



**Temporary Heating
Equipment Since 1981**

ENGINEERING GUIDE

**A guide to the selection of temporary heaters
and heating systems**



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The purpose of the Heat Wagon Engineering Guide is to provide information and instruction in the selection of temporary heat equipment and systems for construction sites, primarily in the early and middle stages of building.

There is no known text on this subject, although there are many on permanent heating systems. Some of the material from the Guide is drawn from such texts as well as from fuel gas codes, gas and propane association publications, and electrical engineering manuals.

This guide is intended for use by individuals who sell temporary heating systems and those who provide technical support.

While the purpose of the Heat Wagon Engineering Guide is to be helpful in the process of estimating temporary heating requirements, determining appropriate systems to use, fuel and electrical costs, and heater placement, Heat Wagon does not assume the ultimate responsibility for the overall effectiveness of individual projects. Actual jobsite conditions may require adjustments not anticipated in this general guide.

In all events, federal, state and local codes take precedence over recommendations in this guide.

BASICS OF TEMPORARY HEATING

In construction, temporary heating is commonly used to allow construction activities to continue throughout the winter season. On-going construction, worker comfort and safety, protection of structural components, concrete curing, and other factors during cold weather can make temporary heating a significant contributor to the profitability of winter work.

Temporary heating is used because permanent heating systems are not yet installed or activated. Little attention has been paid to the necessities of temporary heating design even though there are many sources of information on permanent heat design.

Many factors are considered when a building's permanent system is designed. The first among these factors are design and layout of the building and its intended use.

Insulating values of all structural components are taken into account. Structures that house people and equipment may require more heating and will be designed differently than buildings that serve the sole purpose of warehousing. System designs will account for outdoor design temperature and desired indoor temperatures, wind forces, land mass and other factors. It is assumed that openings, such as doors and windows, will be installed and closed when making these calculations.

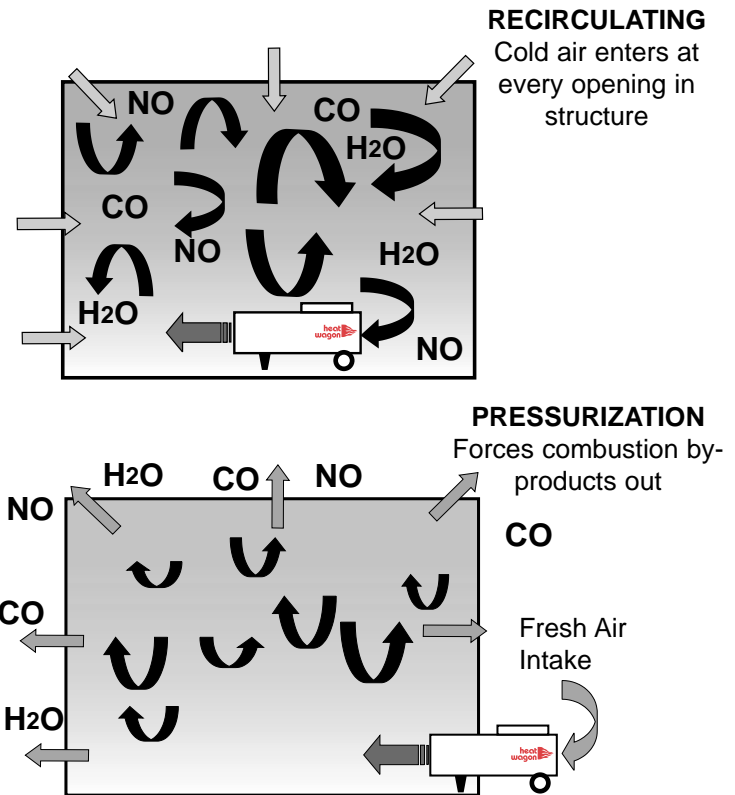
From time to time, contractors or building owners will attempt to use permanent heating designs to determine temporary heat requirements. This is a poor way to calculate heat losses during the construction cycles. Designs for permanent systems do not adequately address heat loss issues such as infiltration of cold air in the early and middle stages of construction. Cold air infiltration is easily the greatest source of heat loss in a building under construction. Even a fully completed building, ready for occupation, suffers from infiltration of cold air.

Another great heat loss is through the roof or ceilings due to conduction and radiation.

Controlling these two main sources of heat loss, by proper system sizing and selection, will also address two other concerns for those contractors who are going to use temporary heat: the accumulation of moisture and the air quality within the building.

RECIRCULATING vs. PRESSURIZATION

There are two basic methods of employing temporary heat. One method is called recirculation and the other is known as pressurization or air exchange.



Recirculation has been used for many years and is derived from the use of relatively small portable heaters sometimes known as torpedo or salamander heaters. The largest of these heaters in common use is 600,000 BTU, with air flow, in cubic feet per minute (CFM) up to 3,000. Historically, the majority of these types of heaters have been fueled by kerosene or fuel oil.

Recirculating, or portable heaters, are placed inside a building and are fired by fuel and air from within the building. While there have been improvements in the design of portable heaters and expanded fuel options, the operation remains the same, that is, burning or consuming of air (oxygen) contained inside the building.

There are problems associated with this method. The predominant problems are: depletion of oxygen during the burning process and accumulation of by-products of combustion back into the heated space which are then recycled through the heater. By-products include carbon monoxide, carbon dioxide, and water vapor which accumulate, while oxygen is depleted.

It is always recommended that outside air be introduced to the interior spaces to prevent the uncomfortable and sometimes dangerous accumulation of these by-products when using recirculating heaters.

In addition to these drawbacks, combustion inside the building with interior air creates a partial vacuum, encouraging infiltration of cold air. As said before, infiltration of cold air is a principal cause of heat loss. Heated air inside the building tends to be spotty and uneven under these conditions.

Recirculating heaters also obstruct work in progress while providing uneven heat distribution. Hoses and tanks are also obstructions.

The other method of employing temporary heat is referred to as the air exchange or the pressurization method. This method addresses all of the problems associated with the recirculation method.

The pressurization type heaters range widely in BTU capacity. They are usually fueled by natural gas, vapor propane, liquid propane, or fuel oil. They all share the characteristic of having high temperature rises, i.e., the difference between input air and output air, high air movement, expressed in cubic feet per minute (CFM), and high static pressure.

High temperature rise with high CFM and high static pressure permit these types of heaters to use air from outside the building to pressurize the building. The net affect of this pressurized air flow is to spread heated air evenly throughout a building.

Several important things begin to happen as this heated air spreads. The foremost is the reversal of infiltration of cooler air. Where cold air has been entering, it is forced back out of the building. The by-products of combustion, carbon monoxide and water vapor are expelled as well. Heated air tends to be more evenly spread throughout the building.

Naturally, efforts to tighten the building enclosure must be made in order to achieve maximum results from pressurization. It is the contractor's responsibility to continually tighten the enclosure.

Regardless of the method selected, pressurizing or recirculating, a consideration of the type of equipment used by either method is needed. The equipment should be portable and compact. Heaters should use readily available fuel and power. Operational safety and environmen-

tal safety are priorities. Heaters should be designed and engineered to meet high standards. It is to be expected that equipment has been tested and approved by independent laboratories for both manufacturing standards and safe operation. There must be rational calculations of estimated fuel expenses, electric costs, set up and maintenance costs, supervisory costs, and so forth.

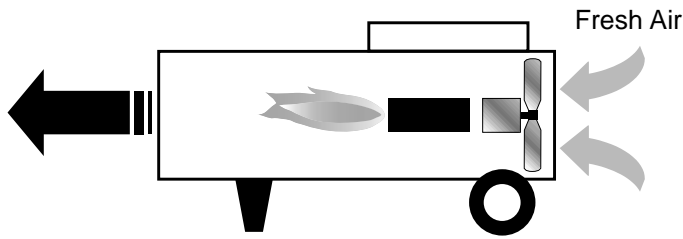
BASIC EQUIPMENT TYPES

There are four basic heater types used in temporary heating. They are direct fired, indirect fired, electric and hydronic.

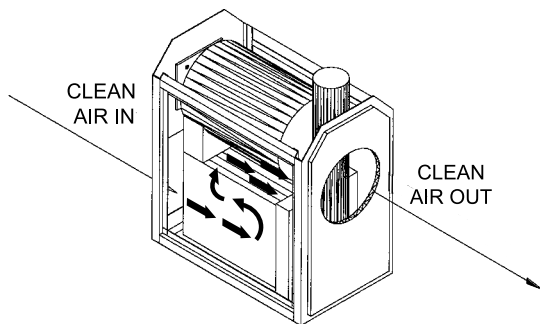
Direct fired are economical and practical for most temporary heat applications, as long as they have been selected, placed, and applied correctly. Direct fired heaters function by drawing cooler air into the heater by means of a fan. The cool air then passes over exposed flame which increases the air temperature. As the heated air passes through the heater the discharge temperature is controlled by heater components. This type of heater is nominally 100% fuel efficient. If 100,000 BTU is introduced to the heater then 100,000 BTU is the approximate output. As mentioned earlier, a small amount of this combustion process produces by-products which are manageable and safe. This is true when used as pressurizing heaters.

Indirect fired heaters operate differently. Cooler air is drawn into a contained burner chamber where the fuel is fired and the combustion process begins. The heater also draws cool air over a separate chamber called a heat exchanger. The two streams of air: combustion air and heat exchange air do not intermingle. Combustion air heats the heat exchanger air. Combustion by-products are discharged through a vent or flue along with the excess heat. The air heated by the heat exchanger is discharged into the structure to be heated. Therefore, in a vented heater, the usable temporary heat is free of any contamination or vapor produced in the combustion process. This heat is clean and it is dry.

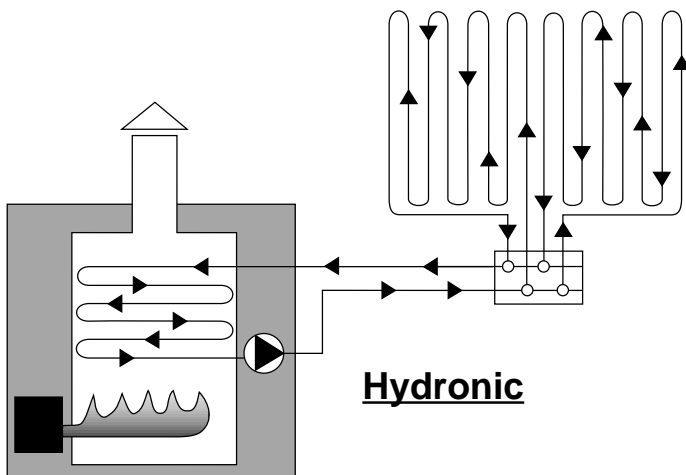
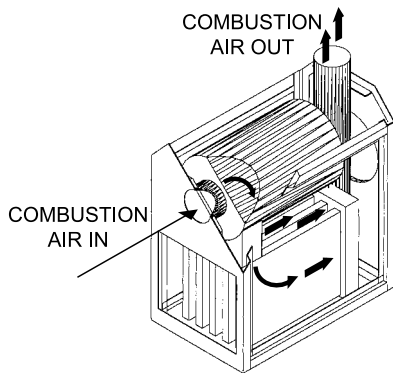
Though still simple in operation and application, indirect fired heaters require more components, mostly in sheet metal parts. It is the nature of vented heaters to produce some waste heat. In the past, the best fuel efficiencies possible were in the 35% - 40% range. Today's manufacturing and design capabilities make it possible to increase efficiencies to about 80%. In short, direct fired heat is nearly 100% fuel efficient while the best available indirect fired heaters are about 80% fuel efficient. As a result, operating costs with indirect fired heaters can be somewhat greater than operating costs with direct fired heaters.



Direct Fired



Indirect Fired



Hydronic

Indirect fired heaters are used in cases where air quality is of utmost importance, such as in hospitals or schools. These heaters are also used where drying is needed. Indirect fired heaters do not add moisture to the building *whether used as pressurizing or recirculating units.*

Temporary heat provides for a third type of heater. Electric heat is used in relatively small enclosures when clean, dry heat is required. The main drawback to electric heat is the small heat capacity relative to the cost to power them. Electric heat is considered to be six or eight times more costly to operate than gas or oil fired units.

A more recent development in temporary heating is known as hydronic heat. It is a hot water circulating system. This type of equipment owes its design to ground thawing equipment which heats a glycol mix and transfers heat through flexible hose to the ground. Hydronic heaters, do not heat the air directly, but instead heat a water glycol mixture which is then pumped through flexible hose to airover heat exchangers. These airover heat exchangers are placed inside a building to provide warm air. The main advantage of this type of system is not the warm air provided which is somewhat limited by its design, but rather the drying effect produced by separating the combustion process from the heat transfer process, as in indirect fired heaters.

All of the heaters described have their own purpose. The challenge is to determine the need, and to then balance cost, convenience, portability, and effectiveness in meeting the primary goal of temporarily heating buildings under construction. After all, temporary heating is meant to permit construction activities to continue during the winter season, safely and profitably.

HEAT TRANSFER

Heat is normally measured in British Thermal Units, or BTU. One BTU is the amount of heat required to raise the temperature of one pound of water, one degree Fahrenheit in a controlled setting.

For convenience, heaters are rated by BTU input, regardless of the type of fuel used. Indirect fired heaters are also rated by fuel efficiency.

Understanding how heat transfer occurs inside a building allows for the best selection of methods and heaters to use. After those decisions are made, it is necessary to decide on fuel choices, power options, heater placement, hose or piping needs, and heat distribution. How heated air performs inside a building is not a particularly difficult

thing to understand. Air is heated, expands, and becomes lighter. Lighter air rises. Heated air tends to layer or stratify and it always wants to move from warm areas to colder areas. When a building is heated with warm air it is heated from the top down and from the warmer areas outward to the cooler areas of the building.

Understanding how heat moves makes it easier to take advantage of that movement. In heating higher ceilings or decks or heating higher floors, the heat is allowed to rise. If it is required that the heat move downward, fans or ductwork is used to direct the warm air to where it is wanted. Tiltable fans, used to force warm air from high ceilings back down to the normal work areas, can slash fuel costs 15-20%.

Heat moves from warm to cold. That means it is not necessary to surround a job with heaters. It is more important to place the heaters near the fuel source, available power, and within building openings such as doors and windows. With this placement, the heaters are used in the pressurization method. Long piping runs and heavy power cables are often an indicator that these principles are not being acknowledged.

CONDUCTION, CONVECTION, RADIATION

There are three forms of heat transfer: conduction, convection, and radiation. They can be defined as follows:

Conduction is the transfer of heat through a solid object (a spoon handle in a hot cup of coffee). Convection is the transfer of heat by movement of fluids or gases. A forced air heater is a convection heater.

Radiation is the transfer of heat from one object to another without warming the space in between (as the sun warms the earth).

The importance of understanding heat transfer is that in temporary heating, the most efficient heating is attained when all three types of heat transfer are put into play and heat sink is attained.

Heat sink is attained when the temperatures of the air, floor, and building framework or sidewalls are all approximately the same.

This is accomplished by pressurizing the building with forced air heaters (convection). The air temperature starts to warm the concrete slab and/or steel which warms itself

(conduction) and then these warm objects throw heat back into the building (radiation). When this occurs, you have attained heat sink. At this point, a heater will drop to low fire automatically or shut off entirely until there is a temperature drop and the entire method repeats itself. A word of caution: in certain instances it is not unusual to take a number of days to attain heat sink. In some instances, higher fuel consumption for the first few days is to be expected.

The most effective and efficient way to heat a building is through pressurization. To pressurize a building is to force more air into the building than it can hold. When this happens, warm air is forced out the crevices, joints, open windows, and doors. When calculating heat loss, remember that the largest heat loss on any structure is infiltration.

If cold air coming into a building can be reversed, temporary heating costs can be reduced by as much as fifty percent.

HEAT LOSS/GAIN

Heat loss is based on the cubic feet of the building. Square feet is of no value in calculating heat loss. Cubic feet should be determined by close inspection of the blue prints, or taking actual measurements. Walking through and around the job to get a "feel" for how the heated air will move is invaluable.

Temperature rise is the difference between anticipated outdoor temperature and desired indoor temperature. See Charts 1-5, Page 12, in this guide for help in determining outdoor temperature. Frequently, a good source is the contractor with local knowledge. The contractor or building owner will also tell you what temperature is desired indoors. The difference is temperature rise. For example, if desired indoor temperature is 45° F and outdoor temperature is 20° F, the temperature rise is 25° F.

Now that cubic feet, outdoor temperature, indoor temperature, and temperature rise is known, heater sizing can begin.

Although there are complex programs to calculate heat loss, they heavily involve elements which have little to do with the estimates needed for temporary heat. For almost all temporary heat projects, the following formula is more than satisfactory.

1 BTU per cubic foot for every 10°F temperature rise. For example, to achieve a 25°F temperature rise, simply multiply cubic feet by 2.5.

| | |
|-----------------------------|---|
| Simple example: | 180,000 cubic foot single floor building |
| Outdoor temperature | 20° F |
| Indoor temperature | 45° F |
| Temperature Rise | 25° F |
| 180,000 x 2.5 = 450,000 BTU | |

Other factors may need to be taken into account, which may cause revisions, either up or down in the estimate. These factors are likely to change as construction continues. A quick reference graph to these factors is included in this guide. See Chart 6, Page 13.

For simple shell construction such as warehouses with little or no partitioning and limited to a single floor, an alternate formula will work almost equally well. That is: divide the cubic feet of the structure by 60 (60 minutes to the hour). This will show the cubic feet per minute (CFM) of air required to completely exchange the building air once per hour. This formula should be limited to single floor, open plan construction.

| | |
|---|------------------|
| Example: | 180,000 cubic ft |
| $180,000 \div 60 = 3,000$ CFM | |
| Select a heater or heaters which will provide at least 3,000 CFM. | |

We have described two formulas for sizing heaters, both of which are used on single floor applications. Multiple floored buildings require additional calculations, but are still based on warm air rising and moving from warm areas to cool areas.

Because most movement of people, equipment and supplies occur on the first floor, it should be provided with additional heat.

For the second and third floor, provide for 50% of the BTU's used on the ground floor. It is possible that no additional heat will be required on the 3rd floor. Use fans to move heat from stairwells into upper floors. The number of such fans depends on the number of stairwells available and are placed on the landings to pull heat from the stairwells onto the floor.

For buildings taller than 5 stories, determine if the builder intends to heat all floors at the same time. Commonly, they do not, in which case, calculate only the heat loss on contiguous floors.

Floor deck heating can be done simply by allowing heat to rise to the underside of the decking. Select heaters with high temperature rise whenever possible. Air movement is

less important in this application. We want the warm air to rise to the underside of the decks and to remain there.

FUEL FACTS

Fuel choices for direct fired and indirect fired heaters are natural gas, vapor propane, liquid propane and fuel oil.

Which fuel is used depends upon customer preference, availability, pressures and flows, and relative cost.

Each fuel has its advantages and disadvantages. Propane offers high pressure and flow. Natural gas offers wide variations in pressure but also offers uninterrupted availability. See Chart 7, Page 14.

At this point, we should mention that there are some applications which call for electric heat. Such applications are not usually considered temporary heat, for our purposes. Electric heaters are not commonly available with high BTU capability. Electric heat is produced by electrical resistance. The greater the resistance, the greater the BTU output. To generate a mere 205,000 BTU requires 3 phase 480 volt 70 amp service. Electric heat is, by far, the most costly way to heat enclosures. The advantage is that the warm air produced, though small, is both free of contaminants and provides dry air. Electric heat is for rooms rather than buildings.

Fuel costs for propane, natural gas, and fuel oil vary widely across the country and can change rapidly. Cost per unit of measure alone should not override other issues.

Propane is an often misunderstood fuel. There is a unique relationship between tank size, outside air temperature, and vaporization rate. Propane in a tank is a liquid. Although propane suppliers vary the ratio from time to time, a "full" tank is 85% liquid and 15% vapor.

When the tank is opened and vapor is used, the liquid propane in the tank "boils" into vapor. This boiling action is caused by the outside temperature on the liquid filled or wetted part of the tank.

As outside temperature drops, boiling slows down. Tank pressure drops and less vapor is produced. Nearly the same thing happens, as propane is consumed. As fuel is consumed, the liquid propane level drops and there is less wetted area of the tank to boil into vapor.

As temperature drops, pressure drops and the vaporization rate drops.

Chart 8, Page 15 demonstrates the rate of vaporization in various tank sizes, 250 gallons through 1,000 gallons, and manifolded at 0° F outside temperature and at 60% of liquid capacity. 60% is used to allow a comfortable margin in calculating tank requirements.

Chart 9, Page 15 demonstrates bulk tank pressures at outside temperatures from -40°F to +40°F.

HOSE AND PIPING

It is best practice to place heaters in building openings close to the fuel source and close to dependable electric power.

In order to choose the correct hose or piping for a heater three things must be known.

- Fuel Type - natural gas, vapor propane or liquid propane
- Fuel pressure at the source
- Distance to the heater

Chart 10, Page 16-17 illustrates flow rates for hose and piping at pressures from less than 1 pound per square inch (psi) through 20 psi for natural gas. The charts given do not give values for 3/4" hose; use 1" pipe as equivalent of 3/4" hose. An example of proper pipe sizing can be found on page 20.

Chart 11, Page 18 shows flow rates for liquid propane in gallons per hour, for hose and piping in diameters from 1/4" through 2". To eliminate potential problems with liquid propane called slugging, use the smallest diameter hose or piping possible, see liquid propane Chart 12, Page 18. Refer to page 21 for proper bulk tank placement. Liquid propane may not be used inside a building under any circumstances. Place and use liquid propane heaters in building openings with all hose and piping outside the building.*

*Please refer to federal, state and local codes for appropriate use of hose and piping. Some codes permit no hose to be used.

HIGH PRESSURE REGULATORS

Heater specifications include minimum and maximum inlet pressure requirement. Specifications may be in inches of water column (w.c.) or pounds per square inch (psi). 27.7 inches w.c. equals 1 psi.

When inlet gas pressure is greater than the maximum pressure called for in the specifications, a high pressure regulator is required. For example, if the specifications reads 14 inches w.c. maximum inlet pressure and gas pressure is 5 psi, a regulator must be added to the heater

at the inlet.

Chart 13, Page 19 will guide you to the correct regulator as specified by Heat Wagon. For circumstances outside the chart parameters please call Heat Wagon Technical Support at 219.464.8818, extension 2003.

ELECTRIC POWER

All Heat Wagon heaters have recommended minimum cord size decals. Circumstances may arise where these recommendations are not suitable for a specific application. Refer to Chart 14, Page 19 for guidance. Whenever possible, place heaters as close as possible to the power source.

BY-PRODUCTS OF THE COMBUSTION PROCESS

Direct fired heater by-products of combustion are carbon dioxide, carbon monoxide, nitrous oxide, and water vapor. Of these, only carbon monoxide and water vapor are of major concern.

OSHA has established standards for carbon monoxide accumulation inside the building envelope. The standard can be found readily in the NIOSH Pocket Guide to Chemical Standards, Publication 97-140. The Pocket Guide is available at no charge from the US Government Printing Office at 866.512.1800.

The 2004 issue of the pocket guide shows the 8 hour time weighted average accumulations for carbon monoxide to be 50 ppm.

Please be aware that this standard applies not to heaters or other equipment, but rather the total accumulation of carbon monoxide in the building envelope over an 8 hour period. Heaters are probably not the cause for carbon monoxide accumulation, particularly when used in their proper mode, as pressurizing heaters. In many instances, other equipment on the job site may be producing far more carbon monoxide than the heaters. Troweling machines, generators, compressors and loaders are often found in the same work space.

It has been said by some temporary heating suppliers that carbon monoxide should be estimated on the basis of the functionality of the heater. This is incorrect. Actual measurements of carbon monoxide accumulation should be taken over time throughout the structure, at various times in a work day. There are devices on the market for that express purpose.

Water vapor, introduced by the combustion process with direct fired heaters, is reduced or eliminated by the pressurization method. Further, for dehumidifying, air movement greatly aids the process. If water vapor becomes an issue, simply add fans to encourage air movement.

COMMON INSTALLATION AND OPERATIONAL PROBLEMS

1. Low Voltage - This is one of the most common problems and is usually the result of the supply cord having too small a wire gauge for its length. Low voltage results in the motor overheating, burnt relay contacts or a relay that will not make contact.

2. Gas Supply Line Too Small

3. Insufficient Vaporization At Supply - Normally caused by improperly sized propane tank.

4. Improper Gas Supply Pressure - Usually a result of supply pressure being too high or too low because of improper or lack of regulation. Refer to the heater's instruction plate for the maximum and minimum inlet pressure rating.

5. Dirty Gas Supply (Dirt in hose or supply pipe) - Dirty gas can cause strainers to plug or form a build up in the burner orifice.

6. Lack Of Preventative Maintenance - Heaters must be cleaned as required, especially when used in a dirty environment.

ON SITE HAZARDS

1. Shorting Or Jumping Out Of Defective Components - This is a very common problem which saves short term expense at the risk of large future costs. Any heaters found in this condition should be removed immediately.

2. Improper Enclosure - When heaters are installed partially to the outside for fresh air intake, strict adherence must be made to the minimum clearance to combustibles given on the instruction plate. Wood framing around a heater poses a potential hazard.

3. Supplying Liquid Propane To A Vapor Heater - This problem has occurred from time to time. To minimize the damage, shut off the gas supply and let the heaters run until all of the liquid in the lines has been burnt.

4. Improper Or No First Stage Regulator - Refer to the heater rating plate for the maximum and minimum inlet pressure rating.

JOB SIZING

Proper job sizing is result of finding out as much information about the construction project as possible. Key information that must be determined are:

1. Cubic feet of structure
2. Design temperature
3. Available fuel source
4. Available power source
5. Enclosure description










Page 22 of this guide will lead you through this process. Once this information is determined heating recommendations can be made.

FUEL AND POWER CONSUMPTION

Many factors (building tightness and actual weather conditions) can effect the fuel consumption on a heating project. Therefore, any cost calculation is just an estimate. Page 23 of this guide provides a worksheet for estimating project costs.

Follow up and communication with the contractor throughout the heating season are extremely important to a successful sale and repeat business. Keeping good records on every job will improve knowledge and future success.

Direct Fired

| Model# | BTU | Fuel Type | | | Min. Pressure | Power Supply | | | CFM | Ductable |
|---|---|-------------|-------------|--------------|----------------------------|--------------|-------------------------|------------|----------------------------|----------|
| | | Propane | Nat. Gas | Liq. Propane | | 120V | 208-240V 1Ø 3Ø | 480V 3Ø | | |
|  S100 | 100,000 | • | • | | 7" w.c. | • | | | 900 | |
|  S405 | 400,000 | • | • | | 7" w.c. | • | | | 2,000 | |
|  1800 1800L | 750,000 750,000 | • | • | • | 9" w.c. 5 psi | • • | | | 4,200 4,200 | • • |
|  2000 2000L | 1,000,000 1,000,000 | • | • | • | 9" w.c. 5 psi | • • | | | 4,200 4,200 | • • |
|  S1505 | 1,500,000 800,000 | • | • | | 9" w.c. | • | | | 7,000 | |
|  2730C | 2,000,000 500,000 | • | • | • | 5 psi | | • • • | | 12,500 | • |
|  S2200D | 2,200,000 1,950,000 LP 1,650,000 NG | • | • | | 10" w.c. | | • • • | | 10,500 | • |
|  3050 | 3,500,000 1,200,000 | • | • | • | 10 psi | | • • • | | 16,000 | • |
|  4210 4215 4220 | 5,000,000 6,000,000 7,000,000 | • • • | • • • | • • • | 30 psi 30 psi 30 psi | | • • • • • • • • • | | 27,500 33,500 40,100 | • |

Electric



| Model# | BTU | KW | Amps | Power Supply | | | CFM | Ductable |
|---------|---------|-------|-------|--------------|-------------------|------------|-------|----------|
| | | | | 120V | 208-240V 1Ø 3Ø | 480V 3Ø | | |
| P1500 | 5,100 | 1.5 | 15 | • | | | 300 | |
| P1800-1 | 65,000 | 18/12 | 75/50 | | • | | 590 | |
| P1800-3 | 65,000 | 18/12 | 50/34 | | | • | 590 | |
| P4000 | 136,000 | 40/20 | 50/20 | | | | 1,800 | |
| P6000 | 204,500 | 60/24 | 70/30 | | | • | 1,800 | |

Indirect Fired



| Model# | BTU | Fuel Type | | | Min. Pressure | Power Supply | | | CFM | Ductable |
|--------|-----------|--------------|----------|----------|---------------|--------------|-------------------|------------|-----|----------|
| | | Vap. Propane | Nat. Gas | Fuel Oil | | 120V | 208-240V 1Ø 3Ø | 480V 3Ø | | |
| LVF90 | 90,000 | | | • | | | | 530 | | |
| HVF180 | 180,000 | | | • | | | | 1,475 | • | |
| HVF300 | 290,000 | | | • | | | | 2,650 | • | |
| VG400 | 400,000 | • | • | | 9" w.c. | • | | 2,100 | • | |
| VF400 | 400,000 | | | • | | • | | 2,100 | • | |
| VG1000 | 1,000,000 | • | • | | 9" w.c. | | • | 4,075 | • | |
| VF1000 | 1,000,000 | | | • | | | • | 4,075 | • | |

CHART 1

| OCTOBER TEMPERATURES | | | | |
|----------------------|----------------|-----------------------|--------------------------|----------------------|
| STATE | CITY | NORMAL DAILY MEAN ° F | NORMAL DAILY MINIMUM ° F | * OUTDOOR DESIGN ° F |
| AK | ANCHORAGE | 34.1 | 28.3 | -23 |
| CO | DENVER | 51.0 | 35.9 | -5 |
| IA | DES MOINES | 52.8 | 42.2 | -10 |
| ID | BOISE | 52.8 | 41.3 | 3 |
| IL | CHICAGO | 52.1 | 42.1 | -8 |
| KY | LOUISVILLE | 58.5 | 48.5 | 5 |
| MA | BOSTON | 54.1 | 46.4 | 6 |
| MD | BALTIMORE | 55.4 | 43.7 | 10 |
| ME | PORTLAND | 47.7 | 37.4 | -6 |
| MI | DETROIT | 51.9 | 42.5 | 3 |
| MN | MINNEAPOLIS | 48.7 | 38.9 | -16 |
| MO | KANSAS CITY | 56.8 | 45.9 | 2 |
| MO | ST. LOUIS | 58.3 | 48.2 | 2 |
| MT | GREAT FALLS | 45.5 | 33.0 | -21 |
| ND | FARGO | 45.3 | 34.4 | -23 |
| NM | ALBUQUERQUE | 57.3 | 43.8 | 12 |
| NY | NEW YORK | 57.7 | 50.9 | 11 |
| NY | ROCHESTER | 50.4 | 41.1 | 1 |
| OH | COLUMBUS | 54.7 | 44.0 | 0 |
| PA | PITTSBURG | 52.5 | 42.5 | 1 |
| SD | SIOUX FALLS | 48.0 | 34.8 | -15 |
| UT | SALT LAKE CITY | 52.5 | 41.0 | 3 |
| VA | RICHMOND | 58.3 | 47.2 | 14 |
| WA | SEATTLE | 52.7 | 45.7 | 21 |
| WV | CHARLESTON | 55.1 | 43.1 | 7 |

Note: * For Permanent Heat Designs Use Outdoor Design

CHART 2

| NOVEMBER TEMPERATURES | | | | |
|-----------------------|----------------|-----------------------|--------------------------|----------------------|
| STATE | CITY | NORMAL DAILY MEAN ° F | NORMAL DAILY MINIMUM ° F | * OUTDOOR DESIGN ° F |
| AK | ANCHORAGE | 21.8 | 15.9 | -23 |
| CO | DENVER | 37.5 | 23.5 | -5 |
| IA | DES MOINES | 37.9 | 29.0 | -10 |
| ID | BOISE | 39.9 | 32.4 | 3 |
| IL | CHICAGO | 39.3 | 31.6 | -8 |
| KY | LOUISVILLE | 47.6 | 39.3 | 5 |
| MA | BOSTON | 44.9 | 37.9 | 6 |
| MD | BALTIMORE | 45.5 | 34.7 | 10 |
| ME | PORTLAND | 38.3 | 29.5 | -6 |
| MI | DETROIT | 40.7 | 33.5 | 3 |
| MN | MINNEAPOLIS | 32.5 | 24.8 | -16 |
| MO | KANSAS CITY | 42.7 | 33.4 | 2 |
| MO | ST. LOUIS | 45.3 | 36.7 | 2 |
| MT | GREAT FALLS | 32.3 | 22.5 | -21 |
| ND | FARGO | 27.0 | 18.7 | -23 |
| NM | ALBUQUERQUE | 44.4 | 31.6 | 12 |
| NY | NEW YORK | 47.6 | 41.6 | 11 |
| NY | ROCHESTER | 39.9 | 32.6 | 1 |
| OH | COLUMBUS | 43.7 | 34.9 | 0 |
| PA | PITTSBURG | 42.3 | 34.2 | 1 |
| SD | SIOUX FALLS | 31.3 | 20.7 | -15 |
| UT | SALT LAKE CITY | 39.6 | 30.4 | 3 |
| VA | RICHMOND | 49.0 | 38.4 | 14 |
| WA | SEATTLE | 45.2 | 39.9 | 21 |
| WV | CHARLESTON | 45.9 | 35.3 | 7 |

Note: * For Permanent Heat Designs Use Outdoor Design

CHART 3

| DECEMBER TEMPERATURES | | | | |
|-----------------------|----------------|-----------------------|--------------------------|----------------------|
| STATE | CITY | NORMAL DAILY MEAN ° F | NORMAL DAILY MINIMUM ° F | * OUTDOOR DESIGN ° F |
| AK | ANCHORAGE | 17.5 | 11.4 | -23 |
| CO | DENVER | 30.3 | 16.4 | -5 |
| IA | DES MOINES | 24.9 | 16.7 | -10 |
| ID | BOISE | 30.6 | 24.1 | 3 |
| IL | CHICAGO | 27.4 | 20.4 | -8 |
| KY | LOUISVILLE | 37.6 | 29.9 | 5 |
| MA | BOSTON | 34.8 | 27.8 | 6 |
| MD | BALTIMORE | 36.7 | 27.3 | 10 |
| ME | PORTLAND | 27.6 | 29.5 | -6 |
| MI | DETROIT | 29.6 | 23.4 | 3 |
| MN | MINNEAPOLIS | 18.7 | 10.9 | -16 |
| MO | KANSAS CITY | 31.3 | 22.5 | 2 |
| MO | ST. LOUIS | 33.9 | 25.8 | 2 |
| MT | GREAT FALLS | 24.3 | 14.4 | -21 |
| ND | FARGO | 12.5 | 4.2 | -23 |
| NM | ALBUQUERQUE | 36.1 | 24.2 | 12 |
| NY | NEW YORK | 37.9 | 32.0 | 11 |
| NY | ROCHESTER | 29.4 | 22.7 | 1 |
| OH | COLUMBUS | 33.5 | 25.9 | 0 |
| PA | PITTSBURG | 32.5 | 25.3 | 1 |
| SD | SIOUX FALLS | 18.3 | 7.8 | -15 |
| UT | SALT LAKE CITY | 30.2 | 22.4 | 3 |
| VA | RICHMOND | 40.4 | 31.1 | 14 |
| WA | SEATTLE | 40.7 | 35.9 | 21 |
| WV | CHARLESTON | 37.5 | 28.2 | 7 |

Note: * For Permanent Heat Designs Use Outdoor Design

CHART 4

| JANUARY TEMPERATURES | | | | |
|----------------------|----------------|-----------------------|--------------------------|----------------------|
| STATE | CITY | NORMAL DAILY MEAN ° F | NORMAL DAILY MINIMUM ° F | * OUTDOOR DESIGN ° F |
| AK | ANCHORAGE | 15.8 | 9.3 | -23 |
| CO | DENVER | 29.7 | 15.2 | -5 |
| IA | DES MOINES | 20.4 | 11.7 | -10 |
| ID | BOISE | 30.2 | 23.6 | 3 |
| IL | CHICAGO | 21.0 | 14.3 | -8 |
| KY | LOUISVILLE | 33.0 | 24.9 | 5 |
| MA | BOSTON | 28.6 | 22.1 | 6 |
| MD | BALTIMORE | 32.3 | 23.5 | 10 |
| ME | PORTLAND | 20.8 | 12.5 | -6 |
| MI | DETROIT | 22.9 | 17.8 | 3 |
| MN | MINNEAPOLIS | 11.8 | 4.3 | -16 |
| MO | KANSAS CITY | 25.7 | 17.8 | 2 |
| MO | ST. LOUIS | 29.6 | 21.2 | 2 |
| MT | GREAT FALLS | 21.7 | 11.3 | -21 |
| ND | FARGO | 6.8 | -2.3 | -23 |
| NM | ALBUQUERQUE | 35.7 | 23.8 | 12 |
| NY | NEW YORK | 31.2 | 26.5 | 11 |
| NY | ROCHESTER | 23.9 | 16.6 | 1 |
| OH | COLUMBUS | 28.3 | 20.3 | 0 |
| PA | PITTSBURG | 26.1 | 19.9 | 1 |
| SD | SIOUX FALLS | 14.0 | 2.9 | -15 |
| UT | SALT LAKE CITY | 27.9 | 21.3 | 3 |
| VA | RICHMOND | 36.4 | 27.6 | 14 |
| WA | SEATTLE | 41.3 | 35.9 | 21 |
| WV | CHARLESTON | 33.4 | 24.2 | 7 |

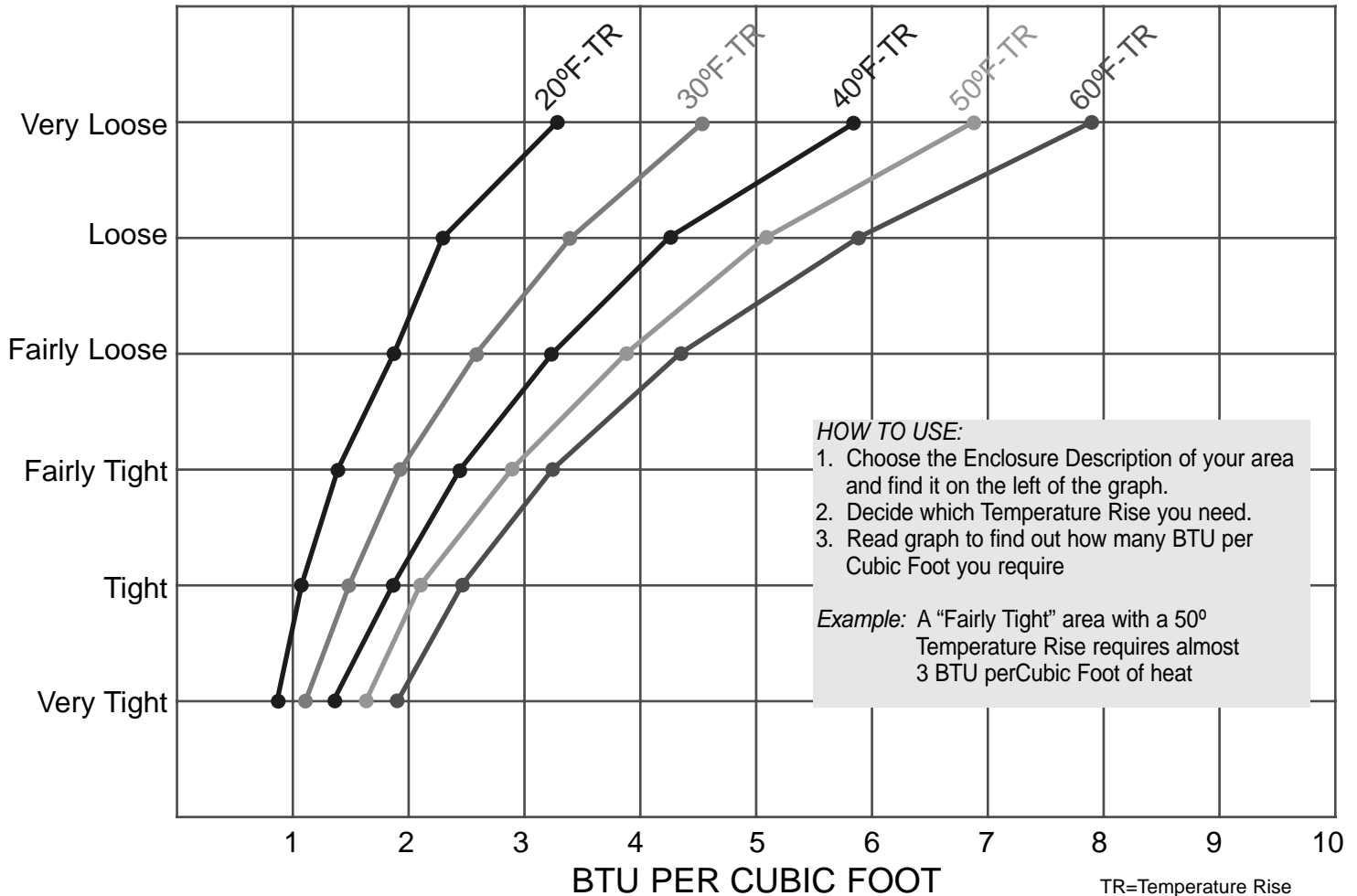
Note: * For Permanent Heat Designs Use Outdoor Design

+V+V+V+

| FEBRUARY TEMPERATURES | | | | |
|-----------------------|----------------|-----------------------|--------------------------|----------------------|
| STATE | CITY | NORMAL DAILY MEAN ° F | NORMAL DAILY MINIMUM ° F | * OUTDOOR DESIGN ° F |
| AK | ANCHORAGE | 18.7 | 11.7 | -23 |
| CO | DENVER | 31.7 | 19.1 | -5 |
| IA | DES MOINES | 26.6 | 17.8 | -10 |
| ID | BOISE | 36.7 | 28.8 | 3 |
| IL | CHICAGO | 27.0 | 19.2 | -8 |
| KY | LOUISVILLE | 37.6 | 28.5 | 5 |
| MA | BOSTON | 31.5 | 24.2 | 6 |
| MD | BALTIMORE | 35.5 | 26.1 | 10 |
| ME | PORTLAND | 24.8 | 15.6 | -6 |
| MI | DETROIT | 27.2 | 20.0 | 3 |
| MN | MINNEAPOLIS | 20.1 | 11.8 | -16 |
| MO | KANSAS CITY | 33.0 | 23.3 | 2 |
| MO | ST. LOUIS | 35.4 | 26.5 | 2 |
| MT | GREAT FALLS | 26.4 | 15.1 | -21 |
| ND | FARGO | 14.1 | 5.4 | -23 |
| NM | ALBUQUERQUE | 41.4 | 28.2 | 12 |
| NY | NEW YORK | 34.8 | 28.3 | 11 |
| NY | ROCHESTER | 25.3 | 17.3 | 1 |
| OH | COLUMBUS | 32.0 | 23.5 | 0 |
| PA | PITTSBURG | 30.5 | 22.3 | 1 |
| SD | SIOUX FALLS | 20.8 | 10.1 | -15 |
| UT | SALT LAKE CITY | 34.5 | 25.5 | 3 |
| VA | RICHMOND | 39.5 | 29.7 | 14 |
| WA | SEATTLE | 43.3 | 37.2 | 21 |
| WV | CHARLESTON | 36.9 | 26.7 | 7 |

Note: * For Permanent Heat Designs Use Outdoor Design

CHART 6 Heat Requirement Estimator
Building Condition vs. BTU/CUBIC FOOT



ENCLOSURE DESCRIPTION

The heat requirement calculator provides general guidelines and is based upon a temperature rise from 20° - 60°F. On-the-job-site experience is a factor in final estimates. A job log is helpful for comparison of the estimates and final requirements, and further facilitates similar structure estimates.

Heating requirements are governed by the type of temporary enclosure that exists. Less heat is required for a tight enclosure.

Additional heating capacity is necessary to reach the desired temperature of a frozen space. The amount of frost in a structure determines the additional heating capacity, which can be terminated when frost and water vapor are no longer factors.

VERY TIGHT

Structural enclosure - windows, doors, and elevators installed, walls exist (not dry-walled) -no partitioning*

TIGHT

Structural enclosure - windows, doors, and elevators installed, walls exist (not dry-walled) -medium partitioning*

FAIRLY TIGHT

Structural enclosure - tight roof and completed walls without insulation, window and door openings enclosed with canvas or plastic - medium to heavy partitioning*

**When heat is supplied from the beginning of the heating season, or if a space is well heated, partitioning isn't a vital factor.*

FAIRLY LOOSE

Structural enclosure - tight roof and nearly completed walls; door, window and other openings covered with plastic or canvas - medium partitioning*

LOOSE

Structural enclosure - tight roof and nearly completed walls; door, window and other openings covered with plastic or canvas - heavy partitioning*

VERY LOOSE

Structural enclosure - tight roof, sheet plastic or canvas walls - space is clear of significant partitioning*

CHART 7

| NATURAL GAS QUICK REFERENCE HOSE CHART | | | | | | | | | | | | | | |
|--|---------|------|---------|------|-----------|------|--------------------|-------|-----------|-------|-----------|-------|----------|-------|
| Hose Length in Feet | 400,000 | | 750,000 | | 1 Million | | BTU 1.5 Million | | 2 Million | | 3 Million | | 4million | |
| | 2PSI | 5PSI | 2PSI | 5PSI | 2PSI | 5PSI | 2PSI | 5PSI | 2PSI | 5PSI | 2PSI | 5PSI | 2PSI | 5PSI |
| 10 | 3/4 | - | 3/4 | - | 3/4 | 3/4 | 3/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 1-1/4 |
| 25 | 3/4 | - | 3/4 | - | 3/4 | 3/4 | 3/4 | 3/4 | 1-1/4 | 1-1/4 | 1-1/4 | 1-1/4 | 1-1/4 | 1-1/4 |
| 35 | 3/4 | - | 3/4 | - | 3/4 | 3/4 | 3/4 | 3/4 | 1-1/4 | 1-1/4 | 1-1/4 | 1-1/4 | - | 1-1/4 |
| 50 | 3/4 | - | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 1-1/4 | - | 1-1/4 | - | 1-1/4 |
| 75 | 3/4 | - | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 1-1/4 | - | 1-1/4 | - | - |
| 100 | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 1-1/4 | - | 1-1/4 | - | 1-1/4 | - | - |
| 125 | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 1-1/4 | - | 1-1/4 | - | - | - | - |
| 150 | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 1-1/4 | - | 1-1/4 | - | - | - | - |
| 175 | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 1-1/4 | - | 1-1/4 | - | - | - | - |
| 200 | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 1-1/4 | - | 1-1/4 | - | - | - | - |
| 225 | 3/4 | - | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 1-1/4 | - | 1-1/4 | - | - | - | - |

Consult figure for applications outside these pressures and hose sizes

CHART 7-1

| VAPOR PROPANE QUICK REFERENCE HOSE CHART | | | | | | | | | | | | | | |
|--|---------|-------|---------|-------|-----------|-------|--------------------|-------|-----------|-------|-----------|-------|----------|-------|
| Hose Length in Feet | 400,000 | | 750,000 | | 1 Million | | BTU 1.5 Million | | 2 Million | | 3 Million | | 4million | |
| | 1/2PSI | 10PSI | 1/2PSI | 10PSI | 1/2PSI | 10PSI | 1/2PSI | 10PSI | 1/2PSI | 10PSI | 1/2PSI | 10PSI | 1/2PSI | 10PSI |
| 10 | 3/4 | 3/4 | 3/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 |
| 25 | 3/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 |
| 35 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 |
| 50 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 3/4 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 |
| 75 | 1-1/4 | 3/4 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |
| 100 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |
| 125 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |
| 150 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |
| 175 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |
| 200 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |
| 225 | 1-1/4 | 3/4 | - | 3/4 | - | 3/4 | - | 1-1/4 | - | 3/4 | - | 1-1/4 | - | 1-1/4 |

Consult figure for applications outside these pressures and hose sizes

CHART 8

| VAPORIZATION RATES IN BTUH @ 0 DEG. F | | | | | | | |
|---------------------------------------|----------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|
| TANK SIZE | NUMBER OF TANKS MANIFOLDED | PERCENTAGE OF TANK FILLED | | | | | |
| | | 10% | 20% | 30% | 40% | 50% | 60% |
| 250 | 1 | 126,900 | 169,200 | 197,400 | 225,600 | 253,800 | 282,000 |
| | 2 | 279,180 | 372,240 | 434,280 | 496,320 | 558,360 | 620,400 |
| | 3 | 486,027 | 648,036 | 756,042 | 864,048 | 972,054 | 1,080,060 |
| 325 | 1 | 160,650 | 214,200 | 249,900 | 285,600 | 321,300 | 357,000 |
| | 2 | 353,430 | 471,240 | 549,780 | 628,320 | 706,860 | 785,400 |
| | 3 | 615,289 | 820,386 | 957,117 | 1,093,848 | 1,230,579 | 1,368,842 |
| 500 | 1 | 198,135 | 264,180 | 308,212 | 352,240 | 396,270 | 440,300 |
| | 2 | 435,897 | 581,196 | 687,066 | 774,928 | 871,794 | 968,660 |
| | 3 | 758,857 | 1,011,809 | 1,180,451 | 1,349,079 | 1,517,714 | 1,686,349 |
| 850 | 1 | 304,425 | 405,900 | 473,550 | 541,200 | 608,850 | 676,500 |
| | 2 | 669,735 | 892,980 | 1,041,810 | 1,190,640 | 1,339,470 | 1,488,300 |
| | 3 | 1,165,947 | 1,554,597 | 1,813,696 | 2,072,796 | 2,331,895 | 2,590,995 |
| 1000 | 1 | 354,240 | 472,320 | 551,040 | 629,760 | 708,480 | 787,200 |
| | 2 | 779,328 | 1,039,104 | 1,212,288 | 1,385,472 | 1,558,656 | 1,731,840 |
| | 3 | 1,356,739 | 1,808,985 | 2,110,483 | 2,411,980 | 2,713,478 | 3,014,976 |

NOTE: USE FOLLOWING MULTIPLIERS FOR OTHER AIR TEMPERATURES

- For -10°F multiply x 0.50
- For +10°F multiply x 1.5
- For +20°F multiply x 2.0
- For +40°F multiply x 3.0
- For +50°F multiply x 3.5
- For +60°F multiply x 4.0

CHART 9 TANK PRESSURES

| Temp. (F) | Approx. Pressure (PSIG)-Propane |
|-----------|---------------------------------|
| -40 | 3.6 |
| -30 | 8.0 |
| -20 | 13.5 |
| -10 | 20.0 |
| 0 | 28.0 |
| 10 | 37.0 |
| 20 | 47.0 |
| 30 | 58.0 |
| 40 | 72.0 |

NATURAL GAS

CHART 10 Capacity of pipe at less than 1.0 - psig inlet pressure in cubic feet of gas per hour
(based on a pressure drop of 0.5 in. w.c. and 0.6 sp gr gas in schedule - 40 pipe)

| IPS, nom., in. | EQUIVALENT PIPE LENGTH, FT. | | | | | | | | | |
|-------------------|-----------------------------|--------|--------|-------|-------|-------|-------|-------|-------|-------|
| | 50 | 100 | 150 | 200 | 250 | 300 | 400 | 500 | 1000 | 1500 |
| 1 | 244 | 173 | 141 | 122 | 109 | 99 | 86 | 77 | 54 | 44 |
| 1-1/4 | 537 | 380 | 310 | 268 | 240 | 219 | 189 | 169 | 119 | 97 |
| 1-1/2 | 832 | 588 | 480 | 416 | 372 | 339 | 294 | 263 | 185 | 151 |
| 2 | 1680 | 1188 | 970 | 840 | 751 | 685 | 594 | 531 | 375 | 306 |
| 2-1/2 | 2754 | 1952 | 1591 | 1379 | 1232 | 1123 | 974 | 869 | 617 | 504 |
| 3 | 5018 | 3549 | 2896 | 2509 | 2244 | 2047 | 1774 | 1587 | 1121 | 915 |
| 4 | 10510 | 7410 | 6020 | 5170 | 4640 | 4480 | 3660 | 3340 | 2360 | 1910 |
| 5 | 19110 | 13480 | 10960 | 9410 | 8440 | 8150 | 6660 | 6070 | 4290 | 3480 |
| 6 | 31140 | 21960 | 17860 | 15320 | 13760 | 13280 | 10860 | 9890 | 7000 | 5670 |
| 8 | 63310 | 44740 | 36380 | 31220 | 28020 | 27040 | 22120 | 20150 | 14250 | 11550 |
| 10 | 113020 | 79720 | 64830 | 55630 | 49940 | 48180 | 39420 | 35920 | 25400 | 20580 |
| 12 | 177450 | 125180 | 101790 | 87350 | 78400 | 75650 | 61900 | 56400 | 39890 | 32320 |

CHART 10-1 Capacity of pipe at 1.0 - psig inlet pressure in cubic feet of gas per hour
(based on a pressure drop of 0.1 psig and 0.6 sp gr gas in schedule - 40 pipe)

| IPS, nom., in. | EQUIVALENT PIPE LENGTH, FT. | | | | | | | | | |
|-------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| | 50 | 100 | 150 | 200 | 300 | 400 | 500 | 1000 | 1500 | |
| 1 | 740 | 520 | 430 | 370 | 300 | 260 | 230 | 170 | 130 | |
| 1-1/4 | 1540 | 1090 | 890 | 760 | 630 | 540 | 490 | 350 | 280 | |
| 1-1/2 | 2330 | 1650 | 1350 | 1160 | 960 | 830 | 740 | 530 | 420 | |
| 2 | 4550 | 3210 | 2640 | 2260 | 1870 | 1610 | 1440 | 1040 | 830 | |
| 2-1/2 | 7330 | 5180 | 4250 | 3650 | 3020 | 2600 | 2320 | 1690 | 1340 | |
| 3 | 13100 | 9260 | 7600 | 6520 | 5400 | 4660 | 4160 | 3020 | 2400 | |
| 3-1/2 | 19320 | 13650 | 11210 | 9610 | 7960 | 6870 | 6130 | 4450 | 3540 | |
| 4 | 26980 | 19070 | 15650 | 13430 | 11120 | 9590 | 8560 | 6220 | 4940 | |
| 5 | 49340 | 34870 | 28620 | 24550 | 20330 | 17550 | 15660 | 11370 | 9030 | |
| 6 | 80560 | 56940 | 46740 | 40909 | 33210 | 28650 | 25580 | 18570 | 14760 | |

CHART 10-2 Capacity of pipe at 2.0 - psig inlet pressure in cubic feet of gas per hour
(based on a pressure drop of 0.2 psig and 0.6 sp gr gas in schedule - 40 pipe)

| IPS, nom., in. | EQUIVALENT PIPE LENGTH, FT. | | | | | | | | | |
|-------------------|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | 50 | 100 | 150 | 200 | 300 | 400 | 500 | 1000 | 1500 | 2000 |
| 1 | 1080 | 760 | 620 | 540 | 440 | 380 | 340 | 240 | 190 | 170 |
| 1-1/4 | 2250 | 1590 | 1300 | 1120 | 910 | 790 | 710 | 500 | 410 | 350 |
| 1-1/2 | 3410 | 2410 | 1970 | 1700 | 1390 | 1200 | 1070 | 760 | 620 | 530 |
| 2 | 6640 | 4700 | 3840 | 3310 | 2700 | 2350 | 2090 | 1480 | 1210 | 1040 |
| 2-1/2 | 10700 | 7580 | 6190 | 5340 | 4360 | 3790 | 3380 | 2390 | 1960 | 1690 |
| 3 | 19120 | 13540 | 11060 | 9540 | 7790 | 6770 | 6040 | 4280 | 3500 | 3020 |
| 3-1/2 | 28200 | 19970 | 16310 | 14070 | 11490 | 9980 | 8900 | 6310 | 5160 | 4450 |
| 4 | 39380 | 27890 | 22780 | 19650 | 16040 | 13940 | 12440 | 8810 | 7210 | 6220 |
| 5 | 72010 | 50990 | 41650 | 35930 | 29300 | 25490 | 22740 | 16120 | 13180 | 11370 |
| 6 | 117580 | 83270 | 68010 | 58670 | 47900 | 41630 | 37140 | 26320 | 21520 | 18570 |

CHART 10-3 Capacity of pipe at 5.0 - psig inlet pressure in cubic feet of gas per hour
(based on a pressure drop of 0.5 psig and 0.6 sp gr gas in schedule - 40 pipe)

| IPS, nom., in. | EQUIVALENT PIPE LENGTH, FT. | | | | | | | | |
|-------------------|-----------------------------|--------|--------|--------|-------|-------|-------|-------|-------|
| | 50 | 100 | 150 | 200 | 300 | 400 | 500 | 1000 | 1500 |
| 1 | 1860 | 1320 | 1070 | 930 | 760 | 660 | 590 | 410 | 340 |
| 1-1/4 | 3870 | 2740 | 2240 | 1930 | 1580 | 1370 | 1220 | 860 | 700 |
| 1-1/2 | 5860 | 4140 | 3390 | 2930 | 2390 | 2080 | 1850 | 1310 | 1060 |
| 2 | 11420 | 8070 | 6600 | 5710 | 4660 | 4050 | 3610 | 2550 | 2080 |
| 2-1/2 | 18400 | 13010 | 10640 | 9200 | 7510 | 6530 | 5820 | 4110 | 3350 |
| 3 | 32860 | 23240 | 19000 | 16430 | 13410 | 11660 | 10390 | 7340 | 5990 |
| 3-1/2 | 48480 | 34280 | 28030 | 24240 | 19780 | 17200 | 15330 | 10820 | 8840 |
| 4 | 67700 | 47880 | 39140 | 33850 | 27630 | 24020 | 21410 | 15120 | 12340 |
| 5 | 123790 | 87540 | 71570 | 61890 | 50530 | 43920 | 39160 | 27640 | 22570 |
| 6 | 202138 | 142950 | 116870 | 101060 | 82500 | 71720 | 63940 | 45140 | 36860 |

CHART 10-4 Capacity of pipe at 10.0 - psig inlet pressure in cubic feet of gas per hour
(based on a pressure drop of 1.0 psig and 0.6 sp gr gas in schedule - 40 pipe)

| IPS, nom., in. | EQUIVALENT PIPE LENGTH, FT. | | | | | | | | | |
|-------------------|-----------------------------|--------|--------|--------|--------|--------|--------|-------|-------|-------|
| | 50 | 100 | 150 | 200 | 300 | 400 | 500 | 1000 | 1500 | 2000 |
| 1 | 2930 | 2070 | 1690 | 1470 | 1190 | 1030 | 920 | 650 | 530 | 460 |
| 1-1/4 | 6090 | 4330 | 3520 | 3050 | 2490 | 2150 | 1920 | 1360 | 1110 | 960 |
| 1-1/2 | 9210 | 6530 | 5330 | 4620 | 3760 | 3260 | 2910 | 2060 | 1680 | 1460 |
| 2 | 17940 | 12720 | 10380 | 9000 | 7330 | 6360 | 5680 | 4020 | 3280 | 2840 |
| 2-1/2 | 28920 | 20500 | 16730 | 14510 | 11820 | 10250 | 9150 | 6480 | 5290 | 4580 |
| 3 | 51650 | 36610 | 29880 | 25920 | 21110 | 18300 | 16340 | 11570 | 9450 | 8190 |
| 3-1/2 | 76180 | 53990 | 44070 | 38240 | 31140 | 26990 | 24110 | 17070 | 13950 | 12080 |
| 4 | 106400 | 75410 | 61550 | 53410 | 43500 | 37700 | 33670 | 23850 | 19480 | 16870 |
| 5 | 194540 | 137890 | 112550 | 97650 | 79540 | 68940 | 61570 | 43600 | 35620 | 30860 |
| 6 | 317650 | 225150 | 183770 | 159450 | 129870 | 112560 | 100540 | 71200 | 58160 | 50390 |

CHART 10-5 Capacity of pipe at 20.0 - psig inlet pressure in cubic feet of gas per hour
(based on a pressure drop of 2.0 psig and 0.6 sp gr gas in schedule - 40 pipe)

| IPS, nom., in. | EQUIVALENT PIPE LENGTH, FT. | | | | | | | | | |
|-------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| | 50 | 100 | 150 | 200 | 300 | 400 | 500 | 1000 | 1500 | 2000 |
| 1 | 4900 | 3470 | 2810 | 2450 | 2000 | 1730 | 1550 | 1070 | 890 | 770 |
| 1-1/4 | 10190 | 7210 | 5840 | 5090 | 4160 | 3600 | 3220 | 2230 | 1860 | 1610 |
| 1-1/2 | 15420 | 10900 | 8830 | 7710 | 6290 | 5450 | 4870 | 3370 | 2810 | 2440 |
| 2 | 30030 | 21230 | 17190 | 15010 | 12260 | 10610 | 9490 | 6570 | 5480 | 4760 |
| 2-1/2 | 48390 | 34220 | 27710 | 24190 | 19750 | 17110 | 15290 | 10590 | 8830 | 7670 |
| 3 | 86420 | 61110 | 49490 | 43190 | 35280 | 30550 | 27310 | 18910 | 15770 | 13690 |
| 3-1/2 | 127480 | 90130 | 73000 | 63710 | 52040 | 45070 | 40280 | 27900 | 23270 | 20200 |
| 4 | 178040 | 125880 | 101950 | 88980 | 72680 | 62940 | 56260 | 38960 | 32500 | 28210 |
| 5 | 325530 | 230170 | 186410 | 162700 | 132890 | 115080 | 102870 | 71240 | 59420 | 51590 |
| 6 | 531530 | 375820 | 304370 | 265660 | 216990 | 187910 | 167980 | 116330 | 97030 | 84240 |

CHART 11

HOSE & PIPE SIZING - LIQUID PROPANE

| LIQUID PROPANE FLOW - GPH | LENGTH OF HOSE OR IRON PIPE (FEET) | | | | | | | | | | | | | | | |
|---------------------------|------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 1/4" | | 3/8" | | 1/2" | | 3/4" | | 1" | | 1 1/4" | | 1 1/2" | | 2" | |
| | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 | HOSE SCHED 40 | PIPE SCHED 80 |
| 10 | 729 | 416 | | | | | | | | | | | | | | |
| 15 | 324 | 185 | | | | | | | | | | | | | | |
| 20 | 182 | 104 | 825 | 521 | | | | | | | | | | | | |
| 40 | 46 | 26 | 205 | 129 | 745 | 504 | | | | | | | | | | |
| 60 | 20 | 11 | 92 | 58 | 331 | 224 | | | | | | | | | | |
| 80 | 11 | 6 | 51 | 32 | 187 | 127 | 735 | 537 | | | | | | | | |
| 100 | 7 | 4 | 33 | 21 | 119 | 81 | 470 | 343 | | | | | | | | |
| 120 | | | 23 | 15 | 83 | 56 | 326 | 238 | | | | | | | | |
| 140 | | | 15 | 9 | 61 | 41 | 240 | 175 | 813 | 618 | | | | | | |
| 160 | | | 13 | 8 | 47 | 32 | 184 | 134 | 623 | 473 | | | | | | |
| 180 | | | | | 37 | 25 | 145 | 106 | 491 | 373 | | | | | | |
| 200 | | | | | 30 | 20 | 118 | 86 | 399 | 303 | | | | | | |
| 240 | | | | | 21 | 14 | 81 | 59 | 227 | 211 | | | | | | |
| 280 | | | | | 15 | 10 | 60 | 44 | 204 | 155 | | | | | | |
| 300 | | | | | 13 | 9 | 52 | 38 | 177 | 135 | 785 | 623 | | | | |
| 350 | | | | | | | 38 | 28 | 130 | 99 | 578 | 459 | | | | |
| 400 | | | | | | | 30 | 22 | 99 | 75 | 433 | 344 | 930 | 794 | | |
| 500 | | | | | | | 19 | 14 | 64 | 49 | 283 | 225 | 627 | 508 | | |
| 600 | | | | | | | | | 44 | 33 | 197 | 156 | 435 | 352 | | |
| 700 | | | | | | | | | 32 | 24 | 144 | 114 | 320 | 259 | | |
| 800 | | | | | | | | | 25 | 19 | 110 | 87 | 245 | 198 | 965 | 795 |
| 900 | | | | | | | | | 19 | 14 | 87 | 69 | 194 | 157 | 764 | 630 |
| 1000 | | | | | | | | | 16 | 12 | 71 | 56 | 157 | 127 | 618 | 509 |
| 1500 | | | | | | | | | | | 31 | 25 | 70 | 57 | 275 | 227 |
| 2000 | | | | | | | | | | | 18 | 14 | 39 | 32 | 154 | 127 |
| 3000 | | | | | | | | | | | 8 | 6 | 17 | 14 | 69 | 57 |
| 4000 | | | | | | | | | | | | | 10 | 8 | 39 | 32 |
| 5000 | | | | | | | | | | | | | | | 25 | 21 |
| 10000 | | | | | | | | | | | | | | | 6 | 5 |

TO USE CHART:

1. Having determined the required flow at point of use, locate this flow in the left hand column. If this falls between two figures, use the larger of the two.
2. Determine total length of piping required from source to point of use. Locate length in the center of this chart.
3. Read across chart from left (required flow) to right to find the total length which is equal to or exceeds the distance from the source to use.
4. From this point read up to find the correct size of pipe required

CHART 12

PIPE & TUBING SIZING - HIGH PRESSURE PROPANE SIZING BETWEEN FIRST AND SECOND STAGE REGULATOR

Maximum propane capacities listed are based on 2 psig pressure drop at 10 psig setting - Capacities in 1,000 Btu/Hr

| PIPE OR TUBING LENGTH FEET | TUBING SIZE, O.D., TYPE L | | | | | | NOMINAL PIPE SIZE, SCHEDULE 40 | | | | | | | | | |
|----------------------------|---------------------------|------|------|------|------|-------|--------------------------------|------|-------|-------|-------|-------|--------|--------|--------|--|
| | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | 1-1/8 | 1/2 | 3/4 | 1 | 1-1/4 | 1-1/2 | 2 | 2-1/2 | 3 | 4 | |
| 10 | 730 | 1700 | 3200 | 2300 | 8300 | 17000 | 3200 | 7500 | 12800 | 24000 | 40000 | 88000 | 133000 | 237500 | 489000 | |
| 20 | 500 | 1100 | 2200 | 3700 | 5800 | 12000 | 2200 | 4200 | 8800 | 18000 | 33000 | 61000 | 92500 | 165500 | 341000 | |
| 30 | 400 | 920 | 2000 | 2900 | 4700 | 9800 | 1800 | 4000 | 7200 | 14000 | 26000 | 49000 | 76500 | 136500 | 281000 | |
| 40 | 370 | 850 | 1700 | 2700 | 4100 | 8500 | 1600 | 3700 | 6800 | 13500 | 24000 | 46000 | 71000 | 127000 | 262000 | |
| 50 | 330 | 770 | 1500 | 2400 | 3700 | 7600 | 1500 | 3400 | 6300 | 12600 | 22500 | 43000 | 65000 | 116000 | 240000 | |
| 60 | 300 | 700 | 1300 | 2200 | 3300 | 7000 | 1300 | 3100 | 5600 | 12000 | 21700 | 40000 | 61000 | 109000 | 224000 | |
| 80 | 260 | 610 | 1200 | 1900 | 2900 | 6000 | 1200 | 2600 | 4900 | 10000 | 18000 | 34000 | 52000 | 93000 | 192000 | |
| 100 | 220 | 540 | 1000 | 1700 | 2600 | 5400 | 1000 | 2300 | 4300 | 9000 | 15000 | 31000 | 45500 | 81500 | 168000 | |
| 125 | 200 | 490 | 900 | 1400 | 2300 | 4800 | 900 | 2100 | 4000 | 7900 | 13500 | 28000 | 41500 | 74000 | 152500 | |
| 150 | 190 | 430 | 830 | 1300 | 2100 | 4400 | 830 | 1900 | 3600 | 7200 | 12600 | 25000 | 37000 | 66500 | 137000 | |
| 175 | 170 | 400 | 780 | 1200 | 1900 | 4000 | 770 | 1700 | 3300 | 6700 | 11400 | 23500 | 34500 | 61500 | 127000 | |
| 200 | 160 | 380 | 730 | 1100 | 1800 | 3800 | 720 | 1500 | 3100 | 6200 | 10600 | 22000 | 32000 | 57500 | 119000 | |

To convert to capacities at 5 psig settings - Multiply by 0.879
 To convert to capacities at 15 psig settings - Multiply by 1.130
 To convert to capacities at 20 psig settings - Multiply by 1.185

To convert to capacities at 30 psig settings - Multiply by 1.345
 To convert to capacities at 40 psig settings - Multiply by 1.488
 To convert to capacities at 50 psig settings - Multiply by 1.618

CHART 13

| SECOND STAGE SERVICE REGULATOR (11SV08, 40SV06) FLOW RATE IN CFH | | | | | | | | |
|--|--------------|------------|-------|------|-------|------|------|------------|
| PRESSURE (PSI) | ORIFICE SIZE | | | | | | | |
| | 1/8" | 1/8"X3/16" | 3/16" | 1/4" | 5/16" | 3/8" | 1/2" | 1/2"X9/16" |
| 1 | | | | 190 | 270 | 280 | 550 | 575 |
| 2 | | 190 | 220 | 300 | 430 | 450 | 820 | 860 |
| 3 | 160 | 215 | 300 | 380 | 550 | 560 | 1030 | 1080 |
| 5 | 230 | 280 | 390 | 550 | 710 | 740 | 1230 | 1310 |
| 10 | 370 | 390 | 600 | 820 | 1050 | 1130 | 1650 | 1680 |
| 15 | 460 | 525 | 800 | 1070 | 1340 | 1460 | | |
| 20 | 610 | 700 | 1000 | 1320 | 1630 | 1800 | | |
| 30 | 800 | 890 | 1340 | 1750 | 1950 | | | |
| 40 | 1030 | 1150 | 1750 | 2050 | | | | |
| 50 | 1200 | 1300 | 2010 | 2300 | | | | |
| 60 | 1310 | 1425 | 2250 | 2500 | | | | |
| 80 | 1900 | 2000 | 2580 | | | | | |
| 100 | 2200 | 2275 | 2700 | | | | | |
| 125 | 2200 | 2275 | 2900 | | | | | |

NOTE: USE 1050 BTU PER CFH FOR NATURAL GAS
USE 2476 BTU PER CFH FOR PROPANE

11SV08 REGULATOR COMES STANDARD WITH 1/2" ORIFICE
40SV06 REGULATOR COMES STANDARD WITH 1/4" ORIFICE

CHART 14

| MINIMUM SUPPLY VOLTAGES | | | | | | |
|-------------------------|-------|-----------|-----------------|--------------|--------------|--------------|
| MODEL | HP | KW | NAME PLATE AMPS | 120V NOMINAL | 240V NOMINAL | 480V NOMINAL |
| S405 | 1/4 | 2.9 | 12 | 105 | | |
| 1800 - 1801 | 1 | 5 | 20 | 105 | | |
| 1500 - 1505 | 1 | 5 | 20 | 105 | | |
| 2000 | 1 | 5 | 20 | 105 | | |
| S2000 - S2200 | 5 | 16.5/9.9 | 20 | | 208 | 440 |
| 2730C 1 PHASE | 3 | 11.5 | 30 | | 208 | |
| 2730C 3 PHASE | 3 | 6.5 | 15 | | 208 | |
| 2730C 3 PHASE | 3 | 5.9 | 10 | | | 440 |
| 3050 1 PHASE | 5 | 16.5 | 30 | | 208 | |
| 3050 3 PHASE | 5 | 10.8 | 20 | | 208 | |
| 3050 3 PHASE | 5 | 9.9 | 15 | | | 440 |
| 4210 1 PHASE | 10 | 27.4 | 60 | | 208 | |
| 4210/4215/4220 3 PHASE | 15 | 27.4/25 | 50 | | 208 | 440 |
| 4210/4215/4220 3 PHASE | 20 | 37.4/34.3 | 60 | | 208 | 440 |
| VF400 | 0.871 | 3.7 | 10 | 105 | | |
| VG400 | 0.871 | 3.7 | 10 | 105 | | |
| VF1000 | 5 | 19 | 30 | | 208 | |
| VG1000 | 5 | 19 | 30 | | 208 | |
| P1800 1 PHASE | 1/10 | 18/12 | 75/50 | | 208 | |
| P1800 3 PHASE | 1/10 | 18/12 | 50/34 | | 208 | |
| P4000 3 PHASE | 1/3 | 40/32/16 | 50 | | | 440 |
| P6000 3 PHASE | 1/3 | 60/48/24 | 75 | | | 440 |

| Wire Size Resistance Chart | | |
|----------------------------|----------|---------------------|
| #6 | 0.000403 | Resistance per Foot |
| #8 | 0.000641 | Resistance per Foot |
| #10 | 0.00102 | Resistance per Foot |
| #12 | 0.00162 | Resistance per Foot |
| #14 | 0.00258 | Resistance per Foot |
| #16 | 0.00409 | Resistance per Foot |
| #18 | 0.00651 | Resistance per Foot |

* These voltages are a minimum. Cold weather can also reduce the amount of voltage. If you are close to these minimums you need to increase wire size or shorten length of cord. Be aware of what power is at source.

To determine voltage drop, the formula is
amps x resistance = voltage drop

Example: 2730C 1 phase 30 amp
Minimum Voltage Required=208V
150 ft x 18 gauge wire (.00651) = .9765
30 amps x .9765 = 29.29 voltage drop
220v (at source) - 29.29 = 190.71volts
Conclusion: Heater will not run, wire too small or cord too long

Options to correct the situation

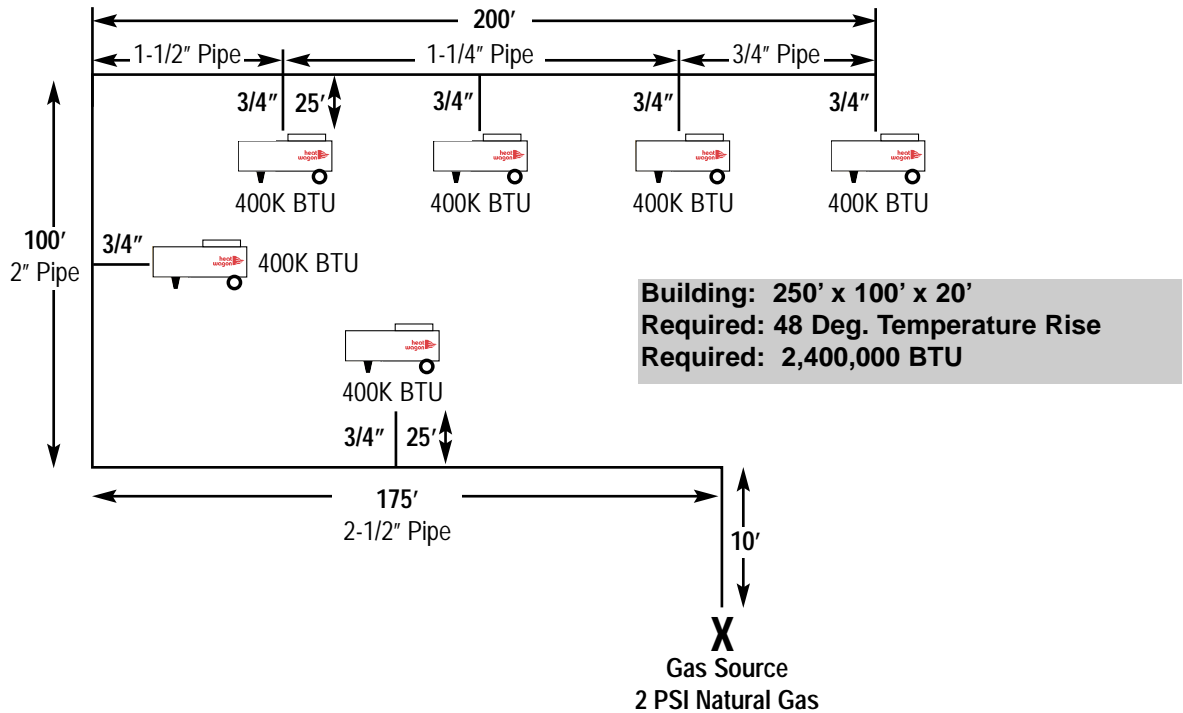
- Increase gauge of wire
Try 14 gauge wire
150 ft. x 14 gauge wire(.00258) = .3870
30 amps x .3870 = 11.61 voltage drop
220v - 11.61 = 208.39 volts
Conclusion: Heater will run, although still might be a problem because of cold weather conditions

Options to correct the situation

- Reduce cord length
Try 50 feet
50 ft. x 18 gauge wire(.00651) = .3255
30 amps x .3255 = 9.765 voltage drop
220v - 9.765 = 210.24 volts
Conclusion: Heater will run

TOTAL GAS LOAD

When determining hose and piping requirements, add all heaters flow requirements on a system for total gas load. In the following Figure use the total gas load, at the available pressure at the source, to determine hose or pipe size.



BULK TANK PLACEMENT

When using propane as a fuel and particularly as a liquid, the tanks should be positioned as shown. This should reduce oil's in propane entering the heater and pouring components. An additional safeguard called a drip leg can be made to place in the heater pipe train.

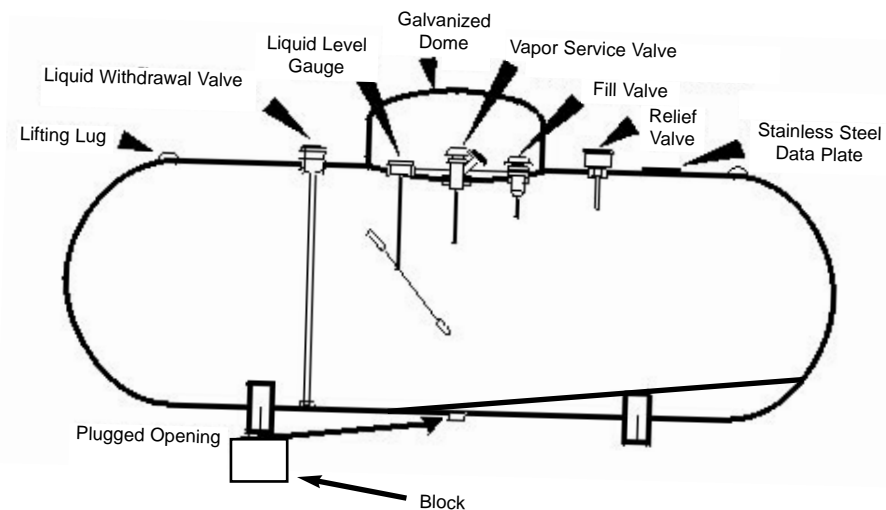


CHART 15

| NATURAL GAS CONSUMPTION | | | | | |
|-------------------------|-----------------|----------|---------------------|----------|--|
| | THERMS PER HOUR | | THERMS/24 HR PERIOD | | |
| | HIGH FIRE | LOW FIRE | HIGH FIRE | LOW FIRE | |
| S405 | 4 | | 96 | | |
| S1505 | 15 | 8 | 360 | 192 | |
| S2200 | 22 | 9.5 | 528 | 228 | |
| 1800S | 7.5 | | 180 | | |
| 1801 | 7.5 | | 180 | | |
| 2000 | 10 | | 240 | | |
| 2730 | 20 | 5 | 480 | 120 | |
| 3050 | 35 | 15 | 840 | 360 | |
| 4210 | 50 | | 1200 | | |
| 4215 | 60 | | 1440 | | |
| 4220 | 70 | | 1680 | | |
| GP400IDF | 4 | | 96 | | |
| GP1100IDF | 10 | | 240 | | |
| VG400 | 4 | | 96 | | |
| VG1000 | 10 | | 240 | | |

NOTE: 100,000 BTU PER THERM
 NOTE: 1 THERM = 100 CUBIC FT

CHART 16

| PROPANE FUEL CONSUMPTION | | | | | |
|--------------------------|------------------|----------|------------------------|----------|--|
| | GALLONS PER HOUR | | GALLONS/24 HOUR PERIOD | | |
| | HIGH FIRE | LOW FIRE | HIGH FIRE | LOW FIRE | |
| S405 | 4.4 | | 105.6 | | |
| S1505 | 16.0 | 8.8 | 393.0 | 211.2 | |
| S2200 | 24.2 | 10.45 | 580.8 | 250.8 | |
| 1800S | 8.3 | | 198.0 | | |
| 1801 | 8.3 | | 198.0 | | |
| 2000 | 11.0 | | 264.0 | | |
| 2730 | 22.0 | 5.5 | 528.0 | 132 | |
| 3050 | 38.5 | 16.5 | 924.0 | 396 | |
| 4210 | 55.0 | | 1320.0 | | |
| 4215 | 66.0 | | 1584.0 | | |
| 4220 | 77.0 | | 1848.0 | | |
| GP400IDF | 4.4 | | 105.6 | | |
| GP1100IDF | 11.0 | | 264.0 | | |
| VG400IDF | 4.4 | | 105.6 | | |
| VG1000IDF | 11.0 | | 264.0 | | |

NOTE: PROPANE 91,960 BTU PER GALLON
 NOTE: 1.1 GAL PER HOUR PER 100,000 BTU



TEMPORARY HEATING ESTIMATING WORK SHEET SINGLE FLOOR APPLICATION

Cubic Feet _____ Enclosure (page 13) _____
 Outdoor Temp _____ °F BTU/Cubic Foot _____
 Indoor Temp _____ °F Cubic Feet x BTU/Cubic Ft. _____ BTU
 Temperature Rise _____ °F Cubic Feet ÷ 60= _____ CFM

Fuel:

Nat Gas _____ w.c. or psi Pressure @ Source
Inches wc/psi

Propane _____ Pressure @ Source

Fuel Oil _____ Grade Power Cable _____

Distance Heat From Source: _____

Electric Power: Phase _____ Volt _____

Distance Power To Heater: _____

Recommended Specs

| Qty. | Model | BTUH | Power | Hose/Pipe Dia. | Power Cable Size | Tank Size | |
|-------|-------|-------|-------|-------------------|---------------------|---------------|---------------|
| | | | | | | V.P. (gal) | L.P. (gal) |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ | _____ | _____ | _____ | _____ |

FUEL CONSUMPTION

Model _____

GPM or CFH _____

(CFH x 100,000 = THERM)

Fuel Cost per GPM/THERM _____

Rental Period (in days) _____

Maximum fuel use per day
in GPM or THERMS (page 21) _____

Max. fuel use per rental period _____

Estimated Fuel Cost _____

Note: Most contractors experience less than 60% of maximum fuel consumption

POWER CONSUMPTION

*KWH/Day (page 19) _____

KWH in rental period _____

Cost per KWH _____

Estimated Power Cost _____

Recommend hose or pipe diameter _____

Recommend power cable size _____

Recommend bulk tank for vapor propane _____

Recommend bulk tank for liquid propane _____

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**Assuming 24 hour/day operation*

SUMMARY OF COSTS

Heater purchase or rental _____

Accessory purchase or rental _____

Estimated fuel cost _____

Estimated power cost _____

TOTAL