. In both cases, when the "W1" call is sensed, the indoor air blower is energized following a specified heating delay.

If at any time a call for both heating and cooling are present, the heating operation will be performed. If operating, the cooling system is halted as with a completion of a call for cooling. Heating always takes priority.

Continuous Blower

By setting the room thermostat fan switch to "ON," the supply air blower will operate continuously.

Intermittent Blower

With the room thermostat fan switch set to "AUTO" and the system switch set to either the "AUTO" or "HEAT" settings, the blower is energized whenever a cooling or heating operation is requested. The blower is energized after any specified delay associated with the operation.

When energized, the indoor blower has a minimum run time of 30 seconds. Additionally, the indoor blower has a delay of 10 seconds between operations.

Optional VAV Blower Operation

For units with VFD, the speed of the indoor blower motor is controlled by duct static pressure. The duct static set point is the pressure that the drive will maintain when operating the unit in VAV mode. If the duct static pressure reaches or exceeds the high-limit set-point, then the supply fan motor will be shutdown.

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

No Outdoor Air Options

When the thermostat calls for the first stage of cooling, the low-voltage control circuit from "R" to "Y1" and "G" is completed. The UCB energizes the economizer (if installed and free cooling is available) or the first available compressor* and the condenser fans. For first stage cooling, compressor #1 is energized. If compressor #1 is unavailable, compressor #2 is energized. After completing the specified fan on delay for cooling, the UCB will energize the blower motor.

When the thermostat calls for the second stage of cooling, the low-voltage control circuit from "R" to "Y2" is completed. Compressor #2 is energized, provided it has not been locked out, and condenser fan motor #1, and condenser fan motor #2 remain energized. (If the ambient temperature is above 60°F.)

If there is an initial call for more than one stage of cooling, the UCB will delay energizing compressors #2, #3 & #4 by 30 seconds each, depending on how many stages are called for, in order to avoid a power in-rush.

Once the thermostat has been satisfied, it will de-energize Y1, Y2, Y3 and Y4. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling.

To be available, a compressor must not be locked-out due to a high or low-pressure switch or freezestat trip and the **Anti-Short Cycle Delay (ASCD)** must have elapsed.

These units utilize a lead-lag feature that results in an equal amount of run hours on all compressors, thereby extending the life of the compressors. This feature works as follows: If the thermostat requires for more than one stage of cooling, the currently off compressor with the least number of run hours will be the next to be energized. When the thermostat requires fewer stages of cooling, the currently running compressor with the most run hours will be the first to be de-energized.

Economizer With Single Enthalpy Sensor

When the room thermostat calls for "first-stage" cooling, the low voltage control circuit from "R" to "G" and "Y1" is completed. The UCB energizes the blower motor (if the fan switch on the room thermostat is set in the "AUTO" position) and drives the economizer dampers from fully closed to their minimum position. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (previously determined), "Y1" energizes the economizer. The dampers will modulate to maintain a constant supply air temperature as monitored by the discharge air sensor. If the outdoor air enthalpy is above the set point, "Y1" energizes compressor #1.

When the thermostat calls for "second-stage" cooling, the low voltage control circuit from "R" to "Y2" is completed. The UCB energizes the first available compressor. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (i.e. first stage has energized the economizer), "Y2" will energize compressor #1. If the outdoor air is above the set point, "Y2" will energize compressor #2. If Y2 brings on compressor #1 and this condition remains for more than 20 minutes, then compressor #2 will be energized until the thermostat is satisfied.

Once the thermostat has been satisfied, it will de-energize "Y1" and "Y2". If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling, and the economizer damper goes to the closed position. If the unit is in continues fan operation, the economizer damper goes to the minimum position.

Economizer With Dual Enthalpy Sensors

The operation with the dual enthalpy sensors is identical to the single sensor except that a second enthalpy sensor is mounted in the return air. This return air sensor allows the economizer to choose between outdoor air and return air, whichever has the *lowest enthalpy* value, to provide maximum operating efficiency.

Economizer With Power Exhaust

A unit equipped with an economizer (single or dual enthalpy) and a power exhaust operates as specified above with one addition. The power exhaust motor is energized 45 seconds after the actuator position exceeds the exhaust fan set point on the economizer control. When the power exhaust is operating, the second stage of mechanical cooling will not operate. As always, the "R" to "G" connection provides minimum position but does not provide power exhaust operation.

Economizer With Optional VAV Or Intelli-Comfort™ Control

The position of the outside air and return air dampers are controlled through a 2-10 VDC signal from the VAV or Intelli-Comfort™ control board. The economizer is enabled only in Occupied or Recovery mode. When the control is not powered or is in Unoccupied mode, the outside air dampers will be closed. When the supply fan is powered and there is no Y1 call, or if free-cooling is unavailable, the control opens the economizer dampers to the minimum position setting.

Free-cooling is available if the outdoor air temperature meets one of the three criteria discussed below, based upon the unit's configuration.

- **Dry Bulb:** The control refers to input from the Outside Air Temperature sensor and will allow free-cooling when the outdoor temperature is less than both the *First-Stage SAT Control* setpoint plus 5 °F, and the *Economizer OAT Enable* setpoint.
- **Single Enthalpy (optional):** A field-installed, Outdoor Air Humidity sensor is connected to the control. When the measured outdoor enthalpy is below the *Outside Air Enthalpy* setpoint, and the outdoor temperature is less than the *First-Stage SAT Control* setpoint plus 5 °F, free-cooling is available.
- **Dual Enthalpy (optional):** Both the field-installed Outdoor Air Humidity and the Return Air Humidity sensors are connected to the control. When the measured outdoor air enthalpy is less than the measured return air enthalpy, and the outdoor temperature is less than the *First-Stage SAT Control* setpoint plus 5 °F, free-cooling is available.

If free-cooling is available with a Y1 call, then the control modulates the economizer dampers to maintain the *First-Stage SAT Control* setpoint, plus or minus one degree. If free-cooling is unavailable, then 1st-stage mechanical cooling is initiated.

If at anytime the outdoor air temperature rises above the *First-Stage SAT Control* setpoint plus 5 °F, while free-cooling is available, then a Y1 call will also initiate 1st-stage mechanical cooling.

For a Y2 call, free-cooling is available based upon the criteria described above, except a *Second-Stage SAT Control* setpoint is used in the determination.

Once the call for cooling has been satisfied, it will de-energize any compressors and condenser fans, after the minimum compressor run times have been satisfied. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed.

Upon de-energizing the final compressor, the blower will continue to run with the economizer damper in its minimum position if in the Occupied mode; otherwise, the blower will stop following the elapse of the fan-off delay for cooling, and the economizer outdoor damper will close.

Economizer With Optional VAV Blower With Power Exhaust

The power exhaust motor is energized via the controller's EXH~ terminal and the ER relay, based on the position of the economizer damper parameter settings in the VAV control. Minimum run time is 10 seconds; minimum off time is 60 seconds. The outlet pressure of the power exhaust fan forces the barometric relief dampers open; gravity closes the dampers when the exhaust fan is off.

Economizer With Optional Intelli-Comfort™ With Power Exhaust

The power exhaust motor is energized via the exhaust relay based on the position of the economizer actuator's auxiliary switch adjustment screw. The adjustment screw represents the outdoor damper position at which to activate power exhaust, and can be set between 25 to 85 degrees open. The outlet pressure of the power exhaust fan forces the barometric relief dampers open; gravity closes the dampers when the exhaust fan is off.

Motorized Outdoor Air Dampers

This system operation is the same as the units with no outdoor air options with one exception. When the "R" to "G" circuit is complete, the motorized damper drives open to a position set by the thumbwheel on the damper motor. When the "R" to "G" circuit is opened, the damper spring returns fully closed.

Cooling Operation Errors

Each cooling system is monitored for operation outside of the intended parameters. Errors are handled as described below. All system errors override minimum run times for compressors.

High-Pressure Limit Switch

During cooling operation, if a high-pressure limit switch opens, the UCB will de-energize the associated compressor, initiate the ASCD (Anti-short cycle delay), and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a high-pressure switch open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (see Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Low-Pressure Limit Switch

The low-pressure limit switch is not monitored during the initial 30 seconds of a cooling system's operation. For the following 30 seconds, the UCB will monitor the low-pressure switch to ensure it closes. If the low-pressure switch fails to close after the 30-second monitoring phase, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the LPS is still open after the ASCD, the compressor will not be energized for 30 seconds. The second and third times that the UCB sees an open LPS will count towards the three occurrences that will cause a UCB lock-out.

Once the low-pressure switch has been proven (closed during the 30-second monitor period described above), the UCB will monitor the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans.

If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a low-pressure switch open three times within one hour of operation, the UCB will lock-out the associated compressor and flash a code (Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Freezestat

During cooling operation, if a freezestat opens, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a freezestat open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Low Ambient Cooling

To determine when to operate in low ambient mode, the UCB has a pair of terminals connected to a temperature-activated switch set at 45°F. When the low ambient switch is closed and the thermostat is calling for cooling, the UCB will operate in the low ambient mode.

Low ambient mode operates the compressors in this manner: 10 minutes on, 5 minutes off. The indoor blower is operated throughout the cycle. The 5-minute off period is necessary to defrost the indoor coil.

Low ambient mode always begins with compressor operation. Compressor minimum run time may extend the minutes of compressor operation. The defrost cycle will begin immediately following the elapse of the minimum run time.

When operating in low ambient mode, the UCB will not lockout the compressors due to a freezestat trip. However, a freezestat trip will de-energize the associated compressor. If the call for cooling is still present at the end of the ASCD and the freezestat has closed, the unit will resume operation.

Safety Controls

The unit control board monitors the following inputs for each cooling system:

1. A suction line freezestat to protect against low evaporator temperatures due to a low airflow or a low return air temperature, (opens at 26 ± 5 °F and resets at 38 ± 5°F).
2. A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure, (opens at 625 ± 25 psig and resets 500 ± 25 psig).
3. A low-pressure switch to protect against loss of refrigerant charge, (opens at 50 ± 5 psig and resets at 71 ± 5 psig).

The above pressure switches are hard-soldered to the unit. The refrigeration systems are independently monitored and controlled. On any fault, only the associated system will be affected by any safety/preventive action. The other refrigerant system will continue in operation unless it is affected by the fault as well.

The unit control board monitors the temperature limit switch of electric heat units and the temperature limit switch and the gas valve of gas furnace units.

Compressor Protection

In addition to the external pressure switches, the compressors also have inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the protector will open to shut down the compressor. The UCB incorporates features to minimize compressor wear and damage. An **Anti-Short Cycle Delay (ASCD)** is utilized to prevent operation of a compressor too soon after its previous run. Additionally, a minimum run time is imposed any time a compressor is energized.

The ASCD is initiated on unit start-up and on any compressor reset or lock-out.

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Reset

Remove the call for cooling, by raising thermostat setting higher than the conditioned space temperature. This resets any pressure or freezestat flash codes.

Electric Heating Sequence Of Operations

The following sequence describes the operation of the electric heat section.

⚠ CAUTION

For units with VFD and electric heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across the heating elements.

Single-stage heating: (applies only to 18 KW heater, all other heaters MUST use a two-stage thermostat)

a. Upon a call for heat by the thermostat, the heater contactor (6M) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

Two-stage heating: (applies to all heaters except 18 KW)

a. Upon a call for first-stage heat by the thermostat, the heater contactor (6M) (6M & 7M on 72 KW, 240V) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

   If the second stage of heat is required, heater contactor (7M) will be energized. Note that on the 54 KW, 240V heater, heater contactors (7M & 8M) will be energized and on the 72 KW, 240V heater, heater contactors (8M & 9M) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

NOTE: All 240 & 480V heaters are provided with manual reset backup protection limits. These will de-energize the heaters should the primary limit fail to open or the contactors fail to open in a failure mode.

Electric Heat Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized.

This limit is monitored regardless of unit operation status, i.e. the limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and a flash code is initiated (See Table 25).

Safety Controls

The UCB monitors the temperature limit switch of electric heat units.

The control circuit includes the following safety controls:

Temperature Limit Switch (TLs)

1. Temperature Limit Switch (TLS 1, 2).

   This control is located inside the heater compartment and is set to open at the temperature indicated in the Limit Control Setting Table 20. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

2. Temperature Limit Switch (TLS 3, 4, 5 and 6).

   This control is located inside the heater compartment and is set to open at the temperature indicated in the Limit Control Setting Table 20. It is a manual reset limit. These limit switches will de-energize the heaters should the primary limit fail to open or the contactors fail to open in a failure mode.

Table 20: Limit Control Setting

Unit (Tons)	Voltage	Heater Kw	Temperature, Limit Switch 1, 2 Opens, °F	Temperature, Limit Switch 3, 4, 5, 6 Opens, °F
15	240	18	120	170
		36	120	170
		54	120	170
		72	120	170
17.5, 20 and 25	240	18	140	200
		36	140	200
		54	140	200
		72	140	200
15, 17.5, 20 and 25	460	18	120	170
		36	120	170
		54	120	170
		72	120	170
15, 17.5, 20 and 25	600	18	120	-
		36	120	-
		54	120	-
		72	120	-

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Reset

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature.This resets any flash codes.

Electric Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter "ON" cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 21 for the required electric heat anticipator setting.

Table 21: Electric Heat Anticipator Setpoint

Heater Kw	Voltage	Setting, Amps	
		Th1	Th2
18	208/230-3-60	0.29	-
36		0.29	0.29
54		0.29	0.58
72		0.29	0.58
18	460-3-60	0.29	-
36		0.29	0.29
54		0.29	0.29
72		0.29	0.29
18	575-3-60	0.29	-
36		0.29	0.29
54		0.29	0.29
72		0.29	0.29

Gas Heating Sequence Of Operations

The following sequence describes the operation of the gas heat section.

⚠ CAUTION

For units with VFD and gas heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across the heat exchanger tubes.

When the thermostat calls for the first stage of heating, the low-voltage control circuit from "R" to "W1" and "G" is completed, thru the UCB. The heat relay "RW1" is energized. The "RW1-2" contacts close energizing the draft motor control. The draft motor control contacts close and start the draft motor. As the speed of the draft motor reaches approximately 2500 RPM, the centrifugal switch contact, located on the end of the draft motor shaft, closes to power the first stage ignition module "IC1", thru the "RW1-1" contacts.

Ignition module "IC1" will immediately start the first stage igniter sparking and will open the redundant valve located inside the first stage main gas valve "GV1" to allow a flow of gas to only the first stage carryover tube. Only after the pilot flame has been ignited and the presence of pilot flame detected at the "IC1" by a signal sent back through the flame sensor is sparking terminated and the first stage main gas valve opened.

Gas flows into each of the main burners and is ignited from the carryover tube flame.

After completing the specified fan on delay for heating, the UCB will energize the blower motor.

If "IC1" fails to detect a pilot flame, it will continue to try for a maximum of 85 seconds to ignite the pilot tube. If the pilot flame is not detected, then "IC1" will lock out first stage furnace operation for five minutes or until 24V power is removed from the module either at the unit or by resetting the room thermostat.

When the thermostat calls for the second stage of heating, the low-voltage control circuit from "R" to "W2" is completed, thru the UCB. Heat relay "RW2" is energized. The "RW2-1" contact is closed energizing the second stage ignition module "IC2". "IC2" will immediately start the second stage igniter sparking and will open the redundant valve located inside the second stage main gas valve "GV2" to allow a flow of gas to the second stage carryover tube. Only after the pilot flame has been ignited and the presence of pilot flame detected at "IC2" by a signal sent back through the flame sensor is sparking terminated and the main gas valve opened.

Gas flows into each of the second stage main burners and is ignited from the carryover tube flame.

If "IC2" fails to detect a pilot flame, it will continue to try for a maximum of 85 seconds to ignite the pilot tube. If the pilot flame is not detected, then "IC2" will lock out first stage furnace operation for five minutes or until 24V power is removed from the module either at the unit or by resetting the room thermostat.

NOTE: That the second stage furnace can operate even if first stage has locked out.

When the thermostat satisfies de-energizing the "RW2"and "RW1", thus opening all gas valves. The blower motor will continue to run after the furnace is shut down until the specified fan off delay for heating has been satisfied. The UCB will de-energize the blower motor.

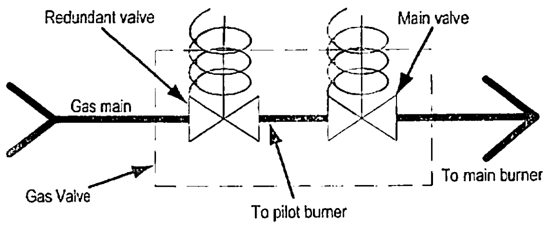


Figure 21: Gas Valve Piping

When the thermostat calls for the first stage of heating, the low-voltage control circuit from "R" to "W1" is completed. A call for heat passes through the UCB to the ignition control board (ICB). The UCB monitors the "W1" call and acts upon any call for heat. Once voltage has been sensed at "W1", the UCB will initiate the fan on delay for heating, energizing the indoor blower after the specified delay has elapsed.

When the thermostat has been satisfied, heating calls are ceased. The GV is immediately de-energized. The blower is de-energized after the fan off delay for heating has elapsed. The draft motor performs a 25-second post purge.

Gas Heating Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized. When the UCB again senses 24 volts from the temperature limit, the draft motor will perform a 25-second post-purge and the indoor blower will be de-energized following the elapse of the fan off delay for heating.

This limit is monitored regardless of unit operation status, i.e. this limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and flash code is initiated (See Table 25).

Gas Valve

The UCB continuously monitors the GV. Any time the UCB senses voltage at the GV without a call for heat for a continuous five-minute period, the UCB will lock-on the indoor blower and a flash code is initiated (Table 25). When voltage is no longer sensed at the GV, the UCB will de-energize the indoor blower following the elapse of the fan off delay for heating.

If voltage has been sensed at the GV for at least 15 seconds during the fan on delay for heating and GV voltage or "W1" is lost, the indoor blower is forced on for the length of the fan off delay for heating.

Safety Controls

The UCB monitors the temperature limit switch of gas heat units.

The control circuit includes the following safety controls:

Limit Switch (LS)

This control is located inside the gas heat compartment and is set to open at the temperature indicated in the Gas Heat Limit Control Settings Table 22. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

Centrifugal Switch (CS)

If the draft motor should fail, the centrifugal switch attached to the shaft of the motor prevents the ignition controls and gas valves from being energized.

Redundant Gas Valve

There are two separate gas valves in the furnace. Each valve contains a main and a redundant valve. The redundant valves are located upstream of the main gas valves. Should either or both of the main gas valves fail in the open position the redundant valves serve as back-ups and shut off the flow of gas.

Flame Sensor Rod / 100% Ignition Control Lock-Out.

The flame rods and controls are located per Proper Flame Adjustment Figure 23. If an ignition control fails to detect a signal from the flame sensor indicating the pilot flame is properly ignited, then the main gas valve will not open. It will continue to try and ignite the pilot for a maximum of 85 seconds, then if the pilot flame is not detected, the ignition control will lock out furnace operation until 24V power is removed from the module either at the unit or by resetting the room thermostat.

Rollout Switch

This switch is located above the main burners in the control compartment, which in the event of a sustained main burner rollout shuts off and locks out both ignition controls closing both gas valves. The ignition controls lock out furnace operation until 24V power is removed from the controls either at the unit or by resetting the room thermostat.

Auxiliary Limit Switch (AUX)

This control is located inside the heat exchanger compartment and is set to open at 190°F. It is a manual reset switch. If AUX trips, then the primary limit has not functioned correctly. Replace the primary limit.

Table 22: Gas Heat Limit Control Setting

Units (Tons)	Capacity, MBH		Limit Control Opens, °F
	Input	Output	
15, 17.5, 20 & 25	300	240	195
15, 17.5, 20 & 25	400	320	195

The ICB monitors the Pressure and Rollout switches of gas heat units.

The control circuit includes the following safety controls:

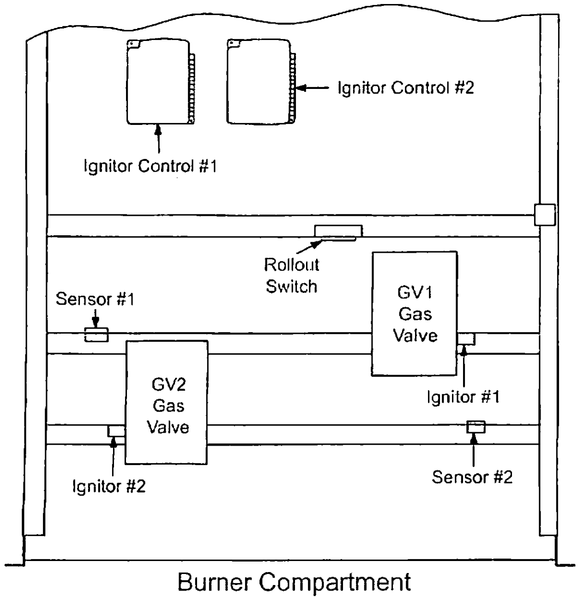


Figure 22: Gas Valve and Controls

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Resets

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature. This resets any flash codes.

Gas Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter "ON cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 23 for the required gas heat anticipator setting.

Table 23: Gas Heat Anticipator Setpoints

Gas Valve	Anticipator Setpoint	
	1st Stage	2nd Stage
Honeywell VR8440	0.30 amp	0.11 amp
White-Rodgers 36C68		

Start-Up (Cooling)

Prestart Check List

After installation has been completed:

1. Check the electrical supply voltage being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Set the room thermostat to the off position.
3. Turn unit electrical power on.
4. Set the room thermostat fan switch to on.
5. Check indoor blower rotation.
   - If blower rotation is in the wrong direction. Refer to Phasing Section in general information section.

   Check blower drive belt tension.
6. Check the unit supply air (CFM).
7. Measure evaporator fan motor's amp draw.
8. Set the room thermostat fan switch to off.
9. Turn unit electrical power off.

Operating Instructions

1. Turn unit electrical power on.
2. Set the room thermostat setting to lower than the room temperature.
3. First stage compressors will energize after the built-in time delay (five minutes).
4. The second stage of the thermostat will energize second stage compressor if needed.

Post Start Check List

1. Verify proper system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.
3. Measure the system amperage draw across all legs of 3 phase power wires.
4. Measure the condenser fan amperage draw.

Start-Up (Gas Heat)

Pre-Start Check List

Complete the following checks before starting the unit.

1. Check the type of gas being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Make sure that the vent and combustion hoods have been properly installed.

Operating Instructions

⚠ CAUTION

This furnace is equipped with an intermittent pilot and automatic re-ignition system. DO NOT attempt to manually light the pilot.

Lighting The Main Burners

1. Turn "OFF" electric power to unit.
2. Turn room thermostat to lowest setting.

3. Turn gas valve knob or switch to "ON" position (See Figure 25).
4. Turn "ON" electric power to unit.
5. Set room thermostat to desired temperature (If thermostat "set" temperature is above room temperature, pilot burner ignition will occur and, after an interval to prove pilot flame, main burners will ignite).

Post Start Checklist

After the entire control circuit has been energized and the heating section is operating, make the following checks:

1. Check for gas leaks in the unit piping as well as the supply piping.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

2. Check for correct manifold gas pressures. (See CHECKING GAS INPUT.)
3. Check the supply gas pressure. It must be within the limits shown on the rating nameplate. Supply pressure should be checked with all gas appliances in the building at full fire. At no time should the standby gas pressure exceed 13 in. or the operating pressure drop below 5.0 in for natural gas units. If gas pressure is outside these limits, contact the local gas utility or propane supplier for corrective action.

Shut Down

1. Set the thermostat to the lowest temperature setting.
2. Turn "OFF" all electric power to unit.
3. Open gas heat access panel.
4. Turn gas valve clockwise to "OFF" position (See Figure 25).

Checking Gas Heat Input

1. Turn off all other gas appliances connected to the gas meter.
2. With the furnace turned on, measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter usually has a 1/2 or a 1 cubic foot test dial.
3. Using the number of seconds for each revolution and the size of the test dial increment, find the cubic feet of gas consumed per hour from the Gas Rate - Cubic Feet Per Hour Table 24.

If the actual input is not within 5% of the furnace rating (with allowance being made for the permissible range of the regulator setting), replace the orifice spuds with spuds of the proper size.

NOTE: To find the Btu input, multiply the number of cubic feet of gas consumed per hour by the Btu content of the gas in your particular locality (contact your gas company for this information - it varies widely from city to city.).

Table 24: Gas Rate Cubic Feet Per Hour

Seconds for One Rev.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
4	450	900
6	300	600
8	228	450
10	180	360
12	150	300
14	129	257
16	113	225
18	100	200
20	90	180
22	82	164
24	75	150
26	69	138
28	64	129

EXAMPLE

By actual measurement, it takes 13 seconds for the hand on the 1-cubic foot dial to make a revolution with just a 300,000 Btuh furnace running. Read across to the column in the table above, headed "1 Cubic Foot", where you will see that 278 cubic feet of gas per hour are consumed by the furnace at that rate. Multiply 278 x 1050 (the Btu rating of the gas obtained from the local gas company). The result is 292,425 Btuh, which is close to the 300,000 Btuh rating of the furnace.

Manifold Gas Pressure Adjustment

Small adjustments to the high-fire gas flow may be made by turning the pressure regulator adjusting screw on the automatic gas valve.

Adjust as follows:

1. Remove the cap on the regulator. It's located next to the push-on electrical terminals.
2. To decrease the gas pressure, turn the adjusting screw counterclockwise.
3. To increase the gas pressure, turn the adjusting screw clockwise.

NOTE: The correct manifold pressure for these furnaces is 3.65 IWG ± 0.3.

Adjustment Of Temperature Rise

The temperature rise (the difference of temperature between the return air and the heated air from the furnace) must lie within the range shown on the CSA rating plate and the data in Table 11.

After the temperature rise has been determined, the CFM can be calculated as follows:

$$CFM = Btu\ Input \cdot \frac{0.8}{(1.08 \cdot \Delta °F)}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts (about 6 feet from the furnace) where they will not be affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise (See SUPPLY AIR DRIVE ADJUSTMENT).

NOTE: Each gas heat exchanger size has a minimum allowable CFM. Below this CFM, the limit will open.

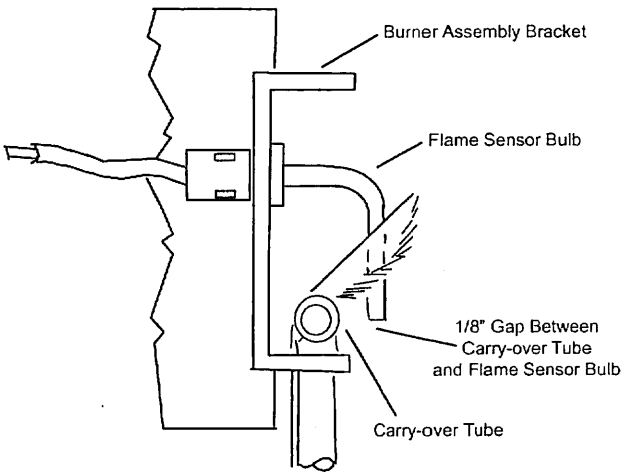


Figure 23: Proper Pilot Flame Adjustment

Pilot Checkout

The pilot flame should envelope the end of the flame sensor. To adjust pilot flame, (1) remove pilot adjustment cover screw, (2) increase or decrease the clearance for air to the desired level, (3) be sure to replace cover screw after adjustment to prevent possible gas leakage.

Put the system into operation and observe through complete cycle to be sure all controls function properly.

Burner Instruction

To check or change burners, pilot or orifices, CLOSE MAIN MANUAL SHUT-OFF VALVE AND SHUT OFF ALL ELECTRIC POWER TO THE UNIT.

1. Remove the screws holding either end of the manifold to the burner supports.
2. Open the union fitting in the gas supply line just upstream of the unit gas valve and downstream from the main manual shut-off valve.
3. Remove the gas piping closure panel.
4. Disconnect wiring to the gas valves and spark ignitors. Remove the manifold-burner gas valve assembly by lifting up and pulling back.

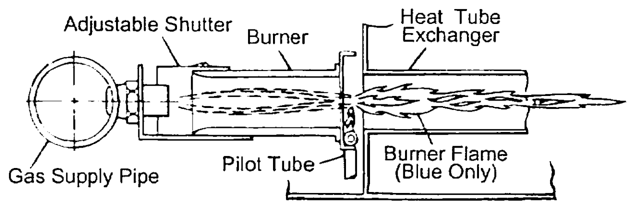


Figure 24: Typical Flame

Burners are now accessible for service.

Reverse the above procedure to replace the assemblies. Make sure that burners are level and seat at the rear of the heat exchanger.

Burner Air Shutter Adjustment

Adjust burner shutters so no yellow flame is observed in the heat exchanger tubes.

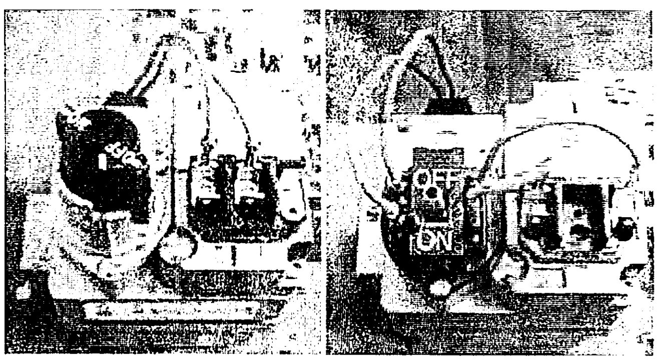


Figure 25: Typical Gas Valve

Charging The Unit

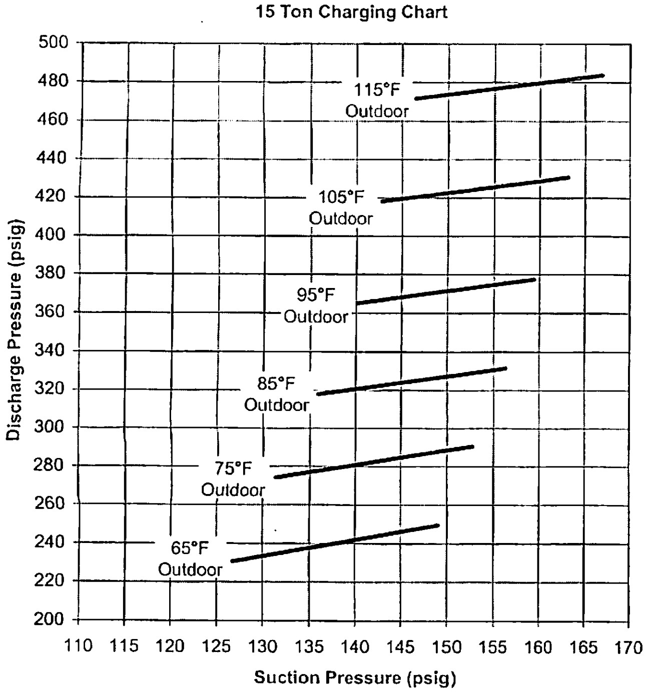


Figure 26: ZJ180 (15 Ton) Charging Chart

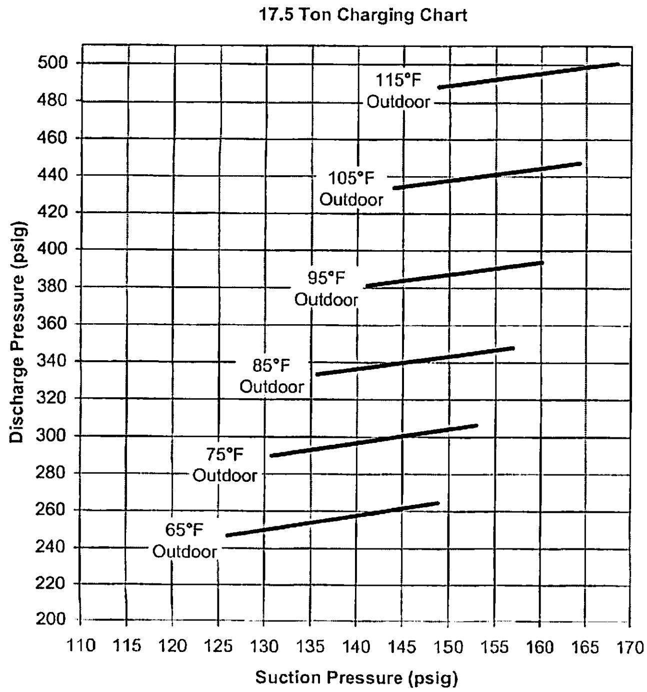


Figure 27: ZJ210 (17.5 Ton) Charging Chart

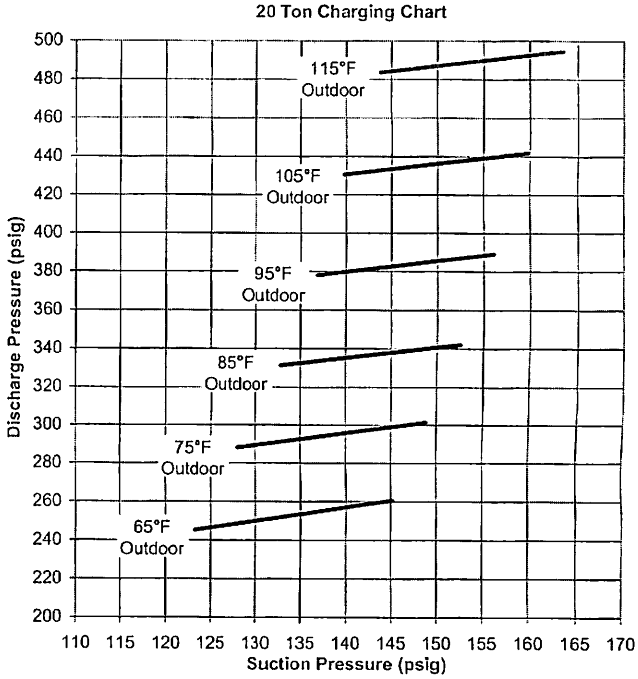


Figure 28: ZJ240 (20 Ton) Charging Chart

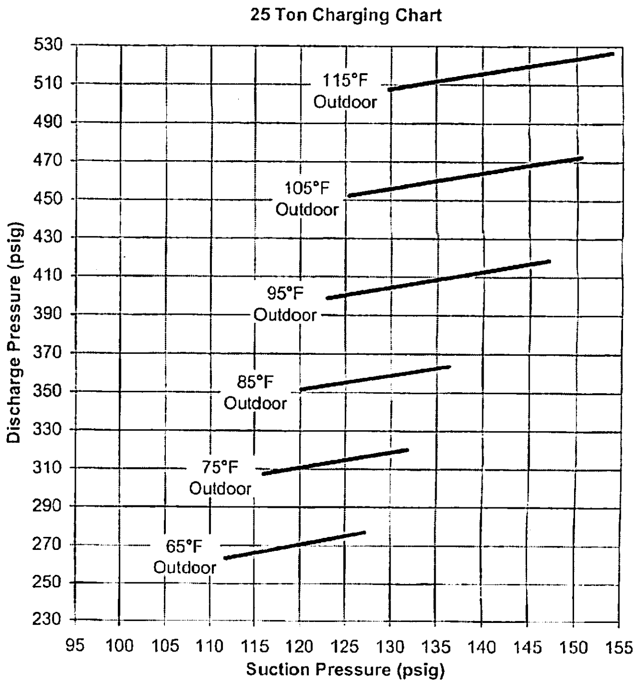


Figure 29: ZJ300 (25 Ton) Charging Chart

Troubleshooting

⚠WARNING

Troubleshooting of components may require opening the electrical control box with the power connected to the unit. **Use extreme care when working with live circuits!** Check the unit nameplate for the correct line voltage and set the voltmeter to the correct range before making any connections with line terminals.

For troubleshooting of optional VFD, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

When not necessary, shut off all electric power to the unit prior to any of the following maintenance procedures so as to prevent personal injury.

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation which could cause injury to person and/or damage unit components. Verify proper operation after servicing.

Cooling Troubleshooting Guide

On calls for cooling, if the compressors are operating but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in the "AUTO" position):

1. Turn the thermostat fan switch to the ON position. If the supply air blower motor does not energize, go to Step 2.
2. If the supply air blower motor does not energize when the fan switch is set to ON, check that line voltage is being supplied to the contacts of the M3, contactor, and that the contactor is pulled in. For units with VFD, check that line voltage is being supplied to the M3-Auxiliary contacts. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied to M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on internal protection. Cancel any thermostat calls and set the fan switch to AUTO. Wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts are present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.

   For units with VFD, if there is line voltage supplied at M3, M3 is pulled in, and the blower motor does not operate, check all power & control wiring connections to and from the drive and for any fault/warning messages displayed on the drive's digital display (refer to the drive user manual for full descriptions, if necessary). Clear any fault by pressing 'RESET' on the drive's keypad and take any corrective action as needed. If the motor still does not operate, replace the motor.
6. If 24 volts is not present at M3, check that 24 volts is present at the UCB supply air blower motor terminal, "FAN". If 24 volts is present at the FAN, check for loose wiring between the UCB and M3.
7. If 24 volts is not present at the "FAN" terminal, check for 24 volts from the room thermostat. If 24 volts are not present from the room thermostat, check for the following:
   a. Proper operation of the room thermostat (contact between R and G with the fan switch in the ON position and in the AUTO position during operation calls).
   b. Proper wiring between the room thermostat and the UCB, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
9. If the thermostat and UCB are properly wired, replace the UCB.

On calls for cooling, the supply air blower motor is operating but compressor #1 is not (the room thermostat fan switch is in the "AUTO" position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling and the compressors will not immediately operate. If both stages of cooling are requested simultaneously and the economizer provides free cooling, following a short delay compressor #1 will be energized unless it is locked out. If compressor #1 is locked out, compressor #2 is energized. Compressor #2 is always energized in place of compressor #1 when compressor #1 is requested but locked out.
2. If no economizer is installed or the economizer is not opening to provide free cooling and compressor #1 does not energize on a call for cooling, check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts are present and M1 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.

7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts is not present from the room thermostat, check for the following:
   a. 24 volts at the thermostat Y1 terminal
   b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.
9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing an alarm code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, cancel any call for cooling. This will reset any compressor lock outs. If the LPS is still open after the ASCD, the compressor will not be energized for 30 seconds. The second and third times that the UCB sees an open LPS will count towards the three occurrences that will cause a UCB lock-out.

NOTE: While the above step will reset any lockouts, compressor #1 may be held off for the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.
11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 "OUT" terminal of the UCB. If 24 volts is present, trace the wiring from Y1 "OUT" for incorrect wiring. If 24 volts is not present at the Y1 "OUT" terminal, the UCB must be replaced.
12. *For units without economizers*: If 24 volts is present at the Y1 OUT terminal, check for 24 volts at the Y1 "ECON" terminal. If 24 volts is not present, check for loose wiring from the Y1 "OUT" terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 "ECON" terminal.
13. *For units with economizers*: If 24 volts is present at the Y1 "OUT" terminal, check for 24 volts at the Y1 "ECON" terminal. If 24 volts is not present, check for loose wiring from the Y1 "OUT" terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 "ECON" terminal. If nothing is found, the economizer control may have faulted and is failing to return the 24-volt "call" to the Y1 "ECON" terminal even though the economizer is not providing free cooling. To test, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB's Mate-N-Lock plug. If compressor #1 energizes, there is a fault in the economizer wiring or the economizer control.
14. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local distributors can test the UCB for this programming.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.
15. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.
16. If none of the above correct the error, replace the UCB.

On calls for the second stage of cooling, the supply air blower motor and compressor #1 are operating but compressor #2 is not (the room thermostat fan switch is in the "AUTO" position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling. If the second stage of cooling is requested, following a short delay, compressor #1 will be energized unless it is locked out. Typically, compressor #2 is energized only during free cooling if the call for the second stage of cooling persists for 20 minutes.
2. Compressor #2 will not energize simultaneously with compressor #1 if a call for both stages of cooling is received. The UCB delays compressor #2 by 30 seconds to prevent a power surge. If after the delay compressor #2 does not energize on a second stage call for cooling, check for line voltage at the compressor contactor, M2, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M2 is pulled in and voltage is supplied at M2, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M2 is not pulled in, check for 24 volts at the M2 coil. If 24 volts is present and M2 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M2, M2 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M2, check for 24 volts at the UCB terminal, C2. If 24 volts are present, check for loose wiring between C2 and the compressor contactor.
7. If 24 volts is not present at the C2 terminal, check for 24 volts from the room thermostat at the UCB Y2 terminal. If

24 volts is not present from the room thermostat, check for the following:

a. 24 volts at the thermostat Y2 terminal
b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and
c. Loose wiring from the room thermostat to the UCB

8. If 24 volts is present at the UCB Y2 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS2, LPS2, and FS2 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS2 has opened, there will be 24 volts of potential between the LPS2 terminals.
9. If 24 volts is present at the UCB Y2 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out,

   remove any call for cooling at the thermostat or by disconnecting the thermostat wiring at the Y1, Y2, Y3 and Y4 on the UCB terminal. This will reset any compressor lock outs, except LPS lockouts these can only be reset by cycling power to UCB.

NOTE: While the above step will reset any lock outs, compressor #1 will be held off for the ASCD, and compressor #2 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y2 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.
11. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local distributors can test the UCB for this programming.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.
12. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C2 terminal wire and jumper it to the Y2 terminal. DO NOT jump the Y2 to C2 terminals. If the compressor engages, the UCB has faulted.
13. If none of the above correct the error, replace the UCB.

On a call for cooling, the supply air blower motor and compressor #2 are operating but compressor #1 is not (the room thermostat fan switch is in the "AUTO" position):

1. Compressor #2 is energized in place of compressor #1 when compressor #1 is unavailable for cooling calls. Check the UCB for alarms indicating that compressor #1 is locked out. Press and release the ALARMS button if the LED is not flashing an alarm.
2. Check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts is present and M1 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.
7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts are not present at the UCB Y1 terminal, the UCB may have faulted. Check for 24 volts at the Y1 ECON terminal. If 24 volts is not present at Y1 "ECON", the UCB has faulted. The UCB should de-energize all compressors on a loss of call for the first stage of cooling, i.e. a loss if 24 volts at the Y1 terminal.
8. If 24 volts are present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.
9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, remove any call for cooling. This will reset any compressor lock outs, except LPS lockouts. These can only be reset by cycling power to the UCB.

NOTE: While the above step will reset any lock outs, compressor #2 will be held off for the ASCD, and compressor #1 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.
11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 "OUT"

terminal of the UCB. If 24 volts is present, trace the wiring from Y1 "OUT" for incorrect wiring. If 24 volts is not present at the Y1 "OUT" terminal, the UCB must be replaced.

12. *For units without economizers:* If 24 volts is present at the Y1 "OUT" terminal, check for 24 volts at the Y1 "ECON" terminal. If 24 volts is not present, check for loose wiring from the Y1 "OUT" terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 "ECON" terminal.

    For units with economizers: If 24 volts is present at the Y1 "OUT" terminal, check for 24 volts at the Y1 "ECON" terminal. If 24 volts is not present, check for loose wiring from the Y1 "OUT" terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 "ECON" terminal. The economizer control may have faulted and is not returning the 24 volts to the Y1 "ECON" terminal even though the economizer is not providing free cooling. To test the economizer control, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB's Mate-N-Lock plug.

13. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. They can be checked by local distributors.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.

14. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.

15. If none of the above correct the error, replace the UCB.

Gas Heat Troubleshooting Guide

On calls for heating, the draft motor operates and the furnace lights but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in "AUTO" position).

⚠WARNING

The furnace may shut down on a high temperature condition during the procedure. If this occurs, the UCB energize the supply air blower motor until the high temperature limit has reset. Caution should be used at all times as the supply air blower may energize regardless of the room thermostat fan switch position.

For troubleshooting of optional VFD, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

1. Place the thermostat fan switch in the "ON" position. If the supply air blower motor energizes, go to Step 9.
2. If the supply air blower motor does not energize when the fan switch is set to "ON," check that line voltage is being supplied to the contacts of the M3 contactor, and that the contactor is pulled in. For units with VFD, check that line voltage is being supplied to the M3-Auxiliary contacts. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied at M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on inherent protection. Cancel any thermostat calls and set the fan switch to "AUTO", wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts is present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.

    For units with VFD, if there is line voltage supplied at M3, M3 is pulled in, and the blower motor does not operate, check all power & control wiring connections to and from the drive and for any fault/warning messages displayed on the drive's digital display (refer to the drive user manual for full descriptions, if necessary). Clear any fault by pressing 'RESET' on the drive's keypad and take any corrective action as needed. If the motor still does not operate, replace the motor.

6. If 24 volts is not present at M3, check that 24 volts is present at the supply air blower motor terminal on the UCB. If 24 volts is present at the UCB terminal, check for loose wiring between the UCB and M3.
   a. If 24 volts is not present at the UCB supply air blower motor terminal, check for 24 volts from the room thermostat. If 24 volts is not present from the room thermostat, check for the following:
      - Proper operation of the room thermostat (contact between R and G with the fan switch in the "ON" position and in the "AUTO" position during operation calls.)
      - Proper wiring between the room thermostat and the UCB, and
      - Loose wiring from the room thermostat to the UCB
7. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
8. If the thermostat and UCB are properly wired, replace the UCB.
9. If the blower motor runs with the fan switch in the "ON" position but does not run shortly after the furnace has ignited when the fan switch is in the "AUTO" position, check the room thermostat for contact between R and G during "W1" calls.

On calls for heating, the supply air blower operates but the draft motor does not (the room thermostat fan switch is in the "AUTO" position).

1. The draft motor has inherent protection. If the motor shell is hot to the touch, wait for the internal overload to reset.
2. If the motor shell is cold with the room thermostat calling for heat, check for line voltage at the motor's Mate-N-Lok connector attached to the evaporator partition. If line voltage is present, replace the draft motor.
3. If line voltage is not present, check for line voltage at the heat relay (RW1) contacts in the main control box and check to see if the (RW1) is pulled in.
4. If the (RW1) relay is pulled in, check for a loose line voltage connection.
5. If the (RW1) relay is not pulled in, check for 24 volts at the (RW1) coil. If 24 volts is present, replace the (RW1) relay. If 24 volts is not present, check for a loose 24 volt connection back to the relay board and check the connections from the room thermostat to the relay board. If all connections are correct, replace the relay board.

The draft motor runs but the furnace does not light and the sparker does not spark.

1. The ignition control (IC1, IC2) may be locked out due to either a flame roll out or 100% shut off. These safety features are described above. If lock-out has occurred, 24V must be removed from the ignition controls. This is done at the unit or by resetting the room thermostat. After resetting 24V, check for proper furnace operation. If lock-out continues to occur, locate the source of the problem and correct.
2. Check all 24 volt connections from the relay board to and in the gas heat section. Check low voltage connections to the (ETD) located in the control box.
3. If the furnace is hot, it may be out on an over-temperature condition, wait for limit reset.
4. If the furnace is cold, check for 24 volts at wire 241 attached to the electrical time delay (ETD) located in the main control box. If 24 volts is not found, replace the ETD.
5. 24 volts is found at wire 241, remove the wires attached to the (TDR) and with a VOM, check for continuity across contacts 1 and 2. If none is found, the (TDR) is open and must be replaced. If there is continuity, re-attach the wires.With the draft motor running, check for 24 volts at terminal 4 of (RW1-2) and (RW2-1). If 24 volts is not present, the centrifugal switch (CS) has not closed or has gone bad. Check the line voltage to the unit - if it is correct, replace the draft motor. If line voltage is low, call the power company.
6. Check for 24V at terminal 2 of (RW1-2 and RW2-1). If 24V is not present, check for 24V at (RW1 and RW2) relay coils. If these relays are pulled in, then check for a loose connection at terminal 2 and terminal 4 of each relay. If no problem is found, then replace (RW1 and/or RW2) as required.
7. If 24 volts is present at the ignitor controls, check all control wiring at the ignitor controls and the high tension wire to the ignitors. Check that the ground wires from the ignitor controls, the gas valves and pilot burners are all intact and making good electrical connection. Check to make sure that the ceramic insulator on the pilot ignitors or sensors is not broken or cracked, if all are intact, replace the ignition control IC1 or IC2.

The draft motor runs and the ignitor sparks at the pilot burner but the pilot does not ignite and a gas odor is not detected at the draft motor outlet.

1. Check to make sure gas is being supplied to the unit. Make sure that the gas pressure to the unit is within the proper limits as described in the "POST START CHECK LIST" page 52 and that the pilot adjust screw is allowing some flow of gas as described in "PILOT CHECKOUT" page 53.
2. Check all wiring between the ignitor control and the gas valve. Check to make sure the ground connections are intact.
3. If the wiring is intact, check for 24 volts across terminals "PV" and "COMMON" on the ignitor control. If 24 volts is not present, replace the ignitor control.
4. If 24 volts is present, remove the pilot burner and remove the pilot orifice from the pilot burner. The orifice is removed in the direction opposite the flow of gas. Inspect the orifice for obstruction. If it is clear, replace the main gas valve.

The ignitor sparks at the pilot burner but the pilot does not ignite and a gas odor is detected at the draft motor outlet.

1. Adjust the pilot adjust screw on the gas valve as described in "PILOT CHECKOUT" page 53.
2. Check the supply pressure as described in "POST START CHECK LIST" page 52. Make adjustments as necessary.

3. Check the pilot orifice for obstruction as described in paragraph above. Clean as needed but the problem should not be the gas valve.

The pilot burner ignites but the ignitor continues to spark and the main burners do not ignite.

1. Make the same checks and adjustment as described in "PILOT CHECKOUT" page 53.
2. Check the supply pressure as described in "POST START CHECK LIST" page 52. Make adjustments as necessary.
3. Make sure that the pilot burner is not bent or damaged.
4. Make sure that the ground connections at the pilot burner, gas valve and ignitor control are intact. Check the high tension wire for good electrical connection. If all are intact, replace the ignitor module.

The pilot burner lights and the spark stops but the main burners do not light.

1. Check electrical connections between the ignitor control and the gas valve. If intact, check for 24 volts across terminals "MV" and "COMMON" terminals. If no voltage detected, replace ignitor control. If voltage is present, replace gas valve.

Furnace lights with roll-out or one burner has delayed ignition.

1. Make sure that the pilot burner is aligned properly with the carryover as described in "PILOT CHECKOUT" page 53.
2. Make sure that the carryovers on adjoining burners are screwed fast and are level with respect to one another.

Main burners light but exhibit erratic flame characteristics.

1. Adjust air shutters as described in "BURNER AIR SHUTTER ADJUSTMENT" page 53.
2. Check the main burner orifices for obstruction and alignment. Removal procedure is described in BURNER INSTRUCTIONS page 53. Clean or replace burner orifices and burners as needed.

Unit Control Board Flash Codes

Various flash codes are utilized by the unit control board (UCB) to aid in troubleshooting. Flash codes are distinguished by the short on and off cycle used (approximately 200ms on and 200ms off). To show normal operation, the control board flashes a 1 second on, 1 second off "heartbeat" during normal operation. This is to verify that the UCB is functioning correctly. Do not confuse this with an error flash code. To prevent confusion, a 1-flash, flash code is not used.

Alarm condition codes are flashed on the UCB lower left Red LED, See Figure 30. While the alarm code is being flashed, it will also be shown by the other LEDs: lit continuously while the alarm is being flashed. The total of the continuously lit LEDs equates to the number of flashes, and is shown in the table. Pressing and releasing the LAST ERROR button on the UCB can check the alarm history. The UCB will cycle through the last five (5) alarms, most recent to oldest, separating each alarm flash code by approximately 2 seconds. Flash code 21 is a non-alarm condition but due to the space constraints of the UCB, will be indicated by the Red LED. In all other cases, a flashing Green LED will be used to indicate non-alarm conditions.

In some cases, it may be necessary to "zero" the ASCD for the compressors in order to perform troubleshooting. To reset all ASCDs for one cycle, press and release the UCB TEST/ RESET button once.

Flash codes that do and do not represent alarms are listed in Table 25.

Table 25: Unit Control Board Flash Codes

Flash Codes	Description	Green LED 16	Red LED 8	Red LED 4	Red Led 2	Red LED 1
On Steady	This is a Control Failure	-	-	-	-	-
1 Flash	Not Applicable	-	-	-	-	-
2 Flashes	Control waiting ASCD[1]	Flashing	Off	Off	On	Off
3 Flashes	HPS1 Compressor Lockout	Off	Off	Off	On	On
4 Flashes	HPS2 Compressor Lockout	Off	Off	On	Off	Off
5 Flashes	LPS1 Compressor Lockout	Off	Off	On	Off	On
6 Flashes	LPS2 Compressor Lockout	Off	Off	On	On	Off
7 Flashes	FS1 Compressor Lockout	Off	Off	On	On	On
8 Flashes	FS2 Compressor Lockout	Off	On	Off	Off	Off
9 Flashes	Ignition Control Locked Out / Ignition Control Failure	Off	On	Off	Off	On
10 Flashes	Compressors Locked Out on Low Outdoor Air Temperature[1]	Flashing	On	Off	On	Off
11 Flashes	Compressors locked out because the Economizer is using free Cooling[1]	Flashing	On	Off	On	On
12 Flashes	Unit Locked Out due to Fan Overload Switch Failure	Off	On	On	Off	Off
13 Flashes	Compressor Held Off due to Low Voltage[1]	Flashing	On	On	Off	On
14 Flashes	EEPROM Storage Failure	Off	On	On	On	Off
15 Flashes	HPS3 Compressor Lockout	Off	On	On	On	On
16 Flashes	HPS4 Compressor Lockout	On	Off	Off	Off	Off
17 Flashes	LPS3 Compressor Lockout	On	Off	Off	Off	On
18 Flashes	LPS4 Compressor Lockout	On	Off	Off	On	Off
19 Flashes	FS3 Compressor Lockout	On	Off	Off	On	On
20 Flashes	FS4 Compressor Lockout	On	Off	On	Off	Off
21 Flashes	Compressor Off due to Low SAT[1]	On	Off	On	Off	On
OFF	No Power or Control Failure	Off	Off	Off	Off	Off

1. Non-alarm conditions.

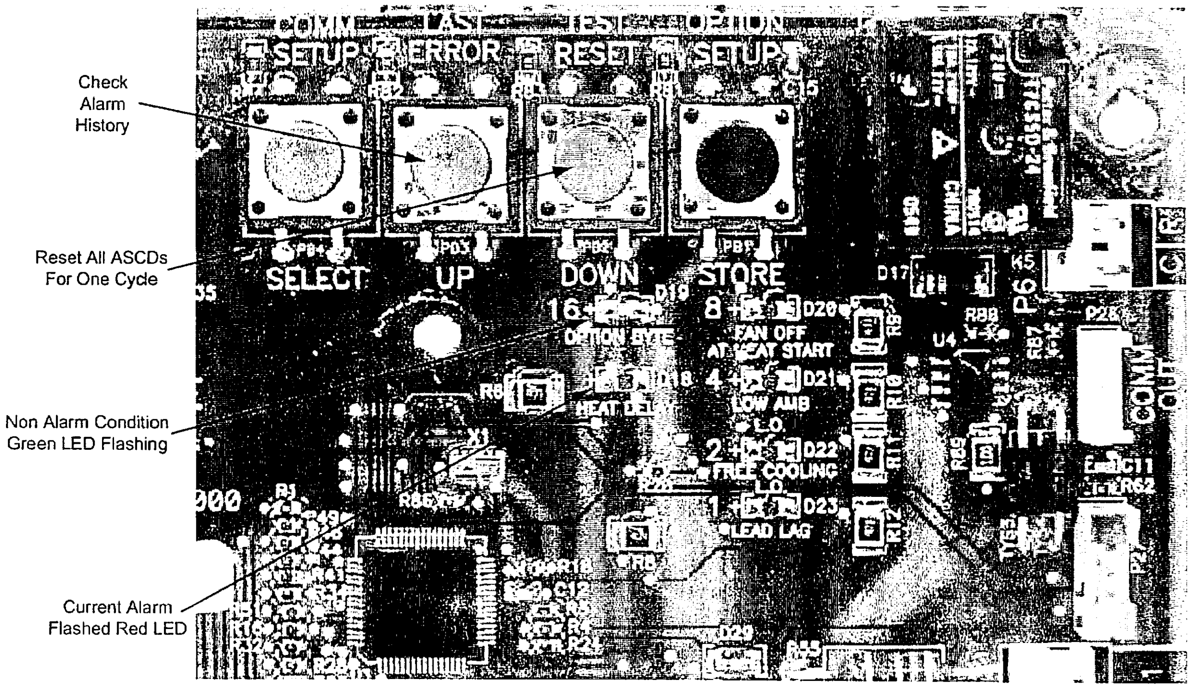


Figure 30: Unit Control Board

Unit Control Board Option Setup

Option Byte Setup

- Enter the Option Setup mode by pushing the OPTION SETUP / STORE button, and holding it for at least 2 seconds.
- The green status LED (Option Byte) will be turned on and the red status LED (Heat Delay) is turned off.
- The 8, 4, 2 and 1 LEDs will then show the status of the 4 labeled options (**(8) Fan Off at Heat Start, (4) Low Ambient Lockout, (2) Free Cooling Lockout**, and **(1) Lead / Lag**).
- Press the UP or Down button to change the LED status to correspond to the desired Option Setup.
- To save the current displayed value, push the OPTION SETUP / STORE button and hold it for at least 2 seconds. When the value is saved, the green LED will flash a few times and then normal display will resume.

NOTE: While in either Setup mode, if no buttons are pushed for 60 seconds, the display will revert to its normal display, exiting the Option Setup mode. **When saving, the control board only saves the parameters for the currently displayed mode (Option Byte or Heat Delay).**

Heat Delay Setup

- Enter the Option Setup mode by pushing the OPTION SETUP / STORE button, and holding it for at least 2 seconds.
- The green status LED (Option Byte) will be turned on and the red status LED (Heat Delay) is turned off.
- Press the COMM SETUP / SELECT button to toggle into the Heat Delay Setup, the green LED will turn off and the red LED for Heat Delay will turn on.
- The 8, 4, 2 and 1 LEDs will then show the status of the Heat Delay, (See Table 26). Press the UP or Down button to change the LED status to correspond to the desired Heat Delay Value.
- To save the current displayed value, push the OPTION SETUP / STORE button and hold it for at least 2 seconds. When the value is saved, the red LED will flash a few times and then normal display will resume.

NOTE: While in either Setup mode, if no buttons are pushed for 60 seconds, the display will revert to its normal display, exiting the Option Setup mode. **When saving, the control board only saves the parameters for the currently displayed mode (Option Byte or Heat Delay).**

Table 26: Heat Delay

Heat Fan On Delay	Heat Fan Off Delay	Red LED 8	Red LED 4	Red LED 2	Red LED 1
60	180	On	On	On	On
60	90	On	On	On	Off
60	60	On	On	Off	On
60	30	On	On	Off	Off
45	180	On	Off	On	On
45	90	On	Off	On	Off
45	60	On	Off	Off	On
45	30	On	Off	Off	Off
30	180	Off	On	On	On
30	90	Off	On	On	Off
30	60	Off	On	Off	On
30	30	Off	On	Off	Off
0	60	Off	Off	On	On
0	30	Off	Off	On	Off
0	10	Off	Off	Off	On
Non-std	Non-std	Off	Off	Off	Off

Optional VAV Control Board Flash Codes

Flash codes are also utilized by the VAV add-on board to aid in troubleshooting optional VAV applications. Flash codes are displayed by a red LED located near the center of the board using a short on/off cycle (approximately 200-ms on and 200-ms off).

To verify that the board is functioning correctly, the LED will display a repetitive 1 second on, 1 second off "heartbeat". Do not confuse this "heartbeat" with the error flash codes shown in the table below. To prevent confusion, a 1-flash, flash code is not used.

Table 27: VAV Control Board Flash Codes

FLASH CODE	DESCRIPTION
On Steady	Control Failure
1 Flash	Not Applicable
2 Flashes	Loss of Communication with UCB
3 Flashes	Space Sensor Failure
4 Flashes	SAT Sensor Failure
5 Flashes	RAT Sensor Failure
6 Flashes	OAT Sensor Failure
7 Flashes	OH Sensor Failure
8 Flashes	RH Sensor Failure
9 Flashes	IAQ Sensor Failure
10 Flashes	OAQ Sensor Failure
11 Flashes	APS Sensor Failure
12 Flashes	Limit 2 Switch Open
13 Flashes	Purge
14 Flashes	VFD Input Failure
15 Flashes	Dirty Filter Switch
OFF	No Power or Control Failure

284810-YIM-D-1008
Supersedes: 284810-YIM-C-0708

Johnson Controls Unitary Products
5005 York Drive
Norman, OK 73069

Vector Industries, Inc.
W220 N1560 Jericho Court, Waukesha WI 53186

BY-PASS FEEDER INSTALLATION & OPERATING INSTRUCTIONS

GENERAL

FA-700 and FA-1000 feeders are designed for 200 psi maximum working pressure.
FA-500 and FA-600 feeders are designed for 300 psi maximum working pressure.
Select valves and fittings to meet working pressure of the system being treated.

Two and five gallon feeders may be used to slug feed powdered or liquid treatments or for use with briquette treatments.

INSTALLATION

Install feeder in accordance with one of three following alternates:

1. Between suction and discharge sides of a pump.
2. On horizontal or vertical piping, using a valve or orifice to create flow through the feeder.
3. Direct to system piping or pump suction using water from a source at higher pressure.

CAUTION: Be sure there is no possibility of chemical backing up into a domestic water supply line.

TO CHARGE FEEDER

1. When using (2) or (5) gallon feeders with briquette treatments - Close inlet and outlet valves and drain by opening valve and petcock. Remove cover and fill with desired number of briquettes. Replace cover, closed drain valve, open inlet and outlet valves, and close petcock after all air has been forced from feeder.

2. When using any feeder with powdered or liquid treatment - Close inlet and outlet valves; drain. Close drain valve, remove cover and fill with liquid or dissolved powdered treatment Replace cover and open inlet and outlet valves.

OPERATION

1. For controlled solution rate, or for continuous feed when using briquette treatments with the (2) gallon or (5) gallon feeders, adjust Flo-Control Valve to give desired rate of flow through the feeder.

2. To slug feed chemical with any feeder, leave inlet and outlet valves wide open until all chemicals are fed to the system being treated. (Note: When slug feed is to be used, Flo- Control Valve can be eliminated from valve requirements.)

NuTone®

INSTALLATION INSTRUCTIONS
READ & SAVE THESE INSTRUCTIONS!

Industrial Paddle Fan

MODELS: PFC-48II & PFC-56II /SERIES

CAUTIONS

WARNING: To reduce the risk of personal injury, do not bend the blade brackets when installing the brackets, balancing the blades, or cleaning the fan. Do not insert foreign objects in between rotating fan blades.

WARNING: To reduce the risk of fire, electric shock, or personal injury, mount to outlet box marked "Acceptable for Fan Support" and use mounting hardware provided with the box.

WARNING: To reduce the risk of fire, electric shock, do not use this fan with any solid-state speed control device.

This product must be mounted and wired in compliance with all local and national electrical codes.

Before wiring the ceiling fan, turn off electric power at the circuit breaker or fuse box and leave off until installation is complete.

Mount outlet box so that it will support at least 35 pounds.

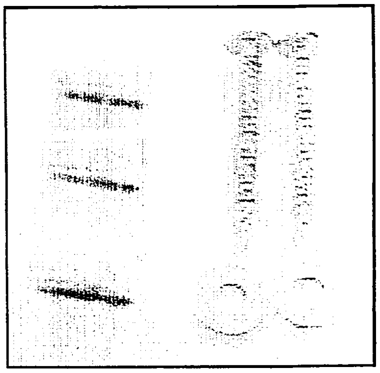
Note: the weight of the fan is as follows:

PFC-48 14 lbs. PFC-56 20 lbs.

LOCATION

1. When fan is installed, you must allow a minimum of 10 feet between floor and bottom of fan blades.
2. For this model, the center of the fan must be located at least 32" from any vertical surface - wall, doors, partitions, etc. This allows minimum clearance for fan blades.
3. Do not mount fan below, next to or between air ducts, beams or any other obstructions which may interfere with the natural air flow pattern created by the fan.
4. Place fans near constantly opening doors and shipping bays to produce an "air shield" effect that helps keep out cold air in winter and dust, odors and insects in the summer.
5. If desired, fans can be installed directly above heat producing machinery to reclaim the heated air.
6. For maximum air flow, fans should be located above aisles in warehouses and storage areas.
7. Make sure fan voltage is compatible with your electrical system.
8. FOR SLOPED CEILING INSTALLATIONS ONLY: Ball and socket mounting system will work on sloped ceilings up to 22° maximum (rise/run = 5/12).

Photo shows hardware included with your new ceiling fan.



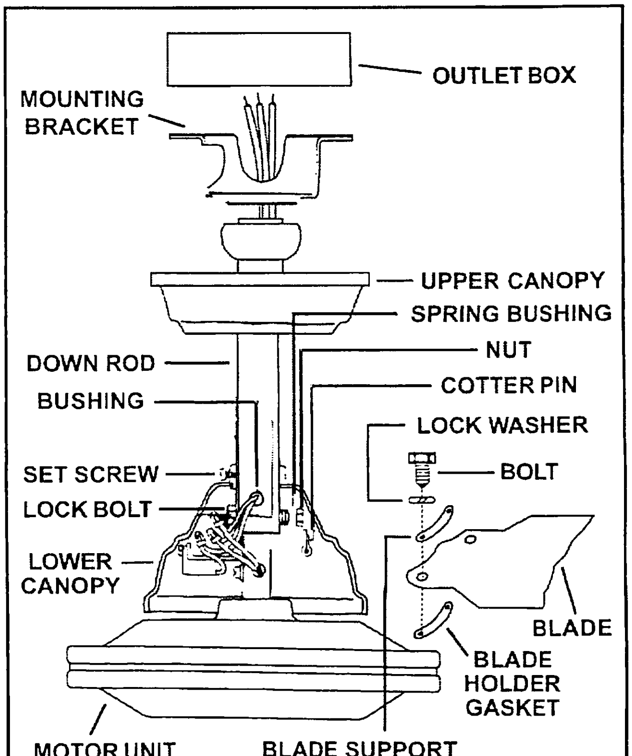


FIGURE 1

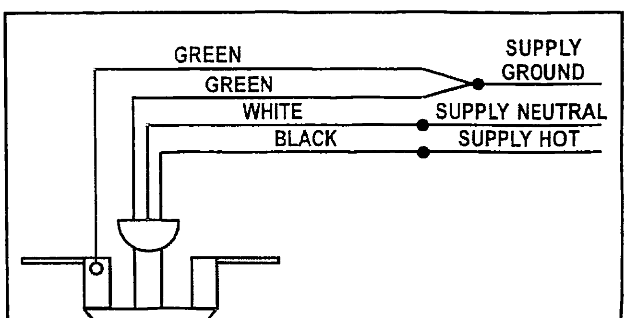


FIGURE 2

HOW TO ASSEMBLE (FIGURE 1 shows fan parts.)

1. Locate upper canopy and remove two (2) screws holding fan mounting bracket in canopy.
2. Locate down rod and remove spring bushing from hole inside of rod and remove set screw from down rod.
3. (FIGURE 3) Place upper canopy and lower canopy on down rod by placing upper canopy over down rod with open end toward plastic ball hanger. Place lower canopy over down rod with open end facing away from plastic ball hanger.
4. Replace spring bushing into hole inside of down rod.
5. (FIGURE 4) Thread the wire from the bushing through the down rod by feeding the white, black and green supply wires from motor through the bushing in the down rod and up through the down rod.
6. Remove cotter pin from bolt on motor shaft. Remove nut, washers and bolt from motor shaft. Slide end of down rod over plastic sleeve on motor shaft so that holes in down rod line up with hole in motor shaft. **(Replace bolt, flat washer, lockwasher, nut and cotter pin). IMPORTANT: Tighten nut until lockwasher is fully compressed. No play or wiggle should be evident between the down rod and the shaft.** Bend out ends of cotter pin to secure. Replace and tighten set screw into down rod that was removed from Step 2.
7. Position lower canopy over motor shaft and wiring until it stops and secure with set screw.
8. Blades may be installed at this time.

   PFC-48 / PFC-56 Remove the two screws, lockwashers, and blade support bracket from motor housing. Leave fiber board gasket in place on motor housing. Place blade, with mounting bracket up, over the gasket and replace the screws, lockwashers, and blade support bracket. Tighten securely. Repeat for each blade.
9. Place black rubber spacers in between the fan hanger bracket and the 4" metal box. Mount the fan hanger bracket to the 4" box marked for fan support. Use the mounting screws or hardware provided with the ceiling box. **IMPORTANT: The ceiling box must be marked as acceptable for fan support.** The box should be securely fastened to the structure so that it will support at least 35 lbs. Supply wiring, 120V, 60 Hz, should be run through a wall switch to the outlet box.
10. Lift fan and place the ball hanger of the fan into the mounting bracket. Rotate down rod until slot in ball hanger engages tab of mounting bracket.
11. Cut off excess length of motor leads allowing 6" of lead to extend into the outlet box. Strip leads approximately 1/4".
12. (FIGURE 2) Connect fan leads to house supply wires using Listed wire connectors. Connect white to white, black to black, and green ground wires from fan and from mounting bracket to the supply ground. After splice connections are made, turn splices upward and carefully push into outlet box with green and white leads on one side of the box and the black leads on the other side of the box.
13. (FIGURE 5) Raise the upper canopy up to the mounting bracket and secure using the two screws removed earlier.
14. Restore electrical power and check for proper operation of the fan.

IMPORTANT SAFEGUARDS

1. Be sure fan is switched off before cleaning it.
2. Keep hands, clothing and other objects away from moving fan blades.
3. Exercise close supervision of children if they are present when fan is operating.
4. Shut off electricity to fan before servicing or working near fan.
5. Do not operate fan if it has been damaged in any manner. Contact your nearest NuTone Authorized Service Center.

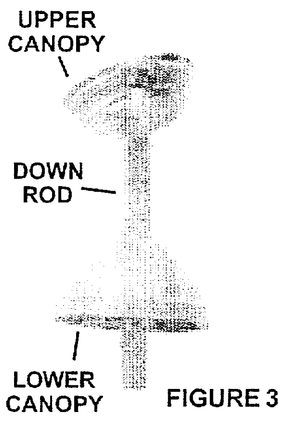


FIGURE 3

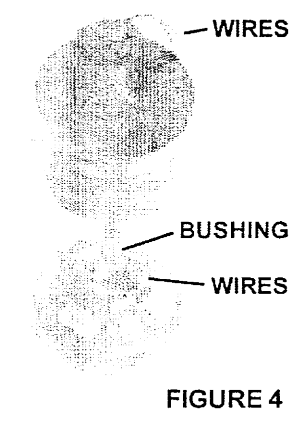


FIGURE 4

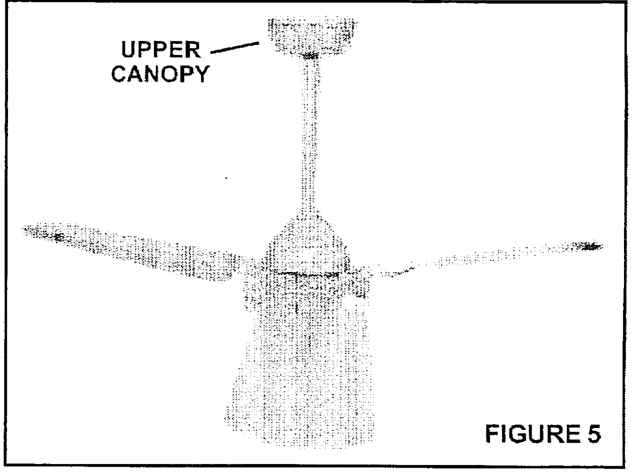


FIGURE 5

NuTone®

Two Year Limited Warranty

WARRANTY OWNER: NuTone warrants to the original consumer purchaser of its products that such products will be free from defects in materials or workmanship for a period of two (2)) years from the date of original purchase. **THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.**

During this two year period, NuTone will, at its option, repair or replace, without charge, any product or part which is found to be defective under normal use and service. THIS WARRANTY DOES NOT EXTEND TO FLUORESCENT LAMP STARTERS OR TUBES. This warranty does not cover (a) normal maintenance and service or (b) any products or parts which have been subject to misuse, negligence, accident, improper maintenance or repair (other than by NuTone), faulty installation or installation contrary to recommended installation instructions.

The duration of any implied warranty is limited to the two year period as specified for the express warranty. Some states do not allow limitation on how long an implied warranty lasts, so the above limitation may not apply to you.

NUTONE'S OBLIGATION TO REPAIR OR REPLACE, AT NUTONE'S OPTION, SHALL BE THE PURCHASER'S SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY. NUTONE SHALL NOT BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH PRODUCT USE OR PERFORMANCE. 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. This warranty supersedes all prior warranties.

WARRANTY SERVICE: To qualify for warranty service, you must (a) notify NuTone at the address stated below or telephone 1/800-543-8687, (b) give the model number and part identification and (c) describe the nature of any defect in the product or part. At the time of requesting warranty service, you must present evidence of the original purchase date.

Date of Installation ____________ Builder or Installer ____________

Model No. and Product Description ____________

IF YOU NEED ASSISTANCE OR SERVICE:

For the location of your nearest NuTone Independent Authorized Service Center:

Residents of the contiguous United States Dial Free 1-800-543-8687

Please be prepared to provide:

Product model number • Date and Proof of purchase • The nature of the difficulty

Residents of Alaska or Hawaii should write to: NuTone Inc. Attn: Department of National Field Service, 4820 Red Bank Road, Cincinnati Ohio 45227-1599.

Residents of Canada should write to: Broan-NuTone Canada, 1140 Tristar Drive, Mississauga, Ontario, Canada L5T 1H9.

Rev. 03/2001

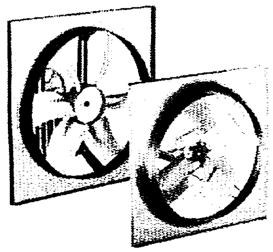
GREENHECK
Building Value in Air.

PN 471755
Sidewall Propeller Fans
Belt Drive, Direct Drive and Reversible
Exhaust, Supply and Filtered Supply

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate, or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

Sidewall Propeller Fans

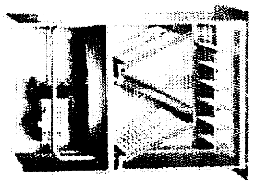


Greenheck's sidewall propeller fan line is the ideal choice for factory and warehouse applications where high volumes of air and low pressures are required. From general ventilation to industrial duty, the range of construction and performance capabilities offered represent the most comprehensive sidewall propeller fan line in the industry.

Performance spans the range between 300 to 87,000 cfm *(510 to 147,814 m^3/hr)* with static pressures to 1.25 in. wg *(249 Pa)*. Fan sizes range from 8 to 54 inches *(203 to 1372 mm)* for direct drive and 20 to 72 inches *(508 to 1829 mm)* for belt drive. Regardless of fan size, performance or duty level, all Greenheck sidewall propeller fans are built to perform with the same high standards of reliability and durability. All models are available in exhaust or supply arrangements.

Models SE1, SS1, SE2, SS2, SCE3, SCS3, SCR3, SBE-1, SBS-1, SBE-2, SBS-2, SBE-3, SBS-3, SBCE, SBCS, and SBCR.

Filtered Supply



Filtered supply wall housings are available in seven sizes for fans ranging from size 24 to 54 inches *(610 to 1372 mm)*. They are designed with the draw-thru concept to achieve the highest filter and fan efficiencies. Permanent 2 inch *(51 mm)* washable filters are accessed through a bolted panel and can be easily removed for cleaning.

General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

DANGER

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

CAUTION

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

CAUTION

Precaution should be taken in explosive atmospheres.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the propeller is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan propeller faster than max cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces, or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

Receiving

Upon receiving the product, check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A *Carrier* Inspection Report should be filled out by the carrier upon arrival and reported to the Traffic Department. If damaged upon arrival, file a claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Note: The filtered supply unit ships with all ordered components completely factory assembled. The optional weatherhood ships knocked down for field assembly and installation.

Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

INDOOR

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F *(-1° to 43°C)*, wide temperature swings may cause condensation and "sweating" of metal parts. All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice, or snow and wipe dry before moving to indoor storage. To avoid "sweating" of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to remove any moisture build up. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ inches *(89 mm)* off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

OUTDOOR

Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles. Fan wheels should be blocked to prevent spinning caused by strong winds.

Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the fan equipment goes into operation.

Pre-Installation Checks

- Check chart below for correct wall opening dimensions.
- Check motor voltage and amperage rating for compatibility with electrical supply. Supply wiring must be properly fused and conform to local and national codes.
- Motor load amperage must be checked and compared to nameplate rating to avoid serious damage to motor when speed is increased.

Wall Opening Requirements

Wall opening size and propeller-to-damper distance are two important dimensions for fan installation.

Fans mounted to the wall require a different wall opening (W.O.) size than those mounted in collars or wall housings. Propeller-to-damper distance (M) is important to reduce turbulence and damper flutter which may lead to premature damper failure.

Figure 1 and 2 show the wall opening (W.O.) required for installations with either a wall housing or collar.

Figure 3 shows the recommended wall opening (W.O.) and the minimum distance (M) suggested between the fan and damper for direct to wall installations.

Figure 4 shows the dimensions and wall opening (W.O.) required for installations with a filtered supply wall housing.

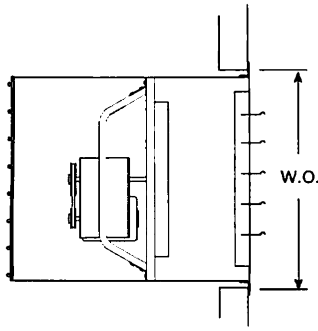


Figure 1 - Wall Housing Installation

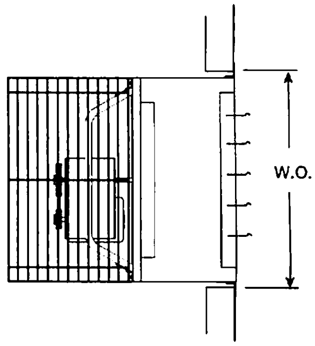


Figure 2 - Wall Collar Installation

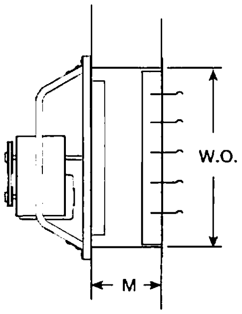


Figure 3 - Direct to Wall Installation

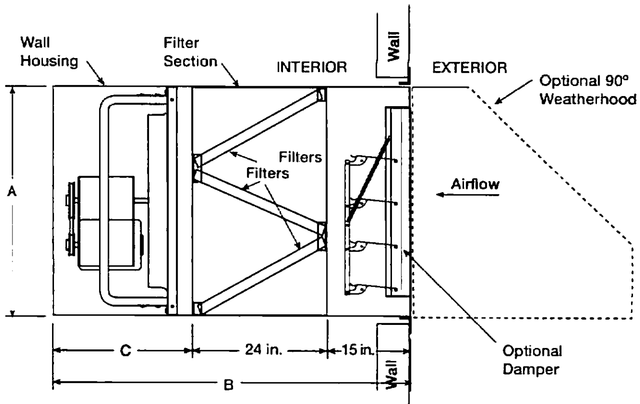


Figure 4 - Filtered Supply Wall Housing Installation

Fan Size	Damper Size Square	Recommended Wall Opening (W.O.) Square			M Minimum	Filtered Supply Wall Housing Only				
		Figures 1 and 2	Figure 3	Figure 4		A	B	C	Filter Quantity & Size	
8	10 *(254)*	14¼ *(362)*	10½ *(267)*	-	6 *(152)*	-	-	-		-
10	12 *(305)*	16¼ *(413)*	12½ *(318)*	-	6 *(152)*	-	-	-		-
12	14 *(356)*	19¼ *(489)*	14½ *(368)*	-	7 *(178)*	-	-	-		-
14	16 *(406)*	21¼ *(540)*	16½ *(419)*	-	8 *(203)*	-	-	-		-
16	18 *(457)*	23¼ *(591)*	18½ *(470)*	-	9 *(229)*	-	-	-		-
18	20 *(508)*	25¼ *(641)*	20½ *(521)*	-	10 *(254)*	-	-	-		-
20	22 *(559)*	27¼ *(692)*	22½ *(572)*	-	12 *(305)*	-	-	-		-
24	26 *(660)*	33¾ *(857)*	26½ *(673)*	33¾ *(857)*	13 *(330)*	32¼ *(819)*	63 *(1600)*	24 *(610)*	4	23¼ x 16¼ *(591 x 413)*
30	32 *(813)*	39¾ *(1010)*	32½ *(826)*	39¾ *(1010)*	13 *(330)*	38¼ *(972)*	65 *(1651)*	26 *(660)*	4	24⅝ x 19¼ *(625 x 489)*
36	38 *(965)*	45¾ *(1162)*	38½ *(978)*	45¾ *(1162)*	14 *(356)*	44¼ *(1124)*	67¼ *(1708)*	28¼ *(718)*	6	23¼ x 22⅛ *(591 x 562)*
42	44 *(1118)*	51¾ *(1314)*	44½ *(1130)*	51¾ *(1314)*	15 *(381)*	50⅛ *(1273)*	72⅞ *(1851)*	34 *(864)*	6	24⅛ x 25⅛ *(613 x 638)*
48	50 *(1270)*	57¾ *(1467)*	50½ *(1283)*	57¾ *(1467)*	16 *(406)*	56⅛ *(1426)*	72⅞ *(1851)*	34 *(864)*	12	23¼ x 18¾ *(591 x 476)*
54	56 *(1422)*	63¾ *(1619)*	56½ *(1435)*	63¾ *(1619)*	17 *(432)*	62⅜ *(1584)*	79¹¹⁄₁₆ *(2024)*	40¹¹⁄₁₆ *(1033)*	12	23¼ x 20¾ *(591 x 527)*
60	62 *(1575)*	69¾ *(1772)*	62½ *(1588)*	-	19 *(483)*	-	-	-		-
72	74 *(1880)*	84¾ *(2153)*	74½ *(1892)*	-	19 *(483)*	-	-	-		-

All dimensions given in inches *(millimeters)*. Filters are 2 inch *(51 mm)* nominal thickness. Above filter sizes are actual dimensions.

WARNING

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

Typical Installation

Move fan to the desired location and determine the method by which the fan is to be mounted as shown in Figures 1-4 shown on page 3. Optional wall mount housings (Figure 1) and wall mount collars (Figure 2) provide a convenient means of mounting sidewall propeller fans while maintaining the proper distance between propeller and damper.

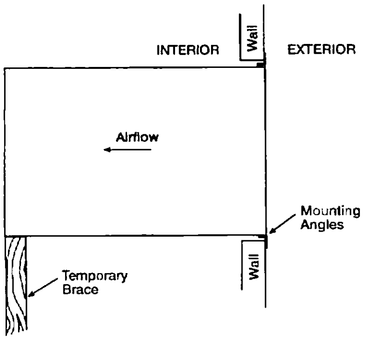
Attach the fan by inserting a suitable fastener through each of the prepunched mounting holes in the fan panel. Care should be taken not to bend or distort the fan panel or drive components during installation.

Support Braces

Wall Housing sizes 42 and larger with heavy motors and all Filtered Supply Wall Housings need additional bracing.

Filtered Supply Wall Housing Installation

Step 1 Install Housing

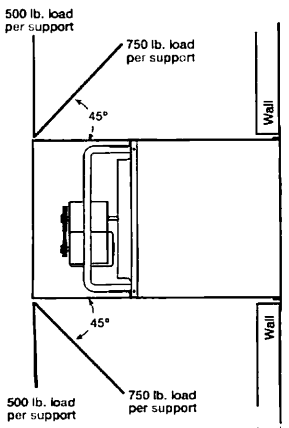


Install housing through wall opening from outside.

Temporarily brace end of unit until permanent support braces are installed.

Secure through prepunched holes in angles with suitable fasteners.

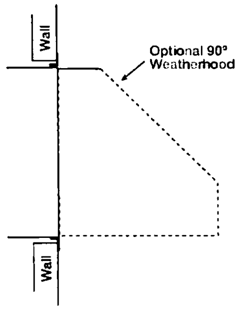
Step 2 Install Support Braces



Choose method of support. Attach support to end of unit (above or below housing) with rods, cable, angle, etc. (supplied by others) as shown.

Vertical braces must carry a minimum load of 500 pounds per support, and angled (45°) braces a minimum of 750 pounds per support based on two supports.

Step 3 Install Weatherhood

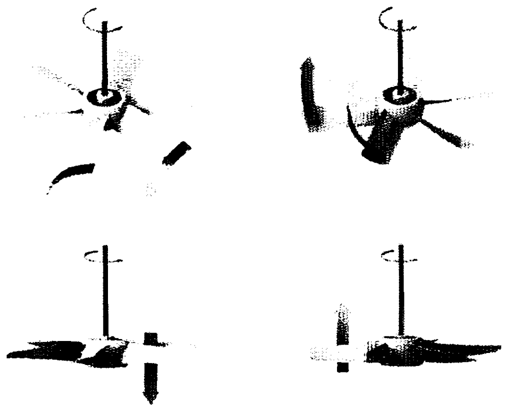


Position weatherhood over end of wall housing and fasten through mounting holes with self-tapping screws. Caulk, flash and complete electrical hook-up to finish installation.

Pre-Starting Checks

Check all fasteners and setscrews for tightness. This is especially important for bearing setscrews.

The propeller should rotate freely and not rub on the fan panel venturi. Rotation direction of the propeller should be checked by momentarily turning the unit on. Propeller blade should cup and throw the air when rotating in the correct rotation as shown in the figure below. Rotation should be in the same direction as the rotation decal affixed to the unit.



For 3-phase installations, fan rotation can be reversed by simply interchanging any two of the three electrical leads. For single-phase installations follow the wiring diagram located on the motor.

For Belt Drive Fans: The adjustable motor pulley is preset at the factory for the specified fan RPM. Fan speed can be increased by closing or decreased by opening the adjustable pulley. Two or three groove variable pitch pulleys must be adjusted an equal number of turns open. Any increase in fan speed represents a substantial increase in horsepower required from the motor. Always check motor load amperage and compare to nameplate rating when changing fan speed.

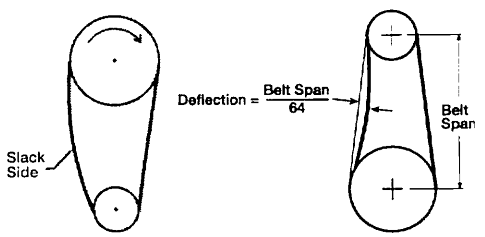
Routine Maintenance

Once the fan has been put into operation, a periodic maintenance program should be set up to preserve the reliability and performance of the fan. Items to be included in this program are: Belts, Bearings, Fasteners and Setscrews, Lubrication, and Removal of Dust and Dirt.

WARNING
Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

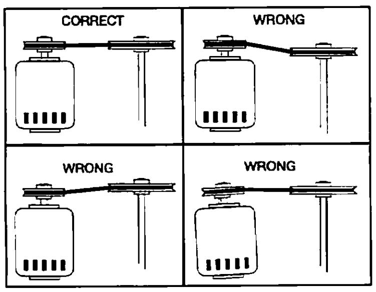
Belts

Premature belt failures are frequently caused by improper belt tension (either too tight or too loose) or misaligned pulleys. The proper tension for operating a V-belt is the lowest tension at which the belts will not slip at peak load conditions. For initial tensioning, the proper belt deflection halfway between pulley centers is 1/64 inch *(0.4 mm)* for each inch of belt span. For example, if the belt span is 64 inches *(1626 mm)*, the belt deflection should be one inch *(25 mm)* using moderate thumb pressure at midpoint of the drive. See figure shown below.



Check belt tension two times during the first 24 hours of operation and periodically thereafter. To adjust belt tension, simply loosen four fasteners (two on each side of the motor plate) and slide the motor plate away from the fan shaft until proper belt tension is attained. On some fans, fasteners attaching the motor to the motor plate must be loosened in order to adjust the belt.

It is very important that the drive pulleys remain in proper alignment after adjustments are made. Misalignment of pulleys will result in premature belt wear noise, vibration and power loss.



Bearings (For belt drive fans only)

Bearings are the most critical moving part of the fan and should be inspected at periodic intervals. Locking collars and setscrews, in addition to fasteners attaching the bearings to the bearing plate, must be checked for tightness. In a clean environment and temperatures above 32°F *(0°C)* and below 200°F *(93°C)*, fan shaft bearings with grease fittings should be lubricated semi-annually using a high-quality lithium based grease. If unusual environmental conditions exist, temperatures below 32°F *(0°C)* and above 200°F *(93°C)*, moisture or contaminants, more frequent lubrication is required.

With the unit running, add grease very slowly with a manual grease gun until a slight bead of grease forms at the seal. Be careful not to unseat the seal by over lubricating or using excessive pressure. Bearings without grease fittings are lubricated for life.

Fasteners and Setscrews

Any fan vibration has a tendency to loosen mechanical fasteners. A periodic inspection should include checking all fasteners and setscrews for tightness. Particular attention should be paid to setscrews or taper-lock bushings attaching the propeller to the motor shaft and the motor shaft to the bearings. Loose bearing setscrews will lead to premature failure of the fan shaft. In addition, check all fasteners attaching the motor to the motor plate.

Lubrication

Refer to the paragraph on bearings for bearing lubrication. Many fractional horsepower motors installed on the smaller fans are lubricated for life and require no further attention. Motors equipped with oil holes should be oiled in accordance with the manufacturer's instructions printed on the motor. Use a high grade SAE 20 machine oil and use caution not to over lubricate. Motors supplied with grease fittings should be greased according to directions printed on the motor.

Removal of Dust and Dirt

Dirt clogs cooling openings on the motor housing, contaminates bearing lubricant and collects on propeller blades causing severe imbalance if left unchecked. The exterior surface of the motor, fan panel and entire propeller should be thoroughly cleaned periodically. Use caution and do not allow water or solvents to enter the motor or bearings. Motors or bearings must not be sprayed with steam or water.

The filters also require periodic cleaning. The 2 inch *(51 mm)* washable aluminum filters are accessed through the bolted access panel.

Troubleshooting

WARNING: Before taking any corrective action, make certain unit is not capable of operation during repairs.

PROBLEM	CAUSE	CORRECTIVE ACTION
Too Much Airflow	Resistance lower than designed	Decrease fan speed.
Reduced Airflow	System resistance too high	Check backdraft dampers for proper operation. Remove obstructions in ductwork. Clean dirty filters. Check for adequate supply air for exhaust fans or exhaust air for supply fans.
	Fan too close to damper	Increase distance between fan and damper.
	Fan speed too low	Increase fan speed.
	Excessive dirt buildup on propeller	Clean propeller.
Excessive Noise	Bearings	Tighten collars and fasteners. Lubricate bearings. Replace defective bearings.
	V-Belt drive	Tighten pulleys on motor and fan shaft. Adjust belt tension. Align pulleys properly. Replace worn belts or pulleys. See Maintenance.
	Excessive vibration	Clean dirt buildup from propeller. Check all setscrews and fasteners for tightness. Check for worn bearing. Correct propeller imbalance. Check for loose dampers, guards or ductwork.
	Defective motor	Replace motor.
	Variable Frequency Drive (VFD)	Check VFD for drive setting, some controllers are able to be adjust to lower the harmonic noises sometimes heard during operation by adjusting a simple setting on the controller.
	Debris	Remove all debris from the fan.
Fan Does Not Operate	Electrical Supply	Check fuses/circuit breakers. Check for switches turned off or disconnected. Check for correct supply voltage.
	Drive	Check for broken or worn belts. Tighten loose pulleys.
	Motor	Assure motor is correct horsepower and not tripping overload protector.

Maintenance Documentation

Job Information

Job Name: ____________

Address: ____________

City: ____________

State: ________ Zip: ________

Phone: ____________

Contact Person: ____________

Service Organization: ____________

Address: ____________

City: ____________

State: ________ Zip: ________

Phone: ____________

Work Done By: ____________

Nameplate Information

Model: ____________

Volts: ______ Hertz: ______ Phase: ______

Amps: ______ Mark: ______

Supply hp: ______ Exhaust hp: ______

Serial Number: ____________

Model Voltage: ____________

Motor Amperage: ____________

Fan RPM: ____________

Field Start-Up Documentation

Actual Voltage: ______ Hertz: ______ Phase: ______

Actual Amperage: ____________

Blower Rotation: ____________

Air Volume: Design cfm: ____________

Actual cfm: ____________

Level of fan (L or H): ____________

Fan RPM Range (min.) ______ (max.) ______

Parts List

NOTE

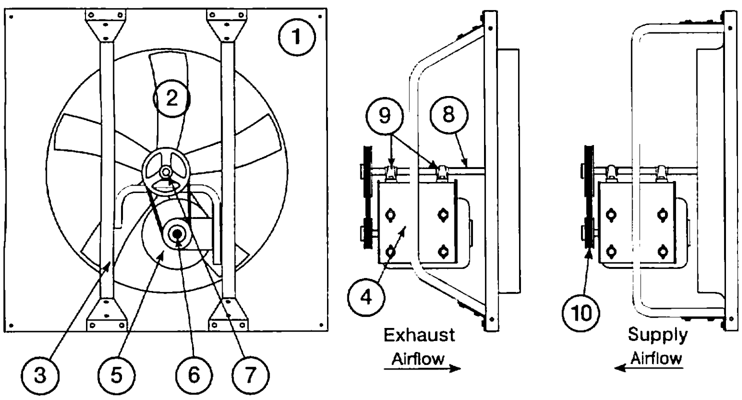
Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

CAUTION

A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof.

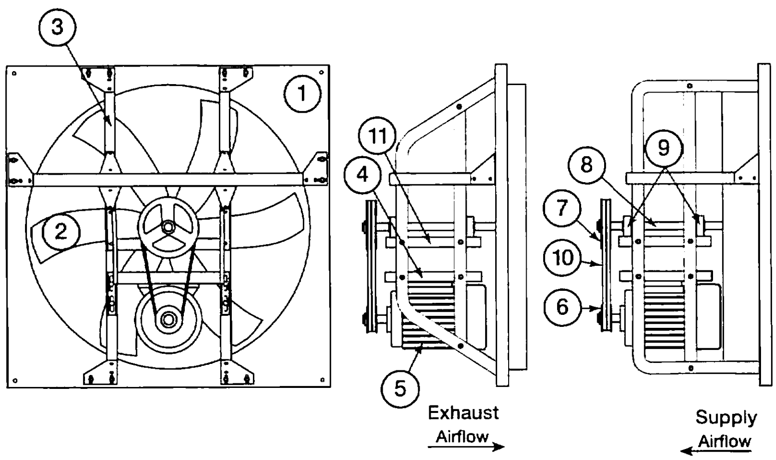
Parts List - Belt Drive

SBE-1, SBS-1, SBE-2 and SBS-2 (L and H propellers)



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor/Bearing Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt

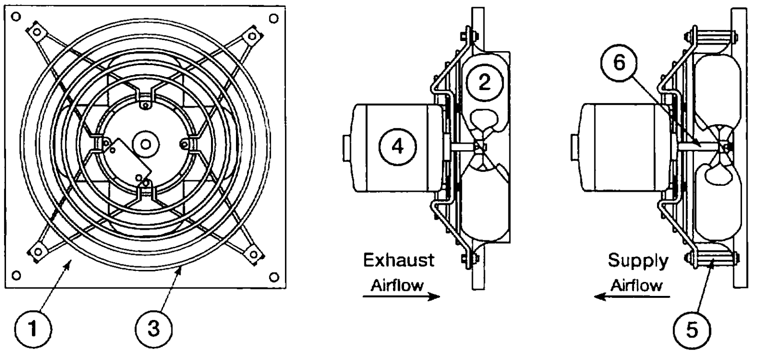
SBE-3, SBS-3, SBCE, SBCS, and SBCR (L and H propellers)



1. Fan Panel
2. Propeller
3. Drive Frame Channel (2)
4. Motor Plate
5. Motor
6. Motor Pulley
7. Shaft Pulley
8. Fan Shaft
9. Bearings (2)
10. Belt
11. Bearing Plate

Parts List - Direct Drive

SE1 and SS1 (Sizes 8 thru 12 - D, G and E motor speeds)

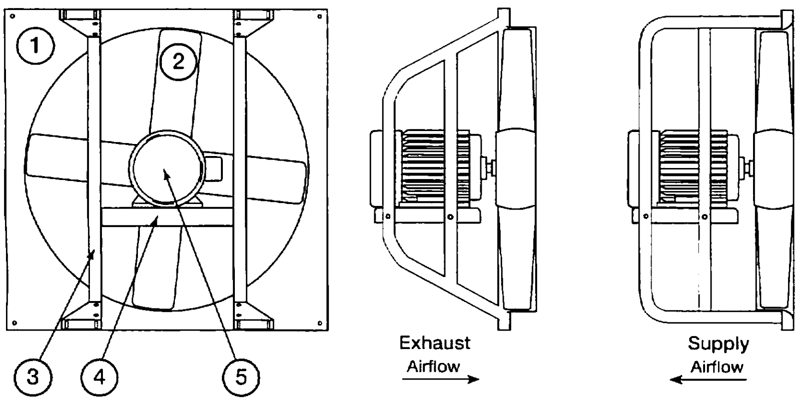


1. Fan Panel
2. Propeller
3. Drive Frame/Motor Support
4. Motor
5. Riser Blocks (4) - supply fan only
6. Shaft Extension- supply fan only

SE1 and SS1 (Sizes 12 thru 24 - A, B and C motor speeds)

SE2 and SS2

SCE3, SCS3 and SCR3



1. Fan Panel
2. Propeller
3. Drive Frame Channels (2)
4. Motor Plate
5. Motor

Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Greenheck Catalog Sidewall Propeller Fans provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at: www.amca.org.

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PN 471558

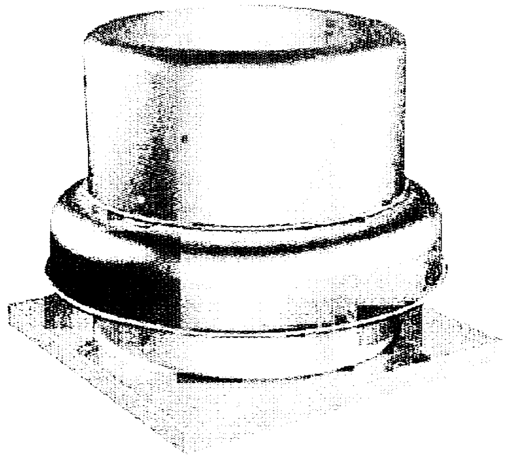
Downblast Centrifugal Roof Exhaust Fans

Installation, Operation and Maintenance Manual

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Model G Direct Drive

Model G is a direct drive downblast centrifugal exhaust fan. These fans are specifically designed for roof mounted applications exhausting relatively clean air. Performance capabilities range up to 4,300 cfm *(7,305 m^3/hr)* and up to 1 in. wg *(249 Pa)* of static pressure. The maximum continuous operating temperature is 180°F *(82°C)*. G models are available in sixteen sizes with nominal wheel diameter ranging from 8 to 18 inches *(203 to 457 mm)* (060 - 180 unit sizes). Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number. All fans are UL/cUL listed Standard 705.



Model GB Belt Drive

GB Model Fans are belt drive downblast centrifugal exhaust fans. These fans are specifically designed for roof mounted applications exhausting relatively clean air. Performance capabilities range up to 44,700 cfm *(75,950 m^3/hr)* and up to 2.5 in. wg *(623 Pa)* of static pressure. The maximum continuous operating temperature is 180°F *(82°C)*. GB models are available in twenty sizes with nominal wheel diameters ranging from 11 to 54 inches *(279 to 1372 mm)* (071-540 unit sizes). Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number. All fans are UL/cUL listed Standard 705.

General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if high winds or seismic activity are present. If more information is needed, contact a licensed professional engineer before moving forward.

DANGER
Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

CAUTION
When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

CAUTION
Precaution should be taken in explosive atmospheres.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the wheel is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan wheel faster than max cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

Receiving

Upon receiving the product check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A Carrier Inspection Report should be filled out by the carrier upon arrival and reported to the Traffic Department. If damaged upon arrival, file a claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Handling

G Direct Drive

Lift unit on to the roof utilizing hooks under the lip of the shroud. Evenly space the hooks around the shroud using a minimum of four lifting straps. Use a spreader bar to ensure the straps do not come in contact with the unit (see figure 1).

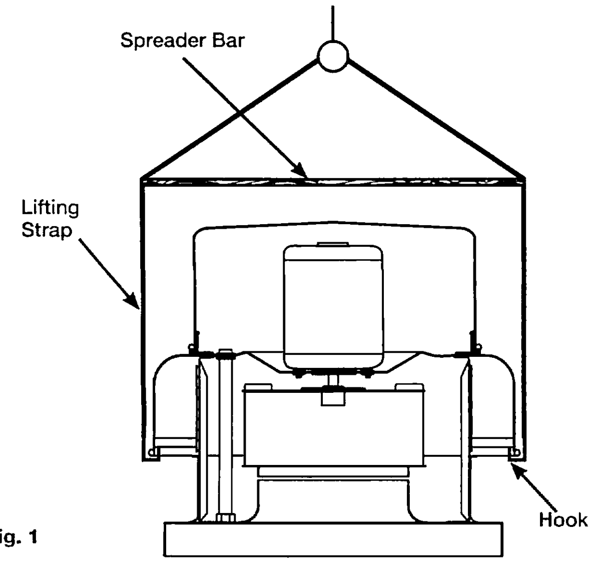


Fig. 1

GB Belt Drive

When lifting the unit on to the roof, use either the four lifting points on the drive frame or the two lifting points on the bearing plate if present (see figure 2 for lifting points). Access to the drive frame is accomplished by removing the screws pointed out in figure 3. The cover can then be removed and placed on a flat surface in an area protected from strong winds.

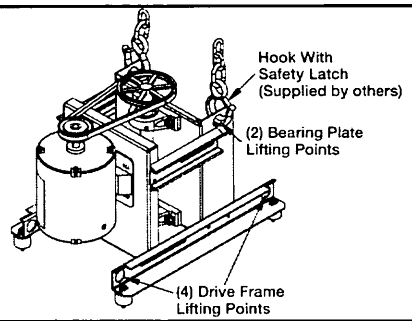


Fig. 2

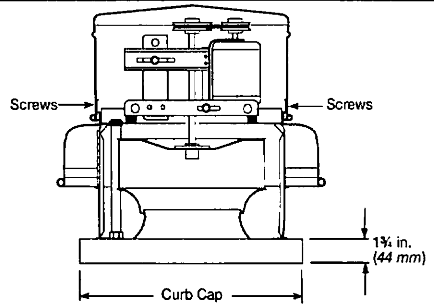


Fig. 3

When G/GB unit is on the roof, move fan to desired location using lifting points and fasten securely through mounting holes in base. Shims may be necessary depending upon roofing material thickness.

The motor amperage and voltage ratings must be checked for compatibility to supply voltage prior to final electrical connection. For G/GB installations, the electrical supply should be routed through the conduit chase located between the curb cap and the bottom of the motor compartment. Wiring must conform to local and national codes.

Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

Indoor

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F *(-1° to 43°C)* (wide temperature swings may cause condensation and "sweating" of metal parts). All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice or snow and wipe dry before moving to indoor storage. To avoid "sweating" of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to get rid of any moisture buildup. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ inches *(89 mm)* off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

Outdoor

Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed.

The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so that it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so that rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles.

Fan wheels should be blocked to prevent spinning caused by strong winds.

Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the fan equipment goes into operation.

Installation

WARNING

Installation, troubleshooting and parts replacement is to be performed only by qualified personnel.

WARNING

Disconnect power before installing or servicing.

Typical Roof Mounting Installation

1. On the roof surface, cut an appropriate sized hole and follow manufacturer's instructions on curb installation. Caulk and flash the curb to ensure a water tight seal.
2. If unit is equipped with a backdraft damper, it should be installed now.
3. Remove motor cover. Access to the motor compartment is accomplished by removing the screws as shown in figure 3.
4. Only on GB Belt Drive fans. On the drive frame use the lifting lugs to lift and place the unit on top of roof curb. (Refer to figure 2 on page 2).
5. Secure fan to curb using a minimum of eight lug screws, metal screws or the suitable fasteners. Shims may be required depending upon curb installation and roofing material.
6. Verify power line wiring is de-energized before connecting fan motor to power source.
7. Connect power supply wiring to the motor as indicated on the motor nameplate or terminal box cover. Check the power source for compatiblity with the requirements of your equipment.
8. Check fan wheel for free rotation, re-center if necessary.
9. Check all fasteners for tightness.
10. Mount and wire safety disconnect switch under motor cover. Wire control switches at ground level, refer to figure 4.
12. Replace motor cover.

Typical Wiring Diagram

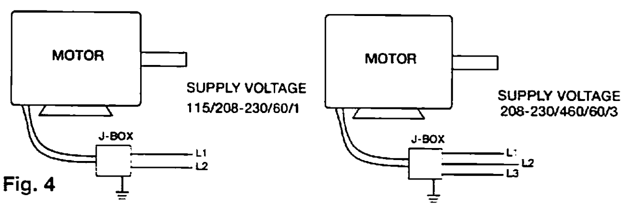


Fig. 4

G - Direct Drive

Model	Curb Cap	Damper	Roof Opening	*Approx. Weight
G 060, 065, 070, 075	17 (*432*)	8 (*203*)	10½ (*267*)	18 (*8*)
G 080, 085, 090, 095	17 (*432*)	10 (*254*)	12½ (*318*)	26 (*12*)
G 101, 121	19 (*483*)	12 (*305*)	14½ (*368*)	43 (*20*)
G 131,141	22 (*559*)	16 (*406*)	18½ (*470*)	58 (*26*)
G 150	26 (*660*)	16 (*406*)	18½ (*470*)	59 (*27*)
G 160, 170	30 (*762*)	18 (*457*)	20½ (*521*)	81 (*37*)
G 180	30 (*762*)	18 (*457*)	20½ (*521*)	118 (*54*)

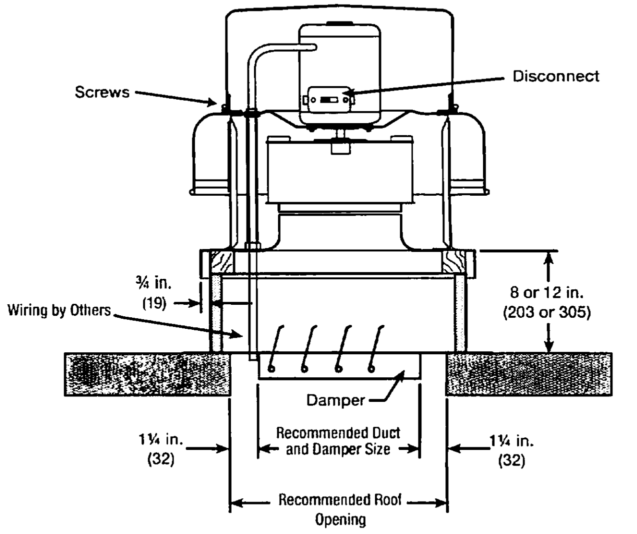
GB - Belt Drive

Model	Curb Cap	Damper	Roof Opening	*Approx. Weight
GB 071, 081, 091	19 (*483*)	12 (*305*)	14½ (*368*)	58 (*26*)
GB 101, 101HP	19 (*483*)	12 (*305*)	14½ (*368*)	63 (*29*)
GB 121	19 (*483*)	12 (*305*)	14½ (*368*)	66 (*30*)
GB 131	19 (*483*)	12 (*305*)	14½ (*368*)	67 (*30*)
GB 141, 141HP	22 (*559*)	16 (*406*)	18½ (*470*)	83 (*38*)
GB 161, 161HP	22 (*559*)	16 (*406*)	18½ (*470*)	89 (*40*)
GB 180, 180HP	30 (*762*)	18 (*457*)	20½ (*521*)	125 (*57*)
GB 200, 200HP	30 (*762*)	18 (*457*)	20½ (*521*)	138 (*63*)
GB 220, 240, 220HP	34 (*864*)	24 (*610*)	26½ (*673*)	158 (*72*)
GB 260	40 (*1016*)	30 (*762*)	32½ (*826*)	305 (*138*)
GB 300, 300HP	40 (*1016*)	30 (*762*)	32½ (*826*)	320 (*145*)
GB 330	46 (*1168*)	36 (*914*)	38½ (*978*)	385 (*175*)
GB 360, 360HP	46 (*1168*)	36 (*914*)	38½ (*978*)	403 (*183*)
GB 420	52 (*1321*)	42 (*1067*)	44½ (*1130*)	495 (*225*)
GB 480	52 (*1321*)	48 (*1219*)	50½ (*1283*)	623 (*283*)
GB 500	64 (*1626*)	54 (*1372*)	56½ (*1435*)	687 (*312*)
GB 540	64 (*1626*)	54 (*1372*)	56½ (*1435*)	748 (*339*)

- *All dimensions are in inches (millimeters). *Approximate weight shown in pounds (kilograms) is the largest cataloged Open Drip Proof motor.*
- *The roof curb should be 1½ in. (38 mm) less than the curb cap to allow for roofing and flashing.*

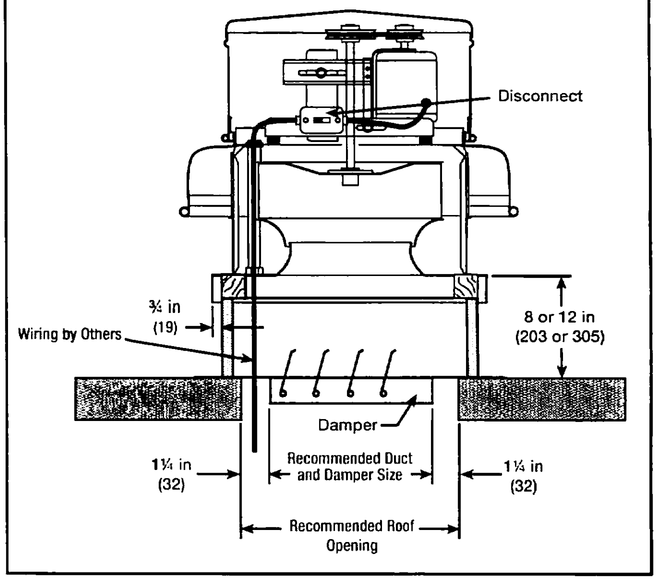
G Direct Drive

Fig. 5 - Typical Roof Mounting Installation



GB Belt Drive

Fig. 6 - Typical Roof Mounting Installation



Pre-Starting Checks

1. Check all fasteners and set screws for tightness. The wheel should rotate freely and be aligned as shown in figure 7 on page 5.
2. Wheel position is preset and the unit is test run at the factory. Movement may occur during shipment and realignment may be necessary.
3. Only G unit - Centering height alignment can be accomplished by loosening the set screws in the wheel and moving the wheel to the desired position.
4. Only GB unit - Centering can be accomplished by loosening the bolts holding the drive frame to the shock mounts and repositioning the drive frame.
5. Only GB unit - Wheel and inlet cone overlap can be adjusted by loosening the set screws in the wheel and moving the wheel to the desired position.
6. Only GB unit - Fan RPM should be checked and verified with a tachometer.
7. Check wheel rotation (viewing from the shaft side) by momentarily energizing the unit. On a G unit the rotation should correspond to the rotation decal on the unit, see figure 8. On a GB unit rotation should be clockwise as shown in figure 8 and correspond to rotation decal on the unit. If wheel rotation is incorrect reverse two of the wiring leads or check motor wiring for single phase.

Wheel Overlap and Gap Dimensions

Model	G - Overlap in. (mm)	H - Gap in. (mm)
G 060-095	-	3/32 (2)
G 101-180	-	1/4 (6)
GB 071-161	1/4 (6)	-
GB 180-240	3/8 (10)	-
GB 260-540	1/2 (13)	-

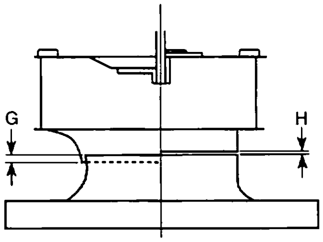
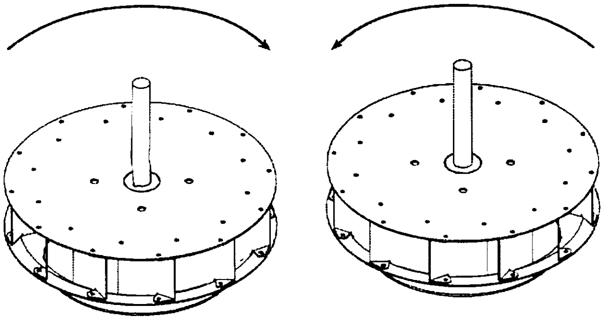


Fig. 7

Wheel Rotation



Clockwise Airflow
G 060-131
All GB Models

Counterclockwise Airflow
G 141-180

Fig. 8

WARNING

Correct direction of wheel rotation is critical. Reversed rotation will result in poor air performance, motor overloading and possible burnout.

WARNING

The fan has been checked for mechanical noises at the factory prior to shipment. If mechanical noise should develop, suggested corrective actions are offered in the Troubleshooting section.

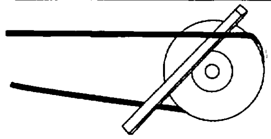
IMPORTANT

Over tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at startup and uneven wear.

Model GB
Pre-Starting Belt Tension Checks

8. Always loosen tension enough to install belts without stretching, see figure 9.
9. For units with two groove pulleys, adjust so the tension is equal in both belts.

Belts



Do not force belt(s). Forcing the belt(s) will break the cords and cause belt failure

Fig. 9

10. If adjustments are made, it is very important to check the pulleys for proper alignment. Misaligned pulleys lead to excessive belt wear vibration, noise and power loss, see figure 10.

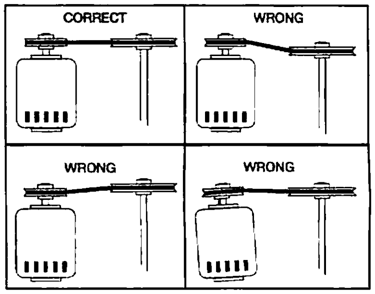


Fig. 10

11. Belt tension can be adjusted by loosening four fasteners on the drive frame, see figure 11. The motor plate slides on the slotted adjusting arms and drive frame angles in the same manner.

Fasteners

*(4) *Fasteners*

**Identical fasteners on opposing side must also be loosened.*

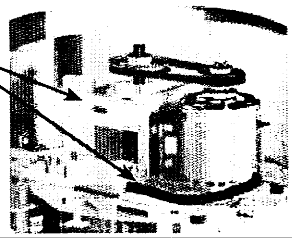


Fig. 11

12a. Sizes 071-161: Belts should be tensioned just enough to prevent slippage at full load.
Note: Belts should have a slight bow on the slack side while running at full load (see figure 12a).

12b. Sizes 180-540: Belt tension should be adjusted to allow 1/64 in. *(0.397 mm)* of deflection per inch of belt span. For example, a 15 in. *(381 mm)* belt span should have 15/64 in. *(0.234 mm)* (or about 1/4 in. *(6 mm)*) of deflection with moderate thumb pressure at mid-point between pulleys (see figure 12b).

Deflection

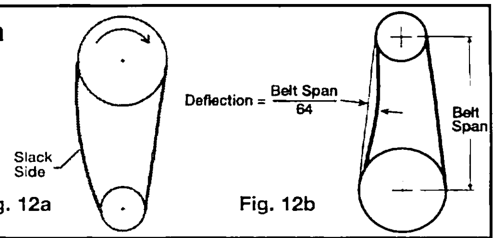


Fig. 12a Fig. 12b

13. The adjustable motor pulley is factory set for the RPM specified. Speed can be increased by closing or decreased by opening the adjustable motor pulley.

14. Any increase in speed represents a substantial increase in the horsepower required by the unit.
15. Motor amperage should always be checked to avoid serious damage to the motor when speed is varied.

Operation: G / GB

1. Before starting up or operating fan, check all fasteners for tightness. In particular, check the setscrews in wheel hub.
2. While in the OFF position or before connecting the fan to power, turn the fan wheel by hand to be sure it is not striking the venturi or any obstacle.
3. Start the fan and shut it off immediately to check rotation of the wheel with directional arrow in the motor compartment.
4. When the fan is started, observe the operation and check for any unusual noises.
5. With the system in full operation and all ductwork attached, measure current input to the motor and compare with the nameplate rating to determine if the motor is operating under safe load conditions.
6. Keep inlets and approaches to fan clean and free from obstruction.

IMPORTANT

Adjust (tighten) belt tension after the first 24-48 hours of operation.

Inspection

Inspection of the fan should be conducted at the first 30 minute and 24 hour intervals of satisfactory operation.

30 Minute Interval

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

24 Hour Interval

Check all internal components. On GB unit only, inspect belt alignment and tension. Adjust and tighten as necessary.

Maintenance: G / GB

Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations and who are experienced with this type of equipment.

Motor maintenance is generally limited to cleaning and lubrication (where applicable). Cleaning should be limited to exterior surfaces only. Removing dust buildup on motor housing ensures proper motor cooling.

WARNING

Always disconnect, lock and tag power source before servicing. Failure to disconnect power source can result in fire, shock or serious injury.

Greasing of motors is only intended when fittings are provided. Many fractional horsepower motors are permanently lubricated and should not be lubricated after installation. Motors supplied with grease fittings should be greased in accordance with manufacturers' recommendations. Where motor temperatures do not exceed 104°F *(40°C)*, the grease should be replaced after 2,000 hours of running time as a general rule.

Wheels require very little attention when moving clean air. Occasionally, oil and dust may accumulate causing imbalance. When this occurs the wheel and housing should be cleaned to ensure smooth and safe operation.

All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.

A proper maintenance program will help these units deliver years of dependable service.

CAUTION

Uneven cleaning of the wheel will produce an out of balance condition that will cause vibration in the fan.

WARNING

This unit should be made non-functional when cleaning the wheel or housing (fuses removed, disconnect locked off).

Belt/Bearing Maintenance GB Unit

1. Belts tend to stretch after a period of time. They should be checked periodically for wear and tightness. When replacing belts, use the same type as supplied with the unit.
2. Matched belts should always be used on units with multi-groove pulleys.
3. For belt replacement, loosen the tensioning device enough to allow removal of the belt by hand.
4. Once installed, adjust belts as shown in "Pre-Starting Checks."
5. Shaft bearings can be classified in two groups: relubricating and non-relubricating. All non-relubricating bearings on standard model GB fans are factory lubricated and require no further lubrication under normal use (between -20° to 180°F *(-29° to 82°C)* in a relatively clean environment).
6. On GB belt driven fans, the standard cast pillow block bearings are factory lubricated and are provided with external grease fittings. Annual lubrication is recommended, or more frequently if needed (see Table 2 on page 7). Do not over-grease. Use only one or two shots of lubricant with a hand gun. Maximum hand gun rating is 40 psi. Rotate bearings during lubrication where good safety practice permits. Caution should be employed to prevent over packing or contamination.
7. Grease fittings should be wiped clean. The unit should be in operation while lubricating. Extreme care should be used around moving parts.

8. Grease should be pumped in very slowly until a slight bead forms around the seal. A high grade lithium base grease should be used.
9. To ensure tightness, check pulley setscrews. Proper keys must be in keyways.
10. Fan RPM should not be readjusted. Only use pulleys of identical size and type when replacing pulleys.
11. During the first few months of operation check bearing set screws periodically to ensure tightness.
12. If unit is to be left idle for an extended period, remove belts and store in a cool, dry place to avoid premature belt failure.

Recommended Relubrication Frequency in Months

NOTE: If unusual environment conditions exist (extreme temperature, moisture or contaminants) more frequent lubrication is required.

A good quality lithium base grease, conforming to NLGI Grade 2 consistency, such as those listed here may be used.

Table 2: Suggested Fan Bearing Greasing Intervals

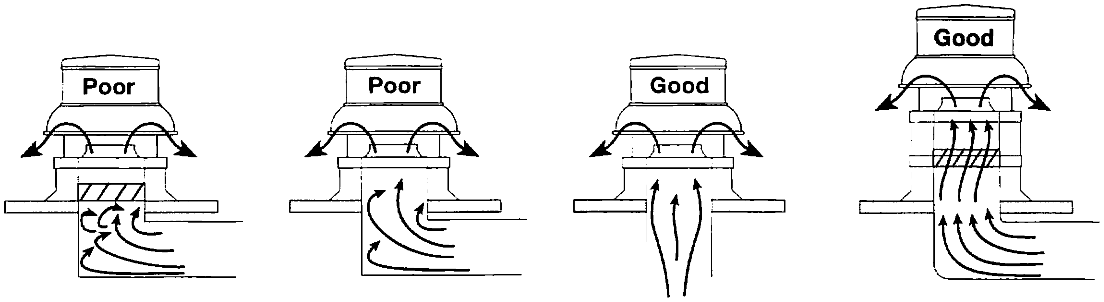
Interval (months)	Type of Service
1 to 3	Heavy duty in dirty, dusty locations; high ambient temperatures; moisture laden atmosphere; vibration.
3 to 6	12 to 24 hours per day, heavy duty, or if moisture is present
6 to 12	8 to 16 hours per day in clean, relatively dry atmosphere
12 to 18	Infrequent operation or light duty in clean atmosphere

Table 3: Grease Manufacturers

Manufacturer	Grease (NLGI #2)
U.S. Electric Motors	Grease No. 83343
Chevron U.S.A. Inc	Chevron SRI Grease #2
Mobil Oil Corporation	Mobilith
	Mobil 532
Texaco, Inc.	Premium BRB #2
	Texaco Multifak #2
Amoco Oil Co.	Rykon Premium #2
Exxon	Unirex N2
Shell	B Shell Alvania #2

Fan Inlet Connections

In order to assure proper fan performance, caution must be exercised in fan placement and connection to the ventilation system. Obstructions, transitions, poorly designed elbows, improperly selected dampers, etc, can cause reduced performance, excessive noise and increased mechanical stress. For performance to be as published, the system must provide uniform and stable airflow into the fan.



Dampers must open fully. Use motorized dampers in low airflow applications to reduce losses.

Avoid sharp turns or entrance conditions which cause uneven flow. Use turning vanes in elbows to reduce adverse effects.

Provide uniform airflow at fan inlet to assure optimum performance.

Provide uniform airflow at fan inlet and through the damper to assure optimum performance. The curb cap should be three wheel diameters from the radius. Use turning vanes in duct when possible.

Troubleshooting

WARNING: Before taking any corrective action, make certain unit is not capable of operation during repairs.

PROBLEM	CAUSE	CORRECTIVE ACTION
Excessive noise or vibration	Wheel rubbing inlet	Adjust wheel and/or inlet cone. Tighten wheel hub or bearing collars on shaft.
	V-belt drive	Tighten pulleys on motor/fan shaft. Adjust belt tension. Align pulleys properly, see page 5/figure 9-10. Replace worn belts or pulleys.
	Bearings	Replace defective bearing(s). Lubricate bearings. Tighten collars and fasteners.
	Wheel unbalance	Clean all dirt off wheel. Check wheel balance, rebalance in place if necessary.
	Bad bearings	Replace.
	Belts too tight or too loose	Adjust tension, see figure 12a-b.
	Wheel improperly aligned and rubbing	Center wheel on inlet, see figure 7.
	Loose drive or motor pulleys	Align and tighten. See "Pre-Starting Checks", see page 5-6.
	Foreign objects in wheel or housing	Remove objects, check for damage or unbalance.
	Fan base not securely anchored	Secure properly.
	Motor hood loose and rattling	Tighten acorn nuts securing motor hood.
	Defective or loose motor bearings	Replace motor with same frame size, RPM-HP
High horsepower	Fan	Check rotation of wheel, see figure 8. Reduce fan speed.
	Duct system	Resize ductwork. Check proper operation of face and bypass dampers. Check filters and access doors.
Fan does not operate	Electrical supply	Check fuses/circuit breakers. Check for switches off. Check for correct supply voltage.
	Drive	Check for broken belts. Tighten loose pulleys.
	Motor	Assure motor is correct horsepower and not tripping overload protector.
Motor overloads or overheats	Lubrication	Check for excessive or insufficient grease in the bearing.
	Mechanical	Replace damaged bearing. Relieve excessive belt tension. Align bearings. Check for bent shaft.
	Belt slippage	Adjust tension or replace bad belts, see page 5-6.
	Over/Under line voltage	Contact power company.
	Incorrect wheel rotation	Check motor wiring, see figure 4.
	Wheel RPM too high	Check drives or slow down fan by opening variable pitch pulley on motor shaft.
	Undersized motor	Check motor ratings with catalog speed and air capacity chart.
	Motor wired incorrectly	Check motor wiring to wiring diagram located on fan motor.
Reduced airflow	System resistance too high	Check system: Proper operation of backdraft or control dampers, obstruction in ductwork, clean dirty filters.
	Unit running backwards	Correct as shown in figure 8.
	Excessive dirt buildup on wheels	Clean wheel.
	Improper wheel alignment	Center wheel on inlets, see Pre-Starting checks and figure 7.
	Dampers closed	Inspect and repair.
	Blocked duct/clogged filter	Clean or replace.
	Belt slippage	Replace and adjust tension.
	Speed to slow	Check for correct drives.

Maintenance Documentation

Job Information

Job Information	Service Organization
Job Name:	Service Organization:
Address:	Address:
City:	City:
State: Zip:	State: Zip:
Phone:	Phone:
Contact Person:	Work Done By:

Nameplate Information

Model:
Volts: Hertz: Phase:
Amps: Mark:
Supply hp: Exhaust hp:
Serial Number:
Model Voltage:
Motor Amperage:
Fan RPM:

Field Start-Up Documentation

Actual Voltage: Hertz: Phase:
Actual Amperage:
Blower Rotation:
Air Volume: Design cfm:
Actual cfm:
Level of fan (L or H):
Fan RPM Range (min.) (max.)

Maintenance Log

Date	Time	Notes

Parts List

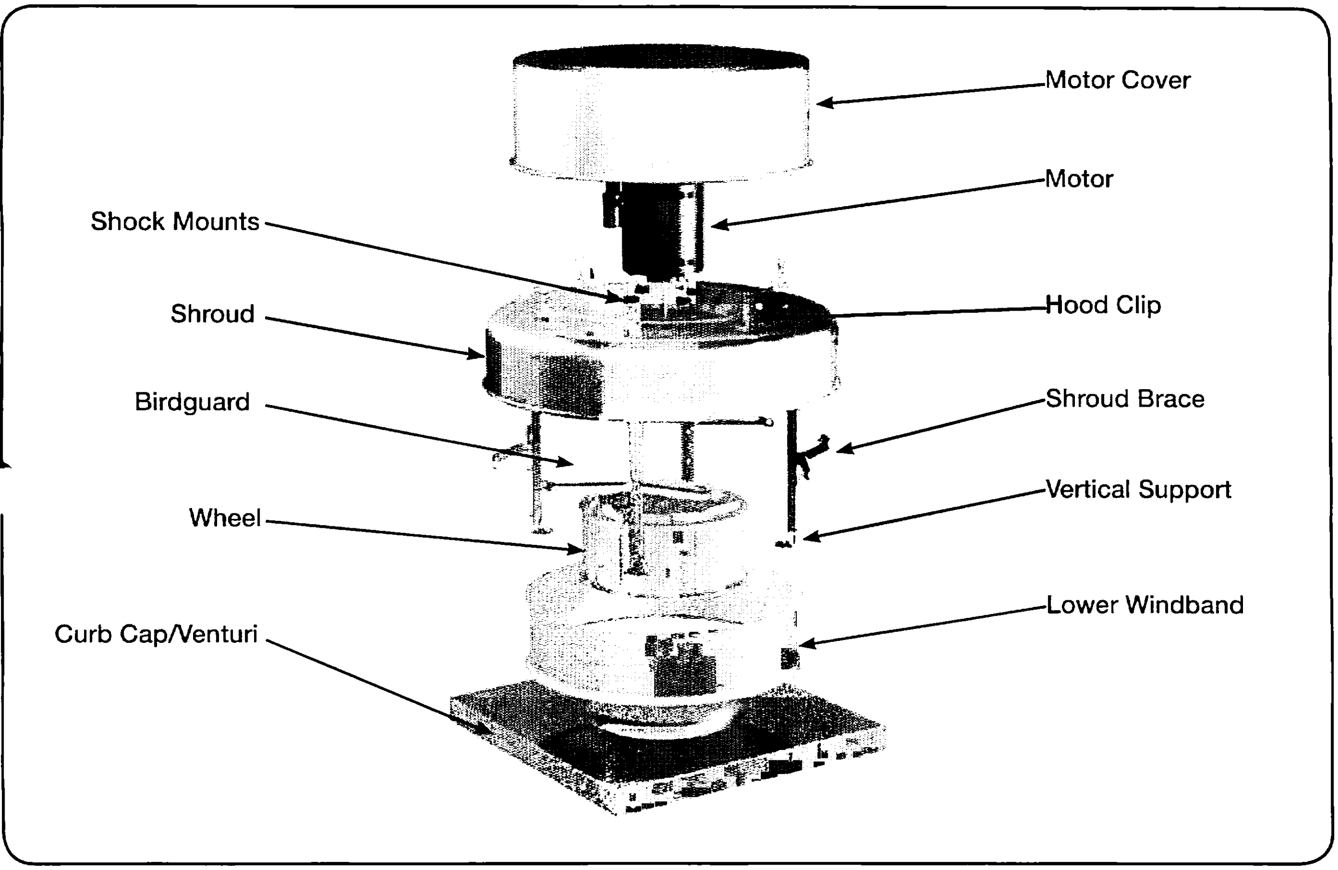
NOTE

Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

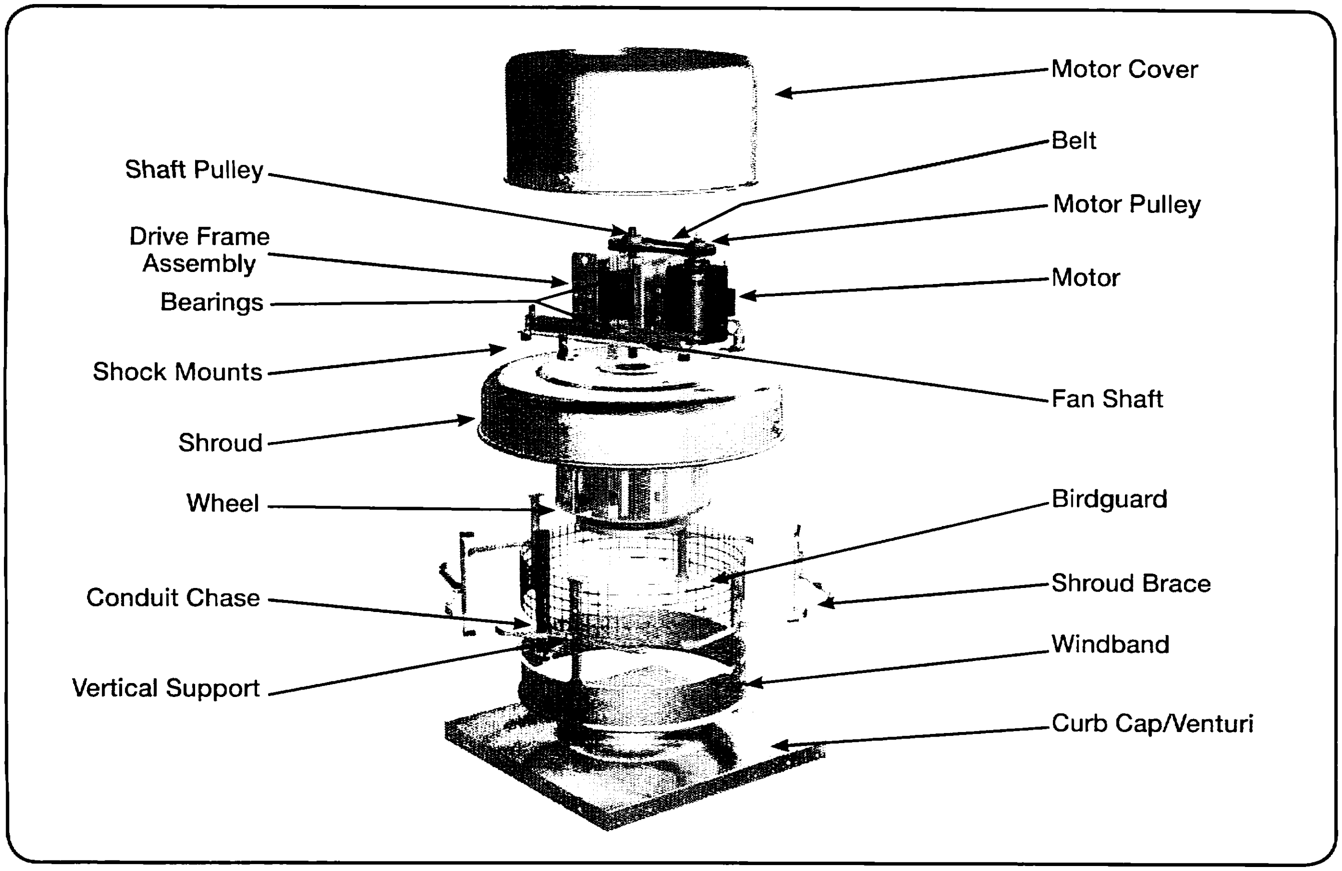
CAUTION

A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof.

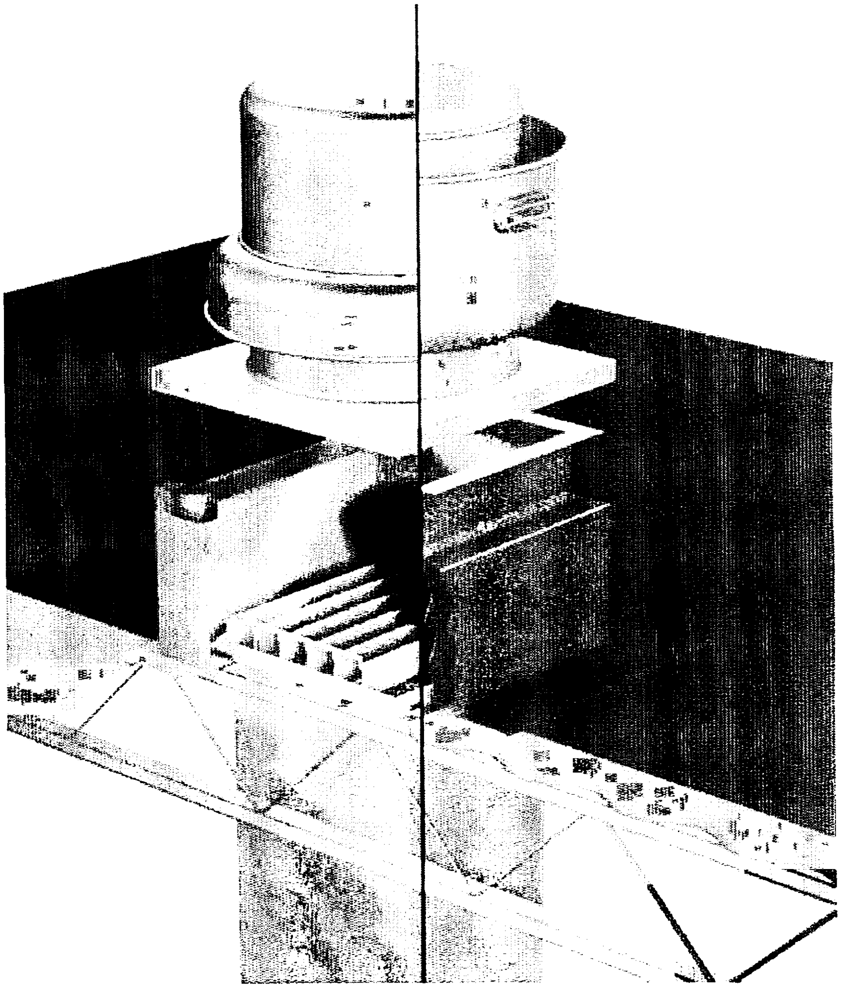
G Direct Drive Centrifugal Roof Exhaust Fan



GB Belt Drive Centrifugal Roof Exhaust Fan



Roof Curb Installation



Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Greenheck Catalog G/GB provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at: www.amca.org.

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Building Value in Air.

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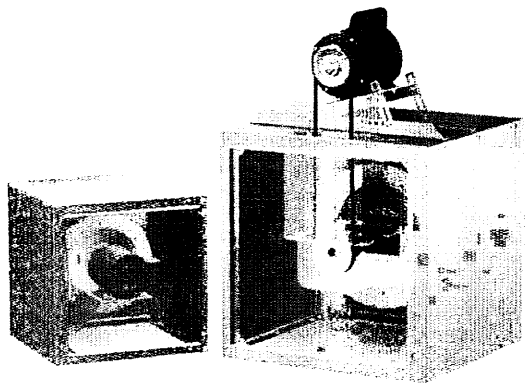
GREENHECK
Building Value in Air.

PN 472058
Models SQ and BSQ
Centrifugal Inline Fans

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage!

Model SQ Direct Drive



Model SQ is a direct drive centrifugal inline exhaust fan. These fans are specifically designed for inline applications. Performance capabilities range up to 5,000 cfm *(8,500 m^3/hr)* and up to 2.0 in. wg *(498 Pa)* of static pressure. SQ fans are available in thirteen sizes with nominal wheel diameter ranging from 6 to 16 inches *(152 to 406 mm)* (060 - 160 unit sizes). Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

Model BSQ Belt Drive

Model BSQ is a belt drive centrifugal inline exhaust fan. These fans are specifically designed for inline applications. Performance capabilities range up to 27,200 cfm *(46,200 m^3/hr)* and up to 4.0 in. wg *(996 Pa)* of static pressure. BSQ fans are available in fourteen sizes with nominal wheel diameter ranging from 7 to 42 inches *(178 to 1067 mm)* (070 - 420 unit sizes). Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.

General Safety Information

Only qualified personnel should install this fan. Personnel should have a clear understanding of these instructions and should be aware of general safety precautions. Improper installation can result in electric shock, possible injury due to coming in contact with moving parts, as well as other potential hazards. Other considerations may be required if seismic activity is present. If more information is needed, contact a licensed professional engineer before moving forward.

DANGER

Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.

CAUTION

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

CAUTION

Precaution should be taken in explosive atmospheres.

1. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2. The rotation of the wheel is critical. It must be free to rotate without striking or rubbing any stationary objects.
3. Motor must be securely and adequately grounded.
4. Do not spin fan wheel faster than max cataloged fan RPM. Adjustments to fan speed significantly effects motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
5. Do not allow the power cable to kink or come in contact with oil, grease, hot surfaces or chemicals. Replace cord immediately if damaged.
6. Verify that the power source is compatible with the equipment.
7. Never open access doors to a duct while the fan is running.

Receiving

Upon receiving the product check to make sure all items are accounted for by referencing the bill of lading to ensure all items were received. Inspect each crate for shipping damage before accepting delivery. Notify the carrier if any damage is noticed. The carrier will make notification on the delivery receipt acknowledging any damage to the product. All damage should be noted on all the copies of the bill of lading which is countersigned by the delivering carrier. A Carrier Inspection Report should be filled out by the carrier upon arrival and reported to the Traffic Department. If damaged upon arrival, file a claim with carrier. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

Unpacking

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts. Sometimes it is not possible that all items for the unit be shipped together due to availability of transportation and truck space. Confirmation of shipment(s) must be limited to only items on the bill of lading.

Handling

Move fan to desired location and determine position of access panels, discharge and motor. Make sure inlet and outlet have at least 2½ times the wheel diameter (duct diameter) before any obstructions like an elbow or transition. Attach the fan to a suitable framework as specified, (hanging or base vibration isolators are recommended). See chart 1 on page 3 for physical dimensions (Figures 1 and 2) and chart 3 on page 4 for dimensions of vibration isolator centerlines (Figures 5-7).

The motor's amperage and voltage ratings must be checked for compatibility to supply voltage prior to final electrical connection. Electrical lead in wires are then connected to the factory supplied safety disconnect switch. All wiring must conform to local and national codes.

Storage

Fans are protected against damage during shipment. If the unit cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the unit during storage. The user assumes responsibility of the fan and accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

Indoor

The ideal environment for the storage of fans and accessories is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F *(-1° to 43°C)* (wide temperature swings may cause condensation and "sweating" of metal parts). All accessories must be stored indoors in a clean, dry atmosphere.

Remove any accumulations of dirt, water, ice or snow and wipe dry before moving to indoor storage. To avoid "sweating" of metal parts allow cold parts to reach room temperature. To dry parts and packages use a portable electric heater to get rid of any moisture buildup. Leave coverings loose to permit air circulation and to allow for periodic inspection.

The unit should be stored at least 3½ in. *(89 mm)* off the floor on wooden blocks covered with moisture proof paper or polyethylene sheathing. Aisles between parts and along all walls should be provided to permit air circulation and space for inspection.

Outdoor

Fans designed for outdoor applications may be stored outdoors, if absolutely necessary. Roads or aisles for portable cranes and hauling equipment are needed. The fan should be placed on a level surface to prevent water from leaking into the fan. The fan should be elevated on an adequate number of wooden blocks so that it is above water and snow levels and has enough blocking to prevent it from settling into soft ground. Locate parts far enough apart to permit air circulation, sunlight and space for periodic inspection. To minimize water accumulation, place all fan parts on blocking supports so that rain water will run off.

Do not cover parts with plastic film or tarps as these cause condensation of moisture from the air passing through heating and cooling cycles.

Fan wheels should be blocked to prevent spinning caused by strong winds.

Inspection and Maintenance During Storage

While in storage, inspect fans once per month. Keep a record of inspection and maintenance performed.

If moisture or dirt accumulations are found on parts, the source should be located and eliminated. At each inspection, rotate the wheel by hand ten to fifteen revolutions to distribute lubricant on motor. If paint deterioration begins, consideration should be given to touch-up or repainting. Fans with special coatings may require special techniques for touch-up or repair.

Machined parts coated with rust preventive should be restored to good condition promptly if signs of rust occur. Immediately remove the original rust preventive coating with petroleum solvent and clean with lint-free cloths. Polish any remaining rust from surface with crocus cloth or fine emery paper and oil. Do not destroy the continuity of the surfaces. Thoroughly wipe clean with Tectyl® 506 (Ashland Inc.) or the equivalent. For hard to reach internal surfaces or for occasional use, consider using Tectyl® 511M Rust Preventive, WD-40® or the equivalent.

Removing From Storage

As fans are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the fan equipment goes into operation.

Chart 1: SQ & BSQ Fan Dimensions

Model	A	B	C	*D	E	*F	*G	*H	Damper	SQ Weight^	BSQ Weight^
SQ 60-75	12 *(305)*	13 *(330)*	12 *(305)*	8⅞ *(225)*	1 *(25)*	-	-	-	9 *(229)*	26 *(12)*	-
SQ 80-95	15 *(381)*	16 *(406)*	15 *(381)*	11⅞ *(302)*	1 *(25)*	-	-	-	12 *(305)*	41 *(19)*	-
BSQ 70-80	15 *(381)*	21 *(533)*	15 *(381)*	11⅞ *(302)*	1 *(25)*	15½ *(394)*	14 *(356)*	12½ *(318)*	12 *(305)*	-	76 *(34)*
BSQ 90	15 *(381)*	21 *(533)*	15 *(381)*	11⅞ *(302)*	1 *(25)*	15½ *(394)*	14 *(356)*	12½ *(318)*	12 *(305)*	-	84 *(38)*
SQ-BSQ 100	17 *(432)*	21 *(533)*	17 *(432)*	13⅞ *(352)*	1 *(25)*	15½ *(394)*	14 *(356)*	12½ *(318)*	14 *(356)*	56 *(25)*	83 *(38)*
SQ-BSQ 120	19 *(483)*	21 *(533)*	19 *(483)*	15⅞ *(403)*	1 *(25)*	17⅞ *(454)*	16 *(406)*	12½ *(318)*	16 *(406)*	67 *(30)*	97 *(44)*
SQ-BSQ 130 (HP)	21 *(533)*	21 *(533)*	21 *(533)*	17⅞ *(454)*	1 *(25)*	17⅞ *(454)*	16 *(406)*	12½ *(318)*	18 *(457)*	67 *(35)*	97 *(44)*
SQ-BSQ 140 (HP)	23 *(584)*	22 *(559)*	23 *(584)*	19⅞ *(505)*	1 *(25)*	17⅞ *(454)*	16 *(406)*	12½ *(318)*	20 *(508)*	104 *(47)*	111 *(50)*
SQ-BSQ 160 (HP)	26 *(660)*	26 *(660)*	26 *(660)*	22⅞ *(581)*	1 *(25)*	20½ *(521)*	17 *(432)*	13⅜ *(340)*	23 *(584)*	160 *(73)*	208 *(94)*
BSQ 180 (HP)	28 *(711)*	28 *(711)*	28 *(711)*	23⅞ *(606)*	1½ *(38)*	24⅜ *(619)*	18 *(457)*	13¾ *(349)*	24 *(610)*	26 *(12)*	245 *(111)*
BSQ 200 (HP)	32 *(813)*	32 *(813)*	32 *(813)*	27⅞ *(708)*	1½ *(38)*	28 *(711)*	20 *(508)*	16 *(406)*	28 *(711)*	26 *(12)*	314 *(142*
BSQ 240 (HP)	39 *(991)*	34 *(864)*	39 *(991)*	34⅞ *(886)*	1½ *(38)*	32⅞ *(835)*	22 *(559)*	19 *(483)*	35 *(889)*	26 *(12)*	415 *(188)*
BSQ 300 (HP)	46 *(1168)*	38 *(965)*	46 *(1168)*	41⅞ *(1064)*	1½ *(38)*	34 *(864)*	22 *(559)*	18 *(457)*	42 *(1067)*	26 *(12)*	537 *(244)*
BSQ 360 (HP)	52 *(1321)*	42 *(1067)*	52 *(1321)*	47⅞ *(1216)*	1½ *(38)*	34 *(864)*	22 *(559)*	18 *(457)*	48 *(1219)*	26 *(12)*	686 *(311)*
BSQ 420 (HP)	58 *(1473)*	50 *(1270)*	58 *(1473)*	53⅞ *(1368)*	1½ *(38)*	34 *(864)*	22 *(559)*	18 *(457)*	54 *(1372)*	26 *(12)*	789 *(358)*

All dimensions in inches (millimeters) and weight is shown in pounds (kilograms). *May be greater depending on motor.
^Weight shown is largest cataloged Open Drip Proof motor.

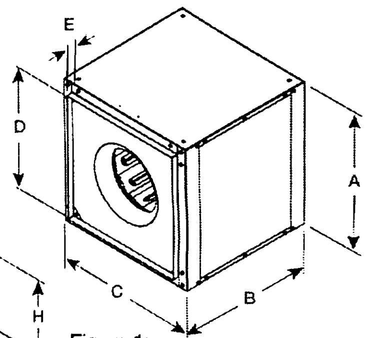


Figure 1:
SQ Dimensions

Chart 2: Filter Option Dimensions

Model	A	B	C	D	WT.	Filter Size	Filter Quantity
SQ-60 - 75	22⅛ *(562)*	12 *(305)*	8⅞ *(225)*	1 *(25)*	40 *(18)*	10 x 12 *(254 x 305)*	1
SQ-80 - 95	45⅝ *(1159)*	15 *(381)*	11⅞ *(302)*	1 *(25)*	74 *(34)*	14 x 25 *(356 x 635)*	1
SQ-100	47¼ *(1200)*	17 *(432)*	13⅞ *(352)*	1 *(25)*	88 *(40)*	16 x 20 *(406 x 508)*	2
SQ-120	52³⁄₁₆ *(1326)*	19 *(483)*	15⅞ *(403)*	1 *(25)*	114 *(52)*	16 x 25 *(406 x 635)*	2
SQ-130	46⅜ *(1178)*	21 *(533)*	17⅞ *(454)*	1 *(25)*	120 *(54)*	20 x 20 *(508 x 508)*	2
SQ-140	52⅜ *(1330)*	23 *(584)*	19⅞ *(505)*	1 *(25)*	174 *(79)*	20 x 25 *(508 x 635)*	2
SQ-160	51⅜ *(1305)*	26 *(660)*	22⅞ *(581)*	1 *(25)*	246 *(112)*	20 x 20 *(508 x 508)*	4
BSQ-70 - 80 - 90	50⅝ *(1286)*	15 *(381)*	11⅞ *(302)*	1 *(25)*	117 *(53)*	14 x 25 *(356 x 635)*	1
BSQ-100	47¼ *(1200)*	17 *(432)*	13⅞ *(352)*	1 *(25)*	120 *(54)*	16 x 20 *(406 x 508)*	2
BSQ-120	52³⁄₁₆ *(1326)*	19 *(483)*	15⅞ *(403)*	1 *(25)*	144 *(79)*	16 x 25 *(406 x 635)*	2
BSQ-130 (HP)	46⅜ *(1178)*	21 *(533)*	17⅞ *(454)*	1 *(25)*	140 *(64)*	20 x 20 *(508 x 508)*	2
BSQ-140 (HP)	52⅜ *(1330)*	23 *(584)*	19⅞ *(505)*	1 *(25)*	181 *(82)*	20 x 25 *(508 x 635)*	2
BSQ-160 (HP)	51⅜ *(1305)*	26 *(660)*	22⅞ *(581)*	1 *(25)*	294 *(133)*	20 x 20 *(508 x 508)*	4
BSQ-180 (HP)	55¹⁄₁₆ *(1399)*	28 *(711)*	23⅞ *(606)*	1½ *(38)*	344 *(156)*	20 x 25 *(508 x 635)*	4
BSQ-200 (HP)	66¹¹⁄₁₆ *(1694)*	32 *(813)*	27⅞ *(708)*	1½ *(38)*	441 *(200)*	12 x 25 *(305 x 635)*	3
						16 x 25 *(406 x 635)*	3
BSQ-240 (HP)	68⅞ *(1749)*	39 *(991)*	34⅞ *(886)*	1½ *(38)*	573 *(260)*	20 x 25 *(508 x 635)*	4
						16 x 25 *(406 x 635)*	4
BSQ-300 (HP)	72⅛ *(1832)*	46 *(1168)*	41⅞ *(1064)*	1½ *(38)*	759 *(344)*	20 x 25 *(508 x 635)*	8
BSQ-360 (HP)	79¼ *(2013)*	52 *(1321)*	47⅞ *(1216)*	1½ *(38)*	957 *(434)*	16 x 25 *(406 x 635)*	10
						20 x 25 *(508 x 635)*	5
BSQ-420	93⅛ *(2365)*	58 *(1473)*	53⅞ *(1368)*	1½ *(38)*	1185 *(538)*	16 x 25 *(406 x 635)*	5
						20 x 25 *(508 x 635)*	10

Note: 24-inch side clearance is recommended for accessing and removing filters. All dimensions in inches (millimeters) and weight (WT.) in pounds (kilograms).

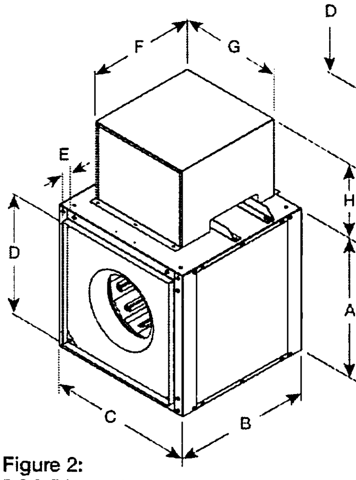


Figure 2:
BSQ Dimensions

Figure 3: Model SQ - Filter Options

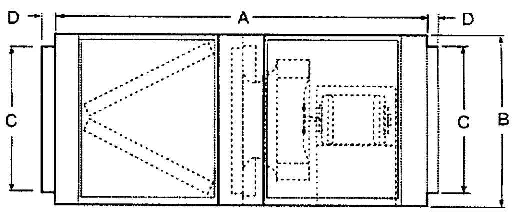
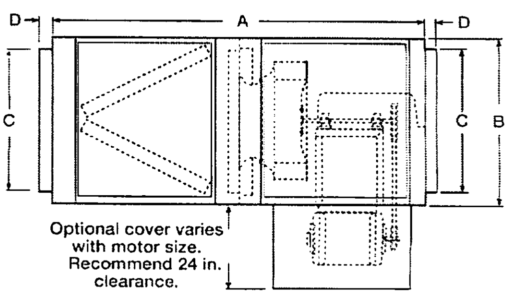


Figure 4: Model BSQ - Filter Options



<table>
<tr><th colspan="15">Chart 3: Vibration Isolator Dimensional Data</th></tr>
<tr><th>Model</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th><th>K</th><th>L</th><th>M</th><th>N</th></tr>
<tr><td>SQ 60-75</td><td>10⅝ (270)</td><td>17 (432)</td><td>15¾ (400)</td><td>8⅞ (225)</td><td>19¾ (502)</td><td>7 (178)</td><td rowspan="7">2 (51)</td><td rowspan="7">1⅜ (35)</td><td rowspan="7">5½ (140)</td><td rowspan="7">2 (51)</td><td rowspan="7">1⅜ (35)</td><td rowspan="7">2 (51)</td><td rowspan="7">6¾ (171)</td><td rowspan="7">2 5/16 (59)</td></tr>
<tr><td>SQ 80-95</td><td>13¼ (337)</td><td>20 (508)</td><td>18¾ (476)</td><td>11⅞ (302)</td><td>43 (1092)</td><td>27⅜ (695)</td></tr>
<tr><td>BSQ 70-90</td><td>18⅝ (473)</td><td>20⅛ (511)</td><td>18¾ (476)</td><td>11⅞ (302)</td><td>48 5/16 (1227)</td><td>27⅜ (695)</td></tr>
<tr><td>SQ-BSQ 100</td><td>18⅝ (473)</td><td>22⅛ (562)</td><td>20¾ (527)</td><td>13⅞ (352)</td><td>44⅞ (1140)</td><td>24 (610)</td></tr>
<tr><td>SQ-BSQ 120</td><td>18⅝ (473)</td><td>24 (610)</td><td>22¾ (578)</td><td>16 (406)</td><td>49⅜ (1254)</td><td>28⅛ (714)</td></tr>
<tr><td>SQ-BSQ 130 (HP)</td><td>18⅝ (473)</td><td>26⅛ (664)</td><td>24¾ (629)</td><td>17⅞ (454)</td><td>44 (1118)</td><td>23 (584)</td></tr>
<tr><td>SQ-BSQ 140 (HP)</td><td>19⅝ (498)</td><td>28⅛ (714)</td><td>26¾ (679)</td><td>19⅞ (505)</td><td>50 1/16 (1272)</td><td>28 (711)</td></tr>
<tr><td>SQ-BSQ 160 (HP)</td><td>23½ (597)</td><td>31 (787)</td><td>29¾ (756)</td><td>22⅞ (581)</td><td>49⅝ (1260)</td><td>23⅝ (600)</td><td rowspan="7">2 (51)</td><td rowspan="7">1⅜ (35)</td><td rowspan="7">5½ (140)</td><td rowspan="7">2 (51)</td><td rowspan="7">1⅜ (35)</td><td rowspan="7">2 (51)</td><td rowspan="7">6¾ (171)</td><td rowspan="7">2⅝ (67)</td></tr>
<tr><td>BSQ 180 (HP)</td><td>25½ (648)</td><td>33½ (851)</td><td>29 9/16 (751)</td><td>22¾ (578)</td><td>52 9/16 (1335)</td><td>24½ (622)</td></tr>
<tr><td>BSQ 200 (HP)</td><td>29⅛ (740)</td><td>37 (940)</td><td>33¾ (857)</td><td>26¾ (679)</td><td>64 3/16 (1630)</td><td>32¼ (819)</td></tr>
<tr><td>BSQ 240 (HP)</td><td>31⅝ (803)</td><td>44¼ (1124)</td><td>40¾ (1035)</td><td>33⅞ (860)</td><td>66½ (1689)</td><td>32⅛ (816)</td></tr>
<tr><td>BSQ 300 (HP)</td><td>35 (889)</td><td>51 (1295)</td><td>47¾ (1213)</td><td>40⅞ (1038)</td><td>69⅛ (1756)</td><td>31⅜ (797)</td></tr>
<tr><td>BSQ 360 (HP)</td><td>38⅜ (974)</td><td>57¼ (1454)</td><td>53½ (1359)</td><td>46¾ (1187)</td><td>76 (1930)</td><td>34 11/16 (881)</td></tr>
<tr><td>BSQ 420 (HP)</td><td>47⅛ (1197)</td><td>63 (1600)</td><td>59⅞ (1521)</td><td>59⅞ (1521)</td><td>90½ (2299)</td><td>40½ (1029)</td></tr>
</table>

All dimensions in inches (millimeters).

Horizontal Hanging or Base Mount

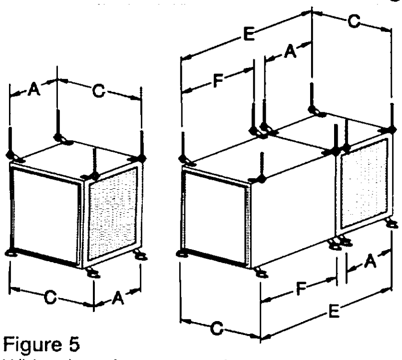


Figure 5
With a hanging mount, the motor may be located on either top or bottom. The base mount allows top motor location only. Both provide access panel on two sides.

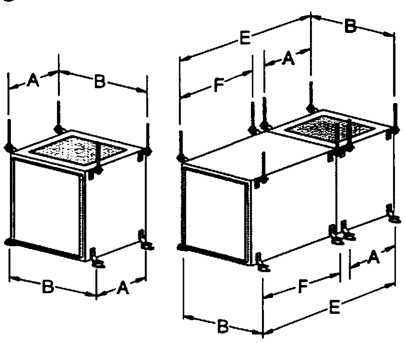


Figure 6
With either a hanging or base mount the motor may be located on either side. The base mount allows top access panels only.

Vertical Hanging or Base Mount

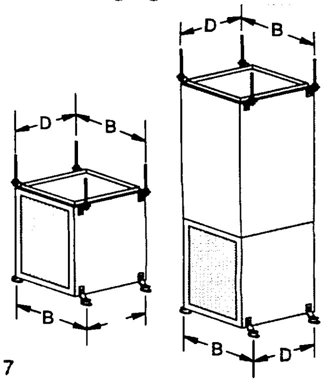
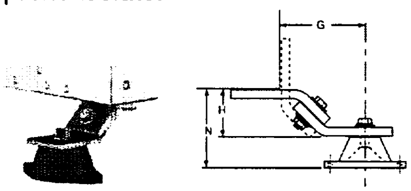


Figure 7
Mounting brackets are turned 90° for vertical mounting. Access panels are located on the two sides adjacent to mounting brackets.

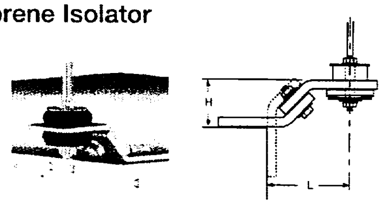
Standing Neoprene Isolator

Figure 8



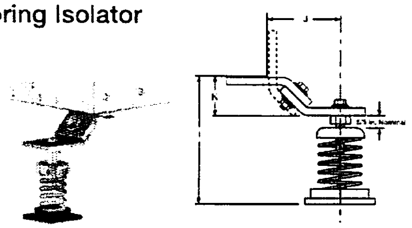
Hanging Neoprene Isolator

Figure 10



Standing Spring Isolator

Figure 9



Hanging Spring Isolator

Figure 11

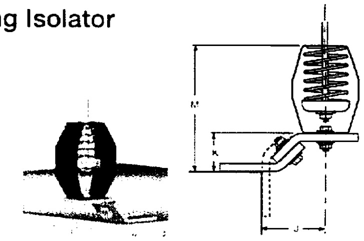


Chart 4: Side Discharge Duct Openings		
Unit Size	**Width**	**Height**
BSQ 70-80-90	11⅞ (302)	11⅞ (302)
SQ 60-75	9⅞ (251)	8⅞ (225)
SQ 80-95	12⅞ (327)	11⅞ (302)
SQ 100/BSQ 100	13⅞ (352)	13⅞ (352)
SQ120/BSQ 120	15⅞ (403)	15⅞ (403)
SQ 130/BSQ 130 (HP)	17⅞ (454)	17⅞ (454)
SQ 140/BSQ 140 (HP)	19⅞ (505)	19⅞ (505)
SQ 160/BSQ 160 (HP)	22⅞ (581)	22⅞ (581)
BSQ 180 (HP)	23⅞ (606)	23⅞ (606)
BSQ 200 (HP)	27⅞ (708)	27⅞ (708)
BSQ 240 (HP)	28⅞ (733)	34⅞ (886)
BSQ 300 (HP)	31⅞ (810)	41⅞ (1064)
BSQ 360 (HP)	32⅞ (835)	37⅞ (962)
BSQ 420	34⅞ (886)	43⅞ (1114)

All dimensions in inches (millimeters).

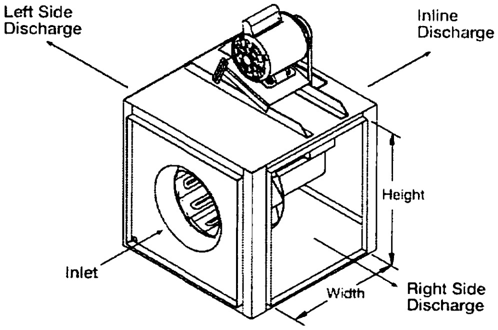


Figure 12

Duct Length: The inlet and outlet duct length should be approximately two to three wheel diameters long before and after the fan to achieve cataloged performance.

Side Discharge: Make sure discharge is orientated in the same direction as originally ordered, performance will change with different discharge positions. Refer to Figure 12 for proper side discharge definition and chart 4 for dimensions, page 4. Refer to the CAPS program or consult factory for performance corrections.

Pre Start-Up Checks

1. Check all fasteners for tightness. The wheel should rotate freely and be aligned as shown in Figure 13. Wheel position is preset and the unit is tested at the factory. Movement may occur during shipment, and realignment may be necessary. Centering can be accomplished by loosening the bolts holding the inlet (venturi) panel and repositioning. Wheel and inlet cone overlap can be adjusted by loosening the setscrews in the wheel and moving the wheel to the desired position.

Wheel Overlap Dimensions

Model	G - Overlap in. *(mm)*	H - Gap in. *(mm)*
SQ 60-95	-	1/8 *(3)*
SQ 100-160	1/4 *(6)*	-
BSQ 70-160	1/4 *(6)*	-
BSQ 180-240	3/8 *(10)*	-
BSQ 300-420	1/2 *(13)*	-

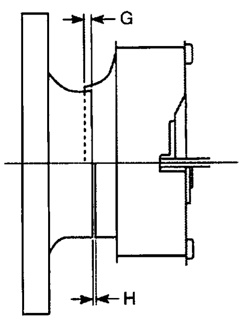


Figure 13

2. **Wheel Rotation:** Direction of wheel rotation is critical. Reversed rotation will result in poor air performance, motor overloading and possible burnout. Check wheel rotation by momentarily energizing the unit (all SQ and BSQ fans have clockwise wheel rotation when viewed from top of fan). Rotation should be clockwise as shown in Figure 14 and correspond to the rotation decal on the unit.

WARNING

Correct direction of wheel rotation is critical. Reversed rotation will result in poor air performance, motor overloading and possible burnout.

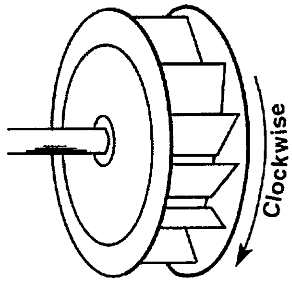


Figure 14

3. **Vibration Isolators:** After fan is moved to desired location, punch out the four knock-out holes which are located on the unit top and bottom panels. Assemble the brackets to the unit according to the appropriate drawings on page 4 and refer to respective parts list on page 11. Make certain all connectors are tight and that all washers are in.

4. **For BSQ Fans:** If adjustments are made, it is very important to check the pulleys for proper alignment. Misaligned pulleys lead to excessive belt wear, vibration, noise, and power loss. (see Figure 15).

5. **For BSQ Fans:** Belt tension can be adjusted by loosening four fasteners marked "R" on the drive frame. (refer to Figure 17 on page 6). The motor plate slides on the slotted adjusting arms. Belt tension should be adjusted to allow 1/64 inch of deflection per inch of belt span. For example, a 15 inch belt span should have 15/64 inch (or about 1/4 inch) of deflection with moderate thumb pressure at mid-point between pulleys (see Figure 16). Overtightening will cause excessive bearing wear and noise. Too little tension will cause slippage at start-up and uneven wear.

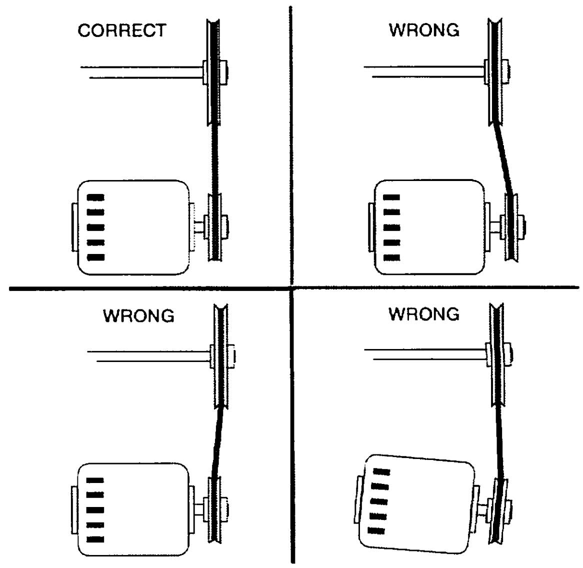


Figure 15

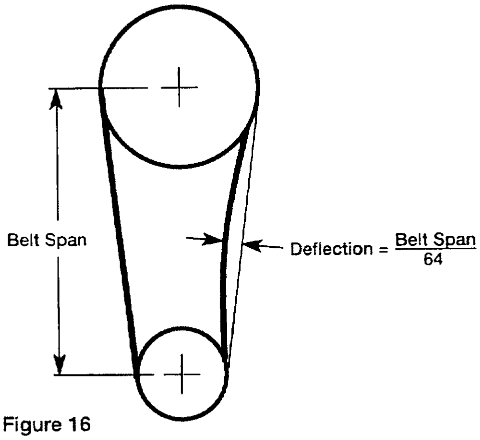
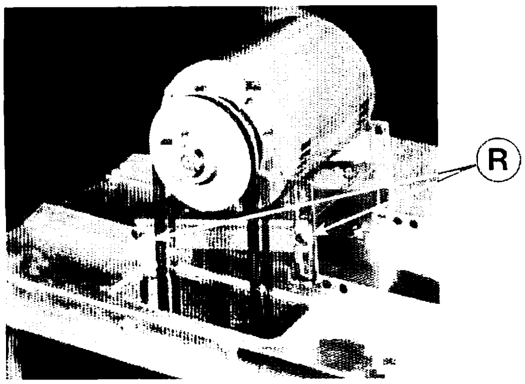


Figure 16



NOTE: Identical fasteners on opposing side must also be loosened.

Figure 17

6. The adjustable motor pulley is factory set for the RPM specified. Speed can be increased by closing or decreased by opening the adjustable motor sheave. Two groove variable pitch pulleys must be adjusted an equal number of turns open or closed. Any increase in speed represents a substantial increase in the horsepower required by a unit. Motor amperage should always be checked to avoid serious damage to the motor when speed is varied.

WARNING

The fan has been checked for mechanical noises at the factory prior to shipment. If mechanical noise should develop, suggested corrective actions are offered in the Troubleshooting section.

IMPORTANT

Over tightening will cause excessive bearing wear and noise. Too little tension will cause slippage at start-up and uneven wear.

IMPORTANT

Adjust (tighten) belt tension after the first 24-48 hours of operation.

Operation: SQ / BSQ

1. Before starting up or operating fan, check all fasteners for tightness. In particular, check the setscrews in wheel hub (and pulleys, if applicable).
2. While in the OFF position or before connecting the fan to power, turn the fan wheel by hand to be sure it is not striking the venturi or any obstacle.
3. Start the fan and shut it off immediately to check rotation of the wheel with directional arrow in the motor compartment, see Figure 14.
4. When the fan is started, observe the operation and check for any unusual noises.
5. With the system in full operation and all ductwork attached, measure current input to the motor and compare with the nameplate rating to determine if the motor is operating under safe load conditions.
6. Keep inlets and approaches to fan clean and free from obstruction.

Inspection: SQ / BSQ

Inspection of the fan should be conducted at the first 30 minute and 24 hour intervals of satisfactory operation.

30 Minute Interval

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

24 Hour Interval

Check all internal components. On BSQ unit only, inspect belt alignment and tension. Adjust and tighten as necessary.

Maintenance: SQ / BSQ

Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations and who are experienced with this type of equipment.

Motor maintenance is generally limited to cleaning and lubrication (where applicable). Cleaning should be limited to exterior surfaces only. Removing dust buildup on motor housing ensures proper motor cooling.

Greasing of motors is only intended when fittings are provided. Many fractional horsepower motors are permanently lubricated and should not be lubricated after installation. Motors supplied with grease fittings should be greased in accordance with manufacturers' recommendations. Where motor temperatures do not exceed 104°F *(40°C)*, the grease should be replaced after 2,000 hours of running time as a general rule.

Wheels require very little attention when moving clean air. Occasionally, oil and dust may accumulate causing imbalance. When this occurs the wheel and housing should be cleaned to ensure smooth and safe operation.

All fasteners should be checked for tightness each time maintenance checks are performed prior to restarting unit.

A proper maintenance program will help these units deliver years of dependable service.

WARNING
Always disconnect, lock and tag power source before servicing. Failure to disconnect power source can result in fire, shock or serious injury.

CAUTION
Uneven cleaning of the wheel will produce an out of balance condition that will cause vibration in the fan.

WARNING
This unit should be made non-functional when cleaning the wheel or housing (fuses removed, disconnect locked off).

Belt/Bearing Maintenance BSQ Unit

1. Belts tend to stretch after a period of time. They should be checked periodically for wear and tightness. When replacing belts, use the same type as supplied with the unit.
2. Matched belts should always be used on units with multi-groove pulleys.
3. For belt replacement, loosen the tensioning device enough to allow removal of the belt by hand. Do not force belts on or off. This may cause cords to break, leading to premature belt failure.
4. Once installed, adjust belts as shown in "Pre-Starting Checks."
5. Shaft bearings can be classified in two groups: relubricating and non-relubricating. All bearings on standard Model BSQ fans are factory lubricated and require no further lubrication under normal use (between -20°F and 180°F in a relatively clean environment).
6. Units installed in hot, humid or dirty locations should be equipped with special bearings. These bearings will require frequent lubrication. Caution should be employed to prevent overpacking or contamination.
7. Grease fittings should be wiped clean. The unit should be in operation while lubricating. Extreme care should be used around moving parts.
8. Grease should be pumped in very slowly until a slight bead forms around the seal. A high grade lithium base grease should be used.

Recommended Relubrication Frequency in Months

NOTE: If unusual environment conditions exist (extreme temperature, moisture or contaminants) more frequent lubrication is required.

A good quality lithium base grease, conforming to NLGI Grade 2 consistency, such as those listed here may be used.

Table 2: Suggested Fan Bearing Greasing Intervals

Interval (months)	Type of Service
1 to 3	Heavy duty in dirty, dusty locations; high ambient temperatures; moisture laden atmosphere; vibration.
3 to 6	12 to 24 hours per day, heavy duty, or if moisture is present
6 to 12	8 to 16 hours per day in clean, relatively dry atmosphere
12 to 18	Infrequent operation or light duty in clean atmosphere

Table 3: Grease Manufacturers

Manufacturer	Grease (NLGI #2)
U.S. Electric Motors	Grease No. 83343
Chevron U.S.A. Inc	Chevron SRI Grease #2
Mobil Oil Corporation	Mobilith
	Mobil 532
Texaco, Inc.	Premium BRB #2
	Texaco Multifak #2
Amoco Oil Co.	Rykon Premium #2
Exxon	Unirex N2
Shell	B Shell Alvania #2

Maintenance Documentation

Job Information

Job Name: ______________________

Address: ______________________

City: ______________________

State: __________ Zip: __________

Phone: ______________________

Contact Person: ______________________

Service Organization: ______________________

Address: ______________________

City: ______________________

State: __________ Zip: __________

Phone: ______________________

Work Done By: ______________________

Nameplate Information

Model: ______________________

Volts: ______ Hertz: ______ Phase: ______

Amps: __________ Mark: __________

Supply hp: __________ Exhaust hp: __________

Serial Number: ______________________

Model Voltage: ______________________

Motor Amperage: ______________________

Fan RPM: ______________________

Field Start-Up Documentation

Actual Voltage: ______ Hertz: ______ Phase: ______

Actual Amperage: ______________________

Blower Rotation: ______________________

Air Volume: Design cfm: ______________________

Actual cfm: ______________________

Level of fan (L or H): ______________________

Fan RPM Range (min.) __________ (max.) __________

Maintenance Log

Date	Time	Notes

Troubleshooting

WARNING: Before taking any corrective action, make certain unit is not capable of operation during repairs.

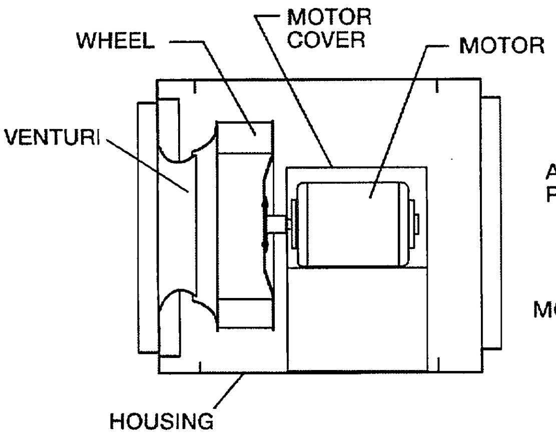
PROBLEM	CAUSE	CORRECTIVE ACTION
Excessive noise or vibration	Wheel unbalance	Clean all dirt off wheel. Check wheel balance, rebalance in place if necessary.
	Bad bearings	Replace.
	Belts too tight or too loose	Adjust tension, see Figure 16.
	Wheel improperly aligned and rubbing	Center wheel on inlet, see Figure 13.
	Loose drive or motor pulleys	Align and tighten. See "Pre-Starting Checks", see page 5-6.
	Foreign objects in wheel or housing	Remove objects, check for damage or unbalance.
Reduced airflow	System resistance too high	Check system: Proper operation of backdraft or control dampers, obstruction in ductwork, clean dirty filters.
	Unit running backwards	Correct as shown in Figure 14.
	Excessive dirt buildup on wheels	Clean wheel.
	Improper wheel alignment	Center wheel on inlets, see Pre-Starting checks and Figure 13.

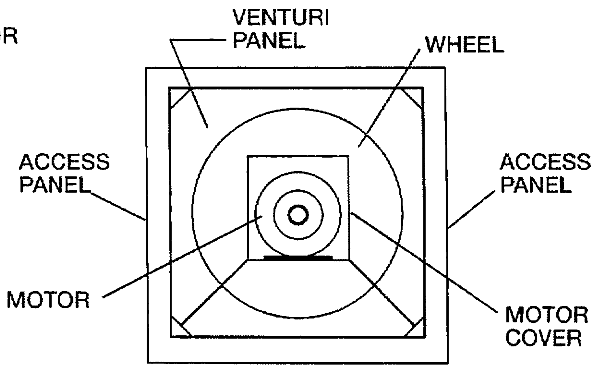
Parts List

NOTE
Each fan bears a manufacturer's nameplate with model number and serial number embossed. This information will assist the local Greenheck representative and the factory in providing service and replacement parts. Before taking any corrective action, make certain unit is not capable of operation during repairs.

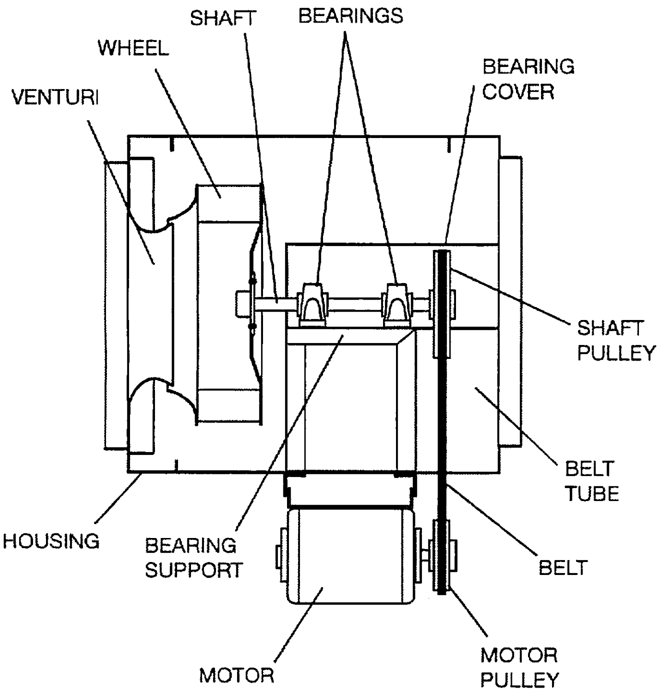
CAUTION
A fan manufactured with an explosion resistant motor does not certify the entire unit to be explosion proof. Refer to UL Listing Mark for the fans approved usage.

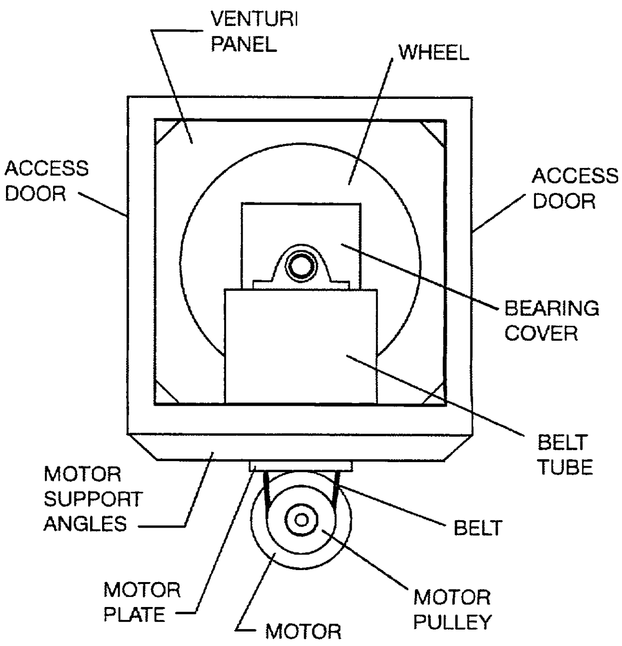
SQ Direct Drive Centrifugal Inline Exhaust Fan





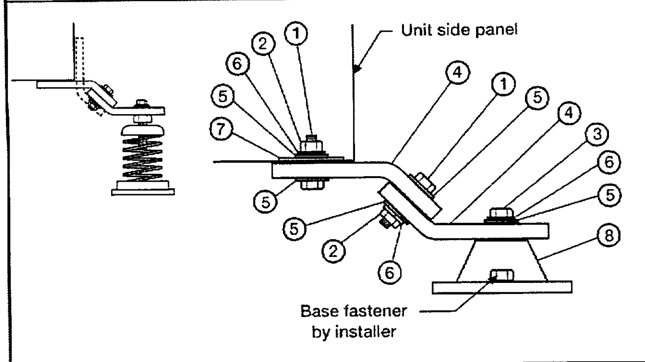
BSQ Belt Drive Centrifugal Inline Exhaust Fan





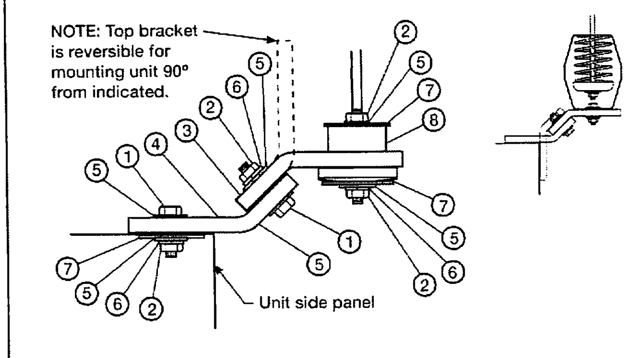
Isolator Parts List

STANDING SUPPORT ISOLATOR



No.	Qty.	Description	SQ-60 thru 140 BSQ-100 thru 140	SQ-160 BSQ-160 thru 420
1	8	Cadium plated hex head bolts	3/8 in. - 16 x 1 in.	3/8 in.-16 x 1 1/4 in.
2	8	Cadium plated hex nuts	3/8 in. - 16	3/8 in. - 16
3	4	Cadium plated hex head bolts	5/16 in. - 18 x 1 in.	3/8 in. - 16 x 1 in.
4	8	Std. mount bracket with (2) 7/16 in. holes	3/16 in.	1/4 in.
5	20	Cadium plated washer	7/8 in. O.D. x 3/8 in. I.D. x 1/16 in.	7/8 in. O.D. x 3/8 in. I.D. x 1/16 in.
6	12	Cadium plated lock washer	3/8 in.	3/8 in.
7	4	Cadium plated washer	1 3/8 in. O.D. x 9/16 in. I.D. x 3/32 in.	1 3/8 in. O.D. x 9/16 in. I.D. x 3/32 in.
8	4	Neoprene or Spring Isolator	Reference appropriate table below for replacement Isolator(s)	

HANGING SUPPORT ISOLATOR



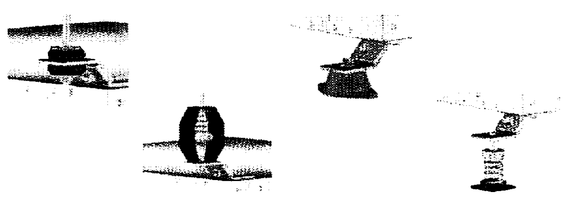
No.	Qty.	Description	SQ-60 thru 140 BSQ-100 thru 140	SQ-160 BSQ-160 thru 420
1	8	Cadium plated hex head bolts	3/8 in. - 16 x 1 in.	3/8 in.-16 x 1 1/4 in.
2	16	Cadium plated hex nuts	3/8 in. - 16	3/8 in. - 16
3	4	Std. mount bracket with (1) 1/4 in. hole	3/16 in.	1/4 in.
4	4	Std. mount bracket with (2) 7/16 in. holes	3/16 in.	1/4 in.
5	24	Cadium plated washer	7/8 in. O.D. x 3/8 in. I.D. x 1/16 in.	7/8 in. O.D. x 3/8 in. I.D. x 1/16 in.
6	12	Cadium plated lock washer	3/8 in.	3/8 in.
7	12	Cadium plated washer	1 3/8 in. O.D. x 9/16 in. I.D. x 3/32 in.	1 3/8 in. O.D. x 9/16 in. I.D. x 3/32 in.
8	4	Neoprene or Spring Isolator	Reference appropriate table below for replacement Isolator(s)	

REPLACEMENT SPRING ISOLATOR(S)

MODEL	FAN SIZES					
BSQ	----	70-130	140-180	200	240-300	360-420
SQ	60-100	120-140	160	----	----	----
BASE MOUNT	FDS-1-35 BLUE	FDS-1-70 GREEN	FDS 1-120 GRAY	FDS 1-120 GRAY	FDS-1-220 BROWN	FDS-1-370 ORANGE
HANGING	SH-1-35 BLUE	SH-1-70 GREEN	SH-1-125 GRAY	SH-1-245 BROWN	SH-1-245 BROWN	SH-1-370 ORANGE

REPLACEMENT NEOPRENE ISOLATOR(S)

MODEL	FAN SIZE		
BSQ	70-140	160-200	240-420
SQ	60-140	160	----
BASE MOUNT	R-1 GREEN	R-2 BLACK	R-2 RED
HANGING	40DUR BLACK	50DUR BLACK	50DUR BLACK



Warranty

Greenheck warrants this equipment to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at our option when returned to our factory, transportation prepaid. Motors are warranted by the motor manufacturer for a period of one year. Should motors furnished by Greenheck prove defective during this period, they should be returned to the nearest authorized motor service station. Greenheck will not be responsible for any removal or installation costs.

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Greenheck Centrifugal Inline Fans Catalog, Models SQ/BSQ provides additional information describing the equipment, fan performance, available accessories, and specification data.

AMCA Publication 410-96, Safety Practices for Users and Installers of Industrial and Commercial Fans, provides additional safety information. This publication can be obtained from AMCA International, Inc. at: www.amca.org.

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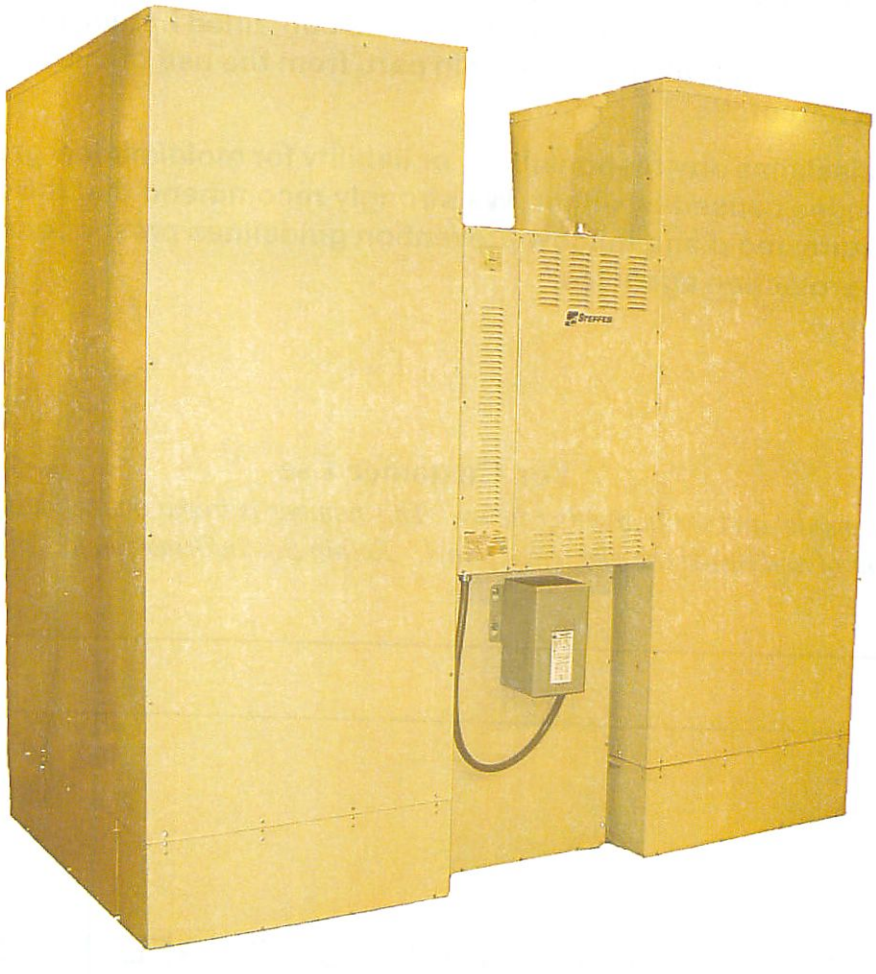
V3

THERM ELECT

OWNER'S AND INSTALLER'S MANUAL



Models: 8150, 8155, 8180, 8185, 8188

Applicable to Software Version 2.0

STEFFES CORPORATION

c UL us LISTED

NOTE IMPORTANT

- The equipment described herein is intended for installation by a qualified technician in accordance with applicable local, state, and national codes and requirements.
- To insure proper installation and operation of this product, completely read all instructions prior to attempting to assemble, install, operate, maintain or repair this product. Upon unpacking of the system, inspect all parts for damage prior to installation and start-up.
- This manual should be retained by the owner upon completion of the installation and made available to service personnel as required.
- Disclaimer: In compiling this manual, Steffes Corporation has used its best judgement based upon information available, but disclaims any responsibility or liability for any errors or miscalculations contained herein, or any revisions hereof, or which result, in whole or in part, from the use of this manual or any revisions hereof.

  Steffes disclaims any responsibility or liability for mold/mildew growth and/or any damages caused by either. We strongly recommend that the user follow the moisture, mold and mildew prevention guidelines prescribed by local or national protection agencies.

For Customer Use

Please record your model and serial number below. This number is found on the identification labels located on the front of and inside the electrical panel. Retain this information for future reference.

Model No. ______________________________

Serial No. ______________________________

RECOGNIZE THESE SYMBOLS AS SAFETY PRECAUTIONS

It is important, both for your personal safety and to avoid possible damage to the equipment and your property, that you observe the safety instructions given following these symbols.

SAFETY PRECAUTIONS

1. DO NOT energize the system while disassembled or without ceramic heat storage brick in place.
2. DO NOT use or store materials that may produce explosive or flammable gases near the system.
3. DO NOT violate the placement and clearance requirements specified in this manual. (Page 3.03)
4. DO NOT place anything on top of the Storage Module(s).
5. Disconnect power to all circuits before servicing. This heating system may be connected to more than one branch circuit.
6. Installation of and/or service to this heating system should be performed by a qualified technician in accordance with information contained herein and with national, state, and local codes and requirements.
7. A repeated message of "CORE FAIL" indicates a need for service by a qualified technician.

WARNING

- **Hazardous Voltage: Risk of electric shock, injury, or death. This system may be connected to more than one branch circuit. Disconnect power to all circuits before installing or servicing. Installation of and/or service to this equipment MUST be performed by a qualified technician.**
- **Risk of injury or fire. Violation of the clearance requirements can cause improper operation of the equipment. Maintain the placement and clearance requirements specified.**

BUILT-IN SAFETY DEVICES

The ThermElect heating system incorporates safety devices to ensure normal operating temperatures are maintained. The chart below describes these safety devices.

DEVICE NAME	FUNCTION	LOCATION ON SYSTEM
Core Charging High Limit Switches (Auto Reset)	These limit switches monitor the core and top temperatures. If normal operating temperatures are exceeded, the system will display "CORE FAIL" and the elements will not be allowed to operate.	Air handler side of each storage module and storage module top panel.
Core Blower Limit Switch (Auto Reset)	This limit switch monitors the discharge air temperature and interrupts power to the core blower if the normal operating temperature is exceeded: 160°F / 71°C (nominal)	Mounted on limit bracket at discharge air outlet.
Supply Air Blower Limit Switch (Manual Reset)	This limit switch monitors the discharge air temperature and interrupts power to both the supply air blower and the core blower if the normal operating temperature is exceeded: 190°F / 88°C (nominal)	Mounted on limit bracket at discharge air outlet.
Core Blower Housing Temperature Limit Switch (Auto Reset)	This limit switch monitors the temperature in the base of the air handler and interrupts power to the core blower if the normal operating temperature is exceeded: 160°F / 71°C (nominal)	In the base of the air handler near the core blower.

TC Table of Contents

Operation

Optional Accessories

Installation

Load Management Control

Appendix

Warranty

1 Operation

Operation

GENERAL OPERATION

The ThermElect heating system stores off-peak electricity in the form of heat. Off-peak electricity is available during times of the day or night when electricity is plentiful and the associated costs are low.

Operation of the heating system is automatic. During off-peak hours, the system converts electricity to heat which is then stored in its ceramic brick core. The amount of heat stored in the brick core of the Storage Module(s) varies in relation to outdoor temperature, current building load, utility peak conditions, and/or the heating requirements.

A heat call from the thermostat or main system control energizes the blowers in the system. The variable speed core blower automatically adjusts its speed to circulate air through the brick core. The supply air blower then delivers the heated air into the desired area through the duct system to maintain constant, comfortable temperature.

The versatility of this system allows it to fit many applications. The system is designed for use as either a sole heating source ("stand alone" furnace) for make up air heating or as a supplement to another ducted heating system such as a heat pump.

SYSTEM USE DURING CONSTRUCTION PHASE

Like most heating equipment manufacturers, Steffes strongly recommends that "Construction Heating Units" be used instead of the permanent heating system during the construction phase. Use of the permanent heating system during this phase may contaminate the duct system and/or internal areas of the heating system. This may cause poor indoor air quality issues and/or improper system operation or equipment damage.

SYSTEM START-UP

On start-up of the system, odors relating to first time operation of the heating components may be experienced. Also, if not used for an extended period of time, dust may accumulate in the system. Allow the heating system to charge to its maximum brick core charge level to expel odors in a timely manner.

As with most heating systems, air borne particles and odors may be drawn into the system and oxidized. **Odors can be amplified; thus, it is not recommended to operate the system if odors such as those from paints, varnishes, or chemicals are present in the air.** Air borne particles, which have been oxidized, are expelled back into the room and may accumulate on air vents or other surfaces. Over time, these particles may appear as a black residue, commonly referred to as soot. High concentrations of air borne particles from aerosols, dust, candles, incense, pet hair, smoke, or cooking can contribute to poor indoor air quality and accelerate the sooting process.

During operation, the heating system may produce minor expansion noises. These noises are the result of the internal components reacting to temperature changes.

TURNING SYSTEM "OFF" AND "ON"

The system is fully automatic and does not need to be manually disabled. Talk to your installer or energy management person for additional information.

CONTROL PANEL

Operation of the ThermElect system is automatic. All operational functions are stored in its microprocessor in function locations and are factory preset. If necessary, the installer can adjust them through the control panel. (See Figure 1.)

CONTROL PANEL
FIGURE 1

Four-Digit LED Display

The four digit LED displays specific operating information. During an editing process, the function locations and the values set in these locations are displayed for viewing and adjusting purposes.

AM and PM Indicator Lights

The AM and PM indicator lights are only utilized if the Steffes Time Clock Module is being installed. With this module installed, the system displays time on AM/PM intervals and the corresponding light flashes. The system can be configured to display military time, in which case both the AM and PM lights illuminate.

Ⓜ Mode (Edit) Button

Activates the editing menu for changing the operating information of the system.

CAUTION

Editing operating information may alter the performance and operation of the system.

⇧ Up and ⇩ Down Arrow Buttons

Used to scroll up or down when viewing or changing operating functions.

▭ Interface Port

FOR SERVICE USE ONLY! Allows technician external access for updating software and troubleshooting.

OPERATING STATUS

The ThermElect system is set to display various operating information as described below. Press and release the up arrow to view this data.

Operating Mode - Indicates the current operating mode of the system.

C = Off-Peak (Charge) Time
P = On-Peak (Control) Time
A = Anticipated Peak Time

NOTE **A bar illuminates on the lower portion of the display's second digit whenever one or more heating elements are energized.**

Outdoor Temperature -"O" followed by a number indicates current outdoor temperature.

Heat Call Status - Indicates the current heat call status being received from the room thermostat.

HC_0 = No Heat Call
HC_1 = Stage 1 Heat Call
HC_2 = Stage 2 Heat Call
HC_3 = Emergency Heat
COOL = Cooling/Air Conditioning Call

Brick Core Charge Level - "CL" (charge level) followed by a number indicates the current percentage of heat stored in the brick core. "CL:_" represents zero percent and "CL: F" represents a full core charge level.

Targeted Brick Core Charge Level - "tL" (target level) followed by a number indicates the current percentage of brick core charge being targeted by the system. A display of "tL:_" indicates a target level of zero percent and "tL: F" indicates a full core charge target level.

Load Control - Current demand (kW) divided by 10. A value of "d 75" is equal to a current demand of 750kW.

TEMPERATURE CONTROL

Temperature set point is adjusted at the wall thermostat(s) or the main system control. If temperature in the area drops below the desired set point, a heat call is initiated and the blower in the ThermElect system is energized. The variable speed core blower automatically adjusts speed in relation to brick core temperature and duct temperature to circulate air through the brick core. The supply air blower then delivers the heated air into the desired area through the duct system to satisfy heating requirements.

When used to supplement heat pump systems, the ThermElect system replaces resistance strip heat, which is typically required as a supplement or back-up to the heat pump system. The outlet sensor monitors the discharge air temperature. If the demand for heat is at a point where the heat pump alone cannot maintain the desired duct temperature, stored heat is used to supplement the heat pump and satisfy the heating requirements.

When the ThermElect system receives a "G" call, the supply air blower is energized; however, no heat is delivered as this is a "fan only" call.

When a "G" call is received with a "Y" call, the supply air blower is energized and the minimum discharge air temperature (as set in Location 48) is targeted.

Anytime the ThermElect system receives a "W" call with any other call from the thermostat (except "O") then the maximum discharge air temperature (as set in Location 49) is targeted. The maximum discharge air temperature is also targeted if the current outdoor temperature (shown in Location 109) is lower than the off-peak lock out temperature (set in Location 46) or the on-peak lockout temperature (set in Location 47).

NOTE **Reference the Supplemental Installer's Guide for more information on system operation.**

BRICK CORE CHARGE CONTROL

The amount of heat stored in the brick core of the Storage Module(s) varies in relation to outdoor temperature, current building load, utility peak conditions, and/or the heating requirements. The outdoor sensor, supplied with the system, monitors outdoor temperature and provides this information to the system. As the outdoor temperature decreases, heating requirements increase and the system stores more heat accordingly.

CHARGE CONTROL OVERRIDE

If desired, the ThermElect system can be programmed to allow a charge control override. This override allows the user to force the system to target a full core charge level and can be initiated or cancelled at any time. If an override is initiated, the system targets a full core charge level during the next off-peak period. It continues to charge during off-peak hours until it achieves full (maximum) core charge or until the override is cancelled. Once full charge is achieved or the override is cancelled, the system charges according to the standard configuration.

MAINTENANCE AND CLEANING

Any air filter(s) in the system should be replaced on a regular basis to ensure proper operation and to maintain overall efficiencies. No additional routine maintenance is required.

If utilizing a heat pump or air conditioning system with the ThermElect system, the indoor coil should be cleaned periodically as dirt accumulation may reduce system efficiency. It is important to follow the manufacturer's maintenance and cleaning recommendations for these devices.

2 Optional Accessories

LOAD MANAGEMENT CONTROL

The ThermElect is a commercial Electric Thermal Storage (ETS) heating system. It uses Demand Free, Off-Peak electricity to provide a low cost heating solution for commercial, industrial, and large residential applications. ETS equipment is designed to store electricity, as heat, during hours when energy costs are lower and kW demand charges are not incurred. The ThermElect's thermal mass consists of a high-density ceramic brick capable of vast heat storage.

The ThermElect system is designed to operate under one of three different load management control strategies.

1. On-Peak/Off-Peak Program

a) The ThermElect system responds to heat calls during the on-peak and off-peak periods; however, only consumes energy (energize heating elements) during the off-peak periods. The ThermElect system is controlled by an external control device such as a meter or time clock module.

b) The ThermElect system also offers on-peak control of external loads by utilizing the dry contacts provided on the relay driver board.

2. 4-20 Milliamp Control (1-5 volt DC)

a) The ThermElect system receives a signal from an external load control device such as a building load management system. This external signal dictates to the ThermElect the maximum amount of energy which can be consumed during a preset time interval.

b) Other external loads would generally be controlled through the building's load management control system.

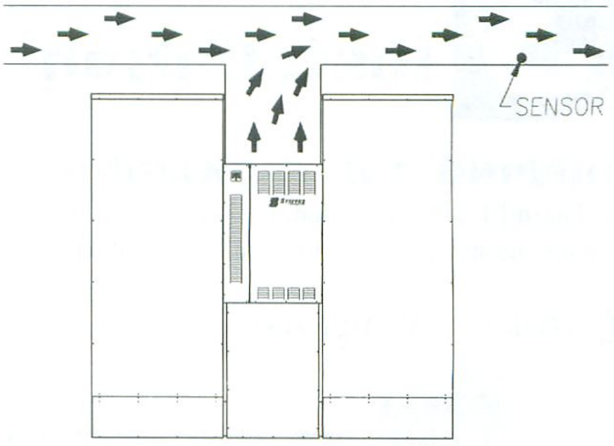
3. Pulse Monitoring

a) The ThermElect system monitors pulse outputs from the power company's electric meter. Program parameters such as desired maximum building kW and pulse ratios for the metering system being used are entered into the ThermElect system. The system then changes proportionally when demand free power is available. This keeps the total building kW usage at or below the desired level.

b) External load management control modules (Order Item # 1908410) are available when using pulse monitoring load control. Each module has eight (8) zones which can be controlled. The ThermElect system must be configured to recongnize the number of load management modules installed (maximum of two per ThermElect system).

Reference the Load Management Section of this manual for more specific information on the individual methods of control.

EXTERNAL DUCT SENSOR



The optional external duct sensor (Order Item #1041536) provides the ability to monitor the duct temperature at an area beyond fresh air makeup and/or beyond other devices and regulate the discharge air temperature accordingly.

The duct sensor feature is enabled if the 4 bit is set in Location 53 (L053). Once enabled, the ThermElect system monitors temperature at both the duct sensor and the output sensor during Y, W, or E calls from the thermostat.

If there is a Y and a G call from the thermostat, the ThermElect system operates the core blower at the required speed to maintain the minimum output temperature as set in Location 48 (L048) at the duct sensor. If there is only one call from Y, W, or E, then the system will operate the core blower at the required speed to maintain the maximum output temperature as set in Location 49 (L049) at the duct sensor. The system is set to turn off the core blower if the output temperature at the output sensor exceeds 150 degrees Fahrenheit.

Optional Accessories

LIFTING HANDLES

Optional lifting handles are available (Order Item #1302120) to aid in moving the ThermElect Storage Module(s) into their final location. It is extremely important to use caution when lifting a Storage Module. Instruct workers to NOT walk under or place any body parts under the Storage Module when lifting and/or moving.

WARNING

HEAVY OBJECT WARNING: Risk of personal injury, or death. ThermElect Hydronic systems are heavy. Use lifting aids to move system into place.

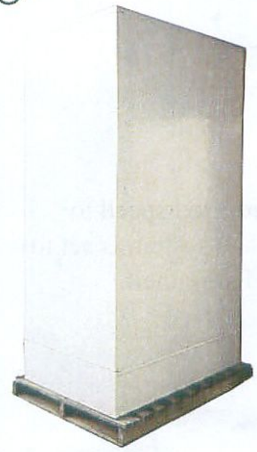
- **Do not place object, hands, and/or body parts under the system when lifting.**
- **Do use care to keep objects, hands, and/or body parts clear of system when lifting.**

3 Installation

SHIPPING AND PACKAGING

The ThermElect Storage Module(s) should always be transported in an upright position to avoid damage to internal components and insulation materials. The information below describes the items shipped with each system.

① STORAGE MODULE(S)



MODEL	MODULES 53kW	MODULES 80kW
8150	1	0
8155	2	0
8180	0	1
8185	1	1
8188	0	2

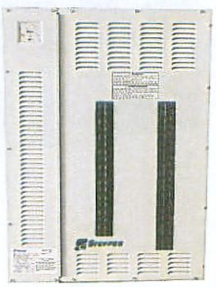
② AIR HANDLER

2000 CFM - Standard
3000 CFM - Optional
(shipped separately)

③ ELECTRICAL PANEL

(includes electrical panel mounting screws, romex connectors, and wiring schematic)

(shipped separately)



208/240V shown

④ INFORMATION PACKAGE

(includes Owner's Manual and Warranty Registration Card)

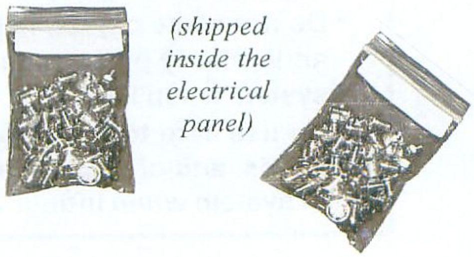
(included on pallet with the electrical panel)

⑤ HEATING ELEMENTS WITH CERAMIC INSULATORS

MODULE	ELEMENTS
53kW	12 (2 boxes of 6)
80kW	18 (3 boxes of 6)

(shipped separately)

⑥ ELEMENT SCREW KIT & INSTALLATION HARDWARE KIT



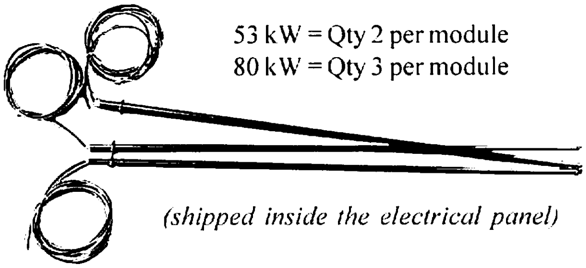
(shipped inside the electrical panel)

⑦ SEAM WRAP

(shipped inside brick storage cavity)

8 CORE THERMOCOUPLE WITH 6' CLEAR PLASTIC TUBE

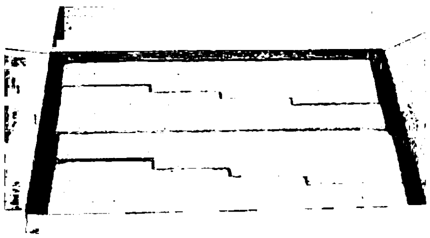
53 kW = Qty 2 per module
80 kW = Qty 3 per module



(shipped inside the electrical panel)

9 TOP AIR CHANNEL BLOCK

1 box of 4 per Storage Module



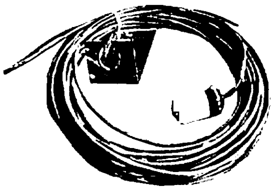
(shipped separately)

10 CERAMIC BRICK

MODULE	BRICK	LBS
53kW	192	3,360
80kW	288	5,040

96 brick per pallet
(shipped separately)

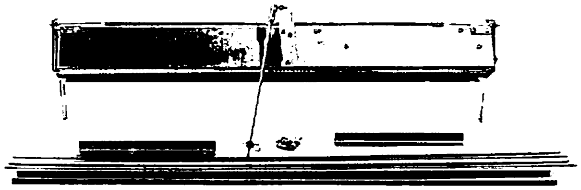
11 OUTDOOR TEMPERATURE SENSOR



(shipped inside the electrical panel)

12 OUTLET DAMPER KIT

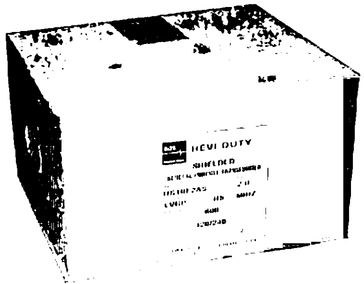
1 per Storage Module
(includes Damper Assembly, Damper Linkage, 2 - L Brackets, 2 - C Clip Drive Brackets, 2 - C Drives, Hardware Screw Kit)



(shipped separately)

13 HIGH VOLTAGE KIT (277V & 347V SYSTEMS ONLY)

Sized for Air Handler
(includes fuses and transformers)



(shipped separately)

14 TRANSFORMER WIRING HARNESS (277V & 347V SYSTEMS ONLY)

(shipped in electrical panel)

Installation

PLACEMENT AND CLEARANCE REQUIREMENTS

The system dimensions and required clearances MUST be taken into consideration when choosing its location within a structure. (See Figure 2 for dimensions and clearance requirements.)

The best installation location for the system is in a space requiring heat so some amount of the heating requirements can be satisfied through static dissipation from the warm outer panels of the Storage Module(s). In situations where the system is not installed in an area it is intended to heat (i.e. garage), it is important to account for the heat lost through static dissipation by making proper adjustments when sizing.

> **⚠ WARNING**
>
> **Risk of injury or fire. Violation of the clearance requirements and/or failure to provide proper ventilation can cause improper operation of the system. Maintain the placement and clearance requirements as specified and provide ventilation as necessary.**

The minimum area required for the installation of the system is 100 square feet per Storage Module. **This area must remain free of debris and room air should be maintained at less than 85° Fahrenheit.** Ventilation MUST be provided if the system is being installed in an area with less than 600 square feet. It is the responsibility of the installer and system designer to provide this ventilation.

In addition to the physical space requirements, the weight of the system must also be taken into consideration when selecting the installation surface. A level concrete floor is the designed installation surface, but most well supported surfaces are acceptable. If unsure of floor load capacity, consult a building contractor or architect.

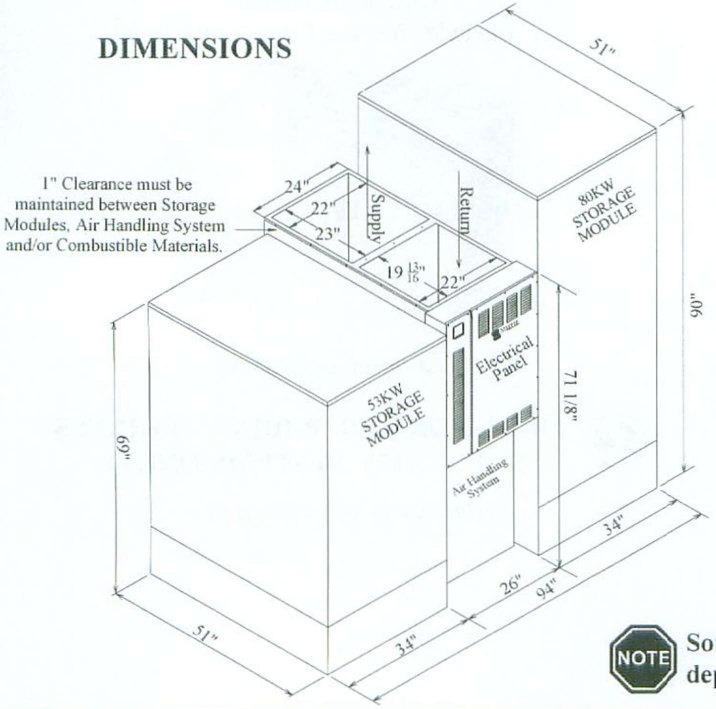
NOTE **Special requirements must be considered if placing the system in a garage or other area where combustible vapors may be present. Consult local, state, and national codes and regulations to ensure proper installation.**

SYSTEM REQUIREMENTS
FIGURE 2

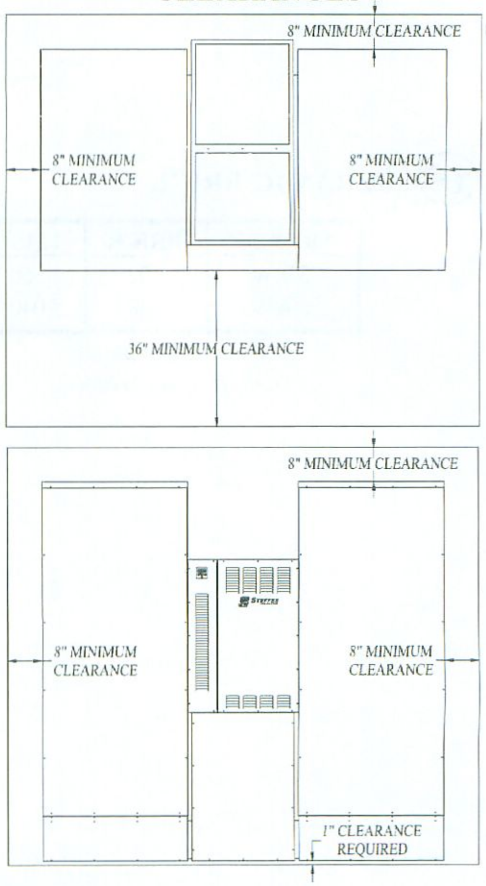
Storage Module (53kW and 80kW)
- Back = 8 inches
- Bottom = 1 inch (from combustible material)
- Sides = 8 inches
- Top = 8 inches (from combustible material)
- Front = 36 inches (for ease in servicing)

Air Handler (2000 and 3000 CFM)
- Back = 1 inch clearance
- Bottom = 1 inch (from combustible material)
- Sides = 1 inch clearance
- Top = 0 inches (from combustible material)
- Front = 36 inches (for ease in servicing)

DIMENSIONS



CLEARANCES



NOTE **Some electrical codes may require a greater front clearance depending on operating voltages and other factors.**

INITIAL SET-UP

Step 1 Remove the Information Package from the outside of the electrical panel and unpackage the Storage Module(s) and Air Handler.

Step 2 Move the system into its installation location. Optional liftting handles are available from the factory. (Order Item #1302120).

NOTE **If using Steffes lifting handles, remove painted front and back panels from brick storage cavity.**

WARNING

HEAVY OBJECT WARNING: Risk of personal injury, or death. ThermElect Hydronic systems are heavy. Use lifting aids to move system into place.

- **Do not place object, hands, and/or body parts under the system when lifting.**
- **Do use care to keep objects, hands, and/or body parts clear of system when *lifting*.**

CAUTION

Risk of improper operation or equipment damage. Read and follow installation instructions carefully.

- DO NOT install the system on its shipping pallet.
- DO NOT extend the leveling legs more than one inch.
- DO use and follow generally accepted safety practices when handling insulation materials.
- Equipment MUST be installed by qualified technician in accordance with all applicable codes and regulations.

ATTACHING STORAGE MODULE(S) TO AIR HANDLER

NOTE **Each side of the Air Handler has a Storage Module Inlet/Outlet Opening, Limit Access Panel and knockout. If using only one Storage Module follow the instructions below for the side of the Air Handler where the Storage Module will be attached.**

Step 1 Remove the screws around the Storage Module Inlet/Outlet Opening(s) on the side of the Air Handler where the Storage Module will be placed. (See Figure 3.)

Step 2 Remove the front painted panel from the Air Handler and set aside.

Step 3 Lift the Storage Module Inlet/Outlet Opening cover(s) out through the front of the Air Handler.

Step 4 Attach the top and bottom C-clip drive brackets and the side L brackets to the Air Handler. (See Figure 3.)

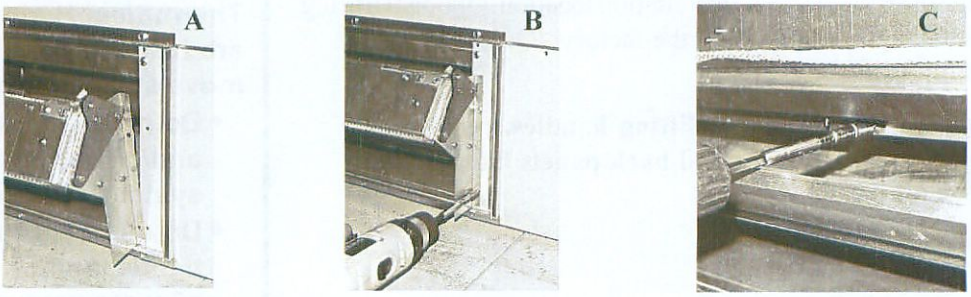
NOTE **When attaching the top C-clip drive bracket, use the top row of screw holes.**

Installation

FIGURE 3

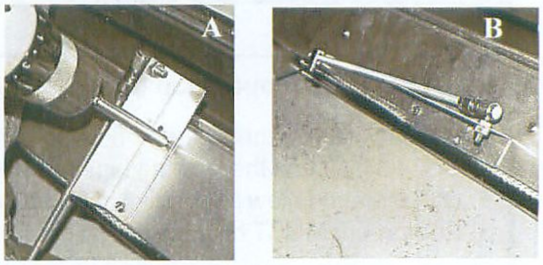
Step 5 Securely mount the damper(s) to the Storage Module(s) using the screws provided in the outlet damper kit. Two screws are required for each side of the damper assembly (Figures 4A and 4B); four screws are inserted along the top and four screws are inserted along the bottom of the damper. To insert the top screws, open the damper as shown in Figure 4C.

FIGURE 4



Step 6 Remove the top two screws from the damper bracket at the center of the damper assembly (Figure 5A). Rotate the damper actuator assembly 90 degrees (Figure 5B) to keep it out of the way when attaching the Storage Module(s) to the Air Handler.

FIGURE 5

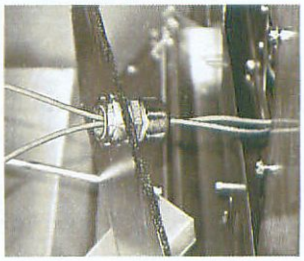


Step 7 Remove the 7/8" (inner) knockout on the limit access panel (Figure 3) on the side(s) of the Air Handler where the Storage Module(s) will be attached.

Step 8 Move the Storage Module(s) within 6" of final position to Air Handler. Once in place, adjust the leveling legs on the bottom of the Storage Module(s) as necessary to prevent rocking. If not placed properly the system may bend or twist during the brick loading process, causing alignment problems during re-assembly.

NOTE **DO NOT extend the leveling legs more than 1".**

FIGURE 6

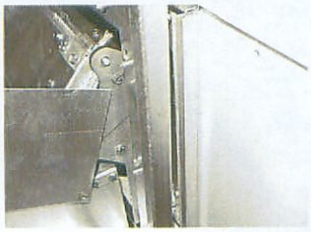


Step 9 Locate the orange limit switch wires in the limit area of the Storage Module(s). Secure the connector located on these limit switch wires into the knockout on the limit access panel (Figure 6).

Step 10 Making certain that the orange limit switch wires between the Air Handler and Storage Module(s) are routed properly, move the Storage Module(s) into their final location next to the Air Handler. The edge of the side L brackets on the Air Handler MUST fit inside the S-Clip brackets on the side(s) of the Storage Module(s). (See Figures 7 and 8.)

FIGURE 7

FIGURE 8



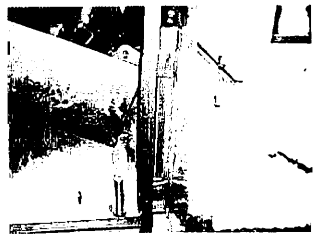
CAUTION

Risk of Improper Operation and Equipment Damage. Improper routing of the limit switch wires can result in improper operation or equipment damage. DO NOT physically damage or route the limit switch wires near high temperature areas. When attaching the Storage Module to the Air Handler make sure the limit switch wires are not pinched or cut. When routing the limt switch wires inside the Air Handler, make sure they are routed through the pre-installed plastic cable ties.

Step 11 Attach the Storage Module(s) to the Air Handler using the C-drives provided (Figure 9). Bend excess length of drives over to seal the damper area (Figure 10).

FIGURE 9

FIGURE 10



Step 12 Route the orange limit switch wires through the pre-installed plastic cable ties on the inside of the Air Handler.

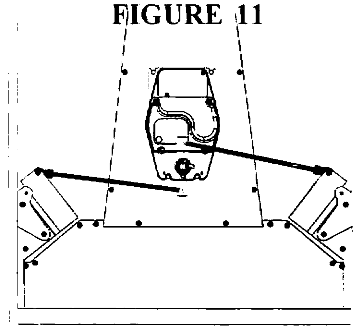
Step 13 Connect the orange limit switch wires from the Storage Module(s) to the orange wires from the electrical panel. When installing dual Storage Modules it is important to connect the wires from the left side of the electrical panel to the left Storage Module and the wires from the right side of the electrical panel to the right Storage Module.

Step 14 Secure the damper actuator linkage(s) to the damper actuator arm(s) inserting the supplied spring clips through the hole in the pivot connector. The top hole in the actuator arm MUST be used for the right side damper. (See Figure 11.)

> **⚠ WARNING**
>
> **Risk of fire and/or equipment damage. When installing dual Storage Modules it is important to connect the orange/black wires from the left side of the electrical panel to the left Storage Module and the right side wires to the right Storage Module.**

NOTE **The upper pivot hole on the actuator arm is for the right side Storage Module. The lower pivot hole on the actuator arm is for the left side Storage Module.**

AIR HANDLER DAMPER LINKAGE FIGURE 11



Step 15 Adjust damper linkage length(s) appropriately to ensure the damper(s) fully close. Check the ball end linkage connector on the damper. The nut side MUST be facing the front of the system. If not, it MUST be inverted.

Step 16 With the system de-energized, adjust the linkage by rotating the quick disconnect end of the linkage until the damper is pressed firmly in the closed position.

ELECTRICAL PANEL INSTALLATION

Step 1 Reinstall the painted front panel on the Air Handler to aid in installation of the electrical panel.

Step 2 Remove the electrical panel front cover and locate the installation hardware package.

Step 3 Remove 1/2" knockout and 1" knockout from sides of electrical panel and Storage Module(s) to allow connection. **DO NOT remove any uneeded knockouts.**

Step 4 Lift the electrical panel onto the support bend of the Air Handler's painted front panel.

Step 5 Secure the electrical panel to the Air Handler with the five 8 x 3/4" sheet metal screws shipped with the outlet damper kit.

Step 6 Remove the lower painted front panel of the Air Handler.

Step 7 Connect the 9-pin blower harness from the Air Handler to the harness from the electrical panel.

NOTE **Knockout must be effectively sealed by connector.**

Step 8 **277/347 only**. Remove one 1/2" knockout from lower left hand bottom panel and connect straight seal-tite connector on conduit to bottom of electrical panel. Connect the other end of the conduit to dry type enclosed transformer. Mount the transformer to the Air Handler's painted front panel. Make connections according to instructions with transformer.

NOTE **Install only the proper size and type fuses in the factory supplied fuse block.**

Installation

BRICK LOADING

Step 1 Remove the painted front panel of the brick Storage Module(s) by removing the sheet metal screws along the top, bottom, and sides of the panel. Detach by pulling the bottom of the panel forward and down.

Step 2 Remove the sheet metal screws around the outer edge of the galvanized front panel. Remove the panel and set it aside.

Step 3 Starting at the bottom, carefully lift each of the insulation blankets and drape them over the top of the Storage Module(s).

> **⚠ CAUTION**
>
> **Risk of equipment damage or personal injury.** Insulation boards located behind the insulation blankets may fall out when blankets are lifted. Use caution when lifting insulation blankets to avoid personal injury or damage to the insulation boards.

Step 4 Remove the rigid insulation boards and place to the side in the order removed.

Step 5 Load the brick, one row at a time, starting at the back of the brick core and working forward. Load bricks as shown in Figure 12. Make certain brick debris does not interfere with brick alignment front to back.

Step 6 Install top air channel block by sliding it up and back into place on top of the bricks. (See Figure 13)

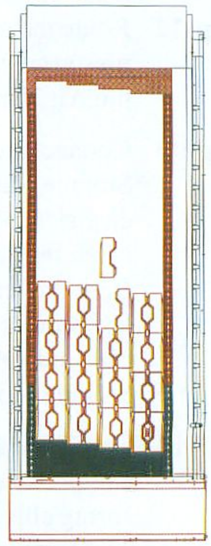
NOTE **For ease of installation, install top block while loading bricks.**

Step 7 Install rigid insulation boards into the Storage Module(s) in the order they were removed in Step 4.

NOTE **The holes in the rigid insulation board MUST line up with the brick openings so elements can be installed.**

> ***BRICK INSTALLATION TIPS:***
> - Install bricks carefully to avoid damage to the insulation panels.
> - Remove loose brick debris to prevent uneven stacking of brick as this can make installation of the elements and the brick core temperature sensor(s) difficult.
> - Brick rows MUST line up front to back and top to bottom.

BRICK LOADING FIGURE 12



> **⚠ WARNING**
>
> **Risk of injury or fire. DO NOT operate the system if damage to the insulation panels on the inner sides of the brick core occurs.**

FIGURE 13

Installation

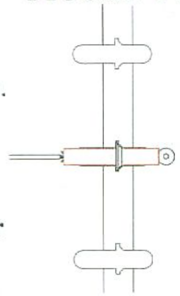
HEATING ELEMENT INSTALLATION

Step 1 After all bricks are loaded and rigid insulation boards are in place, insert the heating elements through the insulation, sliding them in until the cement side rails are flush with the front side of the ceramic brick.

NOTE **Make sure the elements designated as Air Handler side elements are installed on the Air Handler side of the Storage Module(s).**

Step 2 Route the element termination head with ceramic insulator to the appropriate side of the Storage Module(s). Insert the lead into position as shown in Figure 14.

FIGURE 14

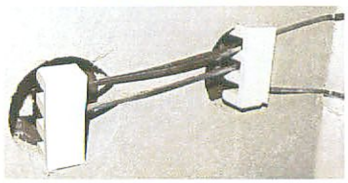


NOTE **Element leads must never cross each other.**

Step 3 Install element lead insulators. These ceramic insulators MUST maintain lead wire spacings as shown in Figure 15.

> **WARNING**
>
> - **HAZARDOUS VOLTAGE: Risk of electric shock, injury, or death.**
>   - **DO NOT remove the electrical panel cover while system is energized.**
>   - **Elements MUST be positioned properly to avoid short circuiting against any surfaces within the system.**
> - **Risk of improper operation or equipment damage. On Dual Storage Module systems, it is critical to route the correct harness to each of the Storage Modules. Mis-routing of harness will result in improper operation and equipment damage. Make certain the harness connected to the right side relay bank in the electrical panel is routed to the right side Storage Module.**

FIGURE 15



Step 4 Lower the insulation blankets back into position, one at a time. Carefully tuck the sides of the insulation into the edges, corners, and around the exposed portions of the heating element to ensure maximum efficiency.

Step 5 Reinstall the galvanized front panel and secure it to the system using the screws originally removed.

Step 6 Route element harnesses through connectors, using one connector/harness until tape is centered in connector. If installing two Storage Modules, use left hand bank of relays for left hand and right hand for right hand. One harness per module is shorter and must be used for inside element connections.

Step 7 Attach element lead wires to element terminals. Start at the top using the appropriate color chart below. Repeat pattern as necessary.

277/347V Systems	**208/240V 3phase Systems**	**240V 1phase Systems**
Black (Top)	Black (Top)	Black (Top)
White	Red	Red
Red	Blue	Black
White	Black	Red
Blue	Red	
White	Blue	

BRICK CORE TEMPERATURE SENSOR INSTALLATION

CAUTION

Risk of improper operation. Proper installation of the brick core temperature sensor is critical to the operation of the heating system. Read and follow installation instructions carefully.

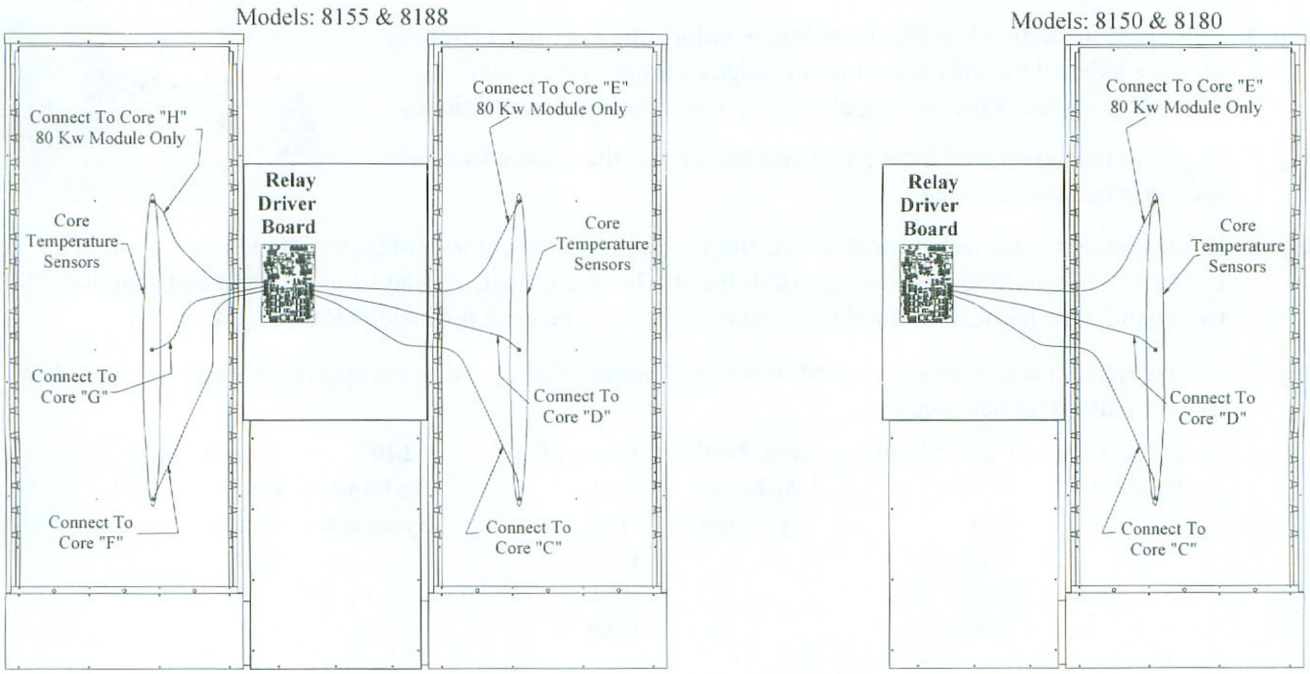
Step 1 Remove the screw(s) by the brick core temperature sensor connector holes in the galvanized front panel.

Step 2 Route the brick core temperature sensors through the clear plastic tube until within six inches of the relay driver board. Cut tube and sensor wires to length as needed. The yellow wire from each sensor must be connected to the Y terminal of the proper sensor connection terminal block, and red to R. **Polarity of sensors is critical.**

Sensor connections MUST be installed as follows:

- **Single Module - 8150 or 8180 (Figure 16)**
  - Bottom sensor to core C
  - Second sensor to core D
  - Third (if equipped) to core E
- **Dual Module - 8155, 8185, and 8188 (Figure 16)**
  - Left module
    - Bottom sensor to core F
    - Second sensor to core G
    - Third (if equipped) to core H
  - Right module
    - Bottom sensor to core C
    - Second sensor to core D
    - Third (if equipped) to core E

CORE TEMPERATURE SENSOR CONNECTIONS
FIGURE 16



NOTE **In systems using both an 80kW and 53kW Storage Module, the 53kW Storage Module must be installed on the left side of the Air Handler.**

Step 3 Insert the brick core temperature sensors through the holes in the galvanized front panel. The sensors must pass through the blanket and board insulation and into the brick core. Use the sensors to aid in making a passageway by rotating the sensors while gently pushing inward.

Step 4 Once brick core sensors are installed, re-install sensor mounting screws to secure and ground the sensors.

Step 5 Re-install the painted front panel, using previously removed screws.

AIR CONDITIONER/HEAT PUMP INTERFACE

The system can accommodate most heat pump or air conditioner indoor coils up to a 7.5-ton capacity provided the heat pump or air conditioner is sized in accordance to supply air delivery rates of the system. Refer to the System Air Delivery Matrix for information on air delivery rates of the supply air blower with regard to the blower's speed, To ensure that adequate air flow is provided for the heat pump or air conditioner system being installed.

When interfacing the system with a heat pump, the indoor coil MUST be placed on the return side of the system in a position that provides even air flow through the coil. The installer needs to make provisions in the plenum to accommodate the coil and air filter. When interfacing with an air conditioner, the indoor coil can be placed on either the supply air or return air side. The condensate drain trap, in a heat pump or air conditioner installation, should be designed for the vacuum in which the system is operating. Typically, taller traps are better suited for these types of applications.

WARNING

Risk of fire. Any one ducting system MUST NOT contain more than one air handling (blower) system. If the application requires multiple systems or it is necessary to have multiple air handlers share the same ductwork, you MUST contact Steffes Corporation. There are special installation requirements that MUST be performed.

Refer to the Room Thermostat Connections Diagrams for more information on interfacing the system with a heat pump or air conditioner. Refer to Location 46 and 47 in the Supplemental Installer's Guide for information on compressor control from the ThermElect system using outdoor temperature lockout.

DUCTING

SUPPLY AIR BLOWER SPEED

For air delivery, the system is equipped with a 2000 CFM Air Handler containing a 3-speed supply air blower. The system is factory wired to operate in medium speed for "heating" and in high speed for "cooling" or a "fan only" thermostat setting.

Blower speed selection is made at the supply air blower. To change blower speed for either "heating" or "cooling" modes, detach the quick disconnect terminals at the supply air blower. Select the blower speed and connect the corresponding wires.

NOTE **When interfacing the system with a heat pump, the blower speed connected to the high speed relay is used for both heating and cooling.**

WARNING

- **HAZARDOUS VOLTAGE: Risk of electric shock, injury or death. DO NOT operate the system without ducting installed to both the air inlet and outlet.**
- **EQUIPMENT DAMAGE: Risk of equipment damage or improper operation. On 3000 CFM systems where there are multiple supply air blowers, both blowers MUST be connected to the same blower speed to avoid equipment damage.**

SYSTEM AIR DELIVERY MATRIX

Supply Air Blower Speed	(External static pressure should not exceed .75 inches water column for all models) .25"		.50"		.75"	
	2000	3000*	2000	3000*	2000	3000*
High (CFM)	2050	2950	1900	2490	1540	2160
Medium High (CFM)	1990	2850	1890	2350	1535	1980
Medium Low (CFM)	1870	2520	1670	2270	1450	N/A
Low (CFM)	N/A	1920	N/A	N/A	N/A	N/A

** An optional 3000 CFM Air Handler is available. The 3000 CFM Air Handler is equipped with two 4-speed supply air blowers.*

LINE VOLTAGE ELECTRICAL CONNECTIONS

To determine the correct wire size required for the circuit feeding the system, refer to the Specifications (Page A.01-A.03) and the system's identification label located on the front of the electrical panel (Figure 17).

WARNING

- **HAZARDOUS VOLTAGE: Risk of electric shock, injury or death. Do not energize the system until installation is complete. Equipment MUST be installed by a qualified technician in accordance with all applicable local, state, and national codes and regulations.**
- **Risk of equipment damage, personal injury or fire. Do NOT install any wiring in line voltage compartment unless rated for line voltage. To ensure proper operation and safety, all wiring in the line voltage compartment MUST be rated for line voltage.**

Step 1 Remove the electrical panel cover.

Step 2 Route all line voltage wires through a knockout and into the electrical panel.

Step 3 Make line voltage connections (See Page 3.10) to lugs of single feed bus and ground lug. Refer to the Line Voltage Wiring Diagrams (Pages A.04 - A.05) for more information on these connections.

SAMPLE SYSTEM IDENTIFICATION LABEL
FIGURE 17

STEFFES CORPORATION

Electric Central Heating Furnace SP99 — c UL us LISTED

Model 8150 S/N 30405505311872 HHC Option STD

Max Discharge Air Temperature 200 degrees F

Max External Static Pressure .75"

Connections Required - Single Circuit Feed

347 Volts 53328 Watts 60 Hz

3 Phase 4 Wire

Min Circuit Ampacity 67.78 Amps

Max Fuse or Circuit Breaker Size 100

Max Amps of Motors Included in Unit

Core Blower	1.2	Amps	1/4	HP
Supply Air Blower #1	5.4	Amps	3/4	HP
Supply Air Blower #2	N/A	Amps	N/A	HP

Unit Clearance Requirements
8100 Series

Allow eight (8) inches from back, sides, and top of Storage Module(s) to combustibles. Allow thirty-six (36) inches front clearance to provide space for servicing of the Air Handler and Storage Module(s). Allow one (1) inch clearance between the Air Handler and Storage Module(s). A one (1) inch bottom clearance is required for the Storage Module(s) and the Air Handler.

NOTE **Use copper or aluminum conductors rated at 75°C or higher for line voltage field connection of this device.**

OUTDOOR TEMPERATURE SENSOR INSTALLATION

An outdoor temperature sensor, shipped in the electrical compartment, is required to be installed with the system. This sensor monitors outdoor temperature and provides this information to the system. The system responds by automatically storing heat in its brick core(s) according to the outdoor temperature and the heating requirements.

The outdoor temperature sensor can be installed in one of two ways: direct wired to the system or wired to the Steffes power line carrier system. **All 208/240V systems are factory configured for automatic charge control with a direct wired outdoor sensor.**

NOTE

- **If connecting to the Steffes power line carrier (PLC) system, follow the installation instructions in the PLC system's Owner's and Installer's Guide.**
- **Outdoor sensor wire MUST NEVER be combined with other control wiring in a multi-conductor cable.**

INSTALLING THE OUTDOOR SENSOR

Step 1 The outdoor sensor must be placed in a location where it can accurately sense outdoor temperature and is not affected by direct sunlight or other abnormal temperature conditions. Select a location and mount the sensor.

Step 2 Route low voltage wire from the outdoor sensor to the electrical compartment through one of the low voltage wire knockouts.

- If the sensor wiring is routed through an external wall, the opening through which the wire is routed MUST be sealed. Failure to do so may affect the accuracy of the outdoor temperature sensor.
- The outdoor sensor is supplied with a lead length of 40 ft. If a greater wire length is needed, it can be extended to a total of 250 ft. No other loads can be controlled or supplied through this cable. It is for connection of the outdoor sensor ONLY. This low voltage cable should not enter any line voltage enclosure.
- Unshielded Class II (thermostat) wire can be used as extension wire provided it is segregated from any line voltage cabling.

Step 3 Connect the outdoor sensor wires to the "OS" and "SC" positions of the twelve (12) position low voltage terminal block located inside the electrical compartment.

NOTE **Refer to Location 10 (L010) of the Supplemental Installer's Guide to select the desired method of charge control.**

THERMOSTAT CONNECTIONS

A low voltage room thermostat is required for room temperature control with the system. Any room thermostat used with this system must be 24 VAC. (Contact the factory for more information on the thermostats available from Steffes.)

INSTALLING THE THERMOSTAT

Step 1 Disconnect power to the system and route low voltage wire between the thermostat and the system.

Step 2 Insulate the wall opening through which the thermostat wires run. Failure to do so may affect the accuracy of the thermostat.

Step 3 Attach the thermostat to a wall. If installing a mechanical thermostat or thermostat with anticipator. a resistor kit is required (Order Item #1190015).

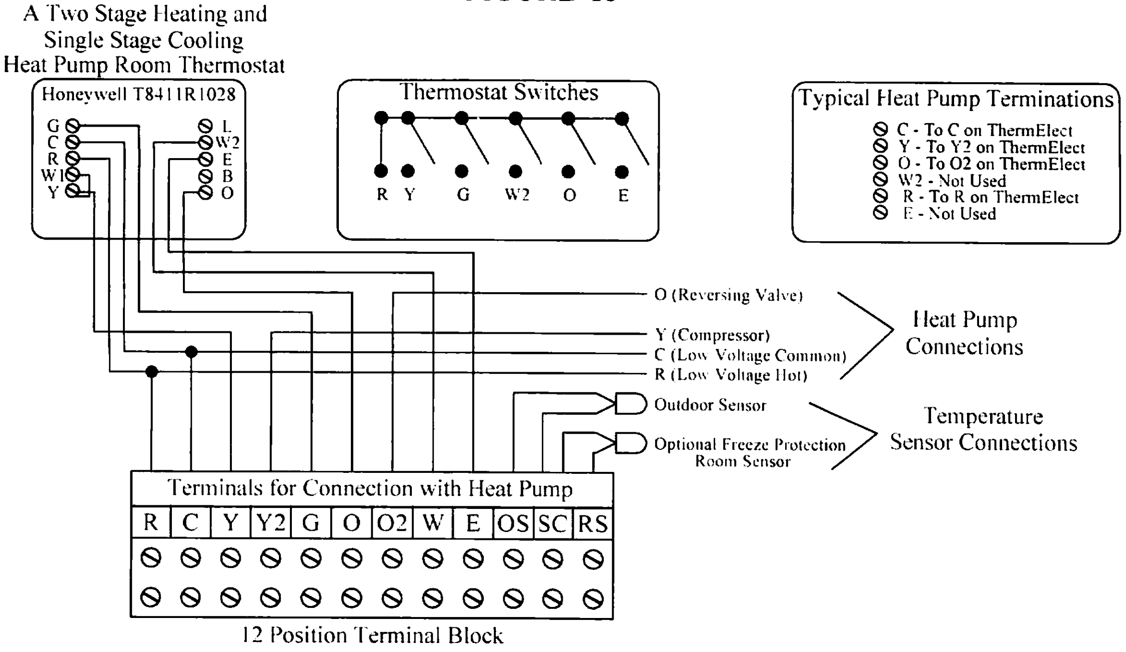
Step 4 Route the low voltage wire into the electrical compartment of the system through one of its low voltage wire knockouts and to the system's twelve (12) position low voltage terminal block.

NOTE **Never install any wiring in the line voltage compartment of the system unless it is rated for line voltage.**

Step 5 Refer to the Room Thermostat Connections Diagrams (Figures 18 and 19) in this manual for proper connections with regard to the application.

NOTE **Refer to Temperature Control in the Operation Section of this manual for specific operation information.**

THERMOSTAT CONNECTIONS (Heat Pump Applications)
FIGURE 18

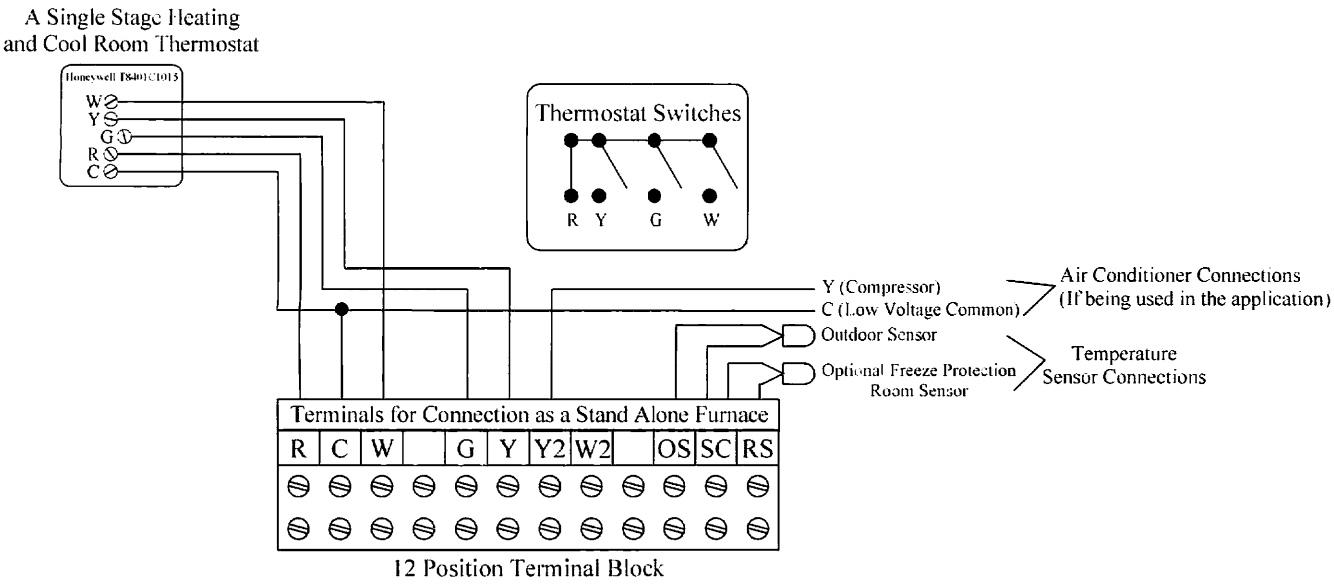


Installation

12-Position Low Voltage Terminal Block Coding

R	= Low Voltage Hot	O	= Reversing Valve Input
C	= Low Voltage Common	O2	= Reversing Valve Output
Y	= Compressor/Stage 1 Heat Call	E	= Emergency Heat
W	= Stage 2 Heat Call	OS	= Outdoor Temperature Sensor
Y2	= Compressor Output	SC	= Outdoor Temperature Sensor Common
G	= Fan Call	RS	= Freeze Protection Room Temperature Sensor

THERMOSTAT CONNECTIONS (Stand Alone Furnace Application)
FIGURE 19



ELECTRONIC AIR FILTER INSTALLATION

The ThermElect system is capable of being connected to an electronic air filter. Connections to the ThermElect system are made to the bottom left relay (FAN ON) on the Base IO Relay Board inside the system's electrical panel. This relay closes during a fan call. Refer to the Line Voltage Wiring Diagrams (Page A.04-A.05) for the location of this relay.

INSTALLER'S FINAL CHECK-OUT PROCEDURE

WARNING

HAZARDOUS VOLTAGE: Risk of electric shock, injury, or death. System may be connected to more than one branch circuit. Disconnect power to all circuits before servicing. Equipment must be serviced by a qualified technician.

Step 1 Verify that the operating mode displayed on the control panel corresponds with the power company's peak control signal. Refer to the Operating Status section (Page 1.02) for more information on the proper operating mode.

Step 2 Press the up arrow one time and verify that the outdoor temperature information displayed on the control panel is approximately the same as the current outdoor temperature. Refer to the Operating Status section (Page 1.02) for more information on the outdoor temperature display.

Step 3 Press the up arrow again and the current heat call status will be displayed on the control panel. Refer to the Operating Status section (Page 1.02) for more information on the heat call status display.

Step 4 Initiate a heat call from the room thermostat and verify that the system recognizes the heat call. Refer to the Operating Status section (Page 1.02) for more information on the various heat call status displays. The supply air blower should operate. In an application interfacing the system with an air conditioner or heat pump, verify that this device is operating appropriately.

Step 5 Initiate a cooling call from the room thermostat, if applicable, and verify that the system recognizes the "COOL" call. The supply air blower should operate. In an application interfacing the system with an air conditioner or heat pump, verify that this device is operating appropriately.

Step 6 Press the up arrow until the targeted brick core charge level is displayed on the control panel. With the system in an off-peak (charge) mode, initiate a charge control override. (See Page 1.03.) Once initiated, the target level of the system should be 100 percent and the control panel should display "tL: F". All of the elements should be energized.

Step 7 With all heating elements operating, disconnect the orange/black wire located at the air outlet, above the damper assembly of each Storage Module. When this wire is disconnected, all heating elements of that Storage Module should turn off. Repeat this step on the second Storage Module (if equipped).

NOTE **Ensuring that all heating elements turn off when the core limit(s) open is important. Make sure Step 7 of the Installer's Final Check-Out Procedure is completed.**

Step 8 With an amp meter, verify that the amperage of the system is correct for the installation. Refer to the System Identification Label on the heating system for information regarding the proper amperage.

Step 9 Cancel the charge control override and verify that all elements in the system de-energize. Refer to the Charge Control Override section (Page 1.03) for instructions on canceling the charge control override.

Step 10 Verify, once again, that the Operating Mode displayed on the control panel corresponds with the power company's peak control signal.

Step 11 In applications utilizing the Steffes Power Line Carrier control system, complete the Installer's Final Check-Out Procedure in the Owner's and Installer's Manual provided with that device.

Step 12 Complete the manufacturer's warranty card and return promptly.

4 LOAD MANAGEMENT

The ThermElect is a commercial Electric Thermal Storage (ETS) heating system. It is generally signaled to use demand free, off-peak electricity to provide a low cost heating solution for commercial, industrial, and large residential applications. ETS equipment is designed to store electricity, as heat, during hours when energy costs are lower and kW demand charges are not incurred. The ThermElect's thermal mass consists of a high-density ceramic brick capable of vast heat storage.

The ThermElect system is designed to operate under one of three different load management control strategies.

ON-PEAK/OFF-PEAK PROGRAM

The ThermElect system responds to heat calls during the on-peak and off-peak periods; however, only consumes energy (energize heating elements) during the off-peak periods. The ThermElect system is controlled by an external control device such as a meter or time clock module and also offers on-peak control of external loads by utilizing the dry contacts provided on the relay driver board.

NOTE **Never install any wiring in a line voltage compartment of the system unless it is rated for line voltage.**

The ThermElect system may be controlled by the Power Company via a peak control signal. This signal can be sent to the equipment using low voltage wiring, a Steffes Time Clock Module, or a Steffes Power Line Carrier control system (208 and 240V applications only). In applications utilizing automatic charge control, outdoor temperature information is required and can be received via an outdoor sensor or power line carrier control system.

The heating system is factory configured for low voltage wire control and is set to charge when the utility peak control switch closes.

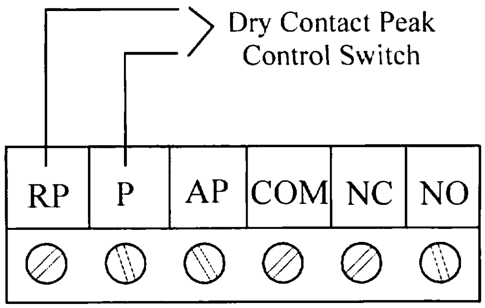
LOW VOLTAGE (DIRECT WIRED) PEAK CONTROL

If using the low voltage peak control option, the system is direct wired to the power company's peak control switch. Field connections from the peak control switch are made to the low voltage terminal block through a low voltage knockout located on the left side of electrical panel.

Step 1 Route a low voltage circuit from the power company's load control or peak signaling device to the six (6) position terminal block (Figure 20) inside the electrical compartment.

Step 2 Connect the field wiring to positions "RP" and "P" on the six (6) position low voltage terminal block. (See Figure 20.)

PEAK CONTROL TERMINAL CONNECTIONS
FIGURE 20



6-Position Low Voltage Terminal Block Coding

RP	=	Peak Control Input Common
P	=	Peak Control Input
AP	=	Anticipated Peak (Pre-Peak) Control Input
COM	=	Peak Control Output Common
NC	=	Peak Control Output (Normally Closed)
NO	=	Peak Control Output (Normally Open)

TIME CLOCK MODULE PEAK CONTROL

The Steffes Time Clock Module is another option for providing a peak control signal to the system. The optional time clock module mounts inside the line voltage electrical compartment and interfaces with the relay board via an interface cable. Peak control times MUST be programmed into the system once the module is installed to enable the time clock feature. Refer to the instructions provided with the time clock module for more information on the installation and operation of this device.

POWER LINE CARRIER (PLC) PEAK CONTROL

NOTE **Power Line Carrier (PLC) control is only available in 208/240V applications.**

The Steffes Power Line Carrier (PLC) control system has the ability to communicate with the system through the existing electrical circuits in the structure. With the power line carrier option, direct wired low voltage connections from the power company's peak signaling switch connect directly to the transmitting device. The switch signals peak control times to the transmitter, the transmitter sends the signals to the system, which receives this information and responds accordingly.

In addition to providing peak control signals, the transmitter also provides outdoor temperature information for automatic charge control, room temperature set back, and anticipated peak utility control signals (if applicable).

The PLC system is optional and must be ordered separately. If utilizing a PLC system, an Owner's and Installer's manual will accompany the transmitting device. Refer to this manual for information on the installation and operation of the power line carrier control system.

4-20 MILLIAMP CONTROL (1-5 VOLT DC)

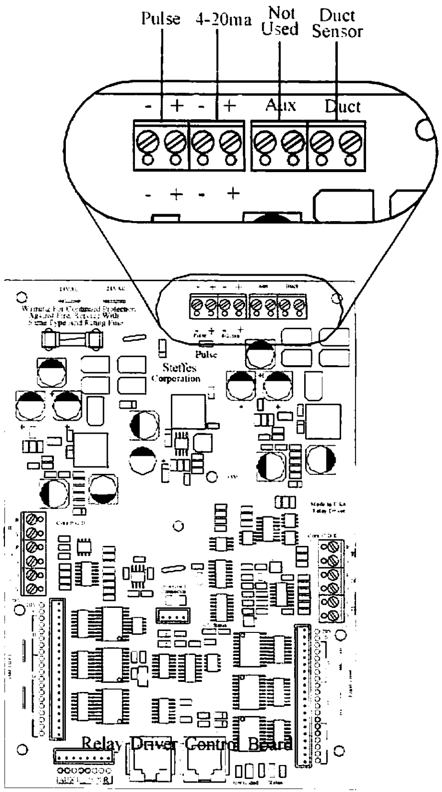
The ThermElect system receives a signal from an external load control device such as a building load management system. This external signal dictates to the ThermElect the maximum amount of energy which can be consumed during a preset time interval. This value is recalculated automatically every 15 minutes.

To enable the 4-20 milliamp control, the one (1) bit must be added to the current value of Location 53 (L053). Once enabled, the ThermElect system will continually monitor the current loop input and randomly shed elements as needed to remain within the maximum load desired by the load management system. Elements will be shed from the hottest core first.

The building's load management system is connected to the ThermElect system with low voltage wire. The wires are routed into the electrical panel and connected to the terminals for 4-20ma on the relay driver board (Figure 21).

Other external loads are generally controlled through the building's load management control system.

4-20 MILLI-AMP OR PULSE MONITORING CONNECTIONS FIGURE 21



PULSE MONITORING

The ThermElect system monitors pulse outputs from the power company's electric meter. Program parameters such as desired maximum building kW and pulse ratios for the metering system being used are entered into the ThermElect system. The system then changes proportionally when demand free power is available. This keeps the total building kW usage at or below the desired level.

To enable pulse monitoring, the 2 bit must be set in Location 53 (L053). Location 54 (L054) needs to be configured for the maximum load (load that can not be exceeded). This value is input as kW/10; therefore, if the maximum load is 1500 kW, the value in L054 would be set to 150. Location 56 (L056) needs to be configured for the input of a single heating element. For example, if the system is using 4,400 watt heating elements a value of 44 would be set in L056 (kW x 10).

To set the number of pulses per kWh, access the ELOC locations and set "E000" to the correct value. Input is registered as (# of pulses/kWh) X 10.

The pulse monitoring device is connected to the ThermElect system with low voltage wire. The wires are routed into the electrical panel and connected to the "pulse" terminals on the relay driver board (Figure 21).

With pulse monitoring, there are many options available for load control. The ThermElect system may be the only load being controlled with the pulse monitoring or other loads can be controlled by the relay driver board or up to two (2) external load management control modules (Order Item #1908410) can be added. Each module has eight (8) zones which can be controlled, for a total of sixteen (16). Configuration of the locations values and the ELOC locations will vary depending on the application and controls utilized. For more information on the proper settings, reference the Supplemental Installer's Guide or contact Steffes Technical Support at 1-888-783-3337.

Appendix A

SPECIFICATIONS

MODEL 8150

Input Voltage	**240**	**120/208**	**120/240**	**277/480**	**347/600**
Phase	**1**	**3**	**3**	**3**	**3**
Number of Wires	2	3	3	4	4
Charging Input (kW)	53.3	48.0	53.3	50.4	53.3
Elements - Quantity Elements - Watts Each	12 4,444	12 4,000	12 4,444	12 4,200	12 4,444
Amps – Core Charging	222.20	133.39	128.44	60.65	51.23
Max. Core & Blower Load (AMPS)	3.0	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	281.50	175.99	169.80	78.69	67.78
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh Storage Capacity - BTU	320 1,091,840				
Approximate Storage Module Weight (lbs)	770				
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	330 (utilizing 2000 CFM Air Handler)*				
Approximate Brick Weight (lbs)	3,440				
Approximate Installed Weight (lbs)	4,540 (add approx. 500 lbs to arrive at shipping weight)				
Number of Brick	192				

MODEL 8155

Input Voltage	**240**	**120/208**	**120/240**	**277/480**	**347/600**
Phase	**1**	**3**	**3**	**3**	**3**
Number of Wires	2	3	3	4	4
Charging Input (kW)	106.6	96.0	106.6	100.8	106.6
Elements - Quantity Elements - Watts Each	24 4,444	24 4,000	24 4,444	24 4,200	24 4,444
Amps – Core Charging	444.40	266.79	256.88	121.30	102.46
Max. Core & Blower Load (AMPS)	3.0	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	559.25	342.73	330.35	154.50	131.82
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh Storage Capacity - BTU	640 2,183,680				
Approximate Storage Module Weight (lbs)	770 per module = 1,540 Total				
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	610 (utilizing 2000 CFM Air Handler)*				
Approximate Brick Weight (lbs)	3,440 per module = 6,880 Total				
Approximate Installed Weight (lbs)	9,030 (add approx. 600 lbs to arrive at shipping weight)				
Number of Brick	192 per module = 384 Total				

* Optional 3000 CFM Air Handler increases approximate installed weight by 40 pounds.

MODEL 8180

Input Voltage	240	120/208	120/240	277/480	347/600
Phase	**1**	**3**	**3**	**3**	**3**
Number of Wires	2	3	3	4	4
Charging Input (kW)	80.0	72.0	80.0	75.6	80.0
Elements - Quantity Elements - Watts Each	18 4,444	18 4,000	18 4,444	18 4,200	18 4,444
Amps – Core Charging	333.30	200.09	192.66	90.97	76.84
Max. Core & Blower Load (AMPS)	3.0	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	420.38	259.36	250.07	116.59	99.80
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh Storage Capacity - BTU	480 1,637,760				
Approximate Storage Module Weight (lbs)	840				
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	400 (utilizing 2000 CFM Air Handler)*				
Approximate Brick Weight (lbs)	5,160				
Approximate Installed Weight (lbs)	6,400 (add approx. 600 lbs to arrive at shipping weight)				
Number of Brick	288				

MODEL 8185

Voltage	120/208	120/240	277/480	347/600
Phase	**3**	**3**	**3**	**3**
Number of Wires	3	3	4	4
Charging Input (kW)	120.0	133.3	126.0	133.3
Elements - Quantity Elements - Watts Each	30 4,000	30 4,444	30 4,200	30 4,444
Amps – Core Charging	333.48	321.10	151.62	128.07
Max. Core & Blower Load (AMPS)	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	426.10	410.62	192.41	163.84
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh Storage Capacity - BTU	800 2,729,600			
Approximate Storage Module Weight (lbs)	770 (53kW) + 840 (80kW) = 1,610 Total			
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	730 (utilizing 2000 CFM Air Handler)*			
Approximate Brick Weight (lbs)	8,600			
Approximate Installed Weight (lbs)	10,940 (add approx. 650 lbs to arrive at shipping weight)			
Number of Brick	192 (53kW) + 288 (80kW) = 480 Total			

* Optional 3000 CFM Air Handler increases approximate installed weight by 40 pounds.

MODEL 8188

Input Voltage	**120/208**	**120/240**	**277/480**	**347/600**
Phase	**3**	**3**	**3**	**3**
Number of Wires	3	3	4	4
Charging Input (kW)	144.0	159.9	151.2	159.9
Elements - Quantity Elements - Watts Each	36 4,000	36 4,444	36 4,200	36 4,444
Amps – Core Charging	400.18	385.32	181.95	153.68
Max. Core & Blower Load (AMPS)	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	509.47	490.90	230.31	195.85
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh Storage Capacity - BTU	960 3,275,520			
Approximate Storage Module Weight (lbs)	840 per module = 1,680 total			
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	760 (utilizing 2000 CFM Air Handler)*			
Approximate Brick Weight (lbs)	10,320 Total			
Approximate Installed Weight (lbs)	12,760 (add approx. 700 lbs to arrive at shipping weight)			
Number of Brick	288 per module = 576 Total			

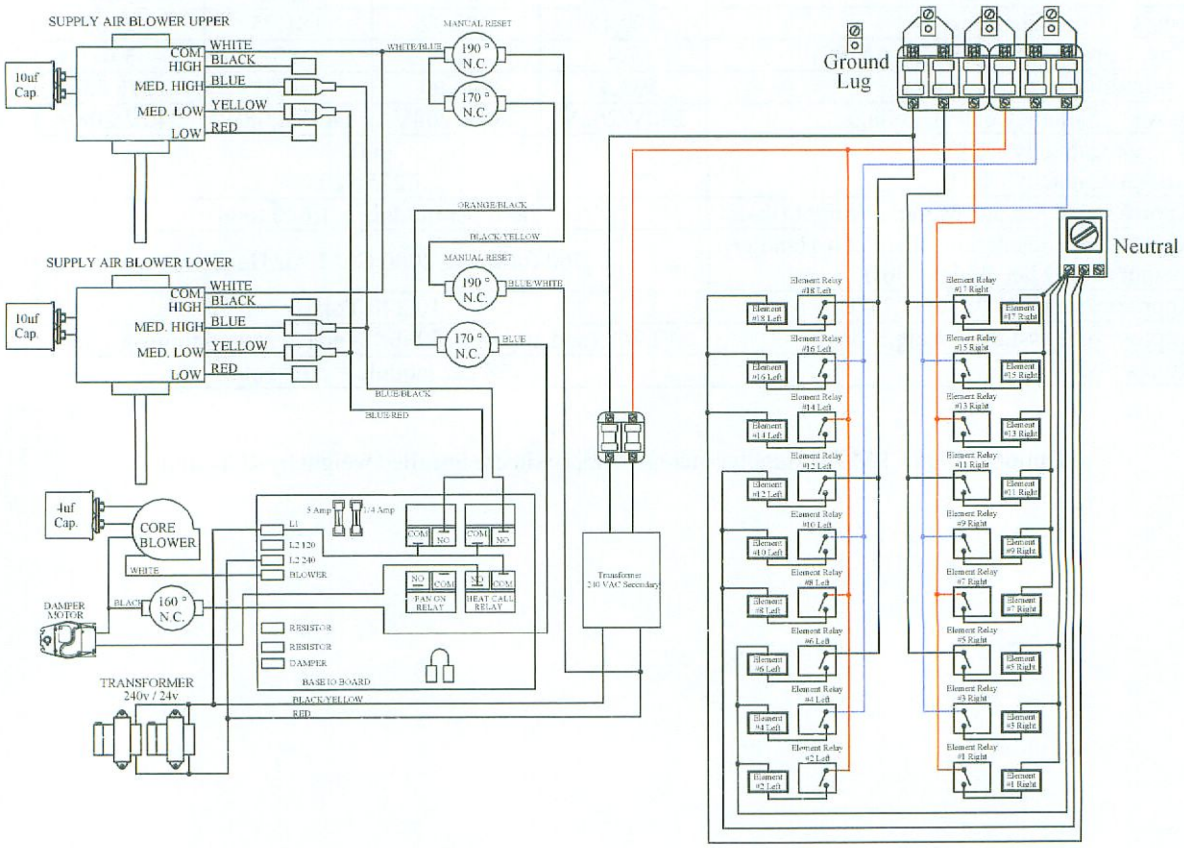
* Optional 3000 CFM Air Handler increases approximate installed weight by 40 pounds.

Appendix

Typical System Line Voltage Wiring Diagram

277/347 3 Phase 4 Wire - 3000 CFM

8180 APPLICATION



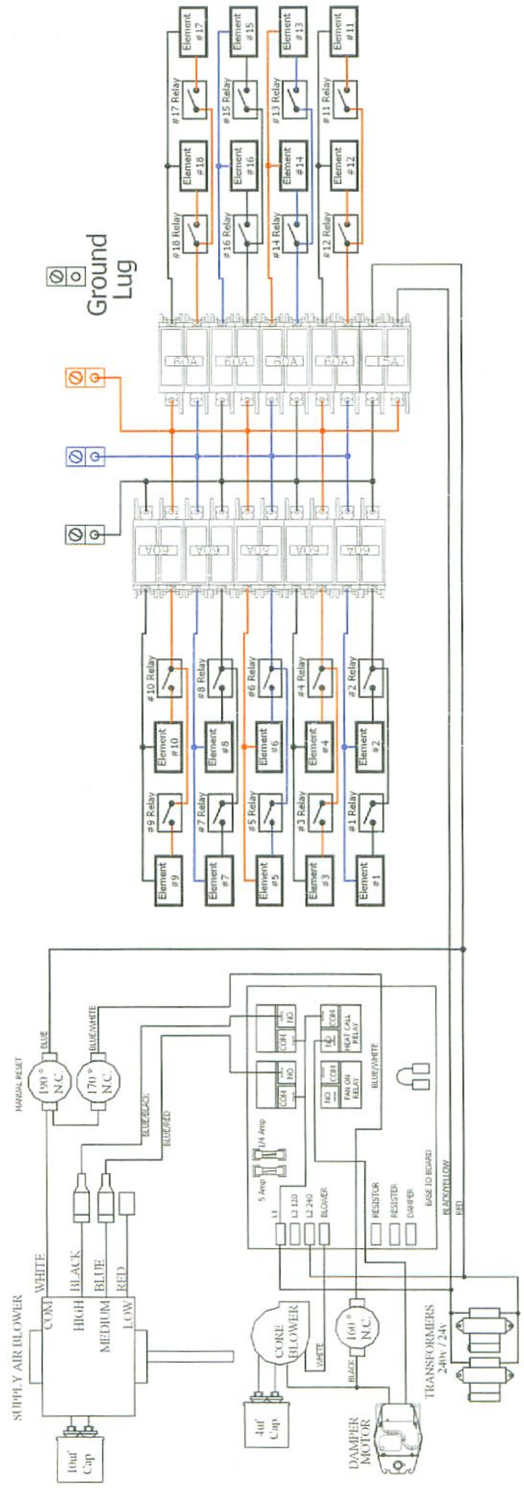
NOTE Use copper or aluminum conductors rated for 75°C or higher for field connection of this device.

Appendix

Typical System Line Voltage Wiring Diagram

208/240 3 Phase 3 Wire - 2000 CFM

8180 APPLICATION



NOTE Use copper or aluminum conductors rated for 75°C or higher for field connection of this device.

Appendix

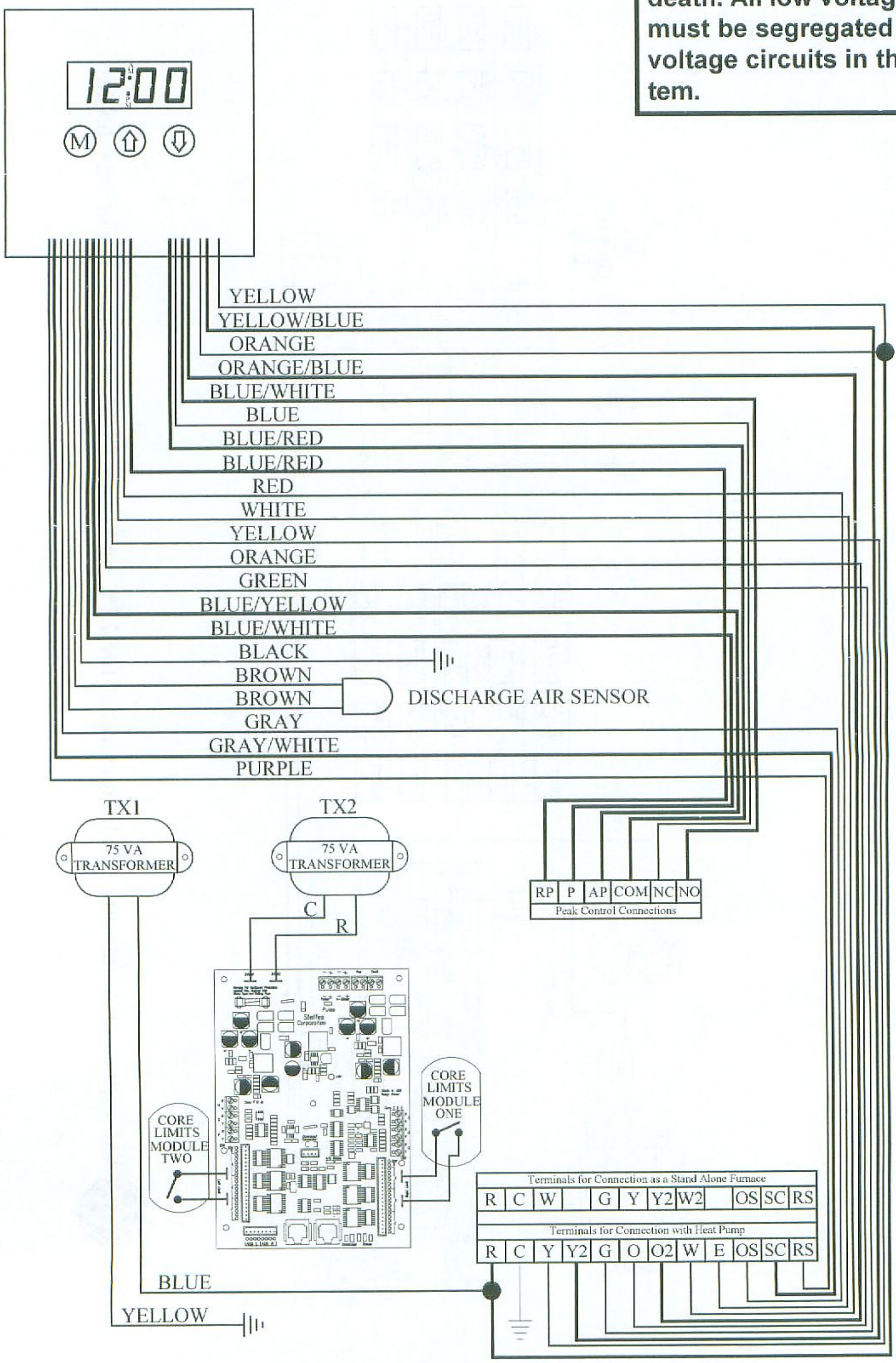
INTERNAL SYSTEM WIRING DIAGRAM - LOW VOLTAGE

The outdoor temperature sensor, room thermostat, and peak control device are connected via low voltage wiring.

System Low Voltage Wiring Diagram

NOTE **The "R" and "C" positions in the low voltage terminal strip may be used as a source of 24 VAC for powering external low voltage devices (30 VA maximum).**

> **WARNING**
>
> **HAZARDOUS VOLTAGE: Risk of electric shock, injury, or death. All low voltage wiring must be segregated from line voltage circuits in the system.**



HELP MENU

The system contains a Help Menu which may be accessed through the control panel. To access the Help Menu, press and release the **M** button until the faceplate displays "HELP". Scroll through the menu by pressing either the up or the down arrow button.

Display Reading	Description
Fxxx	Firmware Version Number - Indicates the version of software installed.
O xx	Outdoor Temperature - Indicates current outdoor temperature as recognized by the system.
tL:xx	Target Level - Indicates the percentage of brick core charge level the system is targeting. During peak periods the value displays as "tL_".
CL:xx	Charge Level - Indicates the percentage of heat storage currently in the brick core.
HE x	Heating Elements Active - Indicates the total number of heating elements currently energized.
PC x	Power Line Carrier Channel - Indicates the channel on which the system is set to receive PLC communication signal.
P x	Power Line Carrier Net Hit Rate Percentage - Indicates the percentage of "GOOD" communication packets received by the system from the PLC transmitter system.
PS x	Indicates which Specialty Timer the system is currently using. The value displayed will be zero if the Specialty Timer is not being utilized.
CC_x	Charge Mode Operation - Indicates the charge control method being utilized during off-peak periods.
CA_x	A-Peak Mode Operation - Indicates the charge control method being utilized during anticipated peak periods.
C1_x	Specialty Timer #1 Charge Mode - Specialty Applications Only.
C2_x	Specialty Timer #2 Charge Mode - Specialty Applications Only.

ERROR CODES

The system has an on-board diagnostic system to monitor various operating conditions. If operating conditions move outside the normal operating range, an error code is displayed on the faceplate. If there are multiple errors simultaneously, only the highest priority error code appears. Once corrected, the next highest priority code will be displayed on the faceplate as "Er—" (i.e., Er05).

WARNING

HAZARDOUS VOLTAGE: Risk of electric shock, injury, or death. System may be connected to more than one branch circuit. Disconnect power to all circuits before servicing. Equipment must be serviced by a qualified technician.

Error Code #	Description
01	Currently not utilized.
02	Currently not utilized.
03	Currently not utilized.
04	Discharge air sensor temperature is out of normal operating range. This can indicate an open sensor, a short in the wiring, or a circuit board which is out of calibration. Take an ohm reading across the sensor to ensure proper operation, check the wiring, and verify the value in L035. Verify that the supply air blower is connected to the supply blower wiring harness located in the base of the system. Compare the sensor reading to the value in L112 to verify proper calibration of the circuit board. *Approximate ohm readings are 70° F = 1,199 ohms; 80° F = 941 ohms; 95° F = 646 ohms.*
05	Outdoor sensor (direct wired) temperature reading is out of normal operating range. The sensor circuit may be open or shorted, the processor control board may be out of calibration, or there may be an incorrect value in L035. If using power line carrier control, make sure the values in L020 and L035 have been set appropriately. Otherwise, verify that the outdoor sensor is connected to OS and SC on the 12-position terminal block. Compare the sensor reading to the value in L113 to verify proper calibration of the circuit board. *Approximate ohm readings are 5° F = 7,646 ohms; 50° F = 2,024 ohms; 95° F = 646 ohms.*

Error Code #	Description
06	Outdoor temperature reading from the transmitting device (PLC system) is out of normal operating range. Check the outdoor sensor attached to the transmitting device and the transmitter for proper operation.
07	Main processor control board temperature sensor is out of normal operating range. Verify that none of the clearances have been violated and inspect the condition of the processor control board.
08	External duct sensor temperature is out of normal operating range. This can indicate an open sensor, a short in the wiring, or the relay driver board is out of calibration. Take an ohm reading across the sensor to ensure proper operation, check the wiring, and verify the value in L053. Compare the sensor reading to the value in L144 to verify proper calibration of the circuit board. *Approximate ohm readings are 60° F = 1552 ohms; 70° F = 1199 ohms; 80° F = 941 ohms. Max 190°F, Min 0°*
09	Aux. Analog input is out of normal operating range. Currently not used.
10	Discharge air temperature has exceeded maximum standard operating temperatures.
11	Core C thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L136 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. Max. 1700°F, min 0°F*
12	Core D thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L137 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV.. Max. 1700°F, min 0°F*
13	Core E thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L138 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV.. Max. 1700°F, min 0°F*
14	Core F thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L139 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV.. Max. 1700°F, min 0°F*
15	Core G thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L140 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV.. Max. 1700°F, min 0°F*
16	Core H thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L141 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV.. Max. 1700°F, min 0°F*
17	Load Control Device (4-20mA) is out of normal range. This can indicate an open sensor, a short in the wiring, or a relay driver board is out of calibration. Take a mA reading across the input to ensure proper operation, check the wiring, and verify the value in L053. Compare the sensor reading to the value in L142 to verify proper calibration of the circuit board. All heating elements should be turned off. *Max. 25mA, min 2mA*
18	Pulse reading is not functional. The pulse input is reading is indicating 0 load even though there are elements, 2 minimum, turned on. All loads should be turned off.
19	There is no communication occurring with the relay driver board. The interface cable may be defective or the relay driver board may be unresponsive. Verify that the values in L090, L091, and L092 are correct for the application.

Error Code #	Description
20	There is no communication occurring between the Base I/O board and the processor control board. A defective board interface cable or an unresponsive Base I/O board can cause this.
21	There is no communication occurring with the first relay expansion board. The interface cable may be defective or the first expansion board may be unresponsive. Check the jumper configuration on the relay expansion board to ensure that J1 and J2 are both in the "OFF" position. Verify that the values in L090, L091, and L092 are correct for the application.
22	There is no communication occurring with the second relay expansion board. The interface cable may be defective or the second expansion board may be unresponsive. Check the jumper configuration on the expansion board and make sure J1 is "ON" and J2 is "OFF". Verify that the values in L090. L091, and L092 are correct for the application.
23	There is no communication occurring with the Steffes Time Clock Module. If this module is installed, verify the value in L035. If correct, the interface cable or the time clock module may be defective.
24	Temperature sensor offset/reference is out of range and indicates that one of the sensors or the core thermocouple may be shorted to ground or the processor control board may be out of calibration.
25	Power line carrier system is active; however, no good data has been received.
26	Insufficient main control board memory. Contact a qualified service technician.
27	Insufficient permanent memory. Contact a qualified service technician.
28	Permanent memory change has been made. Press the **M** button to accept. This error message indicates a change has been made to the software program; therefore, it is important to verify that all location settings are correct for the application.
29	On-board communication system is not fully operable. Contact a qualified service technician.
30	Base control board is in test mode. Check the jumper configuration on the circuit board.
31	Relay expansion board(s) are in test mode. Check the jumper configuration.
39	Indicates the value in Location 13 (L013) has been set to a value greater than the value in Location 12 (L012). The system will not charge until the value in L013 is set lower than L012.
40	Location Values are lost. The EPROM will be updated to the values saved in the main program. Clear error by touching the M button on the heater. If this will not clear the error, replace the processor board.
41	This error may appear when configuring the heater. Clear error by touching the M button on the heater. If this will not clear the error, replace the processor board.
42	Internal communication error. Reprogram or replace processor circuit board.
43	An attempt to load configuration using LO 98 set to 20, 30, 40, or 50 has failed. Each location values will need to be manually set.
Cold Core	Temperature of the brick core is below 40 degrees or the core sensing thermocouple may be open. Verify that the core thermocouple wiring is connected properly and that the values in L090, L091 and L092 are correct for the application. If the value in L110 is reading 30, then the thermocouple is open.
Core Fail	Core high limit switch may be open.
PLC Fail	The system is configured for power line carrier control; however, is not receiving a valid power line carrier communication signal.
LoAd CAP	All controllable loads have been shed and Maximum Load Capacity is still exceeded.

Appendix

W Warranty

Registering your purchase is an essential step to ensure warranty coverage. A Warranty Registration card is included with the Owner's Manual. Simply complete, detach the bottom portion, and return the card today. Retain the top portion of the card for your files.

WARRANTY STATEMENT

Steffes Corporation ("Steffes") warrants that the Steffes Electric Thermal Storage Heating Appliance is free from defects in materials and workmanship under normal use and service. Steffes' obligation under this Warranty is limited to the repair or replacement of the appliance or parts only, which prove to be defective under normal use within **two (2) years** of the date of installation and which Steffes' examination of the returned appliance or part(s) shall verify to Steffes' satisfaction that it is defective. The user shall be responsible for any labor costs associated with the repair or replacement of the appliance or part(s), including the cost of returning the defective appliance or part(s) to Steffes Corporation.

This Warranty is void if the heating appliance is moved from the premises in which it was originally installed. This Warranty shall not apply to an appliance or part which has been altered in any respect, or improperly installed, serviced or used, or has been subject to accident, negligence, abuse or misuse.

THE ABOVE WARRANTY BY STEFFES IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

The user assumes all risk and liability whatsoever resulting from the use of this heating appliance. In no event shall Steffes be liable for any indirect, special or consequential damages or lost profits.

This Limited Warranty contains the complete and exclusive statement of Steffes' obligations with respect to the heating appliance and any parts thereof. The provisions hereof may not be modified in any respect except in writing and signed by a duly authorized officer of Steffes.

Thank you for purchasing Steffes ETS heating equipment. We welcome your comments relating to this manual. Enjoy your new purchase!

V4

STEFFES CORPORATION

"Manufactured in North America"

MASTER SUPPLEMENTAL INSTALLER'S GUIDE FOR

THERMELECT

Models: 8150, 8155, 8180, 8185, 8188, 9150, and 9180

Microprocessor Function Location Descriptions and Values for Setup and Editing

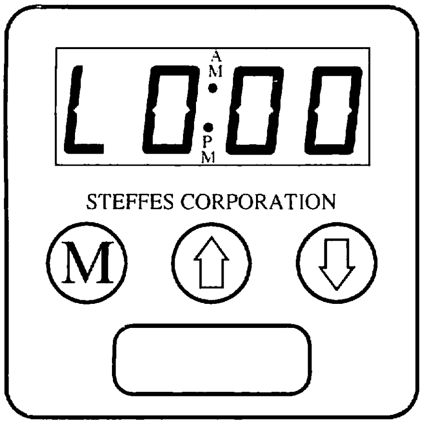
(Applicable to Software Version 2.0)

General Information

The ThermElect heating systems include a microprocessor which contains many program locations that determine system functions. The program locations can be adjusted to customize the heating equipment to the power company and consumer's needs.

This guide provides step-by-step instructions on how to make adjustments to location settings, a description of all program locations in the microprocessor, and the factory default values and ranges for each location.

Accessing Location Information



NOTE: ***Upon power up of the equipment, entry into all program locations is provided for the first two minutes of operation. After this time, the security lockout prevents changes from being made in any locations above 15 (L015). To release the security lockout, refer to L099 in this manual or de-energize the system and then energize again to reset the security free function.***

TO EDIT OR VIEW LOCATION SETTINGS:

STEP 1 Press and hold the **M** button. "EdIt" should be displayed on the faceplate.

STEP 2 While still holding the **M** button and with "EdIt" displayed on the faceplate, press and hold the up arrow button. Continue to hold both buttons simultaneously until "L000" appears on the faceplate.

NOTE: ***If the M button is released before the "L000" is displayed, start over from Step 1.***

STEP 3 Release the buttons. The display will flash between "L000" and the value in this location. The "L" indicates "location" and the last three numbers indicate the specific location number.

STEP 4 Press the up arrow button until the location to be edited is reached. (i.e., Location 8 reads "L008".)

STEP 5 After reaching the location to be edited, press and hold the **M** button. Use the up or the down arrow button to change the value to the desired setting.

STEP 6 Once all changes have been made, release the **M** button. Press the down arrow button until "L000" is displayed. Then, press the down arrow button one more time and the normal display mode will be shown. Any changes made to the location settings will automatically be saved.

NOTE: ***If no buttons on the control panel are pressed, after a brief amount of time, the faceplate will automatically return to its normal operating mode and any changes made to the location settings will automatically be saved.***

Short Cut Keys

M + Up	Edit Mode
M + Up + Down	Charge Control Override (8 bit in L035)
Up + Down	Off Mode (16 bit in L035)
M + Down	Set Back Option (32 bit in L035)

Help Menu

The Help Menu may be accessed by pressing and releasing the M button until the faceplate displays "HELP". Press the up or the down arrow button to scroll through the Help Menu items listed below.

Display Reading	Description
Fxxx	Firmware Version Number - Indicates the version of software installed.
O xx	Outdoor Temperature - Indicates current outdoor temperature as recognized by the heater.
tL:xx	Target Level - Indicates the percentage of brick core charge the heater is targeting. During peak periods, the value displays as "tL _".
CL:xx	Charge Level - Indicates the percentage of heat storage currently in the brick core.
HE x	Heating Elements Active - Indicates the total number of heating elements currently energized.
PC x	Power Line Carrier Channel - Indicates the channel on which the heater is set to receive PLC communication signal.
P x	Power Line Carrier Net Hit Rate Percentage - Indicates the percentage of "GOOD" communication packets received by the heater from the PLC transmitter system.
S x	Indicates which Specialty Timer the heater is currently using. The value displayed will be zero if the Specialty Timer is not being utilized. The Specialty Timer is not utilized in most applications.
CC_x	Charge Mode Operation - Indicates the method of charge control being utilized during off-peak periods. (Refer to L010.)
CA_x	A-Peak Mode Operation - Indicates the method of charge control being utilized during anticipated peak periods. (Refer to L011.)
C1_x	Specialty Timer #1 Charge Mode - Specialty Applications Only (Refer to L030-031.)
C2_x	Specialty Timer #2 Charge Mode - Specialty Applications Only (Refer to L032-033.)

Determine Value of Locations with Multiple Options

To determine the value, check the options desired from the list below. Then, add the numbers from the ***"Value"*** column and enter the sum into this location.

NOTE: ***The check marks (✔) shown in the list below are intended only to serve as an example of a user selection.***

Check	*Value*	*Option Selected*
	1	Display Current Time. (*Not recommended without optional time clock module.*)
	2	Display Day of the Week. (*Not recommended without optional time clock module.*)
✔	4	Display Current Operating Mode (C, P, or A) and Current Room Temperature. (Format: **Cxxx**, **Pxxx**, or **Axxx**)
✔	8	Display Current Room Temperature Set Point. (Format: **Cxxx**, **Pxxx**, or **Axxx**)
	16	Display Current Outdoor Temperature. (Format: **Oxxx**)

Example: To display current room temperature set point and the current operating mode: Enter **12** (4 + 8)

Standard Installation/Configuration Locations (L000-L059)

Loc. No.	Factory Default	Default Range	Description / Function
L000	70 (°F) 21 (°C)	Determined by values in L007/L008.	**8100 SERIES** **Room Temperature Set Point -** Generally not utilized in the 8100 Series systems as the room temperature set point is determined by the thermostat.
	140 (°F) 60(°C)		**9100 SERIES** **Maximum Outlet Water Temperature** - Value indicates the maximum outlet water temperature to be targeted. This value cannot be set higher than the value in L007 or lower than the value in L008. The targeted outlet water temperature is also affected by the values in L012 and L013. For example, if the value in L012 = 60; L013 = 20; L000 = 180; L001 = 140, then at an outdoor temperature of 40 degrees, the targeted outlet water temperature would be 160 degrees. ***NOTE: If an outdoor temperature sensor is NOT installed, the system targets the outlet water temperature as set in L000.***
L001	60 (°F) 16 (°C)	Determined by values in L007/L008.	**8100 SERIES** **Room Temperature Set Back** - Indicates the room temperature set point the system recognizes when receiving a room temperature set back signal.
	140 (°F) 60(°C)		**9100 SERIES** **Minimum Outlet Water Temperature** - Value indicates the minimum outlet water temperature to be targeted. This value cannot be set higher than the value in L007 or lower than the value in L008. The targeted outlet water temperature is also affected by the values in L012 and L013. For example, if the value in L012 = 60; L013 = 20; L000 = 180; L001 = 140, then at an outdoor temperature of 40 degrees, the targeted outlet water temperature would be 160 degrees. ***NOTE: If an outdoor temperature sensor is NOT installed, the system targets the outlet water temperature as set in L000.***
L002	16	0 to 255	**8100/9100 SERIES** **Faceplate Display Configuration** - Specifies the end-user preferences for basic operating of the control panel and configuration of information displayed. ***Value*** ***Option Selected*** 1 Display temperatures in Celsius. Otherwise, temperatures are displayed in Fahrenheit. 2 Display 24-hour time clock. Otherwise, time is displayed on a 12-hour clock with an a.m./p.m. indicator. 4 Faceplate display goes blank after one minute of inactivity. 8 Currently not utilized. 16 Brick core charge set point can be edited at the faceplate by pressing and releasing the **M** button until "Edit" "CorE" appears on the display. Then use the up or down arrow button to change the value to the desired level. ***Only applicable if the value in L010 and/or L011 is set to two (2) or six (6).*** 32 Enables the Edit Mode Activation Delay as described in L022. To enter the Menu when the delay is activated, press and hold the M button and then release.

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
J3	244	0 to 255	8100 SERIES **Faceplate Display Information** - Selects items to display on the faceplate during normal operating mode when pressing the up or down arrow button. ***Value*** ***Option Selected*** 1 Display Current Time. (*Not recommended without optional time clock module.*) 2 Display Day of the Week. (*Not recommended without optional time clock module.*) 4 Display Current Operating Mode (C, P, or A). If the optional freeze protection sensor is installed, current room temperature is also displayed. (Format: **Cxxx**, **Pxxx**, or **Axxx**.) 8 Not used in 8100 Series. 16 Display Current Outdoor Temperature. (Format: **Oxxx**.) 32 Display Heat Call Status. If interfaced with an air conditioning unit or heat pump, cooling status is also displayed. (Format: **HC_x or COOL**.) 64 Display Current Core Charge Level Percentage. (Format: **CL:xx**.) 128 Display Current Core Charge Level Target Percentage. (Format: **tL:xx**.)
			9100 SERIES **Faceplate Display Information** - Selects items to display on the faceplate during normal operating mode when pressing the up or down arrow button. ***Value*** ***Option Selected*** 1 Display Current Time. (*Not recommended without optional time clock module.*) 2 Display Day of the Week. (*Not recommended without optional time clock module.*) 4 Display Current Operating Mode (C, P, or A) and current outlet water temperature. (Format: **Cxxx**, **Pxxx**, or **Axxx**.) 8 Not used in 9100 Series. 16 Display Current Outdoor Temperature. (Format: **Oxxx**.) 32 Display Heat Call Status. If interfaced with an air conditioning unit or heat pump, cooling status is also displayed. (Format: **HC_x or COOL**.) 64 Display Current Core Charge Level Percentage. (Format: **CL:xx**.) 128 Display Current Core Charge Level Target Percentage. (Format: **tL:xx**.)

FACEPLATE DISPLAY CHARACTER REFERENCE:

NOTE: Each "x" represents a digit on the faceplate where a number may display.

C xx = Charge period (off-peak hours), outlet water temperature, or current room temperature if a freeze protection sensor is installed.
P xx = Peak period (on-peak hours) and current room temperature if a freeze protection sensor is installed.
A xx = Anticipated peak period (pre-peak hours) and current room temperature if freeze protection sensor is installed.
Oxxx = Current outdoor temperature.
HC_x = Type of heat call (0 = no heat call, 1 = stage 1, 2 = stage 2, 3 = emergency heat call, COOL = cooling call).
CLxx = Current charge level.
tlxx = Target charge level.

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L004	0	0	**8100/9100 SERIES** **Background Faceplate Display Information** - Reference L003 for information and description of options available.
L005	30	10 to 100	**8100/9100 SERIES** **Faceplate Display "On" Time** - Amount of time in tenths of a second that foreground information (as set in L003) is displayed on the faceplate. Error messages display for half of the time entered in this location.
L006	0	0 to 255	**8100/9100 SERIES** **Automatic Display of Faceplate Information** - Used to specify the cycle (scroll) time of the Faceplate Display Information (as set in L003). Value is specified in units of 1/10th seconds.
L007	85 (°F) 29 (°C)	45 to 195 (°F) 7 to 91 (°C)	**8100 SERIES** **Maximum Room Temperature Set Point** - *Specialty Applications Only!*
	185 (°F) 90.6 (°C)		**9100 SERIES** **Maximum Outlet Water Temperature Set Point** - Maximum temperature to which the outlet water temperature set point can be adjusted in L000 and L001.
L008	45 (°F) 7 (°C)	32 to 80 (°F) 0 to 27 (°C)	**8100 SERIES** **Minimum Room Temperature Set Point** - *Specialty Applications Only!*
			9100 SERIES **Minimum Outlet Water Temperature Set Point** - Minimum temperature to which the outlet water temperature set point can be adjusted in L000 and L001.
L009	0	0 to 1	**8100/9100 SERIES** **Off Mode** - Off mode suspends all functions of the system and is indicated on the faceplate as "OFF". If the shortcut method is enabled in L035, the system can be placed in the off mode by pressing both the up and down arrow buttons at the same time. ***Value*** ***Function*** 0 Normal Operating Mode 1 Off Mode *NOTE: If the system is being used to provide a peak control signal to other devices, or if an air conditioner or heat pump is being used in conjunction with the system, the off mode cannot be used.*

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
10	5	0 to 7	**8100/9100 SERIES** **Off-Peak Method of Charge Control** - Sets the method of brick core charging to be used during off-peak (charge) periods. *Value* *Function* 0 **Core Charging Disabled**: No core charging occurs. 1 **Space Heating Mode**: System maintains a low brick core temperature (as set in L041) if there has been a heat call during the last 22 hours. 2 **Manual Core Charge Control**: User is required to adjust the targeted brick core charge level to the value desired. Refer to L015 for more information. 3 **Automatic Core Charge Control**: Targeted brick core charge level adjusts automatically according to outdoor temperature and values set in L012 and L013. 4 **Sensorless Automatic Core Charge Control**: Targeted brick core charge level adjusts automatically based on heating demand from previous time period (value set in L042). 5 **Intelli-Charge with Wizbang**: Targeted brick core charge level adjusts automatically based 75% on "Automatic Core Charge Control" and 25% on "Sensorless Automatic Core Charge Control". If there are no heat calls in the past 22 hours, the values in L012 and L013 will both be set back 20 degrees. Once a heat call is recognized, these values return to their original set points. On start-up, the system assumes there have been no heat calls. 6 **Intelliman Core Charge Control**: Targeted brick core charge level changes based 75% on "Manual Core Charge Control" and 25% on "Sensorless Automatic Core Charge Control". 7 **Wizbang Core Charge Control**: Targeted brick core charge level adjusts automatically according to outdoor temperature and the values set in L012 and L013. If there are no heat calls in the past 22 hours, the values in L012 and L013 will both be set back 20 degrees. Once a heat call is recognized, these location values return to their original set points. On start-up, the system assumes there have been no heat calls.
L011	5	0 to 7	**8100/9100 SERIES** **Anticipated Peak (Pre-Peak) Method of Charge Control** - Sets the method of brick core operating mode for anticipated peak times. For a detailed description of each method of charge control, refer to Location 10 (L010). *Value* *Function* 0 Core Charging Disabled 1 Space Heating Mode 2 Manual Core Charge Control 3 Automatic Core Charge Control 4 Sensorless Automatic Core Charge Control 5 Intelli-Charge with Wizbang 6 Intelliman Core Charge Control 7 Wizbang Core Charge Control

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L012	50 (°F) 10 (°C)	0 to 90 (°F) -18 to 32 (°C)	**8100/9100 SERIES** **Start Brick Core Charge Set Point** - Specifies the outdoor temperature at which core charging is targeted to begin. *NOTE: **Only applicable if using the Automatic Core Charge or Intelli-Charge options as set in L010 or L011. If utilizing the system with an Air Source Heat Pump which is not controlled during mild outdoor temperatures, a setting of approximately 40°F (7°C) may improve operating efficiencies.***
L013	10 (°F) -12 (°C)	-20 to 90 (°F) -29 to 32 (°C)	**8100/9100 SERIES** **Full Brick Core Charge Set Point** - Specifies the outdoor temperature at which a maximum (full) core charge level is to be targeted. *NOTE: **Only applicable if using Automatic Core Charge or Intelli-Charge options as set in L010 and/or L011. If using Intelli-Charge, energy usage is also a factor in determining the targeted core charge level.***
L014	0	-20 to 20	**8100 SERIES** **Room Temperature Display Calibration** - Currently not utilized.
	5		**9100 SERIES** **Water Temperature Display Calibration** – Used to calibrate the water temperature reading of the system. This value represents the number of degrees the outlet water temperature reading will be increased or decrea by on the display. *Example: If the system is currently displaying an outlet water temperature of 120°F, increasing this value by ten (10) changes the displayed water temperature to 130°F.*
L015	100	0 to 100	**8100/9100 SERIES** **Manual Brick Core Charge Set Point** - Specifies the percentage of core charge the system targets during an off-peak or anticipated peak period when set to use Manual or Intelliman Charge Control method in L010 and/or L011. When using manual charge control, L002 should be set to allow adjustment of this set point from the faceplate. (Reference the 16 bit in L002.) *<u>Value</u>* *<u>Function</u>* 0 Core Charging Disabled 50 Target 50% Core Charge Level 100 Target Maximum (Full) Core Charge Level *NOTE: **If using Manual or Intelliman Charge Control, the value in L099 must NOT be set lower than a value of fifteen (15).***
L016	255	10 to 255	**8100/9100 SERIES** **Damper Control Configuration** - The value in this location MUST be set to 255.

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
17	0		**8100/9100 SERIES** **Board Rise/Room Rise as Core Heats** - If the temperature of the circuit board goes up X number of degrees ("X" being the value entered in this location), the room temperature reading will drop 1 degree. *NOTE: **Do not change setting from the default value without factory authorization.***
L018	255	0 to 255	**8100/9100 SERIES** **Compressor Protection** - Sets the minimum time (in seconds) the compressor remains "OFF" after a heating or cooling call has ended. *NOTE: **Only applicable to installations where the system is being used in conjunction with a heat pump or air conditioner.***
L019	-1		**8100/9100 SERIES** **Power Line Carrier (PLC) Seconds per Bit** *NOTE: **Do not change setting from the default value without factory authorization.***
L020	0	0 to 15	**8100/9100 SERIES** **Power Line Carrier (PLC) Channel Selection** - Indicates the channel on which PLC communication will occur. This value MUST match the setting in the PLC transmitting device. If PLC communication is not used, a value of "0" should be entered. *Value* *Function* 0 PLC Communication Disabled 1-2 PLC Channel 1, 2 (4 minute communication time) 3-11 PLC Channel 3, 4, 5, . . . etc. (1 minute communication time) 12-15 PLC Channel 12, 13, 14, 15 (4 minute communication time) *NOTE 1: **Channels 1 and 2 are original Steffes PLC communication channels. These two channels should not be used on the same distribution transformer or in areas with a high concentration of transmitters, as cross talk may occur.*** *NOTE 2: **PLC Fail message displays after 15 minutes of no communication on startup and after 90 minutes of no communication once the system has received a communication signal.***
L021	0		**8100/9100 SERIES** **Power Line Carrier (PLC) Unit Address for Heater** - Reserved for future use.
L022	40	10 to 255	**8100/9100 SERIES** **Edit Mode Activation Delay** - Time it takes to enter the edit mode while the **M** and the up arrow buttons are pressed simultaneously. Also affects the time it takes to gain access to the menu when pressing and holding the **M** button. Once in edit mode or the menu, locations and their corresponding values can be viewed and/or adjusted. *NOTE: **A value of 40 is approximately 8 seconds.***

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L023	2		**8100/9100 SERIES** **Error Message Reset Time** -Value indicates the minimum number of minutes before an error message resets. The maximum number of minutes before error message reset is the minimum value plus one. *NOTE: Do not change setting from the default value without factory authorization.*
L024	0 (°F) -18 (°C)	0 to 65 (°F) -18 to 18 (°C)	**8100/9100 SERIES** **Freeze Protection Set Point** - Currently not utilized.
L025	0	0 to 65	**Currently not utilized.**
L026	0:00	0:00 to 3:00	**8100/9100 SERIES** **Start Charge Delay Time** - Amount of time the heating elements are to remain de-energized at the start of an off-peak (charge) period. Values are entered in 15-minute increments. Refer to L052, value 16 and 32, for additional options.
L027	0:00	0:00 to 3:00	**8100/9100 SERIES** **Start Charge Ramp Time** - Indicates the length of time over which the heating elements stage on after the Start Charge Delay Time (set in L026) has ended. Values are entered in 15-minute increments.
L028	1	1 to 128	**8100/9100 SERIES** **Minimum Core Blower Speed** - Sets the minimum speed at which the core blower operates when there is a heat call. *Value* *Blower/Controls Configuration* 1 120/240V (standard heater configuration) 5 208V
L029	255	1 to 255	**8100/9100 SERIES** **Maximum Blower Speed** - This value MUST be set to 255.
L030	0	0 to 7	**8100/9100 SERIES** **Specialty Timer #1 Charge Mode** - Specifies the core charge operating mode to be used during timed period #1. Values are interpreted the same as those set in L010. *NOTE: Specialty applications only.*
L031	0:00	0:00 to 16:00	**8100/9100 SERIES** **Specialty Timer #1 Charge Mode Duration** - The length of time that Specialty Timer #1 Charge Mode (as set in L030) is active. *NOTE: Specialty applications only.*

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
32	0	0 to 7	**8100/9100 SERIES** **Specialty Timer #2 Charge Mode** - Specifies the core charge operating mode to be used during timed period #2. Values are interpreted the same as those set in L010. ***NOTE: Specialty applications only.***
L033	0:00	0:00 to 16:00	**8100/9100 SERIES** **Specialty Timer #2 Charge Mode Duration** - The length of time that Specialty Timer #2 Charge Mode (as set in L032) is active. ***NOTE: Specialty applications only.***
L034	0	0 to 16	**Currently not utilized.**
L035	9	0 to 255	**8100/9100 SERIES** **Optional Controls Configuration** - Used to interface the system with optional sensors and controls that may be used in the application. In addition, short-cut methods for some user control functions can be enabled in this location. *Value* — *Option Selected* 1 — Enable Hard Wired Outdoor Temperature Sensor. (Only applicable is using Automatic Core Charge or Intelli-Charge options as set in L010 and/or L011.) 2 — Enable Room Temperature Sensing System. (Only applicable when installing a remote room temperature sensor for freeze protection or other specialty application.) 4 — Enable Time Clock Module Option. This adds both "CLOC" and "DAy" to the menu on the display. (Refer to L060-L089 for setting desired function and operation of the time clock module.) 8 — Ability to Enable/Disable Charge Control Override Option from faceplate. (This option allows user to initiate a one-time full core charge using only the buttons on the faceplate. When utilized, all charge control settings are temporarily overridden to force the system to its maximum charge during the off-peak period.) 16 — Ability to Enable/Disable "OFF" Mode from the faceplate. (Reference L009.) 32 — Currently not utilized.

Loc. No.	Factory Default	Default Range	Description / Function
L036	1	0 to 15	**8100/9100 SERIES** **Control Switch Configuration** - Determines how the system reacts to the control switch signaling device. In standard configuration, a "closed" control switch indicates an off-peak (charge) period, an anticipated peak period, a room temperature set back period or a cooling call (the "O" wiring position on compressor is energized). *Value* *Option Selected* 0 A CLOSED control switch indicates a Peak (Control) time, an Anticipated Peak time, or a Room Temperature Set Back period. 1 An OPEN control switch indicates a Peak (Control) time. 2 An OPEN control switch indicates an Anticipated Peak time. 4 An OPEN thermostat switch enables G, Fan On. 8 An OPEN thermostat switch enables the Reversing Valve (cooling output) on a Heat Pump system. Only applicable in installations where the system is being used to control a heat pump during the cooling mode. 16 An OPEN thermostat switch enables Y, Stage 1. 32 An OPEN thermostat switch enables W, Stage 2. 64 An OPEN thermostat switch enables E, Emergency Heat in the 8100 Series or H, Hydronic Heat in the 9100 Series.
L037	2	0 to 255	**8100/9100 SERIES** **Output Control Configuration** - Configures the output controls of the system. *Value* *Option Selected* 1 Currently not utilized. 2 Deals with output temperature reactions and must be used in all models. 4 Currently not utilized. 8 Enables compressor control if there is a "Cool" call during a peak (control) period. 16 Enables Comfort Override (Comfort override allows the heating elements to be energized, even during peak control periods, provided brick core is depleted and there is a Stage 2 or Stage 3 heat call.) 32 Enables compressor cycling. If it is a peak (control) period and the system receives a cooling call, the compressor turns off and on in 20 minute intervals. (Off 20 minutes, on 20 minutes, off 20 minutes, etc.) 64 Currently not utilized. 128 Interfaces the system with a heat pump that has a reversing valve which is energized for heating (i.e., Rheem, Ruud, etc.).
L038	1		**8100/9100 SERIES** **Multiple of 9600 Baud** ***NOTE: Do not change setting from the default value without factory authorization.***

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
39	5:00	2:00 to 23:45	**8100/9100 SERIES** **Time to go to Full Charge** - Indicates the amount of time the system has to go from room temperature to full charge. The shorter the amount of time, the more aggressively the system charges. *NOTE: **Do not change setting from the default value without factory authorization. Only applicable if using the Sensorless Automatic Core Charge or Intelli-Charge options as set in L010, L011, L030, and/or L032.***
L040	1520°F 827°C	0°F to 1600°F 18°C to 871°C	**8100/9100 SERIES** **Maximum Core Temperature** - Value indicates the maximum brick core charge temperature allowed. *NOTE: **Do not change setting from the default value without factory authorization.***
L041	200°F 93°C	0°F to 600°F 18°C to 316°C	**8100/9100 SERIES** **Minimum Core Temperature** - This value indicates the minimum core charge the system targets during Comfort Override (L035) or when utilizing Space Heating Mode as set in L010, L011, L030, and/or L032. *NOTE: **Do not change setting from the default value without factory authorization.***
42	6:00	2:00 to 8:00	**8100/9100 SERIES** **Sensorless Averaging Period** - Represents the number of hours of history to use when averaging energy usage. *NOTE: **Do not change setting from the default value without factory authorization. Only applicable if using the Sensorless Automatic Core Charge or Intelli-Charge options as set in L010, L011, L030, and/or L032.***
L043	30	10 to 255	**8100/9100 SERIES** **Sensorless Auto Charge "Charge Factor"** - Represents the charging factor used to determine the targeted brick core charge level based on the number of off-peak hours the electric power company offers during a 24-hour period. To charge more aggressively, use a value of 30. *NOTE: **Only applicable if using Sensorless Automatic Core Charge or Intelli-Charge options as set in L010, L011, L030, and/or L032.***
L044	10:00	0 to 10:00	**8100/9100 SERIES** **Discharge Air Cycling Control for Anticipated Peak Mode** - Controls the maximum number of minutes the core blower is allowed to operate within a 10-minute period during an anticipated peak time.
L045	1	0 to 255	**8100/9100 SERIES** **Delay from Heat Call to Blower Activation** *NOTE: **Do not change setting from the default value without factory authorization.***

Standard Installation/Configuration Locations (L000-L059) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L046	5 (°F) -15 (°C)	-20 to 120 (°F) -29 to 49 (°C)	**8100/9100 SERIES** **Compressor Lock-Out Set Point for Off-Peak or Anticipated Peak Modes -** Indicates the outdoor temperature at which the heat pump's compressor is to be locked out (not allowed to operate) during an off-peak or anticipated peak period. ***NOTE: Applicable only if using system in conjunction with a heat pump.***
L047	5 (°F) -15 (°C)	-20 to 120 (°F) -29 to 49 (°C)	**8100/9100 SERIES** **Compressor Lock-Out Set Point for On-Peak Mode** - Indicates the outdoor temperature at which the heat pump's compressor is to be locked out (not allowed to operate) during an on-peak period. ***NOTE: Applicable only if using system in conjunction with a heat pump.***
L048	90 (°F) 32 (°C)	55 to 300 (°F) 13 to 149 (°C)	**8100/9100 SERIES** **Minimum Discharge Air Temperature** - Sets the minimum discharge air temperature of the system during a Stage 1 heat call.
L049	120 (°F) 49 (°C)	55 to 300 (°F) 13 to 149 (°C)	**8100/9100 SERIES** **Maximum Discharge Air Temperature** - Sets the maximum discharge air temperature of the system during a Stage 2 heat call or during compressor control. Also, if there is an Y call, but no G call, the system targets the value in this location.
L050	-5		**8100/9100 SERIES** **Outdoor Temperature Offset** - Used to calibrate the hard wired outdoor temperature sensor reading as sensed by the system (Reference L113).
L051	0		**8100/9100 SERIES** **Static Heat Recovery Relay** - Currently not utilized.
L052	8	0-63	**8100/9100 SERIES** **Optional Features** ***Value*** — ***Description*** 1 — The system will not decrement L040 if a core fail is detected. 2 — "CORE FAIL" is not displayed even if a core fail is detected. 4 — Disables proportional charging; therefore, if the system is charging, all elements are energized. 8 — Enables Clock Editing Security, making it so the clock settings can only be edited for the first two (2) minutes of operation. 16 — Enables space heating during a charge delay time (L026). 32 — Enables Charge Delay (as set in L026) for loads controlled by the peak control relay (COM, NO, NC positions on the 6-position terminal block.)

Loc. No.	Factory Default	Default Range	Description / Function
53	0	0-255	**8100/9100 SERIES** **Load Management Features** – Allows user to enable load management features on the Relay Driver Board (RDB). ***Value*** ***Description*** 1 Enable 4-20mA input on the RDB. 2 Enable Pulse input on the RDB. 4 Enable External Duct Sensor on the RDB. 8 Currently not utilized. 16 Enable Load Management Module 1. 32 Enable Load Management Module 2. 64 Currently not utilized. *NOTE:* ***Do NOT enable the 4-20mA input and the pulse input at the same time.***
L054	0	0-255	**8100/9100 SERIES** **Maximum Load Capacity -** Maximum kW that is allowed before loads start to shed divided by ten (10). [Maximum kW/10]
L055			**Reserved for Future Use.**
L056	44		**8100/9100 SERIES** **Heating Element Input** - The kW input of a single element times ten (kW X 10).
L057	0	0-55	**8100/9100 SERIES** **Air Conditioner Freeze Up Protection –** A temperature is set in this location. If the output temperature is less than this value and the system is in cool mode, the compressor relay opens. This feature is designed to protect the A-coil from icing up.
L058 – L059			**Reserved for Future Use.**

Time Clock Module Installation Locations (L060-L089)

NOTE: Locations L060 through L089 are time clock related programs. The optional Steffes Time Clock Module must be installed in order to utilize the features described in these locations.

Loc. No.	Factory Default	Default Range	Description / Function
L060	1	0 to 255	**8100/9100 SERIES** **Time Clock Module Function Enable -** Indicates what function(s) the optional time clock module is to be used for. *Value* *Option Selected* 0 Time clock module not utilized for control purposes. 1 Enable time clock module to be used for peak control purposes. 2 Enable time clock module to be used for anticipated peak control purposes (Specialty Applications only.) 4 Currently not utilized. 8 Enables time clock module to track calendar for Demand Scheduling.
L061	0:00	0:00 to 16:00	**8100/9100 SERIES** **Anticipated Peak Duration -** Initiates an anticipated peak time prior to each scheduled peak time as programmed in the time clock module and sets the duration of the anticipated peak period. The value entered is specified in 15-minute intervals.
L062	0:00	0 to 23:45	**8100/9100 SERIES** **Weekday Peak Time #1 -** Specifies the time (military) at which the f[illegible] time clock scheduled peak time is to begin each weekday (Monday – Friday).
L063	0:00	0 to 16:00	**8100/9100 SERIES** **Weekday Peak Time #1 Duration -** Sets duration of the first weekday time clock scheduled peak time (as set in L062). Value is specified in 15-minute intervals.
L064	0:00	0:00 to 23:45	**8100/9100 SERIES** **Weekday Peak Time #2 -** Specifies the time (military) at which the second time clock scheduled peak time is to begin each weekday (Monday – Friday).
L065	0:00	0:00 to 16:00	**8100/9100 SERIES** **Weekday Peak Time #2 Duration -** Sets duration of the second weekday time clock scheduled peak time (as set in L064). Value is specified in 15-minute intervals.
L066	0:00	0:00 to 23:45	**8100/9100 SERIES** **Weekday Peak Time #3 -** Specifies the time (military) at which the third time clock scheduled peak time is to begin each weekday (Monday – Friday).

Time Clock Module Installation Locations (L060-L089) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L067	0:00	0:00 to 16:00	**8100/9100 SERIES** **Weekday Peak Time #3 Duration -** Sets duration of the third weekday time clock scheduled peak time (as set in L066). Value is specified in 15-minute intervals.
L068	0:00	0:00 to 23:45	**8100/9100 SERIES** **Weekend Peak Time #1 -** Specifies the time (military) at which the first time clock scheduled peak interval is to begin each weekend day (Saturday and Sunday).
L069	0:00	0:00 to 16:00	**8100/9100 SERIES** **Weekend Peak Time #1 Duration** – Sets duration of the first weekend time clock scheduled peak time (as set in L068). Value is specified in 15-minute intervals.
L070	0:00	0:00 to 23:45	**8100/9100 SERIES** **Weekend Peak Time #2 -** Specifies the time (military) at which the second time clock scheduled peak interval is to begin each weekend day (Saturday and Sunday).
L071	0:00	0:00 to 16:00	**8100/9100 SERIES** **Weekend Peak Time #2 Duration -** Sets duration of the second weekend time clock scheduled peak time (as set in L070). Value is specified in 15-minute intervals.
L072	0:00	0:00 to 23:45	**8100/9100 SERIES** **Weekend Peak Time #3 -** Specifies the time (military) at which the third time clock scheduled peak interval is to begin each weekend day (Saturday and Sunday).
L073	0:00	0:00 to 16:00	**8100/9100 SERIES** **Weekend Peak Time #3 Duration -** Sets duration of the third weekend time clock scheduled peak time (as set in L072). Value is specified in 15-minute intervals.
L074 - L089	0:00	0:00 to 23:45	**Currently not utilized.**

Equipment Series Specific Configuration Locations (L090-L099)

NOTE: L090 through L099 are Configuration Locations. These locations are for setting up the system and access to editing them is only available in the first 4 minutes after powering up the system.

Loc. No.	Factory Default	Default Range	Description / Function
L090	Based on Model	10 to 59	**8100/9100 SERIES** **Model Type** – Specifies the series. *Value* *Heater Series* 48 8100 Series with one storage module 49 8100 Series with two storage modules 58 9100 Series
L091	6	1 to 6	**8100/9100 SERIES** **Elements per Core**
L092	Based on Model	1 to 6	**8100/9100 SERIES** **Brick Core Sensors** - Number of brick core temperature sensors installed. *Model* *Number of Sensors* 8150 2 8180 3 8155 4 8185 5 8188 6 9150 2 9180 3
L093	170 (°F) 76 (°C)	100 to 200 (°F) 38 to 93 (°C)	**8100/9100 SERIES** **Maximum Temperature of Control Board - Factory Purposes Only.** If the processor board temperature is higher than the value in this location, the static recovery relay and the low speed fan relay are closed. *NOTE: Do not change setting from the default value without factory authorization.*
L094	195	150 to 245	**8100/9100 SERIES** **Portion of Range Used in Blower - Factory Purposes Only.** Wave chopping factor for core blower(s). *NOTE: Do not change setting from the default value without factory authorization.*
L095	80	0 to 255	**8100/9100 SERIES** **Jump Start** - This value establishes the speed that the fan starts in when energized. For instance, if a value of 80 is selected, the fan starts in speed 80 and then adjusts to the appropriate speed.

Equipment Series Specific Configuration Locations (L090-L099) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L096	0	0 to 255	**8100/9100 SERIES** **Power Line Carrier Channel Scan for Channels One through Seven -** If the PLC Test is running, this is utilized to indicate which channels are available of Channels 1 through 7. Also, the 1 bit is active as long as the test is in process. ***Value*** ***Channel Available*** 1 Indicates the PLC Channel Test is running 2 Channel 1 is available 4 Channel 2 is available 8 Channel 3 is available 16 Channel 4 is available 32 Channel 5 is available 64 Channel 6 is available 128 Channel 7 is available
L097	0	0 to 255	**8100/9100 SERIES** **Power Line Carrier Channel Scan for Channels Eight through Fifteen** - If the PLC Test is running (refer to L096), this location is utilized to indicate which channels are available of Channels 8 through 15. If the PLC test is still in process, the 1 bit in L096 is active. ***Value*** ***Channel Available*** 1 Channel 8 is available 2 Channel 9 is available 4 Channel 10 is available 8 Channel 11 is available 16 Channel 12 is available 32 Channel 13 is available 64 Channel 14 is available 128 Channel 15 is available
L098	0	0 to 255	**8100/9100 SERIES** **Save / Restore Program Location Default Settings** – Used to save preferred default values or to load previously saved or factory default values. When one of the following values is entered, the action listed is taken and the location resets to a value of zero (0). ***Value*** ***Action Triggered*** 1 Start PLC Channel Scan Testing. 20 Load configuration saved with value of 120. 30 Load configuration saved with value of 130. 40 Load configuration saved with value of 140. 50 Load configuration saved with value of 150. 99 Save configuration to be retrieved from 255. 120 Save configuration to be retrieved from 20. 130 Save configuration to be retrieved from 30. 140 Save configuration to be retrieved from 40. 150 Save configuration to be retrieved from 50. 255 Load the "Factory Defaults".

Equipment Series Specific Configuration Locations (L090-L099) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L099	15	0 to 89	**8100/9100 SERIES** **Editing Locations Security Lock-Out** – Specifies which program locations can be edited from the faceplate after the first minute of operation. Only locations equal to or lower than the value in this location can be edited from the faceplate. *NOTE:* ***This location can always be edited, regardless of what value it is set to. During the first minute of operation, L001 through L099 can be edited. Locations above L099 are "Read Only".***

Read Only Locations (L100-L135)
Used to Determine Current Operating Status

Loc. No.	Factory Default	Default Range	Description / Function
L100			**8100/9100 SERIES** **Current Effective Inputs** – Indicates which digital inputs are currently being used to control space heating and core charging algorithms. The value shown is based on the values in locations L101, L102, L103, and L104. When more than one digital input source is present, this location displays the most recently received input. ***Value*** ***Input*** 1 Peak Interval Signal 2 Anticipated Peak Interval Signal 4 Fan ON or Set Back ("G" Thermostat Input) 8 Reverse Signal ("O" Thermostat Input) 16 Stage One Heat Call 32 Stage Two Heat Call 64 "E" Thermostat Input
L101			**8100/9100 SERIES** **Low Voltage Inputs** – Indicates the sum of values based on the current state of each of the input signals received from low voltage inputs. Refer to L100 for an interpretation of the value.
L102			**8100/9100 SERIES** **Power Line Carrier (PLC) Signal Inputs** – Indicates a value based on the current state of each of the input signals received from a Steffes PLC. Refer to L100 for an interpretation of the value.
L103			**8100/9100 SERIES** **Communication Inputs for Palm/Computer Interface** - Indicates a value based on the current state of each of the input signals received from ETS Tender (Palm or PC Version). Refer to L100 for an interpretation of the value.
L104			**8100/9100 SERIES** **Microprocessor Based Time Clock Module Signal Inputs** – Indicates a value based on the current state of each of the input signals received from the optional microprocessor based time clock module (if installed). Refer to L100 for an interpretation of the value.
L105			**8100/9100 SERIES** **Current Power Line Carrier (PLC) Outdoor Temperature** - Approximates the current outdoor temperature (°F or °C) as received from the PLC transmitting device. The system then uses this information to determine the level of core charge to target when using Automatic Charge Control or Intelli-Charge.

Read Only Locations (L100-L135) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L106			**8100/9100 SERIES** **Power Line Carrier Success Rate Percentage –** This location contains the power line carrier success rate percentage based on the last 33 packets of information.
L107			**8100/9100 SERIES** **Highest Consecutive "BAD" PLC Information Packets Received –** Value shown indicates the most consecutive "bad" packets received by the system from the PLC transmitter since the system was energized. If power to the system is disconnected, the value in this location resets.
L108			**8100/9100 SERIES** **Targeted Brick Core Charge Level –** Indicates the amount of heat storage the system is targeting. This value represents a percentage of brick core charge. When in a peak mode, the value in this location is -50.
L109			**8100/9100 SERIES** **Outdoor Temperature Reading Utilized by System** - Indicates the current outdoor temperature reading the system is using to determine the level of core charge to target when Automatic Charge Control or Intelli-Charge (as set in L010 and L011) are being utilized.
L110			**Currently not utilized.**
L111			**Currently not utilized.**
L112			**8100/9100 SERIES** **Current Discharge Air Temperature** – Indicates the current discharge air temperature (°F or °C) as sensed by the output thermister.
L113			**8100/9100 SERIES** **Current Hard Wired Outdoor Temperature (if using hard wired outdoor temperature sensor only)** – Approximates current outdoor temperature (°F or °C) as received from a hard-wired outdoor sensor. This information is used to determine the level of core charge to target when using Automatic Charge Control or Intelli-Charge. *NOTE: Heat and cold sources will affect the accuracy of the outdoor sensor. Placement of the sensor should be considered during installation, as well as sealing the outdoor-to-indoor wire route opening to ensure the most accurate temperature readings.*

Loc. No.	Factory Default	Default Range	Description / Function
L114			**8100 SERIES** **Current Room Temperature** - Displays the current room temperature as sensed by the room temperature sensor, if enabled in L035, plus the value in L014.
			9100 SERIES **Current Outlet Water Temperature** - Displays current outlet water temperature as sensed by the outlet water temperature control plus the value of L014.
L115			**8100/9100 SERIES** **Microprocessor Control Board Current Operating Temperature** – Indicates the current temperature (°F or °C) the microprocessor control board is operating in.
L116			**8100/9100 SERIES** **Current Day of the Week** – When utilizing the microprocessor based time clock module option, this location indicates current day of the week in accordance to the settings in the module.
L117			**8100/9100 SERIES** **Current Hour of the Day** – When utilizing the microprocessor based time clock module option, this location indicates the current hour of the day in accordance to the settings in the module. Value shown in military time.
L118			**8100/9100 SERIES** **Current Minute of the Hour** – When utilizing the microprocessor based time clock module option, this location indicates the current minute of the hour in accordance to the settings in the module.
L119			**8100/9100 SERIES** **Current Second of the Minute** – When utilizing the microprocessor based time clock module option, this location indicates the current second of the minute in accordance to the settings in the module.
L120			**8100/9100 SERIES** **Core Blower #1 Activation Level** - This location indicates the blower speed of the core blower.
L121			**Currently not utilized.**

Read Only Locations (L100-L135) continued...

Loc. No.	Factory Default	Default Range	Description / Function
L122			**8100 SERIES** **Current Supply Air Blower Speed** – Indicates which supply air blower speed relay is currently active. This determines the speed at which the supply air blower is currently operating. ***Value*** ***Speed*** 0 Supply Air Blower is OFF. 1 Low Speed Relay is Active (RLY 1 on Base I/O). 2 High Speed Relay is Active (RLY 3 on Base I/O). **9100 SERIES** **Currently not utilized.**
L123			**Currently not utilized.**
L124			**Currently not utilized.**
L125			**Currently not utilized.**
L126			**Currently not utilized.**
L127			**8100 SERIES** **Currently not utilized.** **9100 SERIES** **Current Outlet Water Temperature Set Point** - Indicates the outlet water temperature set point currently being targeted.
L128			**8100/9100 SERIES** **Energy Usage** – Monitors energy usage during a charge period to set a targeted core charge level when using Sensorless or Intelli-Charge automatic core charge methods. This value times the value in L043 determines the target level of the sensorless charge control.
L129			**8100/9100 SERIES** **Software Version Number** – Indicates the software version number.
L130			**8100/9100 SERIES** **Core Fail Count** - Indicates the number of core fails. This number is reset anytime the system is restarted.
L131			**Currently not utilized.**
L132			**Currently not utilized.**
L133			**8100/9100 SERIES** **Base I/O Relay Board Firmware Version** - Indicates the firmware version of the base I/O relay board.

Loc. No.	Factory Default	Default Range	Description / Function
L134			**8100/9100 SERIES** **First Expansion Board Firmware Version -** Indicates the firmware version of the first expansion board.
L135			**8100/9100 SERIES** **Second Expansion Board Firmware Version -** Indicates the firmware version of the second expansion board.
L136			**8100/9100 SERIES** **Relay Driver Board (RDB) Firmware Version** – Indicates the firmware version of the RDB.
L137			**8100/9100 SERIES** **Brick Core C Thermocouple Temperature** – Indicates the actual brick core temperature (°F or °C) of brick Core C.
L138			**8100/9100 SERIES** **Brick Core D Thermocouple Temperature** – Indicates the actual brick core temperature (°F or °C) of brick Core D.
L139			**8100/9100 SERIES** **Brick Core E Thermocouple Temperature** – Indicates the actual brick core temperature (°F or °C) of brick Core E.
L140			**8100 SERIES** **Brick Core F Thermocouple Temperature** – Indicates the actual brick core temperature (°F or °C) of brick Core F. **9100 SERIES** **Currently not utilized.**
L141			**8100 SERIES** **Brick Core G Thermocouple Temperature** – Indicates the actual brick core temperature (°F or °C) of brick Core G. **9100 SERIES** **Currently not utilized.**
L142			**8100 SERIES** **Brick Core H Thermocouple Temperature** – Indicates the actual brick core temperature (°F or °C) of brick Core H. **9100 SERIES** **Currently not utilized.**
L143			**8100/9100 SERIES** **External Duct Sensor Temperature -** Indicates the external duct temperature (°F or °C).

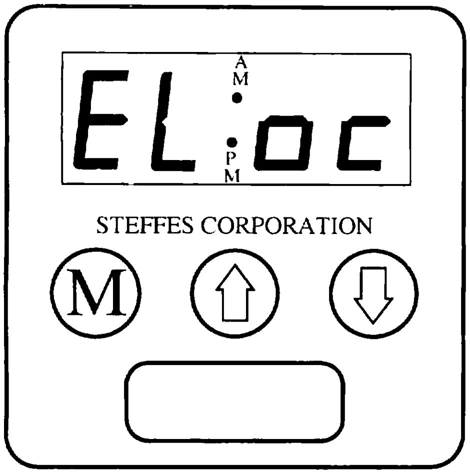
Loc. No.	Factory Default	Default Range	Description / Function
L144			**Currently not utilized.**
L145			**8100/9100 SERIES** **4-20mA Input** – Indicates the mA reading that the load management system is applying to the port on the relay driver board. This value is indicated as a percentage. 0% = No heating elements allowed to operate. 50% = Half of heating elements allowed to operate as needed. 100 % = All heating elements allowed to operate as needed.
L146			**8100/9100 SERIES** **Current kW Reading** – Indicates the current kW reading based on the pulse input.
L147			**8100/9100 SERIES** **Brick Core C Active Heating Elements** – Indicates the number of heating elements energized at any one time in Core C. ***Value*** ***Description*** 1 Element 1 is energized. 2 Element 2 is energized. 4 Element 3 is energized. 8 Element 4 is energized. 16 Element 5 is energized. 32 Element 6 is energized.
L148			**8100/9100 SERIES** **Brick Core D Active Heating Elements** – Indicates the number of heating elements energized at any one time in Core D. ***Value*** ***Description*** 1 Element 1 is energized. 2 Element 2 is energized. 4 Element 3 is energized. 8 Element 4 is energized. 16 Element 5 is energized. 32 Element 6 is energized.
L149			**8100/9100 SERIES** **Brick Core E Active Heating Elements** – Indicates the number of heating elements energized at any one time in Core E. ***Value*** ***Description*** 1 Element 1 is energized. 2 Element 2 is energized. 4 Element 3 is energized. 8 Element 4 is energized. 16 Element 5 is energized. 32 Element 6 is energized.

Loc. No.	Factory Default	Default Range	Description / Function
L150			**8100 SERIES** **Brick Core F Active Heating Elements** – Indicates the number of heating elements energized at any one time in Core F. *Value* *Description* 1 Element 1 is energized. 2 Element 2 is energized. 4 Element 3 is energized. 8 Element 4 is energized. 16 Element 5 is energized. 32 Element 6 is energized **9100 SERIES** **Currently not utilized.**
L151			**8100 SERIES** **Brick Core G Active Heating Elements** – Indicates the number of heating elements energized at any one time in Core G. *Value* *Description* 1 Element 1 is energized. 2 Element 2 is energized. 4 Element 3 is energized. 8 Element 4 is energized. 16 Element 5 is energized. 32 Element 6 is energized **9100 SERIES** **Currently not utilized.**
L152			**8100 SERIES** **Brick Core H Active Heating Elements** – Indicates the number of heating elements energized at any one time in Core H. *Value* *Description* 1 Element 1 is energized. 2 Element 2 is energized. 4 Element 3 is energized. 8 Element 4 is energized. 16 Element 5 is energized. 32 Element 6 is energized **9100 SERIES** **Currently not utilized.**
L153			**Currently not utilized.**
L154			**8100/9100 SERIES** **Core C Temperature At Last Core Fail** - Indicates the Core C temperature at the time of the last core fail. This value is written at the time the display starts showing "CORE FAIL".

Loc. No.	Factory Default	Default Range	Description / Function
L155			**8100/9100 SERIES** **Core D Temperature At Last Core Fail** - Indicates the Core D temperature at the time of the last core fail. This value is written at the time the display starts showing "CORE FAIL".
L156			**8100/9100 SERIES** **Core E Temperature At Last Core Fail** - Indicates the Core E temperature at the time of the last core fail. This value is written at the time the display starts showing "CORE FAIL".
L157			**8100 SERIES** **Core F Temperature At Last Core Fail** - Indicates the Core F temperature at the time of the last core fail. This value is written at the time the display starts showing "CORE FAIL". **9100 SERIES** **Currently not utilized.**
L158			**8100 SERIES** **Core G Temperature At Last Core Fail** - Indicates the Core G temperature at the time of the last core fail. This value is written at the time the display starts showing "CORE FAIL". **9100 SERIES** **Currently not utilized.**
L159			**8100 SERIES** **Core H Temperature At Last Core Fail** - Indicates the Core H temperature at the time of the last core fail. This value is written at the time the display starts showing "CORE FAIL". **9100 SERIES** **Currently not utilized.**
L160			**8100/9100 SERIES** **Current Year** - Indicates the current year.
L161			**8100/9100 SERIES** **Current Month** - Indicates the current month.
L162		0-31	**8100/9100 SERIES** **Current Day of the Month** - Indicates the current day of the month.

Accessing Relay Driver Board (RDB) ELoc Setting Information

If utilizing the ThermElect system for Pulse Monitoring or 4-20 Milliamp Load Control, the relay driver board must be set up for the application. Review the program ELoc settings to determine the proper values.



*NOTE: **Upon power up of the equipment, entry into all program locations is provided for the first two minutes of operation. After this time, the security lockout prevents changes from being made to the relay driver board "Eloc" settings.***

TO EDIT OR VIEW "ELoc" SETTINGS:

STEP 1 Press and release the **M** button until "ELoc" is displayed on the faceplate.

STEP 2 Press the up arrow button once and "E000" will appear on the faceplate.

STEP 3 Release the buttons. The display will flash between "E000" and the value.

STEP 4 To edit "E000", press and hold the **M** button. Use the up or the down arrow button to change the value to the desired setting. Release the buttons.

STEP 5 Use the up arrow button to go to "E001". If changes are needed, press and hold the **M** button. Use the up or the down arrow button to change the value to the desired setting. Release the buttons.

STEP 6 Continue to repeat Step 5 until all "ELoc" values are set accordingly.

STEP 7 Once all changes have been made, release the **M** button. Press the down arrow button until "E000" is displayed. Then, press the down arrow button one more time and the normal display mode will be shown. Any changes made will automatically be saved.

NOTE: ***If no buttons on the control panel are pressed, after a brief amount of time, the faceplate will automatically return to its normal operating mode and any changes made to the location settings will automatically be saved.***

Relay Driver Board (RDB) Location Values and Descriptions

Loc. No.	Factory Default	Default Range	Description / Function
E000			**8100/9100 SERIES** **Pulses per kWh** – (Number of Pulses/kW) x 10
E001			**8100/9100 SERIES** **Billing Day** – Indicates the day of the month on which billing begins. This is the day on which the system starts monitoring kW usage for each month's load limits.
E002			**8100/9100 SERIES** **January Load Limit** – Indicates the maximum demand allowed for the month of January. (kW/10)
E003			**8100/9100 SERIES** **February Load Limit** – Indicates the maximum demand allowed for the month of February. (kW/10)
E004			**8100/9100 SERIES** **March Load Limit** – Indicates the maximum demand allowed for the month of March. (kW/10)
E005			**8100/9100 SERIES** **April Load Limit** – Indicates the maximum demand allowed for the month of April. (kW/10)
E006			**8100/9100 SERIES** **May Load Limit** – Indicates the maximum demand allowed for the month of May. (kW/10)
E007			**8100/9100 SERIES** **June Load Limit** – Indicates the maximum demand allowed for the month of June. (kW/10)
E008			**8100/9100 SERIES** **July Load Limit** – Indicates the maximum demand allowed for the month of July. (kW/10)
E009			**8100/9100 SERIES** **August Load Limit** – Indicates the maximum demand allowed for the month of August. (kW/10)
E010			**8100/9100 SERIES** **September Load Limit** – Indicates the maximum demand allowed for the month of September. (kW/10)
E011			**8100/9100 SERIES** **October Load Limit** – Indicates the maximum demand allowed for the month of October. (kW/10)

Relay Driver Board (RDB) Location Values and Descriptions(L000-L035) continued...

Loc. No.	Factory Default	Default Range	Description / Function
E012			**8100/9100 SERIES** **November Load Limit** – Indicates the maximum demand allowed for the month of November. (kW/10)
E013			**8100/9100 SERIES** **December Load Limit** – Indicates the maximum demand allowed for the month of December. (kW/10)
E014			**8100/9100 SERIES** **kW Load on Relay One of Expansion Board One** – Indicates the amount of load (kW) connected to relay one on the first expansion board draws when energized.
E015			**8100/9100 SERIES** **kW Load on Relay Two of Expansion Board One** – Indicates the amount of load (kW) connected to relay two on the first expansion board draws when energized.
E016			**8100/9100 SERIES** **kW Load on Relay Three of Expansion Board One** – Indicates the amount of load (kW) connected to relay three on the first expansion board draws when energized.
E017			**8100/9100 SERIES** **kW Load on Relay Four of Expansion Board One** – Indicates the amount of load (kW) connected to relay four on the first expansion board draws when energized.
E018			**8100/9100 SERIES** **kW Load on Relay Five of Expansion Board One** – Indicates the amount of load (kW) connected to relay five on the first expansion board draws when energized.
E019			**8100/9100 SERIES** **kW Load on Relay Six of Expansion Board One** – Indicates the amount of load (kW) connected to relay six on the first expansion board draws when energized.
E020			**8100/9100 SERIES** **kW Load on Relay Seven of Expansion Board One** – Indicates the amount of load (kW) connected to relay seven on the first expansion board draws when energized.
E021			**8100/9100 SERIES** **kW Load on Relay Eight of Expansion Board One** – Indicates the amount of load (kW) connected to relay eight on the first expansion board draws when energized.

Relay Driver Board (RDB) Location Values and Descriptions(L000-L035) continued...

Loc. No.	Factory Default	Default Range	Description / Function
E022			8100/9100 SERIES **kW Load on Relay One of Expansion Board Two** – Indicates the amount of load (kW) connected to relay one on the second expansion board draws when energized.
E023			8100/9100 SERIES **kW Load on Relay Two of Expansion Board Two** – Indicates the amount of load (kW) connected to relay two on the second expansion board draws when energized.
E024			8100/9100 SERIES **kW Load on Relay Three of Expansion Board Two** – Indicates the amount of load (kW) connected to relay three on the second expansion board draws when energized.
E025			8100/9100 SERIES **kW Load on Relay Four of Expansion Board Two** – Indicates the amount of load (kW) connected to relay four on the second expansion board draws when energized.
E026			8100/9100 SERIES **kW Load on Relay Five of Expansion Board Two** – Indicates the amount of load (kW) connected to relay five on the second expansion board draws when energized.
E027			8100/9100 SERIES **kW Load on Relay Six of Expansion Board Two** – Indicates the amount of load (kW) connected to relay six on the second expansion board draws when energized.
E028			8100/9100 SERIES **kW Load on Relay Seven of Expansion Board Two** – Indicates the amount of load (kW) connected to relay seven on the second expansion board draws when energized.
E029			8100/9100 SERIES **kW Load on Relay Eight of Expansion Board Two** – Indicates the amount of load (kW) connected to relay eight on the second expansion board draws when energized.
E030 – E035			**Currently not utilized.**

THERMELECT ERROR CODES

The ThermElect systems have an on-board diagnostic system to monitor various operating conditions. If operating conditions move outside the normal operating range, an error code is displayed on the faceplate. If there are multiple errors simultaneously, only the highest priority error code appears. Once corrected, the next highest priority code is displayed. Error codes display as "Er--" (i.e. Er05).

⚠ WARNING

HAZARDOUS VOLTAGE: Risk of electric shock, injury, or death. System may be connected to more than one branch circuit. Disconnect power to all circuits before servicing. Equipment must be serviced by a qualified technician.

Error Code #	Description
01	Currently not utilized.
02	Currently not utilized.
03	Currently not utilized.
04	Discharge air sensor temperature is out of normal operating range. This can indicate an open sensor, a short in the wiring, or a circuit board which is out of calibration. Take an ohm reading across the sensor to ensure proper operation, check the wiring, and verify the value in L035. Verify that the supply air blower is connected to the supply blower wiring harness located in the base of the system. Compare the sensor reading to the value in L112 to verify proper calibration of the circuit board. *Approximate ohm readings are 70° F = 1,199 ohms; 80° F = 941 ohms; 95° F = 646 ohms.*
05	Outdoor sensor (direct wired) temperature reading is out of normal operating range. The sensor circuit may be open or shorted, the processor control board may be out of calibration, or there may be an incorrect value in L035. If using power line carrier control, make sure the values in L020 and L035 have been set appropriately. Otherwise, verify that the outdoor sensor is connected to OS and SC on the 12-position terminal block. Compare the sensor reading to the value in L113 to verify proper calibration of the circuit board. *Approximate ohm readings are 5° F = 7,646 ohms; 50° F = 2,024 ohms; 95° F = 646 ohms.*
06	Outdoor temperature reading from the transmitting device (PLC system) is out of normal operating range. Check the outdoor sensor attached to the transmitting device and the transmitter for proper operation.
07	Main processor control board temperature sensor is out of normal operating range. Verify that none of the clearances have been violated and inspect the condition of the processor control board.
08	External duct sensor temperature is out of normal operating range. This can indicate an open sensor, a short in the wiring, or the relay driver board is out of calibration. Take an ohm reading across the sensor to ensure proper operation, check the wiring, and verify the value in L053. Compare the sensor reading to the value in L144 to verify proper calibration of the circuit board. *Approximate ohm readings are 60° F = 1552 ohms; 70° F = 1199 ohms; 80° F = 941 ohms. Max 190°F, Min 0°F*
09	Aux. Analog input is out of normal operating range. Currently not used.
10	Discharge air temperature has exceeded maximum standard operating temperatures.
11	Core C thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L136 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. Max. 1700°F, min 0°F*
12	Core D thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L137 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. . Max. 1700°F, min 0°F*

Error Code #	Description
13	Core E thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L138 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. . Max. 1700°F, min 0°F*
14	**8100 SERIES ONLY** - Core F thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L139 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. . Max. 1700°F, min 0°F*
15	**8100 SERIES ONLY** - Core G thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L140 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. . Max. 1700°F, min 0°F*
16	**8100 SERIES ONLY** - Core H thermocouple temperature is out of normal operating range. An open, shorted, or otherwise defective thermocouple or a circuit board which is out of calibration can cause this. Check the thermocouple by taking a millivolt reading of the thermocouple. Compare the thermocouple reading to the value in L141 to verify proper calibration of the circuit board. *Approximate DC mV readings are 200° F = 3.8 mV; 700° F = 15.2 mV; 1200° F = 27.0 mV. . Max. 1700°F, min 0°F*
17	Load Control Device (4-20mA) is out of normal range. This can indicate an open sensor, a short in the wiring, or a relay driver board is out of calibration. Take a mA reading across the input to ensure proper operation, check the wiring, and verify the value in L053. Compare the sensor reading to the value in L142 to verify proper calibration of the circuit board. All heating elements should be turned off. *Max. 25mA, min 2mA*
18	Pulse reading is not functional. The pulse input is reading is indicating 0 load even though there are elements, 2 minimum, turned on. All loads should be turned off.
19	There is no communication occurring with the relay driver board. The interface cable may be defective or the relay driver board may be unresponsive. Verify that the values in L090, L091, and L092 are correct for the application.
20	There is no communication occurring between the Base I/O board and the processor control board. A defective board interface cable or an unresponsive Base I/O board can cause this.
21	There is no communication occurring with the first relay expansion board. The interface cable may be defective or the first expansion board may be unresponsive. Check the jumper configuration on the relay expansion board to ensure that J1 and J2 are both in the "OFF" position. Verify that the values in L090, L091, and L092 are correct for the application.
22	There is no communication occurring with the second relay expansion board. The interface cable may be defective or the second expansion board may be unresponsive. Check the jumper configuration on the expansion board and make sure J1 is "ON" and J2 is "OFF". Verify that the values in L090, L091, and L092 are correct for the application.
23	There is no communication occurring with the Steffes Time Clock Module. If this module is installed, verify the value in L035. If correct, the interface cable or the time clock module may be defective.
24	Temperature sensor offset/reference is out of range and indicates that one of the sensors or the core thermocouple may be shorted to ground or the processor control board may be out of calibration.
25	Power line carrier system is active; however, no good data has been received.
26	Insufficient main control board memory. Contact a qualified service technician.

ThermElect Series Error Codes Continued...

Error Code #	Description
27	Insufficient permanent memory. Contact a qualified service technician.
28	Permanent memory change has been made. Press the **M** button to accept. This error message indicates a change has been made to the software program; therefore, it is important to verify that all location settings are correct for the application.
29	On-board communication system is not fully operable. Contact a qualified service technician.
30	Base control board is in test mode. Check the jumper configuration on the circuit board.
31	Relay expansion board(s) are in test mode. Check the jumper configuration.
39	If the value in Location 13 (L013) is set to a value greater than the value in Location 12 (L012), error 39 (Er 39) is displayed and the system doesn't charge until the values are corrected.
40	Location Values are lost. The EPROM will be updated to the values saved in the main program. Clear error by touching the M button on the heater. If this will not clear the error, replace the processor board.
41	This error may appear when configuring the heater. Clear error by touching the M button on the heater. If this will not clear the error, replace the processor board.
42	Internal communication error. Reprogram or replace processor circuit board.
43	An attempt to load configuration using LO 98 set to 20, 30, 40, or 50 has failed. All location values will need to be manually set.
Cold Core	Temperature of the brick core is below 40 degrees or the core sensing thermocouple may be open. Verify that the core thermocouple wiring is connected properly and that the values in L090, L091 and L092 are correct for the application. If the value in L110 is reading 30, then the thermocouple is open.
Core Fail	Core high limit switch may be open.
PLC Fail	The system is configured for power line carrier control; however, is not receiving a valid power line carrier communication signal.
LoAd CAP	All controllable loads have been shed and Maximum Load Capacity is still exceeded.

INSTALLATION INSTRUCTIONS & PARTS LIST

STERLING ENERPAK GAS FIRED BLOWER UNIT HEATERS

ATTENTION: READ THIS MANUAL AND ALL LABELS ATTACHED TO THE UNIT CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THESE UNITS! CHECK UNIT DATA PLATE FOR TYPE OF GAS AND ELECTRICAL SPECIFICATIONS AND MAKE CERTAIN THAT THESE AGREE WITH THOSE AT POINT OF INSTALLATION. RECORD THE UNIT MODEL AND SERIAL No.(s) IN THE SPACE PROVIDED. RETAIN FOR FUTURE REFERENCE.

Model No. ______________________ Serial No. ______________________

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.

DESIGN AMERICAN GAS ASSOCIATION CERTIFIED

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.

CANADIAN GAS ASSOCIATION APPROVED

⚠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.**

APPROVED FOR USE IN CALIFORNIA

⚠WARNING **Install, operate and maintain unit in accordance with manufacturer's instructions to avoid exposure to fuel substances or substances from incomplete combustion which can cause death or serious illness. The state of California has determined that these substances may cause cancer, birth defects, or other reproductive harm.**

⚠WARNING **INSTALLER'S RESPONSIBILITY**

Installer Please Note: This equipment has been test fired and inspected. It has been shipped free from defects from our factory. However, during shipment and installation, problems such as loose wires, leaks or loose fasteners may occur. **It is the installer's responsibility to inspect and correct any problems that may be found.**

RECEIVING INSTRUCTIONS

Inspect shipment immediately when received to determine if any damage has occurred to the unit during shipment. After the unit has been uncrated, check for any visible damage to the unit. If any damage is found, the consignee should sign the bill of lading indicating such damage and immediately file claim for damage with the transportation company.

STERLING®
HVAC PRODUCTS
260 NORTH ELM ST., WESTFIELD, MA 01085
TEL: (413) 564-5540 FAX: (413) 562-5311
http://www.mestek.com
A MESTEK COMPANY

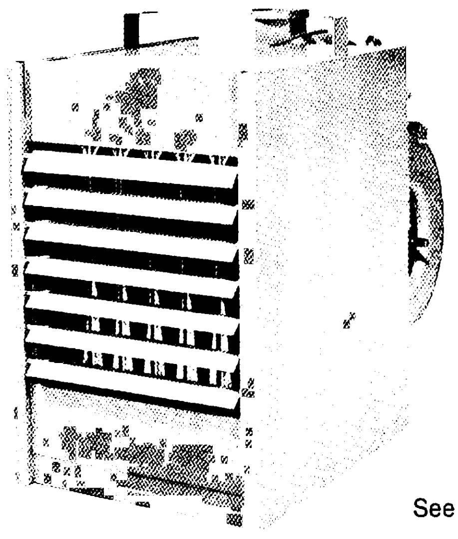
MODELS: QVEB (100, 125, 150, 175, 200, 225, 250, 300, 350, 400) (S,M)

TABLE OF CONTENTS

DESCRIPTION

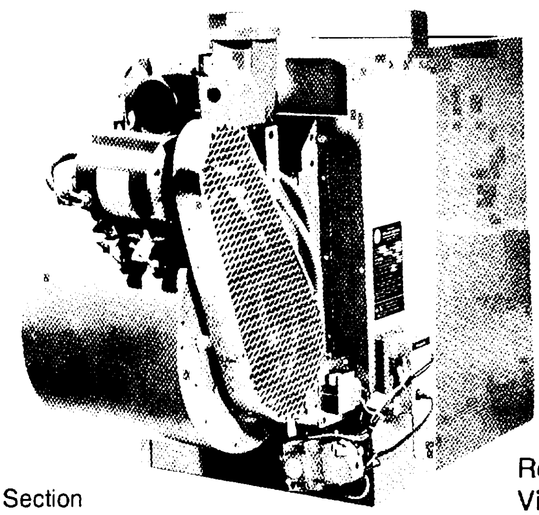
The Power Vented Gas Blower Unit Heater is a factory assembled, high static pressure type, centrifugal blower unit designed for heavy duty applications such as continuous operation or where a single unit heater must do the entire heating job in a large area. These blower type unit heaters may be used with the standard adjustable louvers or with short duct runs and discharge nozzles for spot heating. These blower type unit heaters may be used where low sound levels are required. The designs are certified by AGA/CGA as providing a minimum of 80% thermal efficiency, and approved for use in California. **Do not alter these units in any way.** If you have any questions after reading this manual, contact the manufacturer.

Figure 1 - Power Vented Blower Unit Heaters



Front View

See Identification of Parts Section for unit components.



Rear View

The following terms are used throughout this manual, in addition to AGA/CGA requirements, to bring attention to the presence of potential hazards or to important information concerning the product:

⚠ DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

⚠ WARNING Indicates an imminently hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

⚠ CAUTION Indicates an imminently hazardous situation which, if not avoided, may result in minor injury or property damage.

NOTICE: Used to notify of special instructions on installation, operation or maintenance which are important to equipment but not related to personal injury hazards.

GENERAL SAFETY INFORMATION

⚠WARNING **Failure to comply with the general safety information may result in extensive property damage, severe personal injury or death.**

Installation must be made in accordance with local codes, or in absence of local codes, with ANSI Standard Z223-1996 (N.F.P.A. No.54) National Fuel Gas Code (or the latest edition of). All of the ANSI and NFPA Standards referred to in these installation instructions are those that were applicable at the time the design of this appliance was certified. The ANSI Standards are available from the American Gas Association, 1515 Wilson Boulevard, Arlington, Virginia 22209. The NFPA Standards are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. These unit heaters are designed for use in airplane hangars when installed in accordance with ANSI/NFPA No. 409 and in public garages when installed in accordance with NFPA No. 88A and NFPA No. 88B.

If installed in Canada, the installation must conform with local building codes, or in absence of local building codes, with CGA-B149.1 "Installation Codes for Natural Gas Burning Appliances and Equipment" or CGA-B149.2 "Installation Codes for Propane Gas Burning Appliances and Equipment". These Unit Heaters have been designed and certified to comply with CGA 2.6. Also see sections on installation in AIRCRAFT HANGARS and PUBLIC GARAGES.

⚠WARNING **Do not alter the unit heater in any way or damage to the unit and/or severe personal injury or death may occur**

⚠WARNING **Disconnect all power and gas supplies before installing or servicing the heater. If the power disconnect is out of sight, lock it in the open position and tag it to prevent unexpected application of power. Failure to do so could result in fatal electric shock, or severe personal injury.**

⚠CAUTION **Insure that all power sources conform to the requirements of the unit heater or damage to the unit will result!**

Follow installation instructions CAREFULLY to avoid creating unsafe conditions. All wiring should be done and checked by a qualified electrician, using copper wire only. All gas connections should be made and leak-tested by a suitably qualified individual, per instructions in this manual. Also follow procedures listed on the "Gas Equipment Start-Up Sheet" located in this manual.

Use only the fuel for which the heater is designed (see rating plate). Using LP gas in a heater that requires natural gas, or vice versa, will create the risk of gas leaks, carbon monoxide poisoning and explosion.

⚠WARNING **Do not attempt to convert the heater for use with a fuel other than the one intended. Such conversion is dangerous, as it will create the risks listed previously.**

Make certain that the power source conforms to the electrical requirements of the heater.

⚠WARNING **Do not depend upon a thermostat or other switch as sole means of disconnecting power when installing or servicing heater. Always disconnect power at main circuit breaker as described above. *Failure to do so could result in* fatal electric shock.**

Special attention must be given to any grounding information pertaining to this heater. To prevent the risk of electrocution, the heater must be securely and adequately grounded. This should be accomplished by connecting a grounded conductor between the service panel and the heater. To ensure a proper ground, the grounding means must be tested by a qualified electrician.

Do not insert fingers or foreign objects into the heater or its air moving device. Do not block or tamper with the heater in any manner while in operation or just after it has been turned off, as some parts may be hot enough to cause injury.

This heater is intended for general heating applications ONLY. It must NOT be used in potentially dangerous locations such as flammable, explosive, chemical-laden or wet atmospheres.

In cases in which property damage may result from malfunction of the heater, a backup system or a temperature sensitive alarm should be used.

⚠CAUTION **The open end of piping systems being purged shall not discharge into areas where there are sources of ignition or into confined spaces UNLESS precautions are taken as follows: (1) By ventilation of the space, (2) control of purging rate, (3) elimination of all hazardous conditions. All precautions must be taken to perform this operation in a safe manner!**

Unless otherwise specified, the following conversions may be used for calculating SI unit measurements:

1 foot = 0.305 m	1 inch water column = 0.249 kPa
1 inch = 25.4 mm	1000 Btu/Cu. Ft. = 37.5 MJ/m^3
1 psig = 6.894 kPa	1000 Btu per hour = 0.293 kW
1 pound = 0.453 kg	liter/second = CFM x 0.472
1 gallon = 3.785 L	meter/second = FPM ÷ 196.8
1 cubic foot = 0.028 m^3	

Table 1 – Performance and Dimensional Data – Power Vented Blower Unit Heater

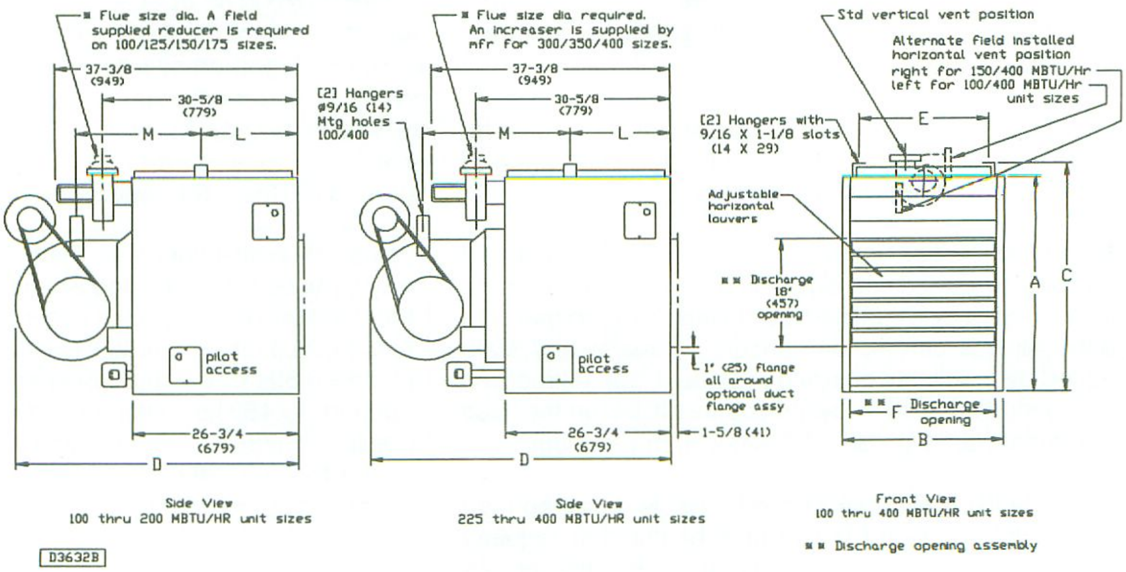
Unit Size	100	125	150	175	200	225	250	300	350	400
PERFORMANCE DATA ‡										
Input BTU/Hr	100,000	125,000	150,000	175,000	200,000	225,000	250,000	300,000	350,000	400,000
(kW)	(29.3)	(36.6)	(43.9)	(51.2)	(58.6)	(65.9)	(73.2)	(87.8)	(102.5)	(117.1)
Output BTU/Hr	80,000	100,000	120,000	140,000	160,000	180,000	200,000	240,000	280,000	320,000
(kW)	(23.4)	(29.3)	(35.1)	(41.0)	(46.9)	(52.7)	(58.6)	(70.3)	(82.0)	(93.7)
Thermal Efficiency (%)	80	80	80	80	80	80	80	80	80	80
Free Air Delivery CFM	1,200	1,575	1,975	2,300	2,400	2,600	2,850	3,950	4,600	4,800
(cu. m/s)	(0.566)	(0.743)	(0.932)	(1.086)	(1.133)	(1.227)	(1.345)	(1.864)	(2.171)	(2.266)
Air Temperature Rise F Deg.	62	59	56	56	62	64	65	56	56	62
(C Deg.)	(34)	(33)	(31)	(31)	(34)	(36)	(36)	(31)	(31)	(34)
Outlet Velocity FPM	880	950	1,030	1,045	965	935	930	1,080	1,090	1,000
(m/s)	(4.47)	(4.83)	(5.23)	(5.31)	(4.90)	(4.75)	(4.72)	(5.49)	(5.54)	(5.08)
Full Load Amps at 115V	8.3	9.8	10.6	10.6	15.2	15.2	15.2	15.2	18.6	18.6
MOTOR DATA : Motor HP	1/4	1/3	1/2	1/2	3/4	3/4	3/4	3/4	1	1
Motor (kW)	(0.19)	(0.25)	(0.37)	(0.37)	(0.56)	(0.56)	(0.56)	(0.56)	(0.75)	(0.75)
Motor Type	SPH	SPH	SPH	SPH	SPH	SPH	SPH	SPH	cap.start	cap.start
R.P.M.	1,725	1,725	1,725	1,725	1,725	1,725	1,725	1,725	1,725	1,725
Amps @ 115V	5.1	6.6	7.4	7.4	12.0	12.0	12.0	12.0	15.4	15.4
DIMENSIONAL DATA in. (mm)										
"A" Height to Top of Unit	31-1/4	31-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4
	(794)	(794)	(921)	(921)	(921)	(921)	(921)	(921)	(921)	(921)
"B" Width of Unit	17-7/8	20-5/8	20-5/8	23-3/8	26-1/8	28-7/8	31-5/8	37-1/8	42-5/8	48-1/8
	(454)	(524)	(524)	(594)	(664)	(733)	(803)	(943)	(1083)	(1222)
"C" Height to Top of Hanger	34-1/8	34-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8
	(867)	(867)	(994)	(994)	(994)	(994)	(994)	(994)	(994)	(994)
"D" Depth to Rear of Housing	42-5/8	44-1/4	44-1/4	47	47	51	51	48-1/4	51	51
	(1083)	(1124)	(1124)	(1194)	(1194)	(1295)	(1295)	(1226)	(1295)	(1295)
"E" Hanging Distance Width	14-1/2	17-1/4	17-1/4	20	22-3/4	25-1/2	28-1/4	33-3/4	39-1/4	44-3/4
	(368)	(438)	(438)	(508)	(578)	(648)	(718)	(857)	(997)	(1137)
"F" Discharge Opening Width	15-3/8	18-1/8	18-1/8	20-7/8	23-5/8	26-3/8	29-1/8	34-5/8	40-1/8	45-5/8
	(391)	(460)	(460)	(530)	(600)	(670)	(740)	(879)	(1019)	(1159)
"J" to Centerline of Flue	5-7/8	7-1/4	7-1/4	8-5/8	10	11-1/4	12-3/4	15-1/2	18-1/4	21
	(149)	(184)	(184)	(219)	(254)	(286)	(324)	(394)	(464)	(533)
"L" Hanger Location	16-3/8	16-3/8	16-3/8	16-3/8	16-3/8	16-3/8	16-3/8	16-3/8	16-3/8	16-3/8
	(416)	(416)	(416)	(416)	(416)	(416)	(416)	(416)	(416)	(416)
"M" Hanging Distance Depth	16-3/8	16-3/8	16-3/8	17-7/8	17-7/8	21-7/8	21-7/8	21-7/8	21-7/8	21-7/8
	(416)	(416)	(416)	(454)	(454)	(556)	(556)	(556)	(556)	(556)
Flue Size Dia-in. *	4	4	4	4	5	5	5	6	6	6
(Dia-mm)	(102)	(102)	(102)	(102)	(127)	(127)	(127)	(152)	(152)	(152)
Blower Size-in.	9	10	10	12	12	12	12	(2) 10	(2) 12	(2) 12
Gas Inlet-Natural Gas-in.	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4
Gas Inlet-LP Gas-in.	1/2	1/2	1/2	1/2	1/2	←		1/2 OR 3/4		→
Approx. Shipping Wt. lb.	262	279	314	336	363	408	427	471	561	594
(kg)	(119)	(127)	(142)	(152)	(165)	(185)	(194)	(214)	(254)	(269)

‡ Ratings shown are for unit installations at elevations between 0 and 2000 ft. (610m). For installations in USA above 2000 ft. (610m), the unit input must be derated 4% for each 1000 ft. (305m) above sea level; refer to local codes, or in absence of local codes, refer to the National Fuel Gas Code, ANSI Standard Z223.1-1996 (N.F.P.A. No. 54), or the latest edition of.

For installations in Canada, any references to deration at altitudes of 2000 ft. (610m) are to be ignored. At altitudes of 2000 to 4500 ft. (610 to 1372m), the unit must be derated to 90% of the normal altitude rating, and be so marked in accordance with the C.G.A. certification.

LEGEND:
SPH = SPLIT PHASE
CAP. START = CAPACITOR START

Figure 2 - Unit Dimensions



DIMENSIONS XXX STANDARD UNITS
DIMENSIONS IN PARENTHESIS (XXX) MILLIMETERS

* Canadian units include a vent cap, and reducer/increaser if req.

INSTALLATION

⚠WARNING Do not install unit heaters in corrosive or flammable atmospheres! Premature failure of, or severe damage to the unit will result!

⚠WARNING Avoid locations where extreme drafts can affect burner operation. Unit heaters must not be installed in locations where air for combustion would contain chlorinated, halogenated or acidic vapors. If located in such an environment, premature failure of the unit will occur!

Since the unit is equipped with an automatic gas ignition system, the unit heater must be installed such that the gas ignition control system is not directly exposed to water spray, rain or dripping water.

NOTE: Location of unit heaters is related directly to the selection of sizes. Basic rules are as follows:

MOUNTING HEIGHT: Unit Heaters must be installed at a minimum of 8 feet (2.4m) above the floor, measured to the bottom of the unit. At heights above 8 feet (2.4m), less efficient air distribution will result. Occasionally unit heaters must be mounted at heights of 12 to 16 feet (3.7 to 4.9m) in order to clear obstacles. When this is the case, it is advisable to use centrifugal blower unit heaters.

AIRCRAFT HANGARS: Unit Heaters must be installed in aircraft hangars and public garages as follows: In aircraft hangars, unit heaters must be at least 10 feet (3.05m) above the upper surface of wings or engine enclosures of the highest aircraft to be stored in the hangar and 8 feet (2.44m) above the floor in shops, offices and other sections of the hangar where aircraft are not stored or housed. Refer to current ANSI/NFPA No. 409, Aircraft Hangars.In Canada, installation is suitable in aircraft hangars when acceptable to the enforcing authorities.

PUBLIC GARAGES: In repair garages, unit heaters must be at least 8 feet (2.44 m) above the floor. In parking structures, unit heaters must be installed so that the burner flames are located 18 in. (457.2mm) above the floor or protected by a partition not less than 18 in. (457.2mm) high. Refer to current NFPA No. 88A, Parking Structures and NFPA No. 88B, Repair Garages. In Canada, installation must be in accordance with current CGA B149 "Installation Codes for Gas Burning Appliances and Equipment."

AIR DISTRIBUTION: Direct air towards areas of maximum heat loss. When multiple heaters are involved, circulation of air around the perimeter is recommended where heated air flows along exposed walls. Satisfactory results can also be obtained where multiple heaters are located toward the center of the area with heated air directed toward the outside walls. Be careful to avoid all obstacles and obstructions which could impede the warm air distribution patterns. Heat throw distances are presented in Figure 2A and Table 2.

Figure 2A - Heat Throw Distances

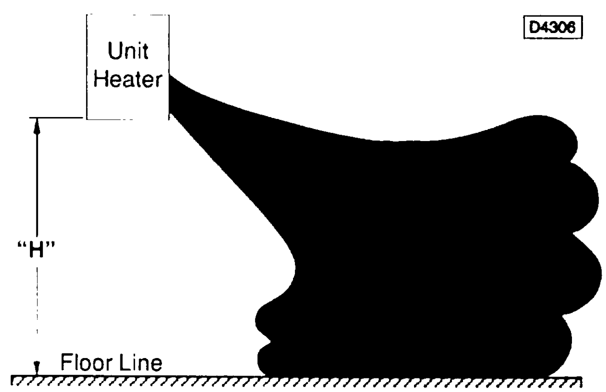


Table 2 - Standard Applications - Heat Throw Distances

"H" Distance From Floor to Bottom of Unit — UNIT SIZE BTU/Hr (kW)

ft. (m)	100,000 (29.3)	125,000 (36.6)	150,000 (43.9)	175,000 (51.2)	200,000 (58.6)	225,000 (65.9)	250,000 (73.2)	300,000 (87.8)	350,000 (102.5)	400,000 (117.1)
8	60	65	70	75	80	85	90	105	110	120
(2.4)	(18.3)	(19.8)	(21.3)	(22.9)	(24.4)	(25.9)	(27.4)	(32.0)	(33.5)	(36.6)
10	54	56	60	64	68	72	78	90	95	100
(3.0)	(16.5)	(17.1)	(18.3)	(19.5)	(20.7)	(21.9)	(23.8)	(27.4)	(29.0)	(30.5)
12	44	46	49	57	61	65	68	80	84	90
(3.7)	(13.4)	(14.0)	(20.7)	(17.4)	(18.6)	(19.8)	(20.7)	(24.4)	(25.6)	(27.4)
15	NR	NR	45	49	52	56	60	70	74	80
(4.6)	NR	NR	(22.6)	(14.9)	(15.8)	(17.1)	(18.3)	(21.3)	(22.6)	(24.4)
20	NR	NR	NR	NR	46	50	54	63	66	70
(6.1)	NR	NR	NR	NR	(14.0)	(15.2)	(16.5)	(19.2)	(20.1)	(21.3)

NR = Not recommended

The installation is to be adjusted to obtain an air throughput within the range specified on the rating plate.

Unit heaters should not be installed to maintain low temperatures and/or freeze protection of buildings. A minimum of 50°F (10°C) thermostat setting must be maintained. If unit heaters are operated to maintain lower than 50°F (10°C), hot flue gases are cooled inside the heat exchanger to a point where water vapor (a flue gas by-product) condenses onto the heat exchanger walls. The result is a mildly corrosive acid that prematurely corrodes the aluminized heat exchanger and can actually drip water down from the unit heater onto floor surface. Additional unit heaters should be installed if a minimum 50°F (10°C) thermostat setting cannot be maintained.

AIR FOR COMBUSTION: The Unit Heater shall be installed in a location in which the facilities for ventilation permit satisfactory combustion of gas, proper venting, and the maintenance of ambient temperature at safe limits under normal conditions of use. The Unit Heater shall be located in such a manner as not to interfere with proper circulation of air within the confined space. When buildings are so tight that normal infiltration does not meet air requirements, outside air shall be introduced per Sections 1.3.4.2 and 1.3.4.3 of ANSI Z223.1 for combustion requirements. A permanent opening or openings having a total free area of not less than one square inch per 5,000 BTU/HR. (1.5 Kw) of total input rating of all appliances within the space shall be provided.

NOTICE: Unit heater sizing should be based on heat loss calculations where the unit heater output equals or exceeds heat loss.

CLEARANCES: Each Gas Unit Heater shall be located with respect to building construction and other equipment so as to permit access to the Unit Heater. Clearance between walls and the vertical sides of the Unit Heater shall be no less than 18 inches (457 mm). A minimum clearance of 6 inches (152 mm) must be maintained between the top of the Unit Heater and the ceiling. The bottom of the Unit Heater must be no less than 12 inches (305 mm) from any combustible. However, in order to insure access to the burner compartment, a minimum distance of 21 inches (533 mm) is required. The distance between the flue collector and any combustible must be no less than 6 inches (152 mm). Also see AIR FOR COMBUSTION and VENTING sections.

NOTICE: Increasing the clearance distances may be necessary if there is a possibility of distortion or discoloration of adjacent materials.

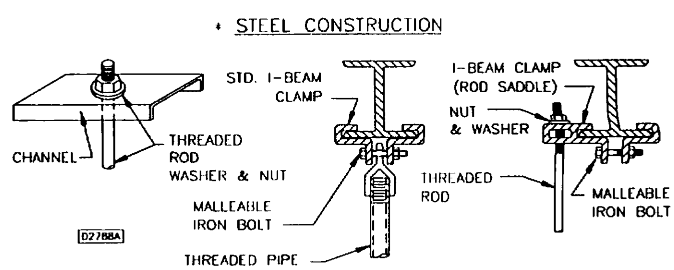
⚠WARNING Make certain that the lifting methods used to lift the unit heater and the structure to which the heater is to be mounted is capable of safely supporting its weight. Under no circumstances must the gas lines, venting system or the electrical conduit be used to support the heater or should any other objects (ie. ladder/person) lean against the heater, gas lines or electrical conduit for support. Failure to heed these warnings may result in property damage, personal injury or death.

⚠CAUTION Unit heaters must be hung level from side to side and from front to back; see Figures 2, 3A and 3B. Failure to do so *will result* in poor performance and or premature failure of the unit.

⚠WARNING Insure that all hardware used in the suspension of each unit heater is more than adequate for the installation. Failure to do so may result in extensive property damage, severe personal injury or death!

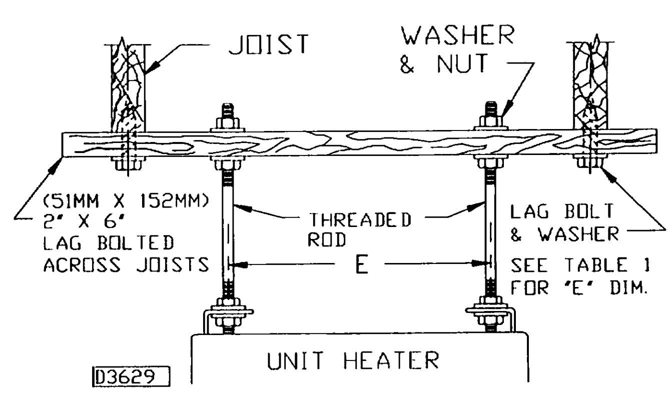
Refer to Figures 3A and 3B, and dimensional data per Table 1 and Figure 2 for suspension of units.

Figure 3A - Heater Mounting*



***All hanging hardware and wood is not included with the unit (To be field supplied).**

Figure 3B - Heater Mounting 100/400 MBTU Sizes Unit Sizes



INSTALLATION – GAS SUPPLY PIPING/SIZING

⚠WARNING To avoid equipment damage or possible personal injury, do not connect gas piping to this unit until a supply line pressure/leak test has been completed. Connecting the unit before completing the pressure/leak test may damage the unit gas valve and result in a fire hazard.

Do not rely on a shut off valve to isolate the unit while conducting gas pressure/leak tests. These valves may not be completely shut off, exposing the unit gas valve to excessive pressure and damage.

PIPE SIZING

To provide adequate gas pressure at the gas unit heater, size the gas piping as follows:

1. Find the cu ft/hr by using the following formula:

$$\text{Cu ft/hr} = \frac{\text{Input}}{\text{Btu per Cu ft}}$$

2. Refer to Table 3. Match "Pipe Run in Feet" with appropriate "Gas Input - Cu Ft/Hr" figure. This figure can then be matched to the pipe size at the end of the column.

Example: It is determined that a 67 foot (20.4m) run of gas pipe is required to connect a 200 MBTU gas unit heater to a 1,000 Btu/cu. ft (0.29 kW) natural gas supply.

$$\frac{\text{200,000 Btu/hr}}{\text{1,000 Btu/cu ft}} = \text{200 Cu ft/hr}$$

Using Table 3, a 1 inch pipe is needed.

NOTICE: See General Safety Information section for english/SI (metric) unit conversion factors.

NOTICE: If more than one gas unit heater is to be served by the same piping arrangement, the total cu ft/hr input and length of pipe must be considered.

NOTICE: If the gas unit heater is to be fired with LP gas, consult the local LP gas dealer for pipe size information.

HEATER INSTALLATION FOR USE WITH PROPANE (BOTTLED) GAS MUST BE MADE BY A QUALIFIED L.P. GAS DEALER OR INSTALLER. HE WILL INSURE THAT PROPER JOINT COMPOUNDS ARE USED FOR MAKING PIPE CONNECTIONS; THAT AIR IS PURGED FROM LINES; THAT A THOROUGH TEST IS MADE FOR LEAKS BEFORE OPERATING HEATER; AND THAT IT IS PROPERLY CONNECTED TO PROPANE GAS SUPPLY SYSTEM.

Before any connection is made to an existing line supplying other gas appliances, contact the local gas company to make certain that the existing line is of adequate size to handle the combined load.

Table 3 - Gas Pipe Size

Maximum Capacity of Pipe in Cubic Feet of Gas per Hour (Cubic Meters per Hour) for Gas Pressures of 0.5 psig (3.5 kPa) or Less, and a Pressure Drop of 0.5 Inch Water Column (124.4 Pa) (Based on a 0.60 Specific Gravity Gas)

Nominal Iron Pipe Size in.	Internal Dia. in.	Length of Pipe, Feet (meters) 10 (3.0)	20 (6.1)	30 (9.1)	40 (12.2)	50 (15.2)	60 (18.3)	70 (21.3)	80 (24.4)	90 (27.4)	100 (30.5)	125 (38.1)	150 (45.7)	175 (53.3)	200 (61.0)
1/2	0.622	175	120	97	82	73	66	61	57	53	50	44	40	37	35
		(4.96)	(3.40)	(2.75)	(2.32)	(2.07)	(1.87)	(1.73)	(1.61)	(1.50)	(1.42)	(1.25)	(1.13)	(1.05)	(0.99)
3/4	0.824	360	250	200	170	151	138	125	118	110	103	93	84	77	72
		(10.2)	(7.08)	(5.66)	(4.81)	(4.28)	(3.91)	(3.54)	(3.34)	(3.11)	(2.92)	(2.63)	(2.38)	(2.18)	(2.04)
1	1.049	680	465	375	320	285	260	240	220	205	195	175	160	145	135
		(19.3)	(13.2)	(10.6)	(9.06)	(8.07)	(7.36)	(6.80)	(6.23)	(5.80)	(5.52)	(4.96)	(4.53)	(4.11)	(3.82)
1 1/4	1.380	1400	950	770	660	580	530	490	460	430	400	360	325	300	280
		(39.6)	(26.9)	(21.8)	(18.7)	(16.4)	(15.0)	(13.9)	(13.0)	(12.2)	(11.3)	(10.2)	(9.20)	(8.50)	(7.93)
1 1/2	1.610	2100	1460	1180	990	900	810	750	690	650	620	550	500	460	430
		(59.5)	(41.3)	(33.4)	(28.0)	(25.5)	(22.9)	(21.2)	(19.5)	(18.4)	(17.6)	(15.6)	(14.2)	(13.0)	(12.2)
2	2.067	3950	2750	2200	1900	1680	1520	1400	1300	1220	1150	1020	950	850	800
		(112)	(77.9)	(62.3)	(53.8)	(47.6)	(43.0)	(39.6)	(36.8)	(34.5)	(32.6)	(28.9)	(26.9)	(24.1)	(22.7)
2 1/2	2.469	6300	4350	3520	3000	2650	2400	2250	2050	1950	1850	1650	1500	1370	1280
		(178)	(123)	(99.7)	(85.0)	(75.0)	(68.0)	(63.7)	(58.0)	(55.2)	(52.4)	(46.7)	(42.5)	(38.8)	(36.2)
3	3.068	11000	7700	6250	5300	4750	4300	3900	3700	3450	3250	2950	2650	2450	2280
		(311)	(218)	(177)	(150)	(135)	(122)	(110)	(105)	(97.7)	(92.0)	(83.5)	(75.0)	(69.4)	(64.6)
4	4.026	23000	15800	12800	10900	9700	8800	8100	7500	7200	6700	6000	5500	5000	4600
		(651)	(447)	(362)	(309)	(275)	(249)	(229)	(212)	(204)	(190)	(170)	(156)	(142)	(130)

1. Determine the required Cu. Ft. / Hr. by dividing the rated heater input by 1000. For SI / Metric measurements: Convert unit Btu. / Hr. to kilowatts. Multiply the unit input (kW) by 0.0965 to determine Cubic Meters / Hour. 2. FOR NATURAL GAS: Select the pipe size directly from the table. 3. FOR PROPANE GAS: Multiply the Cu. Ft. / Hr. (Cubic Meters per Hour) value by 0.633; then use the table. 4. Refer to the metric conversion factors listed in General Safety section for more SI unit measurements/conversions.

PIPE INSTALLATION

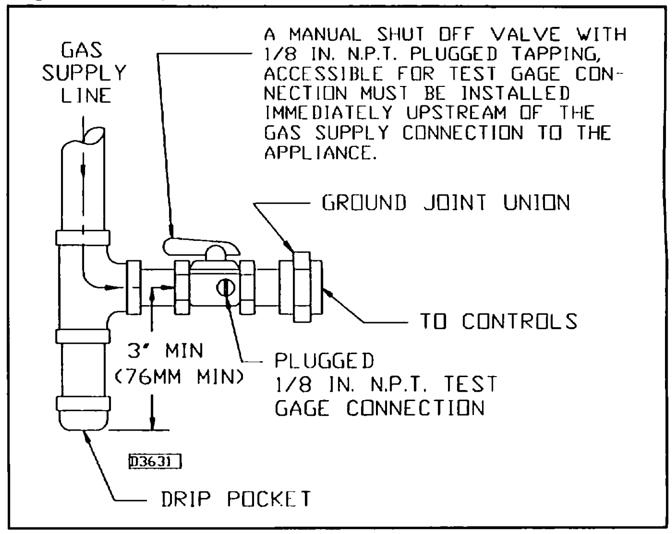
1. Install the gas piping in accordance with applicable local codes.
2. Check gas supply pressure. Each unit heater must be connected to a manifold pressure and a gas supply capable of supplying its full rated capacity as specified in Table 4. A field LP tank regulator must be used to limit the supply pressure to maximum of 14" W.C. (3.5 kPa). All piping should be sized in accordance with ANSI Standard Z223.1-1996, (or the latest edition) National Fuel Gas Code; in Canada, according to CGA B149. See Tables 1 and 3 for correct gas supply piping size. If gas pressure is excessive on natural gas applications, install a pressure regulating valve in the line upstream from the main shutoff valve.
3. Adequately support the piping to prevent strain on the gas manifold and controls.
4. To prevent the mixing of moisture with gas, run the take-off piping from the top, or side, of the main.
5. Standard gas unit heaters, optional two-stage units, and hydraulic modulating units are supplied with a combination valve which includes:
   (a) Manual "A" valve (b) Manual "B" valve (c) Solenoid valve (d) Pilot safety (e) Pressure regulator
   Pipe directly in to combination valve (see Figure 4).
6. A 1/8" N.P.T. plugged tapping, accessible for test gauge connection, must be installed immediately upstream of the gas supply connection to the appliance
7. Provide a drip leg in the gas piping near the gas unit heater. A ground joint union and a manual gas shutoff valve should be installed ahead of the unit heater controls to permit servicing. The manual main shutoff valve must be located external to the jacket. See Figure 4.
8. Make certain that all connections have been adequately doped and tightened.

CAUTION: Do not overtighten the inlet gas piping into the valve. This may cause stresses that would crack the valve!

NOTICE: Use pipe joint sealant resistant to the action of liquefied petroleum gases regardless of gas conducted.

⚠WARNING Check all pipe joints for leakage using a soap solution or other approved method. Never use an open flame or severe personal injury or death may occur.

Figure 4 - Pipe Installation, Standard Controls



⚠DANGER Never use an open flame to detect gas leaks. Explosive conditions may exist which would result in personal injury or death.

The appliance and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig (3.5 kPa).

The appliance must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.5 kPa).

Table 4 - Gas Piping Requirements*

Gas Type	Natural Gas	Propane (LP) Gas
Manifold Pressure	3.5 in. W.C. (0.9 kPa)	10.0 in. W.C. (2.5 kPa)
Supply Inlet Pressure	14 in. W.C. Max. (3.5 kPa)	14 in. W.C. Max. (3.5 kPa)
	5.0 in W.C. Min. (1.2 kPa)	11.0 in W.C. Min. (2.7 kPa)

*For single stage applications only at normal altitudes.

BLOWER SET UP

The drive ratio of the motor and blower sheaves has been preset at the factory for a temperature rise of 65°F at 0" W.C. If the unit is to be operated under different air flow or pressure requirements, the drive ratio must be altered by means of the adjustable sheave on the blower motor, Figure 5.

1. Ensure that all packing material, support blocks, etc. have been removed from the unit.
2. Adjust the blower drive belt tension by means of the two tension bolts on the blower motor base. When proper tension has been achieved, the mid-point deflection of the belt will be 3/4" when subjected to a 5 lb. force.
3. Recheck all electrical connections.
4. When power is applied, ensure that the motor and blower are rotating in a clockwise direction when viewed from the drive side.
5. Measure the current draw of the motor.

⚠ CAUTION The "at speed" current draw of the motor must never exceed that specified on the motor rating plate or severe damage to the motor will result!

BLOWER DRIVE ADJUSTMENT

⚠ WARNING Never attempt to adjust the drive belt without first disconnecting all electrical power to the unit or severe personal injury may result!

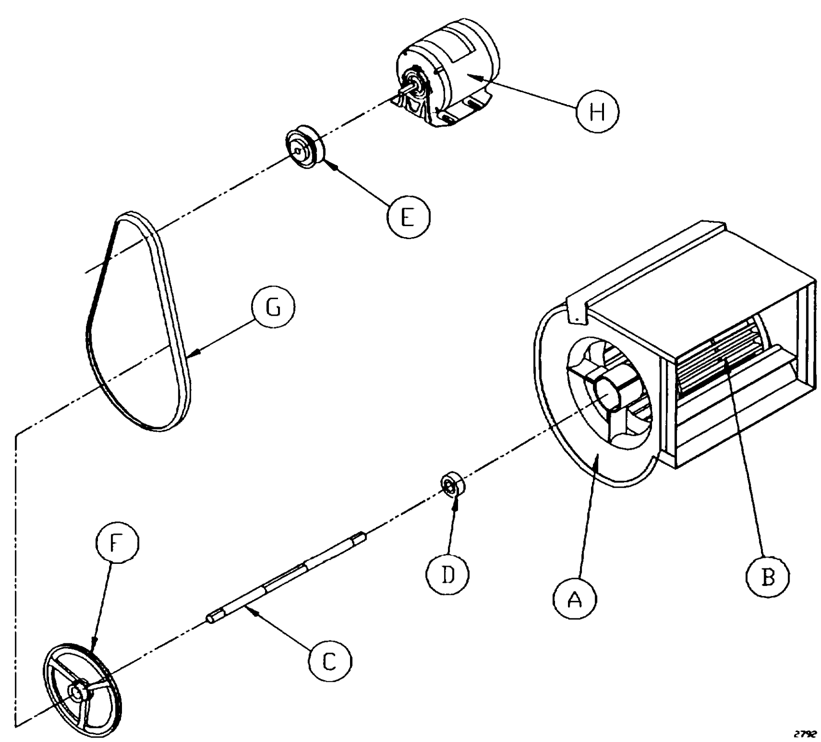
1. Remove the belt guard and loosen the belt tension bolts on the blower motor base.
2. Loosen the set screw on the adjustable half of the motor sheave. To increase the blower speed, turn the adjustable half of the sheave clockwise, counter clockwise to slow the blower. Retighten the set screw.
3. Realign the blower and motor sheaves if necessary.
4. Adjust the belt tension as specified in the BLOWER SET UP section under step 2.
5. Replace the belt guard.

⚠ WARNING Never operate the unit without the belt guard in place or severe personal injury may result!

6. Check that the air flow of the unit, the rpm and current draw of the blower motor and the temperature rise are within the limits specified in Table 1, the blower motor rating plate and the rating plate on the unit, respectively (also see Motor Data on page 10).

Figure 5 - Motor & Blower Assembly *

* PART DESCRIPTION
A. Blower Housing
B. Blower Wheel
C. Blower Shaft
D. Bearings (sets only)
E. Drive Pulley (standard)
F. Driven Pulley (standard)
G. V-Belt



⚠ CAUTION Never operate the unit beyond the specified limits or severe damage to, and or premature failure of, the unit will result!

* NOTICE: THE BLOWER ASSEMBLY FOR THE 100/250 UNITS CONSISTS OF 1 WHEEL, 1 HOUSING, 1 SHAFT AND 1 BEARING SET. FOR 300/400 UNITS THE BLOWER ASSEMBLY CONSISTS OF 2 WHEELS, 2 HOUSINGS, 1 SHAFT AND 1 BEARING SET.

VENTING FOR POWER VENTED (CATEGORY III) UNIT HEATERS

All unit heaters must be vented! All venting installations shall be in accordance with the latest edition of Part 7, venting of Equipment of the National Fuel Gas Code, ANSI Z223.1, or applicable provisions of local building codes for natural or power vented units.

For Canadian installations, also see page 13.

Power vented units are designed to be used with single wall vent pipe utilizing horizontal or vertical venting arrangements (see Figures 7, 8 and 9). These arrangements may **terminate external** to the building using either a single wall or double wall (Type B) vent. See Figures 7 thru 11 for special installation requirements regarding these venting conditions.

⚠WARNING Do not use a type B (double wall) vent internally within the building on our power vented units!

If double wall venting is used, components which are UL Listed and approved for Category III positive pressure venting systems MUST be used.

A Briedart Type L, Field Starkap or an equivalent vent cap must be supplied by the customer for each power vented unit (Canadian units are equipped with the vent cap). The vent pipe diameter MUST be as specified in Table 1 ("D" Dia. Flue Opening). A reducer must be field installed for 100 through 175 MBH Unit Sizes (Canadian units include this required reducer). All 300 through 400 MBH Unit sizes are factory equipped with the required flue increaser. Refer to Figure 10 for additional requirements.

Vent Systems - Termination Clearance Requirements*

Structure	Minimum Clearances for Termination Locations
Door, window or any gravity air inlet	4 feet below 4 feet horizontally 1 foot above
Forced air inlet within 10 ft.	3 feet above
Adjoining building or parapet	6 feet
Adjacent public walkways	7 feet above grade

* If the vent terminal is to be installed near ground level, the vent terminal must be positioned at least six inches above the maximum anticipated snow depth (see page 13 for Canadian requirements).

The venting system for these appliances shall terminate at least four feet (1.2m) below, four feet (1.2m) horizontal from, or one foot (0.3m) above any door, window, or gravity air inlet into any building.

Through the wall vents for these appliances shall NOT terminate over public walkways, or over an area where condensate or vapor could create a nuisance or hazard or could be detrimental to the operation of regulators, relief valves, or other equipment.

The vent pipe equivalent length must be 5 ft. (1.5m) minimum and must not exceed 50 ft. (15.2 m). Equivalent length is the total length of straight sections PLUS 15 ft. (4.6m) for each 90 degree elbow, 8 ft. (2.4 m) for each 45 degree elbow, and 10 ft. (3.0m) for the vent cap. **An elbow should never be attached directly to the venter!**

Maintain 6 in. (152mm) between vent pipe and combustible materials. A minimum of 12 in. (305mm) of straight pipe is required from the venter outlet before installing an elbow in the vent system.

Figure 7 - Horizontal Left Vent Position
(Rear View of Unit Heater)

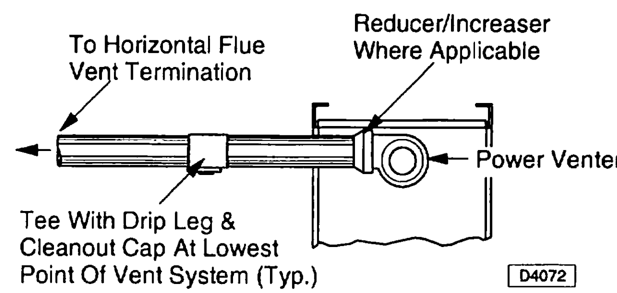


Figure 8 - Horizontal Right Vent Position
(Rear View of Unit Heater)

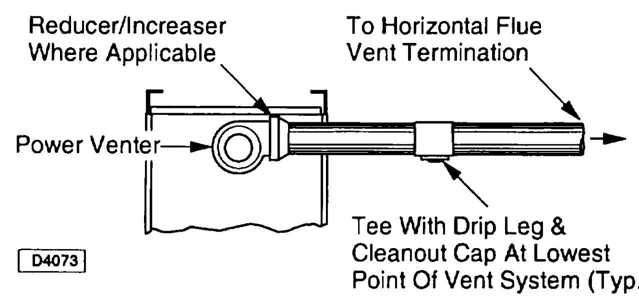
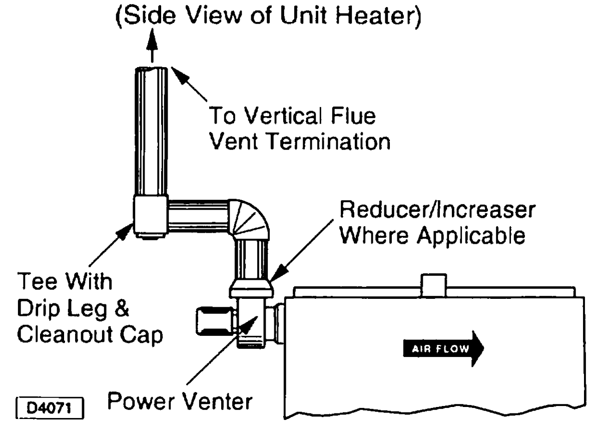


Figure 9 - Vertical Vent Position
(Side View of Unit Heater)



Use single wall pipe constructed of 26 gauge galvanized steel or material or equivalent duribility and corrosion resistance for the vent system. For installation in Canada, use pipe constructed from 0.025 inch thick aluminum or 0.018 inch thick stainless steel.

⚠WARNING Never use a pipe of a diameter other than that specified in Table 1 or Figure 2! Never use pvc or other nonmetallic pipe for venting! To do so may result in serious damage to the unit or severe personal injury or death!

The vent terminal must be installed with a minimum clearance of four feet (1.2m) from electric meters, gas meters, regulators and relief equipment.

Seal ALL vent pipe joints and seams to prevent leakage. Use General Electric RTV-108 or Dow-Corning RTV-732 silicone sealant; or 3M #425 aluminum foil tape.

The vent system must be installed to prevent collection of condensate. Vertical vent pipes should be equipped with condensate drains. Pitch horizontal pipes downward 1/4 in. per foot (21mm per meter) toward outlet for condensate drainage (refer to Figures 7 through 11).

Horizontal portions of the venting system shall be supported at maximum intervals of four feet (1.2m) to prevent sagging (in Canada, support at 3 feet (1m) minimum intervals).

Insulate single wall vent pipe exposed to cold air or running through unheated areas.

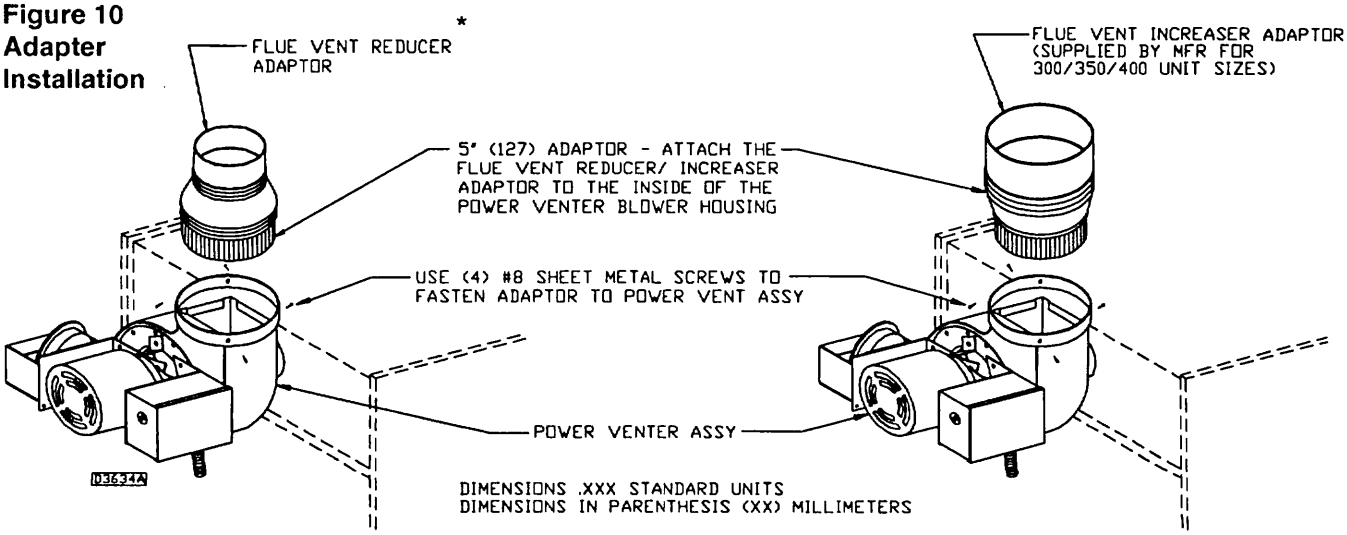
Each unit must have an individual vent pipe and vent terminal per furnace section! Each unit MUST NOT be connected to other vent systems or to a chimney.

Units are shipped from the factory set up for vertical venting. To convert the power venter for horizontal venting, remove the shipping support bracket; refer to Figures 10 and 17, and follow this procedure:

1. Hold power venter motor in position.
2. Remove the three Phillips-head screws from the motor adaptor plate.
3. Remove the three screws which connect the power venter stack to the power venter housing.
4. Rotate the power venter housing to the horizontal position.
5. Replace screws accordingly.

NOTICE: The motor, pressure switch, and junction box bracket MUST remain located as shipped from the factory. Rotate only the blower housing! If the power venter housing is to be moved to the right horizontal position, the junction box must be rotated 90 degrees CCW to clear the connection. To do this, remove all wires, conduit and conduit connector from the junction box, noting location of wires. Move box, using holes provided. Move 7/8" plug from bottom of box to side. Reconnect all wires according to the unit's wiring diagram.

Figure 10
Adapter Installation



REFER TO SPECIFICATION TABLE AND INSTALLATION MANUAL FOR PROPER USAGE

The following instructions apply to Canadian installations in addition to installation and operating instructions:

1. Installation must conform with local building codes, or in absence of local codes, with current CGA B149.1 installation codes for natural gas burning appliances and equipment, or CGA B149.2, installation codes for propane gas burning appliances and equipment.
2. Any references to U.S. standards or codes in these instructions are to be ignored and the applicable Canadian standards or codes applied.
3. Canadian units include vent cap and a reducer (if required) furnished by the manufacturer.
4. If using a metal vent system under positive gauge pressure in Canada, a slip fit vent connection must be secured by at least two corrosion-resistant screws, or other mechanical locking means.
5. The vent shall not terminate – (a) Less than 6 ft. (1.8m) from a combustion air inlet of another appliance. (b) Less than 3 ft. (1m) from any other building opening or any gas service regulator. (c) Directly above a gas utility meter or service regulator.

*USA units - The reducer must be field supplied for 100, 125, 150 and 175 MBH unit sizes.

Figure 11A

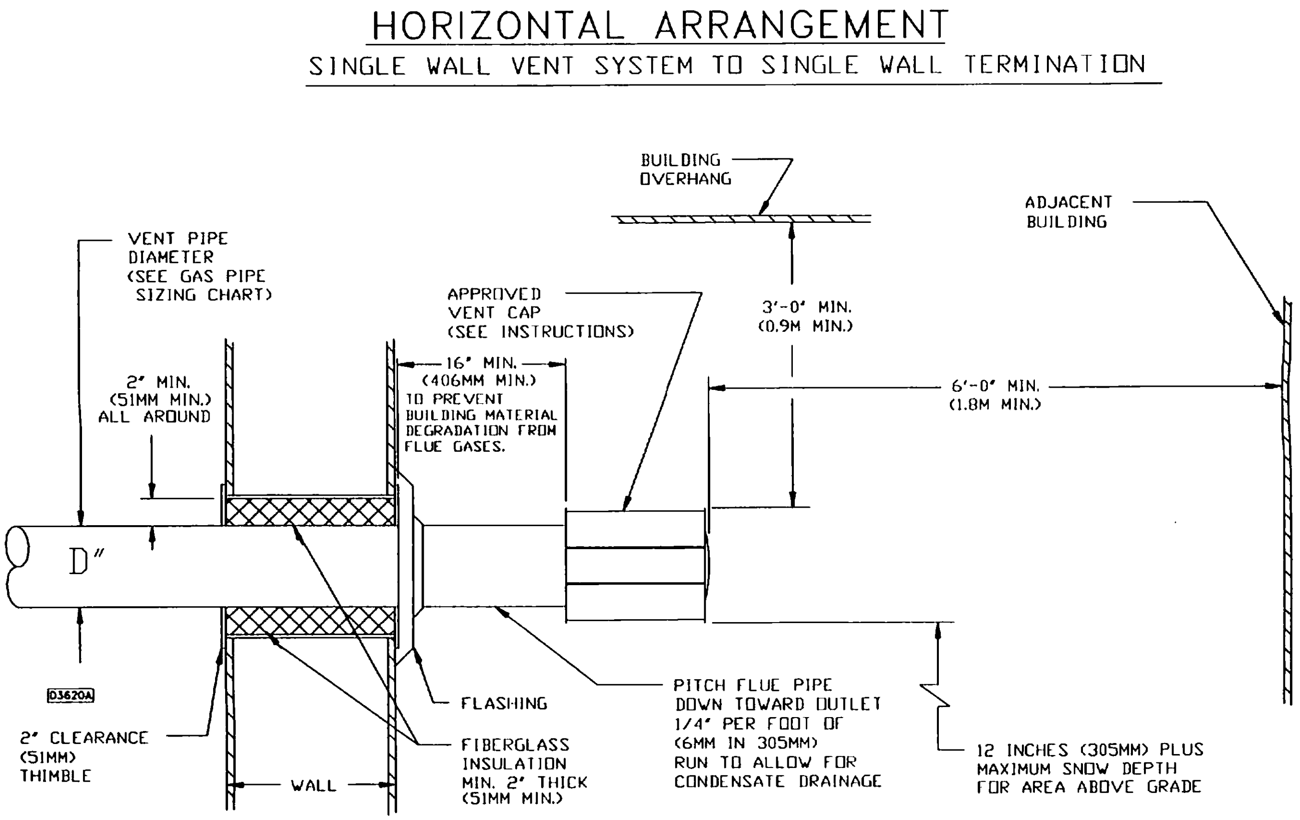


Figure 11B

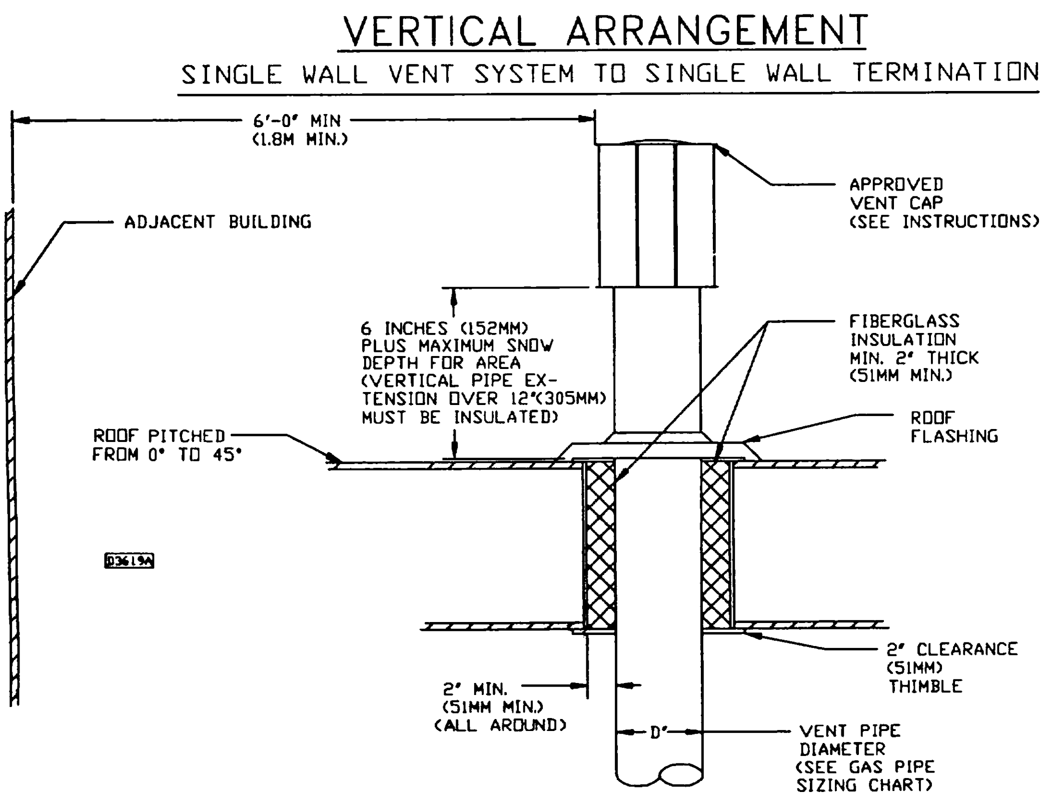


Figure 11C

HORIZONTAL ARRANGEMENT

SINGLE WALL VENT SYSTEM TO DOUBLE WALL TERMINATION

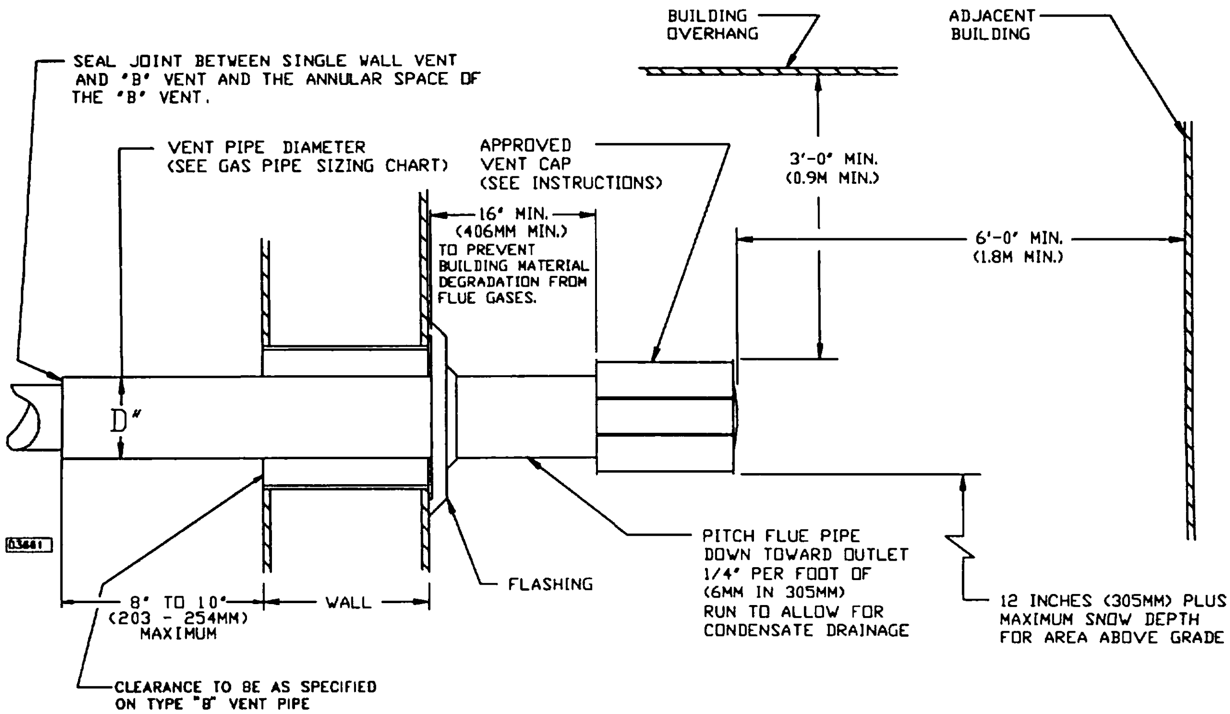
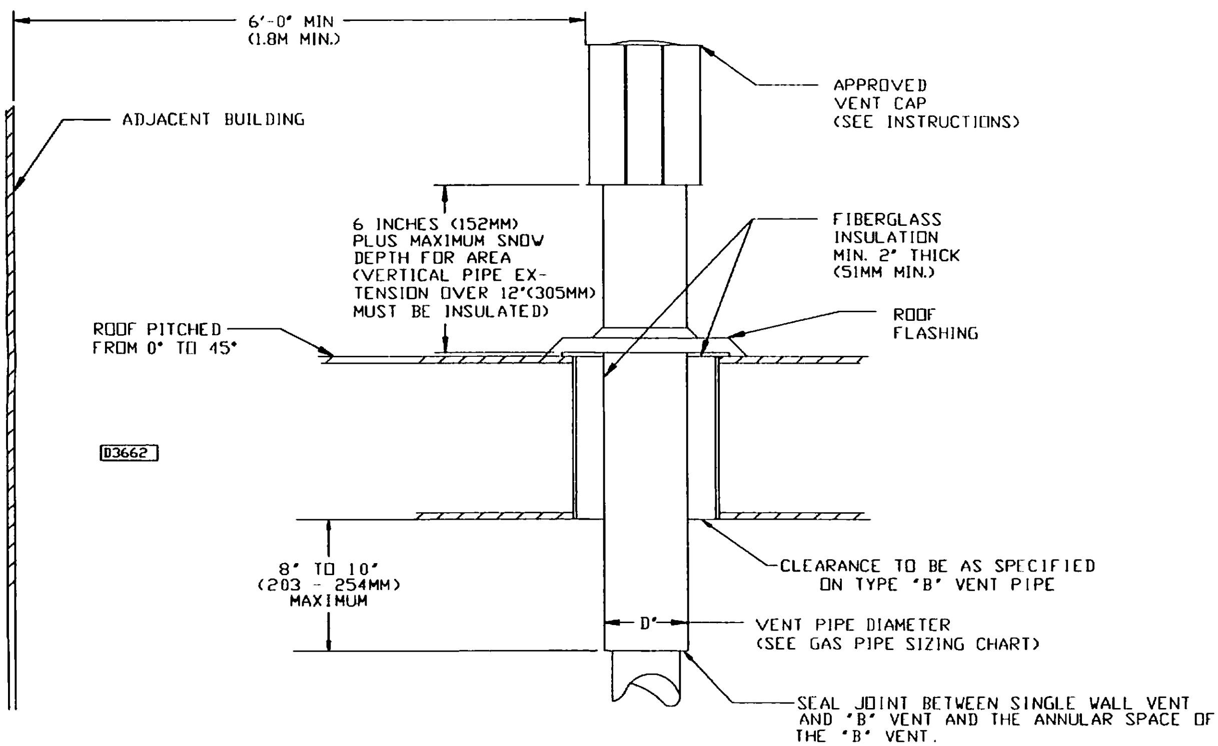


Figure 11D

VERTICAL ARRANGEMENT

SINGLE WALL VENT SYSTEM TO DOUBLE WALL WALL TERMINATION



OPERATION
POWER VENTED BLOWER UNITS
INTERMITTENT (SPARK) PILOT IGNITION

EXPLANATION OF CONTROLS:

1. The unit heater is equipped with a dual automatic gas valve and electric ignition device (separate from the gas valve on most models) which provide the following functions:
   a. The unit heater is equipped with a power vent system consisting of a power venter motor and blower, pressure switch, and sealed flue collector in place of the conventional draft diverter.

⚠ CAUTION The addition of external draft hoods or power venters is not permitted. Addition of such devices may cause severe unit malfunction or failure!

   b. The power venter motor is energized by the room thermostat on a call for heat. The pressure switch measures the flow through the vent system *and energizes* the indirect spark ignition system when the flow is correct.

⚠ WARNING The pressure switch MUST NOT be bypassed. The unit MUST NOT be fired unless the power venter is operating. An unsafe condition could result.

   c. The indirect spark ignition system consists of an ignition control module, a dual combination gas valve, and a spark-ignited pilot burner. When the pressure switch closes, the pilot valve opens and a spark is generated to light the pilot burner. When the flame sensing circuit senses that pilot flame is established, the main gas valve is opened to supply gas to the main burners. When the thermostat is satisfied, the vent system is de-energized and both valves are closed to stop all flow of gas to the unit.
   d. Pilot solenoid valve also functions as a main gas valve to provide redundancy.
   e. Pressure regulator provides proper and steady gas pressure to the main burners.
   f. Manual shutoff valve for service and long term shut-down. (Separate from the automatic valve on some models.)
2. The limit switch interrupts the flow of electric current to the main gas valve in case the heater becomes overheated.
3. The fan switch delays the operation of the fan until the heater is warmed, then keeps the fan running after the gas has been turned off until the useful heat has been removed. **The start-up fan delay must not exceed 90 seconds from a cold start.**
4. The wall thermostat (supplied optionally) is a temperature sensitive switch which operates the vent system and ignition system; it turns the main gas valve ON or OFF to control the temperature of the space being heated. It must be mounted on a vibration free, vertical surface away from air currents, in accordance with the instructions furnished with the thermostat (also refer to Electrical Section).

START-UP

1. Open the manual valve supplying gas to the unit heater, and with the union connection loose, purge air from the gas line. Tighten the union and check for gas leaks, using a soapy water solution only.

⚠ DANGER Never use an open flame to detect gas leaks. Explosive conditions may exist which could result in personal injury or death.

⚠ WARNING Before attempting to light or relight pilot, wait 5 minutes to allow gas which may have accumulated in the burner compartment to escape.

2. Open the manual valve on the unit heater.
3. Turn ON electrical power.
4. The unit should be under the control of the thermostat. Turn the thermostat to the highest point and determine that the power venter motor starts and the pilot and main burners ignite. Turn the thermostat to the lowest point and determine that the power venter motor shuts off and pilot and main burners are extinguished.
5. If pilot adjustment is required, remove the pilot adjustment seal cap and adjust the pilot screw to obtain proper flame. Clockwise rotation decreases pilot flame size. Replace the cap.
6. Turn the thermostat to the desired position.
7. Refer to "Adjustments" section for more specifications.

SHUT DOWN

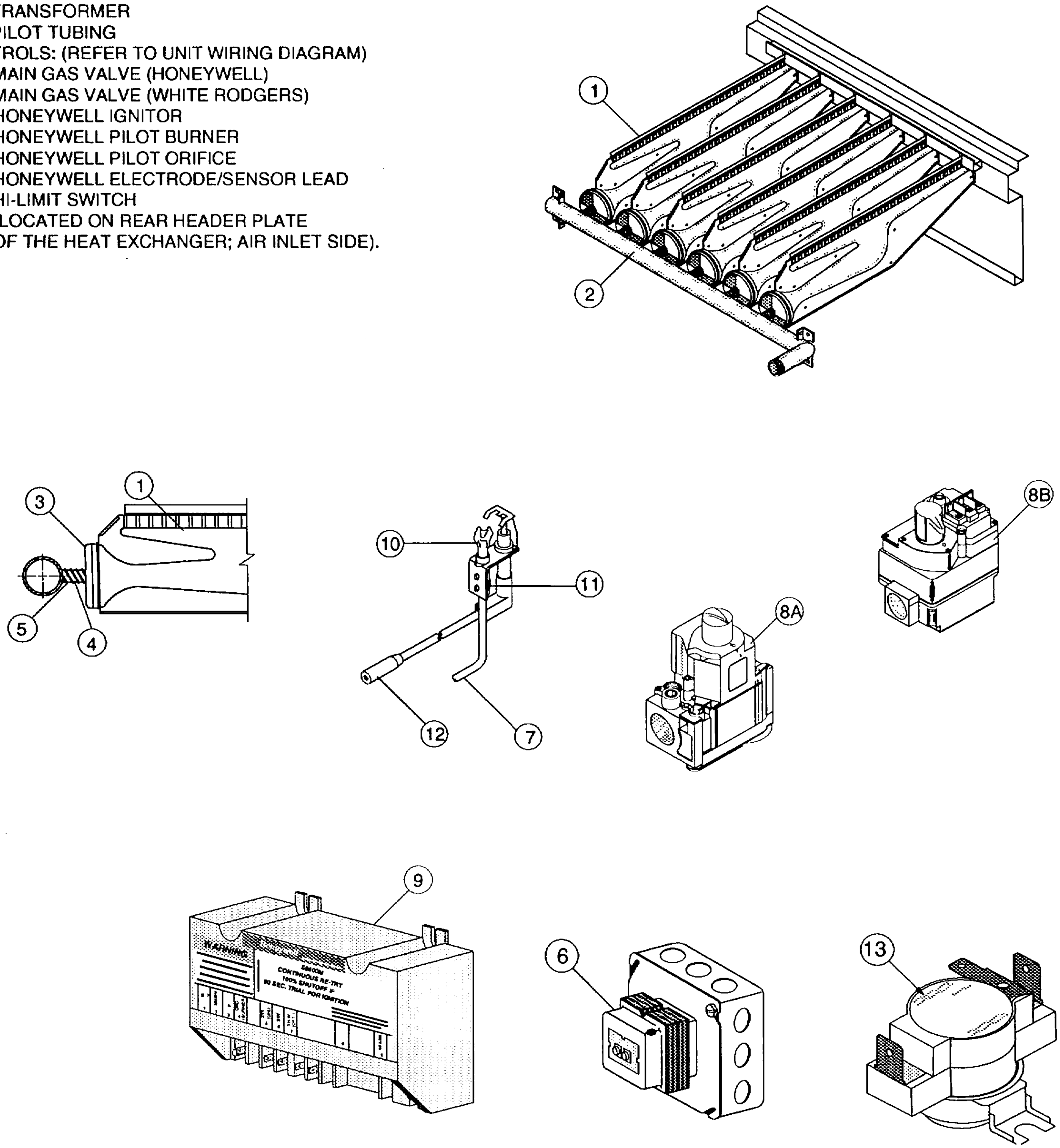
1. Turn the valve selector knob to the "OFF" position.
2. Turn off the electricity.
3. To relight, follow the "start-up" instructions.

See Figure 12 for parts/identification.

Figure 12 - Burner Components
Intermittent Pilot Ignition

BURNER DRAWER COMMON PARTS:
1. MAIN BURNERS
2. BURNER MANIFOLD
3. AIR SHUTTERS
4. BURNER SPRINGS
5. MAIN BURNER ORIFICE
6. TRANSFORMER
7. PILOT TUBING

CONTROLS: (REFER TO UNIT WIRING DIAGRAM)
- 8A. MAIN GAS VALVE (HONEYWELL)
- 8B. MAIN GAS VALVE (WHITE RODGERS)
- 9. HONEYWELL IGNITOR
- 10. HONEYWELL PILOT BURNER
- 11. HONEYWELL PILOT ORIFICE
- 12. HONEYWELL ELECTRODE/SENSOR LEAD
- 13. HI-LIMIT SWITCH
  (LOCATED ON REAR HEADER PLATE
  OF THE HEAT EXCHANGER; AIR INLET SIDE).



GAS INPUT RATE

Check the gas input rate as follows. To calculate metric units, refer to general safety section for metric conversions/SI units):

⚠ CAUTION Never overfire the unit heater, as this may cause unsatisfactory operation or shorten the life of the heater.

1. Turn off all gas appliances that use gas through the same meter as the unit heater.
2. Turn gas ON to the unit heater.
3. Clock the time in seconds required to burn one cubic foot of gas by checking the gas meter.
4. Insert the time required to burn one cubic foot of gas into the following formula and compute the input rate.

$$\frac{3600 \text{ (Sec. Per Hr.) x Btu/Cu. Ft}}{\text{Time (Sec.)}} = \text{Input Rate}$$

For example, assume the Btu content of one cubic foot of gas equalled 1000 and that it takes 18 seconds to burn one cubic foot of gas.

$$\frac{3600 \times 1000}{18} = 200{,}000 \text{ Btu/Hr.}$$

NOTICE: If the computation exceeds or is less than 95 percent of the gas Btu/hr. input rating (see Specifications), adjust the gas pressure.

Adjust the gas pressure as follows:

1. NATURAL GAS: Best results are obtained when the unit heater is operating at its full input rating with the manifold pressure of 3.5 inches W.C. (0.9 kPa). Adjustment of the pressure regulator is not normally necessary since it is preset at the factory. However, field adjustment may be made as follows:
   a. Attach manometer at pressure tap plug adjacent to control outlet.
   b. Remove regulator adjustment screw cap, located on combination gas valve.
   c. With a small screwdriver, rotate the adjustment screw counterclockwise to decrease or clockwise to increase pressure.

⚠ CAUTION Do not force beyond stop limits.

   d. Replace regulator adjustment screw cap.
2. PROPANE GAS: An exact manifold pressure of 10.0 inches W.C. (2.5 kPa) must be maintained for proper operation of the unit heater. If the unit is equipped with a pressure regulator on the combination gas valve, follow steps "a" through "d" above. If the unit is not so equipped, the propane gas supply system pressure must be regulated to attain this manifold operating pressure.
3. The adjusted manifold pressure should not vary more than 10% from the pressure specified in Table 7.

Table 7 - Main Burner Orifice Schedule*

* INPUT IN 1000 BTU	TYPE OF GAS	NATURAL	PROPANE	NO. OF BURNER ORIFICES
	HEATING VALUE	1075 BTU/Ft^3 (40.1 MJ/m^3)	2500 BTU/Ft^3 (93.1 MJ/m^3)	
	MANIFOLD PRESSURE	3.5" W.C. (0.9 kPA)	10" W.C. (2.5 kPA)	
100	FT ^{3}/HR	96	40	4
	ORIFICE DRILL	41	54	
125	FT ^{3}/HR	120	50	5
	ORIFICE DRILL	41	54	
150	FT ^{3}/HR	140	60	6
	ORIFICE DRILL	41	54	
175	FT ^{3}/HR	163	70	7
	ORIFICE DRILL	41	54	
200	FT ^{3}/HR	186	80	8
	ORIFICE DRILL	41	54	
225	FT ^{3}/HR	210	90	9
	ORIFICE DRILL	41	54	
250	FT ^{3}/HR	233	100	10
	ORIFICE DRILL	41	54	
300	FT ^{3}/HR	280	120	12
	ORIFICE DRILL	41	54	
350	FT ^{3}/HR	326	140	14
	ORIFICE DRILL	41	54	
400	FT ^{3}/HR	372	160	16
	ORIFICE DRILL	41	54	

* This schedule is for units operating at normal altitudes of 2000 ft. (610m) or less. For operation at elevations above 2000 feet (610m), input ratings must be reduced at the rate of 4 percent for each 1000 feet (305m) above sea level. **SPECIAL ORIFICES ARE REQUIRED FOR INSTALLATIONS ABOVE 2000 FEET (610M).**

When installed in Canada, any references to deration at altitudes in excess of 2000 feet (610m) are to be ignored. At altitudes of 2000 to 4500 feet (610 to 1372m), the unit heaters must be orificed to 90% of the normal altitude rating, and be so marked in accordance with the C.G.A. certification.

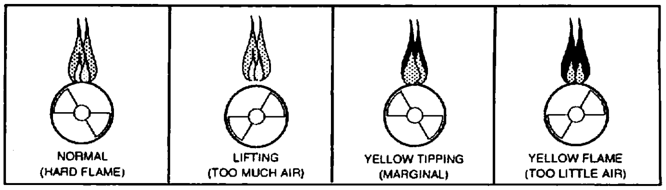
PRIMARY AIR SHUTTER ADJUSTMENT

After the unit has been operating for at least 15 minutes, adjust the primary air flow to the burners. Turn the friction-locked, manually-rotated air shutters clockwise to close, or counterclockwise to open.

For correct air adjustment, close the air shutter until yellow tips in the flame appear. Then open the air shutter to the point just beyond the position where yellow tipping disappears. Refer to Figure 13.

NOTICE: There may be momentary and spasmodic orange flashes in the flame. This is caused by the burning of airborne dust particles, and not to be confused with the yellow tipping, which is a stable or permanent situation when there is insufficient primary air.

Figure 13 - Main Burner Flames



PILOT ADJUSTMENT

1. Remove the pilot adjustment cap.
2. Adjust the pilot screw to provide a properly sized flame.
3. A proper pilot flame is a soft steady flame that envelopes 3/8 to 1/2 inch (9.5 to 12.7mm) of the flame sensor tip.
4. Replace the pilot adjustment cap.

MANIFOLD PRESSURE ADJUSTMENT

If the manifold pressure requires minor adjustment, remove the cap from the pressure regulator and turn the adjustment screw clockwise to increase the pressure, or counterclockwise to decrease the pressure. The adjusted manifold pressure should not vary more than 10% from the pressures specified in Table 4.

MAINTENANCE

PERIODIC SERVICE

NOTICE: It is recommended that the heater and vent system be checked once a year by a qualified serviceman.

All Maintenance/Service info should be recorded accordingly on the Inspection Sheet provided in this manual.

⚠WARNING Open all disconnect switches and disconnect all electrical and gas supplies and secure in that position before servicing unit. Failure to do so may result in personal injury or death from electrical shock.

Should maintenance be required, perform the following inspection and service routine:

1. Inspect the area near the unit to be sure that there is no combustible material located within the minimum clearance requirements listed in this manual

⚠WARNING Under no circumstances should combustible material be located within the clearances specified in this manual. Failure to provide proper clearance could result in personal injury or equipment damage from fire.

2. Turn OFF the manual gas valve and electrical power to the gas unit heater.
3. To clean or replace the main burners, remove the bottom panel and compress the spring by moving the burner toward the manifold. Slide the opposite end of the burner downward from the locating slot while retaining spring is still compressed. Pull the burners away from the heater.
4. With the burners removed, gently wire brush the inside surfaces of the heat exchanger.
5. Remove any dirt, dust, or other foreign matter from the burners using a wire brush and/or compressed air. Ensure that all parts are unobstructed. Inspect and clean pilot burner if necessary.
6. Reassemble the gas unit heater by replacing all parts in reverse order.
7. Complete the appropriate unit start-up procedure as given in the "Operation" section of this manual (see lighting instruction plate on the unit).
8. Check the burner adjustment. See the "Primary Air Shutter Adjustment" section of this manual.
9. Check all gas control valves and pipe connections for leaks.
10. Check the operation of the automatic gas valve and the power venter assembly by lowering the setting of the thermostat, stopping the operation of the gas unit heater. The gas valve should close tightly, completely extinguishing the flame on the main burners.
11. Inspect and service the motor/fan assembly. To maintain efficient air flow, inspect and clean the fan blades and guard to prevent buildup of foreign matter.
12. Check lubrication instructions on the motor. If oiling is required, add 3 to 4 drops of electric motor oil as follows:
    a. Light Duty - After 3 years or 25,000 hours of operation.
    b. Average Duty - Annually after 3 years or 8,000 hours of operation.
    c. Heavy Duty - Annually after 1 year or at least every 1500 hours of operation.

⚠CAUTION Never over oil the motor or premature failure may occur!

13. Check and test the operational functions of all safety devices supplied with your unit.

Table 8 - Power Vented Blowers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
A. Flame lifting from burner ports.	1. Pressure regulator set too high. 2. Defective Regulator. 3. Burner orifice too large.	1. Reset manifold pressure. Refer to "Operation". 2. Replace regulator section of combination gas valve or complete valve. 3. Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
B. Flame pops back.	1. Excessive primary air. 2. Burner orifice too small.	1. Close air shutter. Refer to "Operation". 2. Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
C. Noisy flame.	1. Too much primary air. 2. Noisy pilot 3. Irregular orifice causing whistle or resonance. 4. Excessive gas input. a. Pressure regulator set too high. b. Defective regulator. c. Burner orifice too large.	1. Close air shutter. 2. Reduce pilot gas. Refer to "Operation". 3. Replace orifice. 4. a. Reset manifold pressure. b. Refer to "Operation"; Replace regulator section of combination gas valve or complete valve. c. Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
D. Yellow tip flame (some yellow tipping on propane gas is permissible).	1. Insufficient primary air. 2. Clogged main burner ports. 3. Misaligned orifices. 4. Clogged flue collector. 5. Air shutter linted. 6. Insufficient combustion air.	1. Open air shutters. Refer to "Operation". 2. Clean main burner ports. 3. Replace manifold assembly. 4. Clean flue collector. 5. Check for dust or lint at air mixer opening and around the air shutter. 6. Clean combustion air inlet openings in bottom panel, see "Installation".
E. Floating flame.	1. Blocked venting. 2. Insufficient combustion air. 3. Blocked heat exchanger. 4. Air leak into combustion chamber or flue collector.	1. Clean flue. Refer to "Installation". 2. Clean combustion air inlet openings in bottom panel, see "Installation". 3. Clean heat exchanger. 4. Determine cause and repair accordingly.
F. Gas Odor.	**1. Shut off gas supply immediately!** 2. Blocked heat exchanger/venting. 3. Drafts around heater. 4. Negative Pressure in building. 5. Blocked flue collector.	**1. Inspect all gas piping and repair.** 2. Clean heat exchanger/flue. 3. Eliminate drafts. Refer to "Installation". 4. See "Installation". 5. Clean flue collector.
G. Delayed ignition.	1. Excessive primary air. 2. Main burner ports clogged near pilot. 3. Pressure regulator set too low. 4. Pilot decreases in size when main burners come on. 5. Pilot flame too small. 6. Drafts around heater. 7. Improper venting.	1. Close air shutter. Refer to "Operation". 2. Clean main burner ports. 3. Reset manifold pressure. Refer to "Operation". 4. Supply piping is inadequately sized. Refer to "Installation". 5. Clean pilot orifice. Refer to "Operation". 6. Eliminate drafts. Refer to "Installation". 7. Refer to "Installation".
H. Failure to ignite.	1. Main gas off. 2. Lack of power at unit. 3. Thermostat not calling for heat. 4. Defective limit switch. 5. Improper thermostat or transformer wiring at gas valve. 6. Defective gas valve. 7. Defective thermostat 8. Defective transformer.	1. Open all manual gas valves. 2. Replace fuse or turn on power supply. 3. Turn up thermostat 4. Check limit switch with continuity tester. If open, replace limit switch. 5. Check wiring per diagrams. 6. Replace gas valve. 7. Check thermostat and replace if defective. 8. Be sure 115 volts is supplied to the transformer primary, then check for 24 volts at secondary terminal before replacing.

Power Vented Blowers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
H. continued	9. Loose wiring. 10. Defective ignition control.	9. Check and tighten all wiring connections per diagrams. 10. Replace, if necessary. Also see W, X & Y symptoms.
J. Condensation of water vapor.	1. Improper venting.	1. Refer to "Installation, Venting".
K. Burner won't turn off.	1. Poor thermostat location. 2. Defective thermostat 3. Improper thermostat or transformer wiring at gas valve. 4. Short circuit. 5. Defective or sticking gas valve. 6. Excessive gas supply pressure.	1. Relocate thermostat away from drafts. 2. Replace thermostat. 3. Check wiring per diagrams. 4. Check operation at valve. Look for short (such as staples piercing thermostat wiring), and correct. 5. Replace gas valve. 6. Refer to "Operation".
L. Rapid burner cycling.	1. Loose electrical connections at gas valve, ignitor, pilot or thermostat. 2. Excessive thermostat heat anticipation cycles. 3. Unit cycling on high limit. 4. Poor thermostat location. 5. Draft on Pilot. 6. Defective ignitor control. 7. Blower motor turning too slowly. 8. Defective high limit switch.	1. Tighten all electrical connections. 2. Adjust thermostat heat anticipator for longer cycles. Refer to "Operation". 3. Check for proper air supply across heat exchanger. 4. Relocate thermostat. (Do not mount thermostat on unit). 5. Eliminate drafts. Refer to Installation. 6. Replace ignitor. 7. Clean blower wheel blades; oil blower motor; check for voltage to blower fan. Refer to "Maintenance" section. 8. Jumper limit switch terminals 1 and 2. If burner operates normally, replace switch.
M. Noisy	1. Blower wheel loose. 2. Blower wheel blades dirty. 3. Blower wheel rubbing housing. 4. Bearings are dry. 5. Pulleys loose.	1. Replace or tighten. 2. Clean fan wheel. 3. Realign. 4. Oil bearings on blower motor. (Refer to label on motor). 5. Replace or tighten.
N. Pilot will not light or will not stay lit.	1. Main gas off. 2. Pilot adjustment screw turned too low on combination/automatic main gas valve. 3. Air in gas line. 4. Incorrect lighting procedure. 5. Dirt in pilot orifice. 6. Extremely high or low gas pressure. 7. Defective spark cable. 8. Drafts around unit. 9. Pilot valve not opening (faulty wiring). 10. No spark (faulty wiring). 11. Defective gas valve/ignitor control.	1. Open all manual gas valves. 2. Increase size of pilot flame. Refer to "Operation". 3. Purge air from gas supply. 4. Follow lighting instruction label adjacent to gas valve. 5. Remove pilot orifice. Clean with compressed air or solvent. (Do not ream). 6. Refer to "Operation". 7. Check spark cable connection, and replace if defective. 8. Eliminate drafts. Refer to "Installation". 9. Inspect and correct all wiring. 10. Inspect and correct ignition system wiring. See symptoms W, X, & Y. 11. Replace.
O. Fan will not run.	1. Loose wiring. 2. Defective motor overload protector or defective motor.	1. Check and tighten all wiring connections per diagrams. Thermostat wires tagged "W" and "G" must be connected together (unless special thermostats are used; if so, see thermostat wiring diagram). See electrical connections. 2. Replace motor.

Power Vented Blowers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
O.continued	3. Defective fan switch. 4. Lack of power at unit.	3. Check for 24V across 1 and 3 terminals on fan time delay switch. If 24V is present, jumper terminals numbered 2 and 4. If motor runs, the fan switch is defective and must be replaced. If 24V is not present, check wiring per diagrams. 4. Replace fuse or turn on power.
P. Fan motor turns on and off while burner is operating.	1. Fan switch heater element improperly wired. 2. Defective fan switch. 3. Motor overload protector cycling ON and OFF. 4. Motor not properly oiled.	1. Be sure fan switch heater terminals are connected per diagrams. 2. Replace fan switch. 3. Check motor amps against motor name plate rating, check voltage, replace fan motor if defective. 4. Refer to label on motor.
Q. Fan motor will not stop.	1. Improperly wired fan control. 2. Main burners not lighting while thermostat calls for heat. 3. Defective fan switch.	1. Check all wiring. 2. Refer to H or N symptoms. 3. Replace fan switch.
R. Not enough heat.	1. Incorrect gas input. 2. Heater undersized. 3. Thermostat malfunction. 4. Heater cycling on limit control.	1. Refer to "Operation". 2. This is especially true when the heated space is enlarged. Have the heat loss calculated and compare to the heater output (80% of input). Your gas supplier or installer can furnish this information. If heater is under sized, add additional heaters. 3. Replace thermostat. 4. Check air movement through heat exchanger. Check voltage to fan motor. Clean fan blade and heat exchanger and oil fan motor.
T. Too much heat.	1. Thermostat malfunction. 2. Heater runs continuously. a. Improper Thermostat or transformer wiring at gas valve. b. Short circuit. c. Defective or sticking gas valve. d. Excessive gas supply pressure.	1. Replace thermostat. 2. a. Check wiring per diagrams. b. Check operation at valve. Look for short (such as staples piercing thermostat wiring), and correct. c. Replace gas valve. d. Refer to "Operation".
U. Cold air is delivered on start up.	1. Fan switch heater element improperly wired.	1. Be sure fan switch heater terminals are connected per diagrams.
V. Cold air is delivered during heater operation.	1. Incorrect manifold pressure or input. 2. Voltage to unit too high. 3. Air throughput too high.	1. Refer to "Operation". 2. Check motor voltage with fan running. Should be 115 volts AC. 3. Refer to "Operation".
W. NO Spark.	1. Thermostat not calling for heat. 2. No low voltage. 3. Spark gap closed or too wide. 4. Broken or cracked ceramic on spark electrode.	1. Close thermostat contacts. 2. Check for 24V across 24V terminals of S8600. 3. Set gap to 0.1". 4. Replace pilot assembly.
X. Spark present but pilot does not light.	1. Loose S8600 connections. 2. Improper gas pressure. 3. Is spark in pilot gas stream? 4. No pilot gas — do not use match to test - presence of gas is easily detected by the odor.	1. Check all connections, term. PV feeds 24V to pilot valve. 2. Check pressure — pressure that is either too high or too low may cause a problem. 3. Spark should arc from electrode. 4. Check pilot line for kinks. Insure there are no drafts.

Power Vented Blowers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
Y. Pilot lights — Main valve does not energize.	1. Loose S8600 connections. 2. Cracked or broken sensor ceramic. 3. Check sensor/spark lead for continuity. 4. Measure 24 volts from term. MV to term. MV/PV.	1. Check connections-term. MV feeds main valve. 2. Replace pilot assembly. 3. Replace if needed. 4. If present, replace main valve; if not, replace S8600 Igniter.
Z. Hi-Limit switch tripping.	1. Unit is overfiring. 2. Air flow too low 3. Defective switch.	1. Manifold pressure is too high; adjust. Burner orifices may be too large: verify/replace if req'd. 2. Increase air flow; check fan size. Check for proper voltage. 3. Replace.
AA. Noisy power venter.	1. Power venter wheel loose. 2. Power venter wheel dirty. 3. Power venter wheel rubbing housing. 4. Bearings are dry.	1. Replace or tighten. 2. Clean power venter wheel. 3. Realign power venter wheel. 4. Oil bearings on power venter motor. (Refer to label on motor).
BB. Power venter will not run.	1. Lack of power at unit. 2. Loose wiring. 3. Defective motor overload protector or defective motor. 4. Defective power venter relay. 5. Thermostat not calling for heat. 6. Defective hi-limit switch.	1. Replace fuse or turn on power. 2. Check and tighten all wiring connections per diagrams. Thermostat wires tagged "W" and "G" must be connected together (unless special thermostats are used; if so, see thermostat wiring diagram). See electrical connections. 3. Replace motor. 4. Check for 24V across 1 and 3 terminals on fan relay. If 24V is present, jumper terminals numbered 2 and 4. If motor runs, the relay is defective and must be replaced. If 24V is not present, check wiring per diagrams. 5. Turn up thermostat. 6. Replace defective hi-limit switch.
CC. Power venter motor turns on and off while burner is operating.	1. Power venter relay improperly wired. 2. Defective venter relay switch. 3. Motor overload protector cycling on and off. 4. Motor not properly oiled.	1. Be sure venter relay terminals are connected per diagrams. 2. Replace venter relay. 3. Check motor amps against motor name plate rating, check voltage, replace power venter motor if defective. 4. Refer to label on motor.
DD. Power Venter motor will not stop.	1. Improperly wired venter relay. 2. Main burners not lighting while thermostat calls for heat. 3. Defective venter relay.	1. Check all wiring. 2. Refer to H & N symptoms. 3. Replace venter relay.

IDENTIFICATION OF PARTS
BLOWER UNIT HEATERS

Figure 14
Component Parts
(Bottom View)

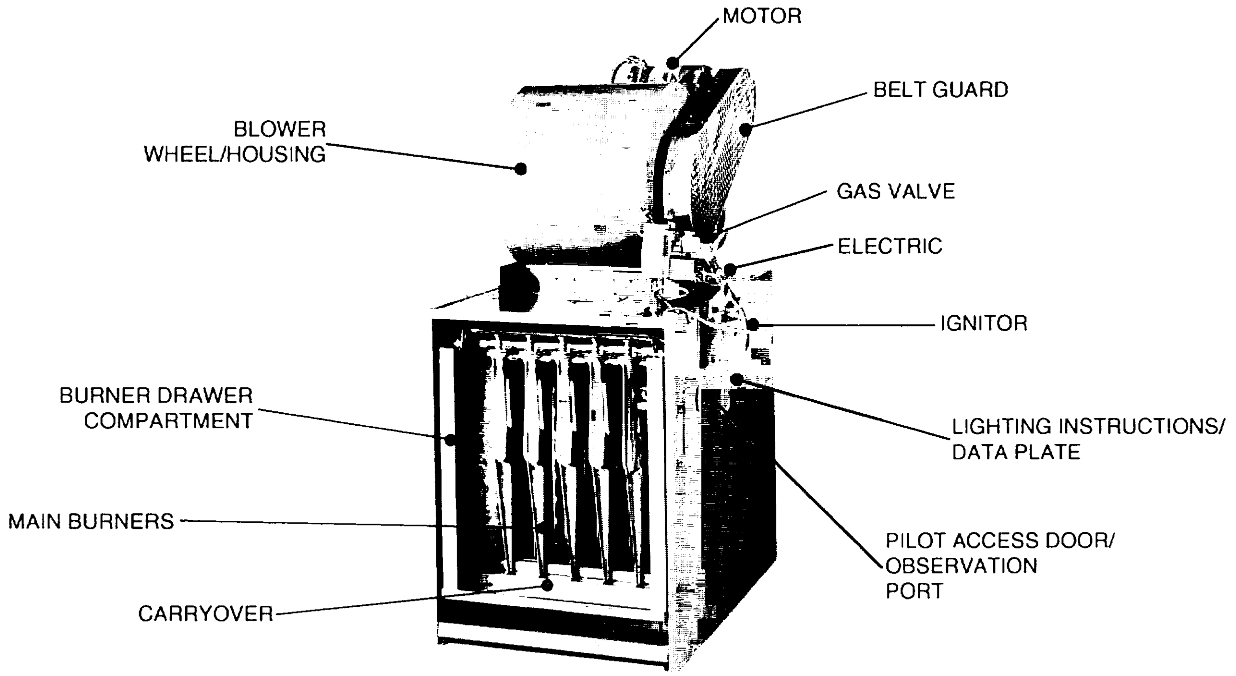


Figure 15
Internal Furnace Components

1. HEAT EXCHANGER
2. FLUE COLLECTOR
3. BURNER DRAWER

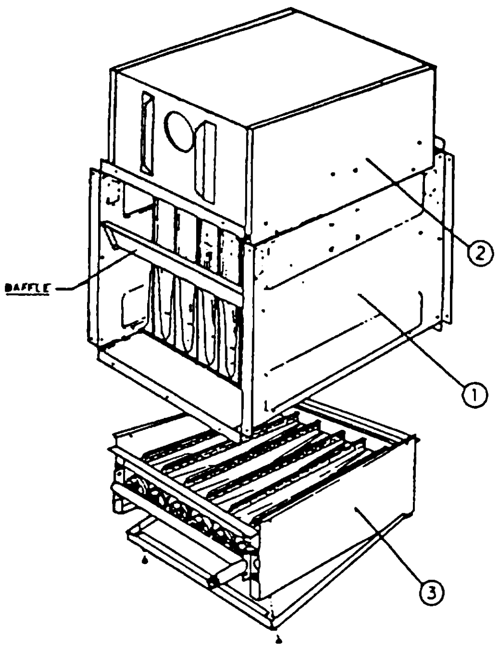


Figure 16
Burner Assembly Parts

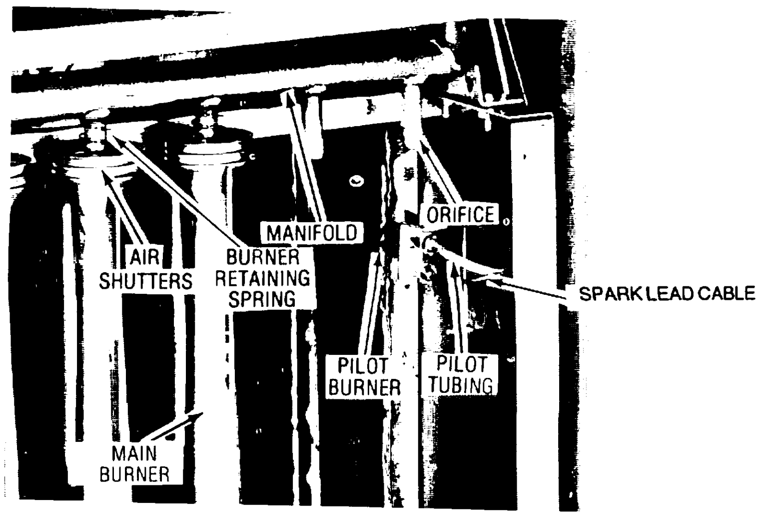
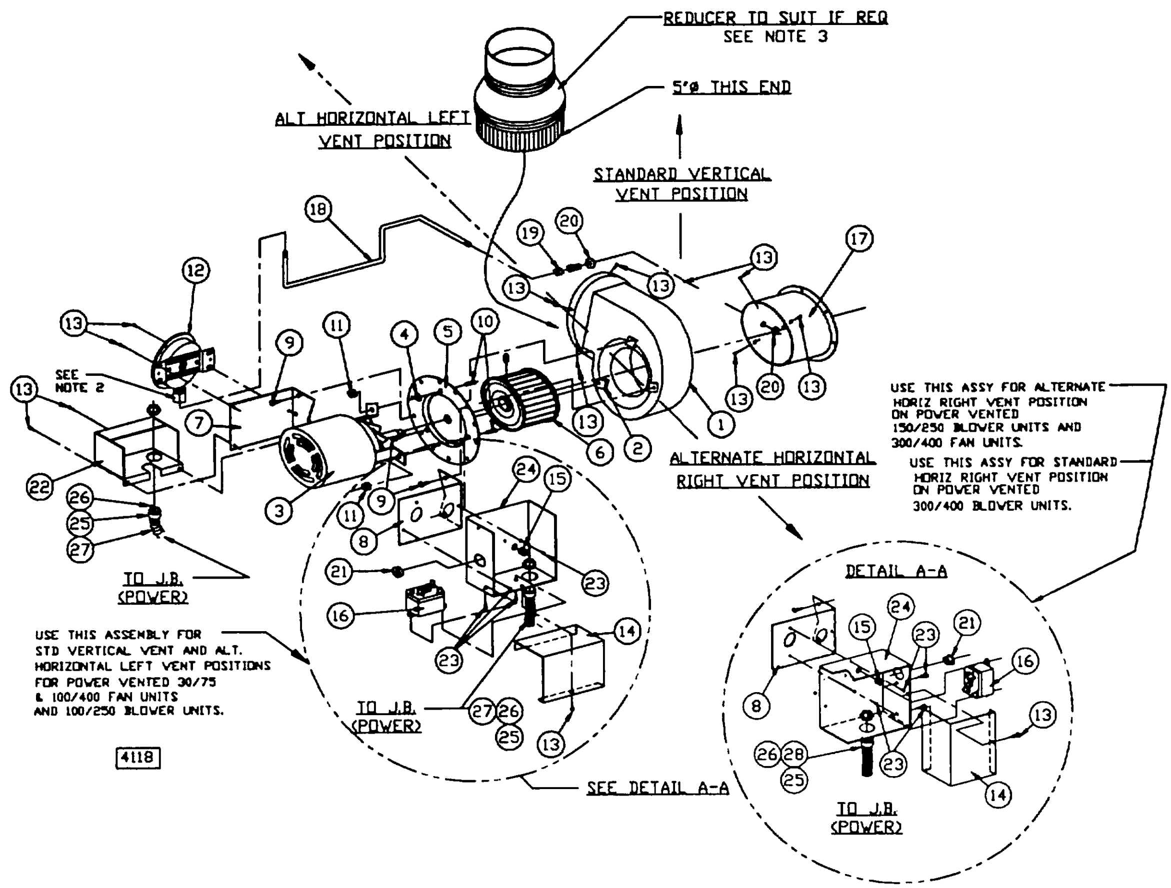


Figure 17 - Power Venter Assembly



REF. NO.	DESCRIPTION	REF. NO.	DESCRIPTION
1	Blower Housing Assembly	13	Drill Screw
2	Speed Nut	14	Junction Box Cover
3	Motor	15	Snap Bushing
4	Washer, Plain	16	Relay (Motor)
5	Plate Adapter	17	Draftor Stack Assembly
6	Blower Wheel*	18	Tubing Formation (Aluminum)
7	Mounting Bracket (Pressure Switch)	19	Male Connector
8	Mounting Bracket (Junction Box)	20	Locknut
9	Screw, S.T.	21	Hole Plug
10	Screw, Machine (L = 3/4")	22	Pressure Switch Cover
11	Nut, Keps (Ext. Lock Washer)	23	Drill Screw
12	Air Pressure Switch	24	Junction Box Base

NOTES:

***1) For Item No. 6, use counter-clockwise rotation.**

2) *DO NOT OVERTIGHTEN CELCON NUT! HAND TIGHTEN ONLY! DO NOT USE TOOLS!*
Approximate 1/3 turn maximum or 8 inch pounds is sufficient from the point where the tube does not slip in or out.

3) Flue Sizes:
100/175 units: 4" dia. flue outlet Reducer required – To be supplied by installer.
200/250 units: 5" dia. flue outlet (no adapter required).
300/400 units: 6" dia. flue outlet Increaser required – To be supplied by manufacturer.
Exception: "CGA" requires manufacturer to supply Canadian units with flue reducers or increasers.

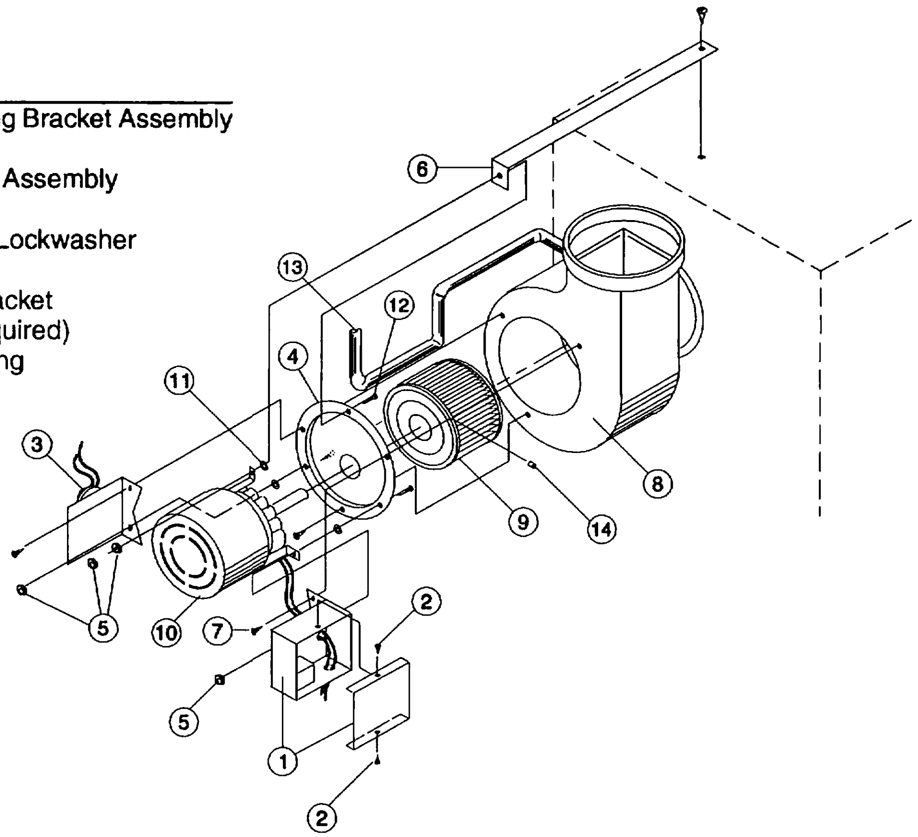
INSTALLATION INSTRUCTIONS
FOR FIELD REPLACEMENT OF POWER VENTER MOTOR

⚠WARNING Never service any compartment without first disconnecting all electrical and gas supplies. Refer to unit's wiring diagram. This replacement must be performed only by a qualified technician.

NOTICE: All hardware (screws, nuts, washers) that will be removed from the unit will be reused for this motor replacement. DO NOT LOSE ANY OF THESE PARTS.

Figure 18 - Identification of Parts

REF. NO.	DESCRIPTION
1	Relay Junction Box/Mounting Bracket Assembly
2	#8 Drill Screws (2 required)
3	Pressure/Mounting Bracket Assembly
4	Mounting Plate Adapter
5	Keps Nut w/External Tooth Lockwasher (4 required)
6	Motor Support Shipping Bracket
7	Phillips Head Screws (3 required)
8	Power Venter Blower Housing
9	Blower Wheel
10	Motor
11	Space Washers (3 required)
12	Machine Screw (3 required)
13	Sensing Tube
14	Set Screw



TOOLS AND PARTS NEEDED:
Wire Stripper and Crimper; Slotted Head and #2 Phillips Head Screwdriver; 3/8" Wrench; 1/8" Allen Wrench (long handle); marker; (1) 1/4" push on terminal for Wire.

NOTES:

1) Remove the cover from the Relay Junction Box (Item 1) by removing two screws (Item 2) top and bottom. Disconnect both wires from the motor lead ends. One is connected to terminal #4 on the venter relay, and the other is connected with a wire nut to a black wire.
2) Remove the sensing tube (Item 3) from the Pressure Switch/Mounting Bracket (Item 3) at motor end only. Separated Combustion Units: Remove both tubes at motor end only - note location.
3) Mark locations of the Relay Junction Box and Pressure Switching Mounting Brackets along with the Motor (Item 10) mounts on the Mounting Adapter Plate (Item 4) - using a marker.
4) Remove nut (Item 5) that secures the Motor Support Shipping Bracket (Item 6) to the Mounting Adapter Plate. Pull this bracket away from the Motor Mounting Adapter Plate.
5) Remove three phillips head screws (Item 7) on the Motor mounting Adapter Plate. Remove the Motor/ Blower Wheel/Adapter Plate assembly from the Power Venter Blower Housing (Item 8).
6) Remove the Blower Wheel (Item 9) from the motor shaft - by removing the set screw (Item 14) using a 1/8" Allen Wrench.
7) Remove the three Motor Mounting Nuts (Item 5), Space Washers (Item 11), and Screws (Item 12). Do not lose these parts! Using caution - the motor will disengage from the Mounting Adapter Plate, along with the Relay Junction Box and Pressure Switch Mounting Brackets will also disengage
8) Reverse order to install the new Power Venter Motor.
9) TEST FIRE THE UNIT FOR A FEW CYCLES, MAKING SURE THAT THE UNIT IS OPERATING SATISFACTORY.

HOW TO ORDER REPLACEMENT PARTS

Please send the following information to your local representative; If further assistance is needed, contact the manufacturer's customer service department.

- Model number
- Serial Number (if any)
- Part description and Number as shown in the Replacement Parts Catalog.

LIMITED WARRANTY

POWER VENTED GAS–FIRED BLOWER UNIT HEATERS

1. The Manufacturer warrants to the original owner at original installation site that the above model of Gas–Fired Heaters (the "Product") will be free from defects in material or workmanship for one (1) year from the date of shipment from the factory, or eighteen (18) months from the date of manufacture, whichever occurs first. The Manufacturer further warrants that the complete heat exchanger, draft hood assembly, and burner will be free from defects in material or workmanship for a period of ten (10) years from the date of manufacture. If upon examination by the Manufacturer the Product is shown to have a defect in material or workmanship during the warranty period, the Manufacturer will repair or replace, at its option, that part of the Product which is shown to be defective.

2. This limited warranty does not apply:
   (a) if the Product has been subjected to misuse or neglect, has been accidentally or intentionally damaged, has not been installed, maintained or operated in accordance with the furnished written instructions, or has been altered or modified in any way by any unauthorized person.
   (b) to any expenses, including labor or material, incurred during removal or reinstallation of the Product.
   (c) to any damage due to corrosion by chemicals, including halogenated hydrocarbons, precipitated in the air.
   (d) to any workmanship of the installer of the Product.

3. This limited warranty is conditional upon:
   (a) advising the installing contractor, who will in turn notify the distributor or manufacturer.
   (b) shipment to the Manufacturer of that part of the Product thought to be defective . Goods can only be returned with prior written approval of the Manufacturer. All returns must be freight prepaid.
   (c) determination in the reasonable opinion of the Manufacturer that there exists a defect in material or workmanship.

4. Repair or replacement of any part under this Limited Warranty shall not extend the duration of the warranty with respect to such repaired or replaced part beyond the stated warranty period.

5. **THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ALL SUCH OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIESOF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED FROMTHIS LIMITED WARRANTY. IN NO EVENT SHALLTHE MANUFACTURER BE LIABLE IN ANY WAY FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OF ANY NATURE WHATSOEVER, OR FOR ANY AMOUNTS IN EXCESS OFTHE SELLING PRICE OFTHE PRODUCT OR ANY PARTSTHEREOF FOUNDTO BE DEFECTIVE. THIS LIMITED WARRANTY GIVESTHE ORIGINAL OWNER OFTHE PRODUCT SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY BY EACH JURISDICTION.**

In the interest of product improvement, we reserve the right to make changes without notice.

GAS EQUIPMENT START-UP

Customer ______________________ **Job Name & Number** ______________________

PRE-INSPECTION INFORMATION
With power and gas off.

Type of Equip: Unit Heater Duct Furnace Indoor Rooftop

Serial Number ______________________ Model Number ______________________

Name Plate Voltage: ____________ Name Plate Amperage: ____________

Type of Gas: Natural LP Tank Capacity _______ lbs. Rating: ______ BTU @ ____ °F
_______ kg ______ kw @ ____ °C

- ❐ Are all panels, doors, vent caps in place?
- ❐ Has the unit suffered any external damage? Damage ______________________
- ❐ Does the gas piping and electric wiring appear to be installed in a professional manner?
- ❐ Has the gas and electric been inspected by the local authority having jurisdiction?
- ❐ Is the gas supply properly sized for the equipment?
- ❐ Were the installation instructions followed when the equipment was installed?
- ❐ Have all field installed controls been installed?
- ❐ Do you understand all the controls on this equipment? ***If not, contact your wholesaler or rep.***
(DO NOT START this equipment unless you fully understand the controls.)

GENERAL
With power and gas off.

- ❐ Make certain all packing has been removed.
- ❐ Tighten all electrical terminals and connections.
- ❐ Check damper linkages for tightness.
- ❐ Check all fans & blowers for free movement.
- ❐ Check all controls for proper settings.
- ❐ Check all set screws on blowers and bearings.
- ❐ Check belt tightness.

BLOWER
With power on and gas off.

- ❐ Check voltage L1 _____ L2 _____ L3 _____
- ❐ Check rotation of main blower.
- ❐ Check motor amps L1 _____ L2 _____ L3 _____
- ❐ Blower RPM ____________
- ❐ Check air filters. *(Record quantity & size.)*

GAS HEATING
With power and gas on.

- ❐ Inlet gas pressure. ____ in. W.C. or ____ kPa
- ❐ Pilot & main burner ignition.
- ❐ Manifold gas pressure. ____ in. W.C. or ____ kPa
- ❐ Cycle on HIGH LIMIT.
- ❐ Cycle firestat and/or freezestat.
- ❐ Check electronic modulation. Set at: __________
- ❐ Check mechanical modulation. Set at: _________
- ❐ Cycle and check all other controls not listed.
- ❐ Check operation of remote panel.
- ❐ Entering air temp. _____ °F or ____ °C
- ❐ Discharge air temp. (high fire) ____ °F. or ____ °C
- ❐ External static pressure _________ in. W.C.
- ❐ Cycle by thermostat or operating control.

Remarks: ____

____

____

INSTALLATION INSTRUCTIONS & PARTS LIST
POWER VENTED ENERPAK GAS FIRED PROPELLER UNIT HEATERS

ATTENTION: READ THIS MANUAL AND ALL LABELS ATTACHED TO THE UNIT CAREFULLY BEFORE ATTEMPTING TO INSTALL, OPERATE OR SERVICE THESE UNITS! CHECK UNIT DATA PLATE FOR TYPE OF GAS AND ELECTRICAL SPECIFICATIONS AND MAKE CERTAIN THAT THESE AGREE WITH THOSE AT POINT OF INSTALLATION. RECORD THE UNIT MODEL AND SERIAL No.(s) IN THE SPACE PROVIDED. RETAIN FOR FUTURE REFERENCE.

Model No. ______________________ Serial No. ______________________

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.

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.

⚠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.

APPROVED FOR USE IN CALIFORNIA

⚠WARNING Install, operate and maintain unit in accordance with manufacturer's instructions to avoid exposure to fuel substances or substances from incomplete combustion which can cause death or serious illness. The state of California has determined that these substances may cause cancer, birth defects, or other reproductive harm.

INSTALLER'S RESPONSIBILITY

Installer Please Note: This equipment has been test fired and inspected. It has been shipped free from defects from our factory. However, during shipment and installation, problems such as loose wires, leaks or loose fasteners may occur. **It is the installer's responsibility to inspect and correct any problems that may be found.**

RECEIVING INSTRUCTIONS

Inspect shipment immediately when received to determine if any damage has occurred to the unit during shipment. After the unit has been uncrated, check for any visible damage to the unit. If any damage is found, the consignee should sign the bill of lading indicating such damage and immediately file claim for damage with the transportation company.

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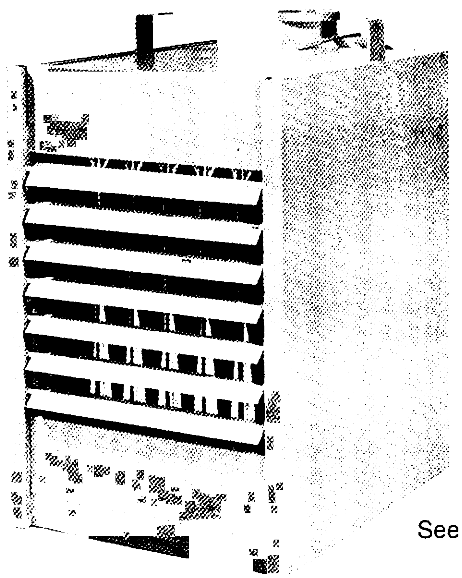
TABLE OF CONTENTS

NOTICE: It is the owner's responsibility to provide any scaffolding or other apparatus required to perform emergency service or annual/periodic maintenance to this equipment.

DESCRIPTION

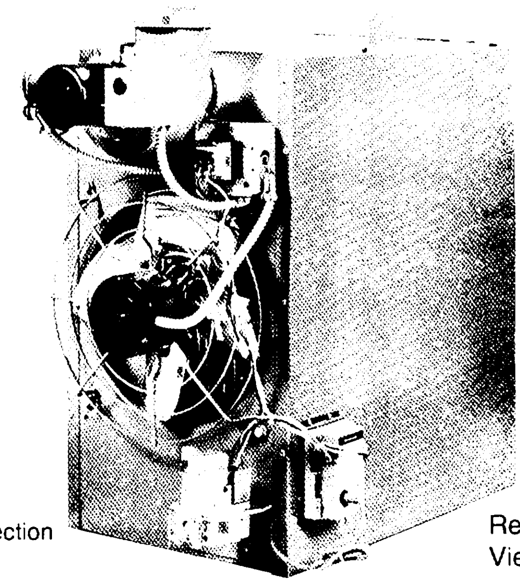
The Power Vented gas unit heater is a factory assembled, power vented, low static pressure type propeller fan heater designed to be suspended within the space to be heated.THESE HEATERS ARE NOT TO BE CONNECTED TO DUCTWORK. The designs are certified by AGA/CGA as providing a minimum of 80% thermal efficiency, and approved for use in California. **Do not alter these units in any way.** If you have any questions after reading this manual, contact the manufacturer.

Figure 1 - Power Vented Propeller Unit Heaters



Front View

See Identification of Parts Section for unit components.



Rear View

The following terms are used throughout this manual, in addition to AGA/CGA requirements, to bring attention to the presence of potential hazards or to important information concerning the product:

⚠DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

⚠WARNING Indicates an imminently hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

⚠CAUTION Indicates an imminently hazardous situation which, if not avoided, may result in minor injury or property damage.

NOTICE: Used to notify of special instructions on installation, operation or maintenance which are important to equipment but not related to personal injury hazards.

GENERAL SAFETY INFORMATION

⚠WARNING **Failure to comply with the general safety information may result in extensive property damage, severe personal injury or death.**

Installation must be made in accordance with local codes, or in absence of local codes with ANSI Standard Z223.1-1996. (N.F.P.A. No.54) National Fuel Gas Code, or the latest edition of. All of the ANSI and NFPA Standards referred to in these installation instructions are those that were applicable at the time the design of this appliance was certified. The ANSI Standards are available from the American Gas Association, 1515 Wilson Boulevard, Arlington, Virginia 22209. The NFPA Standards are available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. These unit heaters are designed for use in airplane hangars when installed in accordance with ANSI/NFPA No. 409 and in public garages when installed in accordance with NFPA No. 88A and NFPA No. 88B.

If installed in Canada, the installation must conform with local building codes, or in absence of local building codes, with CGA-B149.1 "Installation Codes for Natural Gas Burning Appliances and Equipment" or CGA-B149.2 "Installation Codes for Propane Gas Burning Appliances and Equipment". These Unit Heaters have been designed and certified to comply with CGA 2.6. Also see sections on installation in AIRCRAFT HANGARS and PUBLIC GARAGES.

⚠WARNING **Do not alter the unit heater in any way or damage to the unit and/or severe personal injury or death may occur!**

⚠WARNING **Disconnect all power and gas supplies before installing or servicing the heater. If the power disconnect is out of sight, lock it in the open position and tag it to prevent unexpected application of power. Failure to do so could result in fatal electric shock, or severe personal injury.**

⚠CAUTION **Insure that all power sources conform to the requirements of the unit heater or damage to the unit will result!**

Follow installation instructions CAREFULLY to avoid creating unsafe conditions. All external wiring must conform to applicable current local codes, and to the National Electric Code ANSI/NFPA No. 70-1996, or the latest edition of. In Canada, all external wiring must conform to the Canadian Electric Code, Part 1 CSA Standard C22.1. All wiring should be done and checked by a qualified electrician, using copper wire only. All gas connections should be made and leak-tested by a suitably qualified individual, per instructions in this manual. Also follow procedures listed on the "Gas Equipment Start-Up Sheet" located in this manual.

Use only the fuel for which the heater is designed (see rating plate). Using LP gas in a heater that requires natural gas, or vice versa, will create the risk of gas leaks, carbon monoxide poisoning and explosion.

⚠WARNING **Do not attempt to convert the heater for use with a fuel other than the one intended. Such conversion is dangerous, as it will create the risks listed previously.**

Make certain that the power source conforms to the electrical requirements of the heater.

⚠WARNING **Do not depend upon a thermostat or other switch as sole means of disconnecting power when installing or servicing heater. Always disconnect power at main circuit breaker as described above. Failure to do so could result in fatal electric shock.**

Special attention must be given to any grounding information pertaining to this heater. To prevent the risk of electrocution, the heater must be securely and adequately grounded. This should be accomplished by connecting a grounded conductor between the service panel and the heater. To ensure a proper ground, the grounding means must be tested by a qualified electrician.

Do not insert fingers or foreign objects into the heater or its air moving device. Do not block or tamper with the heater in any manner while in operation or just after it has been turned off, as some parts may be hot enough to cause injury.

This heater is intended for general heating applications ONLY. It must NOT be used in potentially dangerous locations such as flammable, explosive, chemical-laden or wet atmospheres.

Do not attach ductwork to this product or use it as a makeup air heater. Such usage voids the warranty and will create unsafe operation.

In cases in which property damage may result from malfunction of the heater, a backup system or a temperature sensitive alarm should be used.

⚠CAUTION **The open end of piping systems being purged shall not discharge into areas where there are sources of ignition or into confined spaces UNLESS precautions are taken as follows: (1) By ventilation of the space, (2) control of purging rate, (3) elimination of all hazardous conditions. All precautions must be taken to perform this operation in a safe manner!**

Unless otherwise specified, the following conversions may be used for calculating SI unit measurements:

1 foot = 0.305 m	1 inch water column = 0.249 kPa
1 inch = 25.4 mm	meter/second = FPM ÷ 196.8
1 psig = 6.894 kPa	liter/second = CFM x 0.472
1 pound = 0.453 kg	1000 Btu per hour = 0.293 kW
1 gallon = 3.785 L	1000 Btu/Cu. Ft. = 37.5 MJ/m^3
	1 cubic foot = 0.028 m^3

Table 1 – Performance and Specification Data – Power Vented Propeller Unit Heater

Unit Size	30	45	60	75	100	125	150	175	200	225	250	300	350	400
PERFORMANCE DATA ‡														
Input BTU/Hr	30,000	45,000	60,000	75,000	100,000	125,000	150,000	175,000	200,000	225,000	250,000	300,000	350,000	400,000
(kW)	(8.8)	(13.2)	(17.6)	(22.0)	(29.3)	(36.6)	(43.9)	(51.2)	(58.6)	(65.9)	(73.2)	(87.8)	(102.5)	(117.1)
Output BTU/Hr	24,000	36,000	48,000	60,000	80,000	100,000	120,000	140,000	160,000	180,000	200,000	240,000	280,000	320,000
(kW)	(7.0)	(10.5)	(14.1)	(17.6)	(23.4)	(29.3)	(35.1)	(41.0)	(46.9)	(52.7)	(58.6)	(70.3)	(82.0)	(93.7)
Thermal Efficiency (%)	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Free Air Delivery CFM	750	800	1,050	1,100	1,480	1,650	2,200	2,530	2,640	2,700	3,100	4,400	5,000	5,300
(cu. m/s)	(0.354)	(0.378)	(0.496)	(0.519)	(0.699)	(0.779)	(1.038)	(1.194)	(1.246)	(1.274)	(1.463)	(2.077)	(2.360)	(2.502)
Air Temperature Rise Deg. F	30	42	42	50	50	56	50	51	56	61	60	50	52	56
(Deg. C)	(17)	(23)	(23)	(28)	(28)	(31)	(28)	(28)	(31)	(34)	(33)	(28)	(29)	(31)
Outlet Velocity FPM	680	720	610	640	775	910	1,045	1,070	1,010	950	980	1,100	1,150	1,050
(m/s)	(3.45)	(3.66)	(3.10)	(3.25)	(3.94)	(4.62)	(5.31)	(5.44)	(5.13)	(4.83)	(4.98)	(5.59)	(5.84)	(5.33)
Full Load Amps at 115V	4.5	4.5	4.5	4.5	5.8	6	7.2	8.2	8.2	8.2	8.2	11.2	13.2	13.2
MOTOR DATA : Motor HP	1/30	1/30	1/30	1/30	1/20	1/10	1/4	1/3	1/3	1/3	1/3	1/4	1/3	1/3
Motor (kW)	(0.025)	(0.025)	(0.025)	(0.025)	(0.037)	(0.075)	(0.186)	(0.249)	(0.249)	(0.249)	(0.249)	(0.186)	(0.249)	(0.249)
Motor Type	SP	SP	SP	SP	SP	SP	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC
R.P.M.	1,050	1,050	1,050	1,050	1,050	1,050	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Amps @ 115V	1.3	1.3	1.3	1.3	2.6	2.8	4.0	4.5	4.5	4.5	4.5	8.0	9.0	9.0
DIMENSIONAL DATA in. (mm)														
"A" Height to Top of Unit	25-3/4	25-3/4	25-3/4	25-3/4	31-1/4	31-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4	36-1/4
	(654)	(654)	(654)	(654)	(794)	(794)	(921)	(921)	(921)	(921)	(921)	(921)	(921)	(921)
"B" Width of Unit	14	14	17-1/2	17-1/2	17-7/8	20-5/8	20-5/8	23-3/8	26-1/8	28-7/8	31-5/8	37-1/8	42-5/8	48-1/8
	(356)	(356)	(444)	(444)	(454)	(524)	(524)	(594)	(664)	(733)	(803)	(943)	(1083)	(1222)
"C" Height to Top of Hanger	27-1/2	27-1/2	27-1/2	27-1/2	34-1/8	34-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8	39-1/8
	(698)	(698)	(698)	(698)	(867)	(867)	(994)	(994)	(994)	(994)	(994)	(994)	(994)	(994)
"D" Depth to Rear of Housing	30-3/8	30-3/8	30-3/8	30-3/8	37-1/2	37-1/2	37-1/2	37-1/2	37-1/2	37-1/2	37-1/2	37-1/2	37-1/2	37-1/2
	(772)	(772)	(772)	(772)	(952)	(952)	(952)	(952)	(952)	(952)	(952)	(952)	(952)	(952)
"E" Hanging Distance Width	11	11	16-1/2	16-1/2	14-1/2	17-1/4	17-1/4	20	22-3/4	25-1/2	28-1/4	33-3/4	39-1/4	44-3/4
	(279)	(279)	(419)	(419)	(368)	(438)	(438)	(508)	(578)	(648)	(718)	(857)	(997)	(1137)
"F" Discharge Opening Width	10	10	15-1/2	15-1/2	15-3/8	18-1/8	18-1/8	20-7/8	23-5/8	26-3/8	29-1/8	34-5/8	40-1/8	45-5/8
	(254)	(254)	(394)	(394)	(391)	(460)	(460)	(530)	(600)	(670)	(740)	(879)	(1019)	(1159)
"G" Depth to Unit Side Jacket	19-3/8	19-3/8	19-3/8	19-3/8	26-3/4	26-3/4	26-3/4	26-3/4	26-3/4	26-3/4	26-3/4	26-3/4	26-3/4	26-3/4
	(492)	(492)	(492)	(492)	(679)	(679)	(679)	(679)	(679)	(679)	(679)	(679)	(679)	(679)
"H" Discharge Opening Height	16-1/4	16-1/4	16-1/4	16-1/4	18	18	18	18	18	18	18	18	18	18
	(413)	(413)	(413)	(413)	(457)	(457)	(457)	(457)	(457)	(457)	(457)	(457)	(457)	(457)
"J" to Centerline of Flue	4	4	5-3/4	5-3/4	5-7/8	7-1/4	7-1/4	8-5/8	10	11-1/4	12-3/4	15-1/2	18-1/4	21
	(102)	(102)	(146)	(146)	(149)	(184)	(184)	(219)	(254)	(286)	(324)	(394)	(464)	(533)
"K" Depth to Centerline of Flue	23-5/8	23-5/8	23-5/8	23-5/8	30-5/8	30-5/8	30-5/8	30-5/8	30-5/8	30-5/8	30-5/8	30-5/8	30-5/8	30-5/8
	(600)	(600)	(600)	(600)	(778)	(778)	(778)	(778)	(778)	(778)	(778)	(778)	(778)	(778)
"L" Hanger Location	13-3/4	13-3/4	13-1/2	13-1/2	16-1/4	16-3/4	16-3/8	16-3/8	16-3/8	16-3/4	16-3/4	16-3/4	16-3/4	16-3/4
	(349)	(349)	(343)	(343)	(413)	(425)	(416)	(416)	(416)	(425)	(425)	(425)	(425)	(425)
Flue Size Dia.-in.*	4	4	4	4	4	4	4	4	5	5	5	6	6	6
(Dia.-mm)	(102)	(102)	(102)	(102)	(102)	(102)	(102)	(102)	(127)	(127)	(127)	(152)	(152)	(152)
Fan Diameter-in.	12	12	14	14	14	16	16	18	18	18	18	(2) 16	(2) 18	(2) 18
Gas Inlet-Natural Gas-in.	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4
Gas Inlet-LP Gas-in.	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	←		1/2 OR 3/4		→
Approx. Shipping Wt lb.	79	94	109	119	174	197	219	238	249	275	305	350	414	461
(kg)	(36)	(43)	(49)	(54)	(79)	(89)	(99)	(108)	(113)	(125)	(138)	(159)	(188)	(209)

‡ Ratings shown are for unit installations at elevations between 0 and 2,000 ft. For unit installations in U.S.A. above 2,000 ft. (610m), the unit input must be derated 4% for each 1,000 ft. (305m) above sea level; refer to local codes, or in absence of local codes, refer to the National Fuel Gas Code, ANSI Standard Z223.1-1996 (N.F.P.A. No. 54), or the latest edition of.

For installations in Canada, any reference to deration at altitudes in excess of 2,000 ft. (610m) are to be ignored. At altitudes of 2,000 ft. to 4,500 ft. (610 to 1372m), the unit must be derated to 90% of the normal altitude rating, and be so marked in accordance with the C.G.A. certification.

LEGEND: SP = SHADED POLE
PSC = PERMANENT SPLIT CAPACITOR

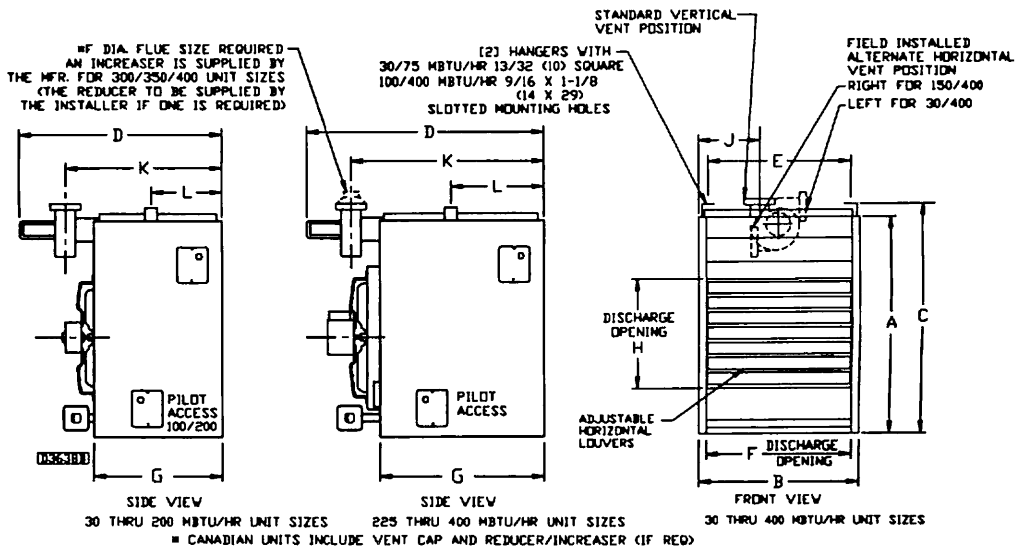


Figure 1A

DIMENSIONS XXX STANDARD UNITS
DIMENSIONS IN PARENTHESIS (XXX) MILLIMETERS

INSTALLATION

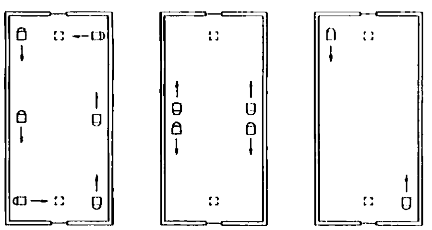
⚠WARNING Do not install unit heaters in corrosive or flammable atmospheres! Premature failure of, or severe damage to the unit will result!

⚠WARNING Avoid locations where extreme drafts can affect burner operation. Unit heaters must not be *installed* in locations where air for combustion would contain chlorinated, halogenated or acidic vapors. If located in such an environment, premature failure of the unit will occur!

Since the unit is equipped with an automatic gas ignition system, the unit heater must be installed such that the gas ignition control system is not directly exposed to water spray, rain or dripping water.

NOTICE: Location of unit heaters is related directly to the selection of sizes (refer to Figure 2). Basic rules are as follows:

Figure 2 - Heater Location



MOUNTING HEIGHT: Unit Heaters must be installed at a minimum of 8 feet (2.4m) above the floor, measured to the bottom of the unit. At heights above 8 feet (2.4m), less efficient air distribution will result. Occasionally unit heaters must be mounted at heights of 12 to 16 feet (3.7 to 4.9m) in order to clear obstacles. When this is the case, it is advisable to use centrifugal blower unit heaters.

AIRCRAFT HANGARS: Unit Heaters must be installed in aircraft hangars and public garages as follows: In aircraft hangars, unit heaters must be at least 10 feet (3.1m) above the upper surface of wings or engine enclosures of the highest aircraft to be stored in the hangar and 8 feet (2.4m) above the floor in shops, offices and other sections of the hangar where aircraft are not stored or housed. Refer to current ANSI/NFPA No. 409, Aircraft Hangars. In Canada, installation is suitable in aircraft hangars when acceptable to the enforcing authorities.

PUBLIC GARAGES: In repair garages, unit heaters must be at least 8 feet (2.4m) above the floor. Refer to the latest edition of NFPA No. 88B, Repair Garages.

In parking structures, unit heaters must be installed so that the burner flames are located a minimum of 18 inches (457mm) above the floor or protected by a partion not less than 18 inches (457mm) high. However, any unit heater mounted in a parking structure less than 8 ft. (2.4m) above the floor must be equipped with an OSHA approved fan guard. Refer to the latest edition of NFPA 88A, Parking Structures.

In Canada, installation must be in accordance with the latest edition of CGA-B149 "Installation Codes for Gas Burning Appliances and Equipment."

AIR DISTRIBUTION: Direct air towards areas of maximum heat loss. When multiple heaters are involved, circulation of air around the perimeter is recommended where heated air flows along exposed walls. Satisfactory results can also be obtained where multiple heaters are located toward the center of the area with heated air directed toward the outside walls. Be careful to avoid all obstacles and obstructions which could impede the warm air distribution patterns. Heat throw distances are presented in Table 2, and Figure 2A.

Figure 2A - Heat Throw Distances

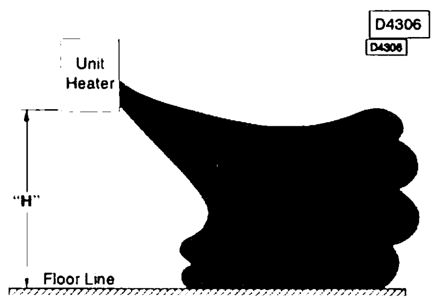


Table 2 - Standard Applications - Heat Throw Distances (Approximate) (see Figure 2A)

UNIT SIZE BTU/Hr (kW)

"H" ft. (m)	30,000 (8.8)	45,000 (13.2)	60,000 (17.6)	75,000 (22.0)	100,000 (29.3)	125,000 (36.6)	150,000 (43.9)	175,000 (51.2)	200,000 (58.6)	225,000 (65.9)	250,000 (73.2)	300,000 (87.8)	350,000 (102.5)	400,000 (117.1)
8 (2.4)	33 (10.1)	33 (10.1)	33 (10.1)	40 (12.2)	60 (18.3)	65 (19.8)	70 (21.3)	75 (22.9)	80 (24.4)	85 (25.9)	90 (27.4)	105 (32.0)	110 (33.5)	120 (36.6)
10 (3.0)	28 (8.5)	28 (8.5)	28 (8.5)	35 (10.7)	54 (16.5)	56 (17.1)	60 (18.3)	64 (19.5)	68 (20.7)	72 (21.9)	78 (23.8)	90 (27.4)	95 (29.0)	100 (30.5)
12 (3.7)	NR	NR	NR	NR	44 (13.4)	46 (14.0)	49 (20.7)	57 (17.4)	61 (18.6)	65 (19.8)	68 (20.7)	80 (24.4)	84 (25.6)	90 (27.4)
15 (4.6)	NR	NR	NR	NR	NR	NR	45 (22.6)	49 (14.9)	52 (15.8)	56 (17.1)	60 (18.3)	70 (21.3)	74 (22.6)	80 (24.4)
20 (6.1)	NR	NR	NR	NR	NR	NR	NR	NR	46 (14.0)	50 (15.2)	54 (16.5)	63 (19.2)	66 (20.1)	70 (21.3)

NR = Not recommended H = Distance from floor to bottom of the unit.

PIPE INSTALLATION

1. Install the gas piping in accordance with applicable local codes.
2. Check gas supply pressure. Each unit heater must be connected to a manifold pressure and a gas supply capable of supplying its full rated capacity (refer to Table 4). A field LP tank regulator must be used to limit the supply pressure to maximum of 14 in. W.C. (3.5 kPa). All piping should be sized in accordance with ANSI Standard Z223.1-1996, (or the latest edition) National Fuel Gas Code; in Canada, according to CGA-B149. See Tables 1 and 3 for correct gas supply piping size. If gas pressure is excessive on natural gas applications, install a pressure regulating valve in the line upstream from the main shutoff valve.
3. Adequately support the piping to prevent strain on the gas manifold and controls.
4. To prevent the mixing of moisture with gas, run the take-off piping from the top, or side, of the main.
5. Standard gas duct furnaces, optional two-stage units, and hydraulic modulating units are supplied with a combination valve which includes:
   (a) Manual "A" valve (b) Manual "B" valve
   (c) Solenoid valve (d) Pilot safety (e) Pressure regulator

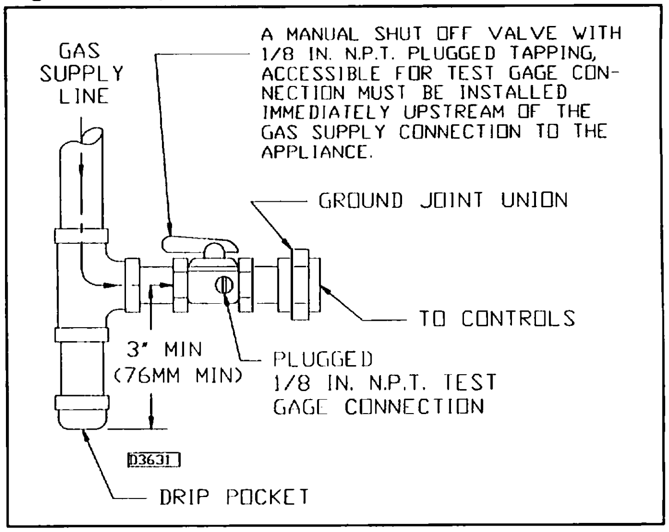
   Pipe directly in to combination valve (see Figure 4).
6. A 1/8 in. N.P.T. plugged tapping, accessible for test gauge connection, must be installed immediately upstream of the gas supply connection to the appliance
7. Provide a drip leg in the gas piping near the gas unit heater. A ground joint union and a manual gas shutoff valve should be installed ahead of the unit heater controls to permit servicing. The manual main shutoff valve must be located external to the jacket. See Figure 4.
8. Make certain that all connections have been adequately doped and tightened.

⚠CAUTION Do not overtighten the inlet gas piping into the valve. This may cause stresses that would crack the valve!

NOTICE: Use pipe joint sealant resistant to the action of liquefied petroleum gases regardless of gas conducted.

⚠WARNING Check all pipe joints for leakage using a soap solution or other approved method. Never use an open flame or severe personal injury or death may occur.

Figure 4 - Pipe Installation, Standard Controls



⚠WARNING Never use an open flame to detect gas leaks. Explosive conditions may exist which would result in personal injury or death.

The appliance and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psig (3.5 kPa).

The appliance must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 psig (3.5 kPa).

Table 4 - Gas Piping Requirements

SINGLE STAGE GAS PIPING REQUIREMENTS*

GasType	Natural Gas	Propane (LP) Gas
Manifold Pressure	3.5 in. W.C. (0.9 kPa)	10.0 in. W.C. (2.5 kPa)
Supply Inlet Pressure	14.0 in. W.C. Max. (3.5 kPa)	14.0 in. W.C. Max. (3.5 kPa)
	5.0 in. W.C. Min. (1.2 kPa)	11.0 in W.C. Min. (2.7 kPa)

**For single stage application only at normal altitudes.*

TWO STAGE GAS PIPING REQUIREMENTS**

Gas Type	Natural Gas	Propane (LP) Gas
Supply Inlet Pressure	6.5 in. W.C. Min. (1.6 kPa)	11.5 in. W.C. Min. (2.9 kPa)

***For two stage applications only at normal altitudes; two stage applications do not apply to the 30/75 MBH models.*

ELECTRICAL CONNECTIONS

⚠ WARNING

HAZARDOUS VOLTAGE!
disconnect ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING. Failure to disconnect power before servicing can cause severe personal injury or death.

Standard units are shipped for use on 115 volt, 60 hertz single phase electric power. The motor nameplate and electrical rating on the transformer should be checked before energizing the unit heater electrical system. All external wiring must conform to ANSI/NFPA No. 70-1996, National Electrical Code (or the latest edition of) and applicable current local codes; in Canada, to the Canadian Electrical Code, Part 1 CSA Standard C22.1.

⚠ CAUTION Do not use any tools (i.e. screwdriver, pliers, etc.) across the terminals to check for power. Use a voltmeter.

It is recommended that the electrical power supply to each unit heater be provided by a separate, fused and permanently live electrical circuit. A disconnect switch of suitable electrical rating for each unit heater should be located as close to the gas valve and controls as possible. Each unit heater must be electrically grounded in accordance with National Electric Code, ANSI/NFPA No. 70-1996 (or the latest edition of) or CSA Standard C22.1. Sample wiring connections are depicted in Figures 6 & 7.

The transformer supplied with this unit heater is internally fused. Any overload or short circuit will ruin the transformer.

THERMOSTAT WIRING AND LOCATION

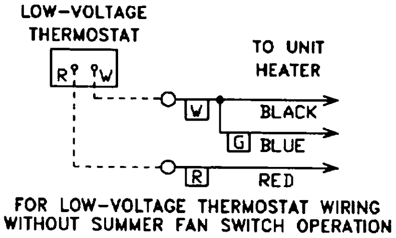
NOTICE: The thermostat must be mounted on a vertical vibration-free surface free from air currents and in accordance with the furnished instructions.

Mount the thermostat approximately 5 feet (1.5 m) above the floor in an area where it will be exposed to a free circulation of average temperature air. Always refer to the thermostat instructions as well as our unit wiring diagram and wire accordingly. Avoid mounting the thermostat in the following locations:

1. Cold areas - Outside walls or areas where drafts may affect the operation of the control.
2. Hot areas - Areas where the sun's rays, radiation, or warm air currents may affect control operation.
3. Dead areas - Areas where air cannot circulate freely, such as behind doors or in corners.

* Thermostat wires tagged "W" and "G" must be connected together except when using a general purpose "SPDT" 24VAC relay and a standard thermostat with subbase, or when using Honeywell T834H-1009 or T834H-1017 thermostats. Also refer to Figure 5 for other wiring connections.

Figure 5 - C1267G



THERMOSTAT HEAT ANTICIPATOR ADJUSTMENTS:

The initial heat anticipator setpoint should equal the thermostat's current amperage draw when the unit is firing. This setpoint should be measured for the best results. Use the recommended ranges as a guide. If further information is needed, consult your thermostat manufacturer's instructions.

Recommended Heat Anticipator Setting Ranges:

Gas Ignition Type	25 ft. (7.6m) T'stat Wiring	50 ft. (15.2m) T'stat Wiring
For Power Vented Units: Intermittent (Spark)	0.85 to 0.90 A	0.90 to 1.1 A Max. Setting on T'stat

FAN TIME DELAY CONTROL

Leads from time delay controls are factory wired to the junction box. The fan control is a time delay relay (approximately 45 seconds ON, 65 seconds OFF). The fan control is rated at 17 amps.

NOTICE: The start-up fan delay must not exceed 90 seconds from a cold start.

NOTICE: For all wiring connections, refer to the wiring diagram that your unit is equipped with (either affixed to the side jacket or enclosed in your unit's installation instruction envelope). Should any original wire supplied with the heater have to be replaced, it must be replaced with wiring material having a temperature rating of at least 105° C.

Should any high limit switch wires have to be replaced, they must be replaced with wiring material having a temperature rating of 200°C minimum.

Figure 10A

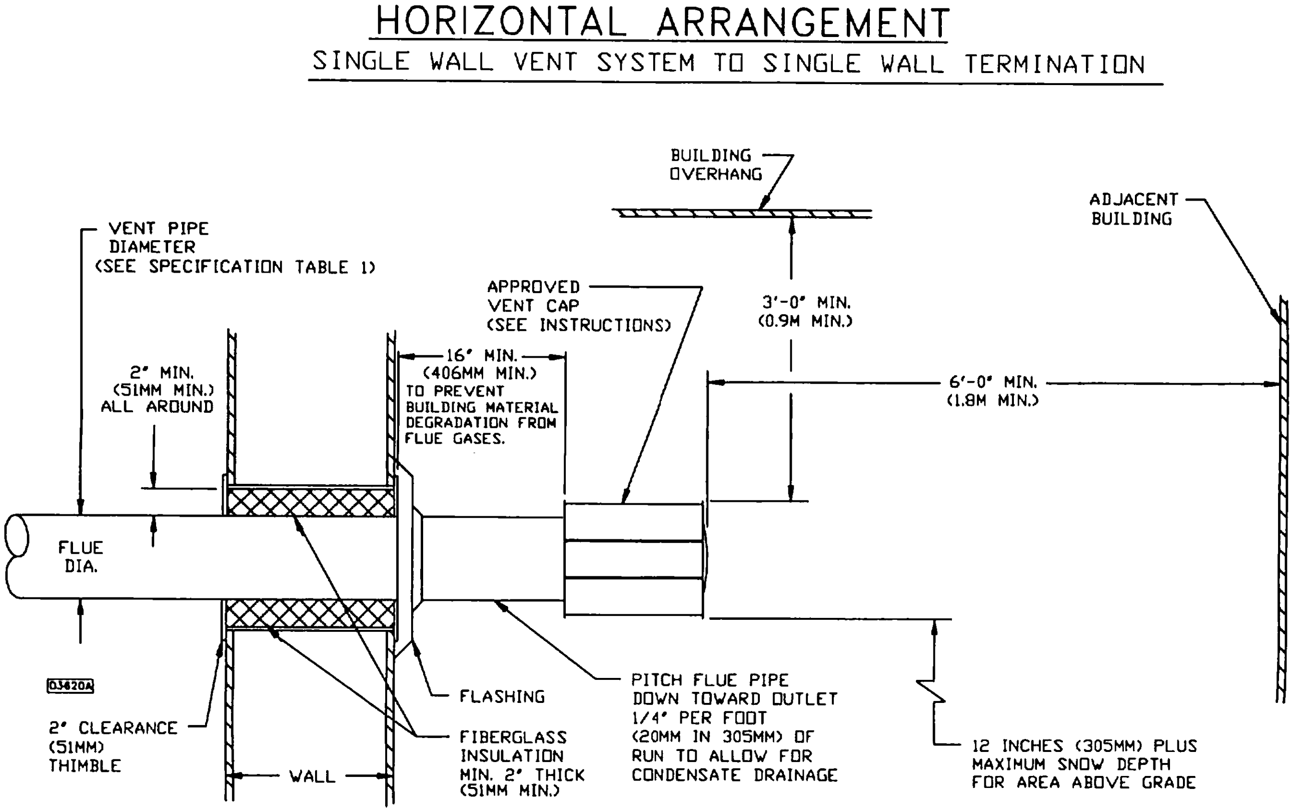


Figure 10B

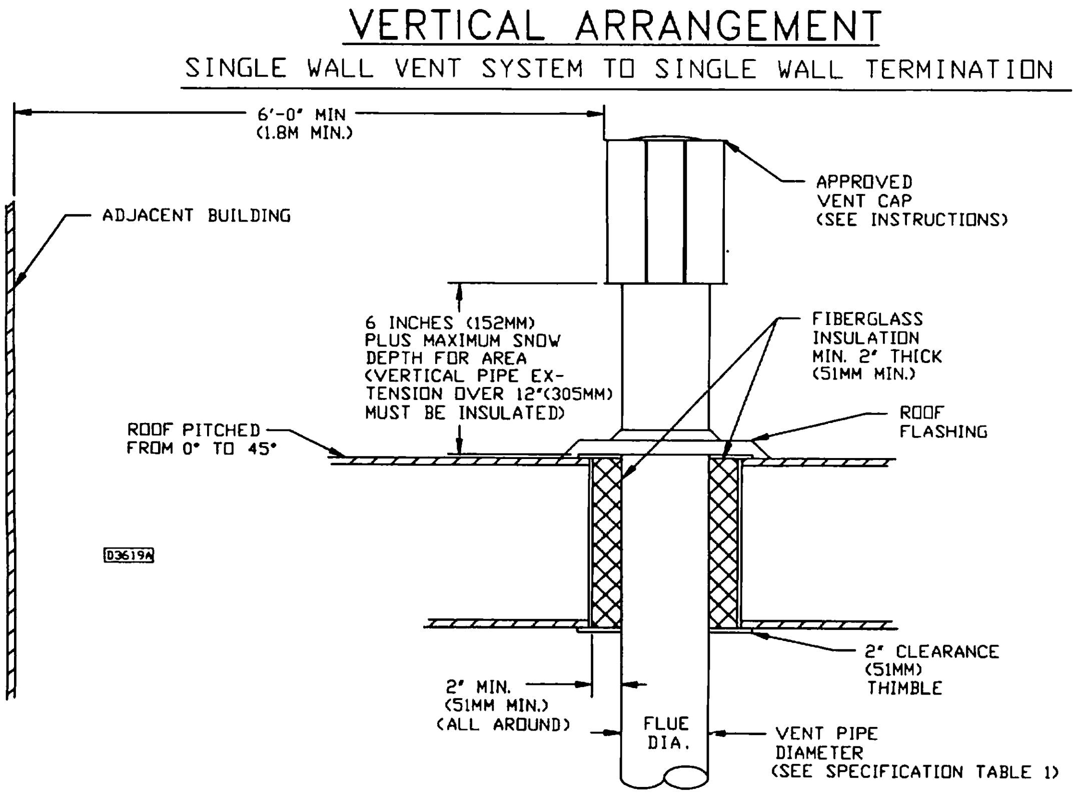


Figure 10C

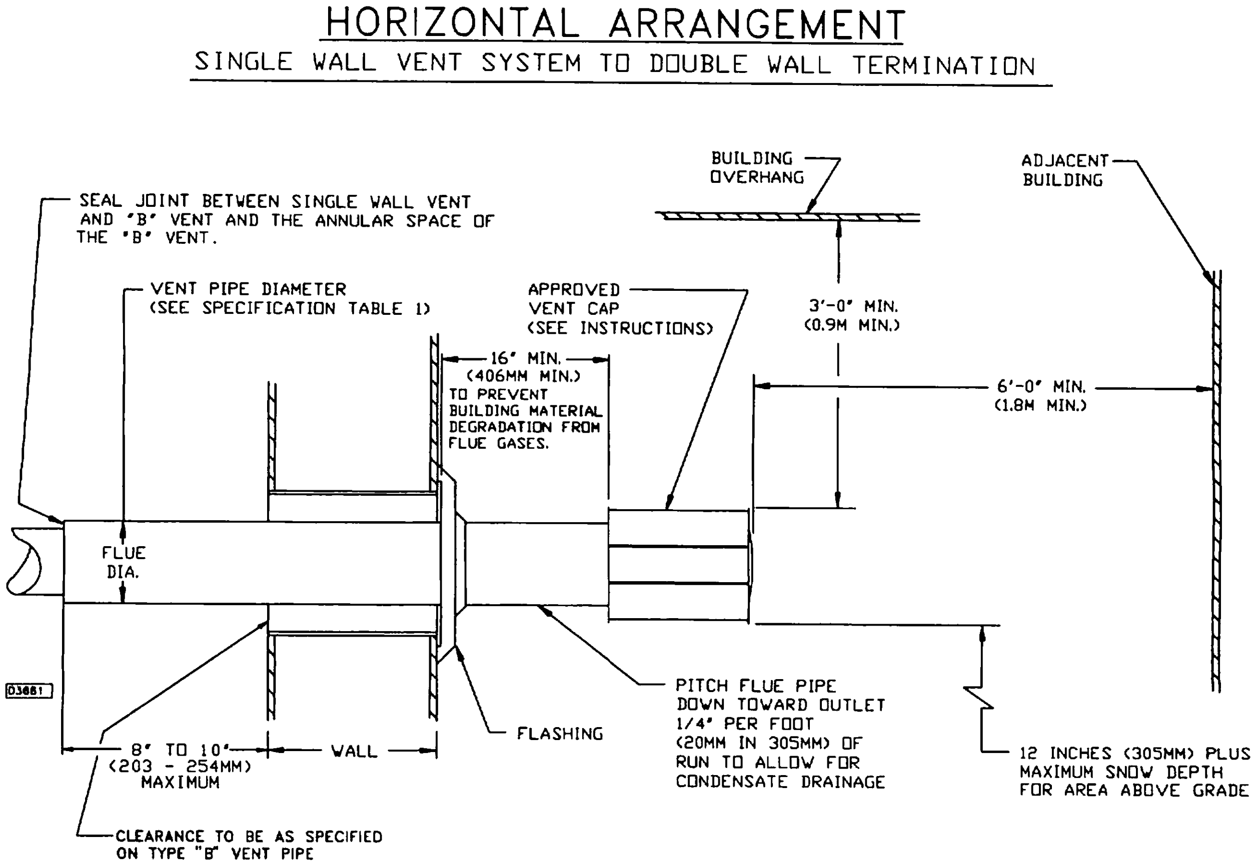
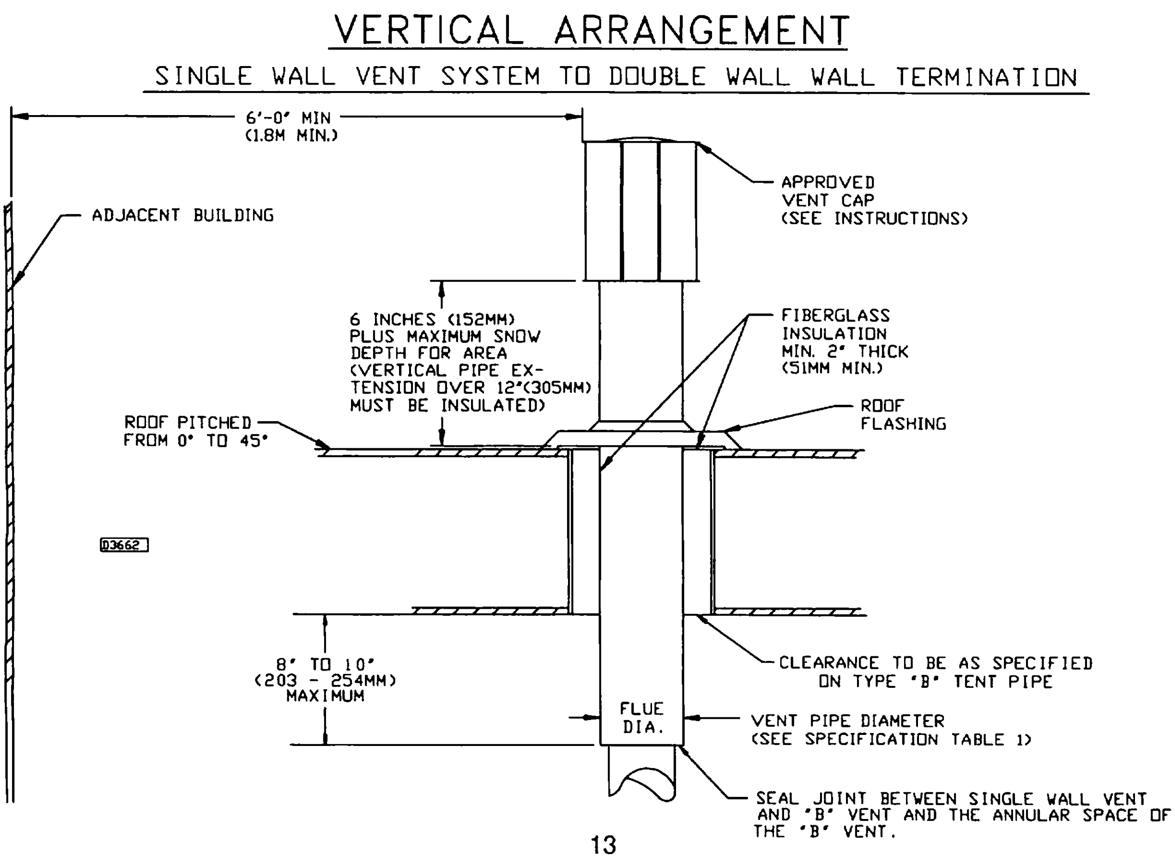


Figure 10D



OPERATION
POWER VENTED PROPELLER UNITS
INTERMITTENT (SPARK) PILOT IGNITION

EXPLANATION OF CONTROLS (See Figure 11):

1. The unit heater is equipped with a power venter system consisting of a power venter motor and blower, pressure switch, and sealed flue collector in place of the conventional draft diverter.
2. The power venter motor is energized by the room thermostat on a call for heat. The pressure switch measures the flow through the vent system and energizes the indirect spark ignition system when the flow is correct. **The pressure switch MUST NOT be bypassed. The unit MUST NOT be fired unless the power venter is operating. An unsafe condition could result.**
3. The indirect spark ignition system consists of an ignition control module, a dual combination valve, and a spark-ignited pilot burner. When the pressure switch closes, the pilot valves opens and a spark is generated to light the pilot burner. When flame sensing circuit senses that the pilot flame is established, the main gas valve is opened to supply gas to the main burners. When the thermostat is satisfied, the vent system is deenergized and both valves are closed to stop all flow of gas to the unit.
4. The limit switch interrupts the flow of electric current to the main gas valve in case the heater becomes overheated.
5. The fan switch delays the operation of the fan until the heater is warmed, then keeps the fan running after the gas has been turned off until the useful heat has been removed. **The startup fan delay must not exceed 90 seconds from a cold start.**
6. The wall thermostat (supplied optionally) is a temperature sensitive switch which operates the vent system and the ignition system to control the temperature of the space being heated. It must be mounted on a vibration free, vertical surface away from air currents, in accordance with the instructions furnished with the thermostat (also refer to Electrical Section).

START-UP (Also refer to lighting instruction plate equipped on the unit)

1. Open the manual valve supplying gas to the unit heater, and with the union connection loose, purge air from the gas line. Tighten the union and check for gas leaks using a soapy water solution only.

⚠WARNING **Never use an open flame to detect gas leaks. Explosive conditions may exist which could result in personal injury or death.**

⚠WARNING **Before attempting to light or relight pilot, wait 5 minutes to allow gas which may have accumulated in the burner compartment to escape. Failure to do so could cause the accumulated gas to ignite rapidly, leading to personal injury or death.**

2. Open the manual valve on the unit heater.
3. Turn ON electrical power.
4. The unit should be under the control of the thermostat. Turn the thermostat to the highest point and determine that the power venter motor starts, and the pilot and main burners ignite. Turn the thermostat to the lowest point and determine that the power venter motor shuts off and the pilot and main burners are extinguished.
5. If pilot adjustment is required, remove the pilot adjustment seal cap and adjust the pilot screw to obtain proper flame. Clockwise rotation decreases pilot flame size. Replace the cap.
6. Turn the thermostat to the desired position.
7. See Gas Input Rate and Adjustments sections.

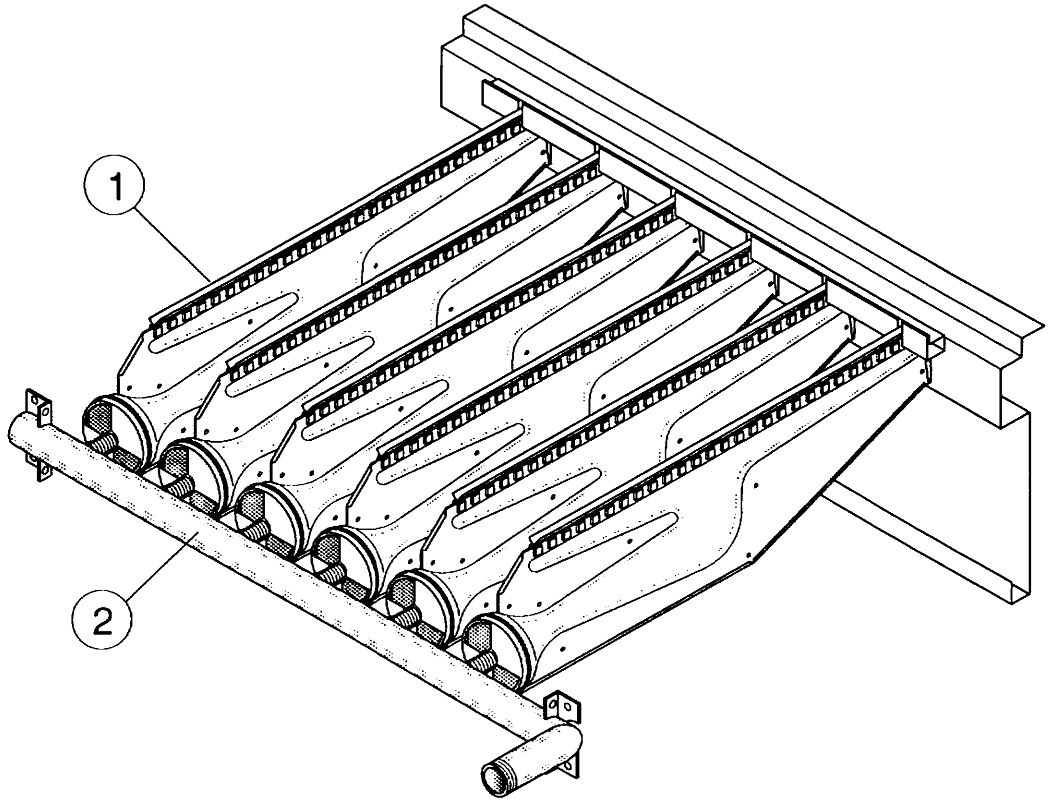
SHUT DOWN

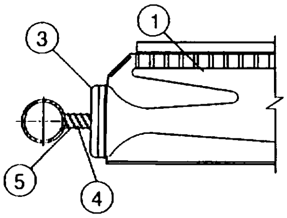
1. Turn the valve selector knob to the "OFF" position.
2. Turn off the electricity.
3. To relight, follow the "start-up" instructions.

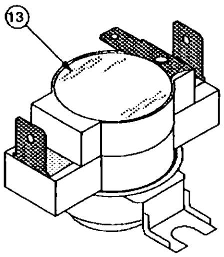
See Figure 11 for parts/identification.

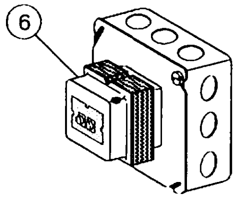
Figure 11 - Burner Components — Intermittent Pilot Ignition
Also refer to Figures 1A, 4, 14, 15 & 16 for component locations.

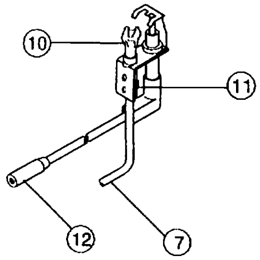
BURNER DRAWER COMMON PARTS:
1.) Main Burners
2.) Burner Manifold
3.) Air Shutters
4.) Burner Springs
5.) Main Burner Orifice
6.) Transformer
7.) Pilot Tubing



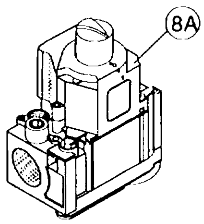


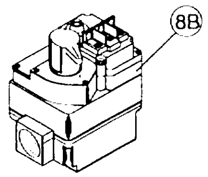


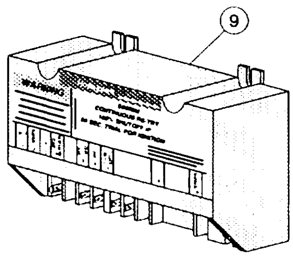


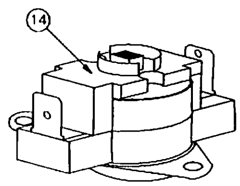


CONTROLS:
8A.) Main Gas Valve (Honeywell)
8B.) Main Gas Valve (White Rodgers)
9. Honeywell Ignitor
10. Honeywell Pilot Burner
11.) Honeywell Pilot Orifice
12.) Honeywell Electrode/Sensor Lead
13.)* High Limit
14.)† Blocked Vent (Spill) Switch
*This safety device is located on the rear header plate of the heat exchanger (air inlet side).
†This safety device is located in the upper right corner of the right jacket panel.









GAS INPUT RATE

Check the gas input rate as follows (Refer to general safety section for metric conversions/SI units):

⚠ CAUTION Never overfire the unit heater, as this may cause unsatisfactory operation or shorten the life of the heater.

1. Turn off all gas appliances that use gas through the same meter as the unit heater.
2. Turn gas on to the unit heater.
3. Clock the time in seconds required to burn one cubic foot of gas by checking the gas meter.
4. Insert the time required to burn one cubic foot of gas into the following formula and compute the input rate.

$$\frac{3600 \text{ (Sec. Per Hr.) x Btu/Cu. Ft}}{\text{Time (Sec.)}} = \text{Input Rate}$$

For example, assume the Btu content of one cubic foot of gas equalled 1000 and that it takes 18 seconds to burn one cubic foot of gas.

$$\frac{3600 \times 1000}{18} = 200{,}000 \text{ Btu/Hr.}$$

NOTICE: If the computation exceeds or is less than 95 percent of the gas Btu/hr. input rating (see Specifications), adjust the gas pressure.

GAS PRESSURE ADJUSTMENTS

Adjust the gas pressure as follows:

1. NATURAL GAS: Optimum results are obtained when the unit heater is operating at its full input rating with the manifold pressure of 3.5 inches W.C. (0.9 kPa). Adjustment of the pressure regulator is not normally necessary since it is preset at the factory. However, field adjustment may be made as follows:
   (a.) Attach manometer at pressure tap plug adjacent to the control outlet.
   (b.) Remove regulator adjustment screw cap, located on combination gas valve.
   (c.) With a small screwdriver, rotate the adjustment screw counterclockwise to decrease or clockwise to increase pressure. Do not force beyond stop limits.
   (d.) Replace regulator adjustment screw cap.
2. PROPANE GAS: An exact manifold pressure of 10.0 inches W.C. (2.5 kPa)must be maintained for proper operation of the unit heater. If the unit is equipped with a pressure regulator on the combination gas valve, follow steps "a" through "d" above. If the unit is not so equipped, the propane gas supply system pressure must be regulated to attain this manifold operating pressure.
3. The adjusted manifold pressure should not vary more than 10% from the pressure specified in Table 5.

Table 5 - Main Burner Orifice Schedule*

* INPUT IN 1000 BTU	TYPE OF GAS	NATURAL	PROPANE	NO. OF BURNER ORIFICES
	HEATING VALUE	1075 BTU/Ft^3 (40.1 MJ/m^3)	2500 BTU/Ft^3 (93.1 MJ/m^3)	
	MANIFOLD PRESSURE	3.5" W.C. (0.87kPA)	10" W.C. (2.49 kPA)	
30	FT^3/HR ORIFICE DRILL	28 49	12 57	2
45	FT^3/HR ORIFICE DRILL	42 49	18 57	3
60	FT^3/HR ORIFICE DRILL	56 49	24 57	4
75	FT^3/HR ORIFICE DRILL	70 49	30 57	5
100	FT^3/HR ORIFICE DRILL	96 41	40 54	4
125	FT^3/HR ORIFICE DRILL	120 41	50 54	5
150	FT^3/HR ORIFICE DRILL	140 41	60 54	6
175	FT^3/HR ORIFICE DRILL	163 41	70 54	7
200	FT^3/HR ORIFICE DRILL	186 41	80 54	8
225	FT^3/HR ORIFICE DRILL	210 41	90 54	9
250	FT^3/HR ORIFICE DRILL	233 41	100 54	10
300	FT^3/HR ORIFICE DRILL	280 41	120 54	12
350	FT^3/HR ORIFICE DRILL	326 41	140 54	14
400	FT^3/HR ORIFICE DRILL	372 41	160 54	16

* This schedule is for units operating at normal altitudes of 2000 ft. (610m) or less. SPECIAL ORIFICES ARE REQUIRED FOR INSTALLATIONS ABOVE 2,000 FT. (610M).

When installed in Canada, any references to deration at altitudes in excess of 2000 feet (610m) are to be ignored. At altitudes of 2000 to 4500 feet (610 to 1372m), the unit heaters must be orificed to 90% of the normal altitude rating, and be so marked in accordance with the C.G.A. certification.

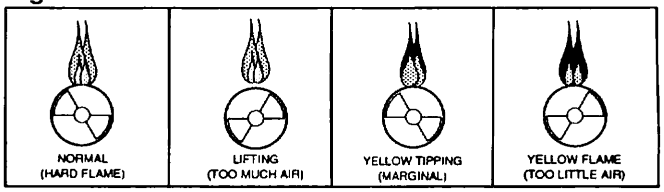
PRIMARY AIR SHUTTER ADJUSTMENT

After the unit has been operating for at least 15 minutes, adjust the primary air flow to the burners. Turn the friction-locked, manually-rotated air shutters clockwise to close, or counterclockwise to open (see Figures 11, 12, 14 and 16).

For correct air adjustment, close the air shutter until yellow tips in the flame appear. Then open the air shutter to the point just beyond the position where yellow tipping disappears. Refer to Figure 12 .

NOTICE: There may be momentary and spasmodic orange flashes in the flame. This is caused by the burning of airborne dust particles, and not to be confused with the yellow tipping, which is a stable or permanent situation when there is insufficient primary air.

Figure 12 - Main Burner Flames



PILOT ADJUSTMENT

1. Remove the pilot adjustment cap.
2. Adjust the pilot screw to provide a properly sized flame.
3. A proper pilot flame is a soft steady flame that envelops 3/8 to 1/2-inch (9.5 to 12.7 mm) of the flame sensor.
4. Replace the pilot adjustment cap.

MANIFOLD PRESSURE ADJUSTMENT

If the manifold pressure requires minor adjustment, remove the cap from the pressure regulator and turn the adjustment screw clockwise to increase the pressure, or counterclockwise to decrease the pressure. The adjusted manifold pressure should not vary more than 10% from the pressures specified in Table 5.

MAINTENANCE

PERIODIC SERVICE

NOTICE: The heater and vent system should be checked once a year by a qualified technician.

All Maintenance/Service information should be recorded accordingly on the Inspection Sheet provided in this manual.

⚠ WARNING Open all disconnect switches and disconnect all electrical and gas supplies and secure in that position before servicing unit. Failure to do so may result in personal injury or death from electrical shock.

Should maintenance be required, perform the following inspection and service routine:

1. Inspect the area near the unit to be sure that there is no combustible material located within the minimum clearance requirements listed in this manual.

⚠ WARNING Under no circumstances should combustible material be located within the clearances specified in this manual. Failure to provide proper clearance could result in personal injury or equipment damage from fire.

2. Turn off the manual gas valve and electrical power to the gas unit heater.
3. To clean or replace the main burners, remove the bottom panel and compress the spring by moving the burner toward the manifold. Slide the opposite end of the burner downward from the locating slot while retaining spring is still compressed. Pull the burners away from the heat.
4. With the burners removed, wire brush the inside surfaces of the heat exchanger.
5. Remove any dirt, dust, or other foreign matter from the burners using a wire brush and/or compressed air. Ensure that all parts are unobstructed. Inspect and clean pilot burner if necessary.
6. Reassemble the gas unit heater by replacing all parts in reverse order.
7. Complete the appropriate unit start-up procedure as given in the "Operation" section of this manual (see lighting instruction plate on the unit).
8. Check the burner adjustment. See the "Primary Air Shutter Adjustment" section of this manual.
9. Check all gas control valves and pipe connections for leaks.
10. Check the operation of the automatic gas valve by lowering the setting of the thermostat, stopping the operation of the gas unit heater. The gas valve should close tightly, completely extinguishing the flame on the main burners.
11. Inspect and service the motor/fan assemblies. To maintain efficient air flow, inspect and clean the fan blades and guard to prevent buildup of foreign matter.
12. Check lubrication instructions on the motor. If oiling is required, add 3 to 4 drops of electric motor oil as follows:
    (a.) Light Duty - After 3 years or 25,000 hours of operation.
    (b.) Average Duty - Annually after 3 years or 8,000 hours of operation.
    (c.) Heavy Duty - Annually after 1 year or at least every 1500 hours of operation.

⚠ CAUTION Never over oil the motor or premature failure may occur!

13. Check and test the operational functions of all safety devices supplied with your unit.

Table 6 - Power Vented Propellers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
A. Flame lifting from burner ports.	1. Pressure regulator set too high. 2. Defective Regulator. 3. Burner orifice too large.	1. Reset manifold pressure. Refer to "Operation". 2. Replace regulator section of combination gas valve or complete valve. 3. Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
B. Flame pops back.	1. Excessive primary air. 2. Burner orifice too small.	1. Close air shutter. Refer to "Operation". 2. Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
C. Noisy flame.	1. Too much primary air. 2. Noisy pilot 3. Irregular orifice causing whistle or resonance. 4. Excessive gas input.	1. Close air shutter. 2. Reduce pilot gas. Refer to "Operation". 3. Replace orifice. 4. Reset manifold pressure. Refer to "Operation"; Replace regulator section of combination gas valve or complete valve; or Check with local gas supplier for proper orifice size and replace. Refer to "Operation".
D. Yellow tip flame (some yellow tipping on propane gas is permissible).	1. Insufficient primary air. 2. Clogged main burner ports. 3. Misaligned orifices. 4. Clogged flue collector. 5. Air shutter linted. 6. Insufficient combustion air.	1. Open air shutters. Refer to "Operation". 2. Clean main burner ports. 3. Replace manifold assembly. 4. Clean flue collector. 5. Check for dust or lint at air mixer opening and around the air shutter. 6. Clean combustion air inlet openings in bottom panel, see "Installation".
E. Floating flame.	1. Blocked venting. 2. Insufficient combustion air. 3. Blocked heat exchanger. 4. Air leak into combustion chamber or flue collector.	1. Clean flue. Refer to "Installation". 2. Clean combustion air inlet openings in bottom panel, see "Installation". 3. Clean heat exchanger. 4. Determine cause and repair accordingly.
F. Gas Odor.	**1. Shut off gas supply immediately!** 2. Blocked heat exchanger/venting. 3. Drafts around heater. 4. Negative Pressure in building. 5. Blocked flue collector.	**1. Inspect all gas piping and repair.** 2. Clean heat exchanger/flue. 3. Eliminate drafts. Refer to "Installation". 4. See "Installation". 5. Clean flue collector.
G. Delayed ignition.	1. Excessive primary air. 2. Main burner ports clogged near pilot. 3. Pressure regulator set too low. 4. Pilot decreases in size when main burners come on. 5. Pilot flame too small. 6. Drafts around heater. 7. Improper venting.	1. Close air shutter. Refer to "Operation". 2. Clean main burner ports. 3. Reset manifold pressure. Refer to "Operation". 4. Supply piping is inadequately sized. Refer to "Installation". 5. Clean pilot orifice. Refer to "Operation". 6. Eliminate drafts. Refer to "Installation". 7. Refer to "Installation".
H. Failure to ignite.	1. Main gas off. 2. Lack of power at unit. 3. Thermostat not calling for heat. 4. Defective limit switch. 5. Improper thermostat or transformer wiring at gas valve. 6. Defective gas valve.	1. Open all manual gas valves. 2. Replace fuse or turn on power supply. 3. Turn up thermostat 4. Check limit switch with continuity tester. If open, replace limit switch. 5. Check wiring per diagrams. 6. Replace gas valve.

Power Vented Propellers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
	7. Defective thermostat	7. Check thermostat and replace if defective.
	8. Defective transformer.	8. Be sure 115 volts is supplied to the transformer primary, then check for 24 volts at secondary terminal before replacing.
	9. Loose wiring.	9. Check and tighten all wiring connections per diagrams.
	10. Defective ignition control.	10. Replace, if necessary. Also see W, X & Y symptoms.
J. Condensation of water vapor.	1. Improper venting.	1. Refer to "Installation, Venting".
K. Burner won't turn off.	1. Poor thermostat location.	1. Relocate thermostat away from drafts.
	2. Defective thermostat	2. Replace thermostat.
	3. Improper thermostat or transformer former wiring at gas valve.	3. Check wiring per diagrams.
	4. Short circuit.	4. Check operation at valve. Look for short (such as staples piercing thermostat wiring), and correct.
	5. Defective or sticking gas valve.	5. Replace gas valve.
	6. Excessive gas supply pressure.	6. Refer to "Operation".
L. Rapid burner cycling.	1. Loose electrical connections at gas valve or thermostat.	1. Tighten all electrical connections.
	2. Excessive thermostat heat anticipator.	2. Adjust thermostat heat anticipator for longer cycles. *Refer to* "Operation".
	3. Unit cycling on high limit.	3. Check for proper air supply across heat exchanger.
	4. Poor thermostat location.	4. Relocate thermostat. (Do not mount thermostat on unit).
	5. Draft on Pilot.	5. Eliminate drafts. Refer to Installation.
	6. Defective ignitor control (if applicable).	6. Replace ignitor.
	7. Unit cycling on high limit.	7. Check for proper air supply across heat exchanger.
	8. Defective high limit switch.	8. Jumper limit switch terminals 1 and 2. If burner operates normally, replace switch.
M. Noisy	1. Fan blades loose.	1. Replace or tighten.
	2. Fan blades dirty.	2. Clean fan wheel.
	3. Vibration isolators deteriorated.	3. Replace vibration isolators.
	4. Bearings are dry.	4. Oil bearings on fan motor. (Refer to label on motor).
N. Pilot will not light or will not stay lit.	1. Main gas off.	1. Open all manual gas valves.
	2. Pilot adjustment screw turned too low on combination/automatic main gas valve.	2. Increase size of pilot flame. Refer to "Operation".
	3. Air in gas line.	3. Purge air from gas supply.
	4. Incorrect lighting procedure.	4. Follow lighting instruction label adjacent to gas valve.
	5. Dirt in pilot orifice.	5. Remove pilot orifice. Clean with compressed air or solvent. (Do not ream).
	6. Extremely high or low gas pressure.	6. Refer to "Operation".
	7. Defective thermocouple.	7. Check thermocouple connection, and replace if defective.
	8. Drafts around unit.	8. Eliminate drafts. Refer to "Installation".
	9. Pilot valve not opening (faulty wiring).	9. Inspect and correct all wiring.
	10. No spark (faulty wiring).	10. Inspect and correct ignition system wiring. See symptoms W, X, & Y.
	11. Defective gas valve.	11. Replace.

Power Vented Propellers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
O. Fan will not run.	1. Loose wiring.	1. Check and tighten all wiring connections per diagrams. Thermostat wires tagged "W" and "G" must be connected together (unless special thermostats are used; if so, see thermostat wiring diagram). See electrical connections.
	2. Defective motor overload protector or defective motor.	2. Replace motor.
	3. Defective fan switch.	3. Check for 24V across H terminals on fan time delay switch. If 24V is present, jumper terminals numbered 1 and 3. If motor runs, the fan switch is defective and must be replaced. If 24V is not present, check wiring per diagrams.
P. Fan motor turns on and off while burner is operating.	1. Fan switch heater element improperly wired.	1. Be sure fan switch heater terminals are connected per diagrams.
	2. Defective fan switch.	2. Replace fan switch.
	3. Motor overload protector cycling on and off.	3. Check motor amps against motor name plate rating, check voltage, replace fan motor if defective.
	4. Motor not properly oiled.	4. Refer to label on motor.
Q. Fan motor will not stop.	1. Improperly wired fan control.	1. Check all wiring.
	2. Main burners not lighting while thermostat calls for heat.	2. Refer to H or N symptoms.
	3. Defective fan switch.	3. Replace fan switch.
R. Not enough heat.	1. Incorrect gas input.	1. Refer to "Operation".
	2. Heater undersized.	2. This is especially true when the heated space is enlarged. Have the heat loss calculated and compare to the heater output (80% of input). Your gas supplier or installer can furnish this information. If heater is under sized, add additional heaters.
	3. Thermostat malfunction.	3. Replace thermostat.
	4. Heater cycling on limit control.	4. There should be NO ducts attached to the front of this heater. Check air movement through heat exchanger. Check voltage to fan motor. Clean fan blade and heat exchanger and oil fan motor.
T. Too much heat.	1. Thermostat malfunction.	1. Replace thermostat.
	2. Heater runs continuously.	2. Check wiring per diagrams; Check operation at valve. Look for short (such as staples piercing thermostat wiring), and correct; Replace gas valve; Refer to "Operation".
U. Cold air is delivered on start up.	1. Fan switch heater element improperly wired.	1. Be sure fan switch heater terminals are connected per diagrams.
V. Cold air is delivered during heater operation.	1. Incorrect manifold pressure or input.	1. Refer to "Operation".
	2. Voltage to unit too high.	2. Check motor voltage with fan running. Should be 115 volts AC.
	3. Air through put too high.	3. Refer to "Operation".
W. NO Spark.	1. Thermostat not calling for heat.	1. Close thermostat contacts.
	2. No low voltage.	2. Check for 24V across 24V terminals of S8600.
	3. Spark gap closed or too wide.	3. Set gap to 0.1".
	4. Broken or cracked ceramic on spark electrode.	4. Replace pilot assembly.

Power Vented Propellers Trouble Shooting Guide

SYMPTOMS	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
X. Spark present but pilot does not light.	1. Loose S8600 connections. 2. Improper gas pressure. 3. Is spark in pilot gas stream? 4. No pilot gas — do not use match to test - presence of gas is easily detected by the odor.	1. Check all connections, term. PV feeds 24V to pilot valve. 2. Check pressure — pressure that is either too high or too low may cause a problem. 3. Spark should arc from electrode. 4. Check pilot line for kinks. Insure there are no drafts.
Y. Pilot lights — Main valve does not energize.	1. Loose S8600 connections. 2. Cracked or broken sensor ceramic. 3. Check sensor/spark lead for continuity. 4. Measure 24 volts from term. MV to term. MV/PV.	1. Check connections-term. MV feeds main valve. 2. Replace pilot assembly. 3. Replace if needed. 4. If present, replace main valve; if not, replace S8600 Igniter.
Z. Hi-Limit switch tripping.	1. Vertical run of flue is too short. 2. Unit is overfiring. 3. Air flow too low 4. Defective switch.	1. Lengthen vertical run of flue pipe (see venting). 2. Burner orifice may be too large: verify/replace if req'd. 3. Increase air flow; check fan size. Check for proper voltage. 4. Replace.
AA. Noisy power venter.	1. Power venter wheel loose. 2. Power venter wheel dirty. 3. Power venter wheel rubbing housing. 4. Bearings are dry.	1. Replace or tighten. 2. Clean power venter wheel. 3. Realign power venter wheel. 4. Oil bearings on power venter motor. (Refer to label on motor).
BB. Power venter will not run.	1. Loose wiring. 2. Defective motor overload protector or defective motor. 3. Defective power venter relay.	1. Check and tighten all wiring connections per diagrams. Thermostat wires tagged "W" and "G" must be connected together (unless special thermostats are used; if so, see thermostat wiring diagram). See electrical connections. 2. Replace motor. 3. Check for 24V across 1 and 3 terminals on fan relay. If 24V is present, jumper terminals numbered 2 and 4. If motor runs, the relay is defective and must be replaced.If 24V is not present, check wiring per diagrams.
CC. Power venter motor turns on and off while burner is operating.	1. Fan relay heater element improperly wired. 2. Defective venter relay switch. 3. Motor overload protector cycling on and off. 4. Motor not properly oiled.	1. Be sure venter relay heater terminals are connected per diagrams. 2. Replace venter relay. 3. Check motor amps against motor name plate rating, check voltage, replace power venter motor if defective. 4. Refer to label on motor.
DD. Power Venter motor will not stop.	1. Improperly wired venter relay. 2. Main burners not lighting while thermostat calls for heat. 3. Defective venter relay.	1. Check all wiring. 2. Refer to H & N symptoms. 3. Replace venter relay.

IDENTIFICATION OF PARTS
PROPELLER UNIT HEATERS

Figure 13
Propeller Parts

115/1/60 MOTOR
FAN GUARD
FAN BLADE
HARDWARE

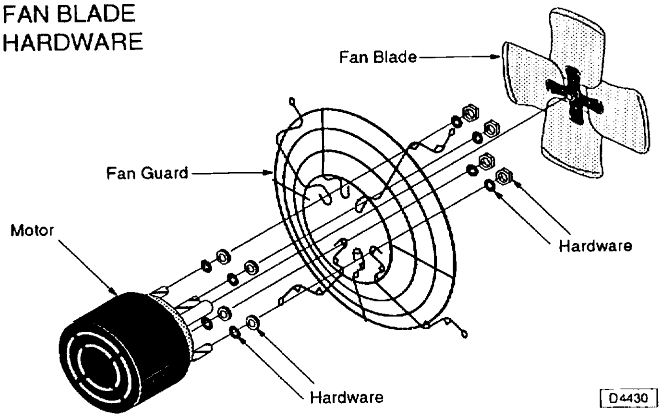


Figure 14
Components Parts
(Bottom View)

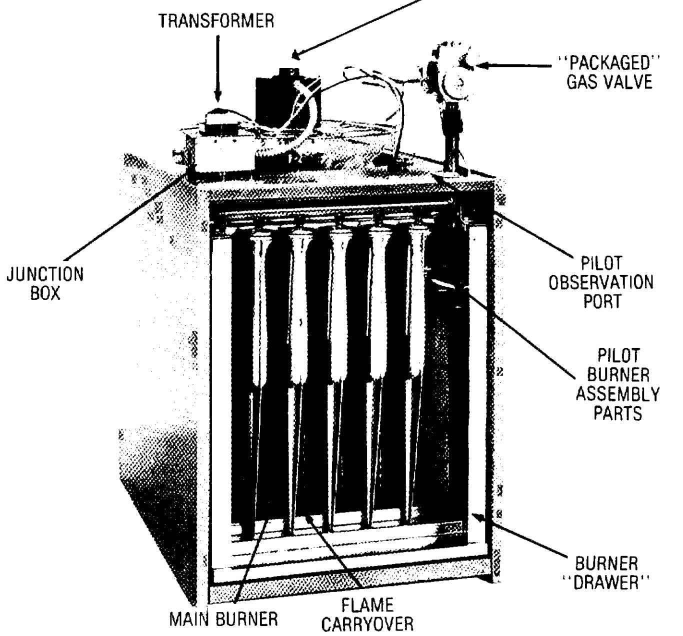


Figure 15
Internal Furnace Components

1. HEAT EXCHANGER
2. FLUE COLLECTOR
3. BURNER DRAWER

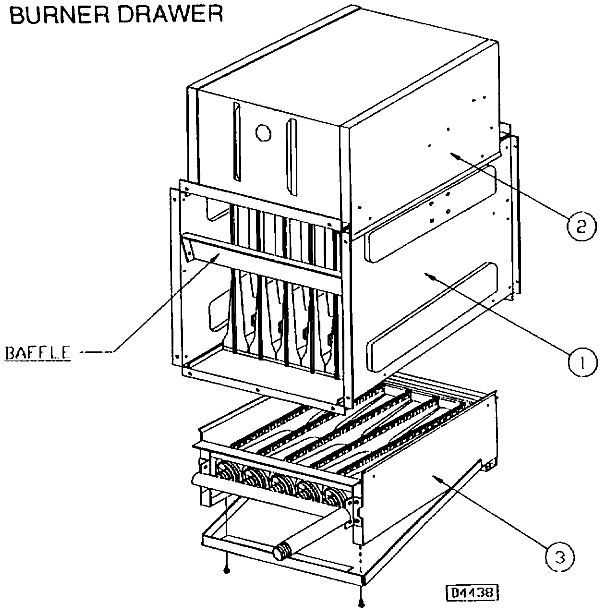


Figure 16
Burner Assy' Parts

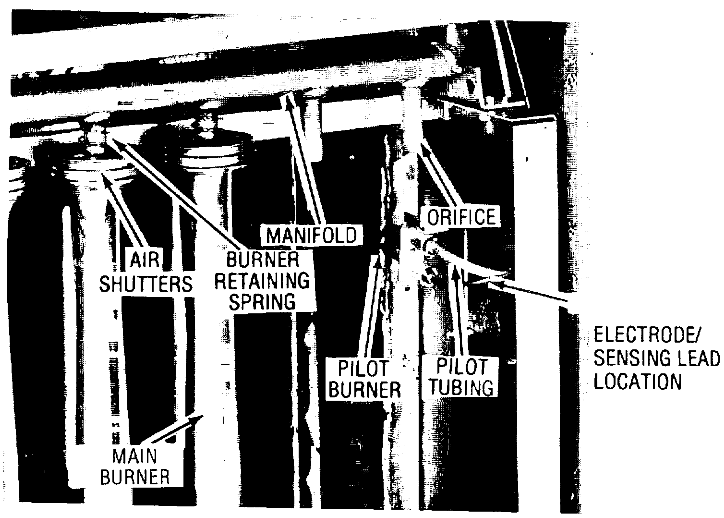
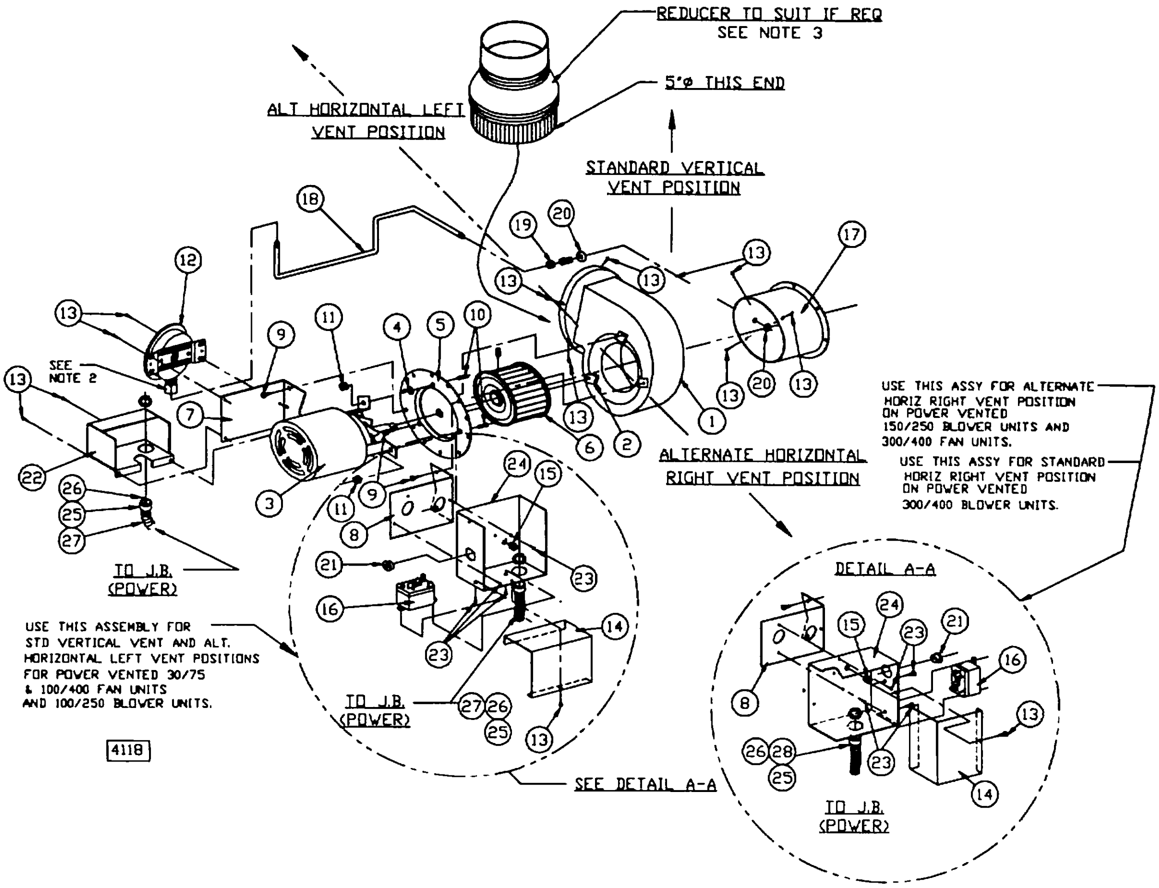


Figure 17 - Power Venter Assembly



REF. NO.	DESCRIPTION	REF. NO.	DESCRIPTION
1	Blower Housing Assembly	13	Drill Screw
2	Speed Nut	14	Junction Box Cover
3	Motor	15	Snap Bushing
4	Washer, Plain	16	Relay (Motor)
5	Plate Adapter	17	Draftor Stack Assembly
6	Blower Wheel*	18	Tubing (Aluminum) Formation
7	Mounting Bracket (Pressure Switch)	19	Male Connector
8	Mounting Bracket (Junction Box)	20	Locknut
9	Screw, S.T.	21	Hole Plug
10	Screw, Machine (L = 3/4")	22	Pressure Switch Cover
11	Nut, Keps (Ext. Lock Washer)	23	Drill Screw
12	Air Pressure Switch	24	Junction Box Base

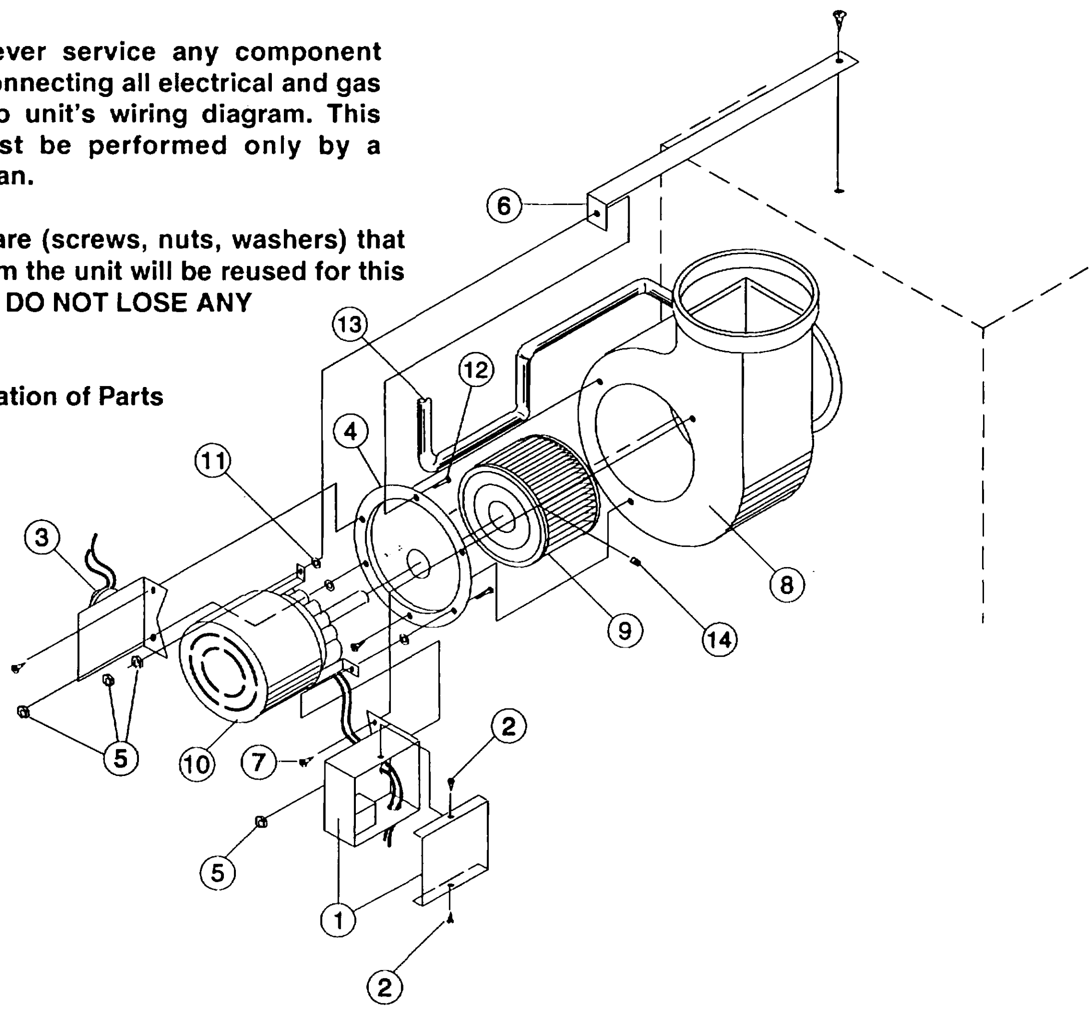
NOTES:
*1) For item No. 6, use counter-clockwise rotation.
2) DO NOT OVERTIGHTEN CELCON NUT! HAND TIGHTEN ONLY! DO NOT USE TOOLS!
Approximate 1/3 turn maximum or 8 inch pounds is sufficient from the point where the tube does not slip in or out.
3) Flue Sizes:
30/75 units: 4" dia. flue outlet Reducer required – To be supplied by installer.
100/175 units: 4" dia. flue outlet Reducer required – To be supplied by installer.
200/250 units: 5" dia. flue outlet (no adapter required).
300/400 units: 6" dia. flue outlet Increaser required – To be supplied by manufacturer.
Exception: "CGA" requires manufacturer to supply Canadian units with flue reducers or increasers, and vent caps.

INSTALLATION INSTRUCTIONS FOR FIELD REPLACEMENT OF POWER VENTER MOTOR

⚠WARNING **Never service any component without first disconnecting all electrical and gas supplies. Refer to unit's wiring diagram. This replacement must be performed only by a qualified technician.**

NOTICE: All hardware (screws, nuts, washers) that will be removed from the unit will be reused for this motor replacement. DO NOT LOSE ANY OF THESE PARTS!

Figure 18 - Identification of Parts



REF. NO.	DESCRIPTION
1	Relay Junction Box/Mounting Bracket Assembly
2	#8 Drill Screws (2 required)
3	Pressure/Mounting Bracket Assembly
4	Mounting Plate Adapter
5	Keps Nut w/External Tooth Lockwasher (4 required)
6	Motor Support Shipping Bracket
7	Phillips Head Screws (3 required)
8	Power Venter Blower Housing
9	Blower Wheel
10	Motor
11	Space Washers (3 required)
12	Machine Screw (3 required)
13	Sensing Tube
14	Set Screw

TOOLS AND PARTS NEEDED:

Wire Stripper and Crimper; Slotted Head and #2 Phillips Head Screwdriver; 3/8" Wrench; 1/8" Allen Wrench (long handle); marker; (1) 1/4" push on terminal for Wire

NOTES:

1) **Remove the cover from the Relay Junction Box (Item 1) by removing two screws (Item 2) top and bottom. Disconnect both wires from the motor lead ends. One is connected to terminal #4 on the venter relay, and the other is connected with a wire nut to a black wire.**
2) **Remove the sensing tube (Item 13) from the Pressure Switch/Mounting Bracket (Item 3) at motor end only. Separated Combustion Units: Remove both tubes at motor end only - note location.**
3) **Mark locations of the Relay Junction Box and Pressure Switch Mounting Brackets along with the Motor (Item 10) mounts on the Mounting Adapter Plate (Item 4) - using a marker.**
4) **Remove nut (Item 5) that secures the Motor Support Shipping Bracket (Item 6) to the Mounting Adapter Plate. Pull this bracket away from the Motor Mounting Adapter Plate.**
5) **Remove three phillips head screws (Item 7) on the Motor Mounting Adapter Plate. Remove the Motor/Blower Wheel/ Adapter Plate assembly from the Power Venter Blower Housing (Item 8).**
6) **Remove the Blower Wheel (Item 9) from the motor shaft - by removing the set screw (Item 14) using a 1/8" Allen Wrench.**
7) **Remove the three Motor Mounting Nuts (Item 5), Space Washers (Item 11), and Screws (Item 12). Do not loose these parts! Using caution - the motor will disengage from the Mounting Adapter Plate, along with the Relay Junction Box and Pressure Switch Mounting Brackets will also disengage.**
8) **Reverse Order to install the new Power Venter Motor.**
9) **TEST FIRE THE UNIT FOR A FEW CYCLES, MAKING SURE THAT THE UNIT IS OPERATING SATISFACTORY.**

HOW TO ORDER REPLACEMENT PARTS

Please send the following information to your local representative; If further assistance is needed, contact the manufacturer's customer service department.
- Model number
- Serial Number (if any)
- Part description and Number as shown in the Replacement Parts Catalog.

LIMITED WARRANTY

POWER VENTED PROPELLER UNIT HEATERS

1. The "Manufacturer" warrants to the original owner at original installation site that the above model Gas-Fired Heater ("the Product") will be free from defects in material or workmanship for one (1) year from the date of shipment from the factory, or one and one-half ($1^1/_2$) years from the date of manufacture, whichever occurs first. The Manufacturer further warrants that the complete heat exchanger, draft hood/ flue collector assembly, and burners will be free from defects in material or workmanship for a period of ten (10) years from date of manufacture. If upon examination by the Manufacturer the Product is shown to have a defect in material or workmanship during the warranty period, the Manufacturer will repair or replace, at its option, that part of the Product which is shown to be defective.

2. This limited warranty does not apply:

   (a) if the Product has been subjected to misuse or neglect, has been accidentally or intentionally damaged, has not been installed, maintained or operated in accordance with the furnished written instructions, or has been altered or modified in any way by any unauthorized person.
   (b) to any expenses, including labor or material, incurred during removal or reinstallation of the Product.
   (c) to any damage due to corrosion by chemicals, including halogenated hydrocarbons, precipitated in the air.
   (d) to any workmanship of the installer of the Product.

3. This limited warranty is conditional upon:
   (a) advising the installing contractor, who will in turn notify the distributor or manufacturer.
   (b) shipment to the Manufacturer of that part of the Product thought to be defective. Goods can only be returned with prior written approval of the Manufacturer. All returns must be freight prepaid.
   (c) determination in the reasonable opinion of the Manufacturer that there exists a defect in material or workmanship.

4. Repair or replacement of any part under this Limited Warranty shall not *extend the* duration of the warranty with respect to such repaired or replaced part beyond the stated warranty period.

5. **THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ALL SUCH OTHER WARRANTIES, INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS LIMITED WARRANTY. IN NO EVENT SHALL THE MANUFACTURER BE LIABLE IN ANY WAY FOR ANY CONSEQUENTIAL, SPECIAL, OR INCIDENTAL DAMAGES OF ANY NATURE WHATSOEVER, OR FOR ANY AMOUNTS IN EXCESS OF THE SELLING PRICE OF THE PRODUCT OR ANY PARTS THEREOF FOUND TO BE DEFECTIVE. THIS LIMITED WARRANTY GIVES THE ORIGINAL OWNER OF THE PRODUCT SPECIFIC LEGAL RIGHTS. YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY BY EACH JURISDICTION.**

In the interest of product improvement, we reserve the right to make changes without notice.

GAS EQUIPMENT START-UP

Customer ______________________________ **Job Name & Number** ____________________

PRE-INSPECTION INFORMATION
With power and gas off.

Type of Equip: Unit Heater Duct Furnace Indoor Rooftop

Serial Number ____________________ Model Number ____________________

Name Plate Voltage: __________ Name Plate Amperage: __________

Type of Gas: Natural LP Tank Capacity _____ lbs. Rating: _____ BTU @ ____ °F
_____ kg _____ kw @ ____ °C

- ❐ Are all panels, doors, vent caps in place?
- ❐ Has the unit suffered any external damage? Damage ____________________
- ❐ Does the gas piping and electric wiring appear to be installed in a professional manner?
- ❐ Has the gas and electric been inspected by the local authority having jurisdiction?
- ❐ Is the gas supply properly sized for the equipment?
- ❐ Were the installation instructions followed when the equipment was installed?
- ❐ Have all field installed controls been installed?
- ❐ Do you understand all the controls on this equipment? **If not, contact your wholesaler or rep. (DO NOT START this equipment unless you fully understand the controls.)**

GENERAL
With power and gas off.

- ❐ Make certain all packing has been removed.
- ❐ Tighten all electrical terminals and connections.
- ❐ Check damper linkages for tightness.
- ❐ Check all fans & blowers for free movement.
- ❐ Check all controls for proper settings.
- ❐ Check all set screws on blowers and bearings.
- ❐ Check belt tightness.

BLOWER
With power on and gas off.

- ❐ Check voltage L1 _____ L2 _____ L3 _____
- ❐ Check rotation of main blower.
- ❐ Check motor amps L1 _____ L2 _____ L3 _____
- ❐ Blower RPM __________
- ❐ Check air filters. *(Record quantity & size.)*

GAS HEATING
With power and gas on.

- ❐ Inlet gas pressure. ____ in. W.C. or ____ kPa
- ❐ Pilot & main burner ignition.
- ❐ Manifold gas pressure. ____ in. W.C. or ____ kPa
- ❐ Cycle on HIGH LIMIT.
- ❐ Cycle firestat and/or freezestat.
- ❐ Check electronic modulation. Set at: __________
- ❐ Check mechanical modulation. Set at: __________
- ❐ Cycle and check all other controls not listed.
- ❐ Check operation of remote panel.
- ❐ Entering air temp. _____ °F or _____ °C
- ❐ Discharge air temp. (high fire) _____ °F. or _____ °C
- ❐ External static pressure ________ in. W.C.
- ❐ Cycle by thermostat or operating control.

Remarks: ____

____

____

acme
ENGINEERING PROD.

OPERATION AND MAINTENANCE MANUAL FOR ACME MGV-CEL4 SERIES MULTIGAS DETECTION AND CONTROL SYSTEM

In the U.S.A.
ACME ENGINEERING PROD. INC.
PMB #10, 2330 State Route 11
Mooers, NY 12958
Tel : (518) 236–5659
Fax: (518) 236–6941

In Canada
ACME ENGINEERING PROD. LTD.
5706 Royalmount Avenue,
Montreal, QC H4P 1K5
Tel : (514) 342–5656
Fax: (514) 342–3131

Web Site : www.acmeprod.com
E-mail : info@acmeprod.com

CEL4 GENERAL SPECIFICATIONS.

- Pollution Degree: 2.
- Installation Category: II
- Maximum Altitude: 2000m.
- Maximum Humidity: 80% up to 88° F (31° C).
- Operating Temperature Range: 40° to 105° F (5 to 40 ° C).
- The CEL4 is manufactured for indoor use.
- Electrical Supply: 120V AC, 50/60Hz, 5A.
- The CEL4 is to be connected to a dedicated power source with voltage fluctuations not exceeding ±10% of the nominal supply voltage.

OPERATING INSTRUCTIONS FOR ACME CEL4 SERIES MULTIGAS DETECTION AND CONTROL SYSTEM.

1. DESCRIPTION OF EQUIPMENT

The ACME CEL4 series is a microprocessor-based multigas monitoring and control system that can be used with a wide variety of ACME toxic, combustible & oxygen gas sensors. The system can supervise up to four independent channels assigned to sensors of the same gas type or a combination of gases.

The sensors are addressable and are field-connected to the Control Panel on a 4-conductor "Daisy Chain". Via a standard RS-485 interface, the Control Panel interrogates each sensor on the line, when the sensor recognizes its address, it transmits its data to the Control Panel.

The CEL4 series offers multiple levels (Low, High & Alarm) ON-OFF outputs with visual status indicators as follows :

- One SPDT relay contact per channel at the Low Level.
- One SPDT relay contact common to all channels at the High Level.
- One SPDT relay contact common to all channels at the Alarm Level.

Relay contacts operated at these levels control the ventilation of the building based on demand, thus substantially saving energy through intermittent operation of ventilation equipment. Local and/or remote alarm devices can also be activated by the Alarm Level contacts.

Please refer to the shop drawing of your system for customized Relay Output Logic according to specifications.

For single-gas detection systems : additionally a 4–20mA analog signal based on the average or worst condition of the four channels is provided.

The LCD provides a digital read-out of gas concentrations and ON-OFF output level status for each channel along with data communication failure conditions.

The CEL4 series comes standard with a 24V AC 50/60HZ input power. However systems with 120V AC or 240V AC input power options are also available. An optional Battery Backup package can also be integrated.

2. SENSOR ENCLOSURE INSTALLATION

- Remove top cover (4 screws).
- Remove face plate by sliding upwards.
- Remove printed circuit board/back plate by sliding upwards.
- Use the 2 key holes to mount the enclosure on wall or column.
- Re-assemble.

3. CONNECTIONS

Connect system as shown on drawings.
Always use color-coded wires.

Important : The functional integrity of the system depends on its being correctly *wired from* beginning to end. Please pay special attention to maintain consistency in the order in which the 4 wire interconnections between the control panel and the remote sensors stations are made, (wires 1-RED, 2-BLACK, 3-ORANGE & 4-YELLOW MUST be connected to terminals 1, 2, 3 & 4 respectively at the control panel and sensors.

If you must, re-check your wiring before power-up.

Wires 1 & 2 : 24V AC power from control panel to remote sensor stations.
Wires 3 & 4 : Signal wires, these connections are polarized and should never be crossed.

4. POWER-UP

Connect Power to the system. Immediately upon power-up, following a series of beeps and 2 consecutive flashes of all the status indicator LEDs. The LCD display on the panel front will start to show the channel numbers and their corresponding gas readings. LCD also displays whether LOW, HIGH and ALARM levels have been reached at each channel. This process shall continue indefinitely under normal operation. The LCD will show a group of four channels at a time.

IMPORTANT :

VOC SENSORS ARE DESIGNED FOR A 5 YEAR LIFE SPAN.
REPLACE THEM ONCE THIS PERIOD HAS LAPSED.
REPLACEMENT DUE DATE : ______________________________
CONTACT FACTORY TO ORDER.

Tel : (518) 236–5659
Fax: (518) 236–6941

VOLATILE ORGANIC COMPOUND (TOLUENE) CALIBRATION

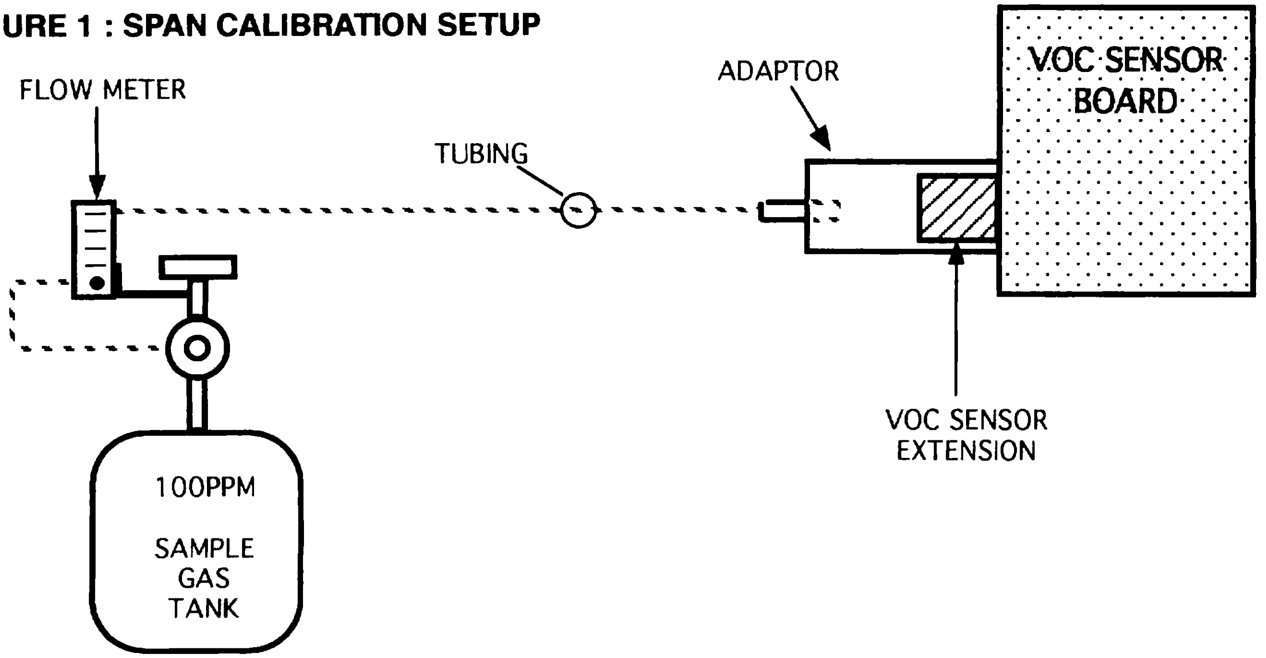
te: The Acme VOC Volatile Organic Compound Sensor/Transmitters are shipped factory calibrated and under normal conditions do not require any field recalibration. Therefore, the procedure described below should be used only for annual verification.

Refer to "Figure 2 : VOC sensor circuit board & test points" on the next page. Before injecting any calibration gas to the sensor make sure that the unit has had at least 72 hours of warm-up time after initial power-up. If you must make any adjustments, make them only after the warm-up period. To calibrate the unit, connect a voltmeter across test points TP4 (+) & TP5 (-) and set to V DC.

A) Make sure that there is no VOC gas present in the vicinity of the sensor. If you must, inject "zero" air in to the sensor to bring about this condition. Air flow should be set at 250 ml/min (0.5 SCFH) and kept for up to 12 minutes. At "zero" VOC condition reading across test points TP4 (+) and TP5 (-) should stabilize around 0.00v ± 0.02V DC. If not, adjust potentiometer P4 to obtain 0.00V (to decrease voltage turn CCW, to increase turn CW).

B) Keep voltmeter connected across TP4 (+) & TP5 (-). Open valve on 100ppm VOC (Toluene 100 PPM) calibration kit (TKR-100), adjust air flow to 250 ml/min (0.5 SCFH) and inject gas into sensor. Wait up to 12 minutes while keeping an eye on the flowmeter to maintain flow until voltage reading stabilizes around 2.00V ± 0.20V DC. If not, adjust span potentiometer P1 to obtain 2.00V (to decrease voltage turn CCW, to increase turn CW).

FIGURE 1 : SPAN CALIBRATION SETUP



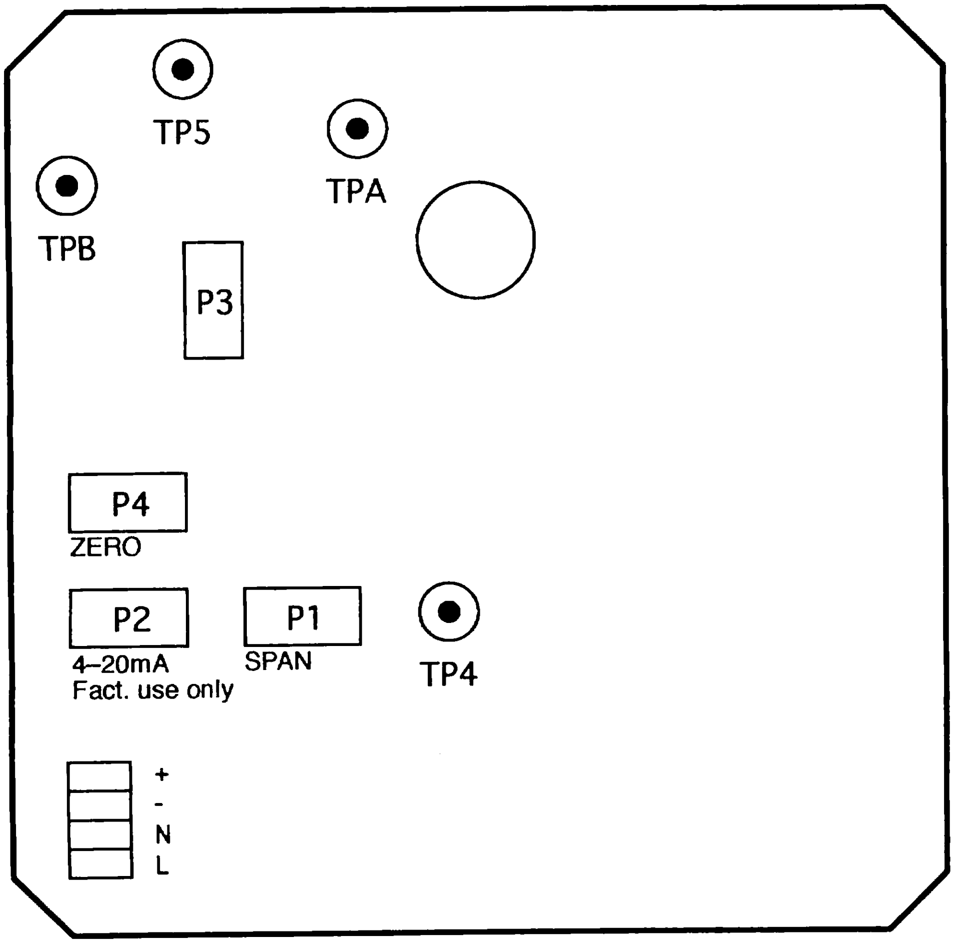


**FIGURE 2 :
VOC SENSOR
CIRCUIT BOARD
& TEST POINTS**

IMPORTANT :

CO SENSORS ARE DESIGNED FOR A 2 YEAR LIFE SPAN.
REPLACE THEM ONCE THIS PERIOD HAS LAPSED.
REPLACEMENT DUE DATE : ______________________________
CONTACT FACTORY TO ORDER.

Tel : (518) 236–5659
Fax: (518) 236–6941

CARBON MONOXIDE CALIBRATION

The Electrochemical CO sensor is calibrated at the factory prior to shipment. We recommend that the CO sensor calibration be checked once approximately after one year of operation following the procedure described below. For reference, see Figure 3: "CO SENSOR CIRCUIT BOARD".

Calibration Procedure

Required tools and equipment : Digital multimeter, TKR-100 CO calibration tank (100 PPM) c/w tubing & flowmeter assembly, trimming screwdriver.

Step 1: Remove top cover from sensor enclosure, slide face plate upwards to take off, you now have hands-free access to the printed circuit board. See Figure 1: "COVER ARRANGEMENT".

Step 2: Set multimeter to DC Volts on 20V scale and connect it across Test Points "TP1" (+) & "TP2" (-) on the sensor board. With no CO present, you should read 0 Volts.

Step 3: Open valve slowly on TKR-100 calibration tank until flow reaches to 1 CFH on the flowmeter, now slide the adaptor onto the sensor, see Figure 2: "SPAN CALIBRATION SET-UP". Keep an eye on the flowmeter, readjust to 1CFH if necessary.

Step 4: Observe the voltage reading on the voltmeter with the 100PPM CO gas flowing into the sensor, the reading should rise and after 1 minute settle around 5.00 Volts. If it does not, adjust potentiometer P1 until it reaches 5.00 Volts. To increase the voltage, turn P1 CCW, to decrease turn CW.

Step 5: End of calibration, remove adaptor from sensor nozzle, close tank valve, disconnect multimeter form unit & re-assemble the enclosure.

FIGURE 3 : COVER ARRANGEMENT

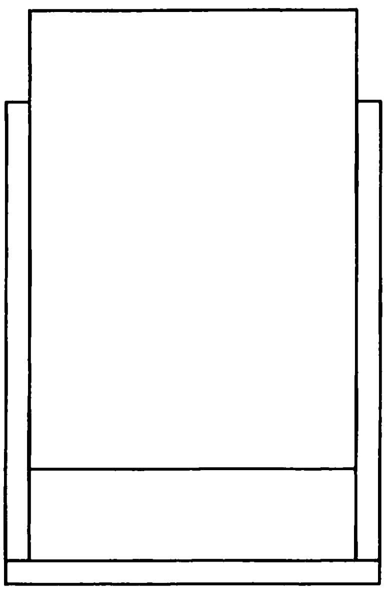


FIGURE 4 : SPAN CALIBRATION SETUP

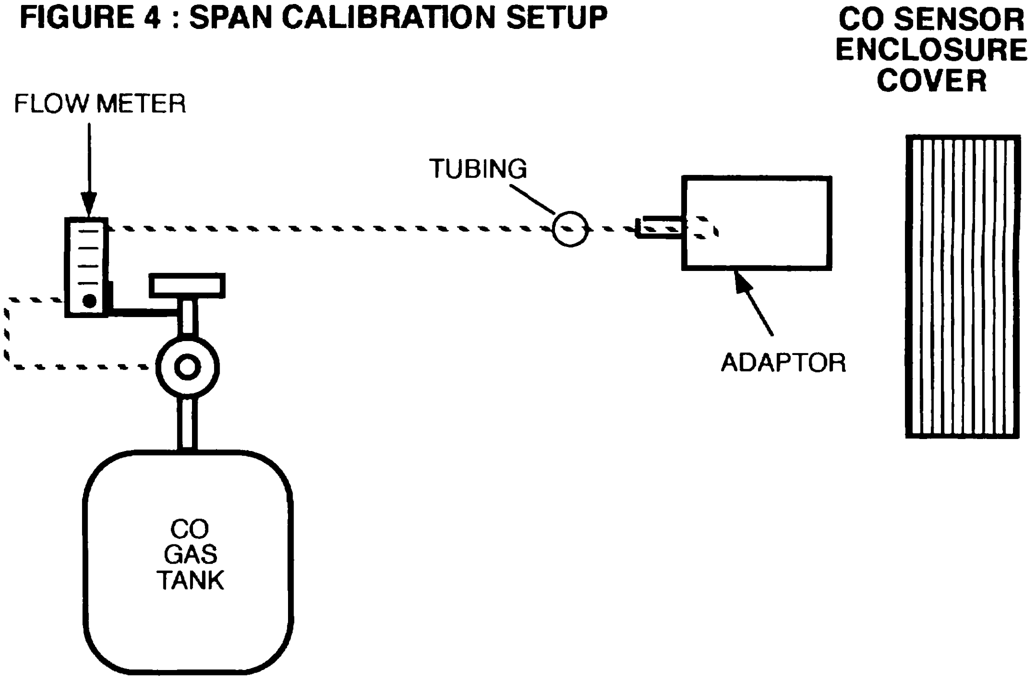
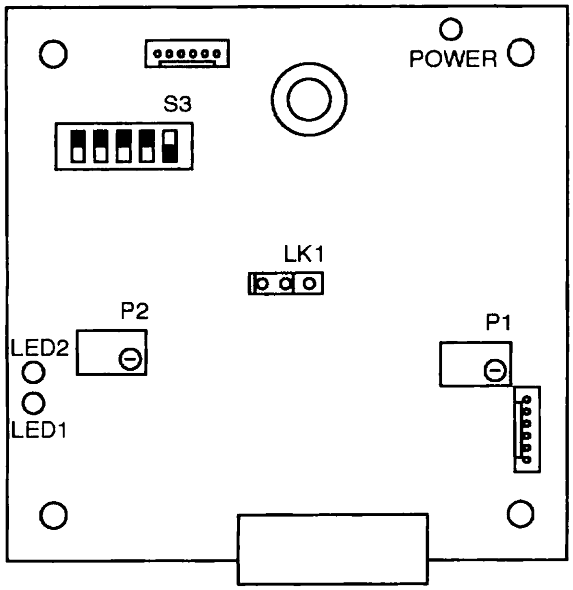


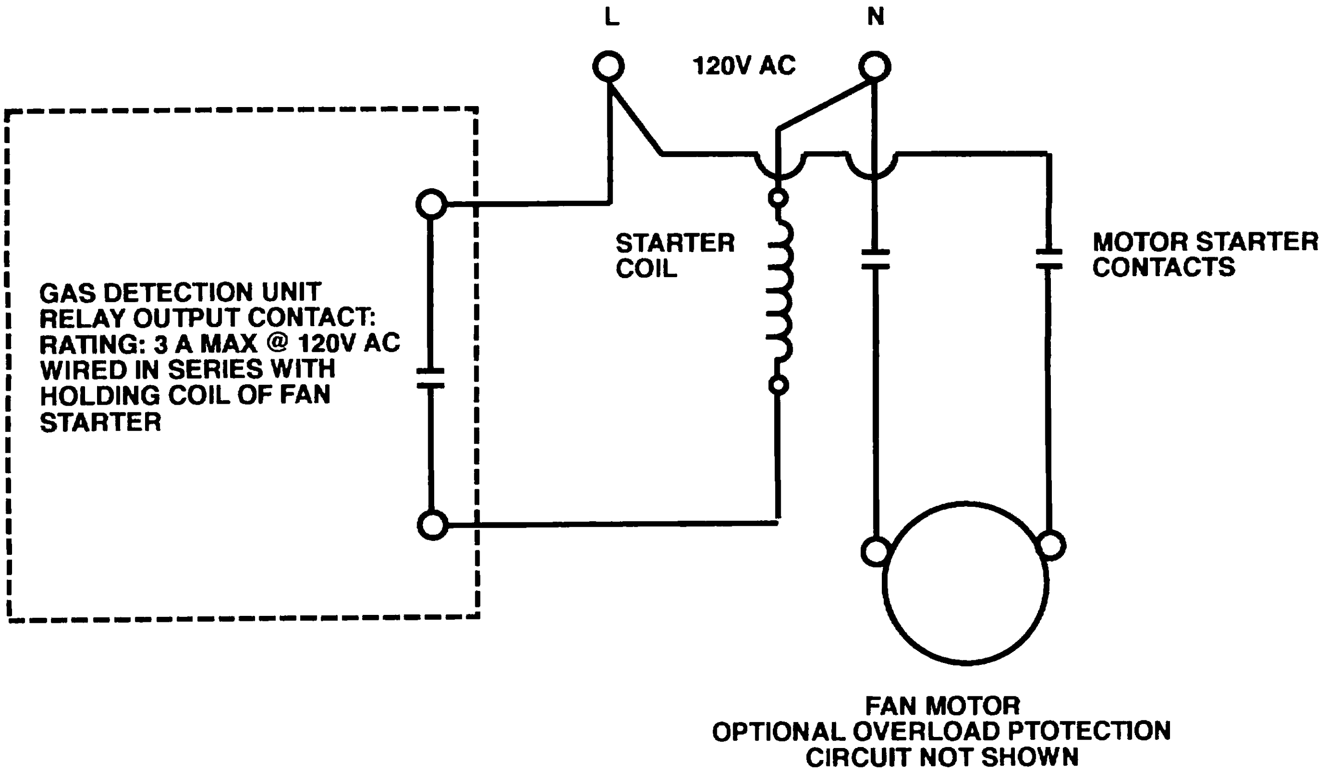
FIGURE 5 : CO SENSOR CIRCUIT BOARD



EXAMPLE OF FAN CONNECTION TO CO UNIT OUTPUT

FOR SINGLE SPEED MOTOR ONLY

FROM POWER CIRCUIT TO FAN MOTOR STARTER *COIL*
FOR SINGLE PHASE 120V AC FAN MOTORS

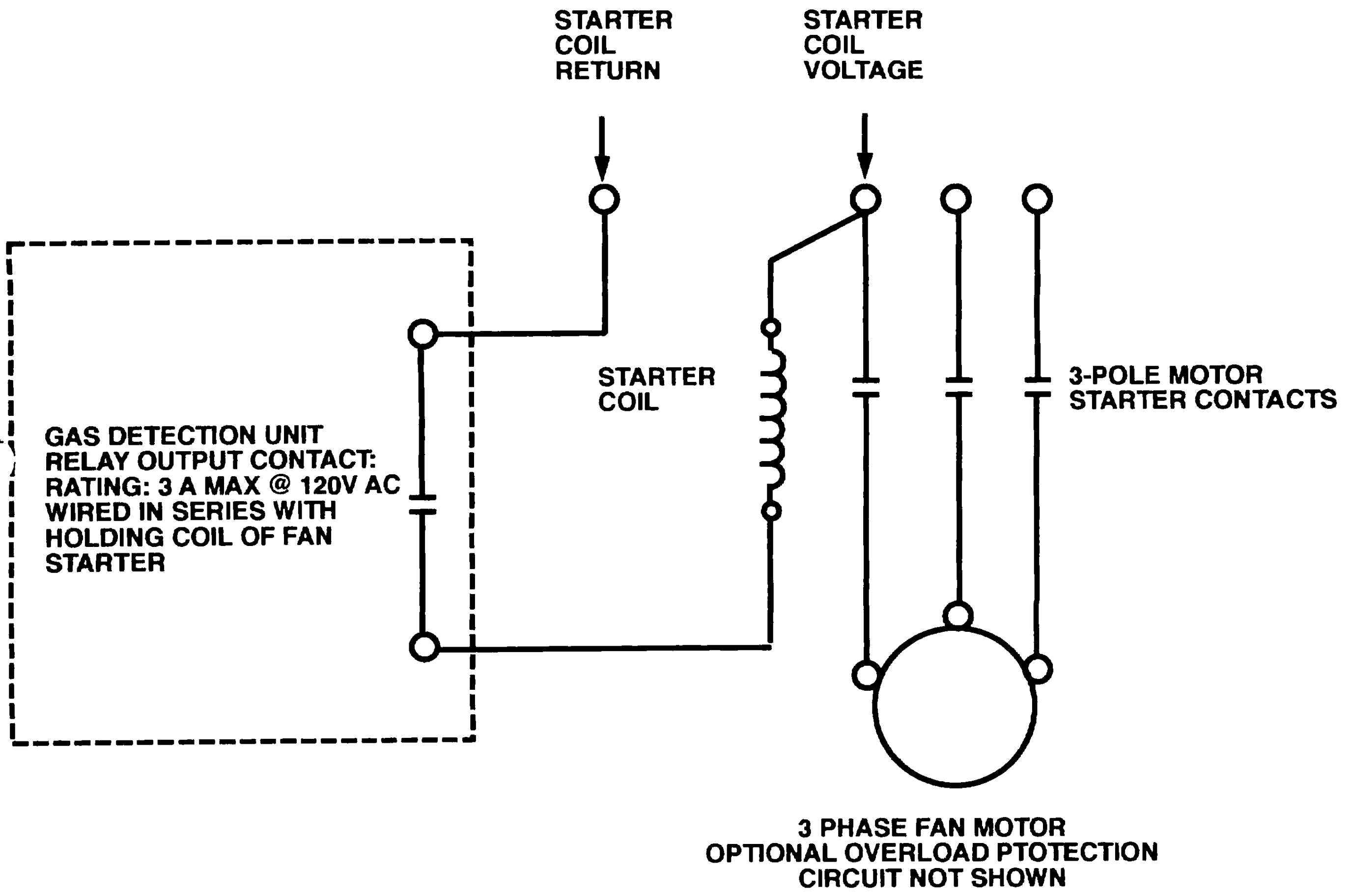


<u>NOTE:</u> **RELAY CONTACT SUPPLY CIRCUIT MUST BE FUSED AT 5A @ 120V, 2A @ 240V**

EXAMPLE OF FAN CONNECTION TO CO UNIT OUTPUT

FOR SINGLE SPEED MOTOR ONLY

FROM POWER CIRCUIT TO FAN MOTOR STARTER COIL FOR 3 PHASE FAN MOTORS



NOTE: RELAY CONTACT SUPPLY CIRCUIT MUST BE FUSED AT 5A @ 120V, 2A @ 240V

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OPERATION AND MAINTENANCE MANUAL FOR ACME MGV-CEL SERIES MULTIGAS DETECTION & CONTROL SYSTEM

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E-mail : info@acmeprod.com

CEL GENERAL SPECIFICATIONS.

- Pollution Degree: 2.
- Installation Category: II
- Maximum Altitude: 2000m.
- Maximum Humidity: 80% up to 88° F (31° C).
- Operating Temperature Range: 40° to 105° F (5 to 40 ° C).
- The CEL is manufactured for indoor use.
- Electrical Supply: 120V AC, 50/60Hz, 5A.
- The CEL is to be connected to a dedicated power source with voltage fluctuations not exceeding ±10% of the nominal supply voltage.

OPERATING INSTRUCTIONS FOR ACME CEL SERIES MULTIGAS DETECTION AND CONTROL SYSTEM.

1. DESCRIPTION OF EQUIPMENT

The ACME CEL series is a microprocessor-based multigas monitoring and control system for up to 32 channels that can be used with a wide variety of ACME toxic, combustible & oxygen gas sensors.

Designed primarily to protect human beings from potential environmental hazards in enclosed areas, this system can also find applications in several industries such as manufacturing, chemical processing, greenhouses, storage facilities, etc.

The CEL series offers multiple ON-OFF levels (LOW, HIGH & ALARM) with visual status indicators. Discrete relay contacts are available to operate on each ON-OFF level to control the ventilation of the building based on demand, thus substantially saving energy through intermittent operation of ventilation equipment. Local and/or remote alarm devices can also be activated by the ON-OFF relays.

The versatility of the system allows the user to customize the system parameters (ON-OFF level setpoints, time delays, hysteresis, scan rate, sensor type and range, etc.) via a password-protected retractable keypad and a 4-line alphanumeric Liquid Crystal Display. The menu-driven options appear in plain english on the LCD display.

The LCD provides a digital read-out of gas concentrations and ON-OFF output level status for each channel along with data communication failure conditions.

The CEL series comes standard with a 120V AC 50/60HZ input power. However systems with 24V AC or 240V AC input power options are also available. An optional Battery Backup package can also be integrated.

The interconnections between the Control Panel and the remote sensors are made in two basic configurations :

A) 4–20mA configuration.
In this configuration, 4–20mA Sensor/Transmitters are individually connected to their analog input terminals of their respective channel at the Control Panel using 2 dedicated pairs of wires (2 twisted pairs are recommended for better noise immunity).

B) RS-485 "Daisy-Chain" configuration.
This configuration allows up to 8 addressable sensors to be connected in a daisy-chain on a single four-conductor cable, substantially reducing wiring costs & labor. The system interrogates each sensor on the line. When the sensor recognizes its address, it transmits its data to the Control Panel.

2. SENSOR ENCLOSURE INSTALLATION

- Remove top cover (4 screws).
- Remove face plate by sliding upwards.
- Remove printed circuit board/back plate by sliding upwards.
- Use the 2 key holes to mount the enclosure on wall or column.
- Re-assemble.

3. CONNECTIONS

Connect system as shown on drawings.
Always use color-coded wires.

Important : The functional integrity of the system depends on its being correctly wired from beginning to end. Please pay special attention to maintain consistency in the order in which the 4 wire interconnections between the control panel and the remote sensors stations are made, (wires 1-RED, 2-BLACK, 3-ORANGE & 4-YELLOW MUST be connected to terminals 1, 2, 3 & 4 respectively at the control panel and sensors.

If you must, re-check your wiring before power-up.

Wires 1 & 2 : 24V AC power from control panel to remote sensor stations.
Wires 3 & 4 : Signal wires, these connections are polarized and should never be crossed.

4. POWER-UP

Connect Power to the system. Immediately upon power-up, following a series of beeps and 2 consecutive flashes of all the status indicator LEDs. The LCD display on the panel front will start to show the channel numbers and their corresponding gas readings. LCD also displays whether LOW, HIGH and ALARM levels have been reached at each channel. This process shall continue indefinitely under normal operation. The LCD will show a group of four channels at a time.

5. SYSTEM PARAMETERS

The system parameters have been stored in the memory at the factory according to the job specifications. In order to modify these parameters, after connecting the portable keypad you must do the folowing :

- To start, press "pause" then press "menu".
- To navigate through the menu, use the arrows.
- The system will display on the LCD : User – Factory – Misc – Default.
- Misc : code is "1111" + "pause" to confirm, this will give you the option to change the user code, change the time delay setting, change the hysteresis (%) and the scan rate.
- User : code is "1111" + "pause" to confirm, this will give you the Misc options and will also give you the option to change the number of channels and perform channel setup (level settings, type of gas and range of sensor).

For more details, see "Configuring gas monitor system parameters" following this section.

REPLACEMENT OF VOC SENSORS

IMPORTANT :

VOC SENSORS ARE DESIGNED FOR A 5 YEAR LIFE SPAN.
REPLACE THEM ONCE THIS PERIOD HAS LAPSED.
REPLACEMENT DUE DATE : ______________________________
CONTACT FACTORY TO ORDER.

Tel : (518) 236–5659
Fax: (518) 236–6941

VOLATILE ORGANIC COMPOUND (TOLUENE) CALIBRATION

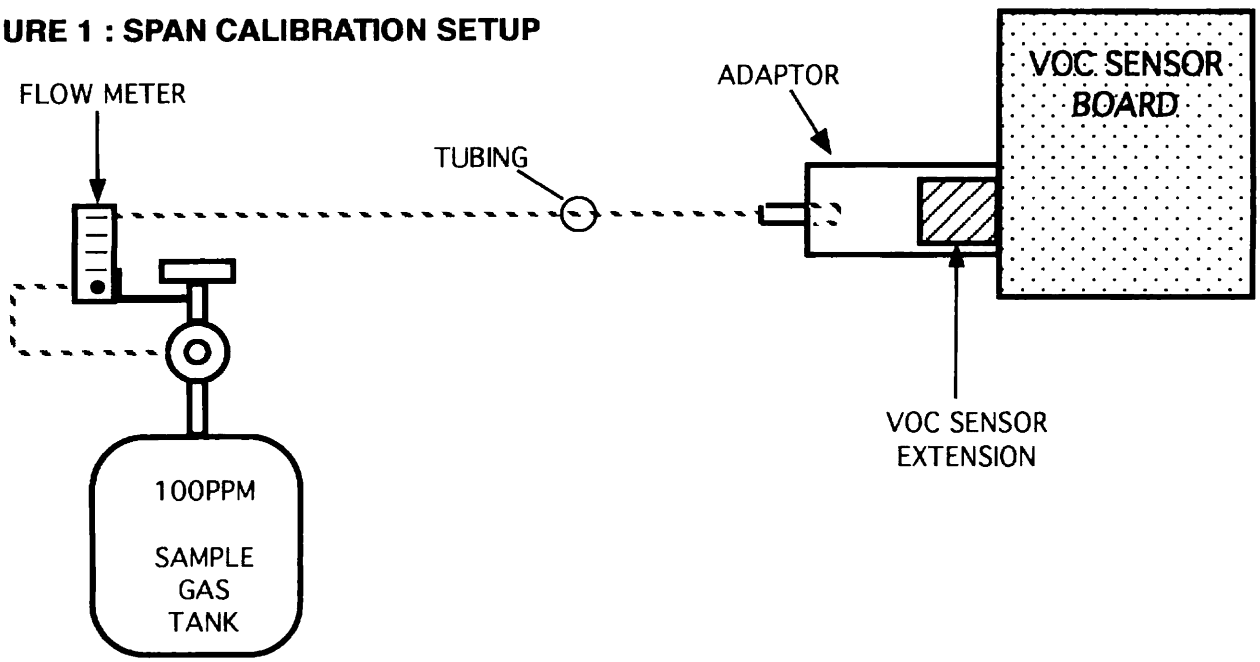
te: The Acme VOC Volatile Organic Compound Sensor/Transmitters are shipped factory calibrated and under normal conditions do not require any field recalibration. Therefore, the procedure described below should be used only for annual verification.

Refer to "Figure 2 : VOC sensor circuit board & test points" on the next page. Before injecting any calibration gas to the sensor make sure that the unit has had at least 72 hours of warm-up time after initial power-up. If you must make any adjustments, make them only after the warm-up period.
To calibrate the unit, connect a voltmeter across test points TP4 (+) & TP5 (-) and set to V DC.

A) Make sure that there is no VOC gas present in the vicinity of the sensor. If you must, inject "zero" air in to the sensor to bring about this condition. Air flow should be set at 250 ml/min (0.5 SCFH) and kept for up to 12 minutes. At "zero" VOC condition reading across test points TP4 (+) and TP5 (-) should stabilize around 0.00v ± 0.02V DC. If not, adjust potentiometer P4 to obtain 0.00V (to decrease voltage turn CCW, to increase turn CW).

B) Keep voltmeter connected across TP4 (+) & TP5 (-). Open valve on 100ppm VOC (Toluene 100 PPM) calibration kit (TKR-100), adjust air flow to 250 ml/min (0.5 SCFH) and inject gas into sensor. Wait up to 12 minutes while keeping an eye on the flowmeter to maintain flow until voltage reading stabilizes around 2.00V ± 0.20V DC. If not, adjust span potentiometer P1 to obtain 2.00V (to decrease voltage turn CCW, to increase turn CW).

FIGURE 1 : SPAN CALIBRATION SETUP



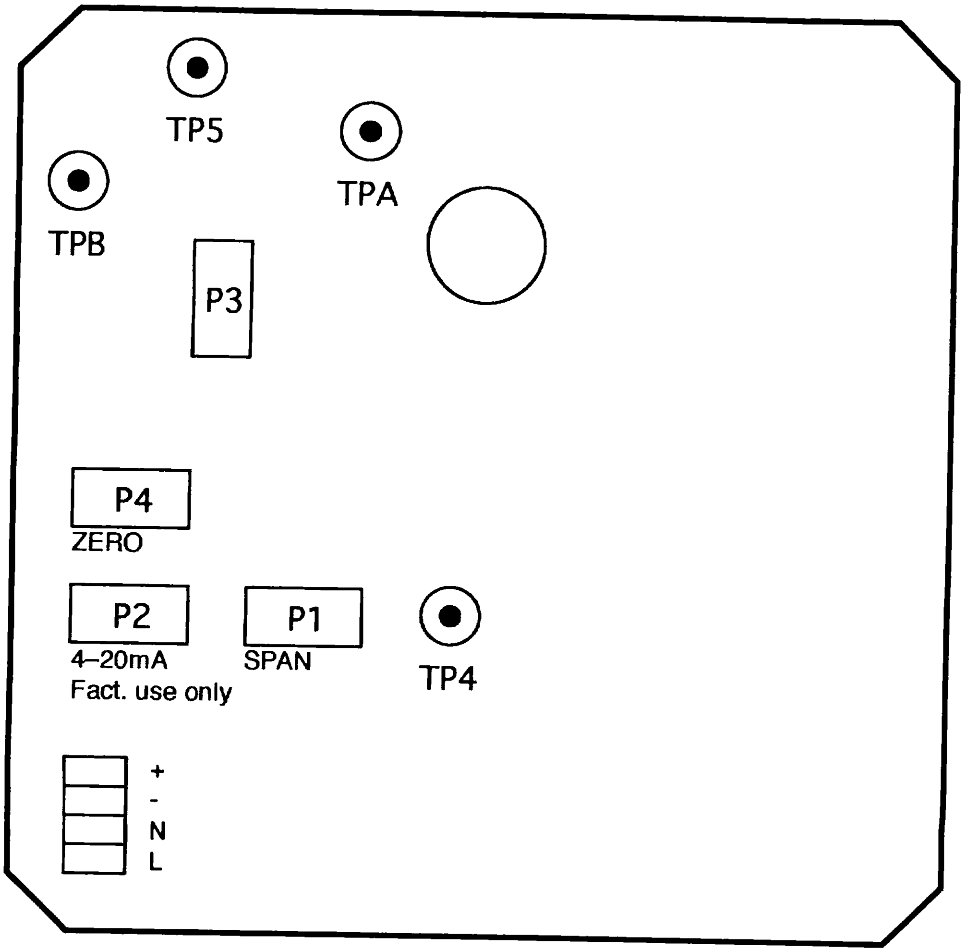


FIGURE 2 : VOC SENSOR CIRCUIT BOARD & TEST POINTS

REPLACEMENT OF CO SENSORS

IMPORTANT :

**CO SENSORS ARE DESIGNED FOR A 2 YEAR LIFE SPAN.
REPLACE THEM ONCE THIS PERIOD HAS LAPSED.
REPLACEMENT DUE DATE : ______________________
CONTACT FACTORY TO ORDER.**

CARBON MONOXIDE CALIBRATION

The Electrochemical CO sensor is calibrated at the factory prior to shipment. We recommend that the CO sensor calibration be checked once approximately after one year of operation following the procedure described below. For reference, see Figure 3: "CO SENSOR CIRCUIT BOARD".

Calibration Procedure

Required tools and equipment : Digital multimeter, TKR-100 CO calibration tank (100 PPM) c/w tubing & flowmeter assembly, trimming screwdriver.

Step 1: Remove top cover from sensor enclosure, slide face plate upwards to take off, you now have hands-free access to the printed circuit board. See Figure 1: "COVER ARRANGEMENT".

Step 2: Set multimeter to DC Volts on 20V scale and connect it across Test Points "TP1" (+) & "TP2" (-) on the sensor board. With no CO present, you should read 0 Volts.

Step 3: Open valve slowly on TKR-100 calibration tank until flow reaches to 1 CFH on the flowmeter, now slide the adaptor onto the sensor, see Figure 2: "SPAN CALIBRATION SET-UP". Keep an eye on the flowmeter, readjust to 1CFH if necessary.

Step 4: Observe the voltage reading on the voltmeter with the 100PPM CO gas flowing into the sensor, the reading should rise and after 1 minute settle around 5.00 Volts. If it does not, adjust potentiometer P1 until it reaches 5.00 Volts. To increase the voltage, turn P1 CCW, to decrease turn CW.

Step 5: End of calibration, remove adaptor from sensor nozzle, close tank valve, disconnect multimeter form unit & re-assemble the enclosure.

FIGURE 1 : COVER ARRANGEMENT

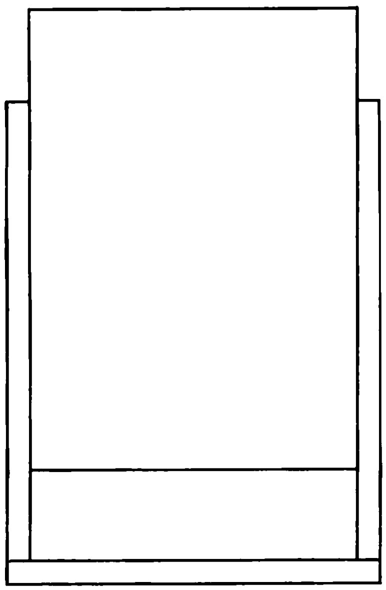


FIGURE 2 : SPAN CALIBRATION SETUP

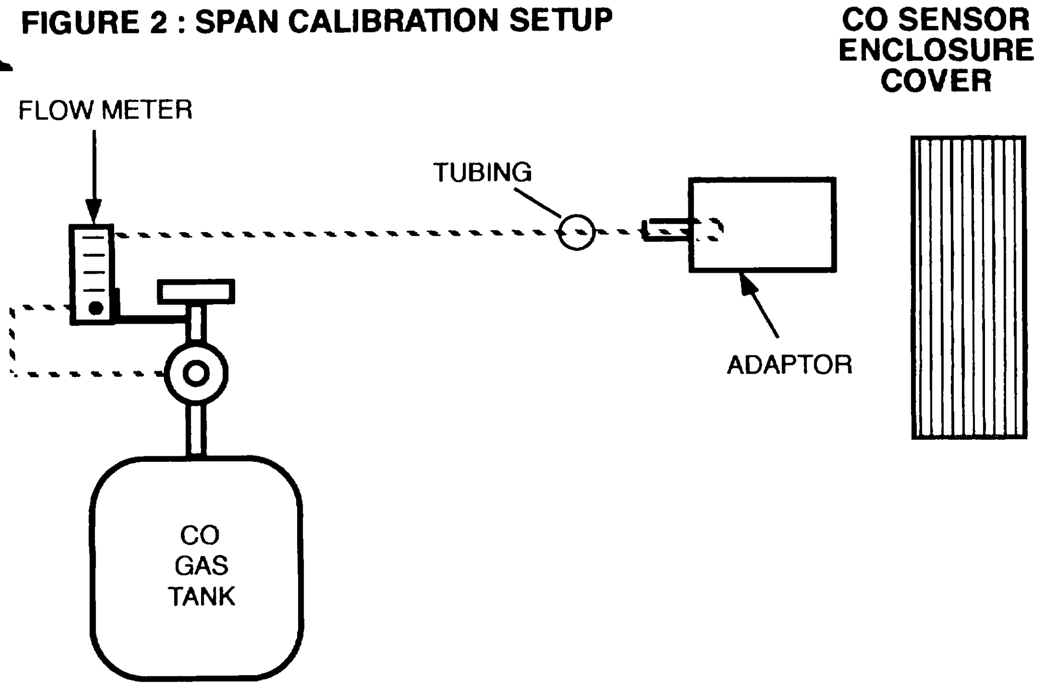
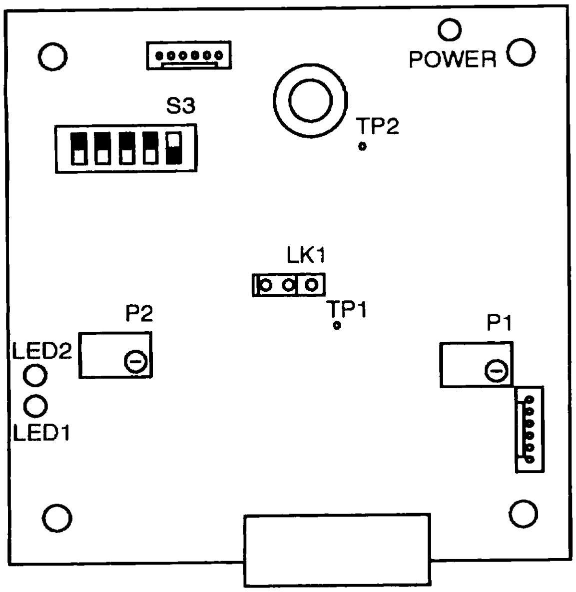


FIGURE 3 : CO SENSOR CIRCUIT BOARD



CONFIGURING GAS MONITOR SYSTEM PARAMETERS

1. POWER-UP SCREEN

On power-up, the following screen will be displayed for a few seconds.

```
*** GAS MONITOR ***
     — V 0.0 —
    [RS-485 I/F]
```

- V 0.0 indicates the version number. (i.e. the number increases with new version updates)
- [RS-485 I/F] or [current loop I/F] will be displayed to indicate a digital or analog interface respectively.

2. MONITOR MODE

The default operation for the GAS MONITOR is to display the active channels with their present gas levels. If more than 4 channels are active, the GAS MONITOR will switch to the next 4 *consecutive* channels for viewing. If all 32 channels are active, then 8 views are shown before repeating.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

01 :	CO	200.00	ppm	
02 :	CO_2	5000	ppm	H
03 :	CO_2	2000	ppm	L
04 :	NO_2	10.00	ppm	H

Figure 2.1

05 :	NO_2	30.30	ppm	L
06 :	O_2	40.00	%	
07 :	COM	2000	%LEL	
08 :	H_2	10.00	ppm	

Figure 2.2

09 :	H_2S	5.00	ppm	
10 :	SO_2	5.00	ppm	
11 :	Cl_2	10.00	ppm	H
12 :	Cl_2	5.00	ppm	L

Figure 2.3

Explanation of fields:

Columns:

1 & 2 :	Channel number from 01 to 32.
3 :	Colon, when flashing indicates "pause" is active. Toggled by PAUSE key.
4 :	Blank.
5 – 8 :	Possible gas types. (Screens 1–3 show the 11 possibilities).
9 – 14 :	Displays present gas level. (Additional detail below)
15 – 18 :	Units for the particular gas selected.
19 :	Blank.
20 :	Trigger level indicator. (Additional detail below).

2. MONITOR MODE (continued)

Gas Level Error Indications (columns 9–14):

-0000	A negative sign indicates the reading is below zero.
– – --	Current loop is open circuit.
xxxxx	No response from sensor (for RS-485 only).
?????	Data error from sensor (for RS-485 only).

Trigger Level Indications (column 20):

L	Low level triggered, output line activated.
H	High level triggered, output line activated.
a	Alarm level triggered, timer activated.
A	Timer complete, output line activated.

3. PAUSE MODE

When the PAUSE key is hit, the display will pause from scrolling to the next active set of channels. Flashing colons indicate that pause is active. The user can manually scroll through the other channels (in groups of 4) by using the UP/DOWN arrow keys.

A PAUSE TIMEOUT, if enabled, will force the monitor back to the automatic scrolling. The timeout is 20 seconds. This feature can be enabled or disabled.
*See MISC MENU – **Pause** selection.*

4. MODIFY SETTINGS MENU

The MOD SETTINGS menu is accessed by pressing the MENU key while Monitor Mode is in pause (i.e. flashing colons).

```
*** MOD SETTINGS ***
 1.User    2.Factory
 3.Misc    4.Defaults
         0.Exit
```

· USER
To enter the USER menu, you must enter the User PIN. The USER menu allows the user to customize each channel and select the number of active channels for a mutiplexed and/or non-multiplexed setup. The system uses the information in the USER settings to operate the unit.
Note: The User PIN can be changed by selecting UserPIN in MISC Menu.
See USER / FACTORY MENU for more information.

· FACTORY
To enter the FACTORY menu, you must enter the FACTORY PIN. The FACTORY menu has the same selections as the USER menu. This feature allows the factory to pre-configure the channels in the case that the user wants to revert back to the factory settings.
See DEFAULTS and USER / FACTORY MENU for more information.

· MISC
To enter the MISC menu, you must enter the USER or FACTORY PIN.
See MISC MENU for more information.

· DEFAULTS
The DEFAULTS selection will overwrite the USER settings with the FACTORY settings. As a safeguard, entry of the DEFAULTS PIN is required.

5. USER / FACTORY MENU

iter the appropriate PIN number to gain access to the USER or FACTORY menu.

```
**** USER MENU *****
1.#_of_Ch 2.Ch_Setup
        0.Exit

          or

*** FACTORY MENU ***
1.#_of_Ch 2.Ch_Setup
        0.Exit
```

• **#_of_Ch**
The following is displayed:

```
# of tot Ch: xx
# of mux Ch: yy
 dwell time: zz sec.
<MENU> to exit
```

Use the UP/DOWN arrow keys to change the number of total channels, multiplexed channels and dwell time. Hold down the key for 1 second to switch to auto increment/decrement.
The LEFT/RIGHT arrow keys are used to select the field. **A flashing colon** indicates the active field.

xx : Total number of channels in use.
1 to 32 active channels if *yy* = 0.
yy to 32 active channels for *yy* = 2 to 32 channels.

yy : Number of multiplexed channels in use.
0 = disable
2 to *xx* active channels for *xx* = 2 to 32 channels.

zz : Dwell time is the amount of time a multiplexed channel is given to register a correct reading before moving on to the next multiplexed channel.
5 to 99 sec.

• Multiplexed channels always start from the 1st channel.
• They are forced to have the same GAS selection as defined in Ch: 01. *See **Ch_Setup** below.*
• For an RS-485 I/F, only 1 sensor board is used for the multiplexed channels. The sensor must be set to address 1 on the DIP switches.
• For current loop I/F, the current loop connection must be made on Ch1.
• Example:

of tot Ch: 10
# of mux Ch: 05
• Channels 1 to 5 are multiplexed at the dwell time rate.
• Channels 6 to 10 run as independent channels.

5. USER / FACTORY MENU (continued)

h_Setup

The following is displayed:

CH:*xx* GAS:*yyyy*
LO:*aaaaa* max=*zzzzz*
HI:*bbbbb*
AL:*ccccc* TIMER:*dd*

Use the UP/DOWN arrow keys to select the channel, change the gas, set trigger points and change alarm timer settings.

The LEFT/RIGHT arrow keys are used to select the field. **A flashing colon** indicates the active field.

xx : Present channel being viewed.
Note: The number of channels accessible in Ch_Setup is defined by the "# of total Ch" in use. *See **#_of_Ch** above.*

yyyy : Gas selection for channel *xx*.
Note: Ch.01 GAS selection is the default channel for all multiplexed channels. The GAS selection cannot be changed from any other multiplexed channel.

zzzzz : Maximum limit setting for gas *yyyy*. This is an information field and is not user programmable.

aaaaa : Trigger setting to activate LO output for channel *xx*. (See Note1 below)

bbbbb : Trigger setting to activate HI output for channel *xx*. (See Note1 below)

cc : Trigger setting to activate ALARM output for channel *xx*. (See Note1 below)

dd : Alarm Delay Timer is used to delay the ALARM output for channel *xx*. The delay can be set from 0 to 60 minutes. Holding the UP or DOWN arrow key for 1 second will switch to a medium-speed auto increment or decrement.

Note1: Holding the UP or DOWN arrow key for 1 second will switch to a high-speed auto increment/ decrement.

6. MISC MENU

Enter the USER or FACTORY PIN to gain access to this menu.

1.Hyster. 2.ScanRate
3.Pause 4.UserPIN
5.Transfer 6.Download
0.Exit

• Hyster.
The following is displayed:

Hysteresis: xx%

<MENU> to exit

xx:1 to 10% hysteresis.

The hysteresis modifies the trigger off value in order that the outputs do not switch erratically at the trigger level. The trigger off value is lowered by the percentage selected of the full range for each channel.

Use the UP/DOWN arrow keys to change the hysteresis. Hold down the key for 1 second to switch to auto increment/decrement.

• ScanRate
The following is displayed:

Scan Rate: xx sec.

<MENU> to exit

xx:1 to 99 seconds.

A programmable scan rate allows the user to view a set of 4 channels for a xx seconds before the next 4 channels are viewed. This feature is only useful for systems with more than 4 channels active.

• Pause
The following is displayed:

*** PAUSE TIMEOUT **
presently ON
0.Off 1.On
<MENU> to exit

The pause timeout can be turned On or Off . If On, the timeout is 20 seconds.

6. MISC MENU (continued)

• **UserPIN**
The following is displayed:

** NEW USER P.I.N.**

<PAUSE> to enter
<MENU> to exit

A new user PIN number can be programmed from this selection.

• **Transfer**
The following is displayed:

*** TRANSFER MODE **
[2400,N,8,1]
1.Transmit 2.Receive
<MENU> to exit

This is a utility used for copying user / factory settings from one unit to the next.

There are 2 ways to transfer settings from one unit to the next;
• A unit to unit connection can be made using a custom serial cable with pins 2 & 3 flipped.
• The data can be transmitted to a PC and stored as a file. This file can then be sent to other Gas Monitors.

Download
The following is displayed:

***** DOWNLOAD *****
[9600,N,8,1]
hit any key to start
<MENU> to exit

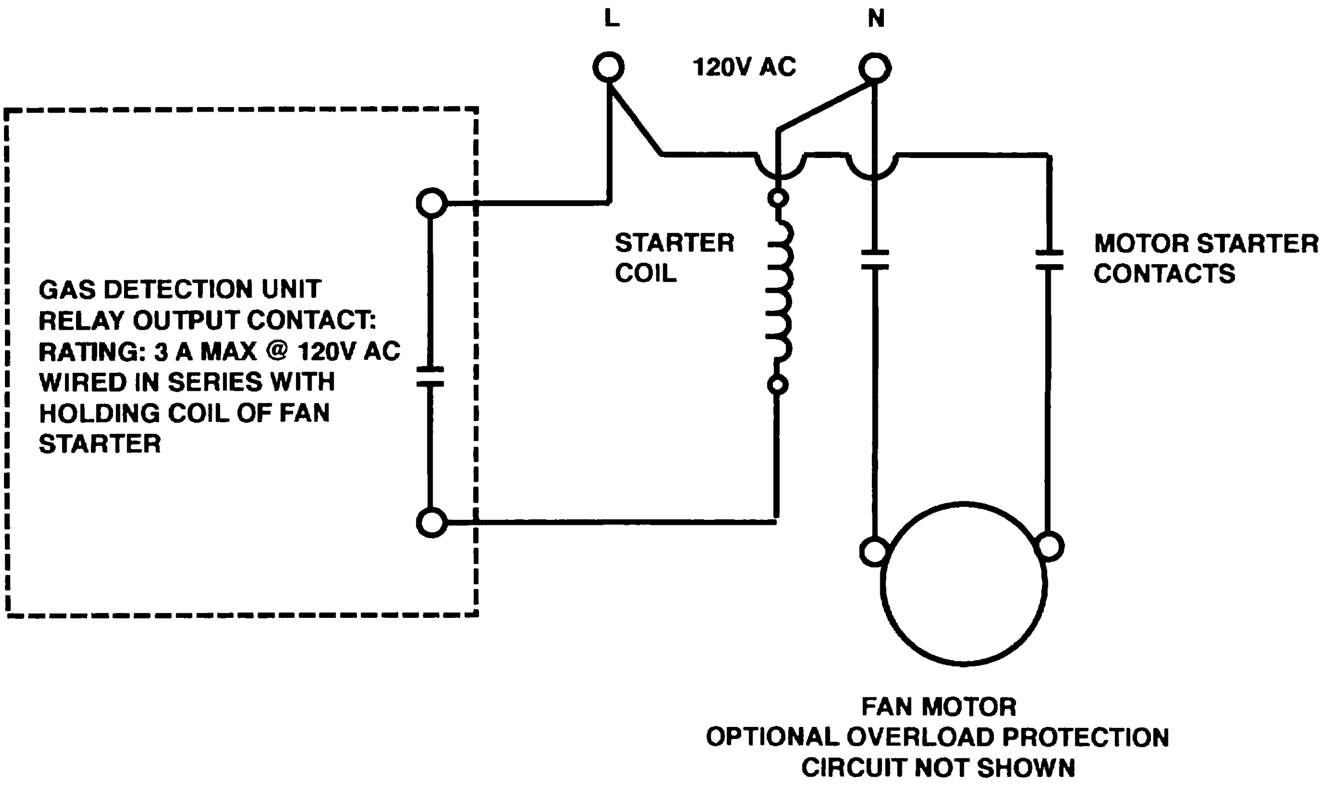
This is a utility used for upgrading the Gas Monitor firmware.
The following are the steps required when performing a firmware upgrade:

1. On the PC side, launch the program that will transmit the "firmware upgrade file" via the serial port.
2. Verify that the file to be downloaded is named as follows:
   GASMONxx.HEX, where xx = new version #
3. Verify that the comm settings are at **9600 baud, no parity, 8 bits, 1 stop bit**.
4. On the Gas Monitor side, hit a key to begin the download sequence.
5. The Gas Monitor will beep for approximately 2 seconds. On the PC side, begin transmitting the file within this interval.
6. If successful, you will hear a series of beeps from the Gas Monitor (for at least 20 seconds). The word "download" should appear on the LCD screen.
7. Once complete, the version # will be displayed as the unit re-boots. (See POWER-UP SCREEN)

EXAMPLE OF FAN CONNECTION TO CO UNIT OUTPUT

FOR SINGLE SPEED MOTOR ONLY

FROM POWER CIRCUIT TO FAN MOTOR STARTER COIL
FOR SINGLE PHASE 120V AC FAN MOTORS

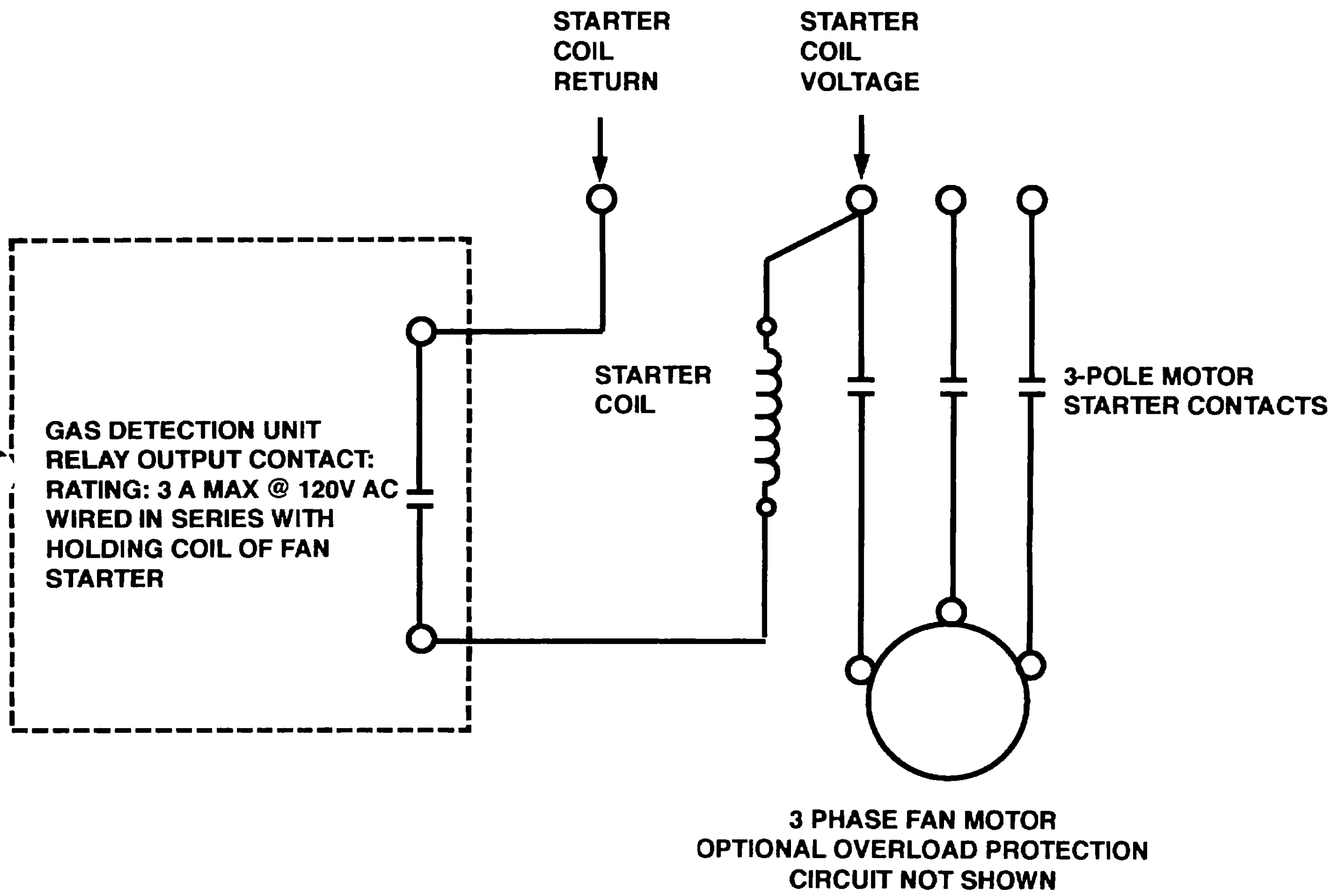


NOTE: RELAY CONTACT SUPPLY CIRCUIT MUST BE FUSED AT 5A @ 120V, 2A @ 240V

EXAMPLE OF FAN CONNECTION TO CO UNIT OUTPUT

FOR SINGLE SPEED MOTOR ONLY

FROM POWER CIRCUIT TO FAN MOTOR STARTER
HAVING 120V AC COIL ONLY
FOR 3 PHASE FAN MOTORS



NOTE: **RELAY CONTACT SUPPLY CIRCUIT MUST BE FUSED AT 5A @ 120V, 2A @ 240V**

Gurney Engineering Corporation
P.O. BOX 211 • MILLBURY, MASSACHUSETTS 01527-0211
TELEPHONE 508-865-9526 • 800-310-9526 • FAX: 508-865-1154

TREATMENT SYSTEM
OPERATING & MAINTENANCE MANUAL
for

Bunker Hill Community College
Health & Wellness Center
Charlestown, MA

Date: September 18, 2008

Gurney Engineering Corporation
P.O. BOX 211 • MILLBURY, MASSACHUSETTS 01527-0211
TELEPHONE 508-865-9526 • 800-310-9526 • FAX: 508-865-1154

CLOSED LOOP SYSTEMS

Closed-loop systems include circulated hot water heating, chilled water cooling, dual-temp and tempered water systems (a/k/a water source heat pump systems). These are also referred to as hydronic systems.

The primary water related problem is corrosion. Secondary problems are deposits and, occasionally, bacterial fouling.

Corrosion in closed loop systems is usually due to the presence of oxygen in the water. Other factors are low pH (acidic) system water and dissimilar metals (i.e., copper/brass and steel/iron) used in system piping and fixtures. In addition, deposits can accelerate corrosion. Cleanliness of systems is important (see below).

Corrosion is best controlled by raising the pH to mildly alkaline range (8.0 - 10.5) and adding corrosion inhibitors. Inhibitors react directly with the metal surfaces to stop oxygen attack and electrolytic reactions. Sodium nitrite and sodium molybdate are the most commonly used inhibitors for steel and iron, now frequently used together. Benzotriazole and tolyltriazole are most commonly used for copper and brass inhibition. Usual practice is to formulate these components together in a single product. **Formula 6201 is a nitrite/azole combination inhibitor.**

Deposits are usually of two types: 1) dirt, oils, pipe dope and mill scale from improper cleaning and flushing of new system, and; 2) iron oxide and hydroxide corrosion products due to non-treatment or improper treatment. The former can be avoided by a thorough pre-operational cleaning with an alkaline detergent solution and flushing of the system. If deposits already exist, most can be removed with specific cleaner formulations used in conjunction with side-stream filtration. The cleaner dislodges the deposits. The filter traps and removes suspended particles from the flow stream. Cartridge-type and bag-type filters are effective for this purpose, using elements or bags rated for 1-micron particle size.

In a clean system, deposit control is maintained by dispersants in the treatment. Dispersants can be added independently or, can be components of a formulated product. Occasionally, side-stream filtration is used in conjunction with dispersants for in-service cleaning. **Formula 6201 contains borate and organic dispersants.**

Bacterial fouling can occur in all closed loop systems. It occurs more frequently in chilled water and dual-temp (winter heating/summer cooling) systems. It occurs most frequently in systems that are partially drained each fall (i.e., coils isolated), especially if glycol is added as a local anti-freeze. Bacterial fouling can be easily controlled by maintaining system cleanliness and by using a small amount of biocide. However, it is best avoided by not draining the system or portions of the system (see below).

Note: A particular type of corrosion problem frequently occurs in systems having coils that are seasonally drained and isolated. This has been common practice in some dual-temp systems and chilled water systems that have coils that would be exposed to freezing temperature during winter months. Frequently the coils are flooded with glycol to mix with any water that is trapped in low points. The glycol is subsequently drained and the coil left open to atmosphere.

Three problems occur. Exposed surfaces in the coils and piping leading to the coils corrode. Bacteria can enter the coils with the air. The residual glycol can deteriorate to acidic compounds.

When the coils are re-opened to the system - despite flushing - corrosion debris, bacteria and deteriorated glycol are distributed throughout the system. System corrosion can be rapid and extensive. Also, it is frequently impossible to maintain treatment concentrations in systems fouled in this manner.

Best method to avoid these problems is to filled the entire system with glycol solution and maintain constant burst protection throughout the system. Where that is not practical due to cost or system design, next best alternative is to keep the coils which must be isolated flooded with glycol solution throughout the winter season, draining and flushing only in the spring just prior to returning to system operation. If there is concern about over-pressurization of the coils from thermal expansion of the fluid, add a small expansion tanks to the coils.

Gurney Engineering Corporation
P.O. BOX 211 • MILLBURY, MASSACHUSETTS 01527-0211
TELEPHONE 508-865-9526 • 800-310-9526 • FAX: 508-865-1154

Bunker Hill Community College
Health & Wellness Center
Charlestown, MA

CLOSED LOOP SYSTEM TESTS & CONTROL LIMITS

TEST	CONTROL LIMITS	CHANGES
pH	8.0 - 10.5	Below limit- test treatment. If low, supplement treatment. If treatment is in range, supplement alkalinity. Above limit - no action if slightly high. Reduce if very high (above 11.0) by adding small amount of mild acid.
Nitrite	600 - 1000	Below range - check conductivity If conductivity has decreased, locate and repair leak. If conductivity has not decreased, add biocide, circulate 24 hrs. and flush system. Supplement treatment with Formula 6201. Above range - no action. However, if grossly above range and pH is excessively high (11.0 or higher), system should be partially flushed to decrease treatment to specified range.
Conductivity		Test and record. No specified range - will vary with source water conductivity, treatment product used and treatment range. Readings can be used to determine if loss of treatment concentration is due to leakage or treatment breakdown (see above).

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PRODUCT DATA

FORMULA 6201
CLOSED SYSTEM INHIBITOR

DESCRIPTION AND USE

FORMULA 6201 is a concentrated liquid blend of alkaline buffers, nitrite, and an azole yellow metal corrosion inhibitor. It is specifically designed for the treatment of closed recirculating water systems constructed of multiple metallurgies. The product is used in both low temperature systems as well as high temperature hot water boiler systems with limited makeup water. It may be used with either hard or soft water makeup and is compatible with glycol antifreezes.

CHEMICAL FEEDING AND CONTROL

FORMULA 6201 is normally shot fed to the system to establish the desired treatment concentration. For most systems, either a shot or bypass feeder is usually used.

Treatment control may either employ the nitrite or sodium nitrite test, whichever is more convenient for the plant. Treatment control ranges vary depending upon the system being treated and will be specified by the technical specialist servicing the facility.

TYPICAL PROPERTIES

Appearance	Extreme pale yellow liquid
Odor	Practically none
Flash Point	None
Specific gravity	1.105-1.135
pH (10% solution)	12.6 $\pm$0.3
Freeze Point	<-5°C(24°F)

SAFETY AND HANDLING

FORMULA 6201 may be toxic by ingestion. Do not take internally. If ingested, drink at least two (2) glasses of water and if the patient is conscious, induce vomiting. Then get immediate medical attention. Contact with eyes causes irritation or burns. If eyes are contacted, immediately flush with clear water for 15 minutes and if irritation persists, get medical attention. For skin contact, wash with soap and water. For additional information, see the Material Safety Data Sheet (MSDS) provided with this product.

PACKAGING

FORMULA 6201 is packaged in 55, 30, and 15 gallon, non-returnable plastic drums. Also, 6 gallon pails are available by special order.

11/91

Material Safety Data Sheet

Hazard Rating:	NFPA	CODE TRANSLATION
Health:	1	0 = Minimal Hazard
Flammability:	0	1 = Slight Hazard
Reactivity:	1	2 = Moderate Hazard
Special:	OX	3 = Severe Hazard
		4 = Extreme Hazard

FORMULA 6201

SECTION I: IDENTIFICATION

Effective Date: 7/1/86
Name and Address:

Revised: JULY 31, 2003
Phone:
Emergency Phone: CHEMTREC (800) 424-9300

Chemical Name: NITRITE BASED INHIBITOR
Formula: SEE SECTION II
Synonyms: COOLING WATER INHIBITOR
Chemical Family: CLOSED SYSTEM TREATMENT
D.O.T. Shipping Name: OXIDIZING SUBSTANCES, LIQUID, N.O.S. (CONTAINS SODIUM NITRITE)
D.O.T. Hazard Class: 5.1 ID No.: UN-3139 Packing Group: PG-II (ERG-35)

SECTION II: INGREDIENTS

A. Hazardous Ingredients	CAS NO.	%	TLV
CAUSTIC SODA (AS Na_2O)	1310-73-2	<1.0	2mg/m^3/15M
SODIUM NITRITE	7632-00-0	<20.0	NONE ESTAB.

B. Other Ingredients	%*	TLV
BORATE SALT	M	NONE ESTAB.
TOLYLTRIAZOLE ESTER	M	NONE ESTAB.

*Legend: L=<1%; M=1-10%; H=>10%

SECTION III: PHYSICAL PROPERTIES

Boiling Point: >212°F
Percent Volatile (volume): >75
Vapor Pressure (mm Hg): N.A.
Vapor Density (air=1): <1

Specific Gravity: 1.105-1.113
pH (10% solution: 12.6 ± 0.3
Solubility in Water: COMPLETE
Evaporation Rate (water=1): 1.0

Appearance and Odor: EXTREME PALE YELLOW LIQUID WITH PRACTICALLY NO ODOR

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

Flash Point (method used): NONE
Flammable Limits in Air (lower): Not Applicable (N.A.) (upper): N.A.

Extinguishing Media: FLOOD WITH WATER. HEAVY WATER JET ADVANTAGEOUS.

Special Fire Fighting Procedures: IF WATER IS EVAPORATED, THE DRY NITRITE CAN BREAK DOWN AT TEMPERATURES ABOVE 610°F TO RELEASE TOXIC NITROGEN OXIDE GASES. WEAR NIOSH APPROVED SELF- CONTAINED BREATHING APPARATUS.

Unusual Fire or Explosion Hazards: IF WATER IS EVAPORATED, THE DRY NITRITE IS AN OXIDIZING AGENT AND CAN SUPPLY OXYGEN TO STIMULATE OR ACCELERATE THE COMBUSTION OF OTHER COMBUSTIBLES. SEE SECTION VII.

Material Safety Data Sheet

FORMULA 6201

SECTION V: HEALTH HAZARD DATA

A. TLV and Source: CALCULATED >200ppm BASED ON Na_2O CONCENTRATION

B. Effects of a Single Overexposure by:

1. Ingestion: MAY BE TOXIC. MAY CAUSE SEVERE IRRITATION TO INTERNAL TISSUES. LARGE AMOUNTS CAN RESULT IN ACUTE TOXIC EFFECTS WHICH MAY BE FATAL.
2. Inhalation: NOT A LIKELY ROUTE OF EXPOSURE.
3. Skin Contact: PROLONGED CONTACT MAY CAUSE IRRITATION.
4. Eye Contact: CAUSES SEVERE IRRITATION OR BURNS.

C. Effects of Repeated Overexposures: OTHER THAN SHORT TERM EFFECTS, NONE KNOWN.

D. Emergency and First Aid Procedures for:

1. Ingestion: DRINK SEVERAL GLASSES OF WATER AND GET IMMEDIATE MEDICAL ATTENTION. INDUCE VOMITING BY STICKING FINGER DOWN THROAT AND CONTINUE UNTIL VOMIT IS CLEAR. IF CYANOSIS (blue skin) DEVELOPS, ADMINISTER OXYGEN.
2. Inhalation: N.A.
3. Skin Contact: WASH WITH SOAP AND WATER OR PLAIN WATER.
4. Eye Contact: IMMEDIATELY FLUSH WITH CLEAR WATER FOR 15 MINUTES AND IF IRRITATION PERSISTS, GET MEDICAL ATTENTION.

E. Other Health Information: CALCULATED ORAL LD_{50} (RAT) BASED ON NITRITE CONTENT IS 625 mg/kg.

SECTION VI: PERSONNEL PROTECTION DATA

Respiratory Protection: NOT NORMALLY REQUIRED
Ventilation: NORMAL VENTILATION SATISFACTORY

Protective Gloves: OPTIONAL
E ye Protection: GOGGLES OR FACE SHIELD

Other Protective Equipment: EYEWASH STATION IN AREA OF USE.

SECTION VII: REACTIVITY DATA

A. Product Stability: STABLE
Conditions to Avoid: SEE SECTION IV.

B. Incompatibility: HAZARDOUS REACTIONS CAN OCCUR WITH ACIDS, AMMONIUM COMPOUNDS, REDUCING AGENTS -PARTICULARLY CYANIDES, THIOCYANATES AND THIOSULFATES, CERTAIN COMBUSTIBLES AND ORGANICS. PRODUCT DECOMPOSES EVEN BY WEAK ACIDS WITH EVOLUTION OF BROWN FUMES OF N_2O_3.

C. Hazardous Combustion or Decomposition Products: OXIDES OF CARBON AND NITROGEN MAY BE RELEASED IF WATER IS EVAPORATED BY THE HEAT OF A FIRE. SEE SECTION IV.

D. Hazardous Polymerization: WILL NOT OCCUR
Conditions to Avoid: NONE KNOWN

SECTION VIII: ENVIRONMENTAL DATA

A. Spill or Leak Procedures: SMALL SPILLS MAY BE FLUSHED WITH COPIOUS QUANTITIES OF WATER TO A SANITARY SEWER OR WASTE TREATMENT FACILITY. LARGER SPILLS SHOULD BE DIKED TO PREVENT RUN OFF AND PUMPED INTO A SUITABLE CONTAINER FOR DISPOSAL.

B. Waste Disposal: SMALL QUANTITIES MAY BE DILUTED WITH WATER AND FLUSHED TO A SANITARY SEWER. LARGER QUANTITIES MAY BE SUBJECT TO FEDERAL, STATE OR LOCAL REGULATIONS (EPA IGNITIBLE WASTE- D001). CONSULT APPROPRIATE REGULATING AGENCIES BEFORE DISPOSING OF WASTE MATERIAL.

C. Other Environmental Data: CALCULATED AQUATIC TOXICITY FOR THE PRODUCT APPROXIMATELY 53 ppm BASED ON SODIUM NITRITE CONTENT OF THE PRODUCT.

SECTION IX: SPECIAL PRECAUTIONS

A. Handling and Storage: STORE IN A COOL DRY PLACE. KEEP CONTAINERS TIGHTLY CLOSED WHEN NOT IN USE. STORE AWAY FROM ACIDS AND OTHER INCOMPATIBLE MATERIALS.

B. Other Precautions: THIS PRODUCT HAS BEEN DESIGNED FOR USE IN SPECIFIC TYPES OF COOLING WATER AND HEATING CIRCUITS AND SHOULD BE USED ONLY IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED BY THE TECHNICAL REPRESENTATIVE SERVICING THE FACILITY. IT MAY NOT BE USED FOR THE TREATMENT OF POTABLE WATERS.

Gurney Engineering Corporation
P.O. BOX 211 • MILLBURY, MASSACHUSETTS 01527-0211
TELEPHONE 508-865-9526 • 800-310-9526 • FAX: 508-865-1154

BY-PASS or FILTER FEEDER OPERATION

Note: The system to which the by-pass or filter feeder is connected is under pressure. As stated below, care must be taken to close the isolation valves on the inlet and outlet piping to the feeder **and** to remove pressure from the feeder before removing the cover. ***Failure to do so may result in leakage or splashing of system water and/or treatment product onto personnel.***

1. **CLOSE VALVES ON BOTH THE INLET AND OUTLET PIPING TO THE BY-PASS OR FILTER FEEDER BEFORE ATTEMPTING TO DRAIN OR REMOVE THE COVER.**

2. Place a pail beneath the drain fitting or connect a hose to the drain fitting and extend to sanitary waste. Open drain valve slowly to relieve all pressure.

3. Open the 4" cover on the feeder by turning counter-clockwise. Lift loosened cover from the top of the feeder.

4. Allow feeder to drain completely.

5. **CLOSE DRAIN VALVE.**

6. If adding treatment product to the system, follow all handling instruction on the Material Safety Data Sheet for the product being used. Pour carefully into feeder to avoid spilling or splashing.

   If the filter feeder is being used for filtration, install a new filter bag in the stainless steel strainer basket.

7. If the amount of treatment product added to the feeder is less than the total capacity of the feeder, add water or system fluid to the feeder to completely fill. Use care to not overfill the feeder.

8. Replace cover and turn clockwise until securely closed.

9. Open valves on inlet and outlet piping. Allow valves to remain open for at least one hour with system recirculation pump operating to assure that product has been transferred into system and thoroughly mixed into system fluid.

10. If filter feeder is being used for filtration, leave inlet and outlet open. If a by-pass feeder or a filter feeder is being used only for treatment product addition, the valves can be closed after an hour of recirculation.

By-Pass & Filter Feeders

By-Pass Feeders

Neptune By-Pass Feeders are a convenient method of introducing treatment chemicals into closed circulating water systems.

Neptune By-Pass Feeders are ideal for treating hot and chilled water circulating loops used in heating and air conditioning systems, process heating and cooling or large engine water jackets.

Neptune offers two styles of By-Pass Feeders: A vertical style with dish bottom in and a vertical style with dish bottom out.

Filters are available for system cleanup and monitoring.

A high pressure cap rated to 300 psi is now standard. The first closure improvement in over two decades.

Neptune
A DOVER COMPANY

BY-PASS FEEDERS – VERTICAL STYLE

DISH BOTTOM IN
MODEL VTF-10HP

DISH BOTTOM OUT
MODEL DBF-5HP

NEW

FILTER FEEDER
MODEL FTF-5DB

Neptune's FIRST Filter Feeder with Full Bottom Drain and Anchor Bolt Holes

Filter Feeders

The Neptune Filter Feeder combines chemical addition and high capacity filtering in one piece of equipment. It is a convenient way to introduce solid or liquid chemicals into hot or cold water closed circulating systems.

- Eliminates need for separate By-Pass Feeder and filter.
- Filtration can be achieved at the same time as chemical addition.
- Extended neck with top inlet allows simple installation of filter bag and basket.
- Filter bags are available in 50, 20, 5 and 1 micron ratings. (Order separately.)
- Filter bags are quickly and easily replaced.

By-Pass Feeders

Caps

All Neptune By-Pass Feeders offer the new style, quick opening, high pressure closure.

These closures offer better sealing with less force and eliminate the need for tools. Design binds cap tightly when under pressure making it necessary to bleed pressure from tank before removing cap.

Underside of cap which contacts liquid is *epoxy-coated.*

OLD STYLE CAPS
Three lug, ⅓ turn design rated to 200 psi.

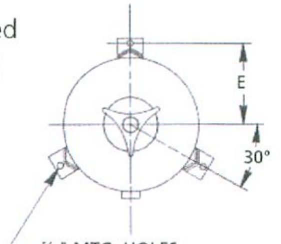
NEPTUNE HIGH PRESSURE CAP
Coarse thread, 2½ turn design rated to 300 psi.

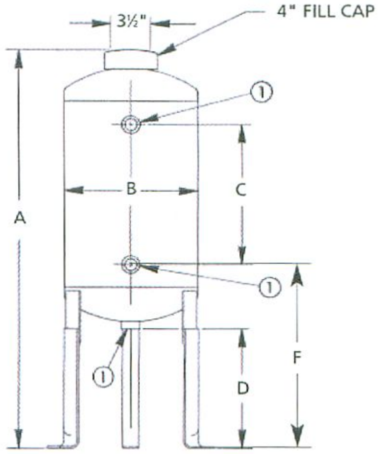
Vertical Style – Dish Bottom Out

The **"DBF"** series features wide-mouth caps manufactured by Neptune. These caps utilize a square section "O" ring seal and will ***close easily by hand.*** Advantages of this series are demountable leg extensions and a ***full bottom drain.*** Optional Filter Bag Kit may be added.

"DBFC" models include a built-in support and mounting for a cartridge filter (order cartridge separately).

See page 3 for filter specifications.





MODEL NUMBER	FILTER	APPROX. CAPACITY	MAX. PRESSURE*	A	B	C	D	E	F	SHIP WEIGHT
DBF-2HP	Optional†	2 Gallons	300 psi	31¼"	6"	12¾"	8⅝"	4⅛"	13¼"	23 lbs.
DBFC-2	Cartridge	2 Gallons	300 psi	31¼"	6"	12¾"	8⅝"	4⅛"	13¼"	23 lbs.
DBF-5HP	Optional†	5 Gallons	300 psi	29¾"	10"	10½"	8"	6⅛"	13"	38 lbs.
DBFC-5	Cartridge	5 Gallons	300 psi	29¾"	10"	10½"	8"	6⅛"	13"	38 lbs.
DBF-10HP	Optional†	10 Gallons	300 psi	45¾"	10"	26½"	8"	6⅛"	13"	61 lbs.

*At 200°F Max. †Filter support not included with base unit. Purchase optional filter bag kit.

Filter Bag Kits

Available for all **"VTF"** and **"DBF"** models up to 10 gallons. Kit includes bag, bag frame, tubing and connectors. The addition of a filter bag allows the By-Pass Feeder to function simultaneously as a side stream filter. (A clean bag is rated at approximately 30 microns.) Cannot be used with DBFC models.

VTF-2HP with filter bag kit installed

MODEL	FOR USE ON
FBK-2	VTF-2HP, DBF-2HP
FBK-5	VTF-5HP, DBF-5HP
FBK-10	VTF-10HP, DBF-10HP

(bag frame shown in front of bag for clarity only)

Gurney Engineering Corporation
P.O. BOX 211 • MILLBURY, MASSACHUSETTS 01527-0211
TELEPHONE 508-865-9526 • 800-310-9526 • FAX: 508-865-1154

CORROSION COUPON RACK OPERATION

Note: The system to which the corrosion coupon rack is connected is under pressure. As outlined below, care must be taken to close the isolation valves on the inlet and outlet piping to the corrosion coupon rack before opening the corrosion coupon rack. ***Failure to do so may result in leakage or splashing of system water onto personnel.***

1. **CLOSED VALVES ON BOTH THE INLET AND OUTLET PIPING TO THE CORROSION COUPON RACK.**

3. Place a pail beneath the lowest tee on corrosion coupon rack. Loosen the lowest coupon holder slowly (this is the plug in or cap on the tee). **Note: There may be some pressure in the corrosion coupon rack. Loosen the first coupon holder slowly to relieve the pressure.**

3. After pressure has been relieve, remove the lowest coupon holder.

4. Allow corrosion coupon rack to drain completely into the pail.

5. Loosen the screw holding the corrosion coupon and remove the coupon from the holder. Do not handle the coupon (use the coupon envelop to hold the coupon). Place the coupon in its' original envelop and enter the removal date on the envelop.

6. Remove a new coupon from its' envelop - using care to not handle the coupon - and attach to the coupon holder. Date the envelop with the insertion date.

7. Insert the coupon holder, with the new coupon attached, into the open tee and tighten sufficiently to avoid leakage.

8. Repeat the process with other coupons being changed.

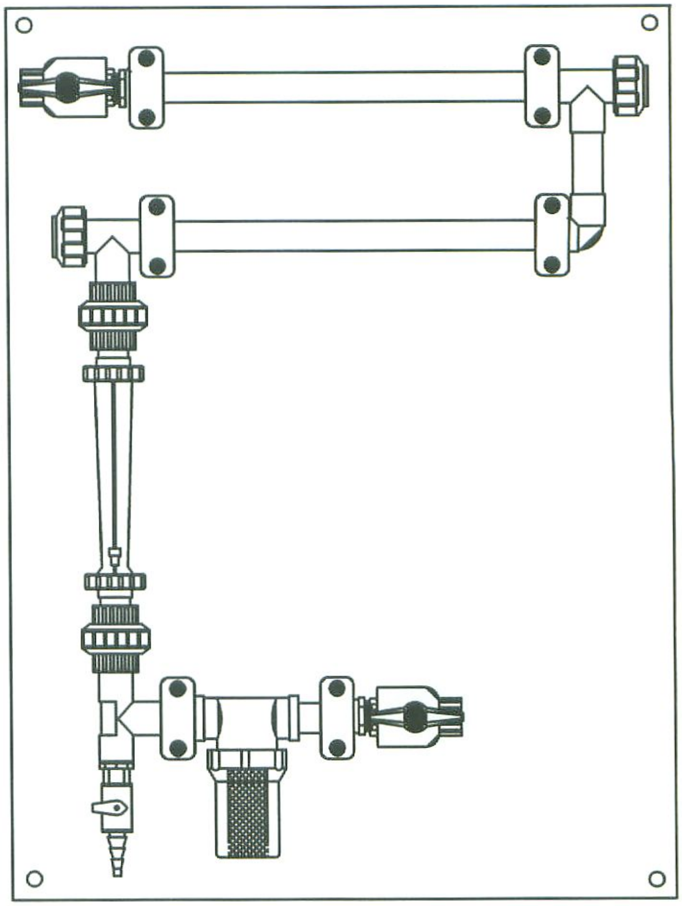
9. Confirm that all coupon holders have to tightened sufficiently into their respective tees to avoid leakage.

10. Open valve on inlet and outlet piping. If any leakage is found, immediately close the valves and tighten the holder(s) as necessary. Reopen the inlet and outlet valves.

11. Put the coupon envelop(s) in a secure place where it/they can be found for the next change.

Advantage Controls Inc. — Data Sheet

Corrosion Coupon Racks



ACR-20-BEG Shown

Key Features

- Built to ASME Specifications
- Quick Release Holder
- Corrosion Resistant
- Polyethylene Panel Mount
- PVC, CPVC Black Iron or Stainless Steel Construction
- Up to Six Coupon Holders
- Inlet & Outlet Ball Valves

Application

Advantage Controls corrosion coupon racks provide a reliable way of monitoring the effectiveness of your water treatment program against the damaging effects of corrosion.

Our revolutionary "Quick Disconnect" coupon holder design with o-ring seal requires no wrenches for removing the coupon. Simple to hand loosen and tighten.

All standard models include the coupon holder(s), nylon coupon mounting hardware, inlet and outlet ball valves mounted on a ¼" corrosion resistant polyethylene panel for a professional installation appearance.

Corrosion Coupon Racks

Select the material, pipe size, number of holders, and options required.
Coupons are not included.

3/4"(24mm) PVC Sch 80 150 PSI 140°F(60°C)

ACR-10	one holder
ACR-20	two holders
ACR-30	three holders
ACR-40	four holders
ACR-50	five holders
ACR-60	six holders

3/4"(24mm) CPVC Sch 80 150 PSI 180°F(82.2°C)

ACR-12	one holder
ACR-22	two holders
ACR-32	three holders
ACR-42	four holders
ACR-52	five holders
ACR-62	six holders

1" (25mm) PVC Sch 80 150 PSI 140°F(60°C)

ACR-11	one holder
ACR-21	two holders
ACR-31	three holders
ACR-41	four holders
ACR-51	five holders
ACR-61	six holders

1" (25mm)CPVC Sch 80 150 PSI 180°F(82.2°C)

ACR-13	one holder
ACR-23	two holders
ACR-33	three holders
ACR-43	four holders
ACR-53	five holders
ACR-63	six holders

3/4" (24 mm) Black Iron 300 PSI 300°F(316°C)

ACR-15	one holder
ACR-25	two holders
ACR-35	three holders
ACR-45	four holders
ACR-55	five holders
ACR-65	six holders

3/4"(24mm)Stainless Steel 300 PSI 600°F(316°C)

ACR-10XSS	one holder
ACR-20XSS	two holders
ACR-30	three holders
ACR-45	four holders
ACR-55	five holders
ACR-65	six holders

Quick disconnect style coupon holders available only on ¾" CPVC & PVC models.

Options: Add to end of model number

A	Flow Control Orifice, 3 gpm
B	Cold Water Flow Indicator, ¾"
C	Flow Control Orifice, 5 gpm
E	Sample Tee with Valve
F	Back Flow Check Valve
G	¾" Clear Strainer
H	Steel Y-Strainer
I	Omit Polyethylene Panel Mount
J	Clear PVC Piping over Coupon
L	¾" FNPT Opening for Corrator Probe

Dimensions: Width 22" (55.8mm)

MODEL	LENGTH
ACR-10	16" (406.4mm)
ACR-20	16"(406.4mm)
ACR-30	20"(508mm)
ACR-40	25"(635mm)
ACR-50	31"(787.4mm)
ACR-60	36"(914.4mm)
ACR-10B	20"(508mm)
ACR-20B	25"(635mm)
ACR-30B	30"(762mm)
ACR-40B	36"(914.4mm)
ACR-50B	41"(1041.4mm)
ACR-60B	47"(1193.8mm)

Notes:

Additional options available. Consult dealer for more information.

Recommended coupon size: 4½"(114.3mm) length x ½"(12.7mm) width x 1/16"15.88mm) thickness with 13/64"(5.16mm) mounting hole.

Get the Advantage

DS-273 70703 Formerly AF-04

Advantage Controls Inc.
4700 Harold Abitz Dr.
Muskogee, OK 74403
800-743-7431 Phone
888-686-6212 Fax
www.advantagecontrols.com

BOSTON Air PRODUCTS

Installation, Operation & Maintance Info

PROJECT:	**Wellesley Municipal Facilities** **Wellesley, MA**
PRODUCT:	**American Coolair Corp / ILG Industries and** **Leading Edge Fans**
ENGINEER:	**Earth Tech**
CONTRACTOR:	**General Mechanical Contractors, Inc.** **29A Sword Street** **Auburn, MA 01501**
SUBMITTED BY:	**Boston Air Products, LLC** **30 First Street – Suite #4** **Bridgewater, MA 02324**
DATE:	**December 29, 2008**

Installation Instructions
For Type CRBA - CRB - UBCA - UBC - UBCHD
Centrifugal Power Roof Ventilators

OPERATION AND MAINTENANCE INSTRUCTIONS – REVERSE SIDE

PRE-INSTALLATION CHECK

Before installation, a careful inspection of the units should be made to detect any concealed shipping damage. If damage is found, contact and file a claim with the delivering carrier. Pulley alignment and belt tension should be checked prior to start-up (see the reverse for further information). Before connecting to the power source, check to make sure that the wheel turns freely without striking anything. CHECK TO MAKE SURE THAT THE DATA ON THE MOTOR NAMEPLATE AGREES WITH THE ELECTRICAL SERVICE THAT IS GOING TO BE APPLIED, DOUBLE CHECKING VOLTAGE AND PHASE. Also, check the wiring diagram to make sure that proper connections are made for the electrical service being applied. Note direction arrow for correct wheel rotation when power is applied. If a backdraft damper is being used, make sure that it is installed with sufficient clearance and that it functions properly when the unit is energized.

INSTALLATION

When installing the fan, make the following checks:

1. Be sure that the fan is mounted on a rigid, level foundation, preferably a prefabricated roof curb.

2. Turn the fan wheel by hand to make sure that it turns freely. If there is interference:

A. Fans with radial interference between inlet and wheel—
Loosen the compartment disc on its supports and/or the compartment disc supports, where possible, and bearing mounting bolts. Adjust position so that there is even clearance between the inlet and the wheel.

B. Fans with axial interference between inlet and wheel—
Loosen the wheel on the shaft and adjust its position axially so that there is running clearance.

3. Make certain that the hub bolts and key are secure.

4. Make certain that all motor and bearing mounting bolts are secure and that the sheaves are at right angles to the shaft.

WARNING CAUTION

DO NOT INSTALL FAN WITH MOVING PARTS WITHIN 8 FEET OF FLOOR OR GRADE LEVEL WITHOUT A GUARD THAT COMPLIES WITH OSHA REGULATIONS. **DO NOT** USE UNLESS ELECTRICAL WIRING COMPLIES WITH ALL APPLICABLE CODES. **DO NOT** WIRE WITHOUT PROVIDING FOR A POWER SOURCE DISCONNECT AT THE FAN ITSELF. **DO NOT** SERVICE EXCEPT BY A QUALIFIED MAINTENANCE TECHNICIAN AND ONLY AFTER DISCONNECTING THE POWER SOURCE. FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN SERIOUS

5. Give a short, supervised running test after tightening down all foundation bolts.

WHEELS

All wheels are computer balanced at the factory. Under particularly dirty conditions, materials may adhere to the fan wheel. The wheel should be checked and cleaned periodically since this could cause a build-up of material causing the wheel to become unbalanced.

WHEELS ARE LIMITED TO 300° F. Motors may have lower limits. Check with the factory before exposing these fans to elevated temperature.

MOUNTING BACKDRAFT DAMPER

If a backdraft damper is being used, check all dimensions to be sure that the damper will fit into the proposed location. Counterbalanced dampers must be installed so that the blades of the damper open in the same direction as the air flow. Blades should open upward for both automatic and motorized dampers.

LIMITED WARRANTY

In the sale of its products, American Coolair Corporation agrees to correct, by repairs or replacement, any defects in workmanship or material that may develop under proper and normal use during a period of one year from the date of shipment from the factory. Any product or part proving, upon American Coolair's examination, to be defective during limited warranty period will be repaired or replaced, at American Coolair's option, f.o.b. factory, without charge.

Deterioration due to wear caused by chemicals, abrasive action or excessive heat shall not constitute defects.

Motors are guaranteed only to the extent of the manufacturer's warranty.

American Coolair's limited warranty does not apply to any of its products or parts that have been subject to accidental damage, misuse by the user, unauthorized alterations, improper installation or electrical wiring, or lack of proper lubrication or other service requirements established by American Coolair.

Repairs or replacements provided under the above terms shall constitute fulfillment of all American Coolair's obligations with respect to limited warranty.

THIS LIMITED WARRANTY STATED HEREIN IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING WITHOUT LIMITATION THAT OF MERCHANTABILITY AND FITNESS. NO LIABILITY FOR REINSTALLATION COST OR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY

Operation and Maintenance Instructions For Type CRBA - CRB - UBCA - UBC - UBCHD Centrifugal Power Roof Ventilators

INSTALLATION INSTRUCTIONS -- REVERSE SIDE

CLEANING AND ADJUSTMENT

The entire fan should be cleaned as necessary to remove accumulated grease, dirt and other foreign matter which may collect on the blades and other parts. For grease extraction units, the wheel should be thoroughly cleaned every two to three months, and the grease trough, drain and container should be checked and emptied as required to prevent grease overflow, as often as every two weeks for heavy grease applications. Belts should be inspected and tension adjusted (see below). Check for belt misalignment which will cause excessive wear and premature failure. This same inspection of belts and adjustment of tension should be made frequently during the first 24-48 hours of operation after installation. If rust or corrosion is found anywhere on the fan, the affected areas should be thoroughly cleaned and refinished.

BELT REPLACEMENT, TENSION AND ADJUSTMENT

1. For convenient access to the unit, remove the roof section.

2. To install new belt(s), loosen the belt tension bolt and nut. Remove old belt(s) from motor and fan pulleys. Thread the new belt(s) onto the pulleys.

<u>CAUTION</u>: DO NOT THREAD THE NEW BELT ONTO THE PULLEYS UNDER TENSION. THIS WILL CAUSE DAMAGE TO THE BELT.

3. Adjust the belt tension (see following paragraph) and re-tighten the tension bolt/nut. Check belt alignment between the fan and motor pulley.

4. To check the belt tension, push belt(s) inward about 1/8" to 1/4" at approximately 5 lb. force for proper tension. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Keep belts free from foreign material which may cause slippage. Make periodic belt and drive inspection and re-tension when slipping occurs. Do not overtension.

LUBRICATION

Fan bearings are factory lubricated for extended service and operation. These pillow block bearings should be lubricated annually or more frequently depending on usage and operating conditions. For best results, use a #2 consistency lithium base grease such as Shell Alvania #2 lubricant or equivalent. Motor bearings should be lubricated according to the motor manufacturer's instructions.

REPAIR PARTS

1. <u>Belts</u> — Belts are standard V-belts used on industrial machines and replacements can be obtained through local industrial supply houses. Make sure the replacement belts are the same section (4L, A, AX, B, BX) and length as the original belts. If more than one belt is used on the fan, replace with matched sets. See previous instructions for belt replacement.

2. <u>Blades</u> — If one or more of the blades on the wheel is damaged, the entire wheel will need to be replaced.

3. <u>Bearings</u> — Pillow block bearings may be replaced in the field.

4. <u>Motors</u> — Motor repairs should only be performed by an authorized motor repair facility. Contact either the motor manufacturer or American Coolair Corporation for locations.

<u>CAUTION</u>: DO NOT RETURN DAMAGED OR DEFECTIVE PARTS TO AMERICAN COOLAIR CORPORATION WITHOUT PRIOR AUTHORIZATION. IF REPAIRS UNDER WARRANTY ARE CLAIMED, SEE WARRANTY TERMS ON THE REVERSE OF THIS PAGE. CLAIMS FOR WARRANTY REPAIRS REGARDING THE MOTOR SHOULD BE MADE DIRECTLY WITH THE

ILG INDUSTRIES DIVISION

AMERICAN COOLAIR CORPORATION

GENERAL OFFICE, JACKSONVILLE, FLORIDA 32203-2300 ~ P.O. BOX 2300 ~ (904) 389-3646 ~ FAX (904) 387-3449 ~ E-MAIL - fans@coolair.com
VANE AXIAL ~ TUBE AXIAL ~ PROPELLER FANS ~ POWER ROOF VENTILATORS ~ CENTRIFUGAL VENTILATORS
MEMBER OF AMCA

Form 705-60-2 (December, 2001)

Installation Instructions
For Type SQBA - SQB - SQDA
Square In-Line Centrifugal Fans

OPERATION AND MAINTENANCE INSTRUCTIONS – REVERSE SIDE

PRE-INSTALLATION CHECK

Before installation, a careful inspection of the units should be made to detect any concealed shipping damage. If damage is found, contact and file a claim with the delivering carrier. Pulley alignment and belt tension should be checked prior to start-up (see the reverse for further information). Before connecting to the power source, check to make sure that the wheel turns freely without striking anything. CHECK TO MAKE SURE THAT THE DATA ON THE MOTOR NAMEPLATE AGREES WITH THE ELECTRICAL SERVICE THAT IS GOING TO BE APPLIED, DOUBLE CHECKING VOLTAGE AND PHASE. Also, check the wiring diagram to make sure that proper connections are made for the electrical service being applied. Note direction arrow for correct wheel rotation when power is applied. If a backdraft damper is being used, make sure that it is installed with sufficient clearance and that it functions properly when the unit is energized.

INSTALLATION

From an operational standpoint, SQ fans may be mounted in any position. For convenience in wiring and service, it is recommended that the fan be mounted so that the motor is easily accessible.

Make sure that the fan is rigidly mounted. The SQ units are designed with slip-fit duct connectors as standard. Flexible duct connections or transition pieces may be used in mounting the fan. However, make sure that proper duct design is maintained so as not to obstruct air flow. For ease of installation, duct flanges and round duct connectors are available. If the fan is not adequately supported by duct work or otherwise, mounting brackets should be used. See Form 750-61 for mounting bracket installation information.

When installing the fan, make the following checks:

1. Turn the fan wheel by hand to make sure that it turns freely. If there is interference:
   A: Fans with radial interference between inlet and wheel—Loosen the motor/bearing plate bolts, and/or bearing bolts (for belt drive units). Adjust position so that there is even clearance between the inlet and the wheel.
   B: Fans with axial interference between inlet and wheel—Loosen the wheel on the shaft and adjust its position axially so that there is running clearance.
2. Make certain that the hub bolts and key are secure.
4. Make certain that all motor and bearing mounting bolts are secure. For belt drive units, make sure that the sheaves are at right angles to the shaft.
5. Give a short, supervised running test after tightening down all hardware.

WHEELS

All wheels are computer balanced at the factory. Under particularly dirty conditions, materials may adhere to the fan wheel. The wheel should be checked and cleaned periodically since this could cause a build-up of material causing the wheel to become unbalanced.

ALUMINUM WHEELS ARE LIMITED TO 300° F. Motors have lower limits. Check with the factory before exposing these fans to elevated temperature.

MOUNTING BACKDRAFT DAMPER

Check all dimensions to be sure that the damper will fit into the proposed location. Dampers must be installed so that the blades open in the same direction as the air flow for both automatic and motorized dampers.

LIMITED WARRANTY

In the sale of its products, American Coolair Corporation agrees to correct, by repairs or replacement, any defects in workmanship or material that may develop under proper and normal use during a period of one year from the date of shipment from the factory. Any product or part proving, upon American Coolair's examination, to be defective during limited warranty period will be repaired or replaced, at American Coolair's option, f.o.b. factory, without charge.

Deterioration due to wear caused by chemicals, abrasive action or excessive heat shall not constitute defects.

Motors are guaranteed only to the extent of the manufacturer's warranty.

American Coolair's limited warranty does not apply to any of its products or parts that have been subject to accidental damage, misuse by the user, unauthorized alterations, improper installation or electrical wiring, or lack of proper lubrication or other service requirements established by American Coolair.

Repairs or replacements provided under the above terms shall constitute fulfillment of all American Coolair's obligations with respect to limited warranty.

THIS LIMITED WARRANTY STATED HEREIN IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING WITHOUT LIMITATION THAT OF MERCHANTABILITY AND FITNESS. NO LIABILITY FOR REINSTALLATION COST OR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY NATURE IS ASSUMED OR SHALL BE IMPOSED UPON AMERICAN COOLAIR.

Operation and Maintenance Instructions
For Type SQBA - SQB - SQDA
Square In-Line Centrifugal Fans

INSTALLATION INSTRUCTIONS – REVERSE SIDE

CLEANING AND ADJUSTMENT

The entire fan should be cleaned as necessary to remove accumulated dust, dirt and other foreign matter which may collect on the blades and other parts. On belt drive units, belts should be inspected and tension adjusted (see below). Check for belt misalignment which will cause excessive wear and premature failure. This same inspection of belts and adjustment of tension should be made frequently during the first 24-48 hours of operation after installation. If rust or corrosion is found anywhere on the fan, the affected areas should be thoroughly cleaned and refinished.

BELT REPLACEMENT, TENSION AND ADJUSTMENT (SQBA, SQB MODELS)

1. For convenient access to the unit, remove the sides of the unit. (Three of the four sides are removable.)

2. To install new belt(s), loosen the motor bracket and belt tension bolts and remove the old belt(s) from motor and fan pulleys. Thread the new belt(s) onto the pulleys.

CAUTION: DO NOT THREAD THE NEW BELT ONTO THE PULLEYS UNDER TENSION. THIS WILL CAUSE DAMAGE TO THE BELT.

3. Position new belt(s) on fan pulley and motor pulley. Adjust belt tension and retighten motor bracket bolts (see following paragraph). Check belt alignment between the fan and motor pulleys.

4. To check the belt tension, push belt(s) inward about 1/4" to 1/2" at approximately 5 lb. force for proper tension. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Keep belts free from foreign material which may cause slippage. Make periodic belt and drive inspection and re-tension when slipping occurs. Do not overtension.

LUBRICATION

Fan bearings are factory lubricated for extended service and operation. These pillow block bearings should be lubricated annually or more frequently depending on usage and operating conditions. For best results, use a #2 consistency lithium base grease such as Shell Alvania #2 lubricant or equivalent. Motor bearings should be lubricated according to the motor manufacturer's instructions.

REPAIR PARTS

1. Belts — Belts are standard V-belts used on industrial machines and replacements can be obtained through local industrial supply houses. Make sure the replacement belts are the same section (4L, A, AX, BX) and length as the original belts. If more than one belt is used on the fan, replace with matched sets. See previous instructions for belt replacement.

2. Blades — If one or more of the blades on the wheel is damaged, the entire wheel will need to be replaced.

3. Bearings — Pillow block bearings may be replaced in the field.

4. Motors — Motor repairs should only be performed by an authorized motor repair facility. Contact either the motor manufacturer or American Coolair Corporation for locations.

CAUTION: DO NOT RETURN DAMAGED OR DEFECTIVE PARTS TO AMERICAN COOLAIR CORPORATION WITHOUT PRIOR AUTHORIZATION. IF REPAIRS UNDER WARRANTY ARE CLAIMED, SEE WARRANTY TERMS ON THE REVERSE OF THIS PAGE. CLAIMS FOR WARRANTY REPAIRS REGARDING THE MOTOR SHOULD BE MADE DIRECTLY WITH THE MOTOR MANUFACTURER.

WARNING CAUTION

DO NOT INSTALL FAN WITH MOVING PARTS WITHIN 8 FEET OF FLOOR OR GRADE LEVEL WITHOUT A GUARD THAT COMPLIES WITH OSHA REGULATIONS. DO NOT USE UNLESS ELECTRICAL WIRING COMPLIES WITH ALL APPLICABLE CODES. DO NOT WIRE WITHOUT PROVIDING FOR A POWER SOURCE DISCONNECT AT THE FAN ITSELF. DO NOT SERVICE EXCEPT BY A QUALIFIED MAINTENANCE TECHNICIAN AND ONLY AFTER DISCONNECTING THE POWER SOURCE. FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN SERIOUS

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MEMBER OF AMCA

Operation & Maintenance Instructions for Type C Propeller Fans

INSTALLATION INSTRUCTIONS—OTHER SIDE

Fan Cleaning and Adjustment. Fan should be cleaned as necessary to remove accumulated dust, dirt and other foreign matter which may collect on the blades or other fan parts. If belt drive, belt(s) should be inspected and tension adjusted (see below). Be sure to check for belt misalignment which can result in excessive wear and premature failure. If rust or corrosion is found, the affected area should be thoroughly cleaned and refinished.

Fan Style. Type C fans are divided in several "styles." It may be important for you to know which style you have. Check the model number on the fan. The letter preceding the size number is the style of that fan. Example: Model CBL42H is a Style L, 42" fan.

Fan Speed Adjustment. On belt drive models equipped with adjustable pitch motor pulley, the pitch setting made at the factory operates the fan at the maximum safe load for the motor. Do not close pulley to increase fan speed as this will overload motor and cause damage to motor or trip-out. Pulley may be opened to reduce fan speed and thus decrease CFM. If further information is required, contact your American Coolair representative.

Belt Replacement and Tensioning (Belt drive models only).

(a) Belts should be inspected and tension adjusted at regular intervals. For belt replacement on Styles L, H, and AL, detach entire blade assembly from frame by removing bolts which connect shaft to X-brace. Tilt or lift blade assembly just enough for belt to clear end of shaft. If fan location makes detachment difficult, it may be possible to remove old belt and replace new one by slipping belt over blade tips—one at a time. By first loosening bolts which connect shaft to X-brace, this procedure is made easier. To replace belt(s) on Style C, loosen motor bracket to release belt tension and drop old belts off motor and fan pulleys. Do not roll new belts over pulleys under tension. This practice can damage belts severely.

(b) To check belt tension, place a finger midway between fan pulley and motor pulley and push belt(s) inward about ½" (at approximately 5 lb. force) for proper tension. To adjust tension on Style L, H and AL models, loosen motor bracket bolts and tap bracket up or down as necessary. Retighten all motor bracket bolts to mantain proper tension. Recheck alignment of belts, motor pulley and fan pulley. On Style C, loosen motor bracket bolts and utilize tension adjustment bolts to obtain correct belt tension. Retighten all motor bracket bolts to maintain correct tension. *CAUTION:* Use of tension adjustment bolts makes it easy to over-tighten belts. When this occurs belts will soon fail. Do not over-tighten. Recheck alignment of belts, motor pulley and fan pulley.

Blade Pitch Adjustment. On Style C (both direct and belt drive), the propeller has blades on which the pitch may be adjusted. The blade pitch on standard models is factory set for specified performance with standard motor fully loaded. As any change in blade pitch will affect motor load, contact factory for instructions before making any field adjustment of blade pitch. DO NOT ATTEMPT TO CHANGE BLADE PITCH WITHOUT FACTORY INSTRUCTIONS.

Lubrication. On all belt drive models, fan bearings are factory lubricated for extended service. On Styles L, H and AL, relubrication as a part of regular maintenance is not necessary. On Style C, pillow block type bearings are used and relubrication annually or more frequently is recommended. For best results, use Shell Alvania No. 3 lubricant or equivalent. For lubrication of electric motor, see instructions supplied by motor manufacturer.

Repair Parts.

(a) **Belts**—Belts are standard V-belts used on industrial machines and replacements may be obtained through local industrial supply houses. If more than one belt is used on the fan, be sure to replace with matched sets. To install belts, see instructions above for belt replacement.

(b) **Blades**—If one or more blades on propeller are damaged, it is recommended that entire blade assembly be removed and returned to the factory for necessary repair and rebalancing. On Styles L, H and AL, detach shaft from X-brace on fan frame and return the complete propeller, bearing assembly and shaft. For convenience in shipment, individual blades may be removed from the fan pulley. On Style C, the propeller may be removed from the drive shaft.

(c) **Bearings**—Field replacement of the bearings on Style L, H and AL models is not recommended. Return entire blade assembly to factory for repairs. Pillow block bearings on Style C may be replaced in the field.

(d) **Motor**—Motor repairs should be performed only by an authorized motor repair station. Contact the motor manufacturer or American Coolair for location of repair station.

CAUTION: *Do not return damaged or defective parts to American Coolair without prior authorization. If repairs under warranty are claimed, see warranty terms in American Coolair catalog or contact the factory at Jacksonville, Florida. Claims for warranty repairs to electric motor should be made direct to the motor manufacturer.*

WARNING CAUTION

DO NOT INSTALL FAN WITH MOVING PARTS WITHIN 8 FEET OF FLOOR OR GRADE LEVEL WITHOUT A GUARD THAT COMPLIES WITH OSHA REGULATIONS. **DO NOT** USE UNLESS ELECTRICAL WIRING COMPLIES WITH ALL APPLICABLE CODES. **DO NOT** WIRE WITHOUT PROVIDING FOR A POWER SOURCE DISCONNECT AT THE FAN ITSELF. **DO NOT** SERVICE EXCEPT BY A QUALIFIED MAINTENANCE TECHNICIAN AND ONLY AFTER DISCONNECTING THE POWER SOURCE. FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN SERIOUS INJURY OR DEATH.

AMERICAN Coolair®

P.O. Box 2300 Jacksonville, Florida 32203-2300
Phone (904) 389-3646
FAX (904) 387-3449

Installation Instructions for Type C Propeller Fans

OPERATION AND MAINTENANCE INSTRUCTIONS—OTHER SIDE

Dimensions of Wall or Other Opening for Mounting Fan. The Type C fan is designed for all-angle usage and may be mounted in any position. When face mounted to a wall, the wall opening should be approximately 3″ less than O.D. of the fan frame (2 inches for Model CDC18). If fan frame is to be recessed into the wall, opening should be ¼″ larger than O.D. of fan frame. (See dimensions on Coolair Form 220-15.)

Fan Style. Type C fans are divided into several "styles." It may be important for you to know which style you have. Check the model number on the fan. The letter preceding the size number is the style of that fan. Example: Model CBL42H is a Style L, 42″ fan.

Air Exhaust or Air Supply Usage. The Type C fan is designed primarily for use as a wall exhaust fan. All direct drive models and all Style C belt drive models may be modified for use as supply fans. They can be furnished in this configuration by the factory or modified on the job, if necessary. Belt drive models in Style L and H cannot be modified in this way. If supply fan usage of a Style L, H or AL model is required, it is recommended that the entire fan unit be mounted in a sheet metal or plywood sleeve and attached to the wall location with fan position reversed 180° from the normal wall exhaust position. See American Coolair Form 220-15 for accessories and application data for wall supply installation. Most Type C fan models may be electrically reversed for temporary or emergency use. Fan will not perform efficiently when electrically reversed.

Pre-Installation Check of Fan. Before installation of fan, check carefully for shipping damage which may result in blade misalignment, deformed parts or other damage. After motor has been mounted on belt drive models, Styles L, H and AL, check pulley alignment and belt tension (see instructions below). All belt drive models, Style C are shipped complete with motor and drive mounted. Before connecting the power source, check motor nameplate to be sure of correct phase and voltage and motor voltage connection when motor is dual voltage. Make sure propeller turns freely without striking fan frame or any foreign object which may interfere with its operation. Note direction arrow on orifice to make sure propeller is rotating in correct direction when power is applied.

Motor Mounting and Belt Adjustment (Belt driven models). Belt drive models, Styles L, H and AL, of the Type C fan are shipped in two packages. The fan assembly, motor bracket and belt comprise one package; the motor and pulley comprise a second package. The following information should be used in mounting the motor to the fan frame and making correct belt adjustments.

(a) Motor Mounting—Style L, H and AL Models (see Figure 1).

(1) Remove motor bracket from its shipping position on fan frame. Attach motor bracket to motor (see Figure 1 for correct positioning of bracket to motor).
(2) Place fan in upright position with bracket mounting holes in uprights below center of fan.
(3) Hang motor and bracket from belt by placing motor pulley on belt and temporarily supporting back of motor as necessary.
(4) Select correct bracket holes so that slots in motor bracket will allow adjustment up and down.
(5) Fasten motor bracket to uprights with four bolts provided. Make sure motor base remains level. Do not tighten bolts until belt tension is adjusted.
(6) Adjust belt tension (see paragraph (c) below) by loosening bolts slightly and tapping motor bracket up or down as necessary. Check motor pulley alignment with fan pulley and adjust pulley position on motor shaft as necessary. (See American Coolair Form 220-42, packed in motor and pulley package, for proper installation instructions of pulley to motor shaft.)
(7) Retighten pulley set screw (if necessary) and motor bracket bolts. IMPORTANT: Motor bracket bolts must be secured to maintan proper belt adjustment.

(b) Motor Mounting—Style C Model (see Figure 2).
All belt drive models Style C are shipped complete with motor and drive mounted.

(c) Belt Tension Adjustment.
After 8 - 10 hours of fan operation following installation, belt tension should be rechecked and adjusted if necessary. To check proper belt tension, place a finger midway between fan pulley and motor pulley and push belt(s) inward about ½″ (at approximately 5 lb. force) for proper tension. Adjustment beyond the slots in the motor bracket may be necessary. If so, remove motor bracket bolts and place in next hole location in fan uprights. This will allow additional belt adjustment as necessary. *CAUTION:* Use of tension adjustment bolts makes it easy to overtighten belts. When this occurs belts will soon fail. Do not overtighten.

NOTE: *All local, state and federal codes should be checked to make sure all wiring, guarding and intended usage of the fan unit(s) comply with all applicable codes. The proper type and class of fan and motor should be used for air being handled such as explosive or other hazardous air mixtures.*


FIGURE 1

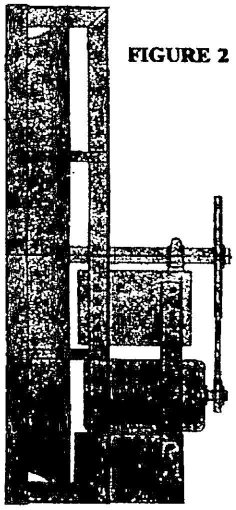


FIGURE 2

AMERICAN Coolair®

P.O. Box 2300 Jacksonville, Florida 32203-2300
Phone (904) 389-3646
FAX (904) 387-3449

Form No. 220-40-12 (3/97) Printed in U.S.A.

Installation, Operation & Maintenance Instructions for Type UD Propeller Fans

INSTALLATION

1. **Dimensions of Wall or Other Opening for Mounting Fan.** The Type UD fan is designed for all angle usage. It may be mounted in any position. When face-mounted to a wall, the wall opening should be approximately 2" less than O.D. of the fan panel. If the fan panel is to be recessed into the wall opening, the opening should be approximately ¼" larger than O.D. of fan panel.

2. **Air Exhaust or Air Supply Usage.** The Type UDU fan can be assembled for either exhaust or supply usage. Prior to installation, check arrangement to be sure it is correct for your application. Most UDU models may be converted from exhaust to supply, or vice versa, in the field. This is accomplished by reversing fan mounting panel, propeller and motor rotation. Most UDU models may be electrically reversed for temporary or emergency use. Fan will not perform efficiently when electrically reversed. UDP models cannot be assembled for supply or converted from exhaust to supply, nor can they be electrically reversed.

3. **Pre-Installation Check of Fan.** Before installaion of fan, check carefully for shipping damage which may result in blade misalignment, deformed parts or other damage. If damage is found, file a claim immediately with delivering carrier. Before connecting to power source, check motor nameplate to be sure of correct phase and voltage. Make sure propeller turns freely without striking fan frame or any foreign object which may interfere with its operation. Note direction arrow on orifice for correct propeller rotation when power is connected.

4. **Speed Controller (Optional Accessory).** If fan model includes a speed controller, it may be used as an on-off switch in addition to controlling fan speed. Speed controller and motor are factory matched. Carefully avoid a mix-up during installation if more than one fan is involved. Speed controller is factory set for maximum speed reduction of 50%. Any adjustment to controller which reduces motor speed below 50% may result in malfunction of motor.

OPERATION AND MAINTENANCE

1. **Fan Cleaning and Adjustment.** The Type UD fan should be cleaned as necessary to remove accumulated dust, dirt and other foreign matter which may collect on the blades or other fan parts. If rust or corrosion is found, the affected area should be thoroughly cleaned and refinished.

2. **Lubrication.** For instructions for lubrication of electric motor see instructions supplied by motor manufacturer.

3. **Repair Parts.**

(a) *Propeller.* If propeller has been damaged, fan should not be operated until a replacement propeller can be obtained from the factory. Field repair is not recommended. If an unbalanced condition develops, thoroughly clean blades to remove dirt or other foreign matter. If unbalance still exists, return to factory for repair or replacement.

(b) *Motor.* Motor repairs should be performed only by an authorized motor repair station. Contact the motor manufacturer or American Coolair for location of repair station.

CAUTION: *Do not return damaged or defective parts to American Coolair without prior authorization. If repairs under warranty are claimed, see warranty terms in American Coolair catalog or contact the factory in Jacksonville, Florida. Claims for warranty repairs to electric motors should be made direct to the motor manufacturer.*

NOTE: *All local, state and federal codes should be checked to make sure all wiring, guarding and intended usage of the fan unit(s) comply with all applicable codes. The proper type and class of fan and motor should be used for air being handled such as explosive or other hazardous air mixtures.*

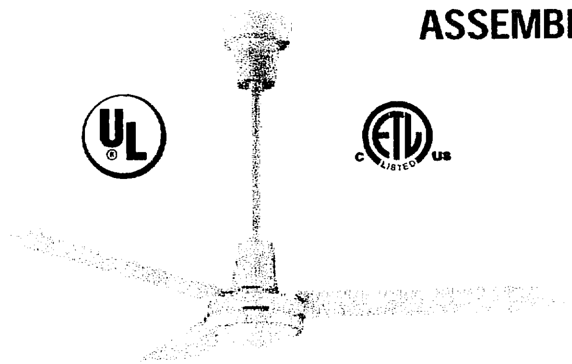
WARNING **CAUTION**

DO NOT INSTALL FAN WITH MOVING PARTS WITHIN 8 FEET OF FLOOR OR GRADE LEVEL WITHOUT A GUARD THAT COMPLIES WITH OSHA REGULATIONS. **DO NOT** USE UNLESS ELECTRICAL WIRING COMPLIES WITH ALL APPLICABLE CODES. **DO NOT** WIRE WITHOUT PROVIDING FOR A POWER SOURCE DISCONNECT AT THE FAN ITSELF. **DO NOT** SERVICE EXCEPT BY A QUALIFIED MAINTENANCE TECHNICIAN AND ONLY AFTER DISCONNECTING THE POWER SOURCE. FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN SERIOUS INJURY OR DEATH.

AMERICAN Coolair®

P.O. Box 2300 Jacksonville, Florida 32203
Phone (904) 389-3646

FORM 240-40-4 (3-88) PRINTED IN U.S.A.



ASSEMBLY INSTRUCTIONS & PARTS MANUAL FOR

LEADING EDGE®
A Division of Marley Engineered Products

COMMERCIAL CEILING FANS

CEILING FANS SHOULD BE INSTALLED BY QUALIFIED INSTALLER.

**MODEL: 3620-1, 4820-1, 5600-1LC
4820-3, 5600-3, 4820-1B**

SPECIFICATIONS

MODEL NUMBER	BLADE SWEEP	COLOR	VOLTAGE	MAX HZ	MAX RPM	MAX AMPS	WATTS	WT (LBS)
3620-1	36"	White	120	50/60	395	.65	75	20
4820-1	48"	White	120	50/60	315	.85	86	22
4820-1B	48"	Black	120	50/60	315	.85	86	22
5600-1LC	56"	White	120	50/60	265	1.0	110	24
4820-3*	48"	White	120	50/60	315	.86	80	23
5600-3*	56"	White	120	50/60	265	1.0	110	26

*This ceiling fan is operated by a pull chain switch which controls the three speeds: 0-off, 1-low, 2-medium, 3-high. (See figure 5 for illustration)

READ INSTRUCTIONS CAREFULLY BEFORE ATTEMPTING TO ASSEMBLE OR SERVICE THE LEADING EDGE CEILING FAN. FAILURE TO COMPLY WITH INSTRUCTIONS COULD RESULT IN PERSONAL INJURY AND/OR PROPERTY DAMAGE.

RETAIN FOR FUTURE REFERENCE.

General Safety Information

WARNING: DISCONNECT POWER BEFORE INSTALLING OR SERVICING THIS EQUIPMENT.

1. All electrical wiring should be done by a qualified electrician in accordance with applicable National Electrical Code and local electrical codes.
2. Do not allow moving blades to come in contact with any part of the body.
3. Mount fan so that fan blades are 7 feet or higher from floor.
4. Make sure hanger hooks are mounted securely to structural ceiling members.
5. Do not mount in an area which will allow the fan to get wet.

WARNING: DO NOT USE IN AN EXPLOSIVE ATMOSPHERE.

6. Make certain that the ground wire is connected to the ground terminal and to a suitable electrical ground.

NOTE: When mounted in cathedral ceilings, the blade tip should be at least 12 inches from the angled roof line to prevent air "blow back" causing possible fan sway.

CAUTION: Read and follow instructions carefully. Failure to comply with instructions could result in the risk of fire, shock and injury to persons.

WARNING: TO REDUCE THE RISK OF PERSONAL INJURY DO NOT BEND THE BLADE BRACKETS WHEN INSTALLING THE BRACKETS OR CLEANING THE FAN. DO NOT INSERT FOREIGN OBJECTS IN BETWEEN ROTATING FAN BLADES.

Description

Leading Edge Fans are designed as a dual purpose product. By minimizing temperature stratification in winter, they can reduce heating costs in high bay buildings. The summertime application provides a gentle downward movement of air for general air recirculation and evaporative cooling. A permanent split capacitor motor and permanently lubricated ball bearings add to the efficiency and quietness of the fans.

Unpacking

1. Remove fan components from carton carefully.
2. Check for shipping damage.
3. Check for missing parts against parts list.

RECOMMENDED MOUNTING HEIGHTS

For heat reclamation, this fan should be mounted on the standard 2' downrod included. In low ceiling applications, the 8" downrod must be used in order to keep the fan blades a minimum of 7' from the floor. On installations through drop ceilings, note the diameter of the downrod hole in the ceiling should be 2½".

CAUTION: Fan blades should not be mounted lower than 7 feet above the floor.

Assembly

This fan includes a "secondary support" safety cable feature that complies with existing C.S.A. (Canadian Standards Association) requirements and all other proposed safety regulations for overhead air movement equipment. To insure proper installation of this important safety feature, please read and follow these instructions carefully.

1. Carefully unwrap the coiled safety cable and motor lead wires.
2. At the motor yoke assembly (A), remove the cotter pin and loosen the hexagon nut. Carefully remove spring washer and the hexagon screw (E). *(See Figure 1)*
3. Slide the upper canopy cover (B) (bell shaped) up the rod. Slide the lower canopy cover (C) up to rod.
4. Feed the three motor lead wires and the safety cable through the center hole in the steel yoke above the motor housing and then continue feeding wires and cable through the downrod until the wires and cable come out at the upper (shackle) end.
5. Reconnect the downrod to the steel yoke and replace the hexagon screw. Secure the spring washer, hexagon nut, and the cotter pin making sure cotter pin is spread to secure in place.

NOTICE: The safety cable should be taped to one side of the yoke with electrical tape to prevent the cable from resting on top of motor during running operation. *(See Figure 2)*

6. Slide the lower canopy (C) to allow a 1/4" minimum height above the motor.

CAUTION: Do not allow the permanently installed lower canopy to touch the revolving motor as damage will occur. Make sure all wires are securely placed to avoid rubbing against the motor.

7. Attach the three blades, curved side down to the motor with the insulation pad mounted between the blade and the motor (See Figure 5). Make sure blade holder is flat against motor platform when tightening blade nuts for secure fit.

CAUTION: Blades must be fastened to the motor as shown in Figure 1. DO NOT reverse blades when installing.

NOTE: Blades are weight balanced per set. DO NOT mix on multiple fan installations.

NOTE:Do not bend fan blade brackets.

WARNING: DISCONNECT CIRCUIT POWER BEFORE MAKING ANY ELECTRICAL CONNECTIONS.

CAUTION: To reduce the risk of personal injury, install the primary mounting directly from building structure and use only the hardware provided with the fan.

8. Before attaching the appropriate "J" hook to the building structure member note the following:

IMPORTANT. WHEN MOUNTING THIS FAN, THE SUPPORT BEAM MUST BE SUITABLE FOR A 50 POUND LOAD LIMIT.

CAUTION: If Pilot hole is used with the wood thread hook, the pilot hole should be drilled no larger than the minor diameter of the screw threads on the hook. Do not put lubricant on the "J" hook. At least 1½" of the screw threads should be inserted into the structural wood joist. When the threaded bolt hook is used, be careful to secure tightly with supplied lockwashers and nuts. Attach the hook as instructed and hang the fan.

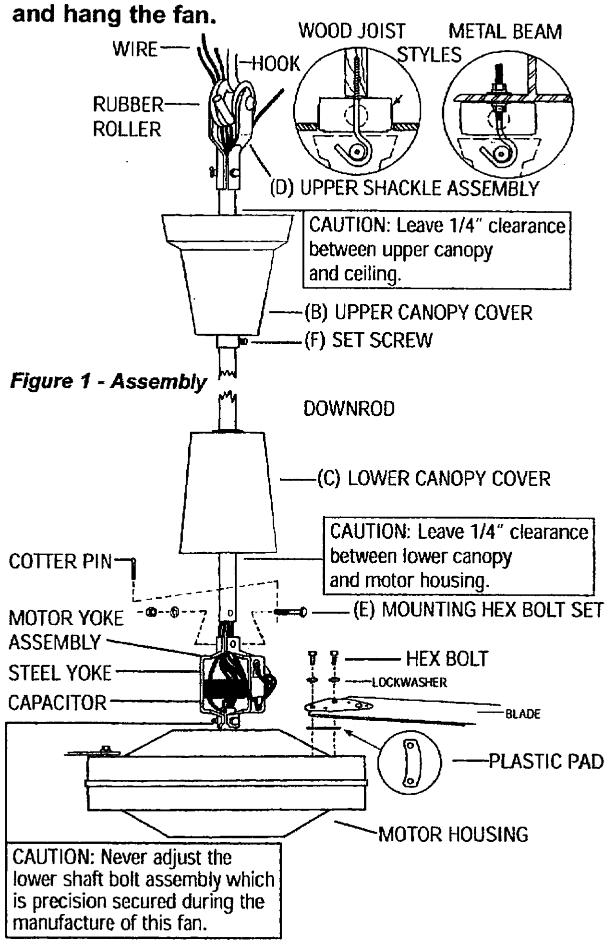


Figure 1 - Assembly

CAUTION: Make sure that blades are attached as shown.

9. This fan is equipped with the required "secondary support" cable. This cable must be affixed to the beam structures and securely clamped in such a manner to support the weight of the fan in the event the mounting hook or other parts fail. After wrapping cable around a structural member that will support 300 lbs., secure cable with supplied cable clamps as illustrated in Figure 3. (Note: Any additional materials needed for specific installations may be purchased from your local distributor.)

NOTICE: Leave approximately 3" but no more than 5" of slack on this safety cable to allow for possible fan movement. Do not exceed more than 5" total slack.

IMPORTANT CAUTION: The safety cable must not be placed between the rubber roller and hook but as illustrated in Figure 3.

10. When hanging fan on factory supplied "J" hook, make sure cable at top of rod is positioned behind "J" hook as illustrated in Figure 3.

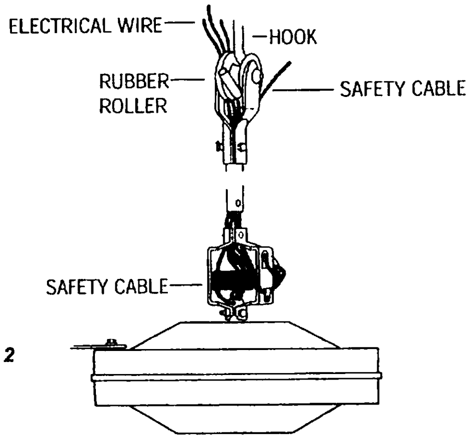


Figure 2

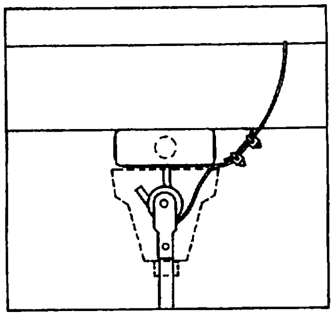


Figure 3

IMPORTANT NOTICE: It is important to note proper installation position of the cable clamps as illustrated in Figure 4. To obtain maximum holding power, install U-bolt section of clip on dead or short end of cable and saddle on long end of cable. Improper installation reduces the efficiency of the connection by as much as 40 percent.

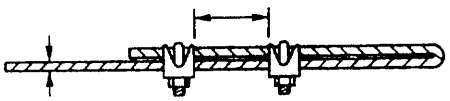


Figure 4

WARNING: DISCONNECT CIRCUIT POWER BEFORE MAKING ANY ELECTRICAL CONNECTIONS.

11. Run the wires from the downrod assembly to the electrical supply using appropriate wiring in accordance with the local code. Connect with listed wire connectors available from your local distributor. Connect black to black, white to white, and green grounding lead to the grounded conductor of the supply circuit. No loose strands or loose connections should be present. After splices are made, the wires should be spread apart so that the green and white are on one side of the outlet box and the black is on the other side. Turn splices upward and carefully push all wiring into outlet box.
12. Slide the upper canopy (B) up the rod to within 1/4" of the ceiling or beam and securely tighten the set screw (F).

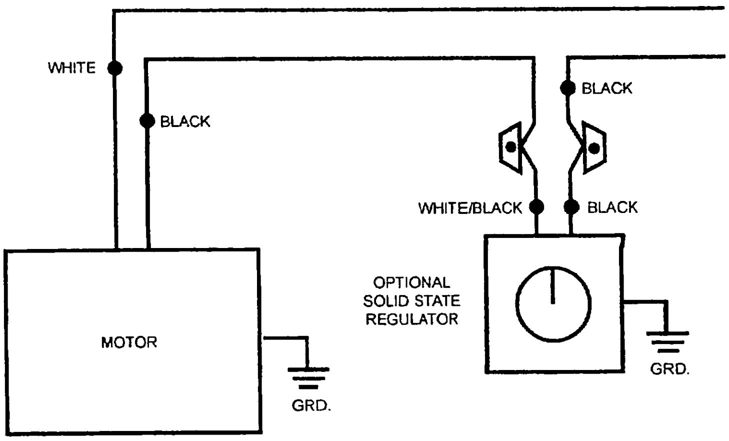


Figure 5

13. If a remote speed control is to be used refer to the installation included with that control for proper in-installation and wiring.
14. Restore power.
15. After completing installation, test run fan in normal operating manner. Inspect for any possible shake or wobble which may be caused by binding as a result of "tight cable". If this should happen, shut off power supply and re-check instructions to correct problem.

NOTE: When any solid state motor speed control is used, a humming noise will be present in the fan on low speed. This hum in no way affects the operation of the fan and is acceptable in most industrial installations. (Not applicable to Models 4820-3 and 5600-3).

CAUTION: Do not flip switch from forward to reverse or vice versa without waiting for motor to stop. Damage to motor or driven equipment can result.

Maintenance

WARNING: THIS FAN HAS AN INTERNAL SELF-RESETTING THERMAL OVERLOAD PROTECTOR. ALWAYS DISCONNECT FROM POWER SUPPLY BEFORE SERVICING.

LUBRICATION

All bearings are permanently lubricated and do not require further lubrication.

CLEANING

This fan may be wiped off with a damp cloth. Do not allow the motor to get wet. Do not use solvents or harsh detergent.

CAUTION: Before servicing or cleaning unit, switch power off at service panel and lock service disconnecting means to prevent power from being switched on accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.

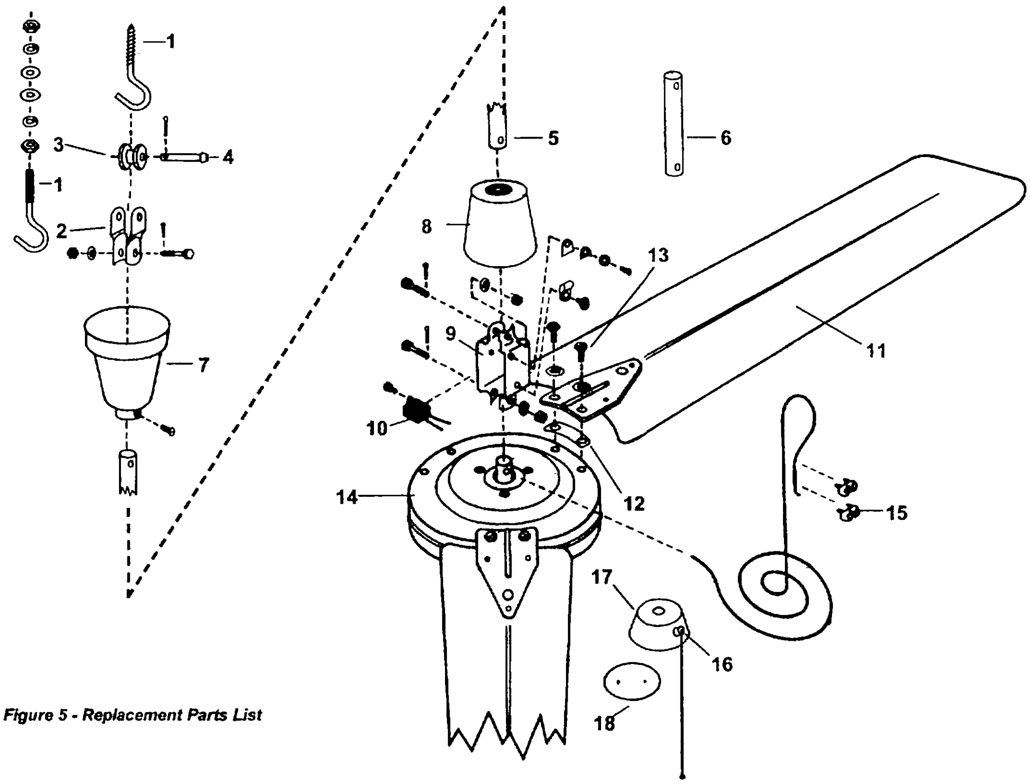


Figure 5 - Replacement Parts List

Replacement Parts

REF. NO.	DESCRIPTION	QTY	PART NO.					
			3620-1	4820-1	4820-1B	5600-1LC	4820-3	5600-3
1	"J" Hook Kit ▲	1	9F2900-01	9F2900-01	9F2900-01	9F2900-01	9F2900-01	9F2900-01
2	Upper Shackle	1	9F2900-03A	9F2900-03A	9F2900-03A	9F2900-03A	9F2900-03A	9F2900-03A
3	Rubber Roller	1	9F2900-04A	9F2900-04A	9F2900-04A	9F2900-04A	9F2900-04A	9F2900-04A
4	Clevis Pin	1	9F2900-05A	9F2900-05A	9F2900-05A	9F2900-05A	9F2900-05A	9F2900-05A
5	24" Downrod	1	9D24BW	9D24BW	9D24BBLK	9D24BW	9D24BW	9D24BW
6	8" Down Rod Pipe	1	9D08	9D08	9D08BBLK	9D08	9D08	9D08
7	Upper Canopy ▲	1	9F2900-07A	9F2900-07A	9F2900-07A	9F2900-07A	9F2900-07A	9F2900-07A
8	Lower Canopy ▲	1	9F2900-08A	9F2900-08A	9F2900-08A	9F2900-08A	9F2900-08A	9F2900-08A
9	Steel Yoke ▲	1	9F2900-10A	9F2900-10A	9F2900-10A	9F2900-10A	9F2900-10A	9F2900-10A
10	Capacitor ▲	1	2100140A	2100140A	2100140A	2100141A	2100144A	2100145A
11	Blades (set of three)	1	9B3620-1	9B4820-1	9B4820-1B	9B5600-1LC	9B4820-3	9B5600-3
12	Blade pads ▲	3	9F2900-19A	9F2900-19A	9F2900-19A	9F2900-19A	9F2900-19A	9F2900-19A
13	Blade Screws ▲	6	9F2900-20A	9F2900-20A	9F2900-20A	9F2900-20A	9F2900-20A	9F2900-20A
14	Motor Assembly ▲	1	9M3620-1	9M4820-1	9M4820-1B	9M5600-1LC	9M4820-3	9M5600-3
15	Cable Clamps ▲	2	9G063947	9G063947	9G063947	9G063947	9G063947	9G063947
16	3-Speed Switch w/Cord	1	-	-	-	-	9F2900-26	9F2900-26
17	Switch Box	1	-	-	-	-	2200003A	2200003A
18	Switch Box Bottom Plate	1	-	-	-	-	2200005A	2200005A

▲ Included in motor assembly.

HOW TO ORDER REPAIR PARTS

In order to obtain any needed repair or replacement parts, warranty service or technical information, please contact Marley Engineered Products Service Center toll-free by calling 1-800-642-HEAT.

When ordering repair parts, always give the information listed as follows:

1. The Part Number
2. The Model Number
3. The Part Description
4. Date of Manufacture

Marley
Engineered Products

SPX Corporation
470 Beauty Spot Rd. East
Bennettsville, SC 29512 USA

INSTALLATION OPERATION AND SERVICE MANUAL

GAS FIRED WALL HUNG & FLOOR MOUNT RESIDENTIAL COMMERCIAL STAINLESS STEEL BOILERS
DynaMax SERIES

HYDRONIC HEATING
Models; DMH081, 101, 151, 201, 251, 211, 261, 291, 391, 501, 601, 701, 801

HOT WATER SUPPLY
Models; DMW082 ,102, 152, 202, 252, 212, 262, 292, 392, 502, 602, 702, 802

COMBINATION HEATING/HOT WATER SUPPLY
Models; DMC083, 103, 153, 203, 253, 213, 263, 293, 393, 503, 603, 703, 803

C US

ENERGY STAR

South Coast AQMD CERTIFIED

WARNING:
If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death

Do not store or use gasoline or other flammable vapours and liquids in the vicinity of this or any other appliance.

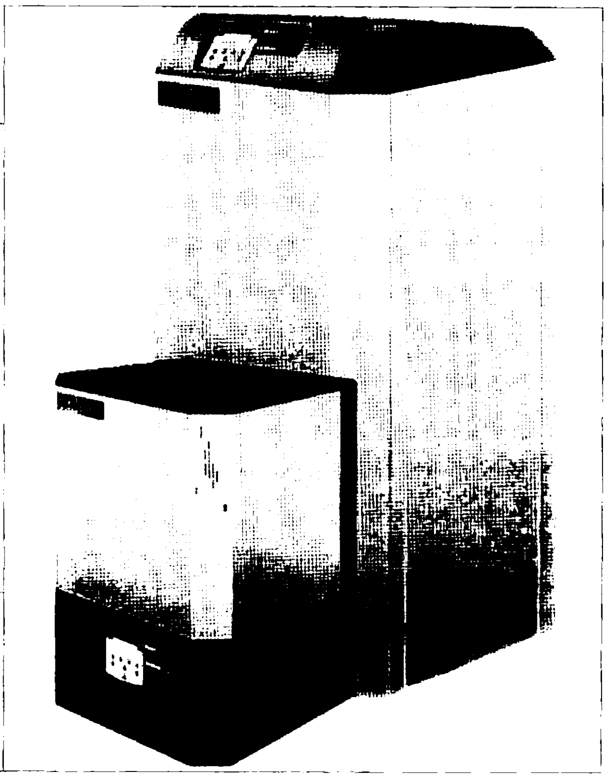
[redacted]

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbour's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

Qualified installer, service agency or the gas supplier must perform installation and service.

To the Installer: After installation, these instructions must be given to the end user or left on or near the appliance.

[redacted] This booklet contains important information about this appliance. Retain for future reference.



CAMUS HYDRONICS LTD.

6226 Netherhart Road, Mississauga, Ontario, L5T 1B7

99-0056
Rev. 01

TABLE OF CONTENTS

PART 1 GENERAL INFORMATION

1.1 INTRODUCTION

The **DynaMax** boiler is a fan assisted boiler based on a push through design which offers several venting options. Heat output is controlled by a one to one air/gas ratio control gas valve which provides seamless modulation. The boiler provides central heating, domestic hot water or combination heating with DHW priority at working pressure up to 160 PSI. It is designed for use with a fully pumped and pressurized water system. The boiler/water heater will automatically modulate to provide heat outputs from 100% down to approximately 20% of rated input.

The DynaMax utilizes a negative pressure gas valve. The operation of the fan will generate a negative pressure in the venturi, which draws in a matching amount of gas through the valve.

During operation the DynaMax maintains a steady state efficiency across the entire range of modulation. Air and gas are metered in precise proportion (1:1 Ratio) allowing combustion characteristics which determine efficiency to remain the same over the entire operating range.

The DynaMax is designed so that all of the sensible heating value and most of the latent heat is being transferred to the water.

1.2 SPECIAL INSTRUCTIONS TO OWNER

This manual supplies information for the installation, operation and servicing of the appliance. It is strongly recommended that this manual be reviewed completely before proceeding with an installation

CAUTION
It is important that all gas appliances are installed by a qualified installer/technician that is trained by Camus Hydronics. It is in your own interest and that of safety to ensure that all local codes, and all the following "NOTES" and "WARNINGS" are complied with. Installing, servicing or adjusting this appliance should be performed only by a qualified installer/technician that is trained by Camus Hydronics. The serviceman must utilize a combustion analyzer with CO_2, CO, and draft gauge, to set the appliance according to Camus Hydronics' recommendations, prior to commissioning.

NOTE
RETAIN THIS MANUAL FOR FUTURE REFERENCE

1.3 CHECKING EQUIPMENT

Check for signs of shipping damage upon receiving equipment. Pay particular attention to parts accompanying the boiler, which may show signs of being hit or otherwise being mishandled. Verify total number of pieces shown on packing slip with those actually received. In case there is damage or a shortage, immediately notify carrier.

1.4 DISPLAY UNIT

The display unit will indicate status and will display selected temperature. Refer to Part 9 DynaMax Control Panel, which provides details to modes and error codes displayed on the appliance.

1.5 SEQUENCE OF OPERATION

1) The power switch is placed in the "ON" position.
2) Minimum 120 VAC 60Hz single phase (15A circuit) is supplied to the DynaMax Field Connection Board.
3) 120 VAC power is supplied to the DynaMax Controller which provides all setup and ignition control functions.
4) Access to settings is through the use of a LPT1/ USB cable using a laptop computer through the LPT1 port on the DynaMax Control Panel.
5) After the appliance water pump starts, flow is proven by the flow proving device. The normally open dry contacts in the low water cutoff (LWCO), if supplied, is to be wired in series with the normally open contacts of the flow proving device. (Refer to Figure 18, page 18 of this Manual)
6) Locate the probe type LWCO in the piping at least 3 feet above the boiler inlet/outlet connection. In all cases check with local codes.
7) Depending on the selected mode, the appliance operates as a master or slave configuration.
8) The DynaMax Controller initiates a start-up sequence once it receives a heat demand.
9) The DynaMax Controller energizes the on-board pump and starts to ramp up the voltage to the electrically commutated DC motor of the combustion fan.
10) The fan will run at Pre-Purge speed until the Pre-Purge timer is satisfied. Once this is complete the DynaMax Controller provides a signal to modulate down to ignition fan speed.
11) The DynaMax controller goes through internal safety checks and if this is satisfied the ignition sequence begins.
12) The DynaMax Controller supplies voltage to the air/gas ratio control valve. The air/gas ratio control valve senses the pressure across the venturi and supplies gas to pre-mix with air.
13) The igniter will continue to spark for 6 seconds, with the gas valve opened, and the fan running at ignition speed.
14) Spark Igniter lights the air/gas mixture. The DynaMax Controller looks for a minimum flame rectification signal of 1.25 μA DC from the flame sensor. If the signal is present the DynaMax Controller will allow the gas valve to remain open. The burner is now firing at starting input rate.
15) The boiler will modulate to the correct fan speed to meet the heat demand. The modulation rate is controlled via Pulse Width Modulation (PWM) signals provided by the DynaMax Controller.
16) The fan speed will slowly decrease as the heat request nears the heat demand. If the heat demand is sustained for a long duration of time the boiler will get to a point of steady-state and the fan will rotate at a constant speed.
17) When the heat demand is satisfied or is removed the burner will shut off and the fan speed will ramp up to the preset Post-Purge speed until the Post-Purge Timer is satisfied.
18) The boiler will then go into Standby as it awaits for the next heat demand.

Table 1: DynaMax Ignition Cycle (in LabVision)

	State						
	Standby	Pre-Purge	Safety On	Safety Off	Ignit 0	Ignit 1	Burn
Time	On	5sec after fan speed is within 300 RPM			2 sec	6 sec	Limited to 24 hrs Continuously[3]
Demand	0	No influence	No influence	No influence	No influence	No influence	> 0
Fan [RPM]	Off	Ignition Speed	Ignition Speed	Ignition Speed	Ignition Speed	Ignition Speed	Requested Power
Gas Valve	Closed	Closed	Closed	Closed	Closed	Open	Open
Spark	Off	Off	Off	Off	On	On4	Off
Ionisation	0	0	0	0	0[1]	Flame must be detected	Flame must be detected

Note:

1. If a flame signal is detected at the end of the pre-purge period a lockout will occur.
2. If at the end of the safety period (6 sec) no flame is detected the control will go to post-purge to remove the unbumed gas. After this, a re-ignition attempt is started following the same cycle. The number of re-ignition attempts is limited to 2 after which a lockout occurs.
3. The burner can only be on continuously for a period of 24 hours. After this the burner is switched off and a restart sequence follows.
4. Sparking stops 2 seconds before the end of the ignition period to allow for ionisation detection.

1.5.2 Heat Transfer Process

1) Burner Input continues to increase until outlet water temperature reaches the Set Point temperature.
2) Burner Input may stabilize at a fixed rate where demand equals input.
3) Burner Input will decrease rate when outlet water temperature approaches temperature Set Point.

1.5.3 End of Sequence

1) Set Point temperature is satisfied.
2) Power to the gas valve is turned off.
3) Combustion Air Fan ramps to a stop over the factory preprogrammed time period.
4) Thermostat is now in standby mode waiting for the next "Call for Heat".

WARNING
To minimize the possibility of serious personal injury, fire or damage to your appliance, never violate the following safety rules.

DO NOT
Do not use this appliance if any part of it has been **under water**. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been **under water** must be replaced

WHAT TO DO IF YOU SMELL GAS
Do not try to light any appliance. • Do not touch any electric switch: do not use any phone in your building. • Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions. • If you cannot reach your gas supplier, call the fire department.

IMPORTANT
Consult and follow local Building and Fire Regulations and other Safety Codes that apply to this installation. Contact the local gas utility company to inspect and authorize all gas and flue connections.
Installation and service must be performed by a qualified technician/installer, and trained by Camus Hydronics.

WARNING
Should overheating occur or the gas supply fails to shut off, **DO NOT** turn off or disconnect the electrical supply to the pump. Shut off the gas supply at a location external to the appliance.

- Boilers and water heaters are heat producing appliances. To avoid damage or injury, do not store materials against the appliance or the vent-air inlet system. Use proper care to avoid unnecessary contact (especially children) with the appliance and vent-air inlet components.
- Never cover appliance, lean anything against it, store trash or debris near it, stand on it or in any way block the flow of fresh air to appliance.
- **UNDER NO CIRCUMSTANCES** may flammable materials such as gasoline or paint thinner be used or stored in the vicinity of this appliance, vent-air inlet system or any location from which fumes could reach the appliance or vent-air inlet system.
- A gas appliance that draws combustion air from the equipment room where it is installed must have a supply of fresh air circulating around it during burner operation for proper gas combustion and proper venting.

1.6 INSTALLATION CODES

The equipment shall be installed in accordance with those installation regulations enforced in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made. In the absence of such requirements, the installation shall conform to the latest edition or current as amended of the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA-B149 Installation Code. All electrical wiring must be done in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with national electrical code, ANSI/NFPA70 and/or the Canadian electrical code part 1 CSA C22.1. Where required by the authority having jurisdiction, the installation must conform to American Society of Mechanical Engineers Safety Code for Controls and Safety Devices for Automatically Fired Boilers, ASME CSD-1. All boilers must conform to the latest edition of the ASME Boiler and Pressure Vessel Code, Section II. Where required by the authority having jurisdiction, the installation must comply with the CSA International, CAN/CGA-B149 and/or local codes. This appliance meets the safe lighting performance criteria with the gas manifold and control assembly provided, as specified in the ANSI standards for gas-fired units, ANSI Z21.13.

1.7 WARRANTY

- Factory warranty (shipped with unit) does not apply to units improperly installed or improperly operated.
- Factory warranty shall apply only when the appliance is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices.
- Excessive **water hardness** causing a lime build-up in the stainless steel coils or tubes is not a fault of the appliance and is not covered by warranty. Consult the factory for recommendations for use in hard water areas. (See Water Treatment and Water Chemistry)
- Using or storing **corrosive chemicals** in the vicinity of this appliance can rapidly attack the stainless steel venting and heat exchanger coils and voids warranty.
- Damage caused by **freezing or dry firing** voids warranty.
- This appliance is not to be used for **temporary heating** of buildings under construction.
- The manufacturer shall **NOT** be held liable for any personal injury or property damage due to ice formation or the dislodging of ice from the vent system or the vent termination

1.8 REMOVAL OF EXISTING APPLIANCE

When an existing appliance is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it .At the time of removal of an existing appliance, the following steps must be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

- Seal any unused openings in the common venting system.
- Visually inspect the venting system for proper size and horizontal pitch and determine that there is no blockage, restriction, leakage, corrosion or other deficiency, which could cause an unsafe condition.
- Insofar as is practical, close all building doors and windows and all doors between the spaces in which the appliances remaining connected to the common venting system are located and other spaces of the building. If applicable turn on the clothes dryers and any appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
- Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so that appliance operates continuously.
- After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition of use.
- Any improper operation of the common venting system should be corrected so that the installation conforms to the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA B149, Installation Codes. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 11 of the National Fuel Gas Code, ANSI Z223.1 and /or CAN/CGA B149, Installation Codes.

Heat exchanger surfaces and vent piping should be checked every six months for deterioration and carbon deposits. Remove all soot or other obstructions from the chimney and flue, which might impede draft action. Replace any damaged or deteriorated parts of the venting system.

A qualified service technician should follow this procedure when inspecting and cleaning the heat exchanger and vent pipe.

1) Turn off electrical power and main manual gas shut-off and allow appliance to cool down.
2) Remove the vent pipe at connection to heat exchanger and check heat exchanger and vent for obstruction and clean as necessary.
3) Remove burner from appliance and carefully clean as required. Never brush or wipe the knitted metal fiber surface. Use a garden hose or gently wash under the tap. Vacuum out any deposits found in the heat exchanger.

CAUTION
Never use a pressure washer or compressed air to clean the burner.

4) Reinstall parts removed in steps 2 and 3. Be sure that vent pipe has proper pitch and is properly sealed. Replace any damaged gasket or refractory. Tighten fan flange mounting nuts to 3 ft-lb.
5) Restore electrical power and gas supply to appliance.
6) Place appliance in operation using lighting instructions provided.
7) Confirm proper operation of all safety devices
8) Check for gas leaks and proper vent operation.

NOTE
Experience has shown that improper installation or system design, rather than faulty equipment, is the cause of most operating problems

1.9 BOILER/FURNACE ROOM OPERATING CONDITION

- Due to low jacket losses from the appliance, temperatures in the vicinity of the boiler room may drop significantly; supplemental heat is required to maintain ambient temperature at minimum of 40°F.

1.10 LOCATION OF UNIT

Install this appliance in a clean, dry location with adequate service clearance.

- Do not locate this appliance in an area where it will be subject to freezing unless precautions are taken. Radiant losses from the DynaMax are minimal and should not be relied on to keep the appliance room warm.
- The appliance should be located close to a floor drain in an area where leakage from the appliance or connections will not result in damage to the adjacent area or to lower floors in the structure, it is recommended that a suitable drain pan, adequately drained, be installed under the unit. Under no circumstances is the manufacturer to be held responsible for water damage in connection with this unit, or any of its components.
- If the appliance is installed above the level of the building's radiation system, a low water cut-off device must be installed in the appliance outlet at a minimum of 3 ft (1M) above the heat exchanger inlet/outlet connections. Some local codes require the installation of a low water cut-off on all systems
- When placing the appliance be aware that a minimum clearance of 24" must be provided at the front to allow easy access to the heat exchanger. DynaMax wall mount units do not require access through the sides and could be placed adjacent to each other with zero clearance. Floor mount units require access on the left side.
- The appliance must be installed so that the ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)
- Appliances located in a residential garage and in adjacent spaces that open to the garage and are not part of the living space of a dwelling unit must be installed so that all burners and burner ignition devices have a minimum clearance of not less than 18" (46cm) above the floor. The appliance must be located or protected so that it is not subject to physical damage by a moving vehicle.
- **DO NOT** install this appliance in any location where gasoline or flammable vapors are likely to be present.
- Appliance must be installed on a level floor. Maintain required clearances from combustible surfaces.
- The appliance designed for indoor installation (Indoor Models) must be installed indoors where it is protected from exposure to wind, rain and weather.
- The appliance designed for outdoor installation (Outdoor Models) must be installed outdoors. For outdoor installations, always consider the use of a shelter such as a garden shed in lieu of direct exposure of the appliance to the elements. The additional protection afforded by the shelter will help to minimize nuisance problems with electrical connections and will allow easier servicing of the appliance under severe weather conditions.

1.11 CLEARANCE FROM COMBUSTIBLE MATERIAL

This appliance is suitable for alcove (a closet without a door) installation with minimum clearances to combustibles as follows:

Table 2: Wall Hung Clearance from Combustibles

Clearances from Combustibles		
	Wall Hung Model	**Floor Mount Model**
TOP:	0"	0"
SIDES:	0"	0"
REAR:	0"	12"
VENT (Vent Adapter):	1"	1"
VENT (PVC/CPVC):	0"	0"
FRONT:	3"	6"

Figure 1: Wall Hung Clearance from Combustibles

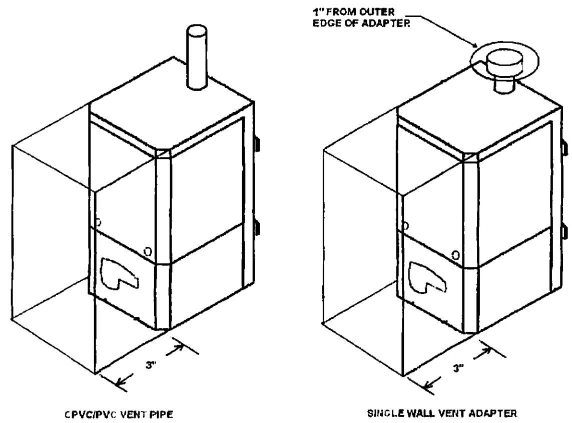
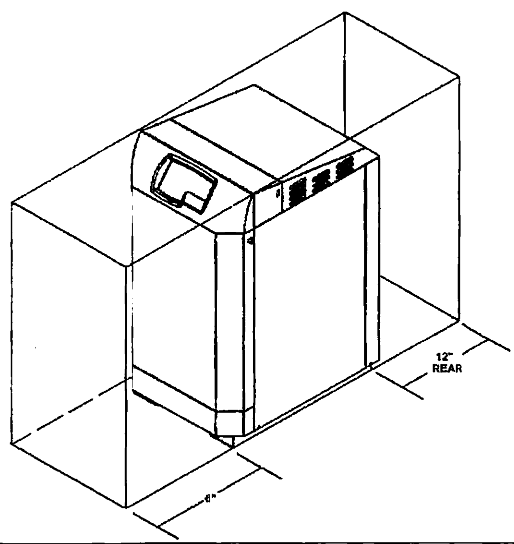


Figure 2: Floor Mount Clearance from Combustibles



NOTE
Clearances from combustible construction are noted on the appliance rating plate

Table 3: DynaMax Wall Hung Service Clearances

Input [BTU/hr]	Service Clearance, Inches (cm)				
	Front	Top	Right Side	Left Side	Rear
80,000	24" (61cm)	3" (8 cm)	4" (10 cm)	4" (10 cm)	0" (0 cm)
100,000	24" (61cm)	3" (8 cm)	4" (10 cm)	4" (10 cm)	0" (0 cm)
150,000	24" (61cm)	3" (8 cm)	4" (10 cm)	4" (10 cm)	0" (0 cm)
200,000	24" (61cm)	3" (8 cm)	4" (10 cm)	4" (10 cm)	0" (0 cm)
250,000	24" (61cm)	3" (8 cm)	4" (10 cm)	4" (10 cm)	0" (0 cm)

Figure 3: DynaMax Wall Hung Model Dimensions

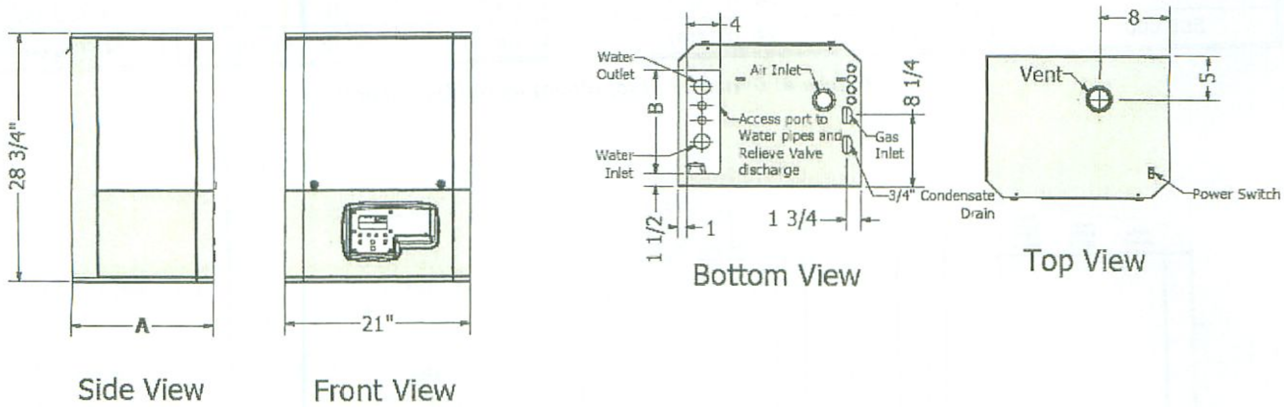


Table 4: Appliance Dimensions and Specifications

Input [BTU/hr]	Depth Dim. "A" [in.]	Dim. "B" [in.]	Equivalent Length of Vent & Air Intake Pipes at Recommended Diameter, [in.]			Water Connection at Boiler [in.] NPT	Gas Connection at Boiler [in.] NPT
			Over 25' and up to 100'	Over 15' and up to 25'	Up to 15'		
80,000	16 1/2	12	3	3	2	1	1/2
100,000	16 1/2	12	3	3	2	1	1/2
150,000	16 1/2	12	3	3	2	1	1/2
200,000	23 1/2	19	3	3	2	1	1/2
250,000	23 1/2	19	3	3	2	1 1/4	1/2

Maintain minimum specified clearances for adequate operation. All installations must allow sufficient space for servicing the vent connections, water pipe connections, circulating pump, bypass piping and other auxiliary equipment, as well as the appliance

Table 5: DynaMax Floor Mount Service Clearances

Input [BTU/hr]	Service Clearance, Inches (cm)				
	Front	Top	Right Side	Left Side	Rear
200,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31cm)	14" (36 cm)
250,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31cm)	14" (36 cm)
299,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31 cm)	14" (36cm)
399,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31 cm)	14" (36 cm)
500,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31 cm)	14" (36 cm)
600,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31 cm)	14" (36cm)
700,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31 cm)	14" (36 cm)
800,000	12" (31cm)	24" (61cm)	0" (0cm)	12" (31 cm)	14" (36 cm)

Figure 4: DynaMax Floor Mount Model Dimensions

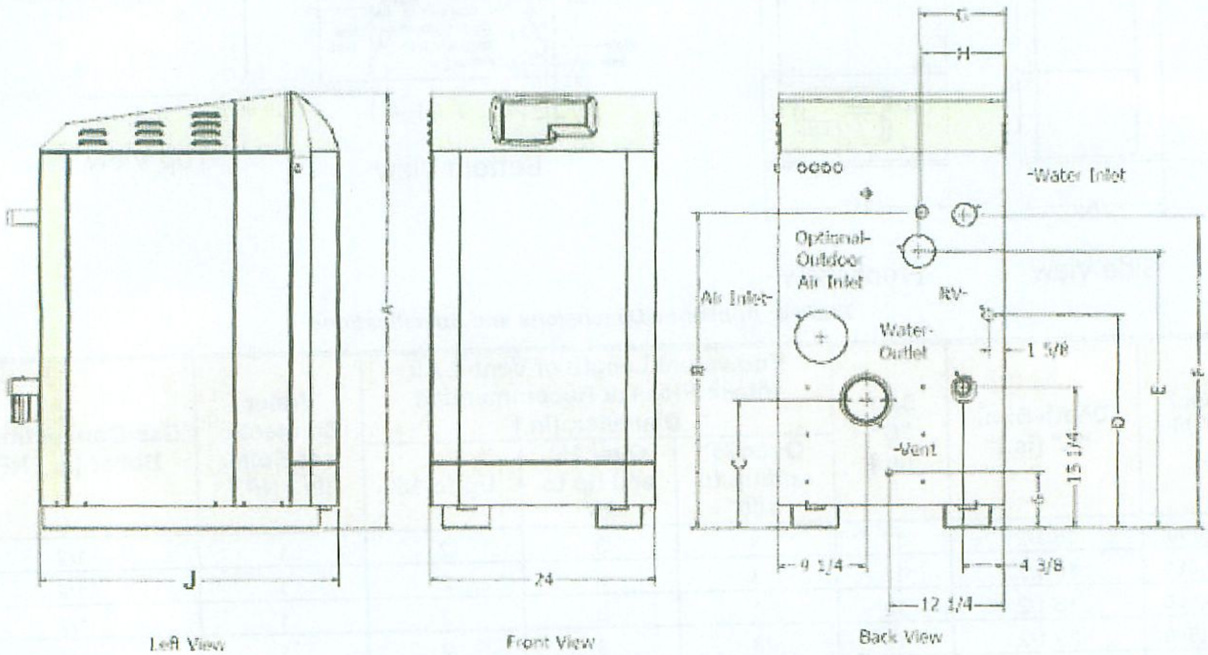


Table 6: Appliance Dimensions and Specifications

Model	Height Dim. "A" [in.]	Dim. "B" [in.]	Dim. "J" [in.]	Equivalent Length of Vent & Air Intake Pipes at Recommended Diameter, [in.]				Water Connection at Heater [in.] NPT	Gas Connection at Boiler [in.] NPT
				Category IV			CAT.II Comb. Vents		
				Over 25' and up to 100'	Over 15' and up to 25'	Up to 15'			
200,000	36	22 3/4	32	3	3	2	4	1	1/2
250,000	36	22 3/4	32	3	3	2	4	1 1/4	1/2
299,000	47 1/8	34 7/8	32	4	3	3	5	1 1/4	3/4
399,000	47 1/8	34 7/8	32	4	3	3	5	1 1/2	1
500,000	47 1/8	34 7/8	32	4	3	3	6	1 1/2	1
600,000	47 1/8	36 1/4	40 1/2	4	3	3	6	2	1
700,000	47 1/8	36 1/4	40 1/2	4 (Air), 5 (Vent)	4	4	7	2	1
800,000	47 1/8	36 1/4	40 1/2	5 (Air), 6 (Vent)	5	5	7	2 1/2	1

Maintain minimum specified clearances for adequate operation. All installations must allow sufficient space for servicing the vent connections, water pipe connections, circulating pump, bypass piping and other auxiliary equipment, as well as the appliance

Figure 5: DynaMax Wall Hung Service Clearances

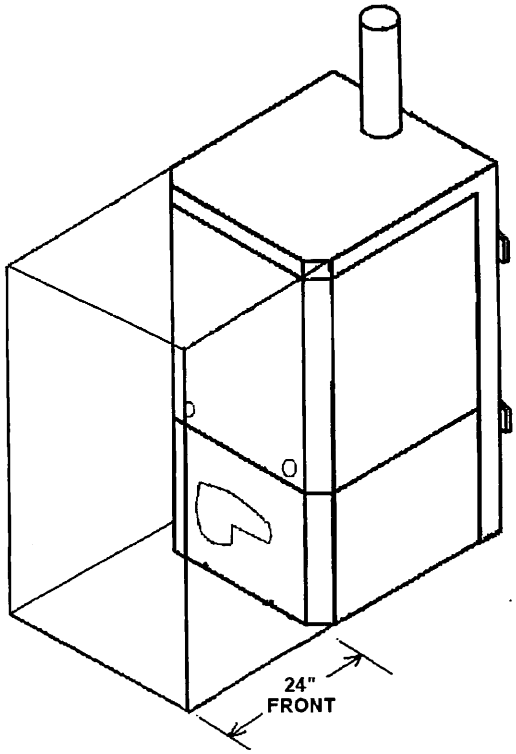
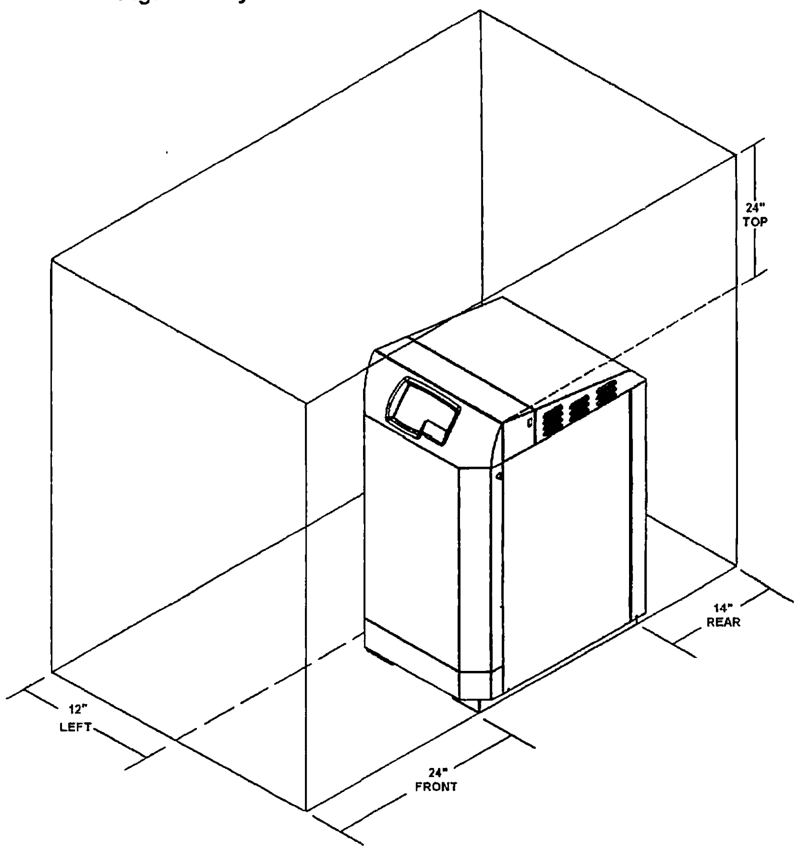


Figure 6: DynaMax Floor Mount Service Clearances



PART 2 AIR INLET AND VENTING

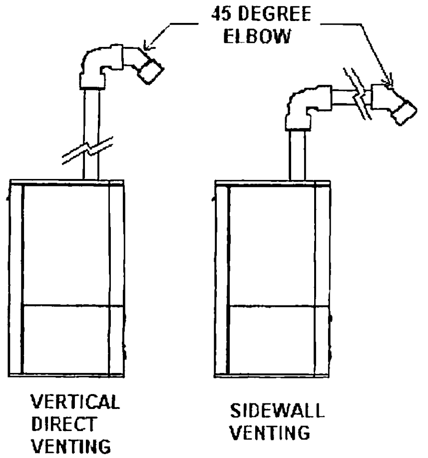
⚠ DANGER

It is extremely important to follow these venting instructions carefully. Failure to do so can cause severe personal injury, death or substantial property damage.

2.1 *GENERAL VENTING GUIDE*

- Single pipe vent with common air from room.

Figure 7: Vertical Venting Configuration



The DynaMax Wall Hung is a category IV condensing appliance, 97% efficient unit. The DynaMax Floor Mount is a category II condensing appliance, 97% efficient.

- The DynaMax may be vented with manufactured prefabricated UL/ ULC listed vents of AL29-4C or 316L stainless steel or with plastic vent certified to UL/ ULC S636, such as, IPEX System 636 CVPC or IPEX System 636 PVC or as permitted by local jurisdictions.
- The DynaMax boiler must be vented and supplied with combustion and ventilation air as described in this section. Ensure that the venting and combustion air supply complies with these instructions regarding the vent system, air system, and combustion air quality.
- Installations must be in accordance with Part 7, "Venting of Equipment", of the latest edition of the National Fuel Gas Code, ANSI Z223.1 for US installations or the latest edition of CAN/CGA Standard B149 Installation Code for Gas Burning Appliances and Equipment in Canada.
- The distance of the vent terminal from adjacent buildings, windows that open and building openings MUST comply with the latest edition of the National Fuel Gas Code, ANSI Z223.1 for U.S. installations or CAN/CGA Standard B149 Installation Code for Canadian Installations.
- Vent connection is made directly to the flue outlet opening on top of the unit for the wall mount unit and at the back of the unit for floor mount. The connection from the appliance vent to the stack must be made as direct as possible. The first 3 feet of vent from the appliance flue outlet must be readily accessible for visual inspection.
- Vent connectors serving appliances vented by natural draft shall not be connected into any portion of a mechanical draft system operating under positive pressure.
- A UL listed concentric vent/air intake kit may be used with the DynaMax.
- Horizontal runs of vent pipe shall be securely supported (approximately every 4 feet) to prevent sagging and maintain a minimum upward slope of ¼" per foot from the appliance to the vent terminal.
- The weight of the venting system must not rest on the unit. Adequate support of the venting system must be provided in compliance with local codes and other applicable codes.
- All connections should be secured and sealed per the vent manufacturer's specifications. When a positive vent system is disconnected for any reason, the flue must be reassembled and resealed according to the vent manufacturer's instructions.
- Do not use an existing chimney as a raceway if another appliance or fireplace is vented through the chimney.
- Inspect completed vent and air supply piping thoroughly to ensure all connections are sealed and are in compliance with the instructions provided and satisfy requirements of all applicable codes.

NOTE
All vent pipes must be properly assembled and supported, and the exhaust must be pitched a minimum of 1/4 inch per foot back to the boiler. All components used to fabricate and assemble the vent system are to originate from the same supplier.

When determining equivalent inlet air and vent lengths of 3" diameter add 3 to 5 feet for each 90° elbow and 2 to 3 feet for each 45° elbow, depending on centerline radius of the elbow.

Example: 30 feet of CPVC pipe + (3 x 5 feet) 90° elbows + (1 x 3 feet) 45° elbow = 48 equivalent feet of piping for centerline radius of 1.5D, where D is the pipe diameter.

2.2 *CATEGORY IV VENTING*

A category IV appliance is individually vented through a dedicated vent.

The DynaMax Wall Hung boilers/ water heaters shall only be vented as a Category IV appliance. The DynaMax Floor Mount appliances may be vented as a Category II or IV appliance.

Both Wall Hung and Floor Mount appliances shall be vented using sealed positive vent suitable for a condensing appliance with the following venting options:

1) Sidewall or rooftop termination where both the vent and combustion air inlet air are in the same zone. The inlet and vent terminals are to be installed with a minimum 12" separation distance between centerline of inlet and centerline of exhaust. Refer to Fig. 8, 9, and 10 for sidewall termination and Fig. 11 for rooftop termination.
2) Sidewall termination with vent and combustion air inlet from separate zones.
3) Single Pipe thru wall or rooftop venting with combustion air inlet from the boiler room.

NOTE
Vent Option 3 not recommended for R-2000 homes or equivalent air tight construction.

2.2.1 Approved Venting Materials Category IV

1) PVC and CPVC (Chlorinated Polyvinyl Chloride) Schedule 40 or 80 approved to ULC S636.
2) Manufactured prefabricated UL/ULC listed vent of AL29-4C or 316L stainless steel. Use of 316L is limited to use in applications where there is no possibility of contaminants in the air such as refrigerants, chlorine etc.
3) PVC-DWV approved to comply with ANSI/ASTM D2665 (US Jurisdictions ONLY when permitted)
4) PVC Schedule 40 approved to comply with ANSI/ASTM D1785. (US Jurisdictions ONLY when permitted)
5) CPVC Schedule 40 approved to comply with ANSI/ASTM F441. (US Jurisdictions ONLY when permitted)

Table 7: Maximum Flue Temperature for Various Vent Materials

Vent Material	Maximum Flue Temperature [°F]
PVC	149
CPVC	194
AL29-4C	300+, limited only by rating of seals
316L Stainless Steel	300+, limited only by rating of seals

Air Inlet (Supply Air or Fresh Air) Piping

- PVC
- CPVC (Chlorinated Polyvinyl Chloride) 1)
- ABS (Acrylonitrile-Butadiene-Styrene)
- Single wall, Galvanized
- Single wall, Stainless steel
- Single wall, Aluminium

Single wall air inlet pipes are to be insulated 5 feet from the wall toward the interior of the building to minimize external sweating.

The following air intake options shall be utilized:

- Outside air sealed direct (vertical or horizontal)
- Outside air ducted to jacket flange
- Indoor Air

Table 8: Required Vent and Air Inlet Diameters

Input [BTU/hr]	Equivalent Length of Vent & Air Intake Pipes at Recommended Diameter*			
	Category IV			Category II
	Over 25' and up to 100'	Over 15' and up to 25'	Up to 15'	
80,000	3"	2"	2"	-
100,000	3"	2"	2"	-
150,000	3"	2"	2"	-
200,000	3"	3"	2"	4"
250,000	3"	3"	2"	4"
299,000	4"	3"	3"	5"
399,000	4"	3"	3"	5"
500,000	4"	3"	3"	6"
600,000	4"	3"	3"	6"
700,000	4" (Air), 5" (Vent)	4"	4"	7"
800,000	5" (Air), 6" (Vent)	5"	5"	7"

* Consult factory for recommendations applicable to venting combinations not shown above.

2.3 CATEGORY II VENTING

A category II appliance may be combined into a common negative pressure venting system designed to ASHRAE requirements using a proven vent sizing program. Vent designs are to be certified by a qualified professional designer acceptable to the authority having jurisdiction.

The DynaMax Floor Mount boiler may be vented as a Category II appliance using sealed vent suitable for a condensing appliance.

2.3.1 Approved Venting Materials Category II

1) PVC and CPVC (Chlorinated Polyvinyl Chloride) Schedule 40 or 80 approved to ULC S636.
2) Manufactured prefabricated UL/ULC listed vent of AL29-4C or 316L stainless steel. Use of 316L is limited to use in where there is no possibility of contaminants in the air such as refrigerants, chlorine etc.
3) PVC-DWV approved to comply with ANSI/ASTM D2665 (US Jurisdictions ONLY when permitted).
4) PVC Schedule 40 approved to comply with ANSI/ASTM D1785. (US Jurisdictions ONLY when permitted)
5) CPVC Schedule 40 approved to comply with ANSI/ASTM F441. (US Jurisdictions ONLY when permitted).

Air Inlet (Supply Air or Fresh Air) Piping

- PVC
- CPVC (Chlorinated Polyvinyl Chloride)
- ABS (Acrylonitrile-Butadiene-Styrene)
- Single wall, Galvanized
- Single wall, Stainless steel
- Single wall, Aluminium

Single wall air inlet pipes are to be insulated 5 feet from the wall toward the interior of the building to minimize external sweating.

The following air intake options shall be utilized:

- Outside air sealed direct (vertical or horizontal)
- Outside air ducted to jacket flange
- Indoor Air

2.4 COMBINED COMBUSTION AIR INLET

Both the Category IV Wall Hung and Category II Floor Mount DynaMax appliances may be installed with a combined combustion air inlet.

The combined combustion air inlet pipe sizing can be calculated using the method shown below:

Equivalent pipe diameter = Sq Root $[(d_1)^2 + (d_2)^2 + (d_3)^2 + \ldots + (d_n)^2]$, where d_n = individual pipe diameter

- Example: Find the equivalent pipe diameter of three air inlet pipes, 3" (7.6cm), 3" (7.6cm) and 4" (10.2cm)

  Equivalent pipe diameter = Sq Root$[(3)^2 + (3)^2 + (4)^2]$ = Sq Root(34) = 5.8", select 6" (15.3cm) equivalent diameter pipe.

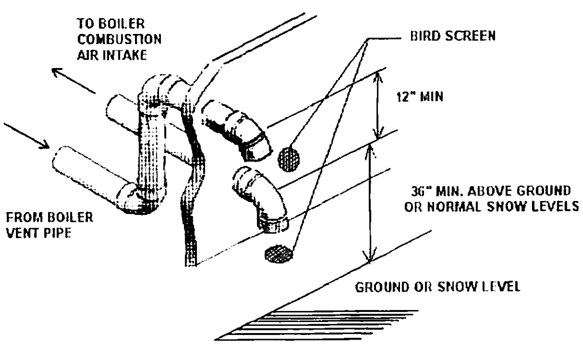
The air inlet point for multiple boiler air inlets must be provided with an exterior opening which has a free area equal to or greater than the total area of all air inlet pipes connected to the common air inlet. This exterior opening for combustion air must connect directly to the outdoors. The total length of the combined air inlet pipe must not exceed a maximum of 100 equivalent feet (30.5m). Deduct the restriction in an area provided by any screens, grills or louvers installed in the common air inlet point. Screens, grills or louvers installed in the common air inlet can reduce the free area of the opening from 25 to 75% based on the materials used. Calculate and compensate accordingly.

2.5 VENT TERMINATION AND AIR INLET CLEARANCES

2.5.1 Sidewall Venting

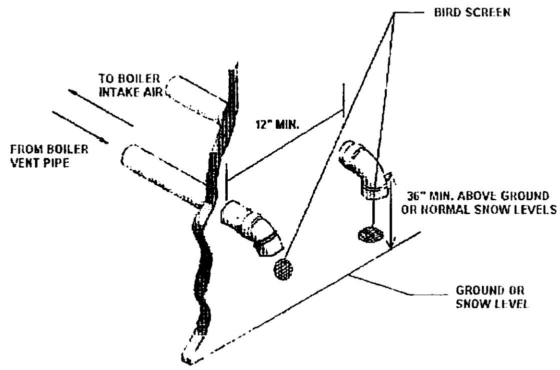
- The first 3 feet (1m) of vent from the appliance flue outlet must be readily accessible for inspection.

Figure 8: Vertical Configuration



* Always check local codes for minimum distance above ground or snow levels

Figure 9: Horizontal Configuration



* Always check local codes for minimum distance above ground or snow levels

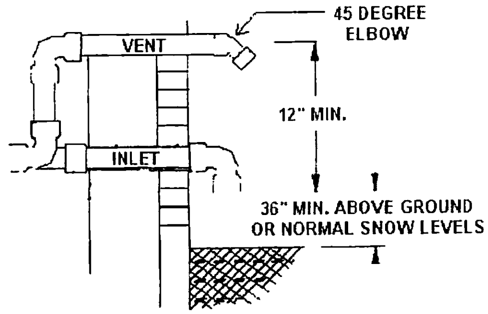
Location of Vent Termination

1) The total length of vent piping must not exceed the limits stated in Table 8.
2) The bottom of the vent terminal shall be located at least 3 feet (1m) above grade or above normal snow levels. In all cases the appliance shall be installed in accordance with local codes
3) The DynaMax can vent up to 100 equivalent feet. Elbows can range from 3 to 5 feet in equivalent length depending on the centerline radius. Vent sizes are 3" for Models 80 to 250 and 4" for Models 299 to 500 for equivalent vent lengths of up to 100'.
4) The vent outlet shall terminate at least 12" (0.30m) away from any forced air inlet. The vent must be at least 7 feet (2.15m) above grade when located adjacent to public walkways due to normal formation of water vapour in the combustion process.
5) The vent outlet MUST NOT terminate below a forced air inlet at any distance
6) The vent cannot terminate below grade. Position the vent termination where vapours will not damage walls or plants or may be otherwise objectionable.
7) The vent terminal shall not be installed closer than 3 feet (1m) from an inside corner of an L-shaped structure, window well, stairwell, alcove, courtyard or other recessed area as wind eddies could affect boiler performance or cause recirculation.
8) DO NOT terminate closer than 4 feet (1.25m) horizontally and vertically from any electric meter, gas meter, regulator, relief valve, or other equipment. In all cases local codes take precedence
9) Position terminations so they are not likely to be damaged by foreign objects, or exposed to a build-up of debris.
10) The vent piping must terminate in an elbow pointed outward or away from the air inlet.
11) Flue gas condensate can freeze on exterior walls or on the vent cap. Frozen condensate on the vent cap can result in a blocked flue condition. Keep the vent cap/terminal clear of snow, ice, leaves, debris etc. Some discolouration to exterior building surfaces is to be expected. Adjacent brick or masonry surfaces should be protected with a rust resistant sheet metal plate.

12) Perform regularly scheduled inspections to ensure that the vent terminal is unobstructed.

2.5.2 Sidewall Air Inlet

Figure 10: Sidewall Vent and Air Inlet Configuration



* Please check local codes for minimum distance above ground or snow levels

Location of a Sidewall Air Inlet Cap

1) The total length of piping for air inlet must not exceed the limits stated in Table 8.
2) The point of termination for the sidewall air inlet cap must be located a minimum of 12 inches (0.30m) away from the flue gas termination, but never above.
3) The air piping must terminate in a down-turned elbow to avoid recirculation of flue products into the inlet air stream.
4) DO NOT terminate closer than 4 feet (1.25m) horizontally and vertically from any electric meter, gas meter, regulator, relief valve, or other equipment. In all cases local codes take precedence
5) DO NOT terminate the air inlet in a window well, stairwell, alcove, courtyard or other recessed area as wind eddies could affect performance or cause recirculation.
6) The air inlet cannot terminate below grade.
7) Locate terminations so they are not likely to be damaged by foreign objects, or exposed to build-up of debris.
8) Perform regularly scheduled inspections to ensure that the air inlet terminal is unobstructed.

Termination and Fittings

1) The air inlet opening must be at least 12 inches (0.30m) away from (never above) the vent termination and at least 3 feet (1m) above grade or above normal maximum snow levels.

2.5.3 Vertical Direct Venting

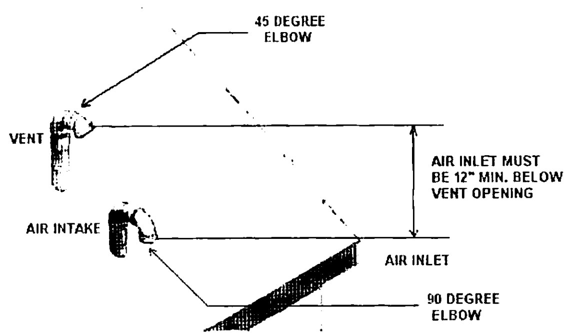
Location of Vent Termination

1) The total length of piping for venting must not exceed the limits stated in Table 8.
2) The vent piping must terminate in a 90° elbow if plastic piping is used or in an approved vent cap if using metal venting. The vent outlet must be at least 1 foot away and 1 foot above from the air inlet opening which must terminate in a double elbow facing downwards.
3) The vertical termination must be a minimum of 3 feet (1m) above the point of exit.
4) A vertical termination less than 10 feet (3.05m) from a parapet wall must be a minimum of 2 feet (0.61m) higher than the parapet wall.
5) DO NOT terminate closer than 4 feet (1.25m) horizontally and vertically from any electric meter, gas meter, regulator, relief valve, or other equipment. In all cases local codes take precedence.
6) Position the air inlet and vent terminations so they are not likely to be damaged by foreign objects, or exposed to build-up of debris.
7) Perform regularly scheduled inspections to ensure that the vent terminal is unobstructed.

Location of a Vertical Air Inlet Opening

1) The total length of piping for inlet air must not exceed the limits given in Table 8.
2) The air inlet consists of two 90° elbows installed at the point of termination for the vertical air inlet pipe. A 90° elbow and a 90° street elbow may be used to make this assembly. If a straight piece of pipe is used between the two elbows, it should not exceed 6" (0.15m) in length. The air inlet opening must be at least 1 foot below the vent opening. The air piping must be no further than 2 feet (0.6m) from the center of the vent pipe. This arrangement avoids exhaust gases from re-circulating into the inlet air stream. Refer to Figure 10.
3) Air inlet must terminate at least 3 feet (1.0m) above the roof or normal snow levels and at least 1 foot (0.3m) below the vent termination.
4) Locate terminations so they are not likely to be damaged by foreign objects or exposed to build-up of debris.
5) Perform regularly scheduled inspections to ensure that the air inlet terminal is unobstructed.

Figure 11: Vertical Direct Venting Configuration



2.5.4 Length of Air Inlet Pipe

The maximum total length of the sidewall or vertical roof top combustion air inlet pipe as installed from the appliance to the air inlet cap must not exceed 100 equivalent feet (30.5m) in length. Subtract 3 to 5 feet (1 to 1.5m) of equivalent length depending on centerline radius for each 90° elbow installed in the air inlet pipe system. Pressure drop in each 45° elbow will be half as much, 2 to 3 feet (0.6 to 1.0m).

PART 3 GAS CONNECTION

Verify that the appliance is supplied with the type of gas specified on the rating plate. Consult factory for installations at high altitude.

3.1 GAS CONNECTION

- Safe operation of unit requires properly sized gas supply piping. See gas line sizing data.
- Gas pipe size may be larger than appliance connection.
- Installation of a union at the appliance gas line connection is required for ease of service and removal of the gas train.
- Install a manual main gas shutoff valve, outside of the appliance gas connection as require by local codes.
- A trap (drip leg) MUST be provided in the inlet gas connection to the appliance.
- Optional gas controls may require routing of bleeds and vents to the atmosphere, outside the building when required by local codes.

Table 9: Recommended Gas Pipe Size

Single Appliance Installation

(For distance from natural gas meter or propane second stage regulator)

Input	0-100 FT		101-200 FT		201-300 FT	
Btu/Hr, x1000	NAT.	L.P.	NAT.	L.P.	NAT.	L.P.
80	¾"	½"	¾"	½"	1"	¾"
100	¾"	½"	1"	¾"	1"	¾"
150	1"	¾"	1 ¼"	1"	1 ¼"	1"
200	1"	¾"	1 ¼"	1"	1 ¼"	1"
250	1 ¼"	1"	1 ¼"	1"	1 ½"	1 ¼"
299	1 ¼"	1"	1 ½"	1 ¼"	1 ½"	1 ¼"
399	1 ¼"	1"	1 ½"	1 ¼"	2"	1 ½"
500	1 ½"	1 ¼"	2"	1 ½"	2"	1 ½"
600	1 ½"	1 ¼"	2"	1 ½"	2"	1 ½"
700	2 "	1 ½"	3"	2 ½"	3"	2 ½ "
800	2 "	1 ½"	3"	2 ½"	3"	2 ½ "

3.2 GAS PIPING

All gas connections must be made with pipe joint compound resistant to the action of liquefied petroleum and natural gas. All piping must comply with local codes and ordinances.

3.3 INSTALL PIPING

- The gas line should be sufficient to handle the total installed capacity. Verify pipe size with your gas supplier.
- Use approved piping as per code free from burrs.
- Install a manual main gas shutoff valve at the appliance gas inlet, outside of the appliance and before the gas valve.
- Run pipe to the Appliance gas inlet.
- Install a sediment trap in the supply line to the Appliance gas inlet.
- Apply a moderate amount of good quality pipe compound.
- For LP gas, consult your LP gas supplier for expert installation.

The appliance and its individual gas shut-off valve must be disconnected from the supply piping when pressure testing the gas supply piping at pressures above ½ PSI

Table 10: Gas Pressures at Inlet to Appliance

	PROPANE	NATURAL GAS
Minimum (inches W.C.)	11	3
Maximum (inches W.C.)	11	14

The gas supply line must be of adequate size to prevent undue pressure drop and must never be smaller than the size of the connection on the appliance. Sizing based on Table 4 or 6 is recommended, depending on model.
Before operating the appliance, the complete gas train and all connections must be tested using soap solution.

Verify that the appliance is supplied with the type of gas specified on the rating plate. Heating values of local natural gas are to be between 950 and 1010 Btu/ft^3. Consult factory if heating values are outside this range or if a gas with a mixture of constituents is being used.

3.4 CHECKING GAS SUPPLY PRESSURE

- Turn the main power switch to "OFF" position.
- Shut off gas supply at the manual gas cock in the gas piping to the appliance. If fuel supply is LP gas, shut off gas supply at the tank.
- Remove the 1/8" hex plug from the gas pressure test port located on the inlet gas supply connection at the rear of the appliance. Install a fitting in the inlet pressure tapping suitable to connect to a manometer or magnahelic gauge. Range of scale should be 0 to 14 inch W.C. or greater to check inlet pressure
- Turn on gas supply at the field installed manual gas cock; turn on LP gas at tank if required.
- Turn the power switch to "ON" position.
- Adjust the thermostat set point to call for heat.
- Observe the gas supply pressure as the burner fires at 100% of rated input. Supply pressure is to remain stable.
- Ensure inlet pressure is within specified range. Minimum and maximum gas supply pressures are specified in Table 10.
- If gas pressure is out of range, contact the gas utility, gas supplier, qualified installer or service agency to determine necessary steps to provide proper gas pressure to the control.
- If gas supply pressure is within normal range, proceed to remove gas manometer and replace pressure tap fittings in the gas piping to the appliance. Turn the power switch to "OFF" position.
- Turn on gas supply at the manual valve; turn on LP gas at tank if required.
- Turn the power switch to "ON" position.
- Adjust the thermostat temperature set point to the desired water temperature so the appliance will call for heat.
- Check appliance performance by cycling the system while you observe burner response. The burner should ignite promptly. Flame profile should be stable, see section 11.2, Visually Check Main Burner Flames. Turn system off and allow burner to cool, then cycle burner again to ensure proper ignition and flame characteristics.

> **IMPORTANT**
> Upon completion of initial installation or following any repair work on the gas system, leak test all gas connections with a soap solution while the main burner is firing. Immediately repair any leak found in the gas train or related components. DO NOT operate an appliance with a leak in the gas train, valves or related gas piping.

3.5 HIGH and LOW GAS PRESSURE SWITCHES (Optional)

High and low gas pressure switches are available as an option and are wired in series with the blocked flue switch. The high gas pressure switch is used to monitor the differential gas pressure between the outlet of the control valve and the fan inlet. If differential gas pressure exceeds the maximum setting of the pressure switch, the appliance will shut down and a low air condition will be indicated on the display panel. The low gas pressure switch is to monitor the minimum incoming gas supply pressure supplied to the gas train. If gas pressure falls below the minimum setting of the pressure switch, the appliance will shut down and a low air condition will be displayed on the display panel.

3.6 AIR/GAS RATIO VALVE

The main gas valve supplying gas to the burner on this appliance utilizes a servo pressure regulator providing a slow opening, fast closing safety shut off and air/gas ratio control for the gas combustion process. The valve is a 1:1 negative pressure gas valve. The valve performs the functions of a pressure regulator, safety shutoff, and air/gas ratio control. Full closing of the valve seat occurs in less than 0.8 seconds when the valve is de-energized. Operation of the gas valve in combination with the combustion air fan allows the burner input rate to vary from 20% to 100% based on temperature demand. The inlet gas supply pressure must be maintained within the specified minimum and maximum pressures.

The air/gas ratio is preset at the factory and adjustment is not usually required if gas supply pressure is maintained within the specified range.
There are no serviceable parts on the air/gas ratio valve control.

Figure 12: DynaMax 80 – 250, 260 1:1 Air/Gas Ratio Control Valve

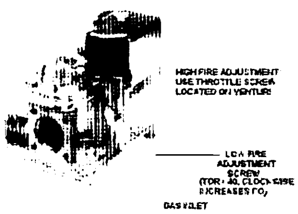


Figure 13: DynaMax 299 – 399 1:1 Air/Gas Ratio Control Valve

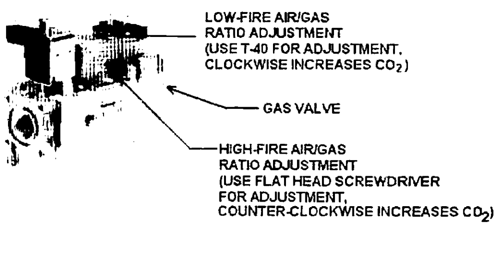
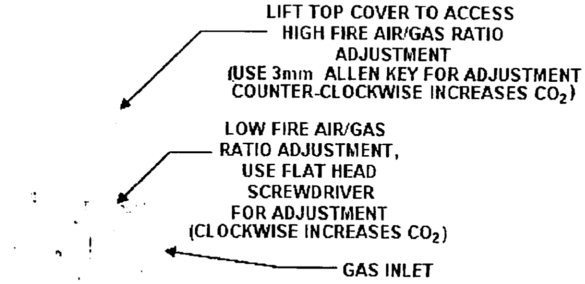
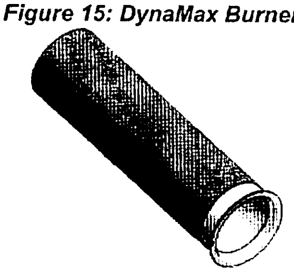


Figure 14: DynaMax 500 – 800 1:1 Air/Gas Ratio Control Valve



3.6 BURNER

Figure 15: DynaMax Burner



This appliance uses a single cylindrical burner installed horizontally into the cavity located in the center of the heat exchanger. There is a unique burner for each one of the DynaMax models.

Burners may NOT be interchanged between different Btu/hr input models. The burner consists of a round mounting flange welded to a ported stainless steel mixing tube. This stainless steel tube is covered with a close fitting, knitted stainless steel metal fiber alloy material that forms the burner outer surface. The burner is setup to operate in blue mode and infrared operating condition should be avoided. Infrared operation will occur only if air to gas adjustments is incorrect. If infrared operation is noted the cause must be corrected.

The burner should be removed for inspection and cleaning on an annual basis. An appliance installed in a dust or dirt contaminated environment will require inspection and cleaning on a more frequent schedule. The fan assisted combustion process may force airborne dust and dirt contaminants, contained in the combustion air, into the burner. With sustained operation, non-combustible contaminants may reduce burner surface area, reduce burner input or cause non-warrantable damage to the burner.

Airborne contaminants such as dust, dirt, concrete dust or dry wall dust can be drawn into the burner with the combustion air and block the burner surface area. **DO NOT** operate this appliance during construction.

The spark igniter and flame sensor are removable from the combustion chamber mounting door without removing the burner assembly.

Never use an open flame (match, lighter, etc.) to check gas connections.

PART 4 WATER CONNECTION

- Check all applicable local heating, plumbing and building safety codes before proceeding.
- If the appliance is installed above radiation level it must be provided with a low water cut-off device at the time of appliance installation (available from Camus). Some local codes require the installation of a low water cut-off on all systems.
- A pressure relief valve is supplied with each DynaMax. The relief valve must be mounted in a vertical position and piped to the floor in a manner acceptable to the enforcing authority.
- Be sure to provide unions and gate valves at inlet and outlet to the appliance so that it can be easily isolated for service.
- On combination heaters a flow setter valve at the appliance outlet facilitates setting of the desired outlet temperature at high fire. Refer to Section 12.9 Domestic Hot Water with Plate Heat Exchanger for more details
- This appliance is a low mass stainless steel tube design which provides for instant heat transfer. All appliances are supplied with an internal suitable specific pump mounted in place. When replacing the pump, replace with one of equal or better-performance.
- An air vent is supplied on the heat exchanger header to eliminate trapped air. Install venting devices at high points in the system as well to eliminate trapped air in the piping.
- Use suitable pipe hangers or floor stands to support the weight of all water and gas piping.
- The DynaMax must be installed so that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, control replacement, etc.)

4.1 FREEZE PROTECTION OUTDOOR INSTALLATION

- Appliance installations are not recommended outdoors or in areas where danger of freezing exists unless precautions are taken. Maintaining a mixture of 70% water and 30% propylene glycol is the preferred method of freeze protection in hydronic systems. **DO NOT** exceed a mixture of 50/50. This mixture will protect the appliance to approximately -35°F (-37°C).
- For Outdoor installations a snow screen should be installed to prevent snow and ice accumulation around the appliance. Regular inspections should be made to ensure that air inlet and vent are free of snow and ice. Always consider the use of a shelter such as a garden shed in lieu of direct exposure of the appliance to the elements. The additional protection afforded by the shelter will help to minimize nuisance problems with electrical connections and will allow easier servicing of the appliance under severe weather conditions.

4.2 WARNING REGARDING CHILLED WATER SYSTEMS

When an appliance is connected to an air conditioning system where the same water is used for heating and cooling, the chiller must be piped in parallel with the appliance. Appropriate flow control valves; manual or motorized must be provided to prevent the chilled water from entering the appliance.

Figure 16: Chilled Water System

4.3 INLET AND OUTLET CONNECTIONS

- All water connections must meet American National Standard Pipe Threads (NPT).
- For ease of service, install unions on inlet and outlet of the appliance. The connection to the appliance marked "Inlet" on the header should be used for return from the system. The connection on the header marked "Outlet" is to be connected to the supply side of the system.

4.4 MINIMUM PIPE SIZE REQUIREMENTS

Minimum water pipe connections are as follows for DynaMax single unit installations. The equivalent number of straight feet of pipe for each valve and fitting in the connecting piping must be considered to properly arrive at the total equivalent feet of straight pipe in the field installed piping to the appliance. Consult factory if longer piping distances are required for a specific application. It is recommended to use copper piping for all system piping to reduce the possibility of the formation of deposits, which may result in heat exchanger starvation.

System pipe size must be in accordance with Table 11 (depending on model) and, between supply and return lines, must not exceed 50 feet of equivalent length. Connection sizes at the heater are given in Tables 4 & 6. Any reduction in recommended pipe size may decrease flow resulting in high temperature rise across the heat exchanger, boiler noise, flashing to steam and non-warrantable heat exchanger damage.

Table 11: Minimal System Pipe Size

Input, Btu/Hr	Water Size, NPT* [in.]
80,000	1
100,000	1
150,000	1
200,000	1 1/4
250,000	1 1/4
299,000	1 1/2
399,000	2
500,000	2
600,000	2
700,000	2
800,000	2

* Equivalent length must not exceed 50 equivalent feet

4.5 HEAT EXCHANGER

This appliance uses precision formed stainless steel tubing to maximize the heat transfer process and achieve 97% steady-state efficiency. This heat exchanger is designed to withstand 160 PSIG working pressure.
A factory installed circulating pump ensures proper water flow during burner operation and creates enough velocity inside the stainless steel tubes and headers that prevents scaling.

4.6 LOW WATER TEMPERATURE SYSTEMS

In applications where the heating system requires supply water temperatures below 110°F, connections may be made directly to the DynaMax. At incoming temperatures of 80°F or lower the DynaMax achieves maximum efficiency. Inlet temperatures must not drop below 40°F to prevent freezing.

4.7 PIPING ARRANGEMENTS

The DynaMax boiler when configured as a hydronic heating boiler allows for 4 modes of operation. For more details on each of the operating modes refer to section 6.3 Central Heating Modes.

4.7.1 Field Supplied Components

1) **Boiler system piping**

   Boiler system piping MUST be sized according to Tables 4 and 6. Reducing the pipe size can restrict the flow rate through the boiler, causing boiler damage and will void the manufacturer's warranty.

2) **Isolation Valves**

   Use only full port ball valves. Failure to supply full port ball valves may result in reduced flow rate through the boiler, causing boiler damage and will void the manufacturer's warranty.

3) **Anti-Scald Mixing Valve**

   An anti-scaled mixing valve is recommended when DHW storage is above 120°F.

4) **Unions**

   Recommended for ease of serviceability.

5) **System Temperature Sensor**

   A system temperature sensor is to be installed in the main header at a point to detect controlled temperature and where it will not lead to short-cycling of the boiler.

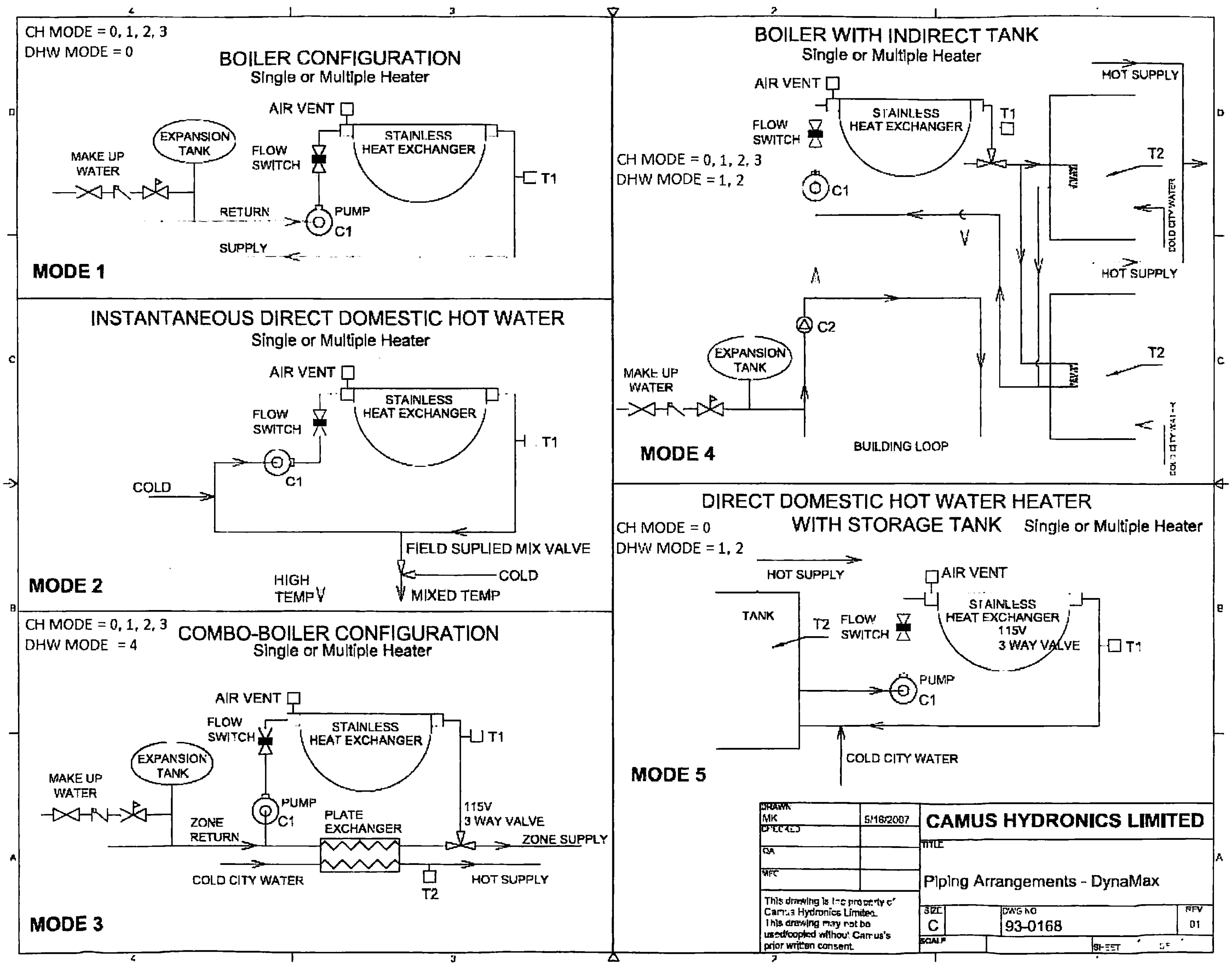
An instantaneous water heater is designed to deliver hot water without the use of a storage tank. It is suitable for applications with variable load such as restaurants, condominiums, apartments and motels and typically used in conjunction with tempering valves to achieve temperature control.

Table 12: Flow and Pressure Drop at a Given Temperature Rise (Hydronic Heating)

Input, Btu/Hr	30 °F (16.7 °C) Temp Rise		35 °F (19.4 °C) Temp Rise	
	USGPM (min. flow)	ΔP Ft.	USGPM. (min. flow)	ΔP Ft.
80,000	5.0	8.2	4.3	6.2
100,000	6.3	12.3	5.4	9.4
150,000	9.5	10.4	8.1	7.8
200,000	12.6	7.2	10.8	5.8
250,000	15.8	11.5	13.5	8.7
299,000	18.9	9.3	16.2	7.0
399,000	25.2	8.4	21.6	6.3
500,000	31.5	9.2	27.0	6.9
600,000	38.8	17.5	32.0	11.8
700,000	45.3	18.2	40.0	14.4
800,000	51.8	23.5	43.0	16.0

Table 13: Flow and Pressure Drop at a Given Temperature Rise (DHW)

Input, Btu/Hr	20 °F (11.1 °C) Temp Rise	
	USGPM (min. flow)	ΔP Ft.
80,000	7.5	11.5
100,000	9.4	26.9
150,000	14.0	27.8
200,000	19.2	25.9
250,000	23.5	28.3
299,000	28.8	25.8
399,000	38.4	23.9
500,000	48.6	29.4
600,000	57.6	34.2
700,000	70.4	40.0
800,000	77.6	43.2



CH MODE = 0, 1, 2, 3
DHW MODE = 0
BOILER CONFIGURATION
Single or Multiple Heater
AIR VENT
EXPANSION TANK
MAKE UP WATER
FLOW SWITCH
STAINLESS HEAT EXCHANGER
T1
RETURN
PUMP
C1
SUPPLY
MODE 1
INSTANTANEOUS DIRECT DOMESTIC HOT WATER
Single or Multiple Heater
AIR VENT
FLOW SWITCH
STAINLESS HEAT EXCHANGER
T1
COLD
C1
FIELD SUPLIED MIX VALVE
COLD
HIGH TEMP
MIXED TEMP
MODE 2
CH MODE = 0, 1, 2, 3
DHW MODE = 4
COMBO-BOILER CONFIGURATION
Single or Multiple Heater
AIR VENT
FLOW SWITCH
STAINLESS HEAT EXCHANGER
T1
EXPANSION TANK
MAKE UP WATER
PUMP
C1
115V
3 WAY VALVE
ZONE RETURN
PLATE EXCHANGER
ZONE SUPPLY
COLD CITY WATER
HOT SUPPLY
T2
MODE 3
BOILER WITH INDIRECT TANK
Single or Multiple Heater
AIR VENT
FLOW SWITCH
STAINLESS HEAT EXCHANGER
T1
HOT SUPPLY
CH MODE = 0, 1, 2, 3
DHW MODE = 1, 2
C1
T2
COLD CITY WATER
HOT SUPPLY
C2
EXPANSION TANK
MAKE UP WATER
T2
MODE 4
BUILDING LOOP
DIRECT DOMESTIC HOT WATER HEATER
WITH STORAGE TANK
Single or Multiple Heater
CH MODE = 0
DHW MODE = 1, 2
HOT SUPPLY
AIR VENT
TANK
T2
FLOW SWITCH
STAINLESS HEAT EXCHANGER
115V
3 WAY VALVE
T1
PUMP
C1
COLD CITY WATER
MODE 5
DRAWN MK 5/16/2007
CAMUS HYDRONICS LIMITED
TITLE
Piping Arrangements - DynaMax
This drawing is the property of Camus Hydronics Limited. This drawing may not be used/copied without Camus's prior written consent.
SIZE C
DWG NO 93-0168
REV 01
SCALE
SHEET

4.8 FLOW PROVING DEVICE (wall mount models only)

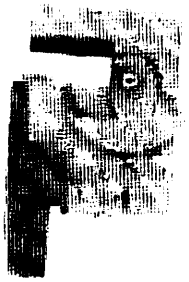


Figure 17: Flow Proving Device

The flow proving device is designed to detect when flow is present. This is done by detecting the amount of current (amperes) that exists in the neutral wire from the pump. When the current becomes too low a flow switch error is displayed indicating a lack of water inside the boiler.

4.9 WATER FLOW SWITCH (shipped loose, floor mount models only)

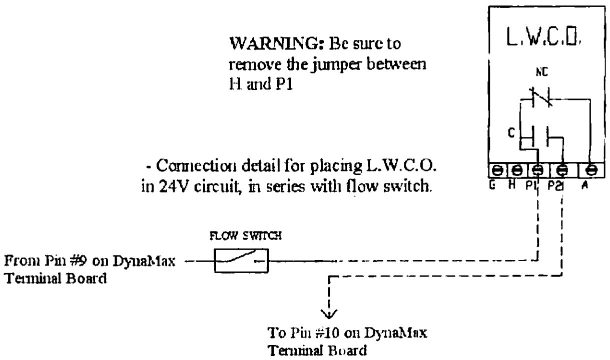
A water flow switch is shipped loose and is to be installed in the outlet piping on all heating boilers and hot water supply boilers. The flow switch is to be installed in a horizontal run of pipe in order to provide effective contact. The flow switch is to be wired into the DynaMax terminal board labelled 'Flow/LWCO'.

4.10 LOW WATER CUTOFF (If Equipped)

If this boiler is installed above radiation level, a low water cut-off device must be installed at the time of boiler installation. Some local codes require the installation of a low water cut-off on all systems. Electronic low water cut-offs are available as a factory supplied option on all models. Low water cut-offs should be tested every six months. The normally open switch contact of the low water cutoff is to be wired in series with the flow switch. This can be wired into the DynaMax terminal labelled 'Flow/LWCO'.

CAUTION
Remove jumper when connecting to 24 VAC circuit.

Figure 18: Low Water Cut Off Electrical Connections



4.11 RELIEF VALVE

This appliance is supplied with a relief valve sized in accordance with ASME Boiler and Pressure Vessel Code, Section IV ("Heating Boilers"). This component is shipped loose. The relief valve is to be installed in the vertical position and mounted in the outlet. No valve is to be placed between the relief valve, and the appliance. To prevent water damage, the discharge from the relief valve shall be piped to a suitable floor drain for disposal when relief occurs. No reducing couplings or other restrictions shall be installed in the discharge line. The discharge line shall allow complete drainage of the valve and line. Relief valves should be manually operated at least once a year.

CAUTION
Avoid contact with hot discharge water

4.12 DHW TUNING VALVE (combination models only)

A DHW tuning valve is provided with DynaMax combination models. In cases where flow control is not possible by the end user the DHW tuning valve is designed to act as a maximum flow controller. The tuning valve is designed to provide the correct amount of hot water for each particular DynaMax model and application. Refer to section 12.9 Domestic Hot Water with Plate Heat Exchanger for further details.

PART 5 ELECTRICAL & CONTROLS

⚠ DANGER

IT IS EXTREMELY IMPORTANT THAT THIS UNIT BE PROPERLY GROUNDED!

5.1 ELECTRICAL CONECTIONS

Minimum 120VAC 60Hz single phase (15A circuit) is required for the DynaMax models DM-080 through DM-750. The appliance, when installed, must be electrically grounded in accordance with the requirements of the authority having jurisdiction or in the absence of such requirements, with the latest edition of the National Electrical Code ANSI/NFPA No. 70. When the unit is installed in Canada, it must conform to the Canadian Electrical Code, C22.1, Part 1 and/or local Electrical Codes.

- All wiring between the appliance and field installed devices shall be made with wire having minimum 220°F (105°C) rating.
- Line voltage wire exterior to the appliance must be enclosed in approved conduit or approved metal clad cable.
- The pump must run continuously when appliance is being fired.
- To avoid serious damage, DO NOT ENERGIZE the appliance until the system is full of water. Ensure that all air is removed from the pump housing and piping before beginning initial operation. Serious damage may result if the appliance is operated without proper flow.
- Provide the appliance with proper overload protection.

5.2 HIGH LIMIT

A manual reset fail-safe high limit aqua-stat control is located at the back of the appliance and the control bulb is installed in a dry well in the heat exchanger outlet. The setting of this control limits maximum discharge water temperature to 210°F. The temperature of the outlet water in the heat exchanger must drop a minimum of 30°F (16.7°C) belo w the setting of the high limit control before the reset function can be activated.

5.3 DYNAMAX CONTROLLER

This appliance uses a direct spark ignition control system. The operation of the DynaMax Controller for the direct spark igniter proves the presence of main flame using a flame sensor proof current (1.25µA). A status point alarm of Flame Fail will be displayed on the main panel if the boiler fails to light after three (3) ignition attempts.

Figure 19: DynaMax Controller

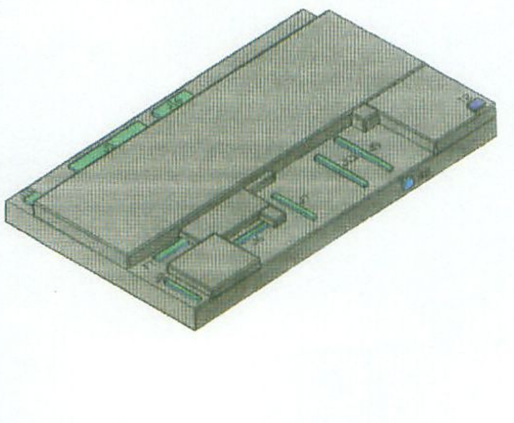


Table 14: Connector Description

Connector	Connector Description
J2	Provides 120V to the DynaMax Controller
J6	3-Way Diverter Valve
J7	On-Board Pump
J13	High-Limit, Gas Valve, Flame Sensor
J9	Fan Power, Fan Modulation
J5	Various Sensors
J16	Safety Switches
J12	Spark Return Signal
T2	Spark Igniter
F1	3.15A Fuse

5.3.1 SERVICE PARTS

The DynaMax Controller is not repairable. Any modification or repairs will invalidate the warranty and may create hazardous conditions that result in property damage, personal injury, fire, explosion and/or toxic gases. A faulty direct spark igniter **MUST** be replaced with a new factory part. **DO NOT** use general purpose field replacement parts. Each appliance has one DynaMax Controller, one direct spark igniter and one flame sensor. A list of recommended spare parts is available.

5.3.2 IGNITION MODULE LOCKOUT FUNCTIONS

The DynaMax Controller may lockout in either a hard lockout condition requiring pushing the reset button to recycle the control for a CSD1 requirement or a soft lockout condition. A typical hard lockout fault for the DynaMax Controller is a 3 trial ignition failure condition. Pushing the reset button on the control panel is the only way to reset the DynaMax Controller that is in a hard lockout condition. The reset button is active after the post purge cycle when there is a lockout condition as indicated by the LCD display. Turning the main power "OFF" and then "ON" or cycling the thermostat will not reset a hard lockout condition. Wait five seconds after turning on the main power before pushing the RESET button when the DynaMax Controller is in a hard lockout condition. Wait for the status LCD display to refresh indicating that the DynaMax Controller is ready before releasing the reset button.

The DynaMax Controller will go into a soft lockout condition, for example, if the supply sensor is disconnected, flow switch, LWCO or air switch are not made. If the fault is not corrected, the boiler will stay in the soft lockout state. Once the fault is corrected, the boiler will automatically return to normal operating state

5.4 ERROR TABLE

The following tables provide a description of all the possible errors with the DynaMax boiler. Errors can be divided into two groups. Soft lockout errors (will disappear when error is gone) and hard lockout errors (can only be reset by the RESET button). A soft lockout error will be indicated with an 'E' prior to the error number. A hard lockout lockout error will be indicated with an 'A' prior to error number.

When the control is in error the pump will be running. This is done to prevent the freezing of the central heating circuit when the boiler is in error during the winter period. For some non volatile lockouts the pump will not be running, see table below for more details.

5.4.1 Hard Lockout 'A' Codes

Table 15: Lockout Codes

Error	Int nr.	Description
IGNIT_ERROR	1	Three unsuccessful ignition attempts in a row
TOO_MANY_FLAME_FAILURES	24	Three times flame lost during one demand
T_MAX_LOCK_ERROR	18	Overheat stat is open
GV_RELAY_ERROR	5	Problems with gas valve relay = internal hardware error (pump not running)
SAFETY_RELAY_ERROR	6	Problems with safety relay = internal hardware error (pump not running)
RAM_ERROR	9	Internal software error
FLAG_BYTE_INTEGRITY_ERROR	27	Internal software error
AD_HI_CPL_ERROR	28	Internal software error
AD_LO_CPL_ERROR	29	Internal software error
REGISTER_ERROR	30	Internal software error
E2PROM_ERROR	12	No communication with E2prom
WRONG_EEPROM_SIGNATURE	10	Contents of e2prom is not up-to-date
STATE_ERROR	13	Internal software error
ROM_ERROR	14	Internal software error
15MS_XRL_ERROR	16	Internal software error
20MS_XRL_ERROR	22	Internal software error
STACK_ERROR	19	Internal software error
FLAME_OUT_TOO_LATE_ERROR	20	Flame still present 10 sec. after closing the gas valve
FLAME_ERROR_1	21	Flame detected just before gas valve opened
41MS_ERROR	23	Internal software error
FAN_ERROR	8	Fan deviation more than 300 rpm longer than 1 minute (when fan speed > 4200 rpm this error is ignored)

To eliminate the hard lockout error,

1) Wait until the boiler has completed it's post-purge cycle, if applicable
2) Press and hold the 'RESET" button until the display reverts back to showing the supply temperature
3) Release the RESET button, the hard lockout has been cleared

5.4.2 Soft Lockout 'E' Codes

Table 16: Blocking Codes

Error	Int nr.	Description
T_SUPPLY_OPEN	51	Supply sensor not connected
T_INLET_OPEN	52	Inlet sensor not connected
T_DHW_OPEN	55	DHW sensor not connected
T_SYSTEM_OPEN	56	System sensor not connected
T_SUPPLY_SHORTED	59	Supply sensor shorted
T_INLET_SHORTED	60	Inlet sensor shorted
T_STACK_SHORTED	65	Stack sensor shorted
T_DHW_SHORTED	63	DHW sensor shorted
E2PROM_READ_ERROR	0	Problems reading from or writing to e2prom
FLAME_ERROR_2	36	False flame detected
PHASE_ERROR	44	Phase and neutral of mains supply are reversed
WD_50HZ_ERROR	43	No earth connected or internal hardware error
NET_FREQ_ERROR	45	Mains frequency differs more than 2% from 60Hz
FAULTY_EARTH_ERROR	46	Earth connection is not ok
STACK_TEMP_ERROR	35	Stack sensor > setpoint + diff. See chapter
LOW_WATER_CUTOFF_ERROR	37	Water pressure is to low
INLET_TEMP_ERROR	40	Inlet temperature is above 90 degrees
WD_COMMUNICATION_ERROR	47	Internal hardware error
REFHI_TOO_LO_ERROR	31	Internal hardware error
REFHI_TOO_HI_ERROR	32	Internal hardware error
REFLO_TOO_LO_ERROR	33	Internal hardware error
REFLO_TOO_HI_ERROR	34	Internal hardware error
RESET_BUTTON_ERROR	66	Reset button pressed more than 7 times within one minute.
APPLIANCE_SELECTION_ERROR	48	Appliance selection code and resistor do not match. This is only checked at startup.

PART 6 CONTROL PANEL

6.1 *DYNAMAX CONTROLLER*

The appliance is provided with a operator interface panel at the front. On a DynaMax Wall Hung boiler the DynaMax Controller can be accessed by removing the upper stainless steel jacket and the lower black sheetmetal jacket which are each held on by two (2) screws. On a DynaMax Floor Mount boiler the DynaMax Controller can be accessed by carefully lifting off the black-coloured Top cover which is held on by four (4) snap lock fasteners.
The Boiler Temperature Controller (BTC) for this appliance is a proprietary Camus DynaMax Controller. It initiates the local call for heat and sets the target supply (appliance outlet) water temperature. This controller accommodates heating and domestic water control with multiple modes of operation which provide set point as well as reset control. It provides the following:

- Readings of inlet and outlet water temperatures, stack temperatures, domestic hot water temperature, flame current, status of heater operation, etc.
- Operation as an auto reset limit.
- Operation as a control for discharge water temperature.
- Optional tank mounted sensor used in conjunction with outlet sensor for domestic hot water.
- Adjustable target temperature
- Display of run hours for maintenance purposes. Counter displays run time up to 10,000 hours. Pressing the **RESET** button will reset the counter.
- Molex, Stocko and AMP connectors for ease of service.
- Error message display.

6.2 SETTING THE DYNAMAX CONTROLLER

Press the **MENU** button and then select the desired setting using the **PREVIOUS** and **NEXT** Buttons. When the desired setting is satisfied press the **ENTER** key and this will save the last setting. In normal operating mode the inlet temperature, outlet temperature, and ON hours can be viewed by pressing the **PREVIOUS** and **NEXT** key. After checking the settings allow the control to return to normal operation on its own.

6.3 CENTRAL HEATING MODES

Mode 0: Central Heating Without Outdoor Reset
In this mode no outdoor sensor is needed. If the room thermostat closes, the pump is switched on. If the supply temperature drops below the hysterese and central heating setpoint (ch_setpoint) temperature the burner is switched on. Burner power is PID regulated between (Supply temperature) T-supply and ch_setpoint. When supply temperature is above the ch_setpoint + hysterese the burner is switched off.

If the room thermostat opens the burner is switched off and the pump runs on for post pump (default: 30 sec).

The anti-freeze monitor on each boiler will monitor the inlet water temperature and when it drops below 50°F (10°C) it will bring on the pump to prevent freezing of the heat exchanger.

Mode 1: Central Heating with Outdoor Reset and Thermostat Control

This mode will only function when an outdoor sensor is connected. The setpoint is calculated depending on the outdoor temperature and the burner will react on the room thermostat. The central heating setpoint is calculated as follows:

ch_setpoint = t_day_ref + [(20 – T_outdoor) * Slope]

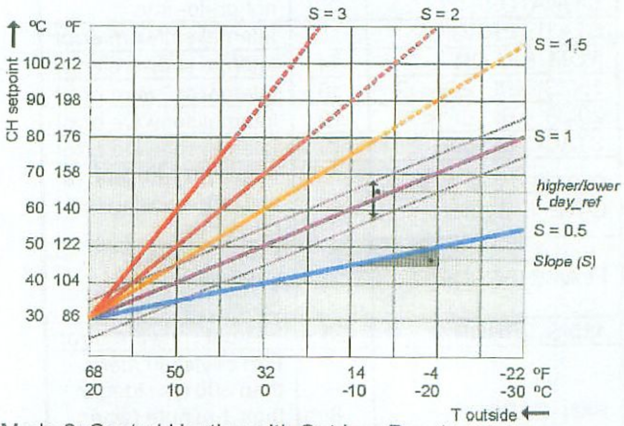
t_day_ref is the reference temperature for central heating setpoint when T_outdoor is 68°F (20°C). T_day_ref is a user settable parameter.

The Slope can be set via the menu between 0.1 to 5.0 with steps of 0.1.

The calculated central heating setpoint is limited between 90°F (32°C) and 185°F (85°C).
The outdoor temperature used for the central heating setpoint calculation is measured once a minute and averaged with the previous measurement. This is done to avoid drastic changes to the boiler when outdoor temperature fluctuates rapidly.
Functionality remains the same as Mode 0 apart from the calculated setpoint.

The anti-freeze monitor on each boiler will monitor the inlet water temperature and when it drops below 50°F (10°C) it will bring on the pump to prevent freezing of the heat exchanger.

Figure 20: Programmable Ch_setpoint curve



Mode 2: Central Heating with Outdoor Reset

An outdoor sensor must be connected for this mode to function properly. The central heating setpoint is calculated the same way as Mode 1. However, the demand does not depend on a room thermostat but instead on the outdoor temperature and the weather compensation setpoint. When the outdoor temperature is below this weather setpoint a central heating demand is created.

Overnight an input signal from a room thermostat (RT) can lower the ch_setpoint. When the RT input closes the ch_setpoint will also be lowered with t_night_reduction. Therefore, RT input does not directly influence central heating demand.

The anti-freeze monitor on each boiler will monitor the inlet water temperature and when it drops below 50°F *(10°C) it* will bring on the pump to prevent freezing of the heat exchanger.

Mode 3: Central Heating with Constant Temperature Loop

No outdoor sensor is needed. The supply temperature is kept constantly at the setpoint temperature. The burner is controlled in a similar way as Mode 0. When the room thermostat contact closes the ch_setpoint will be decreased with t_night_reduction. The pump is always on in this condition.

6.4 *DOMESTIC HOT WATER MODES*

Mode 0: Disables Domestic Hot Water
No domestic hot water is available; therefore the DHW sensor is not supplied.

Mode 1: DHW Storage Tank with Temperature Sensor

The DHW temperature in the tank is measured with a storage tank sensor and set with parameter dhw_setpoint. When the DHW sensor drops below 'DHW_setpoint – dhw_hyst_down' the control detects a demand for the storage tank and activates the pump. If the DHW temperature continues to drop the ignition sequence will begin. When the burner is lit the load is PID-modulated so the supply is regulated towards DHW_setpoint. The burner will fire at steady-state or it shall shut off if the storage tank sensor is greater than 'DHW_setpoint + dhw_hyst_up'. The on-board pump will continue to circulate until the dhw_post_pump_ period timer is satisfied.

With this mode of operation a Pre-Heat function is implemented in the algorithm. If the storage tank sensor detects that the temperature is below DHW_*setpoint* – DHW_*store_hold_warm* the boiler will initiate the ignition sequence and the burner will fire at minimum fire until the storage tank sensor temperature is *satisfies DHW_setpoint + DHW_store_hyst_up*.

The anti-freeze monitor on each boiler will monitor the inlet water temperature and when it drops below 50°F (10°C) it will bring on the pump to prevent freezing of the heat exchanger.

Mode 2: DHW Storage Tank with Aquastat

When the aquastat closes the control detects a demand for the storage tank and starts the pump. Operation of Mode 2 is identical to the operation of Mode 1, but an aquastat replaces the use of a sensor in the storage tank. The Pre-Heat algorithm is not available in this mode of operation

Mode 4: Combination Boiler using Plate Heat Exchanger and DHW Temperature Sensor

In this configuration the boiler can be used for space heating and indirect domestic hot water. Camus supplies an on-board brazed plate heat exchanger, a pump and a 3-way diverter valve.

When a heat demand is detected the pump will run and the 3-way diverter valve switches over to the hydronic heating loop. The pump continues to run until the 'post pump CH period' is complete after cycling through a heat demand cycle. When there is no heat demand the pump will turn off Individually controlled zone pumps will draw hot water from the manifold and return from the zone to the manifold.

The temperature of the water leaving the plate heat exchanger is constantly monitored and when it drops below 'dhw_setpoint – dhw_hyst_down', the on-board pump activates to satisfy a demand for DHW and the 3-way diverter valve switches over to DHW demand. If a central heating demand is present when a DHW demand occurs, the heating demand will be interrupted resulting in domestic hot water priority. The 3-way valve shall switch over from hydronic heating to DHW demand and the boiler will continue to function in this state until DHW demand ends. If hydronic demand is still present after DHW demand ends the 3-way valve switches over to hydronic heating. This results in zero lag, as the burner does not restart when switching between hydronic heating and DHW demand.

Due to the use of a plate heat exchanger a Pre-Heat function is implemented in the algorithm. This ensures the plate is always warm and prevents the user from receiving an initial blast of cold water when they first turn on the tap. The Pre-Heat function is enabled after 2 minutes of burner shut off. If the DHW sensor detects that the temperature is below 'Pre Heat setpoint – pre heat hyst down' the boiler will initiate the ignition sequence and the burner will fire at minimum fire until the DHW sensor temperature is equal to the Pre Heat Setpoint. The Pre Heat function will only activate when a DHW demand is non-existant.

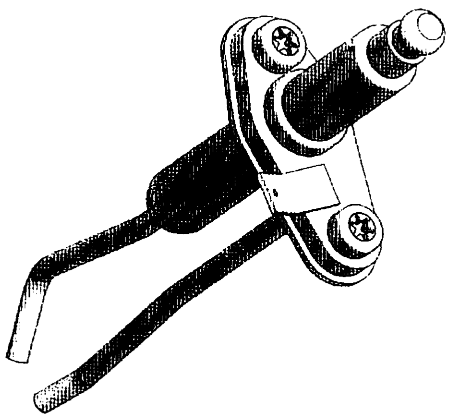
The anti-freeze monitor on each boiler will monitor the inlet water temperature and when it drops below 50°F (10°C) the pump will be activated to prevent the heat exchanger from freezing.

PART 7 COMPONENTS

7.1 DIRECT SPARK IGNITER

The direct spark igniter is inserted directly through the combustion chamber front door and held in place by two torx screws. Care must be taken when removing and/or installing the igniter. Always remove the igniter prior to removing the fan assembly for inspection of the burner and heat exchanger.

Figure 21: Direct Spark Igniter

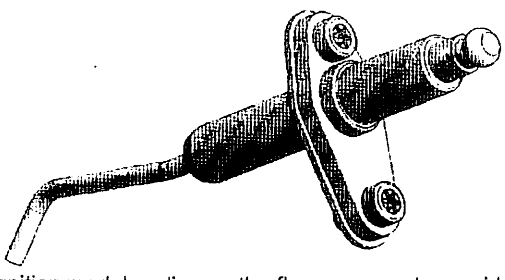


During a trial for ignition sequence a properly operating igniter will generate a continuous spark with a 9/64" (3.6mm) spark gap. It is recommended to clean the direct spark igniter using steel wool as required. **DO NOT** use sandpaper or grit-cloth since this will contaminate the metal surface.

7.2 FLAME SENSOR

The flame sensor is inserted directly through the combustion chamber front door and is screwed into the combustion chamber front door. Care must be taken, when installing the flame sensor, to align it perpendicular to the fan flange and parallel to the burner tube and not to over tighten.

Figure 22: Flame Sensor



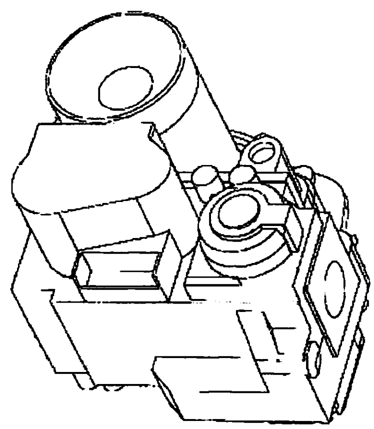
The ignition module relies on the flame sensor to provide a flame rectification signal. Oxide deposits, improper placement or damaged ceramic insulator will result in insufficient signal leading to ignition module lock out. For proper operation minimum 1.25 µA DC must be fed back to the module. Oxide deposit on the sensor rod must be removed with steel-wool. **DO NOT** use sand-paper since this will contaminate the metal surface.

7.3 COMBUSTION AIR FAN

DynaMax uses a modulating air fan to provide combustible air/gas mix to the burner and push the products of combustion through the heat exchanger and venting system. The fan assembly consists of a sealed housing and fan wheel constructed from spark resistant cast aluminium. The fan is operated by a fully enclosed 120 VAC, Single-Phase EC/DC electric motor. The fan housing and motor assembly is fully sealed and SHOULD NOT be field serviced. The power draw of the motor is proportional to the modulated gas input rate of the appliance.

7.4 GAS VALVE

Figure 23: Venturi and Gas Valve Arrangement



The Gas Valve supplied with the DynaMax boiler is a combined valve/venturi assembly. A servo pressure regulator is incorporated into the gas valve to provide stable gas supply. Pressure taps are provided to check inlet and outlet gas pressures. An internal fine mesh screen is incorporated in the inlet of the gas valve to prevent debris from entering the combustion chamber. Gas valves all factory set at low and high fire and modulates to maintain combustion characteristics across the full operating range.

7.5 OUTER JACKET

The outer jacket assembly is constructed from mirror finish stainless steel. This ensures a long life for the jacket assembly, with full integrity

PART 8 LABVISION SOFTWARE

NOTE
LabVision software is available on request from the factory and is not shipped with the boiler/ water heater.

To operate LabVision software a Laptop and LPT1/USB connection cable are needed.

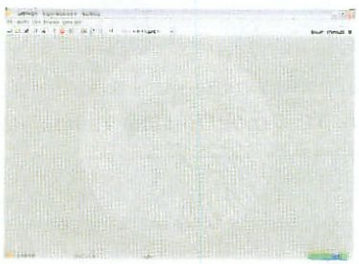
8.1 STARTING UP LAB VISION

Locate the file named LabVision.exe, the appearance of the icon is shown:

Figure 24: LabVision Icon

A startup screen will appear on screen:

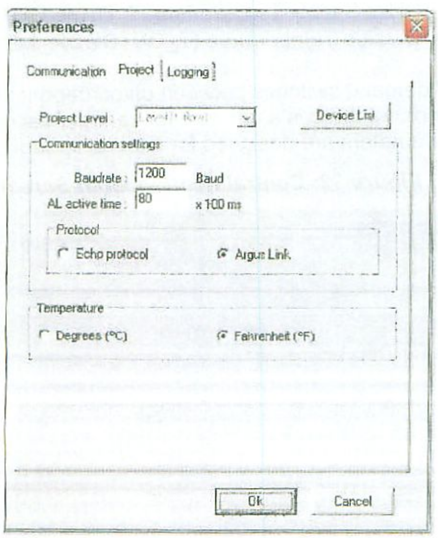
Figure 25: LabVision Startup Screen



When a connection between LabVision and the DynaMax boiler is established the blue status bar on the bottom-right will scroll from right-to-left and back again.
If a connection is not established between LabVision and the DynaMax boiler, a proper connection will need to be established before advancing to the next steps.

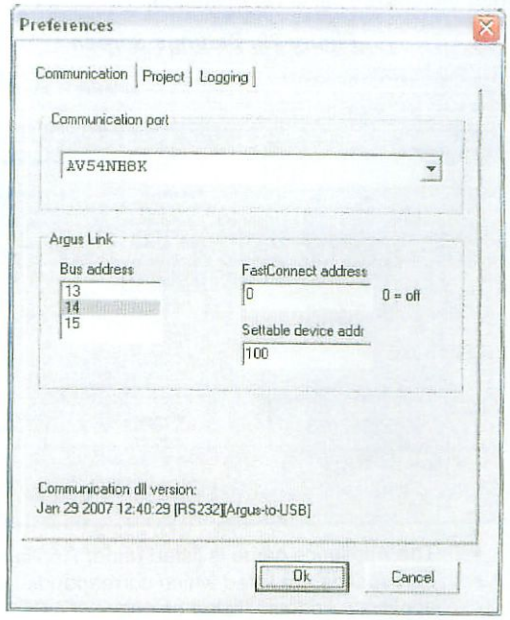
- Go to Options > Communication > Preferences
- A Preferences screen will pop up
- Under the Project Tab in the Protocol box select the Argus Link connection

Figure 26: Selecting Argus Link Protocol



- Click on the Communication Tab
- In the Communication Port pull down menu select the address of Argus Link USB port.
- Click [OK]
- Use the pull down menu to jump to the desired mode of operation.

Figure 27 : Selecting Communication Port



The three blue status bars located at the bottom-right of the screen will move left-to-right and back again. This confirms that a successful connection has been established between LabVision and the DynaMax boiler.

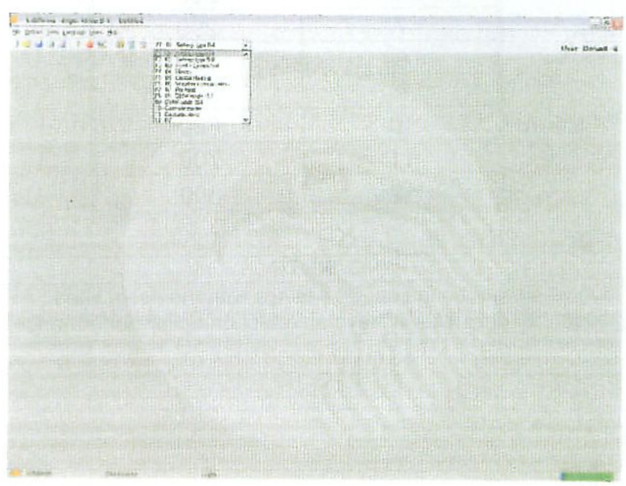
USB connector address is shown in the bottom-left.

NOTE
Do not make any other parameter or setting changes other than those stated in the manual as they will have a detrimental effect to the DynaMax Boiler.

8.2 ADJUSTING FAN SPEEDS

Use the pull down menu to access DynaMax settings:

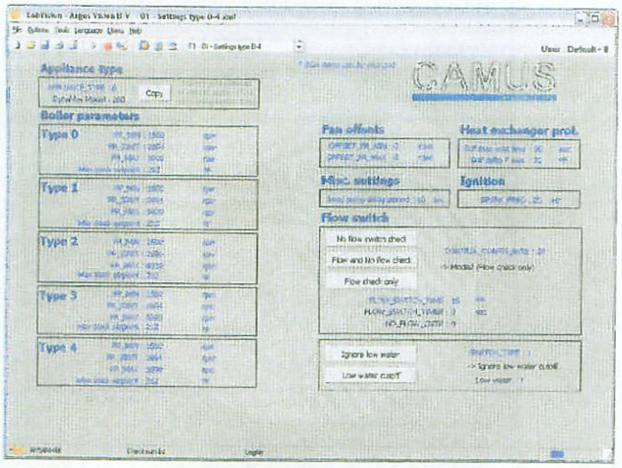
Figure 28: Pull Down Menu



To adjust ignition fan speeds. Use the pull down menu or the function keys on the keyboard, select Settings. This will bring up the Settings screen.

Parameters shown in blue text can be adjusted. To change a blue coloured parameter, place the cursor on top a parameter and double-click. This will bring up a window to enter the desired values of operation.

Figure 29: Settings Screen



- The Appliance name is listed under Appliance Type
- Fan speeds are listed which corresponds to the appliance address, listed below:

Table 17: Appliance Type Designations

Appliance Type	DynaMax Model
0	80
1	100
2	150
3	200
4	210
5	250
6	260
7	299
8	399
9	500
10	600
11	700
12	800

NOTE
Only change the fan speed settings with the associated boiler, as only this will have an effect on boiler performance.

8.3 LABVISION CENTRAL HEATING

Use the pull down menu and select Central Heating to adjust parameters in Central Heating. Before any parameters can be adjusted the blue status bar must track left-to-right and back again. Refer to Section 8.1 to resolve connection issues.

Figure 30: Central Heating Screen

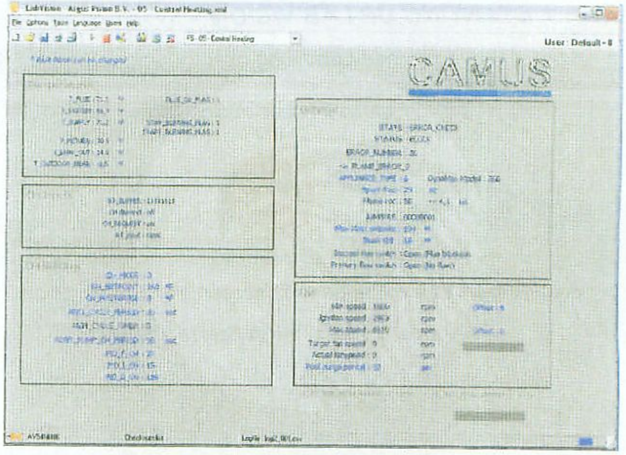
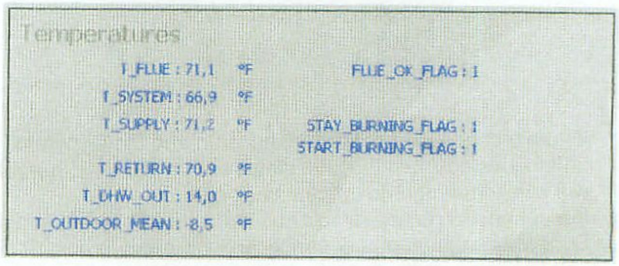


Figure 31: Central Heating Temperature Screen



Real-time temperatures are updated on screen, this includes:

- Stack/Flue Temperature (T_FLUE)
- System Temperature (T_SYSTEM)
- Outlet/Supply Temperature (T_SUPPLY)
- Inlet/Return Temperature (T_RETURN)
- DHW Supply Temperature (T_DHW_OUT)
- Outside Temperature (T_OUTDOOR_MEAN)

The CH demand switches between on/off depending on whether or not there is a demand for central heating. The other parameters are designed for internal control purposes.

Figure 32: Central Heating Input Screen

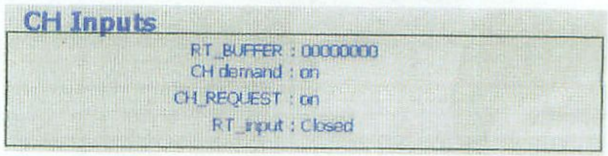
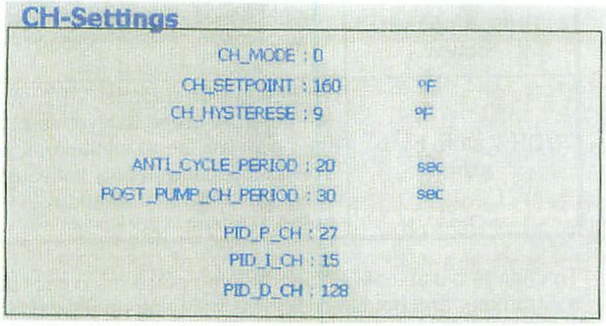


Table 18: CH Input Screen Parameters

Parameter	Parameter Description
CH demand	Displays the state of the room thermostat. When 'on' is shown the thermostat is closed, when 'off' is shown the thermostat is open.
CH_REQUEST	Displays the response of the boiler. 'on' is displayed when the boiler is responding to the CH_demand, and 'off' is displayed when a CH_demand does not exist.

8.3.1 Central Heating Mode, Installer Level

Figure 33: Central Heating Mode Settings



The following parameters can be adjusted:

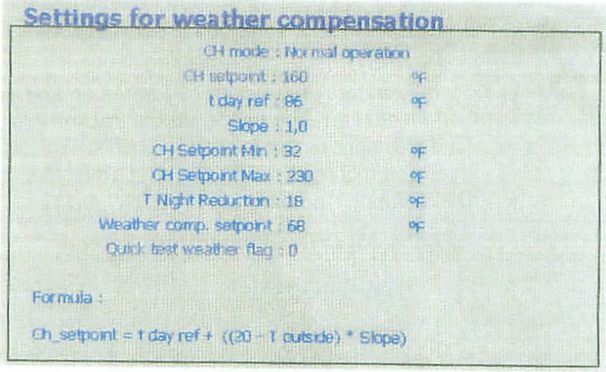
Table 19: CH Mode = 0 Parameters

Parameter	Parameter Description
CH_Setpoint	**CH Mode = 0, 1, 2, 3** To provide a target setpoint for the heating system. (Default: 160°F)
CH_Hysterese	**CH Mode = 0, 1, 2, 3** To provide a modulation rate above and below CH_setpoint. For example, if the value is 10°F and the setpoint is 160°F, the boiler will begin to modulate at 155°F and shut off at 165°F. (Default: 9°F)

To change a blue coloured parameter, place the cursor on top of a parameter and double-click. This will bring up a window to enter the desired values. Take note of the minimum and maximum values that can be entered, as the values entered MUST be within this range.
The Anti_Cycle_Period is designed to prevent the boiler from short-cycling. The preset time must be satisfied before the boiler will start up. Post_Pump_CH_Period determines the time the on-board pump continues to circulate after the burner has shut off and completed its post-purge cycle.

8.3.2 Central Heating Mode = 1, 2, 3 Installer Level

Figure 34: Central Heating Mode = 1, 2, 3 Settings



The following parameters can be adjusted:

Table 20: CH Mode = 1 Parameters

Parameter	Parameter Description
t_day_ref	**CH Mode 1, 2** To determine the outdoor reset temperature. The control uses the following algorithm to adjust the CH_setpoint accordingly: CH_Setpoint = t_day_ref + [(20-T_Outdoor) * Slope (Default: 68°F)
Slope	**CH Mode 1, 2** To determine the outdoor reset temperature. See t_day_ref to understand how Slope affects CH_Setpoint. (Default: 1.0)
T_night_reduction	**CH Mode 2** If setting an alternate temperature for night time usage is desired. This parameter is only engaged when the external clock is satisfied. (Default: 50°F)
Weather_setpoint	**CH Mode 2** When the outdoor temperature is below the preset Weather_setpoint a CH demand is created. Therefore, the CH demand is not dependent on Room Temperature input. (Default: 68°F)

To change a blue coloured parameter, place the cursor over a parameter and double-click. This will bring up a window to enter the desired values of operation. Take note of the minimum and maximum values that can be entered, as the values entered MUST be within this range.

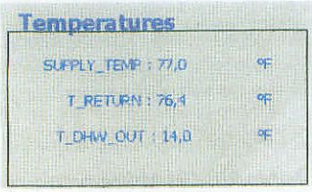
8.4 LABVISION DOMESTIC HOT WATER

Use the pull down menu and select DHW Mode 4 to adjust parameters. Before the parameters can be adjusted the blue status bar must track left-to-right and back again. Refer to Section 8.1 to resolve connection issues.

Real-time temperatures are tracked by LabVision and are displayed on the screen. The temperatures tracked are:

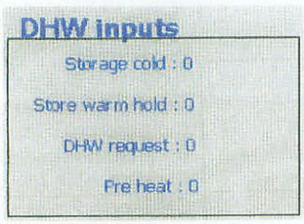
- Outlet/Supply Temperature (T_SUPPLY)
- Inlet/Return Temperature (T_RETURN)
- DHW Supply Temperature (T_DHW_OUT)

Figure 35: DHW Temperature Screen



The DHW section of the screen displays the request that the DynaMax boiler is responding to. The values for the 4 parameters: Storage cold, Tap flow, DHW request, and Pre heat vary from 0 (off) and 1 (on). This information is also listed under the General section as well.

Figure 36: DHW Inputs



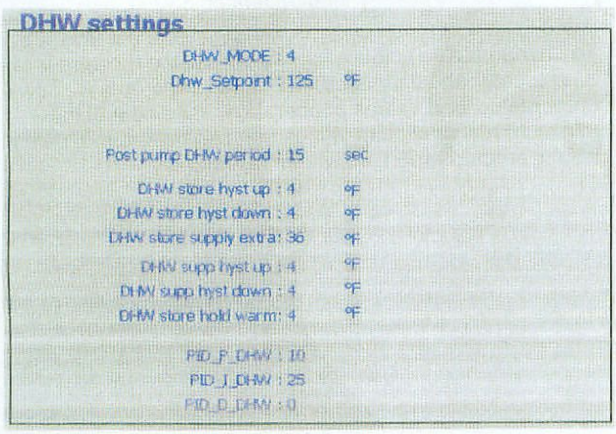
The Pre heat and Tap flow screens are designed to keep the DynaMax operating at its optimum setting, and therefore these parameters will be preset and cannot be changed.

8.4.1 DHW Mode = 0, Installer Level

No parameter changes can be made in this mode as this mode is used for a DynaMax Heating boiler.

8.4.2 DHW Mode = 1, 2 Installer Level

Figure 37: DHW Mode = 1, 2 Settings



The following parameters can be adjusted:

Table 21: DHW Mode = 1, 2 Parameters

Parameter	Parameter Description
Dhw_Setpoint	To provide a target setpoint for the storage tank. (Default: 135°F)
DHW store hyst up	To detect the start of a storage tank demand. (Default: 4°F)
DHW store hyst down	To detect the end of a storage tank demand(Default: 4°F)
DHW store supply extra	Additional increase in the setpoint temperature above Dhw_Setpoint (Default: 36°F)
DHW supp hyst up	To provide a modulation rate above Dhw_setpoint(Default: 4°F)
DHW supp hyst down	Supply temperature below Dhw_Setpoint to start ignition sequence. (Default: 4°F)
DHW store hold warm	When the storage tank temperature drops below this value the boiler will fire at minimum fire. This functionality is only activated when the boiler is in Standby mode. (Default: 120°F)

To change a blue coloured parameter, place the cursor over a parameter and double-click. This will bring up a window to enter the desired values of operation. Take note of the minimum and maximum values that can be entered, as the values entered MUST be within this range

8.4.3 DHW Mode = 4, Installer Level

This mode can <u>ONLY</u> be accessed on a DynaMax Combination model using a plate type heat exchanger. Use the pull down menu and select DHW Mode 4 to adjust parameters. Before parameters can be adjusted the blue status bar must track left-to-right and back again. Refer to Section 8.1 to resolve connection issues.

Figure 38: DHW Mode = 4 Screen

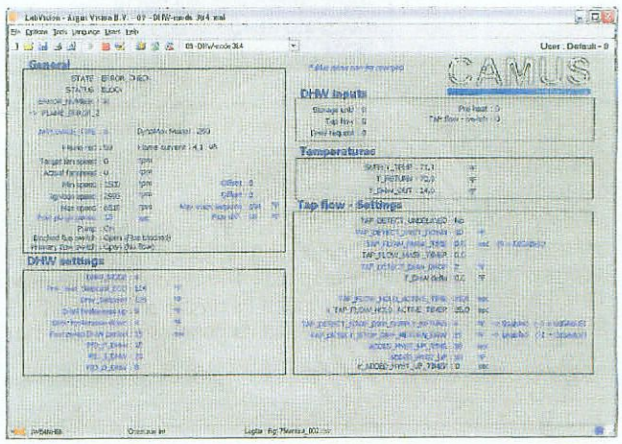
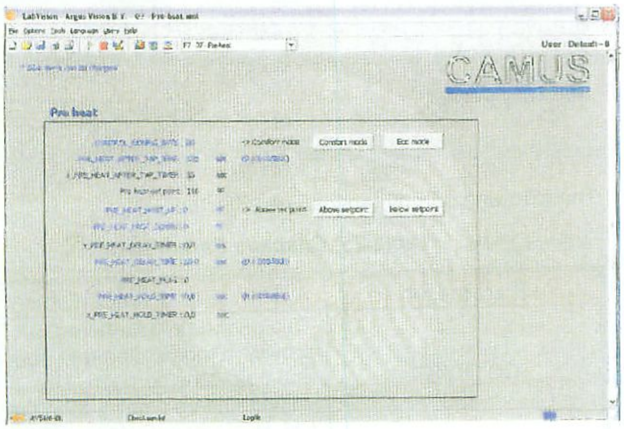


Table 22: DHW Mode = 4 Parameters

Parameter	Parameter Description
DHW_Setpoint	To provide a target setpoint for DHW. (Default: 120°F)
DHW hystereses up	To provide modulation rate above DHW setpoint. (Default: 9°F)
DHW hystereses down	To provide modulation rate below DHW setpoint. (Default: 4°F)
Pre Heat Setpoint	When the plate heat exchanger outlet/supply temperature drops below this value the boiler will fire at minimum fire. This functionality is only activated when the boiler is in Standby mode. (Default: 110°F)
Pre Heat hyst_up	To provide modulation rate above Pre-heat setpoint for the plate heat exchanger during pre-heat. (Default: 0°F)
Pre Heat hyst_down	To detect the start of the pre-heat sequence below Pre Heat Setpoint. (Default: 9°F)

Figure 39: DHW Mode = 4 Pre heat and Tap flow Screen



The General screen provides access to the state of the boiler at any point in time. The State displays the operation of the DynaMax boiler. This parameter ranges from STANDBY, PRE_PURGE, SAFETY_ON, SAFETY_OFF, IGNIT_0, IGNIT_1, and BURN. The complete breakdown of the ignition sequence is listed in Table 43. Status displays that the boiler is in CH, PRE_HEAT or TAP mode.

Table 23: Status Readouts

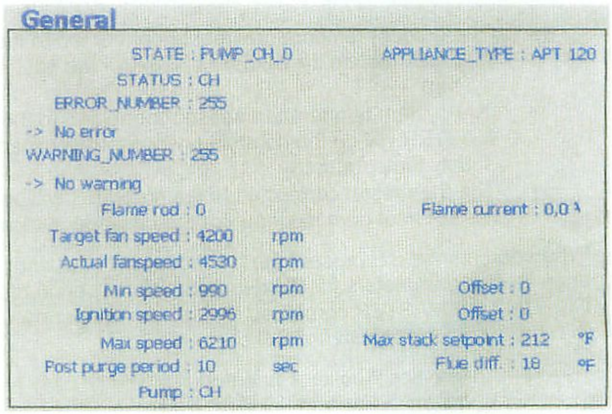
Parameter	Parameter Description
PRE HEAT	Keeps the plate heat exchanger warm. This is accomplished by firing the boiler at minimum fire. This process repeats itself with a 2 minute gap in between firing if the plate has not reached Pre Heat Setpoint.
TAP	When there is a domestic demand and the burner will fire until DHW_Setpoint is satisfied.

DHW Priority

When both a CH demand and DHW demand exist simultaneously, DHW will always have priority. When DHW demand ends the boiler will check the Outlet Temperature sensor or System Sensor and Room Thermostat switch to determine if CH demand exists.

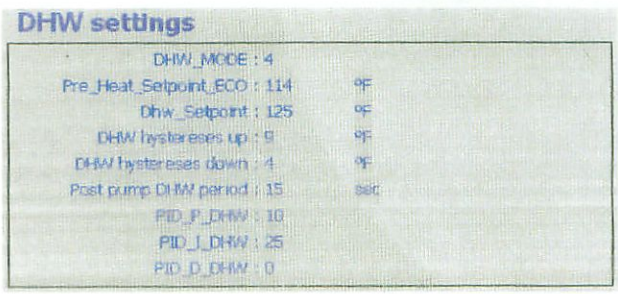
Flame rod current in µA can be observed. Fan speeds cannot be altered here, instead they are varied under the Settings screen. This is covered in Section 8.2 of this manual The Maximum Stack Setpoint Temperature and the Flue Diff. Temperature cannot be changed to preserve reliable and efficient performance.

Figure 40: DHW Mode = 4 General Screen



To change a blue coloured parameter, place the cursor over a parameter and double-click. This will bring up a window to enter the desired values of operation. Take note of the minimum and maximum values that can be entered, as the values entered MUST be within this range

Figure 41: DHW Mode = 4 Settings



8.5 LABVISION CASCADE

When connected in a cascade setup the Master boiler can control up to 7 slave boilers (ie. a total of 8 boilers) from the control panel of the Master Boiler. All diagnostic, control operation can be performed on the Master boiler, which can then relay the relevant information to the slave boilers. Therefore a direct connection to the Master Boiler and LabVision is required for communication using LabVision.

When the master boiler detects a heat demand for CH this boiler will start and uses it own parameters for CH demand. If after cascade_delay_time the system temperature is still below the setpoint the next boiler will start.

When the master temperature (T_system) plus cascade_hyst is greater than the setpoint a boiler will be stopped. If after a period of cascade_delay_time this situation is still present the next boiler is switched off.

In a situation where there is an installation of more than 8 DynaMax boilers in the Cascade system, a Zone Master can be ordered with the system. This Zone Master functions in the same way as the DynaMax Controller controlling the Cascade function and can support up to 64 DynaMax boilers.

Sequence of Operation:

When a boiler is set as MASTER (address =1), the controller of this boiler will drive the cascade. THE CH mode of the master boiler is applicable for the total cascade system.

- The outdoor temperature sensor connected to the MASTER will be the outdoor sensor for the cascade system
- The system temperature sensor connected to the MASTER will be the control sensor for the cascade supply temperature.
- The thermostat connected to the MASTER will be the CH heat demand input for the cascade system.

When demand for CH present the first boiler will start and uses its own parameters for CH demand. After a period of CC_TIME the MASTER compared the system temperature with the cascade setpoint and will check if:

1) An additional boiler is needed
   T_system > CH setpoint – cc_hyst
2) Number of boilers remain the same o
   T_system > CH_setpoint – cc_hyst **AND**
   T_system < CH setpoint + cc_hyst
3) A boiler should stop.
   T_system > CH_setpoint + cc_hyst

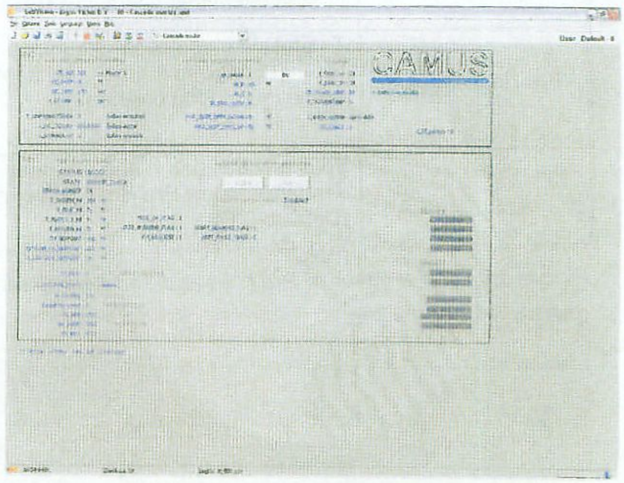
Staging Operation

The control supports a function to rotate the boilers on a timely basis. With parameter CC_STAGE_TIME the time can be set after which the start and stop sequence of the cascade boilers changes.

Table 24: Staging Sequence

cc_stage_time	Start/Stop sequence
1 x cc_stage_time	1-2-3-4-5..x
2 x cc_stage_time	2-3-4-5..x-1
3 x cc_stage_time	3-4-5..x-1-2
4 x cc_stage_time	4-5..x-1-2-3
5 x cc_stage_time	5..x-1-2-3-5

Figure 42: Cascade Screen



The following parameters can be adjusted:

Table 25: Cascade Parameters

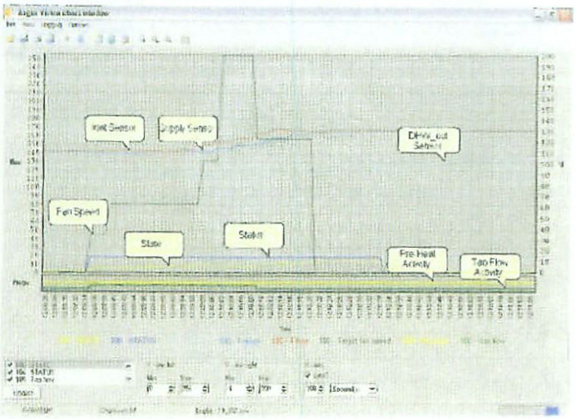
Parameter	Parameter Description
CC_HYST	This parameter is entered to provide a modulation rate above and below the setpoint. This value must be smaller than the CH_Hysterese.(Default: 5°F)
CC_TIME	This parameter is entered to implement a delay time between the startup of one boiler to the next. This timer starts when a flame signal is detected from the first boiler.(Default: 120 sec)
CC_STAGE_TIME	Period after which boiler start-up order changes (Defualt: 100 hrs)

Refer to section 12.14 Cascade Setup to install a Cascade system setup.

8.6 DATA LOGGING

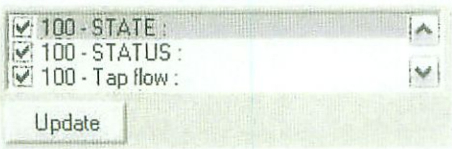
LabVision software also comes equipped with data logging capability which has the ability to track return/supply, DHW temperatures, actual and target fan speed, state and status in a graph as the boiler is operating. This is a beneficial feature as it improves the ability to troubleshoot and diagnose issues in the field.

Figure 43: Data Logging Screen



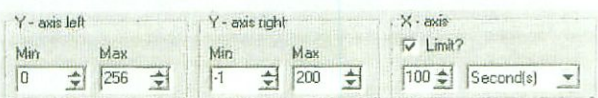
To select the parameters that need to be viewed or recorded, a Parameter Selection Box on the bottom left-side of the screen contains all the parameters that LabVision can track. To view or record the parameter that is required, click the check box beside each parameter. When finished selecting the parameters required, click on Update and this will refresh the logging screen.

Figure 44: Parameter Selection Box



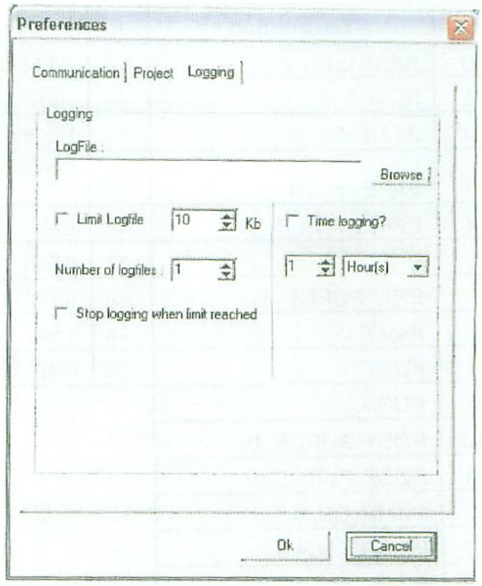
To adjust the viewing area, this can be done by adjusting the margins for the left y-axis, right y-axis and the timeframe with which to view.

Figure 45: Adjust Viewing Area



To record the data that is shown on screen, go to the Toolbar and click on Logging > Start Logging. A window will pop up on screen asking for a file name for the log file to be captured. DO NOT change the file type, as LabVision must record the log file as .Csv. As soon as file name is confirmed by clicking on 'Open', LabVision begins capturing the data immediately.
Also notice that the status bar has changed from blue to red. This demonstrates that LabVision is recording to the log file specified. The amount of data collected can be limited to a certain size inside LabVision. When a maximum memory limit is set, this results in over-writing previously written data in the same log. Therefore it captures the most recent amount of data. To prevent this from occurring this feature can be turned off by clicking on Options > Options > Logging tab and uncheck the parameter 'Limit Logfile'. With this feature disabled the log file will be dependent on time as opposed to memory size.

Figure 46: Unlimited Log File Size



When logging is complete click on Logging > Stop Logging. Notice that the status bar has changed from red to blue. This informs that Logging is complete.
To view a log file, Camus recommends using Microsoft® Excel.

8.6.1 Procedure for Viewing Log Files in Microsoft® Excel

1) Open Microsoft® Excel
2) Use a new spreadsheet, if Microsoft® Excel fails to load a new spreadsheet. Click on File > New..
3) Data > Import External Data > Import Data..
4) A window appears titled 'Select Data Source'
5) Identify the log file that was created and double-click it
6) A new window will pop up titled 'Text Import Wizard'. Select Delimited. Click Next.
7) Place a checkmark beside 'Tab' and 'Semi-Colon' from the checkboxes provided. Click Next.
8) In the 'Column data format' section of the window, ensure that 'General' is selected. Click Finish.
9) An 'Import Data' window will appear and check to see that 'Existing Worksheet' is selected and the text box reads: '=Sheet1!$A$1' or '=$A$1'. This allows the data to start to importing the data at cell 'A1' of the spreadsheet.
10) Click OK.
11) The log file will appear on the spreadsheet.

8.6.2 Analysis of Microsoft® Excel Log File

The log file parameters are divided into columns with a reference to the time of data collection on each row. The Status and State parameters are identified by numbers and these can be translated into a description, listed below.

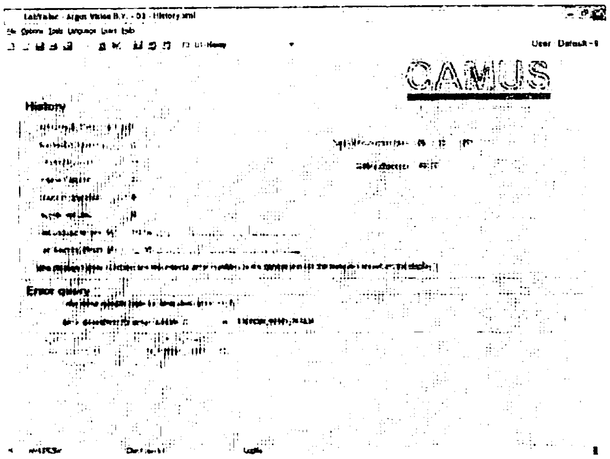
Table 26: Description of State and Status Parameters

State		Status	
#	**Description**	**#**	**Description**
0	RESET_0	0	STANDBY
1	RESET_1	10	ALARM
2	STANDBY_0	14	BLOCK
3	SAFETY_ON	15	FROST_PROTECT
4	SAFETY_OFF	16	CH
5	PRE_PURGE	17	RESET_STATE
6	PRE_PURGE_1	18	STORAGE
7	IGNIT_0	19	TAP
8	IGNIT_1	20	PRE_HEAT
9	BURN_0		
10	POST_PURGE_0		
11	POST_PURGE_1		
12	PUMP_CH_0		
13	PUMP_CH_1		
14	PUMP_HW_0		
15	PUMP_HW_1		
16	ALARM_1		
17	ERROR_CHECK		
18	BURNER_BOOT		
19	CLEAR_E2PROM_ERROR		
20	STORE_BLOCK_ERROR		
21	WAIT_A_SECOND		

8.7 Error History

LabVision has the ability to record past blocking (E) and lockout (A) errors. To access this feature use the pull down menu and select History.

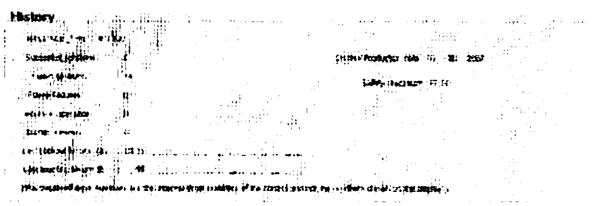
Figure 47: Error History



The blocking and lockout errors are separated into their own respective rows and are identified by their respective error codes. This assists with diagnostic and service work as the behaviour of the boiler can be tracked.

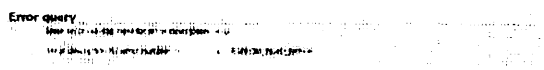
This screen also provides information of the number of Successful Ignitions, Failed Ignitions and Flame failures due to a lost flame signal.

Figure 48: History and Diagnostic Information



Due to a large number of error codes that can be presented, LabVision comes complete with a feature in which to provide a description of each error code. Double click on the phrase 'Enter error number here for description' and a window will appear allowing the installer to identify the error.

Figure 49: Error Query



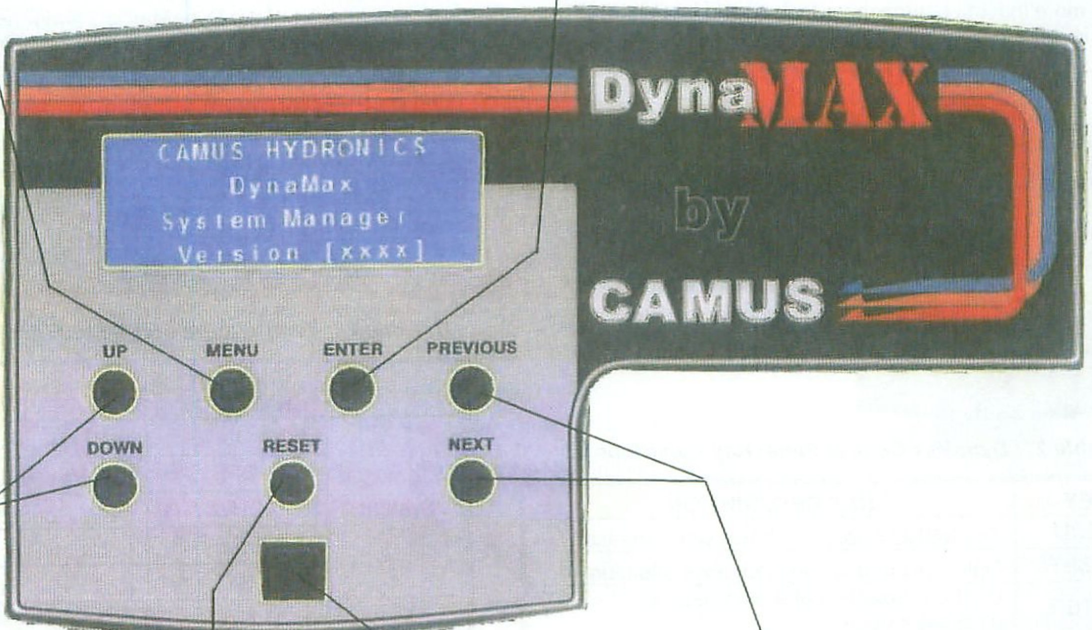
PART 9 DYNAMAX CONTROL PANEL

MENU

- Press to enter Main Menu. This provides access to System Monitor, Settings, Programs and Errors

ENTER

- Press to ENTER to confirm selection or to confirm a parameter change



UP

DOWN

- Press to change boiler parameter values (Setpoint Temperature, Date & Time)

RESET

- Press to reset a lockout error. This shown on the display as A##*

* Where # denotes a digit from 0 – 9.

- PC LPT1 Connection Port

PREVIOUS

NEXT

- Press to change boiler parameter values (Setpoint Temperature, Date & Time)

9.1 INTRODUCTION TO THE DYNAMAX

CONTROL PANEL

For times when a notebook computer is not available, a service technician will still be able to perform all the functions described in LabVision, except for the logging aspect.

The menu structure for the DynaMax Control Panel was designed to be intuitive and easy to use for a first time user. To maintain the DynaMax boiler at its correct settings three levels of security is provided. User, Installer and Factory with an increasing amount of parameters that can be adjusted with each higher level of access. This is done to provide an easy means of communication for the end user and a more indepth approach for factory and installers when installing and troubleshooting.

Figure 50: DynaMax Control Panel Layout

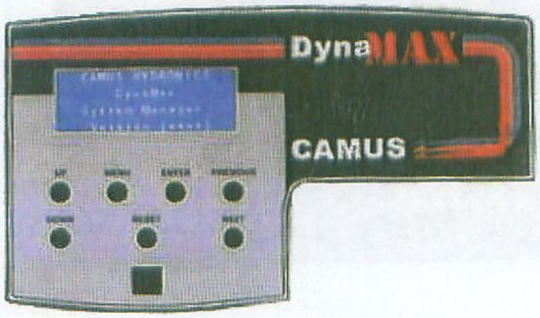


Table 27: DynaMax Control Panel Key Functions

KEY	KEY DESCRIPTION
MENU	The MENU display is shown when pressed.
RESET	Only used during a lockout error situation
ENTER	Confirms selection of a parameter or parameter value
PREVIOUS	Scroll backward through the parameter structure
NEXT	Scroll forward through the parameter structure
UP	Increase a parameter value
DOWN	Decrease a parameter value

Levels of Access

Three access levels to simplify the use of the boiler.

User – Access to general boiler and display settings and will allow adjustments to the central heating and domestic hot water setpoint.

Installer –Access to all user parameters and allows for changes to additional boiler parameters to allow for ease of startup and serviceability.

Camus – Full access to DynaMax parameters and is only open to Camus personnel.

Startup Display

Upon startup of the DynaMax boiler the DynaMax Control Panel startup display is shown. This display is shown for 5 seconds upon startup. The Version # relates to the version of software uploaded onto the boiler control.

Figure 51: DynaMax Home Screen

```
CAMUS HYDRONICS
DYNAMAX
BOILER CONTROL
Version [xxxx xxxx]
```

The display panel then defaults to the next screen which provides System, Boiler and Hot Water temperature. For a DynaMax heater that does not have domestic hot water capability the status will display OFF.
A temperature readout of supply temperatures from the boiler will be displayed. If the DynaMax is a water heater or a combination unit it will also display the Hot Water temperature.

Figure 52: Temperature and Status

```
System:            ON
Boiler:        °F  ON
Hot Water:     °F  OFF
22 JUN 2007     16:38
```

Table 28: Temperature and Status Display Readout

	DISPLAY READOUT	DESCRIPTION
System	ON	Heat Request
	OFF	No Heat Request
	DHW	DHW Request
	ERR	Lockout/ Blocking Error
	NC	No Communication
Boiler	ON	Burner On, Responding to CH Demand
	OFF	Burner Off
Hot Water	ON	Burner On, Responding to DHW Demand
	OFF	Burner Off

9.2 *MENU SCREEN*

From TEMPERATURE AND STATUS display;

1) Press **[MENU]** button.

Display	*Display Readout*	*Description*
MENU →System Monitor ▲ Appliance Settings Display Options ▼ Errors	System Monitor	Monitor Central Heating and DHW settings, if equipped. System Monitor will be open to all levels of access.
	Display Options	Changes to Languages, Date and Time, and Units of measurement. The default setting is English, Fahrenheit and Imperial. 'Display Options' will be open to all levels of access
	Appliance Settings	Changes boiler characteristics. The User level will have access to the first screen inside Appliance Settings which allows for changes in Central Heating setpoint. A 4-digit personal identification number (PIN) needs to be entered before moving further into the controller. If an incorrect PIN# is entered this will result in an error displayed on screen.
	Errors	Displays the lockout or error code along with a description of the error.

9.3 SYSTEM MONITOR DISPLAY

From MENU display;
1) Use **[NEXT]** to select 'System Monitor'
2) Press **[ENTER]**

Display	Display Readout		Description
SYSTEM MONITOR ▲ Active program: Boiler Type Pump:ON Standby▼	Active Program	MASTER	Boiler is designated as a Master boiler in the cascade setup
		SLAVE	Boiler is designated as a Slave boiler in the cascade setup
	PUMP	ON	Pump is active
		OFF	Pump is inactive (idle)
	STATUTS	Standby	Heating and DHW Request (if equipped) is satisfied
		##%	Boiler is firing at the rate indicated
CENTRAL HEATING ▲ Temp (°F) Outd: In : Out : Setp: Flue:▼	Outd		Outdoor Temperature (if equipped)
	In		Boiler Return/Inlet Water Temperature
	Out		Boiler Supply/ Outlet Water Temperature
	Setp		CH Setpoint Temperature
	Flue		Boiler Flue Temperature
DOMESTIC HOT WATER ▲ Temp (°F) DHW : In : Out : Setp: Flue:▼	DHW		DHW Temperature (if equipped)
	In		Boiler Return/Inlet Water Temperature
	Out		Boiler Supply/ Outlet Water Temperature
	Setp		DHW Setpoint Temperature
	Flue		Boiler Flue Temperature
SYSTEM ▲ Temp (°F) Sys : In : Out : Setp: Flue:▼	Sys		System Temperature of Primary Loop
	In		Return/Inlet Temperature to Boiler
	Out		Supply/Outlet Temperature to Boiler
	Setp		Central Heating Setpoint
	Flue		Flue Temperature
RUN TIME ▲ Total Run Time since Installation: 0hrs.▼	Total Run Time Since Installation		Monitors the amount of operational time since the DynaMax was installed. The timer starts counting as soon as it receives a flame signal to the time the flame signal disappears
FAN DIAGNOSTICS(RPM) Min. 1500 Ign. Max. Actual	Min.		Programmed Minimum Fan Speed
	Max.		Programmed Maximum Fan Speed
	Ign.		Programmed Ignition Fan Speed
	Actual		Actual Fan Speed updated in real-time
FLAME CURRENT ▲ Flame Current uA▼	Flame Current		7-9µA: High Fire 3-5 µA: Low Fire

9.4 DISPLAY OPTIONS DISPLAY

From MENU display;

1) Use **[PREVIOUS]/[NEXT]** button to select 'Display Options'.
2) Press **ENTER**

Display	*Display Readout*	*Description*
DISPLAY SETTINGS →Language Date and Time Units	Language	Allows the control to be set to English (default), French or Spanish
	Date and Time	Allows the Date and Time to be changed
	Units	Allows the control to be set to Imperial (default) or Metric units
LANGUAGE →English Français Español	English	Select English Language
	French	Select French Language
	Spanish	Select Spanish Language
DATE AND TIME Wednesday 22 JUN 2008 15:17	Date and Time	1) Use **[NEXT]** to view DATE AND TIME display 2) Use **[UP]/[DOWN]** and the cursor arrow will point to either the Day, Date or Time 3) Press **[ENTER]** to change a parameter. The parameter will begin to flash 4) Use **[UP]/[DOWN]** to change parameter value. 5) Press **[ENTER]** to confirm.
UNITS →Imperial Metric	Units	1) Use **[NEXT]** to view UNITS display 2) Use **[UP]/[DOWN]** to select the desired unit of measurement 3) Press **[ENTER]** to confirm.

9.5 CENTRAL HEATING DISPLAY

1) Use **[PREVIOUS]/[NEXT]** button to select 'Appliance Settings'.
2) Press **ENTER**

Display	Display Readout	Description
APPLIANCE SETTINGS ▲ →Central Heating Domestic Hot Water Cascade Control ▼ Boiler Control	Central Heating	Enters Central Heating branch of display
CENTRAL HEATING Enter Desired Temp.: (45..194): CH_Setpoint 160°F	Setpoint	Allows adjustment of Setpoint. The Setpoint is controlled to the boiler supply/outlet sensor. (Default: 160°F)
CENTRAL HEATING Enter PIN# To Access Additional Parameters: 0000	PIN# Access	1) Use **[NEXT]** to enter INSTALLER ACCESS display 2) Use **[UP/DOWN]** to enter desired PIN #. 3) Press **[ENTER]** to confirm.
CH PARAMETER CH MODE # (0-3): 0	CH Mode of Opeation	Mode 0: Central Heating Without Outdoor Reset Mode 1: Central Heating with Outdoor Reset and Thermostat Control Mode 2: Central Heating with Outdoor Mode 3: Central Heating with Constant Temperature Loop
CH PARAMETER Ignition Fan Speed: ▲ ▼ RPM	Ignition Fan Speed (Mode 0, 1, 2, 3)	Allows for adjustment of Ignition Fan Speed. The Ignition Fan speed should **NOT** be less than minimum fan speed or greater than maximum fan speed.
CH PARAMETER MODE CH Setpoint ▲ (45..185): ▼ 160°F	CH_Setpoint (Mode 0, 3)	Allows adjustment of Setpoint. The Setpoint is controlled to the boiler supply/outlet sensor. (Default: 160°F)
CH PARAMETER MODE CH Hysterese ▲ (-9..36): ▼ 9°F	CH_Hysterse (Mode 0, 1, 2, 3)	To provide modulation rate above and below CH_setpoint. For example, if the value is 10°F and the setpoint is 160°F, the boiler will begin to modulate at 155°F and shut off at 165°F. (Default: 9°F)
CH PARAMETER MODE T_day_ref ▲ (10..120): ▼ 68°F	T_day_ref (Mode 1, 2)	To determine the outdoor reset temperature. The control uses the following algorithm to adjust the CH_setpoint: CH_Setpoint = T_day_ref + [(20-T_Outdoor) * Slope]. (Default: 68°F)
CH PARAMETER MODE Slope ▲ (0.1..5.0): ▼ 1.0	Slope (Mode 1, 2)	To determine the outdoor reset temperature. See T_day_ref to understand how Slope affects CH_Setpoint. (Default: 1.0)

Display	Display Readout	Description
CH PARAMETER MODE T_night_reduction ▲ (32..122): ▼ 50°F	T_night_reduction (Mode 2)	Temperature for night time usage This parameter is only engaged when the external clock is satisfied. (Default: 50°F).
CH PARAMETER MODE Weather_setpoint ▲ (32..122): ▼ 68°F	Weather_setpoint (Mode 2)	When the outdoor temperature is below the preset Weather_setpoint a CH demand is created. Therefore, the CH demand is not dependent on Room Temperature input. (Default: 68°F)

9.6 DOMESTIC HOT WATER DISPLAY

1) Use **[PREVIOUS]/[NEXT]** button to select 'Appliance Settings'.
2) Press **ENTER**

Display	Display Readout	Description
APPLIANCE SETTINGS ▲ Central Heating →Domestic Hot Water Cascade Control ▼ Boiler Control	Domestic Hot Water	Enters Domestic Hot Water branch of display
DOMESTIC HOT WATER Enter Desired Temp.: (45..194): DHW_Setpoint 120°F	DHW Setpoint	Allows adjustment of Setpoint. The Setpoint is controlled to the boiler supply/outlet sensor. (Default: 120°F)
DHW PARAMETER Enter PIN# To Access Additional Parameters: 0000	PIN# Access	1) Use **[NEXT]** to enter INSTALLER ACCESS display 2) Use **[UP/DOWN]** to enter desired PIN #. 3) Press **[ENTER]** to confirm.
DHW PARAMETER DHW MODE # (0-3):	DHW Mode of Opeation	Mode 0: Disables DHW Functionality Mode 1: DHW Storage Tank with Temperature Sensor Mode 2: DHW Storage Tank with Aquastat Mode 3: Combination Boiler using Plate Heat Exchanger and DHW Temperature Sensor
DHW PARAMETER Ignition Fan Speed: ▲ ▼ RPM	Ignition Fan Speed (Mode 0, 1, 2, 3)	Allows for adjustment of Ignition Fan Speed. The Ignition Fan speed should **NOT** be less than minimum fan speed or greater than maximum fan speed.
DOMESTIC HOT WATER Enter Desired Temp.: (45..194): DHW_Setpoint 120°F	DHW Setpoint	Allows adjustment of Setpoint. The Setpoint is controlled to the boiler supply/outlet sensor. (Default: 120°F)

Display	Display Readout	Description
DHW PARAMETER MODE DHW_hyst_up ▲ (0..36): ▼ 9°F	DHW_Hyst_up (Mode 1, 2, 4)	To provide modulation rate above the DHW_setpoint. (Default: 9°F)
DHW PARAMETER MODE DHW_hyst_down ▲ (0..36): ▼ 4°F	DHW_hyst_down (Mode 1, 2, 4)	To provide modulation rate below the DHW_setpoint. (Default: 4°F)
DHW PARAMETER MODE Pre-Heat Setpoint ▲ (100..140): ▼ 110°F	Pre-Heat Setpoint (Mode 0, 1, 2, 3)	During a DHW request, the user will not be subjected to a stream of cold water when the tap is first turned on. This also creates a buffer zone for the boiler to fire up and modulate. (Default: 110°F)
DHW PARAMETER MODE Pre-Heat hyst_up ▲ (0..36): ▼ 0°F	Pre-Heat hyst_up	To provide modulation rate above Pre-heat setpoint for the plate heat exchanger during pre-heat. (Default: 0°F)
DHW PARAMETER MODE Pre-Heat hyst_down ▲ (0..36): ▼ 9°F	Pre-Heat hyst_down	To provide modulation rate below Pre-heat setpoint for the plate heat exchanger during pre-heat. (Default: 9°F)

9.7 *CASCADE CONTROL*

1) Use **[PREVIOUS]/[NEXT]** button to select 'Appliance Settings'.
2) Press **ENTER**

Display	*Display Readout*	*Description*
APPLIANCE SETTINGS ▲ Central Heating Domestic Hot Water →Cascade Control ▼ Boiler Control	Cascade Control	Enters Cascade branch of display
CASCADE PARAMETER ▲ Address Selection: (0..8) Standalone Boiler ▼	Master/Slave Selection	1) Use **[UP]/[DOWN]** to select the option of a 'MASTER Boiler' or 'SLAVE Boiler'. 2) Press **[ENTER]** to confirm. 3) If 'SLAVE Boiler' is selected assign it an address of '2' if this is the boiler immediately after the 'MASTER Boiler. Assign a number of '3' if it is the third boiler in the system. Continue this until all boilers have been assigned an address. Use **[UP]/[DOWN]** to select the correct address 4) Press **[ENTER]** to confirm.
CASCADE PARAMETER ▲ Cascade Delay Time (1..15) 120 sec▼	Cascade Delay Time	Delay time for switching on/off next boiler when ch_setpoint is (not) satisfied. (Default: 120°F)
CASCADE PARAMETER ▲ Cascade Hysterese (0..36) 5°F▼	Cascade Hysterese	Hysterese to start and stop the next slave boilers. (Default: 5°F)
CASCADE PARAMETER ▲ Lead Lag Time (0..2000) 0hrs▼	Lead Lag Time	Period after which boiler start-up order changes. (Default: 100 hrs)

9.6 BOILER CONTROL

1) Use **[PREVIOUS]/[NEXT]** button to select 'Boiler Control'.
2) Press **ENTER**

Display	Display Readout	Description
APPLIANCE SETTINGS ▲ Central Heating Domestic Hot Water Cascade Control ▼ →Boiler Control	Boiler Control	Enters Boiler Control branch of display
BOILER CONTROL System Test ▲ ▼ 0	System Test	Manual override of fan speeds for a time of 10 minutes. Fan speeds can vary from Off, Minimum Power, Ignition Power or Maximum Power
BOILER CONTROL RC V.: 0000 ▲ Control V.: 0000 ▼	DynaMax Control Board Version #	Main Board and Text Display Version Number
BOILER CONTROL Maximum Stack Temp ▲ Material: ▼ PVC	Maximum Stack Limit	Select vent material (PVC, CPVC, AL29-4C, Stainless Steel) (Default: PVC)
CASCADE PARAMETER ▲ Lead Lag Time (0..2000) 0hrs▼	Lead Lag Time	Period after which boiler start-up order changes. (Default: 100 hrs)

9.8 ERROR SCREEN

1) Use **[PREVIOUS]/[NEXT]** to select 'Errors'
2) Press **[ENTER]**.

Display	Display Readout	Description
MASTER lockout int.nr error description →Reset error	Error Screen	**Lockout:** This will display 'Blocking' or 'Lockout' depending on the error **Int.nr:** This will display the error code in the form of an internal number (Lockout code, Table 5.4.1) or (Blocking error, Table 5.4.2) **Error Description:** The error description block shall display the error in text. The description is identical to Table 15 and Table 16 under section 5.4.

PART 10 TROUBLESHOOTING

Table 29: Troubleshooting Table

COMPONENT	FAILURE MODE	ANALYSIS
Incoming Power	• Two wires interchanged, E21	• No effect on safety • Live and Neutral wires are interchanged.
Transformer Tripped	• The 24Volts and 120 Volts wired are interchanged	• Transformer immediately burns out, replace transformer • Fuse on DynaMax Controller blows, replace 3.15A fuse located at F1 on DynaMax Controller.
Pump Fails to Circulate	• Wiring Issue	• Check that wires are correctly wired from the DynaMax Controller to the pump delay relay. • Check that 115V is delivered to pump coil.
	• Faulty Pump on a wet rotor pump	• Pump impeller may be stuck. Use a flat head screwdriver on face of pump to turn impeller manually • Replace Pump
	• Air in the piping system	• Purge all air from the piping system
	• Internal Fault on DynaMax Controller	• Replace DynaMax Controller
Relief Valve	• System pressure exceeds relief valve setting	• Replace the standard relief valve with a higher rated valve up to the maximum pressure of the heat exchanger. • Improperly sized expansion tank.
Flow Proving Device/ LWCO	• Flow Proving Device/ LWCO contacts are open	• Verify LED's on current sensing transformer during a heat demand (wall hung) • Check flow switch paddle (floor mount) • Verify for closed valves or obstructions in boiler piping • Verify that all air has been purged from the system • Verify that wiring is correct
	• Blown Fuse	• Replace 3.15A Fuse located at F1 on DynaMax Controller. • **DO NOT** use alternates as it may damage the DynaMax Controller

SYMPTOM	FAILURE MODE	ANALYSIS
Flame Failure (Pressing the manual RESET on the DynaMax Control Panel will be required to restart the ignition sequqnce)	• The boiler has failed to ignite the burner after 3 unsuccessful attempts (A01)	• Verify that all air has been purged from gas line • Inspect spark electrode and related wiring for damage and connection errors • Verify that the ignition fan speed is set to 3000 RPM through fan diagnostics screen. • Verify that boiler is properly grounded • Verify incoming gas supply pressure and that it coincides with Table 10. • Verify that the vent/ air inlet piping (if equipped) are correctly installed and obstructions are not present. • Verify 120 VAC and 24 VAC is being supplied to the gas valve transformer from the DynaMax Controller during ignition. Check wiring from DynaMax Controller, Gas Valve Transformer and Gas Valve Relay. If a signal cannot be detected, the DynaMax Controller needs to be replaced • If 24 VAC is present, check the outlet of the valve to ensure that gas is flowing. With a manometer connected to the outlet pressure tap of the gas valve a negative pressure should be present during pre-purge. When the valve is energized a change in pressure should occur, if no change is detected the gas valve has failed to open or it is passing insufficient amount of gas. If this is an initial startup increase the low fire gas setting by ¼ turn clockwise. • Inspect flame sensor and associated wiring. Replace if necessary • Inspect the burner. Refer to Burner Maintenenace in section 11.7 • Replace the DynaMax Controller
Flame Disappears During a Run Cycle (Pressing the manual RESET on the DynaMax Control Panel will be required to restart the ignition sequence)	• The DynaMax boiler was running and flame signal suddenly disappeared. This condition occurred 3 times. (A02)	• Verify that minimum fan speed is greater than 2500 RPM • Verify that all air has been purged from gas line • Inspect spark electrode and related wiring for damage and connection errors. • Verify that boiler is properly grounded • Verify incoming gas supply pressure and that it coincides with Table 10. • Verify that the gas line connections to the boiler are adequate • Verify that the vent/ air inlet piping (if equipped) are correctly installed and obstructions are not present • Verify 120 VAC is being supplied to the transformer from the DynaMax Controller during ignition. If a signal cannot be detected, the DynaMax Controller needs to be replaced • Verify that 120 VAC and 24 VAC is being supplied to the gas valve during ignition. If a signal cannot be detected, the transformer needs to be replaced • Inspect flame sensor and associated wiring. Replace if necessary • Inspect the burner. Refer to Burner Maintenance in section 11.7 • Replace the DynaMax Controller if necessary

SYMPTOM	FAILURE MODE	ANALYSIS
Noisy Operation	• Supply Gas Issue	• Refer to Part 3 Gas Connection in this manual. • Natural Gas Pressure should read between 3" w.c. and 14" w.c. • L.P. Gas Pressure should be at 11" w.c.
	• Air/Gas Mixture Issue	• Refer to Gas Valve Adjustment Procedure in section 10.2 of this manual for the proper combustion setting.
	• Air Inlet and/or Vent configuration	• Refer to Part 2 Air Inlet and Venting
	• Dirty/ Damaged Burner	• Refer to Burner Maintenance in section 11.7 of this manual for the burner removal and inspection procedure. Clean or replace the burner, if required.
	• Air in the piping system	• Purge all air from the piping system
	• Incorrect Igniter Gap	• Check that spark gap is 3/16"
Auto Reset High Limit Trips	• The supply/ outlet temperature has exceeded the setpoint temperature specified.	• Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly. Refer to Piping Diagrams in Section 13 of this manual. • Verify that 120VAC is being supplied to the boiler pump on a call for heat. If voltage cannot be detected check wiring. • Verify that the pump is circulating when 120VAC is detected. If not, pump impeller may be stuck. Use a flat head screwdriver on face of pump to turn impeller manually • If 120VAC is present during a call for heat, but the pump still does not circulate, replace the pump. • Replace the main DynaMax Controller if necessary
Manual Reset High Limit Trips (Pressing the manual RESET on the DynaMax Control Panel will be required to restart the ignition sequence)	• A03 appears on boiler display. • Manual Reset Safety High Lmit tripped, supply/outlet temperature in excess of 210°F	• Verify that the capillary tube is broken. If this is the case, replace Manual Reset High Limit • Verify that the system is full of water and that all air has been properly purged from the system. • Verify that the boiler is piped properly. Refer to Piping Diagrams in Section 13 of this manual. • Verify that 120 VAC is being supplied to the boiler pump on a call for heat. If voltage cannot be detected check wiring. • Verify that the pump is circulating when 120 VAC is supplied. If so, pump impeller may be stuck. Use a flat head screwdriver on face of pump to turn impeller manually. • If 120 VAC is present during a call for heat, but the pump still does not circulate, replace pump.
Fan Speed Too Low	• Actual fan RPM is 30% slower than target fan speed.	• Verify wiring connections at the fan and DynaMax Controller. • Replace the fan • Replace the DynaMax Controller.
Fan Speed Too High	• Actual fan RPM is 30% faster than what is required.	• Vent/ Air Inlet Lengths exceed the maximum allowed equivalent lengths. Refer to Air Inlet and Venting Section in Part 2 of this manual. • Verify that there are no obstructions in the vent/ air inlet pipes or at terminations • Verify wiring connections at the fan and DynaMax Controller. • Replace the fan • Replace the DynaMax Controller.

SYMPTOM	FAILURE MODE	ANALYSIS
Temperature Overshoot	• Stack temperature has exceeded the limit set on the boiler.	• Measure the resistance of the flue sensor at room temperature, it should be approximately 10kΩ.
	• The supply/outlet temperature has exceeded the setpoint temperature specified.	• Verify that the system is full of water and that all air has been properly purged from the system • Verify that the boiler is piped properly. Refer to Piping Diagrams in Section 13 of this manual • Verify that 120 VAC is being supplied to the boiler pump on a call for heat. If voltage cannot be detected check wiring • Verify that the pump is circulating when 120 VAC is supplied. If so, pump impeller may be stuck. Use a flat head screwdriver on face of pump to turn impeller manually • If 120 VAC is present during a call for heat, but the pump still does not circulate, replace the pump. • Replace the DynaMax Controller, if necessary.
Sensor Not Connected	• E01 shown on display. Supply/ Outlet sensor • E02 shown on display. Return/ Inlet sensor • E03 shown on display. Flue sensor • E04 shown on display. DHW-Out sensor	• Verify that the sensors are connected • Verify that they are wired correctly. • Measure the resistance of the sensors, 10kΩ sensors. • Replace the sensor if necessary
Sensor Shorted	• E11 shown on display. Supply/ Outlet sensor • E12 shown on display. Return/Inlet sensor • E13 shown on display. Flue sensor • E14 shown on display. DHW-out sensor	• Verify that the sensors are connected • Verify that they are wired correctly. • Measure the resistance of the sensors, 10kΩ sensors. • Replace the sensor if necessary
Fan Not Turning	• A33 shown on display. Fan refuses to rotate	• Check fan power wires • Fan signal wires are interchanged • Minimum fan speed must be greater than 1500 RPM
Reset Button Error	• E51	• Reset button pressed more than 7 times in one minute
Air Switch	• Blocked flue error	• Air Switch wire(s) is/are loose • Air Switch is set too tight, reduce sensitivity by turning screw ¼ turn counter-clockwise.
Flame Detection is out of Sync	• Flame detection is present when no visible signs of a flame exist	• Verify supply voltage for proper polarity. • Check external wiring for voltage feedback • Check internal wiring for proper connections • Check the flame sensor and verify that it is clean • Replace DynaMax Controller
Blank Display Screen	• Blank display screen	• Replace fuse with factory 3.15A fuse. • **DO NOT** use alternates as it may damage the DynaMax Controller

10.1 SETTING THE CORRECT COMBUSTION

1) Switch the main power off to the boiler by placing the toggle switch in the 'OFF' position
2) Switch the main power on to the boiler and adjust setpoint so that boiler begins ignition sequence.
3) Observe the boiler as it goes through its startup cycle and operates at high fire. This cycle is detailed on Table 41 in section 12.14 Ignition Cycle.
4) Insert the combustion measurement probe into the stack when high fire operation is observed. Check to see that fan is running at maximum fan speed using the Control Panel.
5) The combustion values should reside in the range listed in Table 38. If combustion values are not within this range refer to Section 10.2 Gas Valve Adjustment Procedure to correct this issue.

Table 30: Combustion Values

	Natural Gas		Propane	
	CO_2	CO	CO_2	CO
Max. Fire	8.5% - 9.0%	<100 PPM	9.5% - 10.0%	<100 PPM
Min. Fire	8.0% - 8.5%	<100 PPM	9.0% - 9.5%	<100 PPM

6) When the combustion values are satisfied record these values as Camus requires these for warranty purposes.
7) Remove the combustion measurement device and switch the main power off to the boiler by placing the toggle switch in the 'OFF' position.
8) Replace the flue temperature sensor back to its proper location.

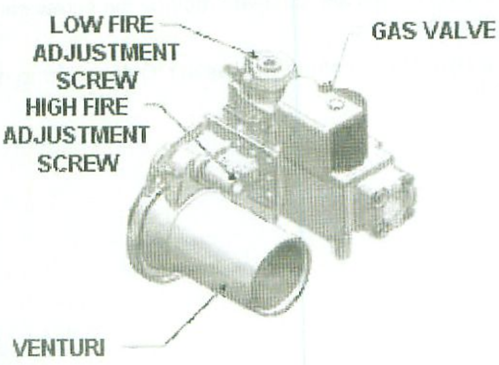
10.2 GAS VALVE ADJUSTMENT PROCEDURE

If adjustment of the gas valve is required use the following procedure.

In order to perform adjustments to the gas valve the DynaMax must be firing before proceeding.

DM 080 – 250, 260

Figure 53: Venturi & Gas Valve Assembly



To adjust the high-fire setting

Use the DynaMax Control Panel

Press the **[MENU]** button > select Appliance Settings and press **[ENTER]** > select Boiler Control and press **[ENTER]** > Enter the correct Installer passcode.

Select 'H' for high power. The DynaMax should respond immediately and fire at maximum fan speed.

Locate the input adjustment screw on the side of the venturi. Using a flat head screwdriver turn the screw clockwise to decrease CO_2 levels and counter-clockwise to increase CO_2 levels. Turn the screw 1/4 turn in either way for each adjustment to keep track of the adjustments. After adjusting the screw wait a moment for the combustion levels to stabilize before attempting to make any further adjustments. Continue this procedure until combustion levels are satisfied.

On the DynaMax Control Panel select 'O' to return to normal operation.

To adjust the low fire setting

Use the DynaMax Control Panel

Press the **[MENU]** button > select Appliance Settings and press **[ENTER]** > select Boiler Control and press **[ENTER]** > Enter the correct Installer passcode.

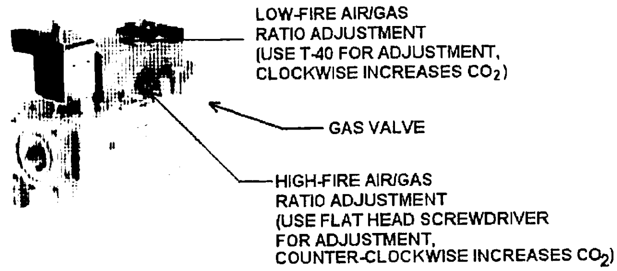
Select 'L' for low power.

The DynaMax should respond immediately and fire at minimum fan speed. When this is achieved locate the low fire adjustment screw as illustrated in Figure 53. This screw is covered with a cap, which can be removed using a Torx 40 screwdriver. With the screw cap removed using a Torx 40 screwdriver rotate clockwise to increase CO_2 levels and counter-clockwise to decrease CO_2 levels. When the correct combustion values are achieved replace the screw cap back on to the gas valve.

On the DynaMax Control Panel select '0' to return to normal operation.

DM 299 – 399

Figure 54: DM 299 – 399 Gas Valve



To adjust the high-fire setting

Use the DynaMax Control Panel

Press the **[MENU]** button > select Appliance Settings and press **[ENTER]** > select Boiler Control and press **[ENTER]** > Enter the correct Installer passcode.

Select 'H' for high power. The DynaMax should respond immediately and fire at maximum fan speed.

Locate the high-fire adjustment screw on the top side of the gas valve. The screw can be identified by a red cylinder casing around the screw. Using a thin flat head screwdriver turn the screw clockwise to increase CO_2 levels and counter-clockwise to decrease CO_2 levels. Turn the screw 1/4 turn in either way for each adjustment to keep track of the adjustments. After adjusting the screw wait a moment for the combustion levels to stabilize before attempting to make any further adjustments. Continue this procedure until combustion levels are satisfied.

On the DynaMax Control Panel select 'O' to return to normal operation.

To adjust the low fire setting

Use the DynaMax Control Panel

Press the **[MENU]** button > select Appliance Settings and press **[ENTER]** > select Boiler Control and press **[ENTER]** > Enter the correct Installer passcode.

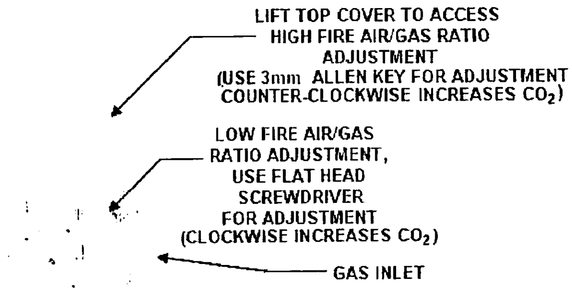
Select 'L' for low power.

The DynaMax should respond immediately and fire at 1500 RPM. When this is achieved locate the low fire adjustment screw as illustrated in Figure 54. Using a flat screwdriver rotate clockwise to increase CO_2 levels and counter-clockwise to decrease CO_2 levels. When the correct combustion values are achieved replace the screw cap back on to the gas valve.

On the DynaMax Control Panel select 'O' to return to normal operation.

DM 500 – 800

Figure 55: DM 500 - 800 Gas Valve



To adjust the high-fire setting

Use the DynaMax Control Panel

Press the **[MENU]** button > select Appliance Settings *and* press **[ENTER]** > select Boiler Control and press **[ENTER]** > Enter the correct Installer passcode.

Select 'H' for high power. The DynaMax should respond immediately and fire at maximum fan speed.

Locate the input adjustment screw on the top side of the gas valve. Using a flat head screwdriver turn the screw clockwise to increase CO_2 levels and counter-clockwise to decrease CO_2 levels. Turn the screw 1/4 turn in either way for each adjustment to keep track of the adjustments. After adjusting the screw wait a moment for the combustion levels to stabilize before attempting to make any further adjustments. Continue this procedure until combustion levels are satisfied.

On the DynaMax Control Panel select 'O' to return to normal operation.

To adjust the low fire setting

Use the DynaMax Control Panel

Press the **[MENU]** button > select Appliance Settings and press **[ENTER]** > select Boiler Control and press **[ENTER]** > Enter the correct Installer passcode.

Select 'L' for low power.

The DynaMax should respond immediately and fire at 1500 RPM. When this is achieved locate the low fire adjustment screw as illustrated in Figure 55. Using a flat screwdriver rotate clockwise to increase CO_2 levels and counter-clockwise to decrease CO_2 levels. When the correct combustion values are achieved replace the screw cap back on to the gas valve.

On the DynaMax Control Panel select 'O' to return to normal operation.

PART 11 MAINTENANCE

CAUTION

It is important that all gas appliances be serviced by a qualified technician trained by Camus Hydronics. It is in your own interest and that of safety to ensure that all local codes, and all the "NOTES" and "WARNINGS" in this manual are complied with. To service or adjust this appliance, it is imperative that the serviceman utilize a combustion analyzer to read CO_2 and CO according to Camus Hydronics recommendations.

Listed below are items that must be checked to ensure safe reliable operations. Verify proper operation after servicing.

11.1EXAMINE THE VENTING SYSTEM

Examine the venting system at least once a year. Check more often in the first year to determine inspection interval. Check all joints and pipe connections for tightness, corrosion or deterioration. Flush the condensate drain hose with water to clean. Clean screens in the venting air inlet system as required. Have the entire system, including the venting system, periodically inspected by a qualified service agency.

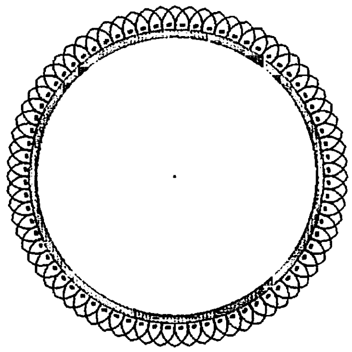
11.2 VISUALLY CHECK MAIN BURNER FLAMES

At each start up after long shutdown periods or at least every six months. A burner view port is located on the combustion chamber front door.

CAUTION

The area around the burner view port is hot and direct contact could result in burns

Figure 56: Normal Burner Flame Profile (short dense and blue)

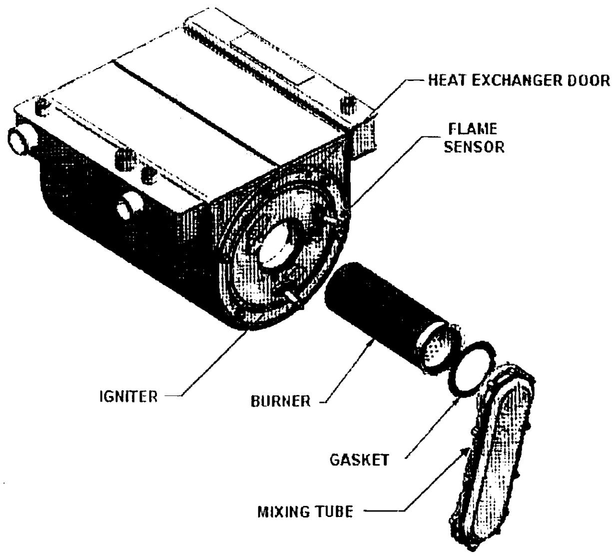


- **Normal Flame**: A normal flame at 100% of burner input is blue, with a well defined flame and no flame lifting.
- **Yellow Tip**: Yellow tipping can be caused by blockage or partial obstruction of air flow to the burner.
- **Yellow Flames**: Yellow flames can be caused by blockage of primary air flow to the burner or excessive gas input. This condition **MUST** be corrected immediately.

If improper flame is observed, examine the venting system; ensure proper gas supply and adequate supply of combustion and ventilation air.

11.3 CLEANING BOILER HEAT EXCHANGER

Figure 57: Heat Exchanger & Burner Assembly



1) Shut down boiler:
    a) Turn the main power off to the boiler
    b) Shut off gas supply at the main manual valve in the gas piping of the main appliance
    c) DO NOT drain the boiler unless it will be exposed to freezing temperatures. If using antifreeze prevention fluid in the heat exchanger, **DO NOT** drain.
2) Allow time for the boiler to cool to room temperature if it has been firing.
3) Remove both the stainless steel upper jacket and the lower sheetmetal jacket.
4) Remove igniter and flame sensor electrodes. If necessary, clean with steel wool. **DO NOT** use sandpaper.
5) Remove the fan/ mixing tube assembly from the heat exchanger door.
6) Remove burner.
7) Examine burner and clean if required as per 11.7.1.
8) Examine heat exchanger surfaces to determine if cleaning is required. If cleaning is required remove the (6) nuts fastening the heat exchanger flange from the heat exchanger.
9) Use a vacuum cleaner to remove any debris that has collected on the heat exchanger surfaces. **DO NOT** use any type of solvent.
10) Finish cleaning by wiping down the boiler heating surfaces with a clean, damp cloth.
11) Re-install the heat exchanger door by evenly torquing down the (6) nuts to 3 ft-lbs, burner, igniter and flame sensor, and fan/ mixing tube assembly. Fasten the nuts back to the heat exchanger assembly.
12) Re-connect the fan assembly to the boiler mixing tube.

NOTE
All gaskets on disassembled components must be replaced with new gaskets/sealant on re-assembly, if required. Gasket kits are available from the factory

CAUTION
When the vent system is disconnected for any reason it must be reassembled and resealed according to vent manufacturer's instruction

11.4 CONDENSATE TREATMENT

Condensate occurs when the products of combustion are cooled below their dew point in the heat transfer process. The liquid condensate formed from this high efficiency heat transfer process is mildly acidic. The condensate will typically have a pH ranging from 4.0 to 5.0 as it is discharged from the condensate drain of the appliance. The condensate collection box where the condensate is collected is constructed of a non-corrosive plastic. All materials external to the appliance in contact with the condensate must be corrosion resistant. Condensate must be able to flow freely from the appliance. All condensate flow is accomplished by gravity requiring a minimum downward slope of 1/4" per foot (21mm/m) to ensure proper flow to a suitable drain. A neutralizer box is mounted inside each DynaMax. All condensate piping and connections must be easily accessible for routine maintenance and inspection. Use solid piping when running condensate line across the floor. Check neutralized pH level regularly or as required by local jurisdiction. Replace neutralizer medium as required.

11.4.1 Condensate Volume

There are several factors affecting amount of condensation created by the appliance, however for rough approximation use.
Condensation Volume, US Gallon/Hr = Input, MBH/1000 x 5.0
Many codes will require the acidic condensate to be neutralized before it can be placed in a drain system. A neutralizer to control the pH of the liquid discharged to a drain system is provided with every DynaMax boiler. The neutralizer consists of an industrial grade, non-corrosive plastic reservoir for collection of the condensate. The condensate collects in the reservoir where it is in direct contact with calcium carbonate neutralizer medium. As the reservoir fills, it provides an extended residence time to neutralize the condensate. Residency time in the neurtalizer reservoir allows time for the pH to be raised. Prime the neutralizer reservoir with 1 litre of water.

As the condensate migrates through the reservoir in typical applications the pH is controlled to a range of 5.5 to 6.0 before exiting the system. Always check with local codes for specific requirements.

11.5 IGNITER AND FLAME SENSOR ELECTRODES

The direct spark igniter is to be checked at every service interval. Clean the direct spark igniter as required to maintain peak ignition efficiency.

1) Turn off main electrical power to the appliance.
2) Turn off main manual gas shutoff to the appliance.
3) Locate the direct spark igniter and flame sensor.
4) Disconnect the power lead to the direct spark igniter and flame sensor
5) Loosen and remove the two (2) torx screws that hold the igniter and flame sensor to the heat exchanger flange.
6) Pull the igniter horizontally out of the heat exchanger flange. Use care, do not hit or break the igniter leads.
7) Remove any debris that has accumulated on the electrodes using steel wool. If the electrodes cannot be cleaned to their original appearance, replacements are needed. Do not use sand-paper since this will contaminate the surface.
8) Check that the igniter and flame sensor gaskets are still in good condition (no tears or seams). If the gaskets are in good condition the electrodes can be re-installed back to the heat exchanger flange.
9) Check that the igniter gap is 3/16".

11.6 CHECK IGNITER GROUND WIRING

1) Inspect boiler ground wire from the heat exchanger flange to J12 of the electrical DynaMax Controller. Check boiler ground wire continuity.
2) Verify that all wiring is in good condition and is securely anchored.

11.7 BURNER MAINTENANCE

The burner should be removed for inspection and cleaning on an annual basis. An appliance installed in a dust or dirt contaminated environment will require inspection and cleaning on a more frequent schedule. The fan assisted combustion process may force airborne dust and dirt contaminants, contained in the combustion air, into the burner. With sustained operation, non-combustible contaminants may reduce burner port area, reduce burner input or cause non-warrantable damage to the burner. Never operate this appliance during construction.

Airborne contaminants such as dust, dirt, concrete dust or dry wall dust can be drawn into the burner with the combustion air and block the burner port area.

11.7.1 Burner Removal and Cleaning

Access to the burner will require the following steps:

- Turn off main electrical power to the appliance.
- Turn off main manual gas shutoff to the appliance
- Remove the front cover.
- Disconnect the gas supply connection to the fan inlet.
- Disconnect the fan motor power wires at the harness.

- Remove the direct spark igniter and the flame sensor.
- Remove the three (3) T-25 screws holding the front burner flange in place to gain access to the burner.
- The burner can now be pulled horizontally out of the heat exchanger cavity.
- Use care to prevent damage to the knitted metal fiber of the burner surface.
- Wash the burner with water, such as a garden hose. Never wipe or brush the surface of the burner.
- For optimal results immerse the burner port area in a solution of dishwashing detergent and hot water. **DO NOT** use chlorine based solvents or cleaning agents on the burner. Allow the burner to remain in the solution for a short period of time to remove, dust, dirt and oil or grease laden contaminants.
- Rinse the burner thoroughly with clean water to remove any residue from the detergent cleaner
- The burner should be air dried after removal from the cleaning solution and rinsing.
- Check all gaskets and replace as necessary. Gaskets affected by heat will not reseal properly and must be replaced.
- Replace the burner in the reverse order that it was removed.

NOTE
When the combustion air fan is removed for any reason, the inlet to the burner must be covered to prevent further foreign objects from falling into the burner. Always look inside the burner to check for dents. Do not place a burner back into operation if the inner distribution screen has been dented during the service operation, call the factory for recommendations. Use care when removing and handling the burner, Sharp objects or impact may damage or tear the metal fiber surface rendering the burner unfit for service.

11.8COMBUSTION AND VENTILATION AIR

Check frequently to be sure that the flow of combustion air to the appliance is not obstructed unless air is piped directly to the heater. Combustion air must be provided to the mechanical room with openings sized per the requirements of the current B149 or National Fuel Gas Code. The DynaMax is setup to allow outdoor combustion air to be connected directly to the appliance.

11.9CONTROL CIRCUIT VOLTAGE

This appliance uses a transformer to supply a low voltage control circuit. The voltage on the secondary side should be 24 to 28VAC when measured with a voltmeter. A secondary voltage of 21VAC or less supplied to 24VAC components may cause operational problems.

11.10 COMBUSTIBLE MATERIALS

CAUTION
Keep appliance clear from combustible materials; do not store **GASOLINE** and other flammable vapors and liquids in the proximity of the appliance.

11.11 FREEZE PROTECTION FOR INDOOR & OUTDOOR INSTALLATIONS

Installations are not recommended in areas where the danger of freezing exists. Proper freeze protection must be provided for appliances installed outdoors, in unheated mechanical rooms or where temperatures may drop to the freezing point or lower. If freeze protection is not provided for the system, a low ambient temperature alarm is recommended for the mechanical room. Damage to the appliance by freezing is non-warrantable.

- **Location** - Heating boilers, hot water supply boilers or water heaters must be located in a room having a temperature of at least 40°F (5°C).
- **Caution** - A mechanical room operating under a negative pressure may experience a downdraft in the flue of an appliance that is not firing. The cold outside air may be pulled down the flue and freeze a heat exchanger. This condition must be corrected to provide adequate freeze protection.
- Freeze protection for the appliance using an indirect coil can be provided by using hydronic system antifreeze. Follow the manufacturer's instructions. **DO NOT** use undiluted or automotive type antifreeze.
- **Shut-down and draining** - If for any reason, the unit is to be shut off in a space where danger of freezing exists, the following precautionary measures must be taken:
  - Shut off gas supply.
  - Shut off water supply.
  - Shut off electrical supply.
  - Drain the main exchanger and the brazed plate heat exchanger, if supplied, completely.
  - Ensure that the pump and connecting piping are fully drained.

11.12 FREEZE PROTECTION FOR A HEATING BOILER SYSTEM (Optional)

- Use only properly diluted inhibited glycol antifreeze designed for hydronic systems. Camus recommends using a 30/70 mixture of glycol antifreeze to water. **DO NOT** exceed a mixture of 50/50.
- Follow the instructions from the antifreeze manufacturer. Quantity of antifreeze required is based on total system volume including expansion tank volume.
- Antifreeze is denser than water and changes the viscosity of the system. The addition of antifreeze will decrease heat transfer and increase frictional loss in the boiler and related piping. Where antifreeze has been used, to maintain the temperature rise across the appliance confirm that the recommended GPM for pure water has been increased by 15% and the head loss by 20%.
- Local codes require a back flow preventer or actual disconnect from city water supply when antifreeze is added to the system.
- When filling or topping-up the system with water mixed with the antifreeze always used distilled or RO (reverse osmosis) water. This will prevent the reaction of the water with antifreeze which can create sludge.

PART 12 INSTALLATIONS

WARNING
Before starting the boiler, smell near the floor and around the boiler for any gas odours or any unusual odour. Remove the stainless steel jacket and smell the interior of the boiler. If there is any sign of a gas leak, do not proceed with startup. Repair all the leaks before attempting to start the boiler.

WARNING
Propane boilers ONLY – Your local propane supplier adds an odorant to the propane gas to allow for propane gas leak detection. In some cases, the added odorant can fade and the gas may not give off any noticeable odour. Before startup have the local propane supplier check for the correct odorant level in the gas.

12.1CHECKING THE INSTALLATION

- Inspect the connections for water, gas and electricity.
- Inlet gas pressure must be a minimum of 3" W.C. for natural gas and 11" W.C. for propane.
- With the boiler off, open the main gas supply valve and vent the trapped air from the piping leading to the boiler. Confirm that all gas connections to the heater are tight and that there are no missing test plugs.

Refer to Section 10.1 Setting the Correct Combustion of the manual for recommendations on setting combustion characteristics

12.2CHECKING THE CONSTRUCTION

- Check the boiler wiring to see that it agrees with the wiring diagram supplied.
- Confirm that all terminal strips and field connections are identified.
- Confirm that the DynaMax Controller control is set in the proper mode. In remote mode an external controller determines the set point and the stage contacts on the DynaMax Controller are always closed. Auto reset limits are fixed in all Modes.
- With the boiler running, check for flue gas leaks along the inner cabinet joints and around the flue outlet.
- Repair any leaks prior to proceeding to the next step.
- At the factory, adjustments were made to achieve proper input and acceptable burner performance at full input and at minimum input.

12.3HEATING BOILER INSTALLATIONS

Before beginning the installation, consult local codes for specific plumbing requirements. The installation should have unions and valves at the inlet and outlet of the appliance so it can be isolated for service. An air separation device must be supplied in the installation piping to eliminate trapped air in the system. Locate a system air vent at the highest point in the system. The system must also have a properly sized expansion tank installed. Typically, an air charged diaphragm-type expansion tank is used. The expansion tank must be installed close to the boiler and on the suction side of the system pump (appliance Inlet) to ensure proper operation. Caution: This appliance should not be operated at less than 12 PSIG cold. Pressure will rise when hot. Expansion tank sizing will determine the pressure when the system is hot. Do not operate the system at less than 18-20 PSIG when hot. Water piping must be supported by suitable hangers or floor stands, NOT by the appliance. Pipe systems will be subject to considerable expansion and contraction. Pipe supports could allow the pipe to slide resulting in noise transmitted into the system. Padding is recommended. The boiler pressure relief valve must be piped to a suitable floor drain. See Section 4.11.

12.4 INSPECT & RECHARGE CONDENSATE COLLECTION/NEUTRALIZING RESERVOIR

1) Inspect the condensate reservoir in the DynaMax, making sure the collection box is intact.
2) Remove screw holding lid on to condensate collection box. Remove lid from the condensate collection box
3) Examine neutralizer medium and refill as necessary with fresh medium
4) Fill with fresh water until the water begins to flow out of drain
5) Re-install the lid and hold-down screw on the condensate collection box.

WARNING
The condensate collection box must be filled with water to prevent flue gas emissions from escaping during boiler operation.
CAUTION
A leak in a boiler "System" will cause the fill system to introduce fresh water constantly, which may cause the tubes to accumulate a line/scale build up. Lime/scale buildup leading to heat exchanger failure is **NOT** covered by warranty.

12.5WATER CONNECTIONS

System pipe size must be in accordance with Table 11 (depending on model) and, between supply and return lines, must not exceed 50 feet of equivalent length. Connection sizes at the heater are given in Tables 4 & 6. Any reduction in recommended pipe size may decrease flow resulting in high temperature rise across the heat exchanger, boiler noise, flashing to steam and non-warrantable heat exchanger damage.

12.6PIPING LENGTHS

The appliance circulator provides the water flow from the primary boiler piping, through the boiler and back to the primary system. Pipe diameter and length are critical to ensure proper flow through the boiler.
The secondary loop piping to and from the appliance must have a fully ported ball valve installed in both the supply and return side piping and will be used for isolation only. *The ball valves must be the same diameter as the installed piping*. If flow control is required, other means of flow control such as globe valve or flow setter should be used.

12.7 SUMMARY

a) Typical Boiler Installations

General Plumbing Rules

1) Check all local codes.
2) For serviceability, always install unions.
3) Always pipe pressure relief valve to an open drain.
4) Locate system air vents at highest point of system.
5) Expansion tank must be installed near the boiler and on the suction side of the system pump.
6) Support all water piping.
7) Place drip pan underneath boiler. (if required)

b) **Placing the Boiler in Operation**

Pre-Start Check List

1) Review the location of the boiler, clearances from combustible surfaces and available service clearances.
2) Review Part 2 Venting. Ensure that all vent components are fabricated from the correct category of materials with adequate clearance from combustibles.
3) Fill the condensate collector with fresh water until water begins to pour out the drain.
4) Ensure that the boiler condensate drain and all vent system condensate drains are properly routed to an acceptable floor drain.
5) Review the vent termination point for proper location and clearances.
6) If a separate combustion air pipe is used, ensure that it is properly sized, sealed and terminated.
7) Review the water piping from the boiler to the system. The boiler must be installed in a primary/ secondary piping system. Review the diameter and equivalent length of the installed piping to and from the boiler to ensure proper flow.
8) Ensure that a properly sized system pump is installed with an expansion tank.
9) Check system pressure. Ensure a minimum of 18-20 PSIG with the system hot and not more than 90% of the rated pressure of the relief valve.
10) Review the installed gas piping from the meter to the boiler. Ensure that the gas pipe, meter and any regulators are adequately sized.
11) Review the field wiring and electrical service for the boiler controls. Ensure that the electrical service(s) is adequately sized.

Boiler Set-Up

1) Ensure that the boiler and piping system are full of water. Bleed all air from the pump housing and secondary loop.
2) Check system for any water leaks.
3) Check system for installation of glycol or water treatment where required. Where glycol has been used to maintain the temperature rise across the appliance confirm that the recommended flow for pure water has been increased by 15% and the head loss by 20%.

Boiler Operational Checks

1) Turn the boiler main power switch to the "ON" position.
2) Verify operation of the text display on the front panel.
3) Program the adjustable points.
4) Push the reset button if a lockout error is displayed.
5) Install a manometer on the gas supply to the boiler and verify minimum gas supply pressure as the burner fires at 100% of rated input.
6) Verify operation of safeties as necessary (low water cut-off, high limit, gas pressure, etc.).

Boiler Operation

1) Appliance should begin the start-up process for the sequence of operation.
2) The boiler will fire at 50% of rated input on initial start-up and adjust input as required to meet system demand.
3) Based on system demand, the appliance will modulate accordingly.
4) As system demand is satisfied, the burner will fire at minimum fire for the given demand and the boiler will cycle off when the demand ceases or is interrupted. When this occurs the combustion air fan will decelerate at a pre-programmed rate before the appliance shuts down.

12.8 DOMESTIC HOT WATER WITH STORAGE TANK

Hot water heaters are designed for installation with a storage tank. The piping between the tank and heater and the control of water velocity, as explained below, are important for correct operation of your hot water heater.

12.9 DOMESTIC HOT WATER WITH PLATE HEAT EXCHANGER

The piping between the plate heat exchanger in the DynaMax boiler and to an outlet tap is important for correct operation of the plate heat exchanger. The following procedure should be followed for setting the domestic hot water tuning valve:

1) There is a temperature tuning valve inside the Dynamax jacket on the domestic hot water outlet from plate exchanger . This valve can be set for field conditions .
2) First identify the highest domestic hot water load . For example in some cases it may be the bath tub and in some cases it may be the clothes washer.
3) Allow the Dynamax to fire up and reach full fire under maximum hot water load demand conditions .
4) Observe the outlet water temperature and close the tuning valve gradually as outlet temperature starts to drop . Allow the system to reach equilibrium between adjustments to the tuning valve .
5) Once the tuning valve is properly set , outlet temperatures will never drop below desired minimum temperature.
6) Seal stem of tuning valve with silicone to prevent unauthorized tampering .

12.10 *TEMPERATURE RISE AT FULL FIRING RATE*

1) The pump must run continuously when the burner is firing.
2) With the pump running and the burner in the water heater or hot water supply boiler in the off cycle, the Return/Inlet temperature and Supply/Outlet temperature readings on the DynaMax Control Panel should read approximately the same temperatures.
3) Turn the hot water heater on and allow time for the temperature to stabilize. Check the temperature rise when the burner is firing at 100% of rated input.
4) Compare the temperature rise on the Control Panel with the required temperature rise at the required flow rate on Tables 39 and 40.
5) Should adjustment be needed, proceed as follows:
6) The DynaMax uses stainless steel heat exchanger tubes which are not sensitive to higher water velocity. If temperature rise is lower than anticipated it is not necessary to reduce flow.

If the temperature rise is too high, the water velocity is too low. Adjust as follows:

1) Check for flow restrictions. Check for debris in strainers
2) Check diameter and equivalent length of the piping between the storage tank and hot water heater.
3) Be sure all valves are open between the hot water heater and the storage tank. Ensure that all ball valves are fully ported.
4) Check the pump to be sure it is running properly and that the pump motor is running in the proper direction.
5) Be sure the pipes between the hot water heater and storage tank are not more than a total of 50 equivalent feet between supply and return lines. If maximum equivalent length for the specified pipe diameter is exceeded, larger diameter pipe may have to be installed to achieve correct flow and temperature rise.
6) Common manifold piping for multiple unit installations will require larger minimum pipe sizes and tank circulating tapping to ensure proper flow.

The required temperature rise and the recommended pump size are based on the heating of potable water with a hardness of 7.5 to 17.0 grains per gallon and a total dissolved solids not exceeding 300 PPM. Consult the factory when heating potable water exceeding these specifications. Water with a hardness of less than 5 grains per gallon will usually have a low pH which can be aggressive and corrosive causing non-warrantable damage to the heater, pump and associated piping. Refer to Tables 39 and 40 for reference.

Table 31: Temperature Rise Across Heat Exchanger (Hydronic Heating)

	TEMPERATURE RISE ACROSS HEAT EXCHANGER			
MODEL [BTU/hr]	30°F (16.7°C)		35°F (19.4°F)	
	USGPM	ΔP-Ft.	USGPM	ΔP-Ft.
80,000	5.0	8.2	4.3	6.2
100,000	6.3	12.3	5.4	9.4
150,000	9.5	10.4	8.1	7.8
200,000	12.6	7.2	10.8	5.8
250,000	15.8	11.5	13.5	8.7
299,000	18.9	9.3	16.2	7.0
399,000	25.2	8.4	21.6	6.3
500,000	31.5	9.2	27.0	6.9
600,000	38.8	17.5	32.0	11.8
700,000	45.3	18.2	40.0	14.4
800,000	51.8	23.5	43.0	16.0

Table 32: Temperature Rise Across Heat Exchanger (DHW)

	TEMPERATURE RISE ACROSS HEAT EXCHANGER	
MODEL [BTU/hr]	20°F (11.1°C)	
	USGPM	ΔP-Ft.
80,000	7.5	11.5
100,000	9.4	26.9
150,000	14.0	27.8
200,000	19.2	25.9
250,000	23.5	28.3
299,000	28.8	25.8
399,000	38.4	23.9
500,000	48.6	29.4
600,000	57.6	34.2
700,000	70.4	40.0
800,000	77.6	43.2

CAUTION
Temperature rise cannot be adjusted when the burner is firing at less than 100% of input rate.
CAUTION
Adequate care **MUST** be taken to prevent potential scald injury when storing water at 140°F (60°C) and hotte r.

WARNING
Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump, instead, shut off the gas supply at a location external to the appliance

12.11 SETTING THE CORRECT COMBUSTION

Refer to Section 10.1 Setting the Correct Combustion.

12.12 CASCADE SETUP

The following components are needed for a Cascade setup
1) DynaMax Ignition Control Board (848-MN)
2) DynaMax Text Display (848-RC)
3) LabVision Software
4) 10kΩ System Sensor

Turn off all the boilers before beginning the setup process.

To setup the DynaMax Cascade system follow the instructions:

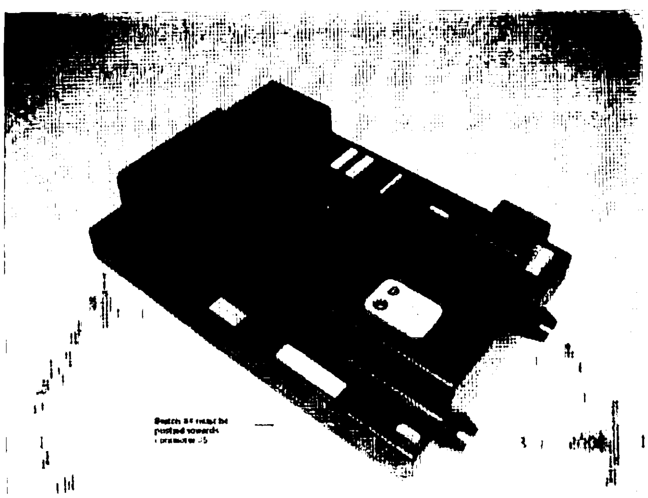
<u>**System Sensor**</u>

Insert the supplied 10kΩ system sensor into the return header to the boilers. The wires coming out of the system sensor should be connected to pin#5 and #6 of the green DynaMax terminal board.

<u>**DynaMax Ignition Control Board (848-MN)**</u>

The S4 connector as shown in Figure 58 is to be pushed towards connector J5 on the Master and Slave boiler(s). This step was done by Camus unless the configuration was altered in the field.

Figure 58: DynaMax Ignition Control Board



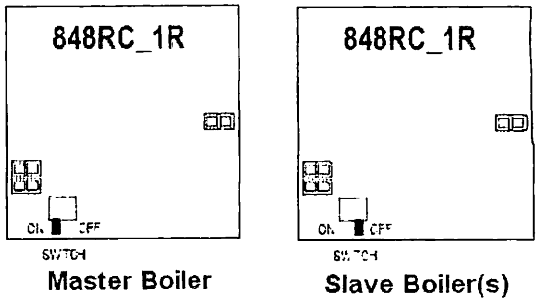
<u>**DynaMax Text Display (848-RC)**</u>

The display has 3 Molex MinifitJr connections at the backside. The single one is to be connected to the DynaMax Ignition Control Board (848-MN). The two other Molex MinifitJr connectors which are located closer to the switch are used for the Cascade setup.

Switch Setup

There is a switch located on the backside of the text display. Only the Master Text Display is required to provide power to the Slave boilers, therefore the switch on the backside of the Master display should be in the ON position, and the switch at the Slave displays should be in the OFF position. Figure 59 refers to how the switch is to be placed.

Figure 59: Text Display Switch Setup



Wiring Setup

Refer to Figure 60 for a pictorial description of how to connect the Cascade system together.

<u>Master Boiler</u>

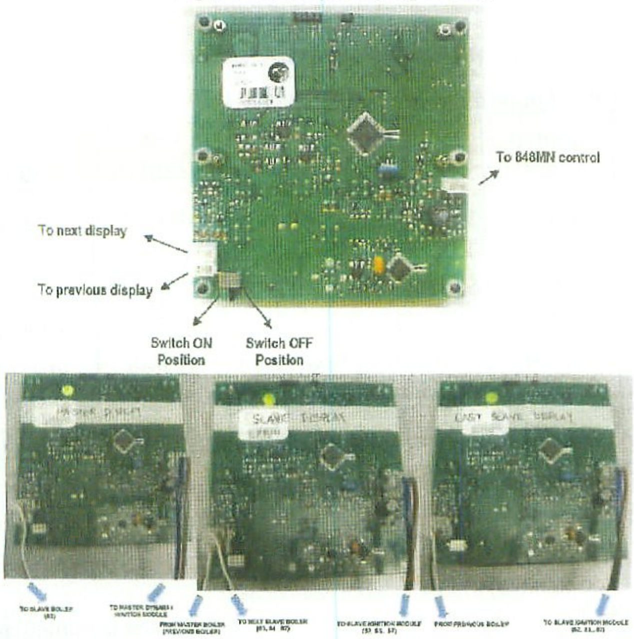
The following needs to be done to the Master Text Display:
1) Connect the "To 848MN control" connector to the DynaMax Ignition Control Board (848-MN). This step was done by Camus unless the display was disconnected in the field.
2) Place Switch to the "ON" position
3) Connect the "To next display" connector. This connector serves as the communication point to the next boiler. The "To previous display" connector is to be left empty (no connection required)

<u>Slave Boiler</u>

The following needs to be done to the Slave Text Display:
4) Connect the "To 848MN control" connector to the DynaMax Ignition Control Board (848-MN). This step is done by Camus unless the display was disconnected in the field.
5) Place Switch to the "OFF" position
6) Connect the "To previous display" connector using the connector from step 3.

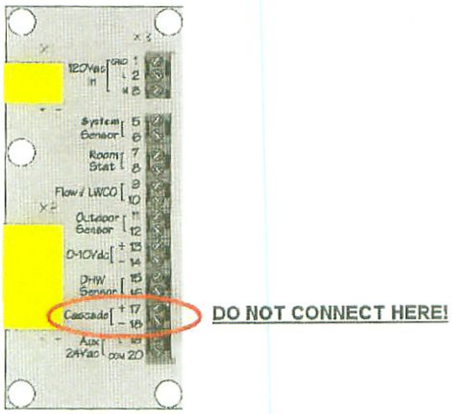
   If there are more than 2 boilers (up to 8) continue with step 7.
   If not, Wiring Setup is complete.
7) Connect the "To next display" connector. This connector serves as the communication point to the next boiler. When this is done all 3 connectors are used on the back of the text display.

Figure 60: Text Display Detail



!!CAUTION!!

DO NOT USE THE CASCADE CONNECTION ON THE DYNAMAX TERMINAL BOARD ON TERMINALS 17 & 18.



Programming the Cascade Setup

Master Boiler

Turn on the DynaMax Master Boiler and wait until the Date and Time to appear.

1) Press **[MENU]**
2) Select "Appliance Settings" (or "Programs" if you have an earlier version of software) using the **[NEXT]** button and press **[ENTER]**.
3) Select "Cascade Control" using the **[NEXT]** button and press **[ENTER]**.
4) Enter "0225" as the PIN Number to gain access. The numbers can be moved up and down using the **[UP]/[DOWN]** keys and press **[ENTER]** to move to the next digit.
5) Select "Master Boiler 1" using the **[UP]/[DOWN]** keys and press **[ENTER]** to confirm.
6) Press **[MENU]** until the Date and Time appear on the home screen.
7) The home screen should read "System: M1". If not, go through steps 1-5 again.
8) The Master boiler is now setup. **DO NOT** turn off the Master Boiler.

Slave Boiler

Turn on the DynaMax Slave Boiler and wait until the Date and Time to appear.

9) Press **[MENU]**
10) Select "Appliance Settings" (or "Programs" if you have an earlier version of software) using the **[NEXT]** button and press **[ENTER]**.
11) Select "Cascade Control" using the **[NEXT]** button and press **[ENTER]**.
12) Enter "0225" as the PIN Number to gain access. The numbers can be moved up and down using the **[UP]/[DOWN]** keys and press **[ENTER]** to move to the next digit.
13) Select "Slave Boiler 2" using the **[UP]/[DOWN]** keys and press **[ENTER]** to confirm.

    If there are more than 2 boilers (up to 8) continue with the step 13.
    If not, go to step 15.
14) Repeat steps 7-10 for the following slave boiler(s)
15) Select the next "Slave Boiler" in the sequence. The boilers must be addressed in sequential order. That is, the Master Boiler is addressed as 1 the first Slave Boiler is addressed as 2, the next Slave Boiler is addressed as 3 etc.
16) Press **[MENU]** until the Date and Time appear on the home screen.
17) The home screen should read "System: S2". The third boiler in this series will be S3 and so on. If not, go through steps 9-14 again.
18) Programming is complete. **DO NOT** turn off the Slave Boiler.

12.13 APPLIANCE

- Remove manometers and tighten test port screws.
- Fill out start up report for each heater. Be sure to record all settings and readings. Retain a copy of report for future reference.
- Start up is now complete and heater may be placed into service.

12.14 IGNITION CYCLE

The ignition cycle is shown in the table below. The values are the default factory settings.

Table 33: DynaMax Ignition Cycle

State →	Standby	Pre Purge	Safety ON	Safety OFF[6]	Ignit_0	Ignit_1	Burn	Post Purge_0	Post Purge_1
Time	0s	5s after fan speed is within 600rpm			2 sec	6 sec	Limited to 24 hours continuously[3]	Max. 10 sec	10 sec.
Demand	0	No influence	No influence	No influence	No influence	No influence	> 0	No influence	No influence
Fan	Off	Ignition speed	Ignition speed	Ignition speed	Ignition speed	Ignition speed	Requested power	Ignition speed	Ignition speed
Gasvalve	Closed	Closed	Closed	Closed	Closed	Open	Open	Closed	Closed
Spark	Off	Off	Off	Off	On	On[4]	Off	Off	Off
Ionisation	0	0	0	0	0[1]	Flame must be detected[2]	Flame must be detected	No flame must be detected[5]	0

Note:

1. If a flame signal is detected at the end of the pre-sprak period (Ignit_0) then a lockout will occur.
2. If at the end of the safety period (6 sec) no flame is detected the control will go to post-purge to remove the unburned gas. After this a re-ignition attempt is started following the same cycle. The number of re-ignition attempts is limited to 2 after which a lockout occurs.
3. The burner can only be on continuously for a period of 24 hours. After this the burner is switched off and a restart sequence follows.
4. Sparking stops 2 seconds before the end of the Ignit_1 period to allow for ionisation detection when measuring ionisation through the spark plug.
5. If after post_purge_0 time (max. 10 sec.) still flame is detected lockout follows
6. Safety ON/OFF in this state the correct working of the safety relay is proved.

If the ignition cycle is started it will continue until completion, even if the demand is removed.

PART 13 PIPING DIAGRAMS

Figure 61: Single Boiler Hydronic Heating Zoned Piping Arrangement

This piping arrangement is designed for:

Central Heating Mode: 0, 1, 2, or 3

DHW Mode: 0

Boiler Address: 100

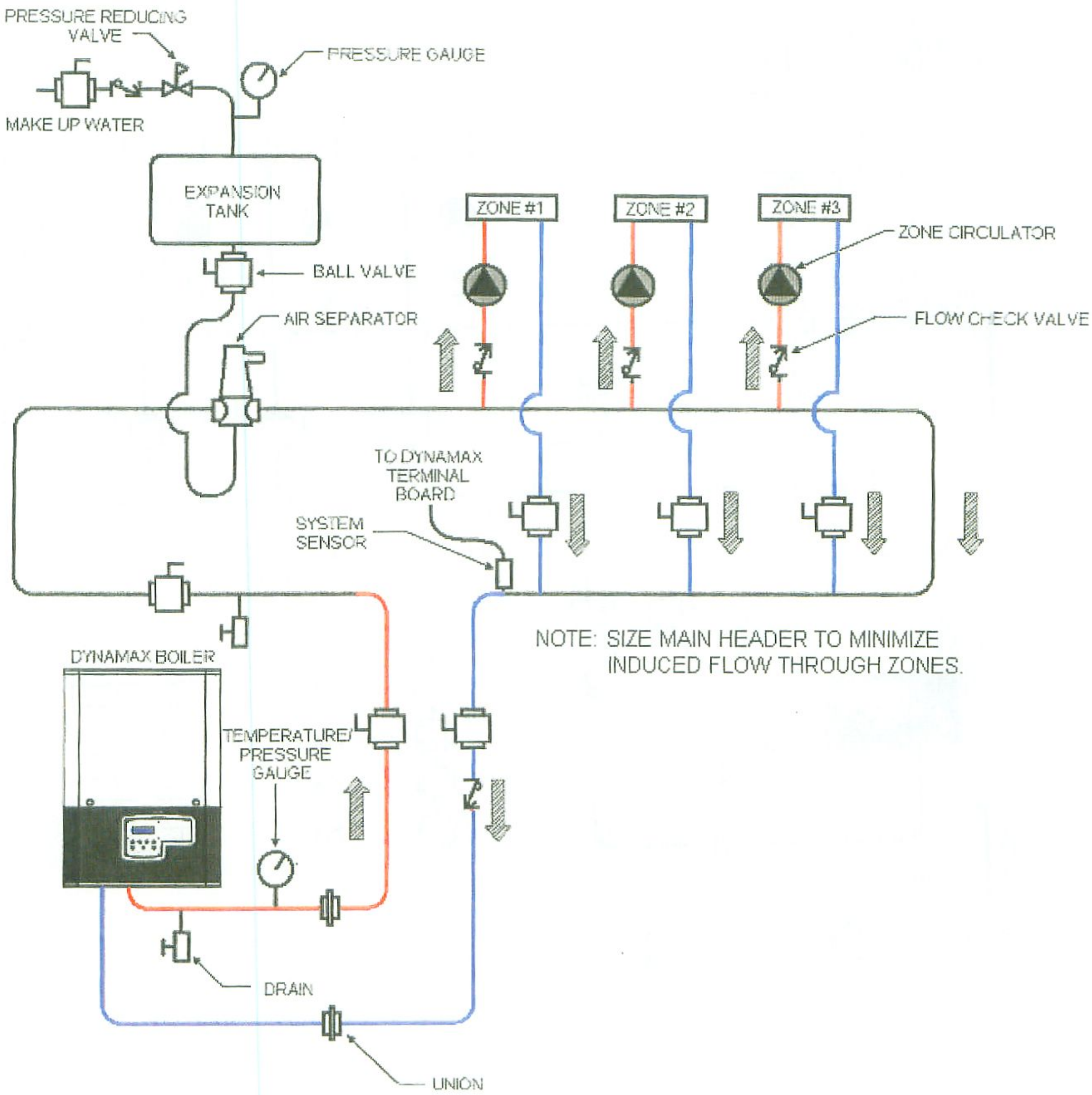


Figure 62: Single Combination Boiler Zoned Piping Arrangement

Central Heating Mode: 0, 1, 2, or 3

DHW Mode: 3, or 4

Boiler Address: Boiler Address = 100

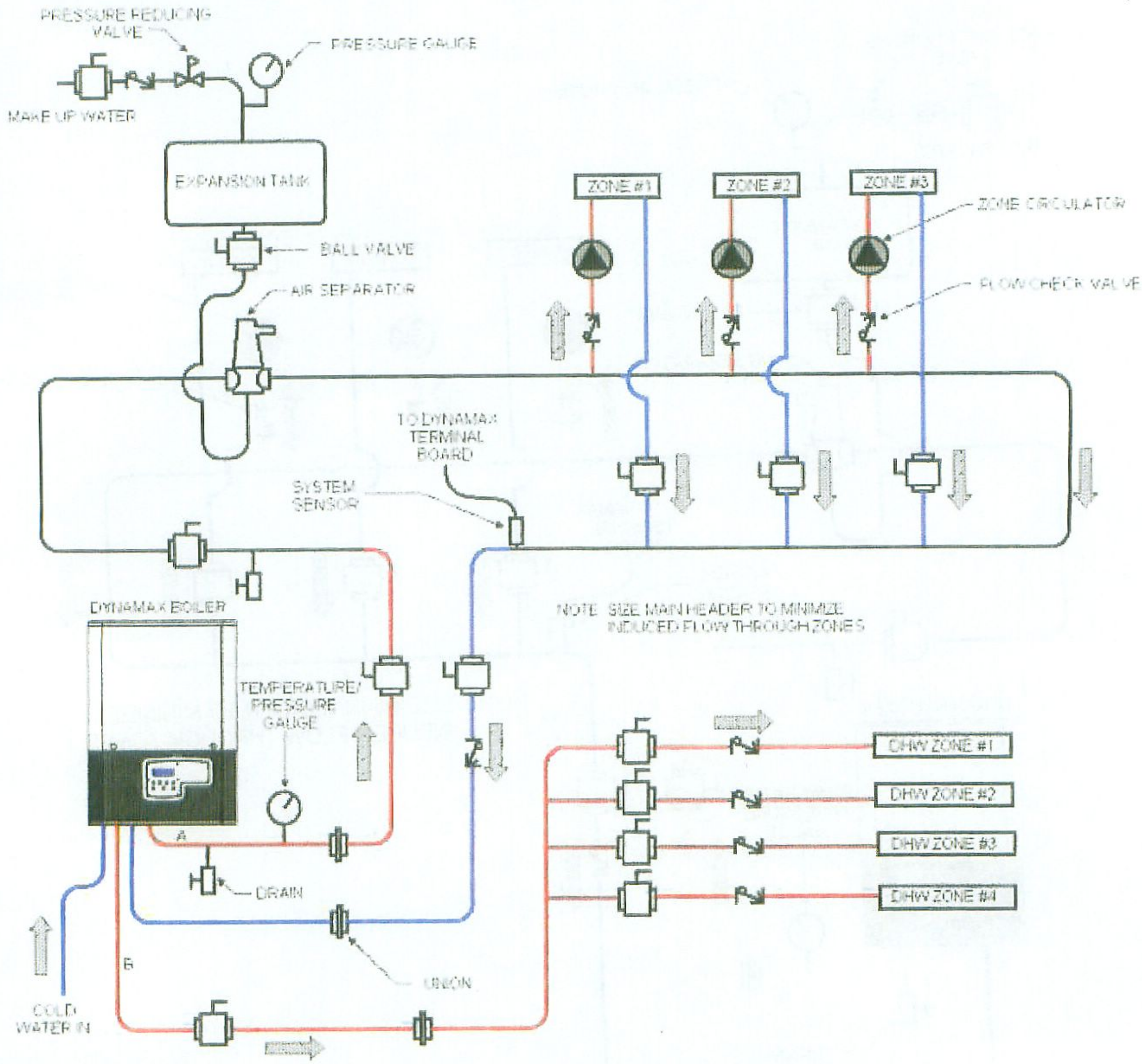


Figure 63: Single Boiler Hydronic Heating & Indirect Storage Tank Zoned Piping Arrangement

Central Heating Mode: 0, 1, 2, or 3

DHW Mode: 1, or 2

Boiler Address: Boiler Address = 100

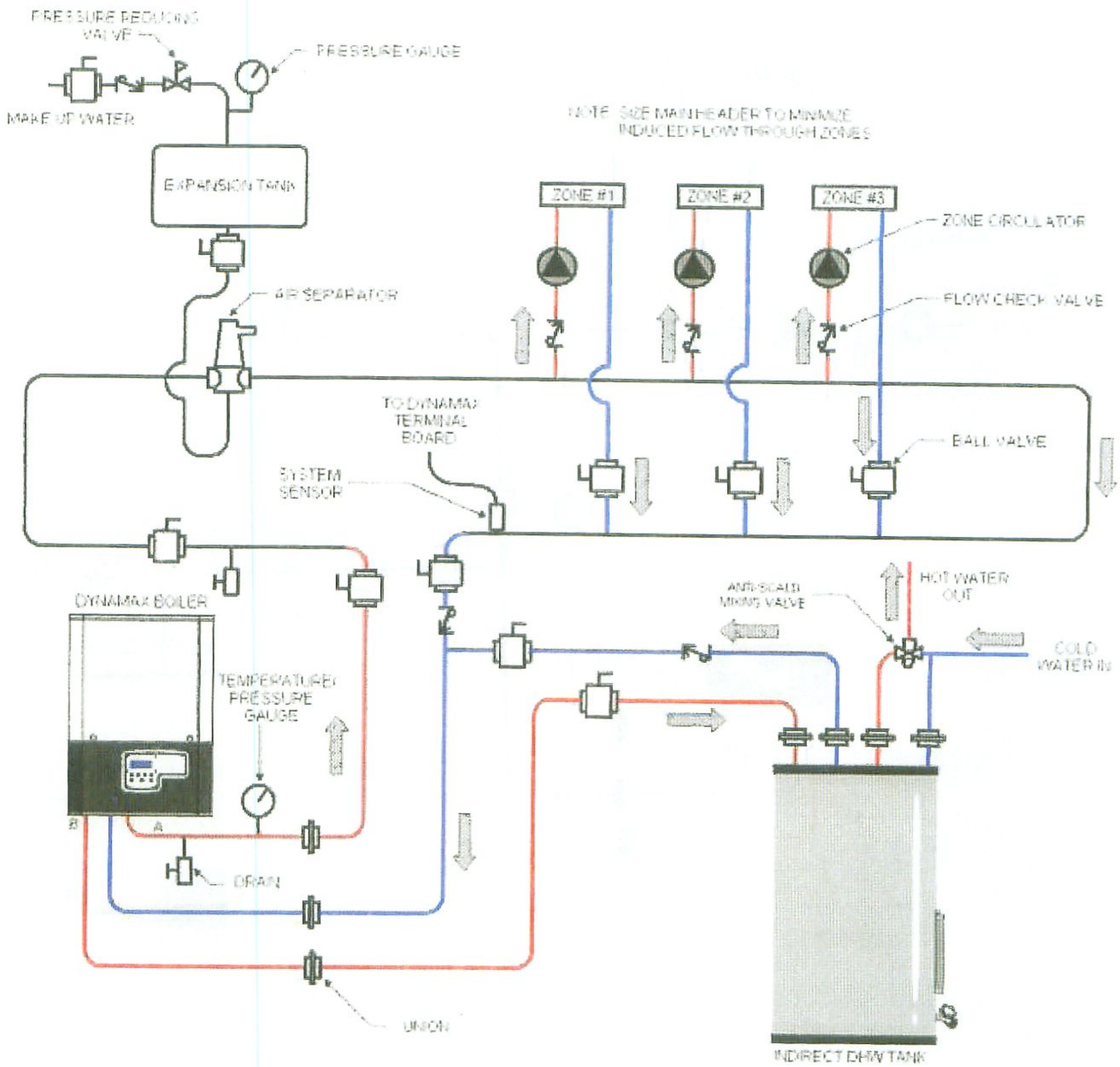


Figure 64: Single Boiler Hydronic Heating & Indirect Storage Tank Non-Zoned Piping Arrangement

Central Heating Mode: 0, 1, 2, or 3

DHW Mode: 1or 2

Boiler Address: Boiler Address = 100

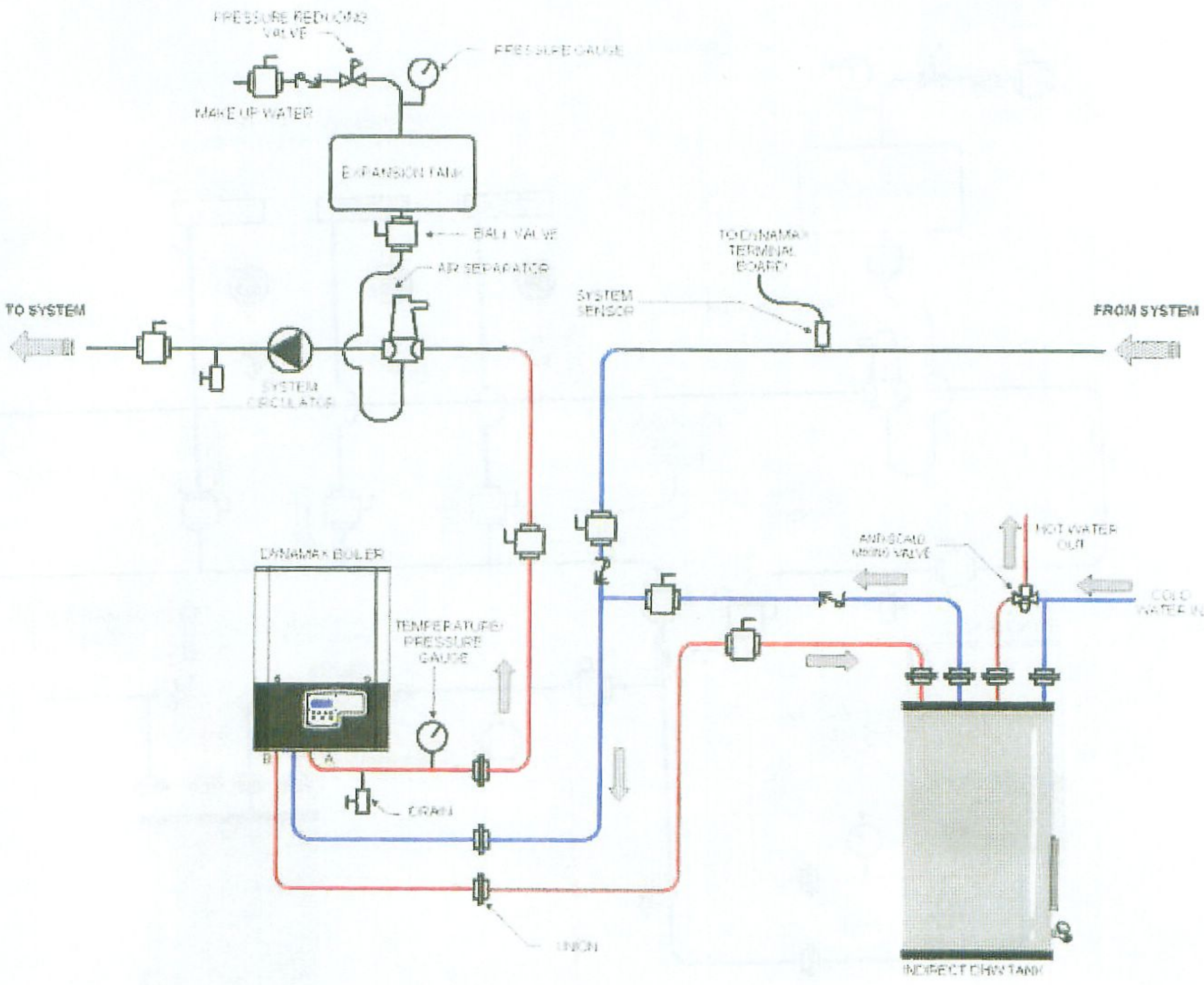


Figure 65: Single Boiler Hydronic Heating & Direct Storage Tank Zoned Piping Arrangement

Central Heating Mode: 0

DHW Mode: 1 or 2

Boiler Address: Boiler Address = 100

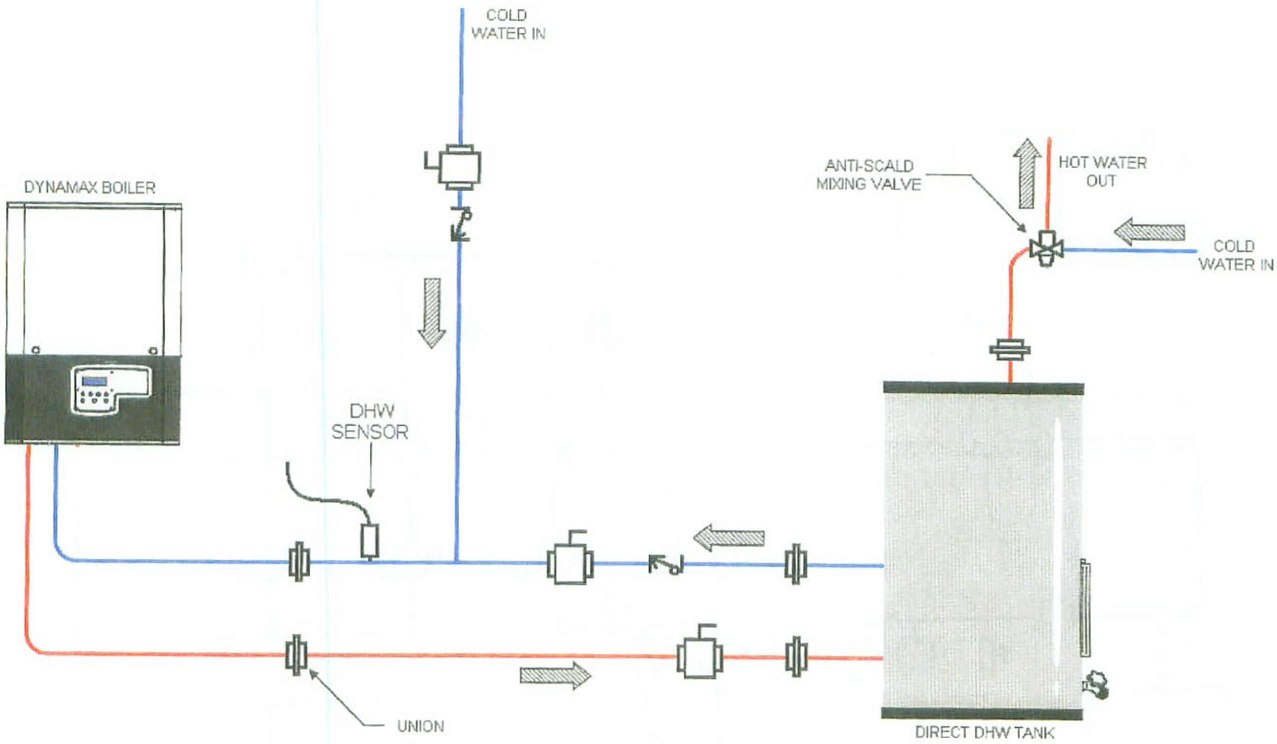
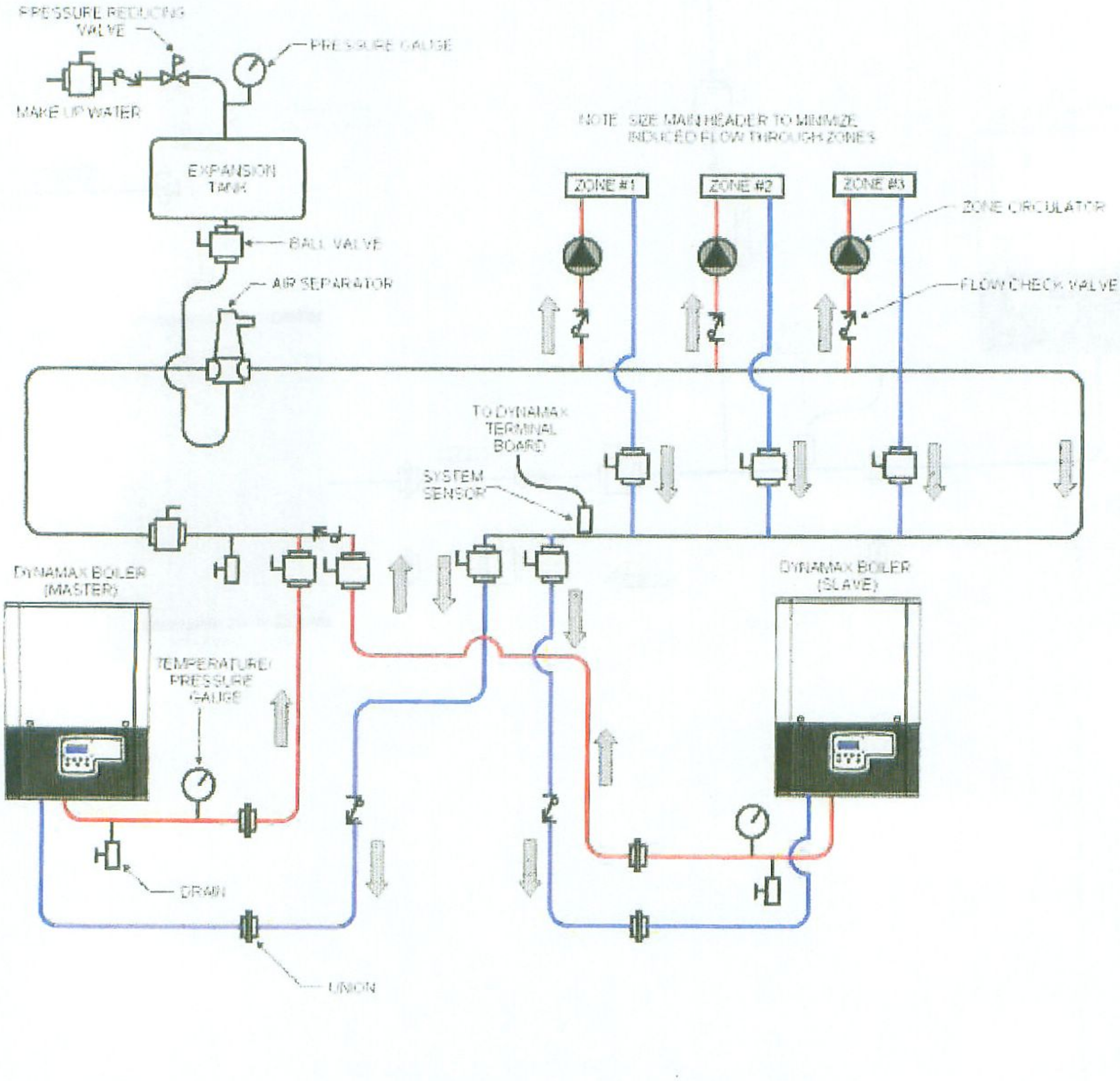


Figure 66: Multiple Boiler Hydronic Heating Zoned Piping Arrangement

Central Heating Mode: 0, 1, 2, 3

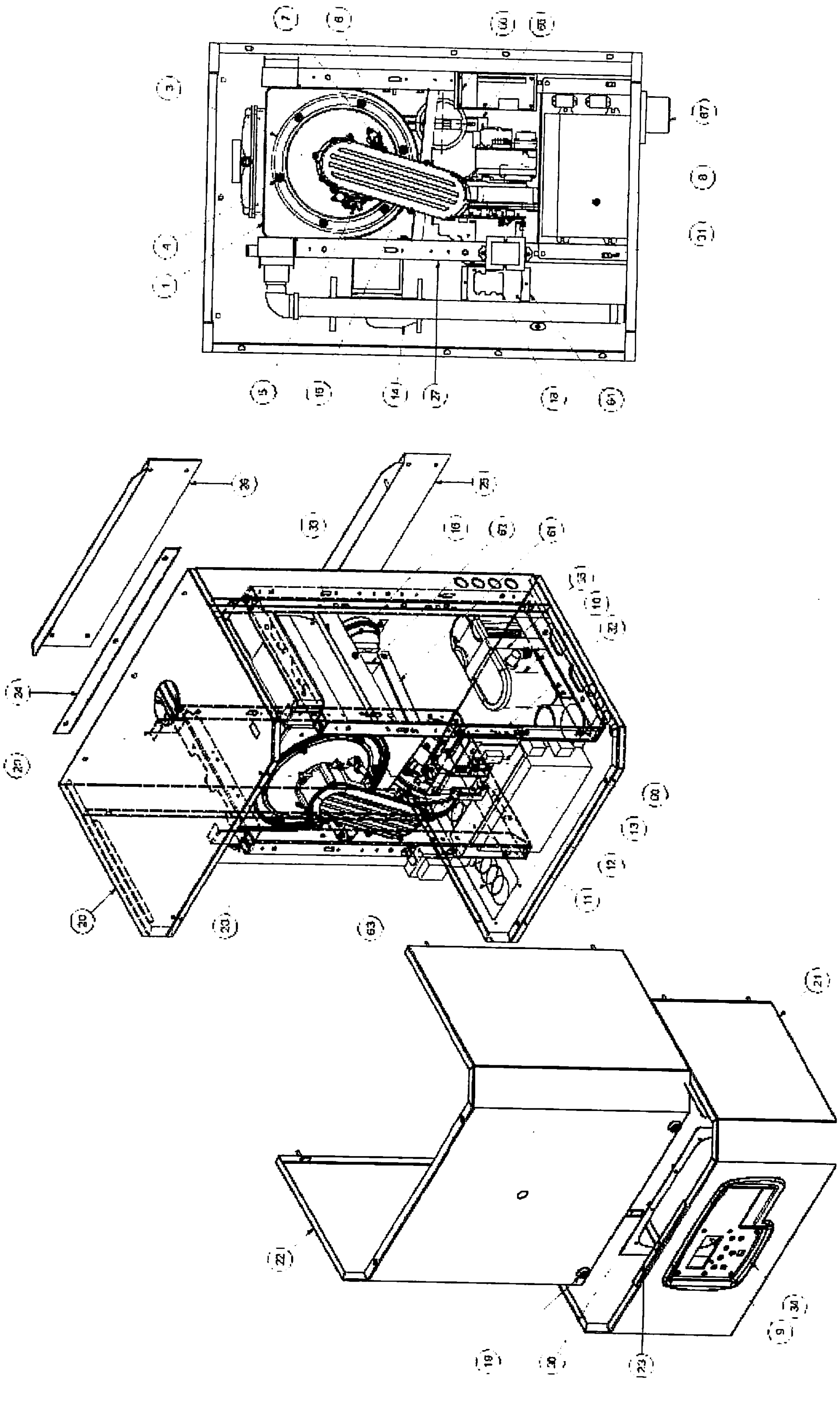
DHW Mode: 0

Boiler Address: Master Boiler Address = 101
Slave Boiler Address = 102

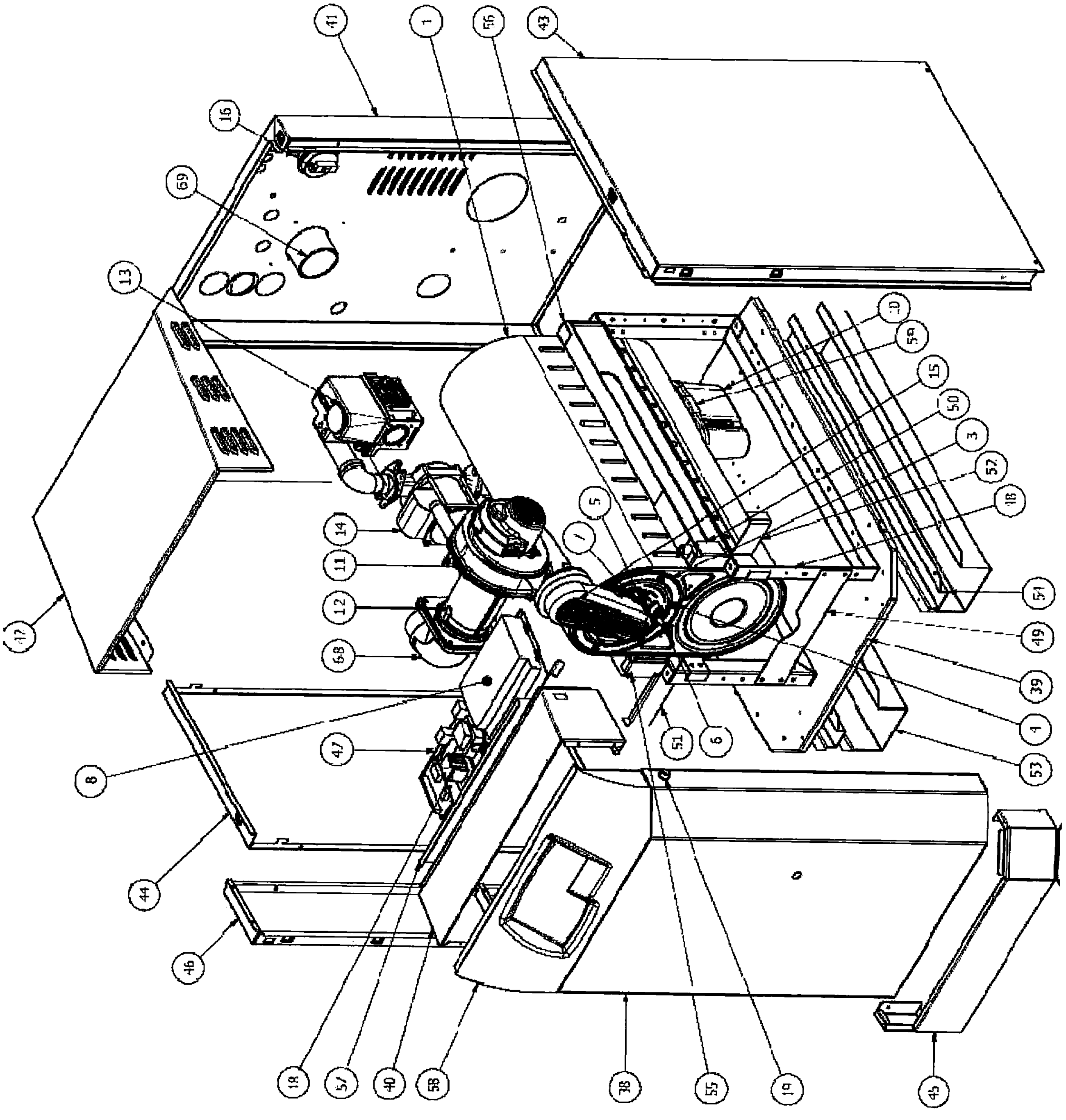


PART 14 EXPLODED VIEW & PARTS LIST

DYNAMAX WALL HUNG



DYNAMAX FLOOR MOUNT



Ref #	Name of Part	Part ID	DynaMax Models													
			ALL	80	100	150	200	210	250	260	299	399	500	600	750	800
1	Heat Exchanger	4 + 1 Wall		X	X											
		5 + 2 Wall				X										
		8 + 4 Wall					X		X							
		8 + 4 Floor						X		X						
		10 + 6 Floor									X					
		15 + 8 Floor										X				
		18 + 10 Floor											X			
		21 +11 Floor												X		
		24 + 12 Floor													X	
2	Burner	80,000 BTU		X												X
		100,000 BTU			X											
		150,000 BTU				X										
		200,000 BTU					X	X								
		250,000 BTU							X	X						
		299,000 BTU									X					
		399,000 BTU										X				
		500,000 BTU											X			
		600,000 BTU												X		
		750,000 BTU													X	
		800,000 BTU														X
3	Heat Exchanger Flange	GM20-65-028-01		X	X	X										
		GM20-65-033-01					X	X	X	X	X	X	X			
4	Heat Exchanger Flange Nuts	GM10-05-012	X													
5	Igniter	GM10-35-108	X													
6	Flame Sensor	GM10-35-109	X													
7	Igniter/Flame Sensor Screws	GM10-05-020	X													
8	DynaMax Controller	848MN	X													
9	DynaMax Control Panel	848RC	X													
10	DynaMax Condensate Neutralizer Box	15-6010	X													
11	Combustion Fan	55667.11221		X	X											
		55667.21120				X										
		55667.01970					X									
		55667.21080						X	X	X						
		55667.21200									X	X				
		55667.14002											X			
		G1G 170												X	X	X
12	Venturi	459000-444-003		X	X											
		459000-444-001				X										
		459000-446-051					X	X	X	X						
		45900450-010									X					
		45900450-020										X				
		VMU300A1046											X	X	X	X

Ref #	Name of Part	Part ID	DynaMax Models												
			ALL	80	100	150	200	210	250	260	299	399	500	600	750	800
13	Gas Valve	VK8115 V1036		X	X	X	X	X	X	X						
		VR8615VB1044									X	X				
		V8730V1015											X			
		V8730C1023												X	X	X
14	Pump (Non E-Series)	Astro 30		X	X											
		Astro 50				X	X	X								
		S25		X	X											
		S35				X	X	X	X	X	X	X	X			
		PL30							X	X	X					
		PL36										X	X	X		
		PL45													X	
	Pump (E-Series)	E7									X					
		E8		X	X	X	X	X	X	X						
		E9										X	X			
		E11				X	X	X								
		E12									X	X				
		E16										X	X	X	X	
		E33												X	X	
		E30														X
	Pump (H-Series)	H54											X			
		H66												X		
		H67													X	
		H68														X
15	Mixing Chamber	GM20-70-011		X	X	X										
		GM20-70-020-01					X	X	X	X	X	X				
16	Air Pressure Switch	8021205256	X													
17	3-Way Valve (Combination Models ONLY)	VC4011ZZ02/E		X	X	X	X	X	X	X	X	X	X	X	X	X
18	High Limit	TCL 110A	X													
19	¼ Turn Lock	Wall Hung	X													
		Floor Mount	X													
20	DynaMax Wall Mount Back Panel	14-5402		X	X	X										
21	DynaMax Wall Mount Front Bottom Wrap	14-5403		X	X	X										
22	DynaMax Wall Mount Front Upper Wrap	14-5404		X	X	X										
23	DynaMax Wall Mount Restrain	14-5405		X	X	X	X		X							
24	DynaMax Wall Mount Mounting Bracket	14-5406		X	X	X	X		X							

Ref #	Name of Part	Part ID	DynaMax Models													
			ALL	80	100	150	200	210	250	260	299	399	500	600	750	800
26	DynaMax Wall Mount Wall Top Bracket	14-5408		X	X	X	X		X							
27	DynaMax Wall Mount Support Frame Assembly	14-5409		X	X	X										
28	DynaMax Wall Mount Bracket Front	14-5410		X	X	X	X		X							
29	DynaMax Wall Mount Rear Bracket	14-5411		X	X	X	X		X							
30	DynaMax Wall Mount Bezel Stiffener Plate	14-5412		X	X	X	X		X							
31	DynaMax Wall Mount Controller Plate	14-5413		X	X	X	X		X							
32	DynaMax Wall Mount Electrical Conduit Plate	14-5415		X	X	X	X		X							
33	DynaMax Wall Mount Electrical Strip Plate	14-5416		X	X	X	X		X							
34	DynaMax Wall Mount Plastic Bezel	15-6001-A		X	X	X	X		X							
35	DynaMax Wall Mount Bracket for Neutralizer Box	14-5419		X	X	X	X		X							
36	Air Inlet/ Vent Adapter	FSA-HEX03		X	X	X	X	X	X	X	X	X				
37	Plate Heat Exchanger (Combination Models ONLY)	LB31-20X		X	X	X										
		LB31-40X					X	X	X	X	X	X	X			
38	DynaMax Floor Front Panel	14-5501									X	X	X			
39	DynaMax Floor Base Panel	14-5502						X		X	X	X	X			
40	DynaMax Floor Top Cover Front	14-5503						X		X	X	X	X			
41	DynaMax Floor Back Panel	14-5504									X	X	X			
42	DynaMax Floor Top Cover Back	14-5505						X		X	X	X	X			
43	DynaMax Floor Side Panel Right	14-5506									X	X	X			

Ref #	Name of Part	Part ID	DynaMax Models													
			ALL	80	100	150	200	210	250	260	299	399	500	600	750	800
45	DynaMax Floor Front Panel Bottom	14-5508						X		X	X	X	X	X	X	X
46	Dynamax Floor Side Panel Left Front	14-5509									X	X	X	X	X	X
47	DynaMax Floor Control Panel Plate	14-5510						X		X	X	X	X	X	X	X
48	DynaMax Floor HX Support Frame	14-5511									X	X	X	X	X	X
49	DynaMax Floor Support Plate	14-5512						X		X	X	X	X	X	X	X
50	DynaMax Floor Bracket Right	14-5513									X	X	X	X	X	X
51	DynaMax Floor Stand Off Left	14-5514									X	X	X	X	X	X
52	DynaMax Floor Stand Off Right	14-5515						X		X	X	X	X	X	X	X
53	DynaMax Floor Support Leg	14-5516						X		X	X	X	X	X	X	X
54	DynaMax Floor Stiffner under Leg	14-5517						X		X	X	X	X	X	X	X
55	DynaMax Floor Bracket Left	14-5518									X	X	X	X	X	X
56	DynaMax Floor Rear Bracket	14-5520									X	X	X	X	X	X
57	DynaMax Floor Mount Top Cover Assembly	14-5521									X	X	X	X	X	X
58	DynaMax Floor Mount Dashboard	15-6002-A						X		X	X	X	X	X	X	X
59	DynaMax Floor Mount Bracket for Neutralizer Box	14-5525									X	X	X	X	X	X
60	Rubber Bushing	33-0101		X	X	X	X	X	X	X						
61	DynaMax Wall Mount Condensate Pan	14-5414		X	X	X	X		X							
62	DynaMax Wall Mount Condensate Pan Brace	14-5417		X	X	X	X		X							
63	Cover Plate	14-5421		X	X	X	X		X							
64	Standoff	14-5423		X	X	X	X		X							

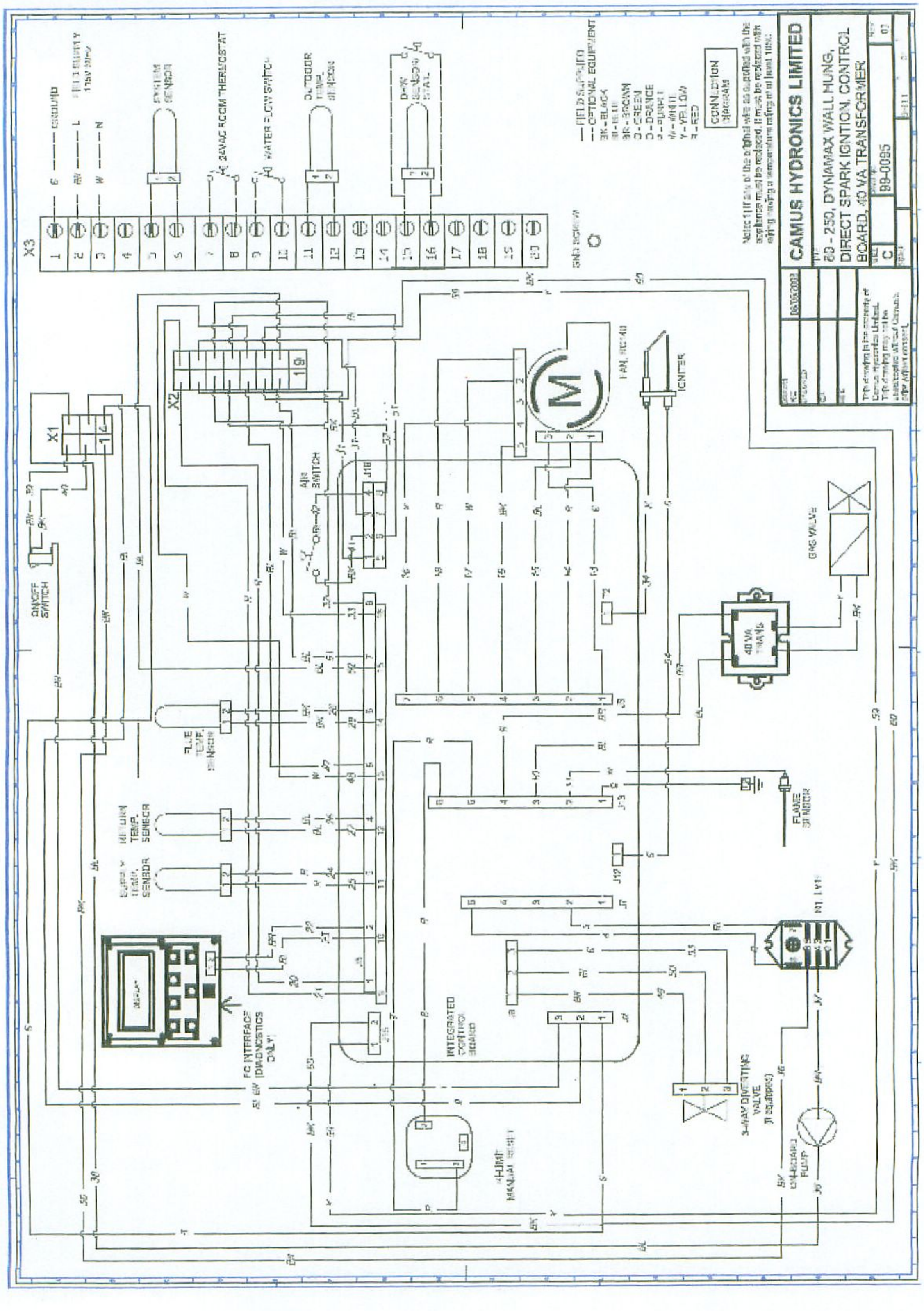
Ref #	Name of Part	Part ID	DynaMax Models													
			ALL	80	100	150	200	210	250	260	299	399	500	600	700	800
66	Electrical Strip Plate Protector	14-5420	X													
67	DynaMax Wall Mount Air Intake Adapter	44-0008		X	X	X	X		X							
68	DynaMax Floor Mount Plastic Flange with 3" Street Elbow	44-0009											X	X	X	
69	DynaMax Floor Mount Air Intake Adapter	44-0010											X	X	X	
70	Igniter Gasket	GM10-25-018	X													
71	Flame Sensor Gasket	GM10-25-004	X													
72	Burner Refractory	GM10-25-098-01		X	X	X										
		GM10-25-107					X	X	X	X	X	X	X	X	X	X
73	Automatic Air Vent	FV-4M1	X													
74	DynaMax Terminal Board	TB-001.001	X													
75	On/Off Switch	W51A152A	X													
76	40VA Transformer	HCT-01E0BB06	X													
77	Supply/Return Sensor	TSD00AS	X													
78	Flue Sensor	TSD20A1	X													
79	Sensor Wire (DMH/DMW: 3, DMC: 4)	CABLE HARNESS	X													
80	DHW Sensor (Clip-on, Combination Models ONLY)	TSC 0AS0	X													
81	Burner Gasket	GM10-25-074-09		X	X	X	X	X	X	X	X	X				
82	Gas Valve Elbow	45900400-132/B		X	X	X	X	X	X	X						
		45900400-144/B									X	X				
83	Gas Valve Wire Harness	45900441-015B		X	X	X										
		45900429-007B					X	X	X	X	X	X				
84	Relief Valve	10-407-05		X	X	X	X	X	X	X						
		10-604-10									X	X	X			
85	Wiring Harness	77-0004		X	X	X	X		X							
		77-0006						X		X	X	X	X	X	X	X
	1/2" Firing Valve	USA0509101T		X	X	X	X		X							

Ref #	Name of Part	Part ID	DynaMax Models												
			ALL	80	100	150	200	210	250	260	299	399	500	600	700	800
88	DynaMax Fan Discharge Orifice	14-0377		X	X	X	X	X	X	X						
89	Expandable Air Inlet Adapter w/o Pressure Test Point	14-0378		X	X	X	X		X							
90	Expandable Air Inlet Adapter	14-0379		X	X	X	X		X							
91	Flex Pipe	2" Diameter		X	X	X	X	X	X	X	X	X				
		3" Diameter											X			
		4" Diameter												X	X	
		5" Diameter														X
92	Flexible Stainless Steel Pipe 1" X 11"	66-0075	X													
93	Flexible Stainless Steel Pipe 1/2" X 11"	66-0073	X													
94	Manual Shutoff Valve Kit	50002653-001	X													
95	Rear Vent Adapter	GM10-15-991-01						X		X						
		GM10-15-992-01									X	X	X			
96	Metal Latch	6521-00-0551-YT						X		X	X	X	X	X	X	X
97	Strike	7800-02						X		X	X	X	X	X	X	X

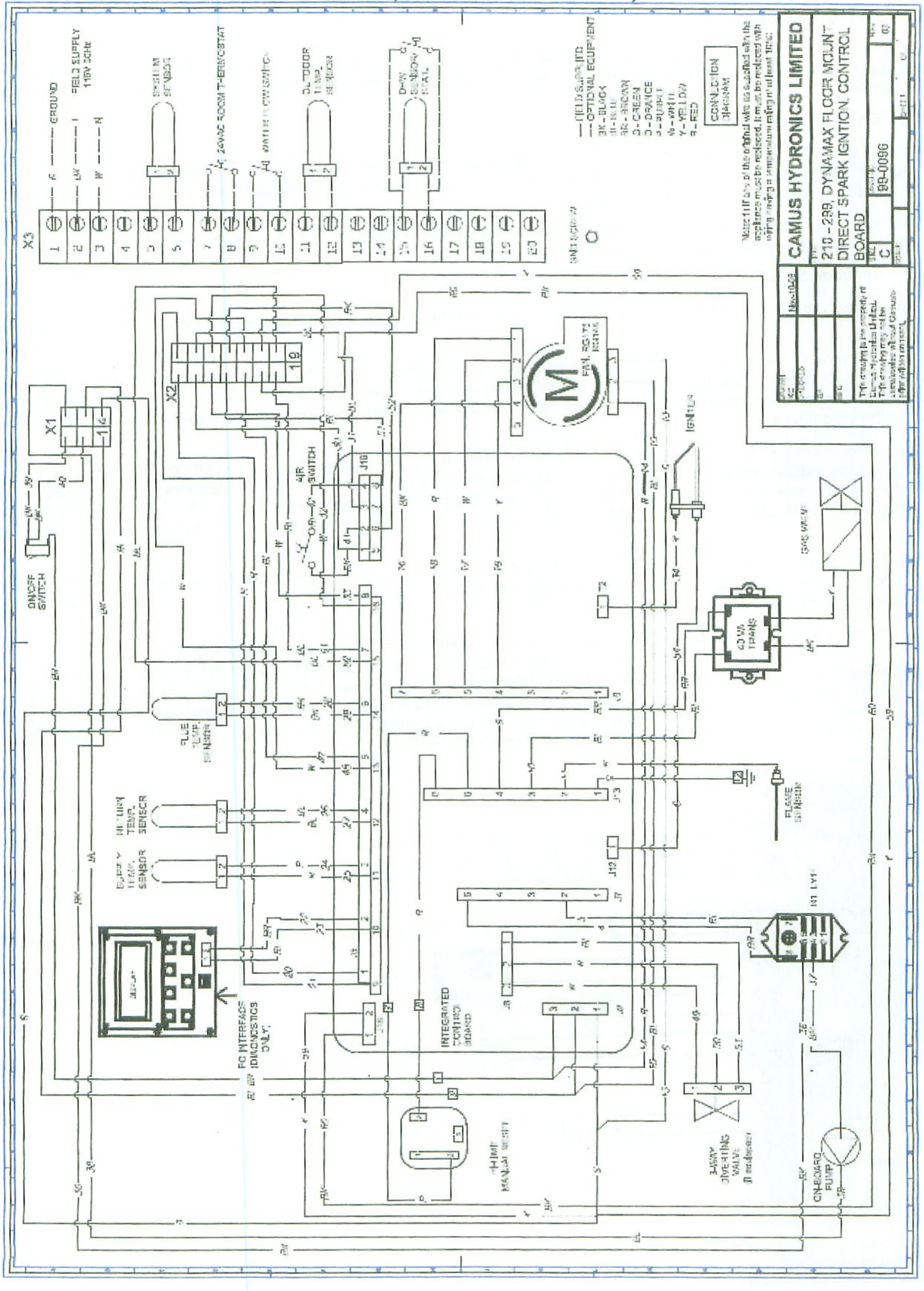
Not shown in Exploded View

PART 15 ELECTRICAL DIAGRAMS

15.1DM 80- 250 INTERNAL WIRING DIAGRAM (WALL HUNG MODELS)



15.2DM 210-299 INTERNAL WIRING DIAGRAM (FLOOR MOUNT MODELS)



15.3FIELD WIRING

15.3.1 System Sensor

The temperature of the primary return can be controlled by installing a system sensor. The DynaMax Controller automatically detects the use of this sensor and controls the burner modulation rate accordingly to maintain the system supply temperature to the set point.

15.3.2 Boiler Management System

An external controller can be connected to control the modulation rate of the burner, set point temperatures along with other user accessible parameters. To gain access to this function connect the 0-10Vdc terminals on the terminal board to the 0-10Vdc terminal on the boiler management system.

To allow for proper functionality ensure that the '+' terminal is connected to the '+' terminal on the terminal board and the '-' terminal is connected to the '-' terminal on the terminal board.

15.3.3 Cascade Setup

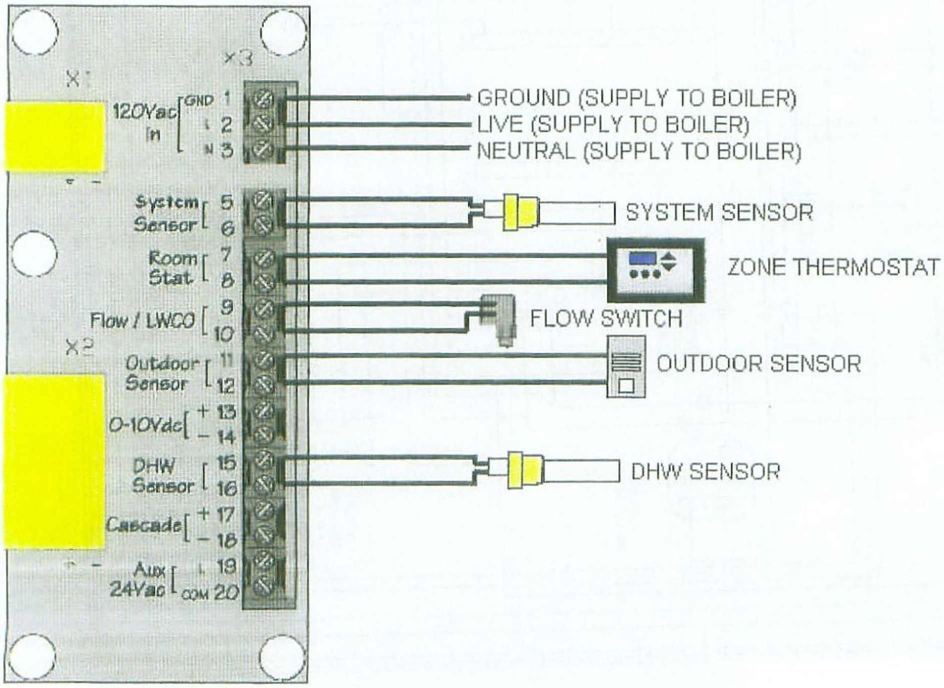
To setup a cascade system a Master boiler must be chosen, and the other boilers connected to it in this system are designated as Slaves.

Connect the system sensor and outdoor sensor (if equipped) to the Master boiler. The Master boiler will use the water temperature in the primary loop to control the operation of the cascade setup. The location of the system sensor should be installed downstream of all the zones in the primary loop. The system sensor is wired into the DynaMax Terminal board as shown in the diagram below.

If outdoor reset is desired, the outdoor sensor needs to be connected to the Outdoor Sensor location on the DynaMax Terminal Board. When the outdoor sensor is connected to the Master boiler, the DynaMax Controller will recognize this automatically and the Master will calculate the water temperature setpoint based on the Ch_Setpoint Curve (Figure 15). If the outdoor sensor is not connected to the Master boiler the DynaMax Controller will maintain a fixed water temperature that is programmed into the control.

If a Zone Thermostat is available, it needs to be connected to the Room Thermostat terminals on the DynaMax Terminal Board. If the boiler is required to run continuously a jumper cable can be placed between the '+' and '-' contacts, this will then force a call for heat on the cascade setup.

Communication between the Master and Slave boilers is accomplished by a running shielded 2-wire cable. Connect one end of the wires to Master 'Cascade +' and the other end to Slave 'Cascade +' on the DynaMax Terminal Board. Setup the other wire in the same manner with one end of the wires to Master 'Cascade -' and the other end to Slave 'Cascade –' on the DynaMax Terminal Board. If more than 2 boilers are connected in a cascade fashion, daisy chain the wiring from the second boiler on the Cascade DynaMax Terminal Board to the third boiler on the Cascade DynaMax Terminal Board. Do the same for the third, the fourth etc. Keep the wires short to minimize the chance of interference signals.



15.4 DETAILED CONNECTOR DESCRIPTION

Connector	Pin #	Connector Description
J2		Provides 120VAC to the DynaMax Controller
	1	Earth/ Ground
	2	120VAC Neutral
	3	120VAC Live
J6		3-Way Diverter Valve
	1	DHW 120VAC Live
	2	CH 120VAC Live
	3	120VAC Neutral
J7		On-Board Pump
	1	Not Used
	2	Pump 120VAC Neutral
	3	Not Used
	4	Not Used
	5	Pump 120VAC Live
J13		High-Limit, Gas Valve, Flame Sensor
	1	120VAC Ground
	2	Flame Sensor
	3	Gas Valve 120VAC Neutral
	4	Gas Valve 120VAC Live
	5	High-Limit Safety
	6	
J9		Fan Power, Fan Modulation
	1	Fan 120VAC Earth/ Ground
	2	Fan 120VAC Live
	3	Fan 120VAC Neutral
	4	Fan Signal +
	5	Fan Hall Effect Signal
	6	Fan Pulse Width Modulation (PWM) Signal
	7	Fan Signal -
J16		Various Sensors
	1	Flow Switch
	2	Air Switch
	3	Flow Switch
	4	Air Switch
	5	Not Used
	6	Not Used
	7	Not Used
	8	Not Used

Connector	Pin #	Connector Description
J5		Various Sensors
	1	Room Thermostat, 24VAC
	2	Control Panel, +
	3	Supply/Outlet Sensor
	4	Return/Inlet Sensor
	5	DHW Sensor/ Tank Stat
	6	Flue/Stack Sensor
	7	System Sensor
	8	Outdoor Sensor
	9	Room Thermostat, 24VAC
	10	Control Panel, -
	11	Supply/Outlet Sensor
	12	Return/Inlet Sensor
	13	DHW Sensor/ Tank Stat
	14	Flue/Stack Sensor
	15	System Sensor
	16	Outdoor Sensor
J12		Spark Return Signal
T2		Spark Igniter
F1		3.15A Fuse

CONDENSING BOILER LIMITED WARRANTY

Camus Hydronics Limited ("Camus") extends the following LIMITED WARRANTY to the owner of this appliance, provided that the product has been installed and operated in accordance with the *Installation* Manual provided with the equipment. Camus will furnish a replacement for, or at Camus option repair, any part that within the period specified below, shall fail in normal use and service at its original installation location due to any defect in workmanship, material or design. The repaired or replacement part will be warranted for only the unexpired portion of the original warranty.

THIS LIMITED WARRANTY DOES NOT COVER

1. Failure to properly install, operate or maintain the equipment in accordance with Camus' manual
2. Abuse, alteration, accident, fire, flood, foundation problems and the like
3. Sediment or lime build-up, freezing, or other conditions causing inadequate water circulation
4. Pitting and erosion caused by high water velocity;
5. Failure of connected systems devices, such as pump or controller
6. Use of non-factory authorized accessories or other components in conjunction with the system;
7. Failing to eliminate air from, or replenish water in, the connected water system
8. Chemical contamination of combustion air or use of chemical additives to water
9. Production of noise, odours, discolouration or rusty water
10. Damage to surroundings or property caused by leakage or malfunction
11. All labour costs associated with the replacement and/or repair of the unit
12. Any failed component of the hydronic system not manufactured as part of the boiler.

HEAT EXCHANGER

If within TWELVE years after initial installation of the appliance, a heat exchanger shall prove upon examination by Camus to be defective in material, thermal shock, leakage or workmanship, Camus will exchange or repair such part or portion on the following pro rated limited warranty

Years into Warranty	% of List Price
8	30
9	40
10	50
11	60
12	70

This term is reduced to SIX years if the appliance is used for other than hydronic space heating. Heat Exchanger shall be warranted for (20) years from date of installation against "Thermal Shock" (excluded, however, if caused by appliance operation at large changes exceeding 150°F between the water temperature at inlet and appliance temperature.

BURNER

If within FIVE years after initial installation of the appliance a burner shall prove upon examination by Camus to be defective in material or workmanship, Camus will exchange or repair such part or portion.

ANY OTHER PART

If any other part fails within one (1) year after installation, or eighteen (18) months from date of factory shipment based on Camus' records, whichever comes first. Camus will furnish a replacement or repair that part. Replacement parts will be shipped f.o.b. our factory.

DURATION OF LIMITED WARRANTY

Any limited warranty, including the warranty of mechantability imposed on the sale of the boiler under the laws of the state or province of sale are limited in duration to one year from date of original installation.

STATE LAW & LIMITED WARRANTY

Some states or provinces do not allow:
a) Limitations on how long an implied warranty lasts
b) Limitations on incidental or consequential damages.
The listed limitations may or may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state and province to province.

CONDITIONS

We will not:

a) Repair or replace any boiler, or part, subject to conditions outlined in 'This Limited Warranty Does Not Cover'
b) Reimburse any costs associated with repair and/or replacement
c) Replace and/or reparir any boiler without complete model number/serial number
d) Replace any boiler without prior receipt of actual rating plate from the appliance.

HOW TO MAKE A CLAIM

Any claim under this warranty shall be made directly to Camus Hydronics Limited Canadian Head Office

SERVICE LABOR RESPONSIBILITY

Camus shall not be responsible for any labour expenses to service, repair or replace the components supplied. Such costs are the responsibility of the owner.

DISCLAIMERS

Camus shall not be responsible for any water damage. Provisions should be made that in the event of a water/appliance or fitting leak, the resulting flow of water will not cause damage to its surroundings.

Name of Owner			
Name of Dealer			
Address			
Model No.			
Serial #:			
Date of Installation:		Date of Initial Operation:	

6226 Netherhart Road, Mississauga, Ontario, L5T 1B7, CANADA

CAMUS Hydronics is a manufacturer of replacement parts for most copper finned water heaters and heating boilers as well as a supplier of specialty HVAC products. Our service line is open 24 hours, 7 days a week!

The CAMUS CERTIFIED! Seal assures you that Reliability, Efficiency & serviceability are built into every single unit! For more information on our innovative products from CAMUS Hydronics Limited, call 905-696-7800 today.

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