

# Understanding Gas Pressure

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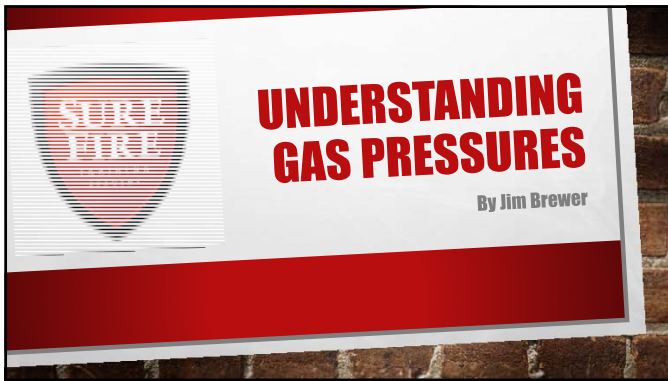
*Magic Sweep Corporation*

This session is intended to help students understand gas pressure in natural gas and propane systems. We will discuss these topics: units of measure for gas, how to measure gas pressure, natural gas delivery, and pressure, gas regulators, regulator venting, gas pressure drop, regulator capacity and installation, LP system pressure, pressure in LP tanks, LP vaporization rates, single & 2 stage LP systems, and LP tank placement.

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## UNITS OF MEASURE

- Inches of water column ("wc) – inches of water column is the traditional method for measuring natural gas or propane. There are 28 inches of water in 1 psi, so it is a fairly small amount of pressure
- Pounds per square inch (psi) – used for measuring gas pressure in the distribution system and other areas where pressure exceeds the traditional 7" WC system for NG or 11" WC for LP

## PRESSURE TERMS

- Service pressure – For NG systems, the pressure delivered to the building downstream of the meter. Commonly, 6 – 7" WC or 2 psi. For LP systems, the pressure downstream of the second stage regulator. Commonly, this is 11" WC but could be 2 psi.
- Medium pressure – a delivery pressure greater than 14" WC, but commonly 2 psi. Requires pressure reduction prior to the appliance.
- Appliance pressure – the max pressure approved for delivery to the appliance, commonly 14" WC or 0.5 psi.
- Manifold pressure – the pressure delivered to the burner or manifold, downstream of the appliance regulator. Generally 3.5" WC for NG or 10" WC for LP.

## MEASURING INCHES OF WATER

- Based on the theory that a column of water exerts pressure at the base, the higher the column the greater the pressure at the bottom
- Originally measured with a water filled u-tube manometer
- Pressure is the total change, above and below the zero point

## DIGITAL MANOMETER

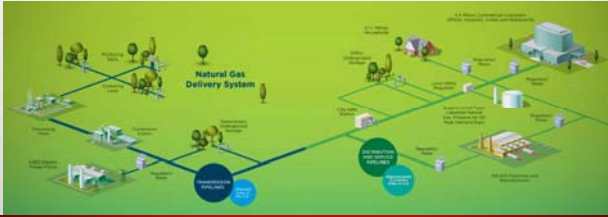
- Gas pressure is now commonly measured with a digital manometer
- Much easier and more practical than a water filled u-tube

## NATURAL GAS DELIVERY

- Countrywide transmission lines deliver gas to the public utility companies at 1000 to 1500 psi
- Utilities receive gas at the "gate" and reduce to 150 psi pressure and add odorant
- Utility transmission lines limited to 150 psi
- Reduce to 60 psi or less for distribution grid

**28" WC = 1 psi**

## NATURAL GAS DELIVERY SYSTEM



## NG DELIVERY TO YOUR HOME / BUSINESS

- Natural gas arrives at your home through the utility distribution system
- Pressure could be anywhere from a ½ pound to 60 psi
- Typical pressure is 15 to 60 psi



## PRESSURE REDUCTION

- The service regulator reduces the incoming gas pressure to 7" WC or 2 psi (or possibly 5 psi in commercial / industrial)
- The gas meter does not change pressure, just records amount of gas passing through the meter (cash register)



## VISUAL INDICATION OF PRESSURE

White face meter

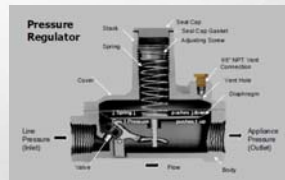


Red face meter



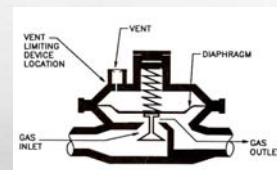
## REGULATORS CONTROL PRESSURE

- Gas pressure is controlled by regulators
- Regulators reduce and stabilize pressure downstream of the regulator
- Regulators can not increase pressure
- Must be selected based on available incoming pressure and desired outlet pressure

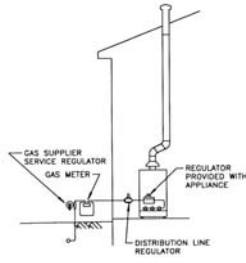


## GAS REGULATORS

- Regulators are used to control gas pressure
- Can only *reduce* incoming pressure
- Provide steady flow
- Must be selected based on available incoming pressure and desired outlet pressure



## REGULATORS IN NG SYSTEM



- In natural gas systems, common uses of regulators include:
  - Service regulator
  - MP regulator
  - Appliance regulator

## SERVICE REGULATOR

- Located "upstream" of the gas meter
- NEVER adjust or alter the service regulator
- The service regulator belongs to, and is the responsibility of, the serving gas supplier



## MP REGULATOR

- "Medium pressure" regulators are used downstream of the "point of delivery" and reduce piping system pressures of 2 or 5 psi down to utilization pressure of 7" WC for natural gas or 11" WC for propane



## APPLIANCE REGULATOR

- Most gas appliances have a regulator to control the appliance manifold or burner pressure
- May be a separate regulator or built-in to a "combination" gas valve



## COMBINATION VALVE

- This valve has a built in appliance regulator



## VENTING REQUIRED

- Regulators must be able to "sense" the atmospheric pressure and vent to the atmosphere
- Blockages of the vent or vent tubing will cause regulator and appliance problems



## VENTING OF REGULATORS

- Pressure regulators that require 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 regulators equipped with and labeled for utilization with approved vent-limiting devices installed in accordance with the manufacturer's instructions.



## REGULATOR VENTING - OUTDOORS

- Regulators requiring venting may be installed indoors and vented to the outdoors with copper tube



## REGULATOR VENTING - INDOORS

- This regulator is installed indoors with a "vent limiter" device
- Regulator must be installed upright and horizontal when a vent limiter is used



## PRESSURE DROP

- Pressure Drop is the loss in pressure due to friction, obstructions, fittings, valves, etc.
- Basically, the higher the pressure drop the higher the pipe capacity
- Use pressure drop to your advantage but be sure to maintain adequate downstream pressure

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60



## PRESSURE DROP

TABLE 402.4(1)  
SCHEDULE 40 METALLIC PIPE

Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.3 in. w.c.
Specific Gravity	0.60

Nominal Length (ft)	PIPE SIZE (inch)													
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12
10	131	273	514	1,060	1,530	3,050	4,360	8,500	17,500	31,700	51,300	105,000	191,000	303,000
20	90	188	353	726	1,090	2,090	3,140	5,900	12,000	21,300	35,300	72,400	132,000	208,000
30	72	151	294	583	873	1,680	2,480	4,740	9,660	17,500	28,300	56,200	106,000	167,000
40	62	129	243	499	747	1,440	2,200	4,050	8,270	15,000	24,200	49,800	90,400	143,000
50	55	114	215	442	662	1,280	2,030	3,590	7,330	13,300	21,500	44,100	80,100	127,000
60	50	104	204	416	620	1,140	1,840	3,260	6,430	11,900	19,400	40,000	73,400	114,000



## PRESSURE DROP

TABLE 402.4(2)  
SCHEDULE 40 METALLIC PIPE

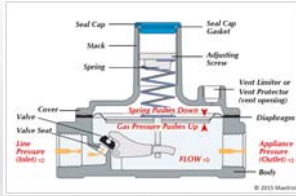
Gas	Natural
Inlet Pressure	Less than 2 psi
Pressure Drop	0.5 in. w.c.
Specific Gravity	0.60

Nominal Length (ft)	PIPE SIZE (inch)													
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12
10	172	360	678	1,390	2,090	4,020	6,800	11,300	23,100	41,800	67,600	139,000	252,000	399,000
20	118	247	466	957	1,430	2,760	4,400	7,780	15,900	28,700	46,500	95,500	175,000	275,000
30	95	199	371	768	1,150	2,220	3,530	6,250	12,700	23,000	37,300	76,700	139,000	220,000
40	81	170	320	657	985	1,900	3,020	5,250	10,900	19,700	31,900	65,600	119,000	189,000
50	72	151	284	583	873	1,680	2,680	4,740	9,660	17,500	28,300	56,200	106,000	167,000
60	65	137	262	520	780	1,430	2,220	4,050	8,270	15,000	24,200	49,800	90,400	143,000



## MAXITROL 325-3 MP REGULATOR

- The maxitrol 325-3 is the most common regulator used in MP systems
- Regulator must be properly sized based on anticipated (downstream) load
- Capacity is determined by charts using the inlet pressure and available pressure drop



## REGULATOR CAPACITY

325 SERIES — capacities expressed in CFH — 0.64 sp gr gas  
Maxitrol recommended maximum inlet pressure.....10 psi

Model Number and Pipe Size	Pressure Drop									
	0.3"	0.5"	1.0"	3.0"	5.0"	7.0"	1/2 psi	3/4 psi	1 psi	
325-3	3/8 x 3/8	30	38	55	95	122	145	204	250	289
	1/2 x 1/2	30	38	55	95	122	145	204	250	289
325-5A	1/2 x 1/2	70	90	128	221	288	338	476	583	673
	3/4 x 3/4	70	90	128	221	288	338	476	583	673
	1 x 1	70	90	128	221	288	338	476	583	673
325-7	1-1/4 x 1-1/4	280	450	581	690	972	1191	1375	1685	1820
	1-1/2 x 1-1/2	280	450	581	690	972	1191	1375	1685	1820



## MP REGULATOR REQUIREMENTS

- The MP Regulator shall be approved and shall be suitable for the inlet and outlet gas pressures for the application
- Make sure the regulator is rated for the inlet pressure and reduces the outlet pressure to a level suitable for the appliances
- The mp regulator shall maintain a reduced outlet pressure under lock up (no flow) conditions
- The regulator must maintain reduced pressure when there is no flow, not all regulators can do this and some could expose downstream units to the full line pressure. Should limit downstream pressure to (the greater of) 5" wc above outlet set point, or 150% of outlet set point,



## MP REGULATOR REQUIREMENTS

### Capacity

- The capacity of the mp regulator, determined by published ratings of its manufacturer, shall be adequate to supply the appliances served

325 SERIES — capacities expressed in CFH — 0.64 sp gr gas  
Maxitrol recommended maximum inlet pressure.....10 psi

Model Number and Pipe Size	Pressure Drop									
	0.3"	0.5"	1.0"	3.0"	5.0"	7.0"	1/2 psi	3/4 psi	1 psi	
325-3	3/8 x 3/8	30	38	55	95	122	145	204	250	289
	1/2 x 1/2	30	38	55	95	122	145	204	250	289
325-5A	1/2 x 1/2	70	90	128	221	288	338	476	583	673
	3/4 x 3/4	70	90	128	221	288	338	476	583	673
	1 x 1	70	90	128	221	288	338	476	583	673
325-7	1-1/4 x 1-1/4	280	450	581	690	972	1191	1375	1685	1820
	1-1/2 x 1-1/2	280	450	581	690	972	1191	1375	1685	1820



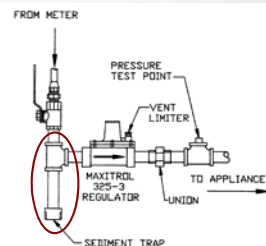
## MP REGULATOR REQUIREMENTS

- The mp regulator shall be provided with access. Where located indoors, the regulator shall be vented to the outdoors or shall be equipped with a leak-limiting device, in either case complying with Section G2421.3
- Access — that which enables a device, appliance or equipment to be reached by ready access or by means that first requires the removal or movement of a panel, door or similar obstruction
- Ready Access — that which enables a device, appliance or equipment to be directly reached, without requiring the removal or movement of any panel, door or similar obstruction



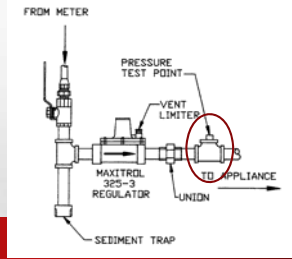
## MP REGULATOR REQUIREMENTS

- A tee fitting with one opening capped or plugged shall be installed between the mp regulator and its upstream shutoff valve. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument and to serve as a sediment trap



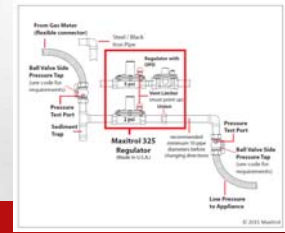
## MP REGULATOR REQUIREMENTS

- A tee fitting with one opening capped or plugged shall be installed not less than 10 pipe diameters downstream of the mp regulator outlet. Such tee fitting shall be positioned to allow connection of a pressure-measuring instrument.



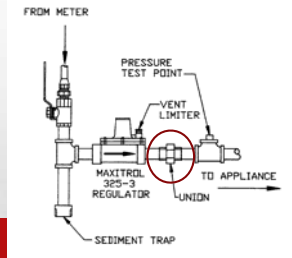
## MP REGULATOR REQUIREMENTS

- Valves with built-in test ports may be substituted for tees with plugs or caps



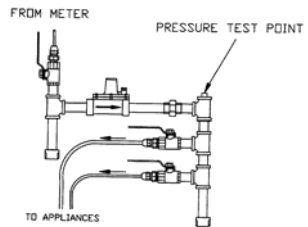
## MP REGULATOR REQUIREMENTS

- Where connected to rigid piping, a union shall be installed within 1 foot of either side of the mp regulator



## MULTIPLE APPLIANCES

- A single mp regulator may be used to supply multiple appliances, provided the regulator has the capacity to supply the total load
- Consult manufacturer data for the specific regulator



## IDENTIFICATION OF PIPING SYSTEMS

- (IFGC) 401.5 Identification.** For other than steel pipe, exposed piping shall be identified by a yellow label marked "Gas" in black letters. The marking shall be spaced at intervals not exceeding 5 feet (1524 mm). The marking shall not be required on pipe located in the same room as the appliance served.



## OVERPRESSURE PROTECTION

- When the appliance design pressure is 14" wc or less and the delivery pressure is greater than 2 psi, overpressure protection devices (OPD's) are required.
- Opd's are generally an additional regulator downstream of the main mp regulator, but designed as a part of the mp regulator



325-5L with OPD 48



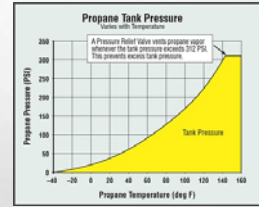
## LP SYSTEM PRESSURES

- The standard system pressure for LP piping systems is 11" WC in the gas piping downstream of the final regulator.
- Appliance regulators reduce this pressure to approximately 9 to 10" WC.

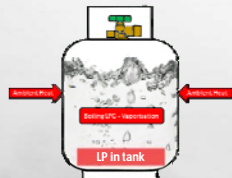


## PRESSURE IN LP TANK

- The pressure in an LP tank is determined by the ambient temperature
- Higher outdoor temps produce higher tank pressure
- LP boils at -44 F and produces pressure in the tank at any temperature above -44 F.



## VAPORIZATION RATE OF LP



Vaporization Rate - 100 Lb. Propane Cylinders (Approximate)

Lbs. of Propane in Cyl.	Maximum Continuous Draw in BTU Per Hour At Various Temperatures in Degrees F				
	0°F	20°F	40°F	60°F	70°F
100	113,000	167,000	214,000	277,000	300,000
80	89,000	132,000	169,000	214,000	237,000
60	67,000	100,000	130,000	169,000	186,000
40	45,000	68,000	90,000	117,000	129,000
20	23,000	35,000	46,000	60,000	66,000

This chart shows the vaporization rate of propane in terms of the temperature of the liquid and the wet surface area of the container. When the temperature is lower and if the container has been equal in it, the vaporization rate of the container is a lower value.



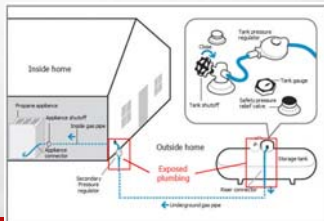
## SINGLE STAGE LP SYSTEM

- In a single stage LP system, the tank pressure is reduced to 11" for delivery into the house piping system
- Regulator may be called a single stage or twin stage regulator
- The twin stage regulator is actually 2 regulators in one



## 2 STAGE LP SYSTEM

- In a 2 stage LP system there is a large tank located away from the building
- The regulator on the tank is the first stage regulator and reduces tank pressure to 10 psi (usually)
- The second stage regulator is located where gas line enters house and reduces the 10 psi line pressure to 11" WC (or possibly 2 psi)

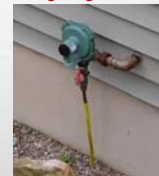


## 2 STAGE LP SYSTEM

First stage regulator

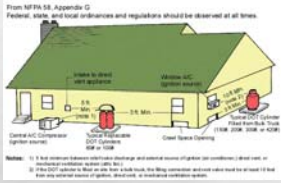


Second stage regulator





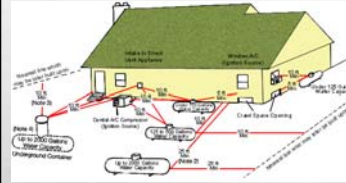
## DOT LP TANK LOCATIONS



- DOT containers can be up to 100 gallon size, and may be exchanged or filled on site
- Exchange tanks must be 3 feet from building opening (below the top of tank), and 5 feet from sources of ignition or appliance intakes
- Site filled tanks must be 3 feet from building opening (below the top of tank), and 5 feet from appliance intakes and 10 feet from sources of ignition
- May be placed alongside building



## ASME LP CONTAINERS



- These are large stationary tanks, and may be buried underground
- Must be 5 feet from building openings (below top of tank)
- Must be 10 feet from ignition source or appliance intakes
- Separation distances from building and lot lines apply, based on tank size

