

Questar Gas Company

Good Practices for
Gas Piping
and
Appliance Installations

QUESTAR
Gas

GREEN STICKER

The proper installation and adjustments of a natural gas appliance is the responsibility of the installer. This book contains tables listing the Btu content (heat value) and specific gravity of gas, deration factors and altitudes throughout Questar's service area. When natural gas space heaters (furnaces, boilers, etc.) and water heating equipment installations have been completed and properly adjusted for the heat value of the gas and derated for altitude according to the manufacturer's installation instructions, the installer shall fill out and post a "GREEN STICKER" on the appliance where it will be visible by the customer. The green sticker is an identifier which will let the customer or a repairman know that the appliance has been properly adjusted.

Effective July 1, 2002, any contractor installing or servicing natural gas appliances in Utah must have a Natural Gas Technician Certification identification with them on the job site. Currently, the certification is not required by Journeyman Plumbers. For further information, contact Rocky Mountain Gas Association.

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SECTION I

(PREFACE)

GENERAL

The information contained in this booklet consists of guidance for plumbing and heating contractors engaged in the installation of gas-fired equipment in the area served by Questar Gas Company (the Gas Company).

Information contained herein has been extracted from local codes adopted and incorporated by local authorities into heating or plumbing ordinances or codes and hence mandatory; however, this booklet does not attempt to set forth all requirements of any such ordinances or codes. Questar Gas Company recommends all plumbing and heating contractors become thoroughly familiar with the requirements of the applicable ordinances or codes, contained in the International Fuel Gas Code, International Residential Code, International Mechanical Code, International Plumbing Code, National Electrical Code, American Gas Association standards, National Board of Fire Underwriters, as well as with the information contained herein so gas installations made by them will measure up to the proper standards of quality and workmanship.

QUESTAR GAS COMPANY 1-800-323-5517

Gas line breaks, leaks, odor or pressure problems ONLY
please call 1-800-541-2824

Additions and/or changes made to the Good Practice Book are indicated by a line in the right margin.

CONTENTS

SECTION I - GENERAL

<u>Paragraph</u>	<u>Page No.</u>
1. General Statement	7
2. Problems Not Covered by This Information	7
GENERAL SAFETY PRECAUTIONS	8
SECTION II - DEFINITIONS	9

SECTION III - GAS PIPING INSTALLATION

<u>Paragraph</u>	<u>Page No.</u>
1. Meter Location	26
2. Meter/Riser Protection	26
3. Service Connections	27
4. Piping Plan	29
5. Gas Piping Material	29
6. Plastic Piping Material	29
7. Corrugated Stainless Steel Tubing (CSST)	30
8. Workmanship and Defects	30
9. LP Gas	31
10. Installation of Gas Piping	31
11. Concealed Piping and Fittings	33
12. Shut-off Valves	33
13. Pressure Testing	34
14. Meter Spot Test	35
15. Appliance Connectors	36
16. Required Gas Supply	37
17. Required Gas Piping Size	38

SECTION IV - APPLIANCE INSTALLATION

<u>Paragraph</u>	<u>Page No.</u>
1. Accessibility and Clearances	46
2. Special Conditions Created by Mechanical Exhausting or Fireplaces	47
3. Installation in Garages	47
4. Hazardous and Prohibited Locations	48
5. Warm-Air Furnace	49
6. Vented Wall Furnaces	49
7. Floor Furnaces	49
8. Suspended Unit Heaters	49
9. Residential Boilers	50
10. Log Lighters	50
11. Unvented Room Heaters	50
12. Gas Logs (Decorative Appliances)	51
13. Water Heaters	51
14. Gas Ranges	52
15. Clothes Dryer	52
16. Commercial Clothes Dryer	53

SECTION V - COMBUSTION AND VENTILATION AIR

<u>Paragraph</u>	<u>Page No.</u>
1. Air for Combustion and Ventilation	54
2. Combustion Air Ducts	54
3. Louvers and Grilles	56
4. Adequate Volume	57
5. Appliances Located in Unconfined Spaces	58
6. Appliances Located in Confined Spaces	58
7. Outside Air	59

SECTION VI - VENTING

<u>Paragraph</u>	<u>Page No.</u>
1. Responsibility	65
2. Appliances Required to be Vented	65
3. Draft Hoods	65
4. Vent and Vent Connector Materials	65
5. Vent and Vent Connector Clearances	66
6. Vent Connectors	66
7. Vent Dampers	67
8. Sizing Vents/Connectors	68
9. Category I Venting	71
10. Category II, III, and IV Venting	71
11. Gas Vent Termination	72
12. Mechanical Draft Termination	73
13. Direct Vent Termination	73
14. Masonry Chimneys	74
15. Prohibited Locations	75

SECTION VII - CONTROLS AND REGULATORS

<u>Paragraph</u>	<u>Page No.</u>
1. Automatic Valves	80
2. Gas Pressure Regulators	80
3. MP Regulators	81
4. Venting of MP Regulators	81
5. Venting for Diaphragm Type Valves	82
6. Atmospheric Vents and Gas Vent Bleed or Relief Lines for Boilers (over 400,000 Btu) ANSICSD-1	82

SECTION VIII - PROCEDURES TO BE FOLLOWED TO
PLACE AN APPLIANCE IN OPERATION

<u>Paragraph</u>	<u>Page No.</u>
1. Procedure	84
2. Burners to be Adjusted	84
3. Appliance Rating	84
4. Clocking Burner Input	85
5. Adjusting Burner Input	91
6. Primary Air Adjustment	91
7. Automatic Pilots	91
8. Protective Devices	91
9. Checking the Draft	91
10. Instructions to the Customer	91
11. Operation/Installation Instructions	91

SECTION IX - MANUFACTURED HOME (MOBILE HOME),
MODULAR HOME, AND PARK TRAILER

<u>Paragraph</u>	<u>Page No.</u>
1. Manufactured Home	110
2. Modular Homes	110
3. Recreation Vehicle	112
4. Gas Piping	112
5. Venting	115
6. Appliance Installation	115
7. Conversion of Appliances Located in Mobile Homes	116
Formulas to know	117
INDEX	119-127

TABLES AND FIGURES

<u>Table</u>	<u>Page No.</u>
I Commercial Meter Spread	28
II Piping Support	32
III Meter Dial Test Times	35
IV Maximum Capacity of Pipe in CFH (4 oz.)	41
V Maximum Capacity of Pipe in CFH (2 lb.)	42
VI Corrugated Stainless Steel Tubing (CSST)	43
VII Duct Sizes Round	61
VIII Vent Sizes	70
IX Vent Termination	73
Vent Tables	76
X Standard Deration Factors	87-90
XI Pressure Factor Multiplier	93
XII Conversion of Inches of Water Column to Ounces of Gas Pressure	94
XIII Clocking Meter - Gas Input to Appliance in Cubic Feet Per Hour (4 ounce)	95-97
XIV Clocking Meter - Gas Input to Appliance in Cubic Feet Per Hour (2 pound)	99-100
XV Orifice Capacities	101-109

<u>Figure</u>	<u>Page No.</u>
1. Meter Set	27
2. Multiple Meter Set	28
3. CSST Bonding	37
4. Sizing a House Piping System	39
5. Volume of Space	57
6. Air Supply from Inside Building	59
7. Air Supply from Crawl Space	61
8. Air Supply from Attic	62
9. Air Supply - One Opening	63
10. Air Supply Horizontally	64
11. Vent Terminations	74
12. Automatic Valve	80
13. Combination LP-Gas and Natural Gas System	111
14. LP-Gas System	111
15. Manufactured Homes	104

GENERAL STATEMENT

1. Questar Gas Company is not responsible for the safe or proper installation of gas piping, equipment or appliances beyond its meter and does not, by the publication and distribution of this booklet, assume any such responsibility. However, if Questar Gas Company finds a gas-burning installation or appliance beyond its meter which it considers to be unsafe, it is authorized to refuse gas supply or gas service to such installation or appliance until the defect or condition which renders it unsafe is corrected.

All persons who are not authorized by Questar Gas Company are prohibited from connecting or disconnecting Questar Gas Company's meters or service pipes or in any way altering or interfering with Questar Gas Company's meters or service pipes. Upon receipt of notice Questar Gas Company will promptly attend to any work required in connection with its meters or service pipes. For connections requiring removal of the gas meter, contact Questar Gas Company for removal of the meter.

PROBLEMS NOT COVERED BY THIS INFORMATION

2. Architects, contractors, engineers, plumbers, heating contractors and fitters are invited to consult with Questar Gas Company on piping or appliance problems and industrial applications not covered by this information.

GENERAL SAFETY PRECAUTIONS

Before leaving any appliance installation or repair, the **installer** shall make certain all orifices, regulators or any other devices which limit gas quantities are so installed and adjusted so the appliance will be furnished gas in an amount not greater than the rated Btu per hour input of the appliance when properly derated for altitude when required.

Pipe and fittings shall never be tested for leaks with an open flame. Soap suds or a gas detecting device may be used.

Any gas piping found to be leaking must be shut off, except while testing for leaks. Under no circumstance shall workers leave premises without either stopping all leaks or shutting off the gas service.

If meters or service regulators are found to be leaking, Questar Gas Company shall be notified at once.

Before lighting pilots, make sure all valves have been turned off for several minutes and the appliance has been thoroughly purged of any unburned gas. When starting or inspecting any automatic gas appliance, special attention shall be given to pilots. Do not attempt to turn pilot lights too low. **Follow manufacturer's lighting instructions.**

Questar Gas Company welcomes inquiries and will be glad to instruct anyone in the method of calculation of heat input, pipe capacities or other technical requirements dealing with natural gas service.

NOTE: Manufacturer's installation instructions of all gas appliances shall be followed unless there is a conflict with local code.

SECTION II

DEFINITIONS

ACCESSIBLE - Having access to but which first may require the removal of an access panel, door or similar obstruction covering the item described.

AIR MIXER - That portion of an injection (Bunsen) type burner into which the primary air is introduced.

AIR SHUTTER - An adjustable device for varying the size of the primary air inlet or inlets.

AMBIENT TEMPERATURE - The surrounding or encompassing temperature.

A.G.A. - American Gas Association

APPLIANCE - A gas appliance is any device which utilizes gas fuel to produce heat, power or light.

APPLIANCE FUEL CONNECTOR - An assembly of listed and approved semi-rigid or flexible tubing and fittings to carry fuel between a fuel piping outlet and a fuel burning appliance.

APPROVED - As to materials, workmanship, and type of construction, means approved by the Administrative Authority as the result of investigation, inspection, or test conducted by a **recognized testing agency** or authority.

AUTOMATIC IGNITION - Automatic ignition shall be interpreted as means which provide for ignition of the gas at a burner when the gas burner valve controlling the gas to that burner is turned on, and will affect re-ignition if the flames of the gas to that burner have been extinguished by means other than closing the gas burner valve.

AUTOMATIC PILOT - Consists of an automatic pilot device and pilot burner securely assembled in fixed relationship.

AUTOMATIC PILOT DEVICE - A device employed with gas-burning equipment which will automatically shut off the gas supply to the burner being served by either direct or indirect means when the pilot flame is extinguished. The pilot burner may or may not be constructed integrally with the device.

BAFFLE - An object placed in an appliance to change the direction of or retard the flow of air, air-gas mixtures or flue gases.

BOILER

a. Low pressure hot-water heating: A boiler furnishing hot water at pressures not exceeding 160 pounds per square inch and at temperatures not exceeding 250° F.

b. Low pressure steam heating: A boiler furnishing steam at pressures not exceeding 15 pounds per square inch.

BOILER HORSE POWER - One boiler horse power equals approximately 42,500 Btu input.

BONDING - The permanent joining of metallic parts to form an electrically conductive path and continuity to safely conduct any current likely to be imposed.

BRANCH LINE - Gas piping which conveys gas from a supply line to the appliance.

BTU - (British Thermal Unit) The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

BURNER - A device for the final conveyance of the gas or a mixture of gas and air to the combustion zone.

- a. Power Burner: A burner in which either gas, air or both are supplied at pressures exceeding, for gas, the line pressure, and for air, atmospheric pressure; this added pressure being applied at the burner.
- b. Pressure Burner: A burner which is supplied with an air-gas mixture under pressure (usually from 0.5 in. to 14 in. of water column {w.c.} and occasionally higher).
- c. Primary Air Burner (Bunsen): The air introduced into a burner and which mixes with the gas before it reaches the port or ports.
- d. Secondary Air Burner (Luminous or Yellow Flame): A burner in which secondary air is depended on for the combustion of the gas.

CSST - Corrugated Stainless Steel Tubing - Used as an integral gas piping system.

CENTRAL HEATING GAS APPLIANCE - A gas appliance normally used as the primary means of heating premises. Ordinarily this includes gas boilers, warm air furnaces, and floor furnaces; but does not include unit heaters, room or space heaters, nor industrial gas boilers.

CHIMNEY, TYPE "A" - Chimneys or vents of masonry reinforced concrete, iron smoke stacks or listed factory all-fuel chimneys.

CIRCUIT -

- a. Parallel: One in which the current has two or more paths to follow.
- b. Series: One where the current has only one path to follow.

COMBUSTIBLE MATERIAL: Pertaining to materials adjacent to or in contact with heat-producing appliance vent connectors,

gas vents, chimneys, steam and hot water pipes, and warm air ducts, shall mean materials made of or surfaced with wood, compressed paper, plant fibers or other materials that will ignite and burn. Such materials shall be considered combustible, even though flame-proofed, fire retardant treated or plastered.

COMBUSTION - Refers to the rapid oxidation of fuel gases accompanied by the production of heat or heat and light.

COMBUSTION AIR - Air necessary for complete combustion of fuel.

CONCEALED - When placed in a finished building, would require removal of permanent construction to gain access.

CONDENSATE (CONDENSATION) - The liquid which separates from a gas (including flue gas) due to a reduction in temperature.

CONDENSING APPLIANCE - An appliance which condenses part of the water vapor generated by the burning of hydrogen in fuel by means of a secondary, recuperative, or condensing coil.

CONFINED SPACE - A room or space having a volume less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning appliances installed in that space.

CONTROL - A device designed to regulate the gas, air, water, and electrical supply to a gas appliance. It may be manual or automatic.

CONVERSION BURNER - A burner designed to supply gaseous fuel to an appliance originally designed to utilize another fuel.

CUBIC FOOT OF GAS (standard) - The amount of gas which would occupy one cubic foot when at a temperature of 60 degrees Fahrenheit, saturated with water vapor and under a pressure equivalent to that of 30 inches of mercury.

DAMPER - A valve or plate for regulating draft.

DECATHERM - Equal to 10 therms or 1,000,000 Btu.

DECORATIVE APPLIANCE - Vented appliance whose primary function is the appearance of the flame.

DEMAND - The maximum amounts of gas required per unit of time, usually expressed in cubic feet per hour or Btu per hour, required for the operation of the appliance or appliances supplied.

DILUTION AIR - Air which enters a draft hood and mixes with the flue gases.

DIRECT VENT APPLIANCE - Appliances which are so constructed and installed that all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

DRAFT HOOD - A device built into an appliance, or made a part of the flue or vent connector from an appliance, which is designed to: (1) ensure the ready escape of the products of combustion in the event of no draft, back draft, or blockage beyond the draft hood; (2) prevent a back draft from entering the appliance, and; (3) neutralize the effect of stack action of the vent or chimney upon the operation of the appliance.

ELEVATED PRESSURE - Pressure more than fourteen (14) inches of water column.

EQUIVALENT HYDRAULIC DIAMETER (EHD) - Measurement of the hydraulic efficiency between different tubing sizes. The higher the number EHD, the greater the capacity of tubing. This number is used when sizing corrugated stainless steel tubing (CSST).

EXCESS AIR - Air which passes through the combustion chamber and the appliance flues in excess of that which is theoretically required for complete combustion.

FLAME SAFE GUARD - A device designed to shut off fuel in the event of flame failure.

FLAMES -

- a. **Yellow, Luminous, or Non-Bunsen:** The flame produced by burning gas without any premixing of air with the gas.
- b. **Bunsen:** The flames produced by premixing some of the air required for combustion with the gas before it reaches the burner ports or point of ignition.

FLUE GASES - Products of combustion plus excess air in appliance flues or heat exchangers (before the draft hood or draft regulator).

FUEL LINE - The independent pipe from the meter to an appliance or appliances.

FURNACES -

- a. **GRAVITY-TYPE WARM-AIR FURNACE** - A warm-air furnace depending primarily on circulation of air through the furnace by gravity. This definition also includes any furnace approved with a booster-type fan which does not materially restrict free circulation of air through the furnace when the fan is not in operation.
- b. **FORCED AIR TYPE CENTRAL FURNACE** - A central furnace equipped with a fan or blower which provides the primary means for circulation of air.

- 1) Horizontal-type Central Furnace - A furnace designed for low headroom installations with air flow through the appliance in a horizontal path.
 - 2) Upflow-type Central Furnace - A furnace designed with air flow essentially in a vertical path, discharging air at or near the top of the furnace.
 - 3) Downflow-type Central Furnace - A furnace designed with air flow essentially in a vertical path, discharging air at or near the bottom of the furnace.
 - 4) Multi Position Furnace - A furnace designed to be installed upflow, downflow and horizontal.
- c. RECESSED FURNACE - A self-contained appliance complete with grilles or equivalent, designed for incorporation in or permanent attachment to a wall, floor, ceiling, or partition; either taking air for combustion from the space to be heated, or having a sealed combustion system the inlet and outlet of which communicates only with the outside air, and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing.

GAS HOSE - A gas conduit which depends for tightness on joint packing on any wall structure other than that formed by a continuous one-piece metal tubing member. Listed gas hose connectors shall be used in accordance with the terms of their listings.

GAS PIPING - Any installation of pipe, valves or fittings used to convey fuel gas, installed on any premises or in any building, but shall not include:

- 1) Any portion of the service piping.
- 2) Any approved piping connection 6 feet (1.8 m) or less in length between an existing gas outlet and a gas appliance in the same room with the outlet.

HAZARDOUS LOCATION - Any location considered to be a fire hazard for flammable vapors, dust and combustible material.

HEATING VALUE (TOTAL) - The number of British Thermal Units produced by the combustion at constant pressure of one cubic foot of gas when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all the necessary corrections have been applied.

HUD - Housing and Urban Development.

INDIVIDUAL MAIN BURNER VALVE - A valve which controls the gas supply to an individual main burner.

LEAK LIMITER - A device limiting the escape of gas from the regulator vent opening in the event of diaphragm failure.

LIMIT CONTROL - A device responsive to changes in pressure or temperature or liquid level for turning on, shutting off, or throttling the gas supply to an appliance.

LISTED - Appliance or material included in a list published by a nationally recognized testing laboratory, inspecting agency or other which specifies approval.

LOG LIGHTER - A manually operated solid fuel ignition appliance for installation in a vented solid fuel burning fireplace.

MAIN BURNER - A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the combustion zone, and on which combustion takes place to accomplish the function for which the appliance is designed.

MAIN BURNER CONTROL VALVE - A valve which controls the gas supply to the main burner manifold.

MAKE-UP AIR - Air being provided to replace air being exhausted.

MANIFOLD - The conduit of an appliance which supplies gas to the individual burners.

MANOMETER - Instrument for measuring gas pressure.

MANUAL MAIN SHUT-OFF VALVE - A manually operated valve in the gas line for the purpose of completely turning on or shutting off the gas supply to the appliance, except to pilot or pilots which are provided with independent shut-off valves.

MECHANICAL DRAFT SYSTEM - A device installed in and made a part of the vent which will provide a positive induced draft.

METER - An instrument installed to measure the volume of gas being delivered.

MICROAMPERE - One millionth of an ampere.

MILLIAMPERE - One thousandth of an ampere.

MILLIVOLT - One thousandth of a volt.

MIXER - The combination of mixer head, mixer throat and mixer tube.

- a. **Mixer Head:** That portion of an injection (Bunsen) type burner, usually enlarged, which primary air flows to mix with the gas stream.
- b. **Mixer Throat:** That portion of the mixer which has the smallest cross-sectional area and lies between the mixer head and the mixer tube.
- c. **Mixer Tube:** That portion of the mixer which lies between the throat and the burner head.

MP - Medium pressure - 1.5 psi - 60 psi.

OCCUPANCY-

- a. GROUP "A" - Group A occupancies include the use of a building or structure, or a portion thereof, for the gathering together of 50 or more persons for purposes such as civic, social or religious functions, recreation, education or instruction, food or drink consumption, or awaiting transportation. A room or space used for assembly purposes by less than 50 persons and accessory to another occupancy shall be included as part of that major occupancy. Assembly occupancies shall include the following:
- 1) Division 1. A building or portion of a building having an assembly room with an occupant load of 1,000 or more and a legitimate stage.
 - 2) Division 2. A building or portion of a building having an assembly room with an occupant load of less than 1,000 and a legitimate stage.
 - 3) Division 2.1. A building or portion of a building having an assembly room with an occupant load of 300 or more without a legitimate stage, including such buildings used for educational purposes and not classed as a Group B or E Occupancy.
 - 4) Division 3. A building or portion or a building having an assembly room with an occupant load of less than 300 without a legitimate stage, including such buildings used for educational purposes and not classed as a Group B or E Occupancy.
 - 5) Division 4. Stadium, reviewing stands and amusement park structure not included within other Group A occupancies. Specific and general requirements for grandstands,

bleachers and reviewing stands are to be found in Chapter 10 of the Building Code.

Exception: Amusement buildings or portions thereof which are without walls or a roof and constructed to prevent the accumulation of smoke in assembly area.

b. Group E Occupancies

- 1) Division 1. Any building used for educational purposes through the 12th grade by 50 or more persons for more than 12 hours per week or four hours in any one day.
- 2) Division 2. Any building used for educational purposes through the 12th grade by less than 50 persons for more than 12 hours per week or four hours in any one day.
- 3) Division 3. Any building or portion thereof used for day-care purposes for more than six persons

c. Group I Occupancies

- 1) Division 1.1. Nurseries for the full-time care of children under the age of six (each accommodating more than five children). Hospitals, sanitariums, nursing homes with non ambulatory patients and similar buildings (each accommodating more than five patients).
- 2) Division 1.2. Health-care centers for ambulatory patients receiving outpatient medical care which may render the patient incapable of unassisted self-preservation (each tenant space accommodating more than five such patients).
- 3) Division 2. Nursing homes for ambulatory patients and homes for children six years of age or over (each accommodating more than five patients or children).

- 4) Division 3. Mental hospitals, mental sanitariums, jails, prisons, reformatories and buildings where personal liberties of inmates are similarly restrained.

ODS - Oxygen Depletion Safety Shut-Off - A system designed to act to shut off the gas supply to the main and pilot burners if the oxygen in the surrounding atmosphere is reduced below a predetermined level.

OFFSET - Combination of approved bends making two changes in direction bringing one section of the vent out of line but into a line parallel with the other section.

ORIFICE - The opening in a cap, spud or other device whereby the flow of gas is limited and through which the gas is discharged to the burner.

ORIFICE CAP (HOOD) - A movable fitting having an orifice which permits adjustment of the flow of gas by the changing of its position with respect to a fixed needle or other device.

ORIFICE SPUD - A removable plug or cap containing an orifice which permits adjustment of gas flow either by substitution of a spud with a different sized orifice or by the motion of a needle with respect to it.

PB - Polybutylene, primarily use to pipe for potable water systems.

PILOT - A small flame which is utilized to ignite the gas at the main burner or burners.

PILOT GENERATOR - Several single thermocouples in a series to produce sufficient current required for the operation of a complete control system.

PLENUM - An air compartment or chamber including uninhabited crawl spaces, areas above a ceiling or below a floor, including air

spaces below raised floors of computer/data processing centers, or attic spaces, to which one or more ducts are connected and which forms part of either the supply-air, return-air or exhaust-air system other than the occupied space being conditioned.

POWER EXHAUSTER - A device installed in and made a part of the vent which will provide a positive induced draft.

PRESSURE DROP - The loss in pressure due to friction, valves, fittings or regulators.

PRESSURE RELIEF DEVICE - A pressure-actuated valve or rupture member designed to automatically relieve excessive pressure.

PURGE - To free a gas conduit of air, gas or a mixture of gas and air.

QUICK DISCONNECT DEVICE - A hand-operated device which provides a means for connecting and disconnecting an appliance or an appliance connector to a gas supply which is equipped with an automatic means to shut off the gas supply when the device is disconnected.

REGULATOR - A device for controlling and maintaining a uniform gas supply pressure.

RELIEF OPENING - The opening provided in a draft hood to permit the ready escape to the atmosphere of the flue products from the draft hood in the event of no draft, back draft, or stoppage beyond the draft hood, and to permit dilution air into the draft hood in the event of a strong chimney updraft.

ROOM HEATER - A self-contained, vented, gas-burning, air-heating appliance intended for installation in the space being heated and not intended for duct connection. This definition shall not include unit heaters, central heating gas appliances or garage heaters.

SECONDARY AIR - The air externally supplied to the flame at the point of combustion.

SEMI-RIGID TUBING - A gas conduit having semi-flexible metal wall structure.

SERVICE PIPING - The pipe which brings the gas from the main to the meter.

SHUT-OFF VALVE - A valve used in piping to control the gas supply to any section of a piping system or to an appliance.

SPECIFIC GRAVITY - As applied to gas, specific gravity is the ratio of the weight of a given volume to that of the same volume of air, both measured under the same conditions.

TEMPERATURE & PRESSURE RELIEF DEVICE - A temperature and pressure-actuated valve or rupture member designed to automatically relieve excessive temperature or pressure.

THERM - A quantity of heat equal to 100,000 Btu.

THERMOCOUPLE - Two wires, of dissimilar metals, welded at one end to form the hot junction. When the hot junction or end of thermocouple is placed in a gas flame an electrical current is generated simply by the application of heat to the junction of the two metals. The amount of current produced is basically dependent upon two factors, the type of metal used and the difference in temperature between the hot and cold junctions.

THERMOSTAT - An automatic device actuated by temperature changes, designed to control the gas supply to a burner, or burners in order to maintain temperatures between predetermined limits.

UNCONFINED SPACE - A room or space having a volume equal to at least 50 cubic feet per 1000 Btu/h of the aggregate input rating

of all fuel-burning appliances installed in that space. Rooms communicating directly with the space in which the appliances are installed, through openings not furnished with doors, are considered a part of the unconfined space.

UNIT HEATERS - A heating appliance designed for nonresidential space heating and equipped with an integral means for circulation of air.

UNUSUALLY TIGHT CONSTRUCTION - Construction where:

- a. Walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder with a rating of one perm or less with any openings gasketed or sealed, and
- b. Weather-stripping on openable windows and doors, and
- c. Caulking or sealants are applied to areas such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels and at penetrations for plumbing, electrical and gas lines and at other openings.

VENT - A listed factory-made vent pipe and vent fittings for conveying flue gases to the outside atmosphere that extends in a generally vertical direction.

VENTS -

- a. Type "A" Gas Vents: See Chimney, Type "A".
- b. Type "B" Gas Vents: Factory-made gas vents listed by a nationally recognized testing agency for use with appliances with draft hoods and other Category I appliances. Vent requires 1" clearance from combustibles.

- c. Type “C” Gas Vents: Unlisted single wall vent constructed of iron or aluminum that has not been tested by a testing agency and requires a minimum of 6" clearance from combustibles.
- d. Type “B-W” Gas Vents: Factory-made gas vents listed by a nationally recognized testing agency for venting listed or approved gas-fired vented recessed wall heaters.
- e. Type “L” Gas Vents: A venting system consisting of listed vent piping and fittings for use with oil-burning appliances listed for use with Type L or with listed gas appliances.
- f. Listed Single Wall Gas Vents: **When listed single wall vent material is used, clearances and installation shall be in accordance with the listing and the manufacturer’s installation instructions.**

VENT COLLAR - That portion of an appliance designed for the attachment of the draft hood or vent connector.

VENT CONNECTOR - That portion of the vent system which connects the gas appliance to the gas vent or chimney.

VENT SYSTEM - The gas vent or chimney and vent connector, if used, assembled to form a continuous open passageway from the gas appliance to the outside atmosphere for the purpose of removing flue gases.

VENTED APPLIANCE CATEGORIES -

- a. Category I - An appliance which operates with a non positive vent pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
- b. Category II - An appliance which operates with a non positive vent pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

- c. Category III - An appliance which operates with a positive vent pressure and with a vent gas temperature that avoids excessive condensate production in the vent.
- d. Category IV - An appliance which operates with a positive vent pressure and with a vent gas temperature that is capable of causing excessive condensate production in the vent.

VENTILATION AIR - Enough air to ventilate appliances to within safe operating temperature.

WATER HEATER -

- a. Automatic Instantaneous: The type which heats the water as it is drawn.
- b. Automatic Storage: The type which combines a water heating element and water storage tank, gas to the main burner being controlled by a thermostat.
- c. Circulating or Tank: Manually controlled type usually connected to the ordinary hot water tank.

SECTION III

GAS PIPING INSTALLATION

1. METER LOCATIONS: Questar Gas Company determines the location of its meters. Meters should be set outside for easy accessibility and service. Meters should not be set under roof valleys or other places where excessive amounts of water, snow or ice would drip from the roof onto the meter set and freeze. Ice and snow protection is required. Remote meter sets are discouraged.

Meters, when set inside, will be installed immediately adjacent to and in the same room where the gas service line enters the building. Meters will be placed where they will be easily accessible, not exposed to extreme heat sources and located at least 3 feet from any ignition source.

Meters are to be located in ventilated spaces accessible for examination, reading, replacement and maintenance.

Questar Gas recommends the service line riser, meter and regulator should be located 3 feet away from any permanent air intake into the building.

2. METER/RISER PROTECTION - Meter/Riser locations not requiring protection are preferred. If a customer insists on a location where damage to the meter is likely, meter protection will be required at the customer's expense.

Locations of specific concern are described as follows: service line risers on the driveway side of a structure where there is not at least 5 feet from the driveway to the building, proximity to roadways, alleyways, parking lots, dock areas, garage areas, and any other areas where vehicle accessibility would warrant a barrier.

3. **SERVICE CONNECTIONS:** All house piping should be extended to a point 14 inches on the right-hand side of the location provided for the gas service line and 30 inches above ground level. For multiple meter installations where two or more house lines terminate at a multiple meter set, they should be spaced not less than 10 inches nor more than 12 inches apart for each additional meter location and the fuel lines should extend 3 inches through the foundation. (See Figure 1, Page 27 and Figure 2, Page 28)

Gas piping at multiple meter installations shall be plainly marked by a metal tag or other permanent means attached to the pipe by the installing agency, designating the building or the part of the building being supplied. Apartments should be permanently and clearly marked before meters will be set.

METER SET

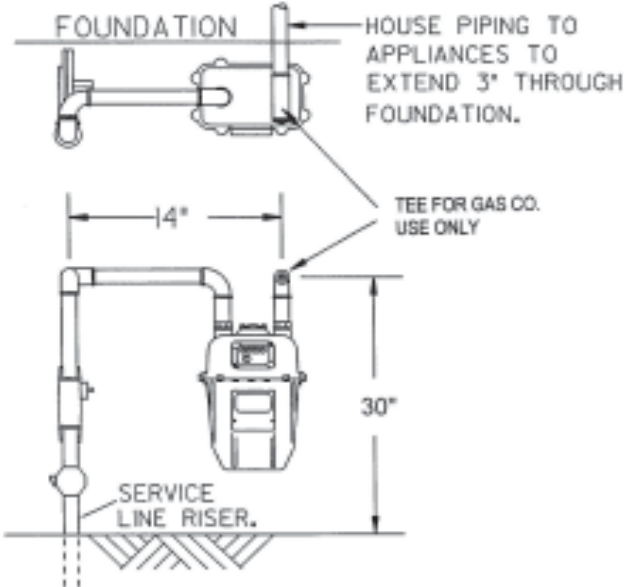


FIGURE 1

MULTIPLE METER SET

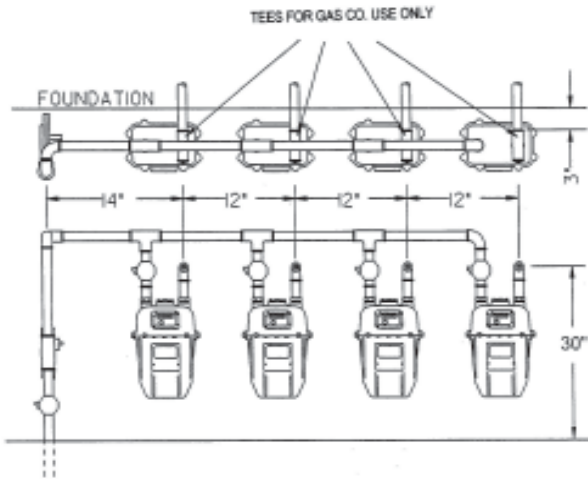


FIGURE 2

For commercial meter spread refer to Table I. For detailed information, contact Pre-construction Department.

COMMERCIAL METER SPREAD		
4 ounces - 5 pounds		
Any set larger than 10,000 CFH, contact Questar Gas for proper sizing.		
CONSUMPTION METER SPREAD PAD SIZE		
600 - 1,000 CFH	3 feet	2' x 3'
over 1,000 - 10,000	CFH 5 feet	3' x 4'

TABLE I

For large commercial or industrial installations consult Questar Gas Company for location of the service line, meter and fuel line.

4. PIPING PLAN: It is recommended before proceeding with the installation of a gas piping system a piping sketch or plan be prepared showing the proposed location of the piping as well as the pipe size of different branches. Adequate consideration should be given to future demands and provisions made for added gas service. If a piping plan is provided, Questar Gas Company will be glad to review it without charge or obligation.
5. GAS PIPING MATERIALS: These recommendations apply to all gas piping run on the customer's side of the meter. Since gas piping will form a permanent part of the building, inside and above ground piping shall be standard weight iron or steel (galvanized or black), malleable iron fittings and approved shut-off valves or corrugated stainless steel tubing system. For ferrous gas piping underground installation see Page 32.

Copper pipe or tubing shall not be installed in any piping for gas.

6. PLASTIC PIPING MATERIAL: Plastic polyethylene pipe materials and compression couplings must be approved for natural gas applications and must be installed underground. All plastic pipe and fittings must conform to ASTM D2513 (60 psi and above high density pipe approved 3408).

Plastic pipe must be joined by individuals qualified in the heat fusion method of connecting pipe and fittings or approved mechanical fittings. A minimum number 18 insulated yellow copper tracer wire shall be installed with underground non-metallic gas piping and shall terminate above grade at each end. Tracer wire shall not come in contact with plastic piping.

Risers and prefabricated risers inserted with plastic pipe shall conform to ASTM D2513, shall be metallic, have a space of 10 inches from the bottom of the service valve and grade, and shall be wrapped or coated to a point at least 6 inches above grade or protected in an approved manner. When a riser

connects underground to plastic pipe, the underground horizontal metallic portion of the riser shall extend at least 12 inches before connecting to the plastic pipe by means of an approved transition fitting, adapter or heat fusion. It is recommended an anodeless riser be used. If anode-type riser is used, a properly sized anode shall be installed.

Plastic pipe used underground for customer fuel lines must be approved polyethylene material and be buried a minimum of 12 inches. It shall not be used inside buildings or above ground. PVC (Polyvinyl Chloride) is not approved for piping systems in Questar Gas's service area. Individual gas lines (metallic or plastic) to single outside appliance (outside lights, grilles, etc.) shall be installed a minimum of 8 inches below grade, provided such installation is approved and installed in locations not susceptible to physical damage.

7. CORRUGATED STAINLESS STEEL TUBING (C.S.S.T.):

Approved corrugated stainless steel tubing may be used for gas piping provided it is part of a system where tubing and fittings have been tested and listed for such gas piping system. Installer shall be certified by the manufacturer's representative. System shall be installed as per manufacturer's installation instructions and local codes. All new installation of CSST piping systems are now required to be bonded to the electrical service grounding electrode system at the point where the gas service enters the building. The bonding requirements are intended to reduce the chances of damage to the CSST from lighting induced electric energy. Refer to Figure 3. For sizing a CSST system, use the manufacturer's installation instruction sizing charts or the IFGC CSST tables. Questar Gas will require that a manufacturer-approved termination plate will be installed anytime that CSST passes through a wall, floor, partition, etc.

8. WORKMANSHIP AND DEFECTS:

Gas piping shall be gas-tight and built along lines which are unlikely to cause physical injury to inhabitants or weakness in the building structure. All pipe shall be either new or be in good condition, adequate for use with natural gas, free from internal obstruction and burred ends reamed to the full bore of the pipe.

In no case is it acceptable to repair defects in pipe or fittings. The defective pipe, fitting or threaded joint having been located shall be removed and replaced with sound material.

9. LP GAS: When changing from LP gas to natural gas, the supply line from the LP gas tank must be disconnected and plugged before natural gas will be turned into the building.
10. INSTALLATION OF GAS PIPING: All joints in an iron piping system, unless welded, shall be threaded joints, having approved standard threads. Threaded joints shall be made up with approved pipe thread compound or teflon tape on male threads only.

Gas piping downstream of the point of delivery is no longer allowed to enter or exit a building at a point below grade. This requirement is intended to lessen the possibility of gas leakage entering a building through a foundation wall penetration.

Fuel lines extending through a foundation wall, above ground, shall have protective coating, wrap or sleeve.

Location Limitations: Gas piping inside any building shall not be run in or through an air duct, clothes chute, chimney or vent, ventilating duct, dumbwaiter or elevator shaft.

Piping installed downstream of the point of delivery shall not extend through any townhouse unit other than the unit served by such piping. Refer to IFGC 404.1.

Gas piping may be installed in **accessible** above-ceiling spaces.

Changes in direction of gas pipe shall be made by the use of fittings, factory bends or field bends. Refer to IFGC 405.2 for field bend requirements.

All rigid gas piping shall be adequately supported by metal straps or hooks at intervals not to exceed those listed:

1/2"	6 feet
3/4" or 1"	8 feet
1 1/4" or larger (horizontal)	10 feet
1 1/4" or larger (vertical)	every floor level

TABLE II

Gas piping exposed in exterior locations shall be protected from corrosion and physical damage. Gas piping shall be 3 1/2" above grade or roof surface.

Ferrous gas piping installed underground in exterior locations shall be protected from corrosion by approved coatings. All gas pipe protective coatings shall be approved types, machine applied, and conform to recognized standards. Field primer and wrapping shall provide equivalent protection and is restricted to those short sections and fittings necessarily stripped for threading or welding. Zinc coatings (galvanizing) shall not be deemed adequate protection for piping below ground.

At the time of installation all horizontal metallic piping shall have at least 12 inches of earth cover or other equivalent protection. Underground ferrous gas piping shall be electrically isolated from the rest of the gas system with listed or approved isolation fittings installed a minimum of 6 inches above grade.

New installations of underground ferrous gas piping shall be **cathodically protected**. It is recommended existing underground ferrous gas piping be cathodically protected or replaced with approved plastic gas piping and anodeless risers.

Underground distribution and fuel lines (metallic or plastic) shall have a clearance of 3 feet when running parallel or 12

inch vertical direction when crossing from any underground facility (water, sewer, electric, etc.).

EXCEPTION: Unless installed under the joint trenching agreement.

NOTE: Underground piping shall not be covered or concealed until inspected by the Administrative Authority.

11. **CONCEALED PIPING, FITTINGS AND DEVICES:** Unions, regulators, shut-off valves, flex connectors, gas hoses and automatic valves shall not be concealed. Bushings shall not be utilized in the fuel line before the appliance shut-off valve.

12. **SHUT-OFF VALVES:** Valves used in connection with gas piping shall be approved types. An accessible approved shut-off valve shall be installed in the fuel supply piping outside of each appliance and ahead of the union or connector within 6 feet of the appliance and in the same room. In addition, appliance shutoff valves are now permitted to be located within 50 feet of the appliance on a remote manifold such as used with a CSST parallel piping system.

EXCEPTION: When approved by the authority having jurisdiction, shut-off valves for listed, vented decorative appliances may be accessibly located in an area remote from the appliance. Such valve shall be permanently identified and shall serve no other equipment.

An approved shut-off valve shall be installed upstream of the MP regulator.

Shut-off valves shall be located to provide for ready access of operation and installed in a location where it will not be damaged. Installation of valves under appliances, such as wall heaters and fireplaces, should be installed in such a manner where the appliance can be removed without removal of the valve. Valves are prohibited in concealed locations and furnace plenums.

Gas outlets for a barbecue shall have a shut-off valve outside the building and connected to the rigid gas piping.

Gas piping supplying more than one building on any one premises shall be equipped with separate shut-off valves to each building, arranged so the gas supply can be turned on or off to any individual or separate building. Such shut-off valve shall be located outside the building it supplies and shall be readily accessible.

Shut-off valves on multiple unit fuel lines from a master meter shall be installed to isolate the gas service to each unit. Each shut-off valve shall be marked for identification and be accessible to the tenant.

Questar Gas Company will install and maintain necessary service line valves on its service pipes for shutting off the supply of gas to the customer's premises.

13. **PRESSURE TESTING:** Before the piping system is put in service and considered satisfactory, the piping shall be tested with a minimum air pressure of 3 psig, and shall hold this pressure for 10 minutes with no drop. The range of the gauge shall not be greater than five times the test pressure. Where extensions are made to existing house piping through which gas is being used, the installer shall make all necessary tests and checks.

Piping carrying gas at pressures in excess of 2 psig pressure shall be tested at 1 ½ times the proposed maximum working pressure.

NOTE: This is a minimum pressure test.

If a drop in pressure occurs while gas piping is under air pressure, the customer or installer must make necessary repairs and the appropriate gas piping shall be retested.

14. **METER SPOT TEST:** Where no changes are made in the house piping the following procedures may be used:

Connect all appliances to gas piping system.

Turn each appliance shut-off valve to the on position and turn appliance control valve to the off position. (If an appliance is equipped with an 'A' valve and a pilot 'B' valve, shut both off and spot test meter to this point.)

Before meter spot test, cap or plug unused outlets.

When all connections are completed, slowly release gas into piping, all appliances to remain off.

Observe if meter test dial has stopped. If movement on test dial continues, shut off all gas at the meter service line valve and find where consumption is going. If test dial stops, apply meter spot test for leakage. Watch the test dial of the meter to see if gas is passing through the meter. Begin test with the test hand on the upstroke. Test times for various meter dials are indicated on Table III.

Dial Styles Cubic Feet	Test Time/Minutes
Manometer Test	5
1/4	5
1/2	5
1	7
2	10
5	20
10	30

TABLE III

After meter spot test determines there are no leaks, bleed air from piping and place appliance in the proper operating condition.

NOTE: When bleeding air from piping ensure there is no source of ignition and area is well ventilated.

15. APPLIANCE CONNECTORS: Each appliance shall be connected with a ground joint union or an approved flexible connector. Appliance connections shall have a diameter not less than the inlet connection to the appliance as provided by the manufacturer. Examples of approved flexible connectors: Z.21.24 (approved single wall flex connector), Z.21.45 (other than all metal connector) and AGA 3-87 (approved outdoor flex connector.)

Flexible connectors shall have an overall length not to exceed 6 feet.

Movable appliances equipped with casters shall be equipped with approved flexible connector (Z.21.69 - movable appliances) and tether line for that use.

Flexible connectors shall not be concealed within or extended through walls, floors, partitions or ceilings. Flexible connectors are permitted to extend through an appliance housing where the connector is protected by means of a factory equipped grommet.

EXCEPTION: Fireplace inserts may have flexible connector run through the appliance housing as long as a factory equipped grommet, sleeve or other means of protection is installed in accordance with the listing of the appliance.

Connectors shall be of adequate size to provide the total demand of the connected appliance.

Appliances may be connected to the fuel gas piping by means of an approved listed quick-disconnect device with an approved shut-off valve connected to the rigid gas piping.

16. **REQUIRED GAS SUPPLY:** Gas piping shall be sized by CFH. To obtain the cubic-feet-per-hour of gas required, divide the input of appliances by the average Btu heating value per cubic foot of the gas. See Table X, Pages 87-90 or consult Questar Gas Company for the average Btu per cubic foot if it is not known.

Example: 100,000 Btu/h rated furnace installed in an area with 890 Btu per cubic foot.

$$\frac{100,000}{890} = 112 \text{ CFH}$$

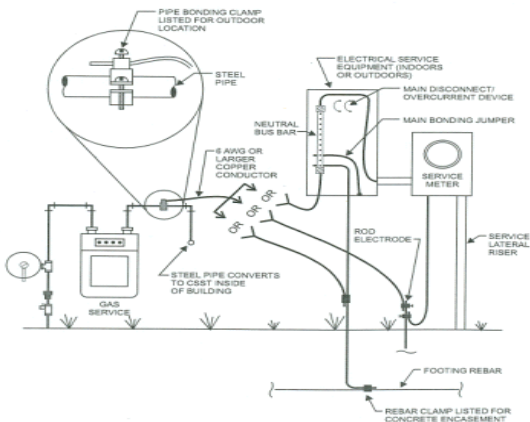


FIGURE 3
CSST BONDING

17. **REQUIRED GAS PIPING SIZE:** When installing a main fuel supply line to a water heater and furnace location, a 1-inch minimum pipe size is recommended to allow for future appliance load. Questar Gas Co. requires a 3/4" minimum pipe size through the wall for meter set support. The minimum size of piping outlet at the gas supply or meter connection shall be three-quarters (3/4) inch.

The maximum design operating pressure for piping systems located inside buildings shall not exceed 5 psig except where one or more conditions in IFGC 402.6 (1-4) are met.

All welded joints in the piping system shall be welded by a qualified pipeline welder.

When an additional appliance is to be served through present gas piping, capacity of the existing piping shall be properly sized and replaced with larger piping if necessary.

To determine the size of any section of pipe in a system, proceed as follows:

- (a) Calculate the gas demand in cubic feet per hour of the appliance to be attached to each outlet. See Required Gas Supply Page 37, Paragraph 16 to calculate demand.
- (b) Measure the length of pipe from the meter to the most remote outlet.
- (c) In Table IV, Page 41, select the distance, or the next longer distance if the table does not give the exact length.
- (d) Use this horizontal line to locate all gas demand figures for this particular system of piping.
- (e) Starting at the most remote outlet, find the horizontal line

just selected, determine the gas demand for the outlet. If the exact figure of demand is not shown, choose the next larger figure in the horizontal line.

- (f) Above the demand figure will be the correct size of gas piping.
- (g) Proceed in a similar manner for each outlet and each section of gas piping. For each section of piping, determine the total gas demand by that section as follows (using an assumed gas content of 890 Btu/Cu. Ft.).

EXAMPLE OF SIZING A HOUSE PIPING SYSTEM

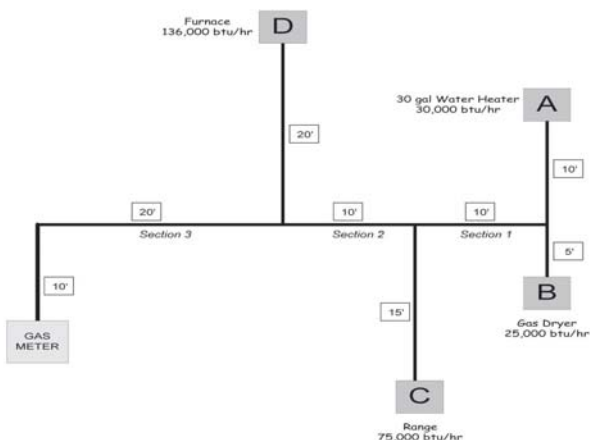


FIGURE 4

SOLUTION AND EXAMPLE: (Rated Input/890 Btu/Cfh)

- | | |
|-----------------------------------|----------------|
| (1) Maximum demand for outlet "A" | 34 CFH |
| Maximum demand for outlet "B" | 28 CFH |
| Maximum demand for outlet "C" | 84 CFH |
| Maximum demand for outlet "D" | <u>153 CFH</u> |
| Total Demand | 299 CFH |

(2) The length of pipe from the gas meter to the most remote outlet (Outlet “A”) is 60 feet. THIS IS THE ONLY DISTANCE USED.

(3) Using horizontal line marked 60 feet:

	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6
60	66	138	260	530	810	1,520	2,400	4,300	8,800	28,400

Outlet “A” supplying 34 cubic feet an hour requires 1/2-inch pipe.

Outlet “B” supplying 28 cubic feet an hour requires 1/2-inch pipe. Section 1 supplying outlets “A” and “B”, 62 cubic feet an hour requires 1/2-inch pipe.

Outlet “C” supplying 84 cubic feet an hour requires 3/4-inch pipe. Section 2 supplying outlets “A”, “B”, and “C”, 146 cubic feet an hour requires 1-inch pipe.

Outlet “D” supplying 153 cubic feet an hour requires 1-inch pipe. Section 3 supplying outlets “A”, “B”, “C”, and “D”, 299 cubic feet an hour requires 1 1/4-inch pipe.

**MAXIMUM CAPACITY OF PIPE IN
CUBIC FEET OF GAS PER HOUR
-4 OUNCES-**

(Inlet Pressure less than 2 PSI and a Pressure Drop of 0.5 Inch

Water Column and 0.6 Specific Gravity Gas)

CAPACITIES BASED ON NUMBERS FROM IFGC

STANDARD PRESSURE

PIPE SIZE (inch)											
Nominal	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068	4.026	5.047	6.065
Length (ft)	Capacity in Cubic Feet of Gas Per Hour										
10	172	360	678	1390	2090	4020	6400	11,300	23,100	41,800	67,600
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900	28,700	46,500
30	95	199	374	768	1,150	2,220	3,530	6,250	12,700	23,000	37,300
40	81	170	320	657	985	1,900	3,020	5,350	10,900	19,700	31,900
50	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300
60	66	137	257	528	791	1,520	2,430	4,290	8,760	15,800	25,600
70	60	126	237	486	728	1,400	2,230	3,950	8,050	14,600	23,600
80	56	117	220	452	677	1,300	2,080	3,670	7,490	13,600	22,000
90	52	110	207	424	635	1,220	1,950	3,450	7,030	12,700	20,600
100	50	104	195	400	600	1,160	1,840	3,260	6,640	12,000	19,500
125	44	92	173	355	532	1,020	1,630	2,890	5,890	10,600	17,200
150	40	83	157	322	482	928	1,480	2,610	5,330	9,650	15,600
175	37	77	144	296	443	854	1,360	2,410	4,910	8,880	14,400
200	34	71	134	275	412	794	1,270	2,240	4,560	8,260	13,400
250	30	63	119	244	366	704	1,120	1,980	4,050	7,320	11,900
300	27	57	108	221	331	638	1,020	1,800	3,670	6,630	10,700
350	25	53	99	203	305	587	935	1,650	3,370	6,100	9,880
400	23	49	92	189	283	546	870	1,540	3,140	5,680	9,190
450	22	46	86	177	266	512	816	1,440	2,940	5,330	8,620
500	21	43	82	168	251	484	771	1,360	2,780	5,030	8,150
550	20	41	78	159	239	459	732	1,290	2,640	4,780	7,740
600	19	39	74	152	228	438	699	1,240	2,520	4,560	7,380

TABLE IV

**MAXIMUM CAPACITY OF PIPE IN
CUBIC FEET OF GAS PER HOUR
-2 psig-**

(Inlet Pressure 2 PSI)

Table based on a 1.0 PSI pressure drop.

ELEVATED PRESSURE

PIPE SIZE (inch)								
Nominal	½	¾	1	1¼	1½	2	2½	3
Actual ID	0.622	0.824	1.049	1.380	1.610	2.067	2.469	3.068
Length (ft)	Capacity in Cubic Feet of Gas Per Hour							
10	1,510	3,040	5,560	11,400	17,100	32,900	52,500	92,800
20	1,070	2,150	3,930	8,070	12,100	23,300	37,100	65,600
30	809	1,760	3,210	6,590	9,880	19,000	30,300	53,600
40	753	1,520	2,780	5,710	8,550	16,500	26,300	46,400
50	673	1,360	2,490	5,110	7,660	14,700	23,500	41,500
60	615	1,240	2,270	4,660	6,980	13,500	21,400	37,900
70	569	1,150	2,100	4,320	6,470	12,500	19,900	35,100
80	532	1,080	1,970	4,040	6,050	11,700	18,600	32,800
90	502	1,010	1,850	3,810	5,700	11,000	17,500	30,900
100	462	934	1,710	3,510	5,260	10,100	16,100	28,500
125	414	836	1,530	3,140	4,700	9,060	14,400	25,500
150	372	751	1,370	2,820	4,220	8,130	13,000	22,900
175	344	695	1,270	2,601	3,910	7,530	12,000	21,200
200	318	642	1,170	2,410	3,610	6,960	11,100	19,600
250	279	583	1,040	2,140	3,210	6,180	9,850	17,400
300	253	528	945	1,940	2,910	5,600	8,920	15,800

NOTE: For borderline capacities that might exceed table figures - consult local Questar Gas office.

TABLE V

**CORREGATED STAINLESS STEEL
TUBING (CSST)**

Natural Gas (Pressure: 2.0 psi) (Pressure Drop: 1.0 psi)

TUBE SIZE (EDH*)											
	13	15	18	19	23	25	30	31	37	46	62
Length (ft)	MAXIMUM CAPACITY in Cubic Feet Per Hour										
10	270	353	587	700	1,098	1,372	2,592	2,986	4,509	9,599	21,637
25	166	220	374	444	709	876	1,620	1,869	2,887	6,041	13,715
30	151	200	342	405	650	801	1,475	1,730	2,642	5,509	12,526
40	129	172	297	351	567	696	1,273	1,470	2,297	4,763	10,855
50	115	154	266	314	510	624	1,135	1,311	2,061	4,255	9,715
75	93	124	218	257	420	512	922	1,066	1,692	3,467	7,940
80	89	120	211	249	407	496	892	1,031	1,639	3,355	7,689
100	79	107	189	222	366	445	795	920	1,471	2,997	6,881
150	64	87	155	182	302	364	646	748	1,207	2,442	5,624
200	55	75	135	157	263	317	557	645	1,049	2,111	4,874
250	49	67	121	141	236	284	497	576	941	1,886	4,362
300	44	61	110	129	217	260	453	525	862	1,720	3,983

*EHD = Equivalent Hydraulic Diameter

13-15 = 3/8" 18-19 = 1/2" 23-25=3/4" 30-31=1" 37=1 1/4" 46=1 1/2" 62=2"

**TABLE VI
CORREGATED STAINLESS STEEL
TUBING (CSST)**

Natural Gas (Pressure: 5 psi) (Pressure Drop: 3.5 psi)

TUBE SIZE (EDH*)											
	13	15	18	19	23	25	30	31	37	46	62
Length (ft)	MAXIMUM CAPACITY in Cubic Feet Per Hour										
10	523	674	1,084	1,304	1,995	2,530	4,923	5,659	8,295	18,080	40,353
25	322	420	691	827	1,289	1,616	3,077	3,543	5,311	11,378	25,580
30	292	382	632	755	1,181	1,478	2,803	3,228	4,860	10,377	23,361
40	251	329	549	654	1,031	1,284	2,418	2,786	4,225	8,972	20,246
50	223	293	492	586	926	1,151	2,157	2,486	3,791	8,015	18,119
75	180	238	403	479	763	944	1,752	2,021	3,112	6,530	14,809
80	174	230	391	463	740	915	1,694	1,955	3,016	6,320	14,341
100	154	205	350	415	665	820	1,511	1,744	2,705	5,646	12,834
150	124	166	287	339	548	672	1,228	1,418	2,221	4,600	10,489
200	107	143	249	294	478	584	1,060	1,224	1,931	3,977	9,090
250	95	128	223	263	430	524	945	1,092	1,732	3,553	8,135
300	86	116	204	240	394	479	860	995	1,585	3,240	7,430

*EHD = Equivalent Hydraulic Diameter

13-15 = 3/8" 18-19 = 1/2" 23-25=3/4" 30-31=1" 37=1 1/4" 46=1 1/2" 62=2"

TABLE VI (continued)

CORREGATED STAINLESS STEEL TUBING (CSST)

Natural Gas (Pressure: 7 – 8 inches W.C.) Pressure Drop: .5 inch W.C.)

TUBE SIZE (EDH*)											
	13	15	18	19	23	25	30	31	37	46	62
Length (ft)	MAXIMUM CAPACITY in Cubic Feet Per Hour										
5	46	63	115	134	225	270	471	546	895	1,790	4,142
10	32	44	82	95	161	192	330	383	639	1,261	2,934
15	25	35	66	77	132	157	267	310	524	1,027	2,398
20	22	31	58	67	116	137	231	269	456	888	2,078
25	19	27	52	60	104	122	206	240	409	793	1,860
30	18	25	47	55	96	112	188	218	374	723	1,698
40	15	21	41	47	83	97	162	188	325	625	1,472
50	13	19	37	42	75	87	144	168	292	539	1,317
60	12	17	34	38	68	80	131	153	267	509	1,203
70	11	16	31	36	63	74	121	141	248	471	1,114
80	10	15	29	33	60	69	113	132	232	440	1,042
90	10	14	28	32	57	65	107	125	219	415	983
100	9	13	26	30	54	62	101	118	208	393	933
150	7	10	20	23	42	48	78	91	171	320	762
200	6	9	18	21	38	44	71	82	148	277	661

*EHD = Equivalent Hydraulic Diameter

13-15 = 3/8" 18-19 = 1/2" 23-25=3/4" 30-31=1" 37=1 1/4" 46=1 1/2" 62=2"

TABLE VI (continued)

CORREGATED STAINLESS STEEL TUBING (CSST)

Natural Gas (Pressure: 7 – 8 inches W.C.) (Pressure Drop: 3.0 inch W.C.)

TUBE SIZE (EDH*)											
	13	15	18	19	23	25	30	31	37	46	62
Length (ft)	MAXIMUM CAPACITY in Cubic Feet Per Hour										
5	120	160	277	327	529	649	1,182	1,365	2,141	4,428	10,103
10	83	112	197	231	380	462	828	958	1,538	3,199	7,156
15	67	90	161	189	313	379	673	778	1,254	2,541	5,848
20	57	78	140	164	273	329	580	672	1,090	2,197	5,069
25	51	69	125	147	245	295	518	599	978	1,963	4,536
30	46	63	115	134	225	270	471	546	895	1,790	4,142
40	39	54	100	116	196	234	407	471	778	1,548	3,590
50	35	48	89	104	176	210	363	421	698	1,383	3,213
60	32	44	82	95	161	192	330	383	639	1,261	2,934
70	29	41	76	88	150	178	306	355	593	1,166	2,717
80	27	38	71	82	141	167	285	331	555	1,090	2,543
90	26	36	67	77	133	157	268	311	524	1,027	2,398
100	24	34	63	73	126	149	254	295	498	974	2,276
150	19	27	52	60	104	122	206	240	409	793	1,860
200	17	23	45	52	91	106	178	207	355	686	1,612

*EHD = Equivalent Hydraulic Diameter

13-15 = 3/8" 18-19 = 1/2" 23-25=3/4" 30-31=1" 37=1 1/4" 46=1 1/2" 62=2"

TABLE VI (continued)

CORREGATED STAINLESS STEEL

TUBING (CSST)

Regulator	Pipe Size	Capacity	Leak Limiter
**Maxitrol 325-3LX	3/8" & 1/2"	250 CFH	12A09
**Maxitrol 325-5ALX	1/2"	425 CFH	12A39
**Maxitrol 325-5ALX	3/4" & 1"	550 CFH	12A39
**Maxitrol 325-7L	1 1/4" & 1 1/2"	1,000 CFH	Vent
**300 O.A.R.A.	1/2"	250 CFH	"O" 3-18
**600 O.A.R.A.	3/4"	550 CFH	"O" 6-38
"FAGAS F-BH 2	1/2"	250 CFH	#F

*Z21.80 only **Z21.18 & Z21.80

TABLE VI (continued)

Z21.18 the ANSI standard for appliance regulators, intended for application in natural gas systems.

Z21.80 the ANSI standard for line pressure regulators, intended for application in natural gas systems.

To conform to the ANSI Z21-80 standard for line pressure regulators, installations exceeding 2 psi (up to and including 5 psi) require a tested and approved over-protection device (OPD) for use with the regulator. The OPD will limit the downstream pressure to 2-psi maximum in the event of line regulator failure.

OPD47 – Maxitrol 325-3LX reg. (3/8" & 1/2")

OPD48 – Maxitrol 325-3LX reg. (1/2")

OPD48 – Maxitrol 325-5ALX reg. (1/2" & 3/4")

OPD600 – Maxitrol 325-5ALX reg. (3/4" & 1")

OPD210 – Maxitrol 325-7L reg. (1 1/4" & 1 1/2")

SECTION IV

APPLIANCE INSTALLATION

1. **ACCESSIBILITY AND CLEARANCES**: Every gas appliance shall be located with respect to building construction and other equipment so sufficient clearance shall be maintained to permit cleaning of heating surfaces; the replacement of filters, blowers, motors, burners, controls, and vent connectors; the lubrication of moving parts, where required, and the adjustment and cleaning of burners and pilots. Refer to manufacturer's installation instructions when required.

All appliances shall be installed with clearances from combustible material in accordance with A.G.A. listings, U.L. (Underwriters Laboratories), National Board of Fire Underwriters publications, and local requirements. Minimum clearances shall be maintained between combustible walls and gas appliances and their venting systems. **Gas equipment shall not be installed on carpeting unless the equipment is listed for such installation.**

Gas appliances installed in an attic, furred space or crawl space (under floor) shall be accessible by an opening not less than 20 inches by 30 inches and a passageway not less than 30 inches high by 22 inches wide. The passageway shall not be more than 20 feet in length from the access opening to the equipment and its controls.

The access opening and passageway shall be large enough for removal of the largest piece of equipment installed in the space.

The passageway in the attic shall have continuous solid flooring not less than 24 inches wide and an open working space, not less than 30 inches deep by 30 inches wide on the control side of the equipment. The same working space shall be provided for equipment in crawl spaces.

EXCEPTION: Where the passageway is not less than 6 feet high for its entire length, the passageway shall be not greater than 50 feet in length.

A level working platform not less than 30 inches in depth and width shall be provided at the service side of the equipment.

EXCEPTION: A working platform need not be provided when the equipment can be serviced from the required access opening.

A permanent electrical outlet and lighting fixture controlled by a switch located at the required passageway opening shall be provided at or near the equipment.

2. SPECIAL CONDITIONS CREATED BY MECHANICAL EXHAUSTING OR FIREPLACE: Operation of exhaust fans, kitchen ventilation systems, clothes dryers, swamp coolers or fireplaces may create conditions requiring special attention to avoid unsatisfactory operation of installed gas appliances.

Gas-burning appliances installed in rooms ventilated by exhaust fans shall be protected against the possibility of the fan pulling a down draft on the appliance vents. This may be done by the installation of a permanent fresh air opening(s) to the room from the outside.

3. INSTALLATION IN GARAGES: Gas designed appliances may be installed in a garage under the following conditions:
- (a) Appliances installed in garages where they may be subjected to mechanical damage, shall be suitably guarded against such damage by being installed behind protective barriers or by being elevated or located out of the normal path of vehicles.

- (b) Appliances located in garages and other hazardous location which generate a glow, spark, or flame capable of igniting flammable vapors shall be installed with a source of ignition at least 18 inches above the floor level. Equipment shall not be installed in areas where open use, handling or dispensing of combustible, flammable or explosive materials occur.

EXCEPTION: Elevation of the ignition source is not required for appliances that are listed as flammable vapor resistant and for installation without elevation. If the appliances are enclosed in an isolated space/room that does not open to the garage and all combustion air is taken directly from the outdoors.

- (c) Rooms or spaces not part of the living space communicating directly with a private garage through openings shall be considered part of the private garage.

NOTE: Appliances installed in a garage must have proper air for combustion.

4. HAZARDOUS AND PROHIBITED LOCATIONS: Gas appliances shall not be installed in any hazardous location, unless listed and approved for that specific location. **Gas fired appliances shall not be installed in or obtain combustion air from bathrooms, bedrooms, toilet rooms, storage rooms and surgical rooms.**

EXCEPTION: This shall not apply to the following appliances:

- (a) Direct vent appliances obtaining combustion air from the outdoors.
- (b) Vented room heaters, vented decorative appliances and vented decorative appliances designed to be installed in solid fuel-burning fireplaces, provided the room the appliance is installed in will supply enough combustion air (an unconfined space) and is not of unusually tight construction.

(c) Appliances installed in a dedicated enclosure and all combustion air is taken from outdoors and the enclosure is equipped with a solid door that is weather stripped and is self closing.

5. WARM-AIR FURNACE: Return air inlets shall not be located within 10 feet of any appliance firebox, solid fuel burning appliance or draft diverter in the same enclosed room .

Cold air return opening shall not be located in a closet, bathroom, toilet room, kitchen, garage, mechanical room, boiler room or furnace room.

All equipment must have an electrical disconnect located within the same room.

6. VENTED WALL FURNACES: Vented wall furnaces shall be installed in accordance with their listing. Panels, grilles and access doors of appliances which must be removed for normal servicing operation shall not be attached to the building construction. Vented wall furnaces shall be located so as not to cause a fire hazard to walls, floors, combustible furnishings or doors.

7. FLOOR FURNACES: Floor furnaces shall have 18 inches clearance on the control side of the appliance and 12 inches clearance on the remaining sides and back. There will be 6 inches clearance on bottom of appliance.

8. SUSPENDED UNIT HEATERS: Shall be installed according to the manufacturer's installation instructions and its listing.

(a) A unit heater shall not have duct work attached unless listed in the installation instructions for such use.

(b) A unit heater shall be installed with clearances to combustible material of not less than 18 inches at the sides,

12 inches at the bottom and 6 inches above the top unless stated otherwise in appliance installation instructions.

- (c) Overhead heaters located in public garages or other areas frequented by vehicles shall be installed a minimum of 8 feet above the floor. Where vehicles exceed 6 feet, appliances shall be installed a minimum of 2 feet above the highest vehicle. Overhead heaters installed in private garages shall be installed a minimum 6 feet above the floor.

9. RESIDENTIAL BOILERS: Shall be installed according to the manufacturer's installation instructions and its listing.

(HOT WATER) Minimum required safeties:

- Aquastat
- Pressure/altitude guage
- Pressure relief valve
- Proof of flame

(STEAM) Minimum required safeties:

- Pressure trol
- Low water cutoff
- Pressure relief valve
- Proof of flame

10. LOG LIGHTERS: Approved log lighters, where properly installed, may be used for the lighting of logs only.

11. UNVENTED ROOM HEATERS: Shall not be used as the sole source of comfort heating in a dwelling unit.

- (a) Unvented room heaters shall not have an input rating greater than 40,000 Btu/h.
- (b) Unvented room heaters shall not be installed in occupancies in use Groups A, E and I (see definitions).

- (c) Unvented room heaters shall be equipped with an oxygen depletion sensitive (ODS) safety shut-off system. ODS's may be cleaned but shall not be adjusted or altered which will result in the changing of the appliance set point.
- (d) Unvented room heaters installed in a bedroom shall be no larger than 10,000 Btu and unvented room heaters installed in a bathroom shall be no larger than 6,000 Btu.
- (e) Unvented room heaters shall not be installed in a confined space.

12. GAS LOGS (DECORATIVE APPLIANCES): Approved gas logs may be installed in solid fuel burning fireplaces provided the following conditions are met:

- (a) The gas log is installed in accordance with the manufacturer's installation instructions.
- (b) If the fireplace is equipped with a damper, it shall be permanently blocked open a sufficient amount to prevent spillage of combustion products into the room.
- (c) Gas logs when equipped with a pilot shall have a safety shut-off valve.
- (d) An insert or stove shall be listed for use with a gas log.

13. WATER HEATERS: Water heaters shall be installed according to their listings and shall be equipped with a temperature and pressure relief valve rated at 150 psi and 210⁰ or per tank rating whichever is less. It is recommended a drain tube is used and it shall be rated at 100 psi and 180⁰. No size reduction on drain tube is allowed. In seismic Zone 3 and 4, water heaters shall be anchored or strapped to resist horizontal displacement due to earthquake motion. Water heaters used in combination as space heating shall be equipped with a tempering valve to limit the

temperature of the potable distribution side to 140°F.

14. GAS RANGES: Shall be installed according to the manufacturer's installation instructions and applicable codes. Commercial ranges shall not be installed in residential applications.
15. CLOTHES DRYER: Shall be installed according to the manufacturer's installation instruction and applicable codes.

The moisture exhaust duct shall be installed in accordance with the appliance manufacturer's instructions and recommendations, as to material and maximum length.

Unless permitted or required by the dryer manufacturer's installation instructions and approved by the building official, domestic dryer moisture exhaust ducts shall not exceed a total combined horizontal and vertical length of 35 feet. Deduct 5 feet for each 90-degree elbow and 2 1/2 feet for every 45-degree elbow. Clothes dryer flexible ducts (transition ducts) shall be semi-rigid metal and limited to a single length and shall not exceed 8 feet. This duct shall not be concealed in building construction.

A clothes dryer moisture exhaust duct shall not be connected into any vent connector, gas vent, or chimney and must be independent of all other systems.

Ducts for exhausting clothes dryers shall not be put together with sheet metal screws or other fastening means which extend into the duct.

Moisture exhaust ducts shall not terminate beneath the building or in the attic area.

Moisture exhaust ducts shall terminate on the outside of the building and shall be equipped with a back-draft damper.

Every vertical portion of the vent shall be provided with a clean-out or other means for the interior of the duct.

16. COMMERCIAL CLOTHES DRYER: Commercial clothes dryers shall be installed according to installation instruction and IFGC Section 613.7.

SECTION V

COMBUSTION AND VENTILATION AIR

1. AIR FOR COMBUSTION AND VENTILATION: Appliances shall be installed in a manner and in a location with sufficient ventilation to permit complete combustion of the gas, proper venting of the appliance, maintain safe operating temperature and proper supply of air.
 - (a) Openings and ducts shall not connect appliance enclosures with a space in which the operation of an exhaust fan may adversely affect the flow of combustion air. Exhaust fans, kitchen ventilation, clothes dryers and fireplaces shall be taken into consideration when calculating combustion air.
 - (b) Where a closet is designed for the installation of a clothes dryer, an opening having an area of not less than 100 square inches free air shall be provided in the closet enclosure for make-up air.
 - (c) Combustion air supply shall not be obtained from any hazardous location or from any area in which objectionable quantities of flammable vapor, lint or dust are given off. Combustion air shall not be taken from a refrigeration machinery room.
2. COMBUSTION AIR DUCTS: Combustion air ducts shall:
 - (a) Be of galvanized steel.

EXCEPTION: Within residential structures, unobstructed stud and joist spaces may be used, provided not more than one required fire stop is removed.

NOTE: Flexible duct shall not be used for combustion air ducts.

- (b) Have a minimum cross-sectional dimension of 3 inches.
- (c) Terminate in an unobstructed space allowing for combustion air movement to the appliance.
- (d) Have the same cross-sectional areas as the free area of the openings to which they connect.
- (e) Serve a single appliance enclosure.
- (f) Serve only upper or lower combustion air openings; the separation between ducts serving upper and lower combustion air openings shall be maintained to the source of combustion air.
- (g) Combustion air ducts shall not be installed so as to pass through construction where fire dampers are required.

NOTE: Manually-operated dampers shall not be installed in combustion air ducts.

- (h) Ducts which terminate in an attic shall not be screened. The ducts shall terminate a minimum of 6 inches above the attic insulation.
- (i) When using outside air, the air must pass through continuous ducts of the required cross-sectional area extending from the appliance enclosure to the outside of the building. The required upper combustion air duct shall extend horizontally or upwards to the outside of the building. Where not otherwise prohibited, combustion air may be obtained from a properly ventilated attic area.

(j) When combustion air is taken from the attic, the ventilation openings shall not be subject to ice or snow blockage. Attic ventilation shall be sufficient to provide the required volume of combustion air for the appliances.

(k) Combustion air obtained from under floor areas shall have free opening areas to the outside equivalent to the required combustion air needed.

3. **LOUVERS AND GRILLES**: In calculating free area as required, consideration shall be given to the blocking effects of louvers, grilles, or screens protecting such opening. If the free area through the design of louver or grille is known, it shall be used in calculating the size of opening required to provide the free area specified. If the design and free area is not known it may be assumed that wood louvers will have 25% free area and metal louvers and grilles will have 75% free area.

Grille and screen openings cannot be smaller than 1/4 inch.

EXAMPLE 1: If a metal grille is used and 100 square inches of free area is required

$$\frac{100}{.75} = 133.3 \text{ or } 134 \text{ square inches of metal grille to allow 100 square inches of free area measured across the grille opening.}$$

EXAMPLE 2: If a wood louver is used and 100 square inches of free area is required

$$\frac{100}{.25} = 400 \text{ square inches of wood louver to allow 100 square inches of free area measured across the grille opening.}$$

4. **ADEQUATE VOLUME (CONFINED SPACE):** If the volume of the room or space in which fuel-burning appliances are installed is equal to or greater than 50 cubic feet per 1,000 Btu/h of combined input rating of appliances, infiltration may be regarded as adequate to provide combustion air. Rooms communicating directly with the space in which the equipment is installed may be considered part of the non-confined space as long as openings between them have no doors. Exclude from the calculation the input ratings of listed direct vent appliances, cooking appliances, refrigerators and domestic clothes dryers.

To determine if air is required use the following example:

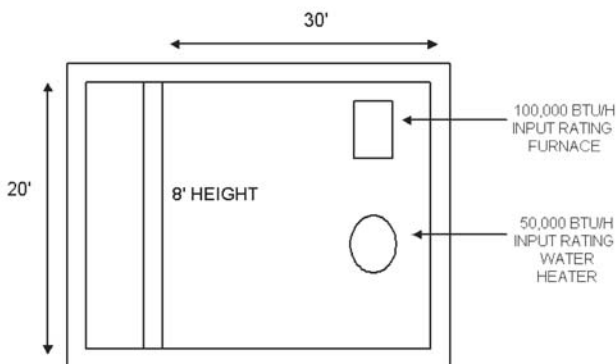


FIGURE 5

$$\frac{150,000}{1,000} = 150 \text{ BTU} \times 50 = 7500$$

CU. FT. REQUIRED (MINIMUM)

$$20 \times 30 \times 8 = 4800 \text{ CU. FT.} =$$

THIS WOULD BE A CONFINED SPACE AND COMBUSTION AIR WILL BE REQUIRED

The air supply for gas appliances may be obtained by application of one of the methods in Paragraphs 5 through 7.

5. APPLIANCES LOCATED IN UNCONFINED SPACES: In unconfined spaces in buildings of conventional frame, brick, or stone construction, infiltration is normally adequate to provide air requirements. **If the unconfined space is within a building of unusually tight construction**, the air supply shall be obtained from outdoors or from spaces freely communicating with the outdoors using one of the approved methods for outside combustion air.

6. APPLIANCES LOCATED IN CONFINED SPACES:

All Air from Inside the Building - if allowed by local code - The confined space shall be provided with two permanent openings communicating with other spaces of sufficient volume so the combined volume of all spaces meets the criteria for unconfined space. One opening located within the upper 12 inches of the enclosure and one opening located within the lower 12 inches of the enclosure. Each opening shall have a free area of not less than 1 square inch per 1,000 Btu per hour of total input rating of all appliances within the enclosure with a minimum requirement of 100 square inches free area. (See Figure 5, Page 59)

EQUIPMENT LOCATED IN CONFINED SPACES
ALL AIR FROM INSIDE THE BUILDING

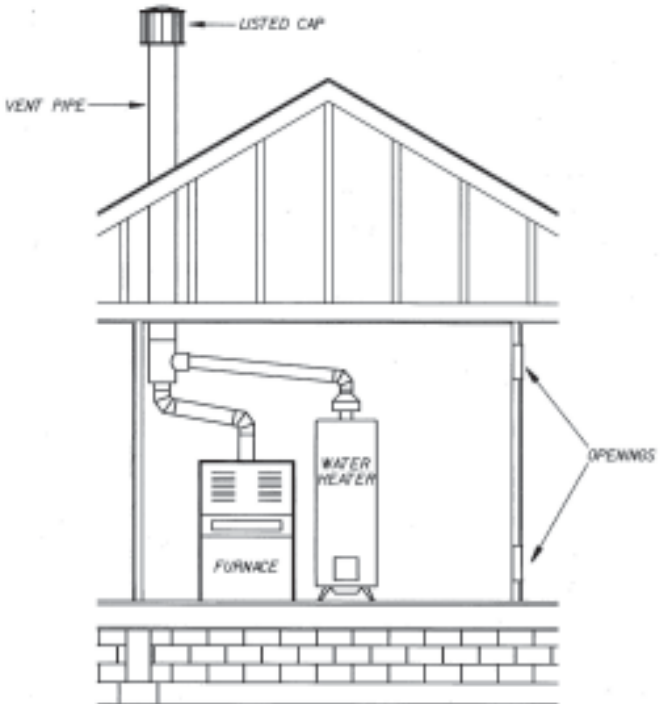


FIGURE 6

7. OUTSIDE AIR: All air from the outdoors shall be obtained using one of the following methods.
- (a) Two Openings - The confined space shall be provided with two permanent openings, one located within the top 12 inches and one located within the bottom 12 inches of

the enclosure. The openings shall communicate directly or by ducts with the outdoors or spaces (properly ventilated crawl space or attic) freely communicating with the outdoors. (See Figures 6 & 7, Pages 61 & 62).

1. Vertical or Direct (1-4,000). When directly communicating through an outside wall or by vertical ducts, each opening shall have a minimum free area of 1 square inch per 4,000 Btu per hour of total input rating of all equipment in the enclosure.
 2. Horizontal (1-2,000). When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of not less than 1 square inch per 2,000 Btu per hour of the total input rating of all equipment in the enclosure. (See Figure 9, Page 64).
- (b) One Opening (1-3,000). The confined space shall be provided with one permanent opening located within the top 12 inches of the enclosure. The opening shall communicate directly or by duct to the outdoors. All the appliances in the enclosure shall have minimum clearances of 1 inch on the sides and back and 6 inches on the front. The opening shall be a minimum of 1 square inch per 3,000 Btu/h of total input rating of all appliances in the enclosure and not less than the combined cross sectional area of the appliance vent connectors in the confined space. (See Figure 8, Page 63)

For combined use of inside and outside combustion air refer to the IFGC, Section 304.7.1 through 304.7.3.

Round Duct Size Inches

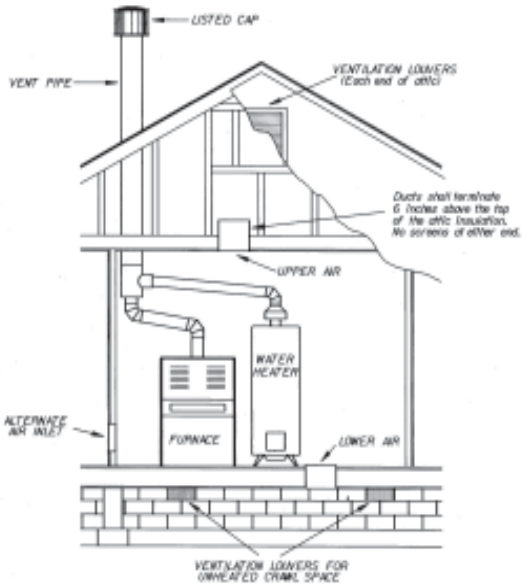
3	4	5	6	7	8	9	10	11	12
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Nominal Area Square Inches

7.06	12.56	19.63	28.27	38.48	50.27	63.62	78.54	95.03	113.10
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TABLE VII

EQUIPMENT LOCATED IN CONFINED SPACES
 ALL AIR FROM OUTDOORS--INLET AIR FROM
 PROPERLY VENTILATED CRAWL SPACE AND
 OUTLET AIR TO PROPERLY VENTILATED ATTIC



Notice the upper openings may not be taken from a crawl space.

FIGURE 7

EQUIPMENT LOCATED IN CONFINED SPACES ALL AIR FROM OUTDOORS THROUGH PROPERLY VENTILATED ATTIC

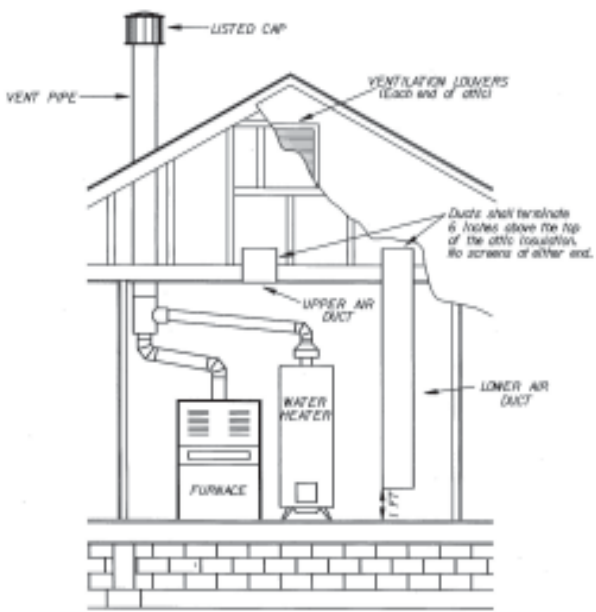


FIGURE 8

EQUIPMENT LOCATED IN CONFINED
ALL AIR FROM OUTDOORS OR PROPERLY
VENTILATED ATTIC WITH ONE OPENING

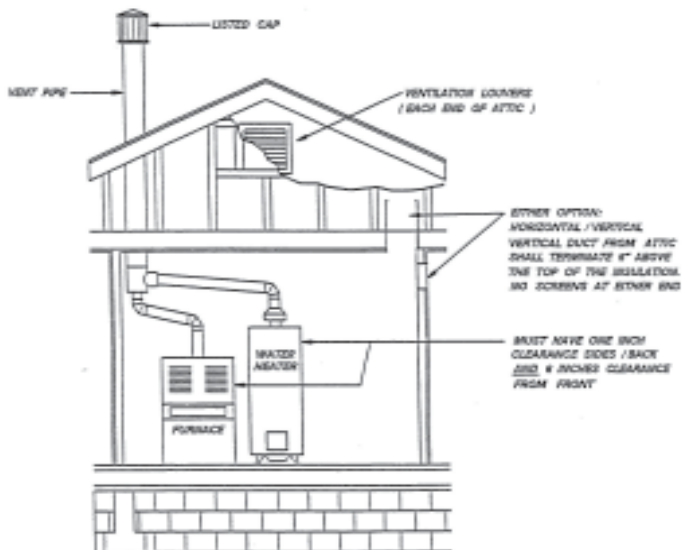


FIGURE 9

EQUIPMENT LOCATED IN CONFINED SPACES ALL AIR FROM OUTDOORS
HORIZONTALLY

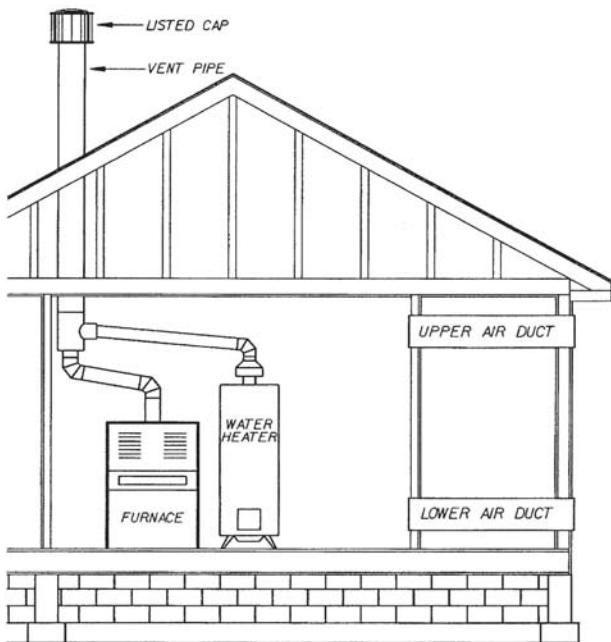


FIGURE 10

SECTION VI

VENTING

1. **RESPONSIBILITY: Responsibility for the proper venting of appliances rests with the installing agency.**
2. **APPLIANCES REQUIRED TO BE VENTED**: Every appliance designed to be vented shall be connected to a venting system as specified.

Venting systems shall be designed and constructed as to develop a positive flow adequately conveying all combustion products to the outside atmosphere.

3. **DRAFT HOODS**: Every appliance designed with a draft hood shall have a draft hood installed in the position for which it was designed and shall be located so the draft hood relief opening is at least 6 inches from any surface other than the appliance it serves, measured in a direction 90 degrees to the plane of the relief opening. When a greater or lesser clearance is indicated on the equipment label, the clearance shall not be less than that specified on the label. The draft hood of the appliance and the combustion air opening shall be in the same room.
4. **VENT AND VENT CONNECTOR MATERIALS**: Materials for vents or vent connectors on domestic or small commercial installations, shall be such as to resist the corrosive action of flue gases and condensate. In general, this requirement prohibits the use of black iron, galvanized iron, or copper for vents or vent connectors for gas designed appliances.

Aluminum vent is required for most residential and commercial applications. For commercial installations see the 2006 IFGC.

Galvanized steel vent or aluminized steel (factory vent kits) may be used for venting sealed combustion appliances, provided appliance is listed for such use.

Plastic vent pipe may be used in accordance with the terms of the listing and the appliance manufacturer's installation instructions.

5. VENT AND VENT CONNECTOR CLEARANCES: Vents and vent connectors shall be installed with minimum clearances from combustibile material as set forth by the National Board of Fire Underwriters and by local regulating agencies.

Type "C" (unlisted single wall) gas vent material used as a vent connector shall not pass through any floor, ceiling or attic and shall have 6 inches clearances to combustibile material. The entire length of Type "C" vent must be accessible for inspection, cleaning and replacement. Listed single wall vent material shall be installed according to its listing.

An appliance shall be located as close as practical to the venting system.

The entire length of a vent connector shall be provided with ready access for inspection, cleaning, and replacement. (Refer to IFGC 503.10.12.)

6. VENT CONNECTORS: Connectors shall be used to connect fuel-burning appliances to a vertical chimney or vent unless the chimney or vent is attached directly to the appliance. Such connectors shall be installed within the space or area in which the appliance is located and shall be connected to a chimney or vent in such a manner as to maintain the clearance to combustibles as required by the listing and the manufacturer's installation instructions.

EXCEPTION: Listed appliances with integral venting systems such as direct vent appliances need not comply.

Every portion of a vent connector shall have a rise of not less than 1/4 inch per linear foot from the appliance to the vertical vent or chimney.

When the connector used for a Category I gas appliance must be located or pass through an unconditioned space, that portion of the connector shall be listed Type "B" or Type "L" vent material and shall not be covered with insulation.

Connectors shall be securely supported for the design and weight of the materials employed to maintain proper clearances. Joints shall be fastened with sheet metal screws, rivets or other approved means. At the point of connection of the single-wall connector to the double-wall gas vent, three sheet metal screws or rivets may be used as an approved means.

NOTE: Per manufacturer's installation instructions, screws shall not penetrate inner liner on "B" vent. "B" vent shall not be cut to accommodate vent connectors - use factory "B" vent fittings.

7. VENT DAMPERS: Automatically operated vent dampers, heat reclaimers, and recuperators shall be of a listed type and installed in accordance with the terms of their listings and the manufacturer's installation instructions. They shall be arranged to prevent the initiation or increase of firing unless the damper is opened to a safe position.

Manually operated dampers shall not be placed in connectors of gas-burning appliances. Fixed baffles shall not be classified as dampers.

A connector entering a masonry chimney shall extend through the wall to the inner face of the liner, but not beyond, and shall be firmly cemented to masonry. A thimble may be used to

facilitate removal of the connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement. Connectors shall connect to a masonry chimney not less than 12 inches (305 mm) above the lowest portion of the interior of the chimney. (Refer to IFGC 501.9) Masonry chimney shall be provided with a cleanout opening having a minimum height of 6 inches. The upper edge of the opening shall be located not less than 6 inches below the lowest chimney inlet opening. (Refer to IFGC 501.15.3.) If 6 inches are not available, a clean out shall be provided by installing a capped tee in the connector next to the chimney.

Vent connectors serving gravity vent type appliances shall not be connected to a venting system served by a mechanical draft system unless the connection is made on the negative pressure side of the mechanical draft system and appliance is approved for that type of installation. When a mechanical draft system is employed, provision shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the appliance for safe performance.

The venting system on all gas appliances shall be examined to ensure they are properly installed, have adequate draft and the products of combustion are going up the vent connector and vent properly. When the appliance is equipped with a draft hood, to ensure proper draft a match test will be made both before and after indoor blower starts to run on appliances so equipped.

Each vent connector of a multiple venting system shall have the greatest possible rise consistent with the headroom available between the draft hood outlet or the vent collar and the point of interconnection to a manifold or to a common vent.

8. SIZING VENTS/CONNECTORS SERVICING ONLY DRAFT-HOOD EQUIPPED APPLIANCES AND PRE-VENT TABLE INSTALLATIONS: Vent systems shall be sized and constructed

so as to develop a flow adequate to convey all combustion products to the outside atmosphere. The area of the vent shall not be less than the area of the largest vent connector inlet.

In no case may the vent connector, for its entire length, from a gas designed appliance be smaller than the outlet vent collar provided by the manufacturer.

A connector shall be as short and straight as possible. The horizontal run of an uninsulated connector to a natural draft chimney shall be not more than 75 percent of the height of the vertical portion of the chimney above the connector, unless part of an engineered system.

The horizontal run of an insulated connector to a natural draft chimney shall be not more than 100 percent of the height of the vertical portion of the chimney above the connector, unless part of an engineered system. The horizontal length, design and construction of combined connectors or connectors to a manifold joining two or more appliances to a chimney, shall be determined in accordance with approved engineering methods.

When two or more draft hood equipped vent connectors are joined together, the area of the vent or chimney shall not be less than the area of the largest vent connector inlet plus 50% of the areas of all additional inlets nor greater than seven times the smaller draft-hood outlet area.

Appliances which are connected to a common venting system shall be located within the same story of the building, except on new installations where all the appliances served by the common vent are located in rooms or spaces accessed only from the outdoors. The appliance enclosures shall not communicate with the occupiable areas of the building. Where the same vertical vent or chimney is used for gas appliances on more than one floor, all appliances except those on the lowest floor shall be provided with as much vertical vent connector rise as possible before connecting into the common vent.

Two or more connectors shall not enter a common venting system unless the inlets are offset in such a manner that no portion of an inlet is opposite the other inlets. When two or more appliances are common vented, the smaller connector shall enter at the highest level. Multiple connectors shall be attached to the vertical chimney or vent at an angle of 45 degrees or less relative to vertical.

The following shows the size of vents and cross-sectional areas.

Vent Size Inches						
3	4	5	6	7	8	9
Nominal Area Square Inches						
7.06	12.56	19.63	28.27	38.48	50.27	63.62
50% Square Area Inches						
3.53	6.28	9.82	14.14	19.24	25.13	31.81

TABLE VIII

The cross-sectional area can be determined by using the following formula:

$$D^2 \times .7854 = \text{Nominal area square inches}$$

Example: A 6" vent has 28.27 nominal area square inches.

$$6" \times 6" \times .7854 = 28.27 \text{ sq. inches}$$

The common vent size can be determined by using the nominal area square inches formula and using the nominal area square inches of the largest vent connector inlet plus 50% of the nominal area square inches of all additional inlets provided all the appliances are draft hood equipped.

Another means of determining a common vent size can be achieved by using the square root method.

Example: A 4" and 5" vent connector:

$$5" \times 5" \times 1(100\%) = 25"$$

$$4" \times 4" \times .5(50\%) = 8"$$

$$25" + 8" = 33"$$

Common vent size required is 6"

$$6" \times 6" = 36" \text{ (square root of } 36" \text{ is } 6")$$

36" is greater than but not less than the 33" needed. If the square root works out to be a lesser number, use a larger number that will be just larger than the number needed.

Every gravity type vent shall extend in as nearly a vertical direction as possible having no offsets greater than 45 degrees from vertical.

NOTE: Do not use the above methods for sizing Category I fan-assisted appliances.

9. CATEGORY I APPLIANCE VENTING: For proper vent and vent connector sizing of Category I fan assisted appliances refer to the vent tables and instructions provided by the manufacturer with each Category I appliance, IFGC Section 504 or Policies & Procedures Manual. Vent Category I natural draft appliances per manufacturer's installation instructions. See paragraph 8 for venting exception when venting only 1 or 2 Category I draft-hood equipped appliances.
10. CATEGORY II, III, and IV VENTING: The sizing of vents for Category II, III and IV gas equipment shall be in accordance with the manufacturer's instruction, provided no conflict exists with manufacturer's instructions and local or national codes.

11. **GAS VENT TERMINATION**: Vents shall extend above the roof surface, through a flashing, and terminate in a **LISTED** vent cap installed in accordance with its listing and the manufacturer's installation instructions.

Venting systems shall terminate not less than 3 feet above any forced air inlet located within 10 feet. This provision shall not apply to the combustion air intake of a direct vent appliance.

Gravity-type venting systems, other than a Type "BW" gas-venting system or a venting system which is an integral part of a listed appliance shall terminate not less than 5 feet above the highest vent collar which it serves. Type "BW" gas vents shall terminate at least 12 feet vertically above the bottom of the wall furnace.

Decorative shrouds shall not be installed at termination vents unless listed and labeled for use with that specific venting system and installed according to manufacturer's installation instructions.

Type "B" or "BW" gas vent shall terminate as follows:

Gas vent caps having an internal diameter of 12 inches or less shall be permitted to be terminated in accordance with Table IX, provided they are located at least 8 feet from a vertical wall or similar obstruction. All other Type "B" gas vent shall terminate not less than 2 feet above the highest point where they pass through the roof and at least 2 feet higher than any portion of a building within 10 feet.

VENT TERMINATION

ROOF SLOPE	MINIMUM HEIGHT FROM ROOF TO LOWEST DISCHARGE OPENING (feet)
Flat to 6/12	1.0
Over 6/12 to 7/12	1.25
Over 7/12 to 8/12	1.5
Over 8/12 to 9/12	2.0
Over 9/12 to 10/12	2.5
Over 10/12 to 11/12	3.25
Over 11/12 to 12/12	4.0
Over 12/12 to 14/12	5.0
Over 14/12 to 16/12	6.0
Over 16/12 to 18/12	7.0
Over 18/12 to 20/12	7.5
Over 20/12 to 21/12	8.0

TABLE IX

12. MECHANICAL DRAFT TERMINATION: Appliances shall terminate not less than 4 feet below or 4 feet horizontally, nor less than 1 foot above, any door, operable window or gravity air inlet into any building. The bottom of the vent shall be 12" above grade.

13. DIRECT VENT TERMINATION: Vent terminations of direct vent appliances with input ratings less than 10,000 Btu/h shall terminate not less than 6 inches from any opening which products of combustion could enter the building. Appliances over 10,000 Btu/h but not exceeding 50,000 Btu/h shall terminate

not less than 9 inches from any opening. Appliances with ratings over 50,000 Btu/h shall terminate not less than 12 inches from any opening into the building.

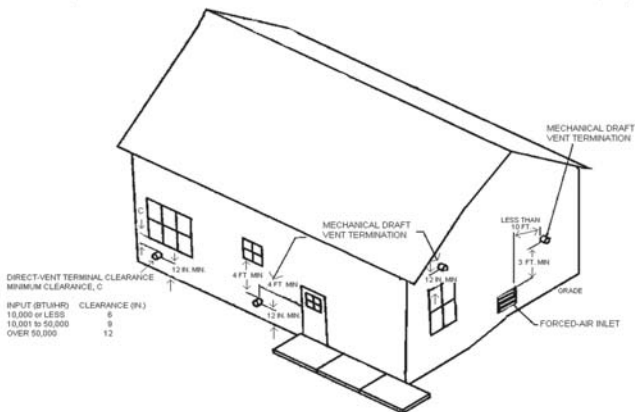


FIGURE 11

NOTE: Both vent and air intake shall be located at least 12 inches above grade.

14. **MASONRY CHIMNEYS:** Masonry chimneys shall be installed according to local building codes and lined with approved clay flue lining, or a listed chimney lining system that resists corrosion, erosion, softening or cracking from vent gases.

(1) Category I appliances. The effective area of the chimney when connected to more than one draft hood equipped appliance shall be not less than the area of the largest vent or chimney connector plus 50 percent of the area of the additional vent or chimney connectors, nor greater than seven times the smallest draft-hood outlet area.

- (2) Automatically controlled gas appliances connected to a chimney which also serves equipment burning liquid fuel shall be equipped with an automatic pilot. A gas appliance vent connector and a chimney connector from an appliance burning liquid fuel may be connected into the same chimney through separate openings, provided the gas appliance is vented above the liquid fuel-burning appliance, or both may be connected through a single opening if joined by a suitable fitting located at the chimney.
- (3) The chimney passageway shall be examined to ascertain it is clear and free of obstructions and **SHALL BE PROPERLY CLEANED IF PREVIOUSLY USED FOR VENTING SOLID- OR LIQUID-FUEL-BURNING APPLIANCES.**

When inspection reveals an existing chimney is not safe for the intended application, it shall be rebuilt to conform to chimney standards of the Building Code or replaced with an approved gas vent or factory-built chimney.

15. **PROHIBITED INSTALLATIONS:** Outside vents or chimneys should not be used except for large industrial installations.

A vent connector shall not be connected to a chimney serving a fireplace unless the fireplace opening is permanently sealed and the fireplace discontinued for use.

Gas appliances shall not be common vented with a chimney serving a separate appliance designed to burn solid fuel.

No portion of a venting system shall pass through any circulating air duct or furnace plenum.

Category 1 Vent Tables

TABLE 1		DOUBLE WALL COMMON VENT W/ DOUBLE WALL CONNECTOR, SINGLE APPLIANCE														
Height H (Ft)	Lateral L (Ft)	3"			4"			5"			6"			7"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308
	20	48	52	35	55	116	79	69	206	134	84	322	206	107	464	295
30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	475
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	385
	10	27	70	50	37	150	102	48	262	171	59	403	261	77	580	371
	15	33	64	NR	44	141	96	57	249	163	70	389	249	90	560	357
	20	56	58	NR	53	132	90	66	237	154	80	374	237	102	542	343
	30	NR	NR	NR	73	113	NR	88	214	NR	104	346	219	131	507	321

Category 1 Vent Tables

TABLE 2		DOUBLE WALL COMMON VENT W/ SINGLE WALL CONNECTOR, SINGLE APPLIANCE														
Height H (Ft)	Lateral L (Ft)	3"			4"			5"			6"			7"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Mix	Max	Min	Mix	Max	Min	Mix	Max	Min	Mix	Max	Min	Mix	Max
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	284
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213
	4	NR	NR	33	74	92	63	102	152	102	146	225	152	187	313	208
	6	NR	NR	31	83	89	60	114	147	99	163	220	148	207	307	203
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246
	5	NR	NR	37	77	102	69	107	168	114	151	252	171	193	352	235
	8	NR	NR	33	90	95	64	122	161	107	175	243	163	223	342	225
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344
	2	39	61	41	59	117	80	82	193	128	119	287	194	152	400	272
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261
	10	NR	NR	34	97	100	68	132	171	112	188	261	171	237	369	241
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	314
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298
	10	NR	NR	39	95	116	79	128	201	131	182	308	203	228	438	284
20	15	NR	NR	NR	NR	NR	72	158	186	124	220	290	192	272	418	269
	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334
30	10	NR	NR	41	93	129	86	125	223	146	177	344	224	222	491	316
	15	NR	NR	NR	NR	NR	80	155	208	136	216	325	210	264	469	301
	20	NR	NR	NR	NR	NR	NR	186	192	126	254	306	196	309	448	285
	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472
30	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382
	10	NR	NR	NR	91	144	98	122	255	168	171	397	257	213	570	367
	15	NR	NR	NR	115	131	NR	151	239	157	208	377	242	255	547	349
30	20	NR	NR	NR	NR	NR	NR	181	223	NR	246	357	228	298	524	333
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	389	477	305

Category 1 Vent Tables

TABLE 3		DOUBLE WALL COMMON VENT W/ DOUBLE WALL CONNECTOR, TWO OR MORE APPLIANCES														
Height H (ft)	Rise R (ft)	3"			4"			5"			6"			7"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242

COMMON VENT TABLE ALL DOUBLE WALL VENTING

Vent Height H (ft)	4"			5"			6"			7"		
	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT
6	92	81	65	140	116	103	204	161	147	309	248	200
8	101	90	73	155	129	114	224	178	163	339	275	223
10	110	97	79	169	141	124	243	194	178	367	299	242
15	125	112	91	195	164	144	283	228	206	427	352	280
20	136	123	102	215	183	160	314	255	229	475	394	310
30	152	138	118	244	210	185	361	297	266	547	459	360

Category 1 Vent Tables

TABLE 4		DOUBLE WALL COMMON VENT W/ SINGLE WALL CONNECTOR, TWO OR MORE APPLIANCES														
Height H (Ft)	Rise R (Ft)	3"			4"			5"			6"			7"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	NR	NR	26	NR	NR	46	NR	NR	71	NR	NR	102	207	223	140
	2	NR	NR	31	NR	NR	55	NR	NR	85	168	182	123	215	251	167
	3	NR	NR	34	NR	NR	62	121	131	95	175	198	138	222	273	188
8	1	NR	NR	27	NR	NR	48	NR	NR	75	NR	NR	106	226	240	145
	2	NR	NR	32	NR	NR	57	125	126	89	184	193	127	234	266	173
	3	NR	NR	35	NR	NR	64	130	138	100	191	208	144	241	287	197
10	1	NR	NR	28	NR	NR	50	119	121	77	182	186	110	240	253	105
	2	NR	NR	33	84	85	59	124	134	91	189	203	132	248	278	183
	3	NR	NR	36	89	91	67	129	144	102	197	217	148	257	299	203
15	1	NR	NR	29	79	87	52	116	138	81	177	214	116	238	291	158
	2	NR	NR	34	83	94	62	121	150	97	185	230	138	246	314	189
	3	NR	NR	39	87	100	70	127	160	109	193	243	157	255	333	215
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325	165
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346	197
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363	223
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380	175
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397	208
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235

COMMON VENT TABLE ANY SINGLE WALL VENTING

Vent Height H (ft)	4"			5"			6"			7"		
	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT	+FAN	+NAT	+NAT
6	NR	78	64	NR	113	99	200	158	144	304	244	196
8	NR	87	71	NR	126	111	218	173	159	331	269	218
10	NR	94	76	163	137	120	237	189	174	357	292	236
15	121	108	88	189	159	140	275	221	200	416	343	274
20	131	118	98	208	177	156	305	247	223	463	383	302
30	145	132	113	236	202	180	350	286	257	533	446	349

SECTION VII

CONTROLS AND REGULATORS

1. **AUTOMATIC VALVES:** A shut-off valve shall be installed upstream of an automatic valve. (See Figure 11)

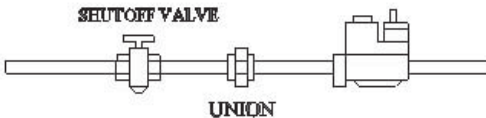


FIGURE 12

An automatic gas valve controlled from a remote point, such as a thermostat, shall supply gas to only one appliance. All automatic gas valves shall conform with manufacturer's ratings and be installed according to the following provisions:

- (a) The automatic valve will be designed to shut off the gas supply in case of power supply failure.
 - (b) The automatic gas valve shall be of a size to allow the required amount of low pressure gas to the appliance.
 - (c) Industrial Service: The automatic gas valve shall be sized for commercial and industrial service and be compatible with the type of equipment and available gas pressure.
2. **GAS PRESSURE REGULATORS:** A gas pressure regulator or gas equipment pressure regulator shall be installed where the gas appliance is designed to operate at a lower pressure than the fuel gas system. Access shall be provided to pressure regulators and be protected from physical damage. Regulators installed on the exterior of the building shall be approved for outdoor installation. Vent piping for relief vents and breather vents shall be constructed with the same material used for gas piping systems.

3. MPREGULATORS: MP (medium pressure) regulators installed in the system shall comply with the following.

- (a) The MP regulator shall be approved and shall be suitable for the inlet and outlet gas pressures for the application.
- (b) The MP regulator shall maintain a reduced outlet pressure under lockup (no-flow) conditions. The new Z21.80 standard requires the use of an over-pressure protection device (OPD) for supply pressure above 2 psi tested and approved with the regulator
- (c) The capacity of the MP regulator, determined by the published ratings of its manufacturer, shall be adequate to supply the appliance(s) served.
- (d) The MP pressure regulator shall be accessible for servicing.
- (e) A tee fitting with one opening capped or plugged shall be installed between the MP regulator and its upstream shut-off valve. Tee fitting shall be located to allow connection of a pressure-measuring instrument and to serve as a sediment trap.
- (f) A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the MP regulator outlet. Tee fitting shall be located to allow connection of a pressure measuring instrument.

4. VENTING OF MPREGULATORS: Line gas pressure regulators requiring a vent shall have an independent vent to the outside of the building. The vent shall be designed to prevent the entry of water or foreign objects.

EXCEPTION: A vent to the outside of the building is not required for MP regulators equipped with and labeled for utilization with approved vent-limiting devices and must be installed according to manufacturer's installation instructions.

5. VENTING FOR DIAPHRAGM TYPE VALVES: Diaphragm type valves shall be equipped to convey bleed gas to the outside atmosphere or into the combustion chamber adjacent to a continuous pilot.

In the case of bleed lines leading outdoors, means shall be employed to prevent water from entering this piping and also to prevent blockage of lines by insects and foreign matter.

Under no circumstances shall bleed lines terminate in the gas utilization equipment vent, chimney or exhaust system.

In the case of bleed lines entering the combustion chamber, the bleed line shall be located so the bleed gas will be readily ignited by the pilot and the heat liberated thereby will not adversely affect the normal operation of the safety shut-off system. The termination of the bleed line shall be securely held in a fixed position relative to the pilot.

A bleed line(s) from a diaphragm type valve and a vent line(s) from a gas appliance pressure regulator shall not be connected to a common manifold. Neither shall terminate in a positive pressure combustion chamber.

6. ATMOSPHERIC VENTS AND GAS VENT BLEED OR RELIEFLINES FOR BOILERS (OVER 400,000 BTU) ASME CSD-1:

- (a) Gas pressure regulator, pressure interlock switches and all other valve train components requiring atmospheric air pressure to balance a diaphragm or other similar device, shall be provided with a pipe-threaded connection for the vent line. This line shall be piped by the installer to the outdoors at a safe point of discharge as determined by the authority having jurisdiction. A means shall be provided at the terminating point to prevent a blockage of the line by foreign material, moisture, or insects.

- (b) Atmospheric vent lines, when manifolded, shall be sized in accordance with an approved design that minimizes back pressure in the event of diaphragm rupture. Refer to IFGC 410.3.1.
- (c) Atmospheric vent lines shall not be connected to any common or manifolded gas vent, bleed or relief lines.
- (d) Gas vent, bleed or relief lines shall have provisions to be piped by the installer to the outdoors at a safe point of discharge as determined by the authority having jurisdiction. A means shall be provided at the terminal point to prevent stoppage of the lines by foreign material, moisture or insects. However, a gas bleed line from a diaphragm control valve and vent line from an appliance regulator may be vented to a constant burning pilot.
- (e) Gas vent lines with normally open, fully ported, electrical operated valves shall be sized in accordance with manufacturer's instructions.

SECTION VIII

PROCEDURES TO BE FOLLOWED TO PLACE AN APPLIANCE IN OPERATION

1. PROCEDURE: Under this heading appears the fundamental procedure to be followed in placing an appliance in operation and instructing the customer in its safe and satisfactory use. It is the responsibility of the installing agency to put into effect the procedures in the following paragraphs.
2. BURNERS TO BE ADJUSTED: The purpose for burner input adjustment is to maintain a ration of 1 part fuel to 10 parts air. Not adjusting the appliance for the elevation and local Btu value will cause over firing, combustion problems, and lost efficiency. Over firing may render an appliance unsafe and cause premature failure to the combustion chambers. The appliance adjustment is the responsibility of the installer and should be completed at the time of installation, following procedures outlined in the installation instructions.

Appliance regulator shall be checked for proper input pressure. Failure to check for proper appliance regulator pressure may over fire the burners and render the appliance unsafe. Most appliance manufacturers allow a plus or minus .3 inch water column adjustment. Consult installation instructions for proper regulator adjustment.

To convert from inches of water column to ounces of gas pressure, see Table XII, Page 94.

3. APPLIANCE RATING: Appliance ratings are established by American Gas Association Testing Laboratories at sea level.

NOTE: For proper deration procedures, see appliance installation instructions.

Appliances may not require any deration, 2% per 1,000 or 4% per 1,000. The following is an example to derate an appliance 4% per 1,000.

$$\text{Formula: } \frac{\text{Elevation}}{1,000} \quad \times \quad .04 \quad = \quad \mathbf{X}$$

$$1.00 \quad - \quad \mathbf{X} \quad = \quad \text{deration factor (multiplier)}$$

Example: Salt Lake City ~ 4,350 ft. elevation

$$\frac{4,350}{1,000} \quad \times \quad .04 \quad = \quad .174$$

$$1.00 \quad - \quad .174 \quad = \quad .826 \text{ (round to nearest hundreth .83)}$$

.83 will be the deration factor (multiplier)

Proper deration of the appliance will be accomplished by the use of the following formula:

$$\frac{\text{appliance input} \times \text{deration factor (multiplier)}}{\text{Btu per cubic foot}}$$

Example: Salt Lake City ~ 100,000 Btu rated appliance

$$\frac{100,000 \times .83}{890} = 93.258 \text{ CFH}$$

See Table X, Pages 87-90 for deration factors, specific gravity and Btu/cubic ft., or if the Btu/cubic ft. is not listed contact Questar Gas.

4. **CLOCKING BURNER INPUT:** To check the appliance input, the test hand on the meter shall be timed for at least one revolution and the input determined by using this time. For

smaller test dials (1/4 and 1/2) allow at least two revolutions on larger input appliances. Test dials are generally marked 1/2, 1, 2, or 5 cubic feet per revolution, depending upon the size of the meter. Information for converting the test hand readings to cubic feet per hour is given in Table XIII, Pages 95-97 and Table XIV, Pages 98-100, or use the formula: (for four ounce pressure)

$$\frac{60 \times 60 \times \text{dial size}}{\text{number of seconds for one revolution}}$$

EXAMPLE: 1/2 foot test hand takes 11 seconds for one revolution

$$60 \times 60 \times 1/2 = 1800$$

$$\frac{1800}{11} = 164 \text{ CFH}$$

(For elevated pressure, use above formula and multiply CFH by pressure factor from service regulator badge. For two pound pressure use Table XI, Page 93.)

STANDARD DERATION FACTORS

CENTER	DERATION FACTOR (MULTIPLIER)		ELEVATION	SPECIFIC GRAVITY	BTU/CUBIC FT.
	4 %	2 %			
SALT LAKE	.83	.91	4350	0.60	890
Alta	.66	.83	8600	0.60	755
Snowbird	.69	.84	7800	0.60	778
HEBER	.77	.89	5660	0.60	843
Coalville	.78	.89	5586	0.60	846
Deer Valley	.70	.85	7500	0.60	786
Francis	.74	.87	6560	0.60	815
Henefer	.79	.89	5355	0.60	851
Jeremy Ranch	.74	.87	6400	0.60	821
Kamas	.74	.87	6473	0.60	817
Midway	.78	.89	5550	0.60	847
Oakley	.74	.87	6475	0.60	818
Park City	.72	.86	7000	0.60	803
Pinebrook	.74	.87	6400	0.60	821
Summit Park	.72	.86	7000	0.60	803
Wanship	.76	.88	5900	0.60	837
Woodland	.76	.88	6000	0.60	833
TOOELE	.80	.90	4900	0.60	867
Grantsville	.82	.91	4400	0.60	883
PRICE	.77	.89	5680	0.62	896
Castledale	.78	.89	5660	0.56	800
East Carbon	.75	.87	6300	0.62	877
Ferron	.76	.88	5930	0.56	843
Helper	.76	.88	5900	0.62	891
Kenilworth	.74	.87	6604	0.62	865
ROOSEVELT	.79	.90	5150	0.62	913
Altamont	.75	.87	6375	0.62	873
Bonanza	.78	.89	5450	0.62	904
Dutch John	.74	.87	6400	0.60	845
Vernal	.79	.89	5300	0.62	908
MOAB	.84	.92	4025	0.60	923
Monticello	.72	.86	7066	0.60	820

TABLE X

STANDARD DERATION FACTORS

CENTER	DERATION FACTOR (MULTIPLIER)		ELEVATION	SPECIFIC GRAVITY	BTU/CUBIC FT.
	4 %	2 %			
PROVO	.83	.91	4350	0.56	868
Birds Eye	.78	.89	5400	0.56	834
Cedar Fort	.79	.90	5125	0.56	851
Nephi	.80	.90	5100	0.56	842
Santaquin	.80	.90	4900	0.56	849
Woodland Hills	.77	.89	5650	0.56	828
OGDEN	.83	.91	4350	0.60	890
Morgan	.80	.90	5000	0.60	862
Ogden Valley	.80	.90	5000	0.60	862
LAYTON	.83	.91	4350	0.60	890
BRIGHAM CITY	.83	.92	4220	0.60	890
Mantua	.79	.90	5175	0.60	856
Tremonton	.83	.91	4325	0.60	890
LOGAN	.82	.91	4500	0.60	880
FILLMORE	.80	.90	5100	0.60	885
Beaver	.76	.88	5900	0.60	862
Delta	.81	.91	4650	0.60	900
Holden	.78	.90	5150	0.60	883
Kanosh	.79	.90	5200	0.60	882
Leamington	.81	.91	4700	0.60	898
Lynndyl	.81	.90	4800	0.60	895
Meadow	.81	.90	4800	0.60	895
Milford	.80	.90	4950	0.60	889
Minersville	.79	.89	5300	0.60	879
Oak City	.80	.90	5105	0.60	885
Scipio	.79	.89	5300	0.60	879
RICHFIELD	.79	.89	5290	0.56	838
Aurora	.80	.90	5150	0.56	841
Axtell	.80	.90	5150	0.56	841
Centerfield	.80	.90	5100	0.56	842
Central/Annabella	.79	.90	5340	0.56	836
Chester	.78	.89	5510	0.56	832

TABLE X (continued)

STANDARD DERATION FACTORS

CENTER	DERATION FACTOR (MULTIPLIER)		ELEVATION	SPECIFIC GRAVITY	BTU/CUBIC FT.
	4 %	2 %			
Richfield					
Circleville	.76	.88	6060	0.56	815
Elsinore	.79	.89	5330	0.56	836
Ephraim	.78	.89	5515	0.56	831
Fairview	.76	.88	5960	0.56	819
Fayette	.80	.90	5050	0.56	844
Fountain Green	.77	.89	5750	0.56	825
Glenwood	.79	.89	5300	0.56	838
Gunnison	.80	.90	5100	0.56	842
Indianola	.76	.88	6000	0.56	818
Joseph	.78	.89	5435	0.56	834
Junction	.76	.88	6020	0.56	817
Manti	.78	.89	5560	0.56	830
Marysvale	.76	.88	5920	0.56	820
Mayfield	.78	.89	5540	0.56	831
Monroe	.79	.89	5375	0.56	835
Moroni	.78	.89	5520	0.56	831
Mount Pleasant	.77	.88	5840	0.56	822
Panguich	.74	.87	6624	0.56	797
Redmond	.80	.90	5100	0.56	842
Salina	.79	.90	5140	0.56	841
Sevier	.78	.89	5542	0.56	830
Sigurd	.79	.89	5260	0.56	838
Spring City	.77	.88	5800	0.56	823
Sterling	.78	.89	5560	0.56	830
Venice	.79	.89	5260	0.56	838
Wales	.78	.89	5500	0.56	832
CEDAR CITY	.77	.89	5720	0.56	825
Brian Head	.61	.80	9800	0.56	708
Enoch	.77	.89	5720	0.56	825
Enterprise	.79	.89	5300	0.60	879
Hamilton Fort	.77	.89	5647	0.56	828
Kanarrville	.78	.89	5480	0.56	832
New Castle	.79	.90	5200	0.60	882
Paragonah	.77	.88	5860	0.56	822
Parowan	.76	.88	6060	0.56	815
Summit	.76	.88	5950	0.56	817

TABLE X (continued)

STANDARD DERATION FACTORS

CENTER	DERATION FACTOR (MULTIPLIER)		ELEVATION	SPECIFIC GRAVITY	BTU/CUBIC FT.
	4 %	2 %			
ST. GEORGE	.89	.94	2760	0.56	919
Central	.79	.90	5200	0.60	882
Dameron Valley	.82	.91	4606	0.56	859
Diamond Valley	.81	.91	4660	0.56	855
Hurricane	.87	.94	3250	0.56	903
Ivins	.88	.94	2960	0.56	912
LaVerkin	.87	.94	3200	0.56	906
Leeds	.86	.93	3460	0.56	896
Santa Clara	.89	.94	2760	0.56	919
Springdale	.84	.92	3913	0.56	883
Toquerville	.85	.92	3760	0.56	886
Veyo	.82	.91	4500	0.60	905
Washington	.89	.94	2760	0.56	919
Winchester Hills	.84	.92	3900	0.56	883
ROCK SPRINGS	.75	.87	6300	0.62	877
Baggs	.75	.87	6250	0.62	878
Granger	.75	.87	6260	0.62	878
Green River	.75	.87	6300	0.62	877
Wamsutter	.73	.87	6740	0.62	862
EVANSTON	.73	.86	6800	0.60	809
Big Piney	.73	.86	6820	0.62	860
Kemmerrer	.72	.86	6958	0.60	800
LaBarge	.74	.87	6600	0.62	867
Lyman	.73	.87	6700	0.62	863
Randolph	.75	.87	6280	0.60	825
Woodruff	.75	.87	6340	0.60	823

TABLE X (continued)

5. ADJUSTING BURNER INPUT: The input rate shall be adjusted to the required rate by changing a fixed orifice size, changing the adjustment of an adjustable orifice or by readjusting the gas pressure regulator outlet pressure as per manufacturer's instructions, normally plus or minus .3" water column (when a regulator is provided). For convenience in determining the proper orifice size, consult Table XV, Pages 101-109, use the table corresponding with the specific gravity of the gas in your location. After adjusting input, install a sticker on the front of the appliance, visible to the customer, listing company name and date. (Stickers available at local Questar Gas Office.).

EXAMPLE: 93 cf/h is required for an appliance with four burners. Specific gravity of the gas is .60 and manifold pressure is 3.5inches water column.

$93 \div 4 = 23.25$ cf/h per burner, a number 44 orifice will be required.

6. PRIMARY AIR ADJUSTMENT: The primary air for injection (Bunsen) type burner shall be adjusted for proper flame characteristics in accordance with the manufacturer's instructions. Normally, the primary air adjustment shall first be set to give a soft blue flame having luminous tips and then increased to a point where the yellow tips just disappear. After setting the primary air, the adjustment means shall be secured in position.

NOTE: After all adjustments are made, a CO test should be performed.

7. AUTOMATIC PILOTS: When an automatic pilot is provided it shall be checked for proper operation and adjustment in accordance with the manufacturer's instructions. If the pilot safety does not function properly it shall be replaced.

8. PROTECTIVE DEVICES: All protective devices furnished with the appliances such as a limit control, fan control, low water cut-off device, manual operating features, etc., shall be operational.
9. CHECKING THE DRAFT: On vent connected appliances, the appliance shall be operated for a few minutes and the installation checked to see that the products of combustion are going up the vent properly by passing a lighted match or taper around the edge of the relief opening. If drawing properly, the match flame will be drawn into the draft hood. If not, the products of combustion will tend to extinguish this flame. If the products of combustion are escaping from the relief opening of the draft hood, the appliance shall not be left in operation unless and until proper adjustments or repairs are made to ensure adequate draft through the vent.
10. INSTRUCTIONS TO THE CUSTOMER: The customer shall be thoroughly instructed on the operation of the appliance.
11. OPERATION / INSTALLATION INSTRUCTIONS:
MANUFACTURER'S OPERATING AND INSTALLATION INSTRUCTIONS SHALL BE LEFT WITH THE CUSTOMER

PRESSURE FACTOR MULTIPLIER

MULTIPLIER TO OBTAIN FOUR OUNCES FLOW RATE					
ELEVATION FEET	ATMOSPHERIC PRESSURE, psi	METER PRESSURE, psig			
		1	2	5	10
2,000	13.70	1.0540	1.1259	1.3417	1.7021
3,000	13.52	1.0547	1.1275	1.3462	1.7112
4,000	12.70	1.0581	1.1356	1.3681	1.7561
4,350	12.60	1.0586	1.1366	1.3709	1.7620
5,000	12.20	1.0604	1.1410	1.3828	1.7864
6,000	11.80	1.0624	1.1457	1.3955	1.8125
7,000	11.30	1.0651	1.1519	1.4126	1.8476
8,000	10.90	1.0675	1.1574	1.4273	1.8799
9,000	10.50	1.0700	1.1632	1.4432	1.9105

Multipliers for reducing gas volumes to a pressure base of four ounces above an average atmospheric pressure of each elevation.

TABLE XI

CONVERSION OF INCHES OF WATER COLUMN TO OUNCES OF GAS PRESSURE

INCHES OF WATER COLUMN	OUNCES OF GAS PRESSURE
1.73	1
3.46	2
5.19	3
6.92	4
8.62	5
10.38	6
12.11	7
13.84	8
15.57	9
17.30	10
19.03	11
20.76	12
22.49	13
24.22	14
25.95	15
27.68	16
29.41	17
31.14	18
32.89	19
34.60	20

To convert from inches of water column to ounces per square inch — multiply by the factor 0.5780.

TABLE XII

**CLOCKING METER GAS INPUT TO APPLIANCE
IN CUBIC FEET PER HOUR**

FOUR OUNCE METER PRESSURE				
SECONDS FOR ONE REVOLUTION AT FOUR OUNCE METER PRESSURE	SIZE OF TEST METER DIAL			
	ONE-HALF CU. FT.	ONE CU. FT.	TWO CU. FT.	FIVE CU. FT.
	CUBIC FEET PER HOUR			
10	180	360	720	1,800
11	164	327	655	1,636
12	150	300	600	1,500
13	138	277	554	1,385
14	129	257	514	1,286
15	120	240	480	1,200
16	113	225	450	1,125
17	106	212	424	1,059
18	100	200	400	1,000
19	95	189	379	947
20	90	180	360	900
21	86	171	343	857
22	82	164	327	818
23	78	157	313	783
24	75	150	300	750
25	72	144	288	720
26	69	138	277	692
27	67	133	267	667
28	64	129	257	643
29	62	124	248	621
30	60	120	240	600
31	58	116	232	581
32	56	113	225	563
33	55	109	218	545
34	53	106	212	529
35	51	103	206	514
36	50	100	200	500
37	49	97	195	486
38	47	95	189	474
39	46	92	185	462

TABLE XIII

**CLOCKING METER GAS INPUT TO APPLIANCE
IN CUBIC FEET PER HOUR**

FOUR OUNCE METER PRESSURE				
SECONDS FOR ONE REVOLUTION AT FOUR OUNCE METER PRESSURE	SIZE OF TEST METER DIAL			
	ONE-HALF CU. FT.	ONE CU. FT.	TWO CU. FT.	FIVE CU. FT.
	CUBIC FEET PER HOUR			
40	45	90	180	450
41	44	88	176	439
42	43	86	171	429
43	42	84	167	419
44	41	82	164	409
45	40	80	160	400
46	39	78	157	391
47	38	77	153	383
48	38	75	150	375
49	37	73	147	367
50	36	72	144	360
51	35	71	141	353
52	35	69	138	346
53	34	68	136	340
54	33	67	133	333
55	33	65	131	327
56	32	64	129	321
57	32	63	126	316
58	31	62	124	310
59	31	61	122	305
60	30	60	120	300
62	29	58	116	290
64	28	56	113	281
66	27	55	109	273
68	26	53	106	265
70	26	51	103	257
72	25	50	100	250
74	24	49	97	243
76	24	47	95	237
78	23	46	92	231

TABLE XIII (continued)

**CLOCKING METER GAS INPUT TO APPLIANCE
IN CUBIC FEET PER HOUR**

FOUR OUNCE METER PRESSURE				
SECONDS FOR ONE REVOLUTION AT FOUR OUNCE METER PRESSURE	SIZE OF TEST METER DIAL			
	ONE-HALF CU. FT.	ONE CU. FT.	TWO CU. FT.	FIVE CU. FT.
	CUBIC FEET PER HOUR			
80	23	45	90	225
82	22	44	88	220
84	21	43	86	214
86	21	42	84	209
88	20	41	82	205
90	20	40	80	200
94	19	38	77	191
98	18	37	73	184
100	18	36	72	180
104	17	35	69	173
108	17	33	67	167
112	16	32	64	161
116	16	31	62	155
120	15	30	60	150
130	14	28	55	138
140	13	26	51	129
150	12	24	48	120
160	11	23	45	113
170	11	21	42	106
180	10	20	40	100

TABLE XIII (continued)

CLOCKING METER GAS INPUT TO APPLIANCE
IN CUBIC FEET PER HOUR

TWO POUND METER PRESSURE				
SECONDS FOR ONE REVOLUTION AT FOUR OUNCE METER PRESSURE	SIZE OF TEST METER DIAL			
	ONE-HALF CU. FT.	ONE CU. FT.	TWO CU. FT.	FIVE CU. FT.
	CUBIC FEET PER HOUR			
10	205	409	818	2,045
11	186	372	744	1,859
12	170	341	682	1,704
13	157	315	629	1,573
14	146	292	584	1,461
15	136	273	545	1,363
16	128	256	511	1,278
17	120	241	481	1,203
18	114	227	454	1,136
19	108	215	431	1,076
20	102	205	409	1,023
21	97	195	390	974
22	93	186	372	930
23	89	178	356	889
24	85	170	341	852
25	82	164	327	818
26	79	157	315	787
27	76	151	303	757
28	73	146	292	730
29	71	141	282	705
30	68	136	273	682
31	66	132	264	660
32	64	128	256	639
33	62	124	248	620
34	60	120	241	602
35	58	117	234	584
36	57	114	227	568
37	55	111	221	553
38	54	108	215	538
39	52	105	210	524

TABLE XIV

**CLOCKING METER GAS INPUT TO APPLIANCE
IN CUBIC FEET PER HOUR**

TWO POUND METER PRESSURE				
SECONDS FOR ONE REVOLUTION AT FOUR OUNCE METER PRESSURE	SIZE OF TEST METER DIAL			
	ONE-HALF CU. FT.	ONE CU. FT.	TWO CU. FT.	FIVE CU. FT.
	CUBIC FEET PER HOUR			
40	51	102	205	511
41	50	100	200	499
42	49	97	195	487
43	48	95	190	476
44	46	93	186	465
45	45	91	182	454
46	44	89	178	445
47	44	87	174	435
48	43	85	170	426
49	42	83	167	417
50	41	82	164	409
51	40	80	160	401
52	39	79	157	393
53	39	77	154	386
54	38	76	151	379
55	37	74	149	372
56	37	73	146	365
57	36	72	144	359
58	35	71	141	353
59	35	69	139	347
60	34	68	136	341
62	33	66	132	330
64	32	64	128	320
66	31	62	124	310
68	30	60	120	301
70	29	58	117	292
72	28	57	114	284
74	28	55	111	276
76	27	54	108	269
78	26	52	105	262

TABLE XIV (continued)

**CLOCKING METER GAS INPUT TO APPLIANCE
IN CUBIC FEET PER HOUR**

TWO POUND METER PRESSURE				
SECONDS FOR ONE REVOLUTION AT FOUR OUNCE METER PRESSURE	SIZE OF TEST METER DIAL			
	ONE-HALF CU. FT.	ONE CU. FT.	TWO CU. FT.	FIVE CU. FT.
	CUBIC FEET PER HOUR			
80	26	51	102	256
82	25	50	100	249
84	24	49	97	243
86	24	48	95	238
88	23	46	93	232
90	23	45	91	227
94	22	44	87	218
98	21	42	83	209
100	20	41	82	205
104	20	39	79	197
108	19	38	76	189
112	18	37	73	183
116	18	35	71	176
120	17	34	68	170
130	16	31	63	157
140	15	29	58	146
150	14	27	55	136
160	13	26	51	128
170	12	24	48	120
180	11	23	45	114

TABLE XIV (continued)

ORIFICE CAPACITIES **specific gravity = 0.56**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
1	233.01	215.73	196.93	176.14	164.76	152.54
2	218.92	202.68	185.02	165.48	154.80	143.31
3	203.34	188.25	171.85	153.71	143.78	133.11
4	195.80	181.28	165.48	148.01	138.45	128.18
5	189.30	175.26	159.99	143.10	133.85	123.92
6	186.56	172.72	157.67	141.02	131.92	122.13
7	181.08	167.65	153.04	136.88	128.04	118.54
8	177.48	164.32	150.00	134.17	125.50	116.19
9	172.18	159.40	145.52	130.15	121.75	112.72
10	167.78	155.34	141.80	126.83	118.64	109.84
11	163.50	151.37	138.18	123.60	115.61	107.04
12	160.14	148.26	135.34	121.05	113.23	104.83
13	153.40	142.02	129.65	115.96	108.47	100.42
14	148.49	137.48	125.50	112.25	105.00	97.21
15	145.24	134.47	122.75	109.79	102.70	95.08
16	140.45	130.03	118.70	106.17	99.31	91.94
17	134.17	124.22	113.39	101.42	94.87	87.83
18	128.75	119.20	108.81	97.32	91.04	84.28
19	123.50	114.34	104.37	93.35	87.33	80.85
20	116.19	107.57	98.20	87.83	82.16	76.07
21	113.34	104.93	95.79	85.68	80.14	74.20
22	110.49	102.29	93.38	83.52	78.12	72.33
23	106.32	98.43	89.86	80.37	75.18	69.60
24	103.58	95.90	87.54	78.30	73.24	67.81
25	100.16	92.73	84.65	75.71	70.82	65.57
26	95.82	88.71	80.98	72.43	67.75	62.73
27	92.97	86.07	78.57	70.28	65.74	60.86

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV

ORIFICE CAPACITIES **specific gravity = 0.56**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
28	88.40	81.84	74.71	66.82	62.51	57.87
29	82.92	76.77	70.08	62.68	58.63	54.28
30	73.96	68.47	62.51	55.91	52.30	48.42
31	64.54	59.76	54.55	48.79	45.64	42.25
32	60.32	55.85	50.98	45.60	42.65	39.49
33	57.24	52.99	48.38	43.27	40.47	37.47
34	55.24	51.14	46.69	41.76	39.06	36.16
35	54.22	50.19	45.82	40.98	38.34	35.49
36	50.85	47.08	42.97	38.44	35.96	33.29
37	48.45	44.86	40.95	36.63	34.26	31.72
38	46.17	42.74	39.02	34.90	32.65	30.22
39	44.40	41.11	37.52	33.56	31.40	29.07
40	43.03	39.84	36.37	32.53	30.43	28.17
41	41.32	38.25	34.92	31.23	29.22	27.05
42	39.21	36.30	33.14	29.64	27.72	25.67
43	35.50	32.86	30.00	26.83	25.10	23.24
44	33.16	30.70	28.02	25.06	23.45	21.71
45	30.13	27.90	25.47	22.78	21.31	19.73
46	29.39	27.21	24.84	22.22	20.78	19.24
47	27.62	25.57	23.34	20.88	19.53	18.08
48	25.91	23.99	21.90	19.59	18.32	16.96
49	23.91	22.14	20.21	18.08	16.91	15.65
50	21.97	20.34	18.57	16.61	15.54	14.38
51	20.15	18.65	17.03	15.23	14.24	13.19
52	18.09	16.75	15.29	13.68	12.79	11.84
53	15.87	14.69	13.41	11.99	11.22	10.39
54	13.58	12.57	11.48	10.27	9.60	8.89

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.56**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
55	12.10	11.20	10.23	9.15	8.55	7.92
56	9.69	8.97	8.19	7.33	6.85	6.34
57	8.29	7.67	7.00	6.26	5.86	5.42
58	7.90	7.32	6.68	5.97	5.59	5.17
59	7.53	6.97	6.37	5.69	5.33	4.93
60	7.17	6.64	6.06	5.42	5.07	4.70
61	6.82	6.31	5.76	5.16	4.82	4.46
62	6.47	5.99	5.47	4.89	4.58	4.24
63	6.13	5.68	5.18	4.64	4.34	4.02
64	5.81	5.38	4.91	4.39	4.11	3.80
65	5.49	5.08	4.64	4.15	3.88	3.59
66	4.88	4.52	4.12	3.69	3.45	3.19
67	4.59	4.25	3.88	3.47	3.24	3.00
68	4.31	3.99	3.64	3.26	3.05	2.82
69	3.82	3.54	3.23	2.89	2.70	2.50
70	3.52	3.25	2.97	2.66	2.49	2.30
71	3.03	2.81	2.56	2.29	2.14	1.98
72	2.80	2.59	2.37	2.12	1.98	1.83
73	2.58	2.39	2.18	1.95	1.82	1.69
74	2.27	2.10	1.92	1.72	1.61	1.49
75	1.97	1.83	1.67	1.49	1.40	1.29
76	1.79	1.66	1.51	1.35	1.27	1.17
77	1.45	1.34	1.23	1.10	1.02	0.95
78	1.15	1.06	0.97	0.87	0.81	0.75
79	0.94	0.87	0.80	0.71	0.67	0.62
80	0.82	0.76	0.69	0.62	0.58	0.53

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.60**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
1	225.11	208.41	190.25	170.17	159.18	147.37
2	211.49	195.80	178.74	159.87	149.55	138.45
3	196.44	181.87	166.02	148.50	138.91	128.60
4	189.16	175.13	159.87	142.99	133.76	123.84
5	182.88	169.31	154.56	138.24	129.31	119.72
6	180.23	166.86	152.32	136.24	127.44	117.99
7	174.94	161.96	147.85	132.24	123.70	114.52
8	171.47	158.75	144.92	129.62	121.24	112.25
9	166.34	154.00	140.58	125.74	117.62	108.89
10	162.09	150.07	136.99	122.53	114.62	106.11
11	157.96	146.24	133.50	119.41	111.69	103.41
12	154.71	143.23	130.75	116.95	109.39	101.28
13	148.20	137.21	125.25	112.03	104.79	97.02
14	143.46	132.82	121.24	108.44	101.44	93.92
15	140.32	129.91	118.59	106.07	99.22	91.86
16	135.68	125.62	114.67	102.57	95.94	88.83
17	129.62	120.00	109.55	97.98	91.65	84.86
18	124.38	115.16	105.12	94.02	87.95	81.43
19	119.31	110.46	100.83	90.19	84.36	78.11
20	112.25	103.93	94.87	84.85	79.37	73.49
21	109.50	101.37	92.54	82.77	77.43	71.68
22	106.74	98.82	90.21	80.69	75.48	69.88
23	102.71	95.09	86.81	77.64	72.63	67.24
24	100.07	92.64	84.57	75.64	70.76	65.51
25	96.76	89.58	81.78	73.14	68.42	63.34
26	92.57	85.70	78.24	69.98	65.46	60.60
27	89.81	83.15	75.91	67.89	63.51	58.80

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.60**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
28	85.40	79.07	72.18	64.56	60.39	55.91
29	80.11	74.17	67.70	60.56	56.65	52.44
30	71.45	66.15	60.39	54.01	50.53	46.78
31	62.36	57.73	52.70	47.14	44.09	40.82
32	58.28	53.95	49.25	44.05	41.21	38.15
33	55.30	51.20	46.74	41.80	39.10	36.20
34	53.37	49.41	45.11	40.34	37.74	34.94
35	52.38	48.49	44.27	39.59	37.04	34.29
36	49.12	45.48	41.52	37.13	34.74	32.16
37	46.81	43.34	39.56	35.38	33.10	30.64
38	44.60	41.29	37.70	33.72	31.54	29.20
39	42.89	39.71	36.25	32.42	30.33	28.08
40	41.57	38.49	35.13	31.42	29.40	27.21
41	39.92	36.96	33.74	30.17	28.23	26.13
42	37.88	35.07	32.01	28.63	26.78	24.80
43	34.29	31.75	28.98	25.92	24.25	22.45
44	32.03	29.66	27.07	24.21	22.65	20.97
45	29.11	26.95	24.60	22.01	20.58	19.06
46	28.39	26.29	24.00	21.46	20.08	18.59
47	26.68	24.71	22.55	20.17	18.87	17.47
48	25.03	23.17	21.15	18.92	17.70	16.39
49	23.10	21.39	19.52	17.46	16.33	15.12
50	21.23	19.65	17.94	16.05	15.01	13.90
51	19.46	18.02	16.45	14.71	13.76	12.74
52	17.48	16.18	14.77	13.21	12.36	11.44
53	15.33	14.19	12.95	11.59	10.84	10.03
54	13.12	12.15	11.09	9.92	9.28	8.59

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.60**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
55	11.69	10.82	9.88	8.84	8.26	7.65
56	9.36	8.67	7.91	7.08	6.62	6.13
57	8.01	7.41	6.77	6.05	5.66	5.24
58	7.64	7.07	6.45	5.77	5.40	5.00
59	7.28	6.74	6.15	5.50	5.15	4.76
60	6.93	6.42	5.86	5.24	4.90	4.54
61	6.59	6.10	5.57	4.98	4.66	4.31
62	6.25	5.79	5.28	4.73	4.42	4.09
63	5.93	5.49	5.01	4.48	4.19	3.88
64	5.61	5.20	4.74	4.24	3.97	3.67
65	5.30	4.91	4.48	4.01	3.75	3.47
66	4.71	4.36	3.98	3.56	3.33	3.09
67	4.43	4.10	3.75	3.35	3.13	2.90
68	4.16	3.85	3.52	3.15	2.94	2.73
69	3.69	3.42	3.12	2.79	2.61	2.42
70	3.40	3.14	2.87	2.57	2.40	2.22
71	2.93	2.71	2.47	2.21	2.07	1.92
72	2.71	2.51	2.29	2.05	1.91	1.77
73	2.49	2.31	2.11	1.88	1.76	1.63
74	2.19	2.03	1.85	1.66	1.55	1.44
75	1.91	1.77	1.61	1.44	1.35	1.25
76	1.73	1.60	1.46	1.31	1.22	1.13
77	1.40	1.30	1.18	1.06	0.99	0.92
78	1.11	1.03	0.94	0.84	0.78	0.73
79	0.91	0.84	0.77	0.69	0.64	0.60
80	0.79	0.73	0.67	0.60	0.56	0.52

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.62**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
1	221.45	205.02	187.16	167.40	156.59	144.97
2	208.05	192.62	175.84	157.27	147.12	136.20
3	193.25	178.91	163.32	146.08	136.65	126.51
4	186.09	172.28	157.27	140.67	131.58	121.82
5	179.90	166.56	152.05	136.00	127.21	117.78
6	177.30	164.15	149.85	134.03	125.37	116.07
7	172.09	159.33	145.45	130.09	121.69	112.66
8	168.68	156.17	142.56	127.51	119.27	110.43
9	163.63	151.50	138.30	123.70	115.71	107.12
10	159.46	147.63	134.77	120.54	112.75	104.39
11	155.39	143.86	131.33	117.46	109.88	101.73
12	152.19	140.90	128.62	115.04	107.61	99.63
13	145.79	134.97	123.21	110.21	103.09	95.44
14	141.13	130.66	119.27	106.68	99.79	92.39
15	138.03	127.79	116.66	104.34	97.60	90.36
16	133.48	123.58	112.81	100.90	94.38	87.38
17	127.51	118.05	107.77	96.39	90.16	83.48
18	122.36	113.28	103.41	92.49	86.52	80.10
19	117.37	108.66	99.20	88.72	82.99	76.84
20	110.43	102.24	93.33	83.47	78.08	72.29
21	107.72	99.72	91.04	81.42	76.17	70.52
22	105.00	97.21	88.74	79.37	74.25	68.74
23	101.04	93.55	85.40	76.38	71.45	66.15
24	98.44	91.14	83.20	74.41	69.61	64.44
25	95.19	88.13	80.45	71.95	67.31	62.31
26	91.06	84.31	76.96	68.84	64.39	59.62
27	88.35	81.80	74.67	66.79	62.47	57.84

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.62**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
28	84.01	77.78	71.00	63.51	59.41	55.00
29	78.81	72.96	66.60	59.57	55.72	51.59
30	70.29	65.08	59.41	53.14	49.70	46.02
31	61.34	56.79	51.84	46.37	43.38	40.16
32	57.33	53.08	48.45	43.34	40.54	37.53
33	54.40	50.36	45.98	41.12	38.47	35.61
34	52.50	48.61	44.37	39.69	37.12	34.37
35	51.53	47.70	43.55	38.95	36.43	33.73
36	48.33	44.74	40.84	36.53	34.17	31.64
37	46.05	42.63	38.92	34.81	32.56	30.15
38	43.88	40.62	37.08	33.17	31.03	28.72
39	42.20	39.07	35.66	31.90	29.84	27.62
40	40.89	37.86	34.56	30.91	28.92	26.77
41	39.27	36.35	33.19	29.68	27.77	25.71
42	37.26	34.50	31.49	28.17	26.35	24.39
43	33.74	31.23	28.51	25.50	23.85	22.09
44	31.51	29.17	26.63	23.82	22.28	20.63
45	28.64	26.51	24.20	21.65	20.25	18.75
46	27.93	25.86	23.61	21.11	19.75	18.29
47	26.25	24.30	22.19	19.84	18.56	17.19
48	24.62	22.80	20.81	18.61	17.41	16.12
49	22.73	21.04	19.21	17.18	16.07	14.88
50	20.88	19.33	17.65	15.78	14.77	13.67
51	19.15	17.73	16.18	14.47	13.54	12.53
52	17.19	15.92	14.53	13.00	12.16	11.26
53	15.08	13.96	12.74	11.40	10.66	9.87
54	12.91	11.95	10.91	9.76	9.13	8.45

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

ORIFICE CAPACITIES **specific gravity = 0.62**

ORIFICE DRILL SIZE	7" WC CFH	6" WC CFH	5" WC CFH	4" WC CFH	3 1/2" WC CFH	3" WC CFH
55	11.50	10.65	9.72	8.69	8.13	7.53
56	9.21	8.53	7.78	6.96	6.51	6.03
57	7.88	7.29	6.66	5.95	5.57	5.16
58	7.51	6.95	6.35	5.68	5.31	4.92
59	7.16	6.63	6.05	5.41	5.06	4.69
60	6.82	6.31	5.76	5.15	4.82	4.46
61	6.48	6.00	5.48	4.90	4.58	4.24
62	6.15	5.69	5.20	4.65	4.35	4.03
63	5.83	5.40	4.93	4.41	4.12	3.82
64	5.52	5.11	4.67	4.17	3.90	3.61
65	5.22	4.83	4.41	3.94	3.69	3.42
66	4.64	4.29	3.92	3.51	3.28	3.04
67	4.36	4.04	3.69	3.30	3.08	2.85
68	4.09	3.79	3.46	3.10	2.90	2.68
69	3.63	3.36	3.07	2.75	2.57	2.38
70	3.34	3.09	2.82	2.53	2.36	2.19
71	2.88	2.67	2.43	2.18	2.04	1.89
72	2.66	2.47	2.25	2.01	1.88	1.74
73	2.45	2.27	2.07	1.85	1.73	1.60
74	2.16	2.00	1.82	1.63	1.53	1.41
75	1.88	1.74	1.59	1.42	1.33	1.23
76	1.70	1.58	1.44	1.29	1.20	1.11
77	1.38	1.28	1.16	1.04	0.97	0.90
78	1.09	1.01	0.92	0.82	0.77	0.71
79	0.89	0.83	0.76	0.68	0.63	0.59
80	0.78	0.72	0.66	0.59	0.55	0.51

NOTES: Discharge coefficient of orifice is 0.90

For appliances not equipped with an appliance regulator, use pressure of 7 inches water column.

TABLE XV (continued)

SECTION IX

MANUFACTURED HOME (MOBILE HOME), MODULAR HOME, AND PARK TRAILER

1. MANUFACTURED HOME (Mobile Home): A structure, transportable in one or more sections, which in the traveling mode, is 8 body feet or more in width and 40 body feet or more in length or when erected on site is 320 or more square feet and is built on a permanent chassis and designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air-conditioning and electrical systems contained therein. If above specifications are not met consult manufacturer's tag on home or contact Manufactured Housing Division of the State for approval to convert to natural gas. Mobile homes are built under the Federal Standard (Part 3280 CFR) in accordance with HUD's Construction and Maintenance standards. Manufactured homes may be connected to the natural gas system if tagged for combination use. See Figure 12, Page 111.

NOTE: Each manufactured home shall have a tag of 3 inches by 1 3/4 inches minimum size permanently attached to the exterior skin at or near each gas supply connection or the end of the pipe, which reads (combination LP-gas and natural gas system) depending upon the fuel used. See Figure 12, Page 111 or Figure 13, Page 111.

2. MODULAR HOMES: Modular homes designed only for erection or installation on a site-built permanent foundation. The structure is not designed to be moved once erected or installed on a site-built permanent foundation. Modular and site-built homes are constructed to the same building code required by the state. Building additions to modular and mobile homes are also governed by local building codes.

COMBINATION LP-GAS AND NATURAL GAS SYSTEM

This gas piping system is designed for use of either liquefied petroleum gas or natural gas.

NOTICE: BEFORE TURNING ON GAS BE CERTAIN APPLIANCES ARE DESIGNED FOR THE GAS CONNECTED AND ARE EQUIPPED WITH CORRECT ORIFICES. SECURELY CAP THIS INLET WHEN NOT CONNECTED FOR USE.

When connecting to site outlet, use a listed gas supply connector rated at

100,000 BTUH
or more

250,000 BTUH

Before turning on gas, make certain all gas connections have been made tight, all appliance valves are turned off, and any unconnected outlets are capped.

After turning on gas, test gas piping and connections to appliances for leakage with soapy water or bubble solution and light all pilots.

FIGURE 13

LP-GAS SYSTEM

This gas piping system is designed for use of liquefied petroleum gas only.

DO NOT CONNECT NATURAL GAS TO THIS SYSTEM.

**CONTAINER SHUT-OFF VALVES
SHALL BE CLOSED DURING TRANSIT.**

When connecting to sit outlet, use a listed gas supply connector rated at

100,000 BTUH
or more

250,000 BTUH

Before turning on gas, make certain all gas connections have been made tight, all appliance valves are turned off, and any unconnected outlets are capped.

After turning on gas, test gas piping and connections to appliances for leakage with soapy water or bubble solution and light all pilots.

FIGURE 14

3. RECREATION VEHICLE: A vehicular type unit primarily designed for recreational camping, travel or seasonal use which has its own mode of power or is mounted on or towed by another vehicle. The basic entities are: travel trailer, folding camping trailer, park trailer, truck camper, motor home and multi-use vehicles. Recreation vehicles cannot be connected to the natural gas system.

4. GAS PIPING: The mobile home must be supported on all four corners in a manner which will permit safe installation of a house piping connection.

Refer to Section III of this Good Practice Book for proper sizing, installation and piping material.

The minimum size of piping outlet at the gas supply or meter connection, for a mobile home shall be three-quarters (3/4) inch.

The gas piping supply system shall not exceed 14 inches water column (1/2 psi) and not less than 7 inches water column.

A gas piping lateral terminating in a mobile home lot where the riser is surrounded by a concrete slab, shall not be required to be installed in a conduit, provided the concrete slab is entirely outside the wall line of the mobile home, is not continuous with any other concrete slab and is used for stabilizing other utility connections.

The mobile home fuel line piping shall extend outside the mobile home skirting and shall be connected to the meter set outlet using an approved rubber coated outdoor flex connector listed for use on a mobile home conforming to TSC-9 standard or ANSI Z21.75. The flexible connector must not exceed 6 feet in length and be

sized to adequately supply the total demand of the connected mobile home. All materials used for gas piping shall be new and free from defects.

The gas piping outlet from the meter shall be installed in a proper and secure manner.

Where a mobile home is located in a mobile home park and served by a master meter, a shut-off valve of the locking type shall be installed upstream of the flexible connector on the gas riser to the mobile home, kept locked off at all times and the open end of the connector plugged or capped when gas is not being supplied to the mobile home. The customer shall supply the locks.

The service line valve is to be turned on by qualified individual only.

Where fuel gas piping is to be installed in both portions of an expandable or multiple unit mobile home, the design and construction of the crossover may be solid pipe, solid pipe with a shut-off valve and a ground joint union, a shut-off valve and an approved outdoor rubber coated flex connector conforming to TSC-9 standard, or ANSI Z21.75 or a quick disconnect device. The shut-off valve or quick disconnect device fitting shall be installed on the **SUPPLY** side of the gas system ahead of the point of crossover. All points of crossover shall be accessible from the exterior of the mobile home.

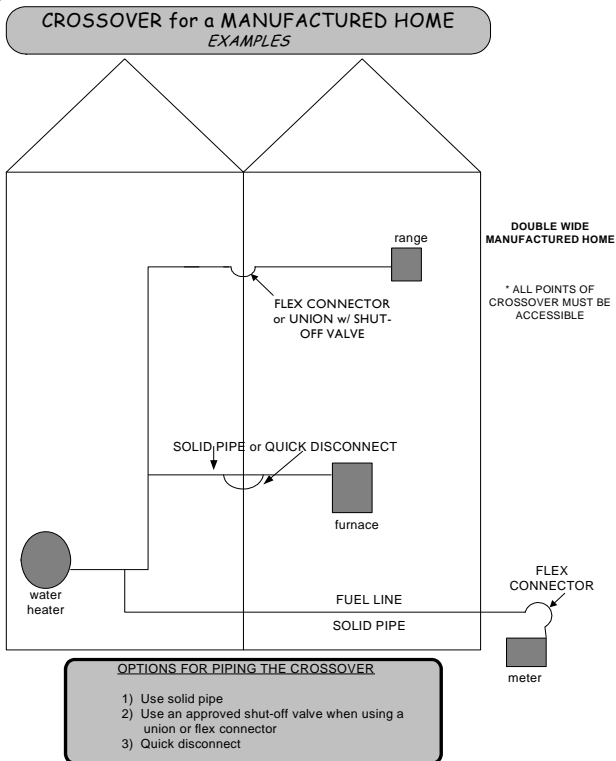


FIGURE 15

Valves - A shut-off valve shall be installed in the fuel piping at each appliance inside the mobile home structure, upstream of the union or connector in addition to any valve on the appliance and so arranged to be accessible to permit servicing of the appliance and removal of its components. The shut-off valve shall be located within 6 feet of a cooking appliance and within 3 feet of any other appliance.

Listed appliance connectors when used shall not run through walls, floors, ceilings or partitions, except for cabinetry and shall be 3 feet or less in length or 6 feet or less for cooking appliances.

Gas Piping System Openings - all openings in the gas piping system shall be closed gas tight with threaded pipe plugs or pipe caps when not in use.

Electrical grounding of fuel line is unacceptable, bonding is acceptable. The fuel line shall be considered properly bonded when the fuel line is connected to the terminal on the chassis by clamps, solder-less connectors or suitable grounding type straps.

Hangers and Supports - All gas piping shall be adequately supported by galvanized or equivalently protected metal straps or hangers at intervals of not more than 4 feet, except where adequate support and protection is provided by structural members. Solid iron pipe gas supply connection(s) shall be rigidly anchored to a structural member within 6 inches of the supply connection(s).

5. VENTING - No exhaust or venting shall terminate beneath the mobile home.

Venting system terminations shall not be less than three feet from any motor driven air intake discharging into habital areas.

6. APPLIANCE INSTALLATION - The installation of each appliance shall conform to the terms of its listing and the manufacturer's instructions. Every appliance shall be secured in place to avoid displacement. For the purpose of servicing and replacement, each appliance shall be both accessible and removable.

All fuel burning appliances except ranges, ovens and clothes dryers, shall be installed to provide for the complete separation of the combustion system from the interior atmosphere of the mobile home. Combustion air inlets and flue gas outlets shall be listed or certified as components of the appliance. The required separation may be obtained by:

1) The installation of direct vent system (sealed combustion system) appliances, which may be accessible from inside the mobile home

by opening a door or removing an access panel or other opening into the enclosure.

(2) The installation of appliances within enclosures so which separate the appliance combustion system and venting system from the interior atmosphere of the manufactured home. There shall not be any door, removable access panel or other opening into the enclosure from the inside of the mobile home. Any opening for ducts, piping, wiring, etc. shall be sealed.

7. CONVERSION OF APPLIANCES LOCATED IN MOBILE HOMES: When changing from LP gas to natural gas the LP tank must be disconnected and plugged before natural gas will be turned into the mobile home gas lines.

Fuel-burning appliances shall not be converted from one fuel to another fuel unless converted in accordance with the terms of their listing and the appliance manufacturer's instructions.

All gas appliances shall conform to the minimum standards and recommendations as contained in this booklet, all applicable local laws or ordinances and with the most recent standards and the Manufactured Home Construction & Safety Standards 3280 CFR.

Derating of appliances:

BTUs X Multiplier divided by heat content = CFH

Example 120,000 X .83 divided by 890 = 111.9 cfh

Formula for multiplier factor

(Example 5625 ft. – 5.625 X .04 = .225 minus 1. = -.78)

Vent Tables:

Minimum for Vent Tables: BTUs X multiplier (125,000 X .83 = 103.7 cfh)

Vent Table Reductions: (minus for the maximum capacity)

Reduce 10% - for manifold prior to common vent

Reduce 10% - for each 90 degree elbow over 2 ells

Reduce 10% - for 2, 45 degree angles in common vent

Reduce 10% - for horizontal length exceeding length (1 ½ times diameter)

Reduce 20% - if corrugated liner in chimney

Reduce 20% - if common vent has 90 degree angle

(offset cannot exceed 1 ½ times the diameter of the common vent)

Vertical flues cannot exceed 7 times the smallest vent collar

(example – 3" = 7.06" X 7 = 49.48")

In no case shall the vent connector be up sized more than 2 consecutive table size diameters

Flexible Vent Connectors & Liners:

(ALL vent pipes have a 1" clearances form combustibles)

Z Flex – (2 types) single wall size off single wall chart, double wall size off double wall chart

Ameri-Vent – (2 types) single wall size off single wall chart, double wall size off double wall chart

Metal Fab – sized off the single wall chart

Tru-Flex – sized off the double wall chart per manufacture

Flexi-Liner – common vent chimney liner only

Piping supports:

Horizontal: ½" = 6 ft, ¾" & 1" = 8 ft., 1 ¼" & larger = 10 ft

Vertical: 1 ¼" & larger every floor, piping supports for mobile homes = 4 ft

Combustion Air Grill Sizing:

To size grill – Total BTUs divided by .75 (metal) .25 (wood)

To figure free area in grills – times by .75 (metal) .25 (wood)

Example - 12" X 11" grill = 132 X .75 = 99 sq" of free area through grill

Wood door example - 32" X 28" = 896 X .25 = 224 sq" of free area through louver

Combustion Air for Industrial:

BTUs divided by 10,000 X 2.5 divided by 300 = square Ft of Air Needed

Example – 5,000,000 divided by 10,000 = 500 X 2.5 = 1250 divided by 300 = 4.166 cu ft

Or BTUs divided by 4000 = CFM divided by 300 = square Ft of Air
Adequate Volume: To determine if confirmed space 1/50 rule

Total BTUs divided by 1000 X 50 = CU ft of air required (minimum)

Total of 150,000 BTUs 150 X 50 = 7500 of cubic feet needed

Area size example = 12' X 15' X 18' = 1440 cubic feet

Clocking Meters:

60 X 60 X dial size divided by # of seconds = CFH

60 X 60 X dial size divided by CFH = # of seconds

Pressure Sets

60 X 60 X dial size X multiplier, divided by # of seconds = CFH

60 X 60 X dial size X multiplier, divided by CFH = # of seconds

Pressure Factors for SLC: 1 lb = 1.0586, 2 lbs = 1.1366, 5 lbs = 1.3709

Formula for square inches in a round duct: Diameter² (D²) x .7854 = X of square inches in duct

CO Air Free Formula:

$$\frac{20.9}{(20.9 - O_2)} \times \text{CO} = \text{CO Air Free}$$

Example:

20.9 – 11.5 (oxygen reading) = 9.4

20.9 divided by 9.4 = 2.22

140 ppm (CO reading) x 2.22 = 310.8 ppm air free

CFH for pipe sizing = BTUs divided by heat content of gas (125,000 divided by 890 = 140.4 cfh)

() REPRESENTS THE DEFINITION

Accessible	(9) 46
Adequate Volume (for combustion air)	57
Adjustment of Burners	84
Adjustment of Burner Input	91
Adjustment of Appliance Rating	84
Adjustment of Primary Air	91
AGA	(9)
Air for Combustion	54
Air Mixer	(9)
Air Shutter	(9)
Air Supply from Attic	62
Air Supply from Crawl Space	61
Air Supply Horizontally	64
Air Supply from Inside Building	59
Air Supply - One Opening	63
Ambient Temperature	(9)
Appliance	(9)
Appliance Accessibility	46
Appliance Connectors	36
Appliance Fuel Connector	(9)
Appliance Installation	46,115
Appliance Installation in Mobile Homes	115
Appliance in Bedrooms or Bathrooms	48
Appliance Installed in Garages	47
Appliance Location	46
Appliance Rating	84
Appliance Requiring Venting	65
Approved	(9)
Atmospheric Vents	82
Attic	46
Automatic Gas Valve	80
Automatic Ignition	(9)
Automatic Pilot	(10) 91
Automatic Pilot Device	(10)
Automatic Valves	80

() REPRESENTS THE DEFINITION

Baffle	(10) 67
Barbecues	34
Bathrooms	48
Bedrooms	48
Boilers	(10) 50, 82
Bonding	(10)
Branch Line	(10)
Brick Chimneys	74
Btu Rating	(10) 87
Burner	(10-11)
Burner Adjustment	84
Burner Input, Checking & Adjusting	91
Category I Venting	71
Category II, III, IV Venting	71
Cathodic Protection	32
Central Heating Gas Appliance	(11)
Checking Automatic Pilot	91
Checking Draft	92
Chimney Termination	72
Chimneys	(11) 67
Chimney Sizing	68
Circuit	(11)
Clearances	46, 66
Clocking Meter	85, 95-100
Closet	54
Clothes Dryer	52
Combustible Material	(11)
Combustion	(12)
Combustion Air	(12) 54
Combustion Air Ducts	54
Commercial Clothes Dryer	53
Compound (pipe thread)	31
Concealed	(12)
Concealed Piping and Fittings	33
Condensate	(12)

() REPRESENTS THE DEFINITION

Condensing Appliance	(12)
Confined Space	(12) 58
Connectors (gas)	36
Connectors (vent)	66
Controls	(12) 80
Conversion Burners	(12)
Crawl Space	46,56, 61
CSST (Corrugated Stainless Steel Tubing)	(11) 30
Cubic Foot of Gas	(12)
Damper	(13)
Decathern	(13)
Decorative Appliance	(13) 51
Defective Pipe	30
Definitions	9
Demand	(13)
Deration Factors	87-90
Dilution Air	(13)
Direct Vent Appliance	(13) 48,73
Direct Vent Termination (non-mechanical)	73
Direct Venting	74
Draft	92
Draft Hoods	(13) 65
Dual Mobile Homes	114
Ducts	54
Electrical Ground	115
Elevated Pressure	(13)
Equipment Location	59-64
Equivalent Hydraulic Diameter (EHD)	(13)
Excess Air	(14)
Exhaust Ducts	52
Exhaust Fans	47

INDEX

Page

() REPRESENTS THE DEFINITION

Fireplaces	47
Fittings	33
Flame Safe Guard	(14)
Flames	(14)
Flammable Vapors	48
Flexible Connectors	36,112,113
Floor Furnaces	49
Flue Gases	(14)
Forced Air Type Central Furnace	(14)
Fuel Line	(14)
Fuel Line Sizing	38
Garages	47
Gas Hose	(15)
Gas Logs	51
Gas Piping	(15)8, 38,112
Gas Piping Installation	26,112
Gas Piping Material	29
Gas Piping System	112
Gas Ranges	52
Gas Vent, Bleed	82
Gas Vent/Chimney Termination	72
General Safety Precautions	8
General Statement	7
Gravity Type Warm-Air Furnace	(14)
Grilles and Louvers	56
Hazardous Locations	(16)48
Heaters	49
Heating Valve	(16)
Horizontal Combustion Air Ducts	64
Individual Main Burner Valve	(16)

INDEX	Page
() REPRESENTS THE DEFINITION	
Installation	26,31,92
Installation in Garages	47
Installation Instructions	92
Instructions to Customers	92
Leak Limiting Devices	(16)81
Limit Controls	(16)
Line Gas Pressure Regulators	81
Listed Vent Caps	72
Log Lighters	(16)50
Louvers and Grilles	56
LP Gas	31,111
Main Burner	(16)
Main Burner Control Valve	(16)
Make-up Air	(17)54
Malleable Iron	29
Manifold	(17)
Manometer	(17)
Manual Main Shut-off Valve	(17)
Manufactured Home	110
Manufacturers Installation Instructions	8,91
Masonry Chimneys	74
Materials	29
Maximum Capacities	41
Mechanical Draft System	(17)73
Mechanical Exhausting	47
Meter	(17)
Meter Dial Test Time	35
Meter Location	26
Meter/Riser Protection	26
Meter Set	27
Meter Spot Test	35
Microampere	(17)

() REPRESENTS THE DEFINITION

Milliampere	(17)
Millivolt	(17)
Mixer	(17)
Mobile Home	110
Mobile Home Conversions	116
Mobile Home Gas Connection and Turn-on	112-113
Mobile Home Gas Piping	112
Modular Homes	110
Multiple Meters	28
Occupancies	(18-20)
Operating Instructions	92
Orifice	(20)
Orifice Cap	(20)
Orifice Capacities	101-109
Orifice Spud	(20)
Outside Air	59
Oxygen Depletion Safety Shut-Off (ODS)	(20) 51
Pilot	(20) 91
Pilot Generator	(20)
Pipe Capacity	41-42
Pipe Materials	29
Pipe Sizing	38
Piping Plan	29
Piping Installation	26
Piping Support	32
Piping System	112
Plastic Pipe Material	29
Plenum	(20)
Power Exhauster	(21)
Pressure Drop	(21)
Pressure Relief Valves	(21)
Pressure Tests	34
Primary Air Adjustment	91
Problems Not Covered	7

() REPRESENTS THE DEFINITION

Procedure	84
Prohibited Installation	75
Protective Devices	92
Purge	(21)
Quick Disconnect Device	(21)
Ranges	52
Recreation Vehicles	112
Refrigerators	57
Regulators	(21) 80
Relief Lines for Boilers	82
Relief Opening	(21)
Required Gas Piping Size	38
Required Gas Supply	37
Required Venting	65
Residential Boilers	50
Risers	26,29
Room Heaters	(21)
Safety Precautions	8
Secondary Air	(22)
Semi-Rigid Tubing	(22)
Service Connection	27
Service Line Location	26
Service Piping	(22)
Shut-off Valves	(22) 33
Sizing House Piping System	38
Sizing Vent Connectors	68
Sizing Vertical Vents or Chimneys	68
Solid Fuel	48
Special Conditions	47
Specific Gravity	(22)

() REPRESENTS THE DEFINITION

Spot Test	35
Support	32
Suspended Unit Heater	49
Telephone Number	1
Temperature and Pressure Relief Device	(22)
Termination	72
Testing	34
Thermocouple	(22)
Thermostat	(22)
Tracer Wire	29
Tubing	29
Type "A", "B", "BW", "C" Vents	(23-24)
Unconfined Space	(22-23) 48, 58
Underground Piping	29
Unions	33
Unit Heaters	(23) 49
Unsafe	7,84
Unusually Tight Construction	(23)
Unvented Room Heaters	50
Valves	80
Vent	(23-24)
Vent and Vent Connector Clearances	66
Vent and Vent Connector Material	65
Vent/Chimney Termination	72-73
Vent Collar	(24)
Vent Connector	(24)
Vent Connector and Vertical Vent Sizing	69
Vent Connector Sizing	70
Vent Dampers	67
Vent Installation	71
Vent Sizes	68
Vent System	(24)
Vent Wall Furnaces	49

() REPRESENTS THE DEFINITION

Vented Appliance Category	(24-25)
Ventilation Air	(25)
Venting for Diaphragm Type Valves	82
Venting of MP Regulators	81
Vertical Combustion Air Ducts	60
Volume of Space	57
Wall Furnaces	49
Warm-Air Furnace	(14)49
Water Heater	(25)51
Welded Joints	38
Workmanship	31

