



An Invensys Company

Regulator Installation and Maintenance Instructions

043 Service Regulator

The 043 Service Regulator is designed to handle a variety of small loads. Use the 043 for industrial or commercial applications. This regulator can also be used for standard residential services: boilers, burners, furnaces/ovens, unit heaters, gas engines, and other applications.

Although most 043 installations are for natural gas, it can be used for air, dry CO₂, nitrogen, propane, or butane.

Simple design and rugged construction provide an ideal combination of economy, dependability, and excellent performance.

The 043 Service Regulator is available in many sizes and is capable of managing various inlet and outlet pressures.

MAXIMUM INLET PRESSURES Red, Blue, Green & Orange Springs					
Orifice	3/8"	5/16"	1/4"	3/16"	1/8"
Pressure	10 psi	20 psi	40 psi	60 psi	125 psi
Black Spring					
Orifice	3/8"	5/16"	1/4"	3/16"	1/8"
Pressure	20 psi	40 psi	60 psi	80 psi	125 psi

PIPE SIZES		
Angle Body Models: 043-90, 043-91, 043-92	Straight Through Body Models: 043-180, 043-181, 043-182	
3/4" X 3/4"	3/8" X 3/8"	3/4" X 3/4"
3/4" X 1"	3/8" X 1/2"	3/4" X 1"
1" X 1"	1/2" X 1/2"	1" X 1"

Installation and Start-Up

- Remove the shipping plugs from both the regulator inlet and outlet connections and from 1/4" vent on -90 and -180 models.
- Make certain that the inside of the piping and the regulator inlet and outlet connections are clean — they must be free of dirt, pipe dope and other debris.
- Use pipe joint material only on the male threads of the pipe being connected to the regulator. **Do not** use pipe joint material on the female threads of the regulator.
- Install the regulator in the line. Make certain that the gas flow through the regulator is in the direction as indicated by the arrow on the regulator body.

The regulator may be installed in any position: upright, upside down, vertical piping, diagonal piping, etc. The diaphragm case assembly may be rotated by removing four screws (2) to various positions in relation to the body.

The diaphragm case vent must be positioned to protect against flooding, drain water, ice formation, traffic, tampering, etc. The vent must be protected against nest-building animals, bees, insects, etc., to prevent vent blockage and minimize the chances for foreign material from collecting in the vent side of the regulator

diaphragm. If required, the upper diaphragm case may be rotated by removing the upper to lower case flange screws and rotating the upper diaphragm case to the desired position. Reinstall the diaphragm flange screws and tighten to hold the upper diaphragm case in position and reseal.

CAUTION

Turn gas on very slowly. If an outlet stop valve is used, it should be opened first. Do not overload the diaphragm with a sudden surge of inlet pressure. Monitor the outlet pressure during start-up to prevent an outlet pressure overload.

- Turn the gas on very slowly.
- Make certain that there are no leaks and that all connections are tight.
- Adjust outlet pressure (set-point) by removing cap (4) and turning adjustment spring button (5). Turn clockwise to increase and counter-clockwise to decrease outlet pressure. Only adjust when gas is flowing through regulator.

CAUTION

It is the user's responsibility to assure that all regulator vents and/or vent lines exhaust to a non-hazardous location away from ANY POTENTIAL sources of ignition. Where vent lines are used, it is the user's responsibility to assure that each regulator is individually vented and that common vent lines ARE NOT used.

- The vent connection is an escape path for flammable gas and it must be located and/or piped so that potential discharge occurs in a safe area away from buildings, open flames, collection areas, arcing devices, etc.

Regulators that are installed indoors or in a non-vented area must be vented to the outside. Simply run vent piping from the regulator vent connection to a non-hazardous location on the outside, away from any potential sources of ignition. The vent piping must be connection size or larger and piped to a safe area. The vent discharge must be protected against the potentials outlined in instructions #4, #8, and #9.

For regulators equipped with internal relief valves (IRV), (models 043-92 and 043-182), vent piping must be vent connection size or larger. This will assure that the vent piping will be large enough to be able to vent all of the internal relief valve discharge to atmosphere without excessive back pressure that would result in excessive pressure increase in the regulator.

The outlet of the vent piping must allow for the free and unobstructed passage of air and gas and must be protected against the potentials listed in instructions #4, #8 and #9.



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- 9** For outdoor installations, it is recommended that the regulator be installed so that the regulator vent faces downward to avoid the potential for water or other foreign matter entering the regulator and interfering with the proper operation of the regulator.

CAUTION

Regulators are pressure control devices with numerous moving parts subject to wear that is dependent upon particular operating conditions. To assure continuous satisfactory operation, a periodic inspection schedule must be adhered to with the frequency of inspection determined by the severity of service and applicable laws and regulations.

Servicing

- 1** For access to valve (10) and orifice (8), remove screws (2) and remove diaphragm case assembly from body. Orifice (8) unscrews from body.
When removing and replacing the orifice, be careful to use a 3/4" hex socket wrench that is in good condition. This socket must be sharp, free of wear and not rounded.
When replacing orifice (8), tighten to 20 to 25 ft.-lbs. of torque. Use a moderate amount of sealant, such as Best-O-Life or Rector Seal #5.
- 2** To replace diaphragm assembly, remove spring, remove flange screws (7), and remove top diaphragm case (16) or (16a). Make certain all parts are reassembled in their correct order and all screws and joints are tightened evenly and firmly, to 13 to 16 ft.-lbs. of torque. Make certain Tetraseal (3) is in position.
- 3** Upon completing reassembly, make certain that the regulator is free of leaks.

Over Pressurization Protection

Protection must be provided for the downstream piping system and the regulator's low pressure chambers to assure against the potential over-pressurization due to a regulator malfunction or a failure of the regulator to lock-up. The allowable over-pressurization is the lowest of the maximum pressures permitted by federal codes, state codes, Equimeter Bulletin RDS-1498, or other applicable standards. The method of providing over-pressure protection could be a relief valve, a monitor regulator, a shut-off device or any similar device.

Temperature Limits

The 043 Service Regulator can be used for flowing temperatures from -20°F. to 150°F.

Buried Service

The 043 Service Regulator *is not* recommended for buried service.

Condensed Parts List

ILL. NO.	DESCRIPTION	PART NUMBER
2	Hex Washer Hd., Indented, Screw, 1/4"-20 x 5/8"	951039
3	Tetraseal (or O-Ring) 1 1/4" x 1 7/16"	904076
4	Seal Cap	143-08-005-03
5	Adjustment Spring Button	143-08-009-00
6	Spring—See Table	—
7	Fil. Hd. Stl. Mach. Screw, #10-24 x 1/2"	919755
8	Orifice, 3/8" aluminum	143-08-023-18
	Orifice, 5/16" aluminum	143-08-023-17
	Orifice, 1/4" aluminum	143-08-023-16
	Orifice, 3/16" aluminum	143-08-023-15
	Orifice, 1/8" aluminum	143-08-023-14
9	Deflector	143-08-078-00
10	Valve & Stem Assembly	143-08-511-01
15	Diaphragm Assembly with Internal Relief Valve (IRV)—use with Ill. No. 16 Top Diaphragm Case Only	143-08-550-01
15a	Standard Diaphragm Assembly—use with either 16 or 16a Top Diaphragm Case	143-08-550-00
16	Top Diaphragm Case with 3/4" vent and vent flapper valve	143-08-503-00
16a	Top Diaphragm Case with 1/4" vent	143-08-003-01

Spring Ranges

Outlet Pressure Ranges	Spring Color	Spring Part Number
3 1/2" to 6 1/2" w.c.	Red	143-08-021-00
5" to 8 1/2" w.c.	Blue	143-08-021-01
6" to 14" w.c.	Green	143-08-021-02
12" to 28" w.c.	Orange	143-08-021-03
1 psi to 2 psi	Black	143-08-021-06

Regulator General Assembly

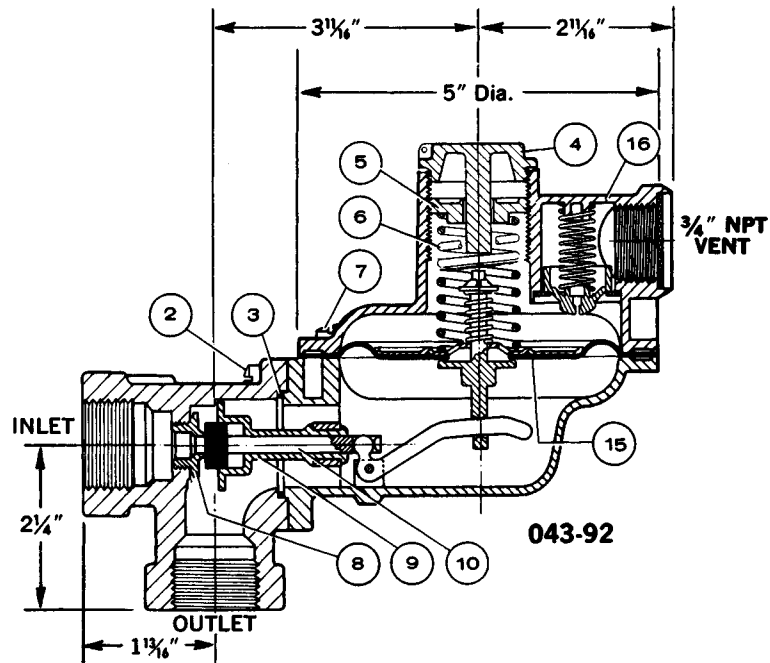
Model No.	Type	Vent Size	Pipe Sizes	Body
043-90	Standard Regulator	1/4"		
043-91	Standard Regulator	3/4"	3/4" & 1"	Angle
043-92	Regulator with Internal Relief (IR)	3/4"		
043-180	Standard Regulator	1/4"		
043-181	Standard Regulator	3/4"	3/8", 1/2",	Straight Through
043-182	Regulator with Internal Relief (IRV)	3/4"	3/4" & 1"	



Regulator General Assembly

Model 043-92

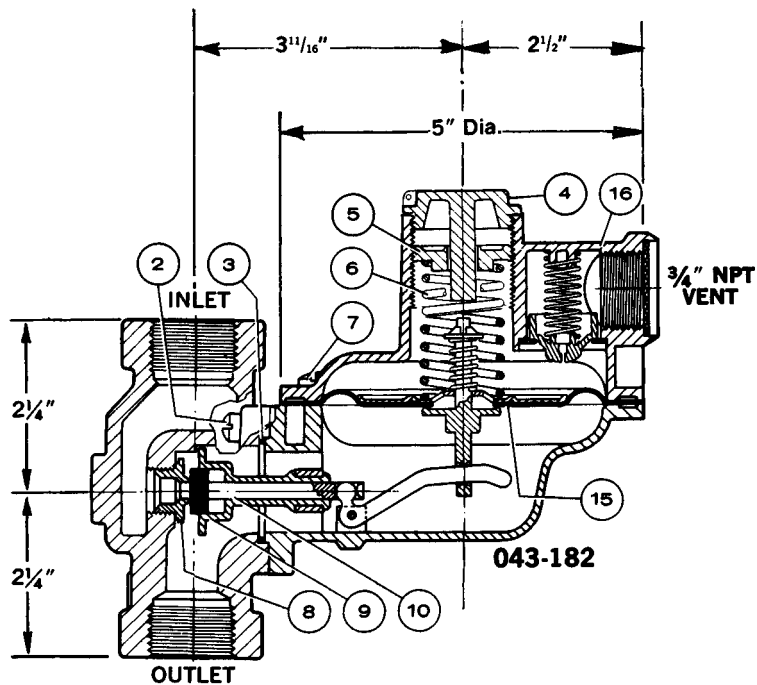
PIPE SIZES
3/4" X 3/4"
3/4" X 1"
1" X 1"



Regulator General Assembly

Model 043-182

PIPE SIZES
3/4" X 3/4"
3/4" X 1"
1" X 1"

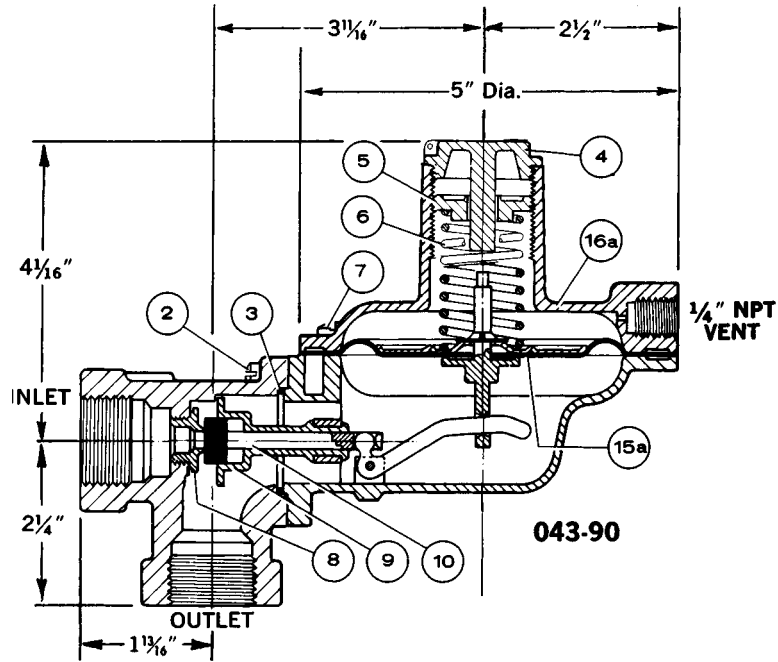




Regulator General Assembly

Model 043-90

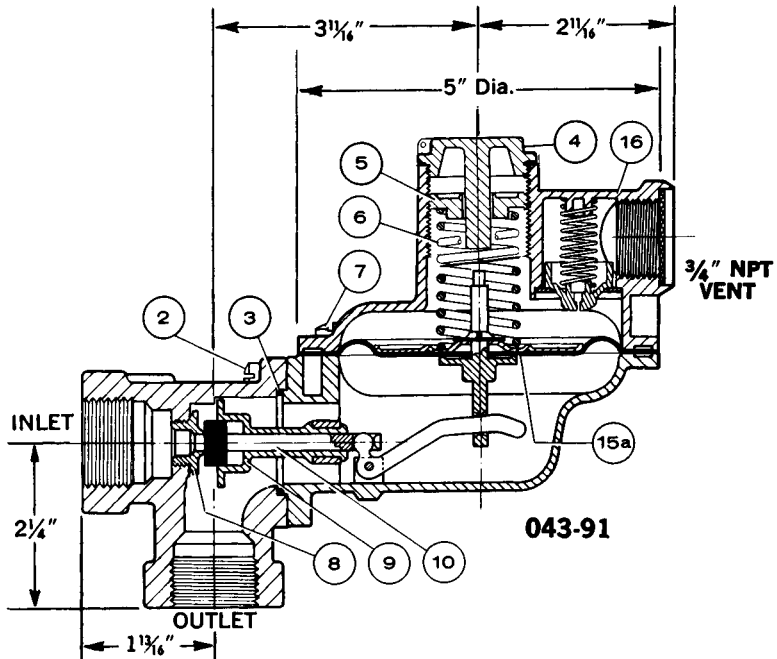
PIPE SIZES
3/4" X 3/4"
3/4" X 1"
1" X 1"



Regulator General Assembly

Model 043-91

PIPE SIZES
3/4" X 3/4"
3/4" X 1"
1" X 1"

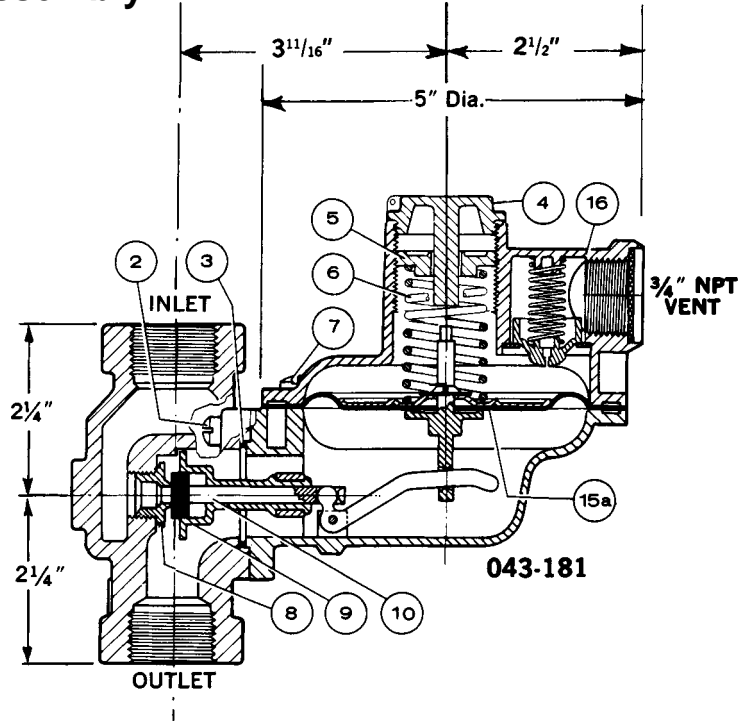




Regulator General Assembly

Model 043-181

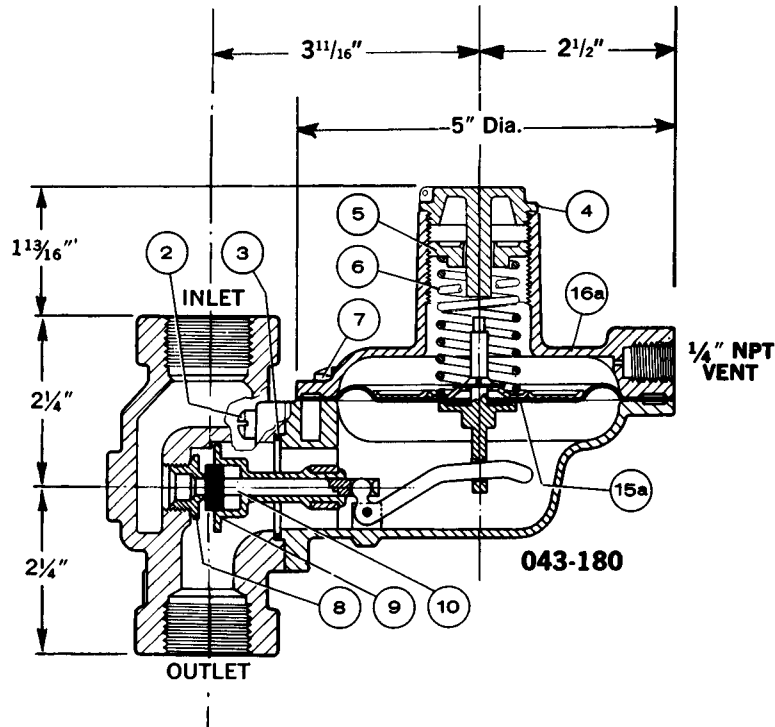
PIPE SIZES
$\frac{3}{4}$ " X $\frac{3}{4}$ "
$\frac{3}{4}$ " X 1"
1" X 1"



Regulator General Assembly

Model 043-180

PIPE SIZES
$\frac{3}{4}$ " X $\frac{3}{4}$ "
$\frac{3}{4}$ " X 1"
1" X 1"



043 Service Regulator Capacity Table

CAPACITY* in SCFH Natural Gas (0.6 specific gravity—14.65 psia—60°F)

PIPE SIZE (Inlet & Outlet) NPT	Inlet† Pressure (psi)	Outlet Pressure Range* 3 1/2" w.c. to 28" w.c.					Outlet Pressure Range* 1 psi to 2 psi (Black Spring)				
		Orifice Size					Orifice Size				
		3/8"	5/16"	1/4"	3/16"	1/8"	3/8"	5/16"	1/4"	3/16"	1/8"
3/8" X 3/8"	1/2	—	—	60	—	—	—	—	—	—	—
	1	—	—	100	—	—	—	—	—	—	—
	2	—	—	200	75	—	—	—	—	—	—
	3	—	—	240	100	50	—	125	100	60	50
	5	—	—	260	220	70	—	250	200	125	80
	10	—	—	300	270	100	—	400	250	200	125
	20	—	—	350	300	200	—	450	450	400	225
	40	—	—	350	350	230	—	—	450	450	375
	60	—	—	—	350	270	—	—	500	500	450
	80	—	—	—	—	300	—	—	—	550	500
	100	—	—	—	—	300	—	—	—	—	550
125	—	—	—	—	300	—	—	—	—	550	
3/8" X 1/2" 1/2" X 1/2"	1/2	—	140	130	—	—	—	—	—	—	—
	1	—	180	160	130	—	—	—	—	—	—
	2	—	250	210	160	120	—	—	—	—	—
	3	—	310	270	200	140	—	120	100	60	50
	5	—	380	370	250	160	—	250	200	125	80
	10	—	450	450	420	250	—	400	250	200	125
	20	—	500	500	450	450	—	500	450	400	250
	40	—	—	500	500	500	—	650	650	600	400
	60	—	—	—	500	500	—	—	650	650	500
	80	—	—	—	—	500	—	—	—	650	650
	100	—	—	—	—	500	—	—	—	—	650
125	—	—	—	—	—	—	—	—	—	650	
1/2" X 3/4" 3/4" X 3/4"	1/2	100	—	—	—	—	—	—	—	—	—
	1	200	180	—	—	—	—	—	—	—	—
	2	300	250	200	—	—	—	—	—	—	—
	3	500	400	250	—	—	125	125	100	60	50
	5	800	750	500	300	—	250	250	200	125	80
	10	800	800	600	450	200	400	400	250	200	125
	20	—	800	700	650	400	500	500	450	400	250
	40	—	—	800	700	650	—	700	650	650	400
	60	—	—	—	800	700	—	—	900	900	650
	80	—	—	—	—	700	—	—	—	900	750
	100	—	—	—	—	800	—	—	—	—	900
125	—	—	—	—	800	—	—	—	—	900	
1/2" X 1" 3/4" X 1" 1" X 1"	1/2	150	150	100	90	70	—	—	—	—	—
	1	200	190	125	100	90	—	—	—	—	—
	2	300	250	200	125	110	—	—	—	—	—
	3	500	400	350	230	125	125	125	100	60	50
	5	900	850	600	300	150	250	250	200	125	80
	10	900	900	700	450	200	400	400	250	200	125
	20	—	900	800	650	400	750	750	500	400	250
	40	—	—	900	800	700	—	1000	900	900	400
	60	—	—	—	900	800	—	—	1000	900	650
	80	—	—	—	—	800	—	—	—	1000	900
	100	—	—	—	—	900	—	—	—	—	1000
125	—	—	—	—	900	—	—	—	—	1000	

*Capacities are based on maximum outlet pressure variations as follows:

RED and BLUE Springs—1" w.c. droop or 2" w.c. boost (-1" w.c. or +2" w.c.)

GREEN Spring—2" w.c. droop (-2" w.c.) ORANGE Spring—3" w.c. droop (-3" w.c.)

BLACK Spring—10% droop

†1/2 psi, 1 psi and 2 psi Inlet Pressures apply only to RED and BLUE Springs.

Last capacity figure in each column indicates maximum allowable inlet pressure (except for emergency conditions).

NOTE: The above performance data is based on normal testing at 70°F flowing temperature. Changes in performance can occur at extreme low flowing temperatures.



Maximum Emergency Pressure

The maximum pressure the regulator inlet may be subjected to under abnormal conditions without causing damage to the regulator is the maximum inlet pressure +50 psi.

The maximum pressure the diaphragm may be subjected to without causing damage to the internal parts of the regulator is the set-point +3 psi (set-point is defined as the outlet pressure a regulator is adjusted to deliver).

If either of the above pressure limits are exceeded, the regulator must be taken out of service and inspected. Damaged or otherwise unsatisfactory parts must be repaired or replaced.

The maximum pressure that can be safely contained by the diaphragm case is 10 psi (safely contained means no leakage as well as no bursting).

Before using any of the above data, make sure this entire section is clearly understood.

Orifice Size	Maximum Inlet Pressure For Full Capacity Relief	
	A	B
1/8"	26 psig	73 psig
3/16"	9 psig	24 psig
1/4"	5 psig	14 psig
5/16"	4 psig	11 psig
3/8"	3 psig	8 psig

A—Outlet pressure will not exceed 1 psi.

B—Outlet pressure will not exceed 2 psi.

NOTE: Above data based on 5" - 8 1/2" w.c. (Blue) spring

Capacities

FULL OPEN CAPACITY

Use the following formula for the full open capacity of 043 regulators:

$$1. Q = K \sqrt{P_0 (P_1 - P_0)} \dots \dots \dots \text{(for } \frac{P_1}{P_0} < 1.894)$$

$$2. Q = \frac{KP_1}{2} \dots \dots \dots \text{(for } \frac{P_1}{P_0} > 1.894)$$

Q = maximum capacity of the regulator (in SCFH of 0.6 specific gravity natural gas)

K = the "K" factor, the regulator constant (from the table below)

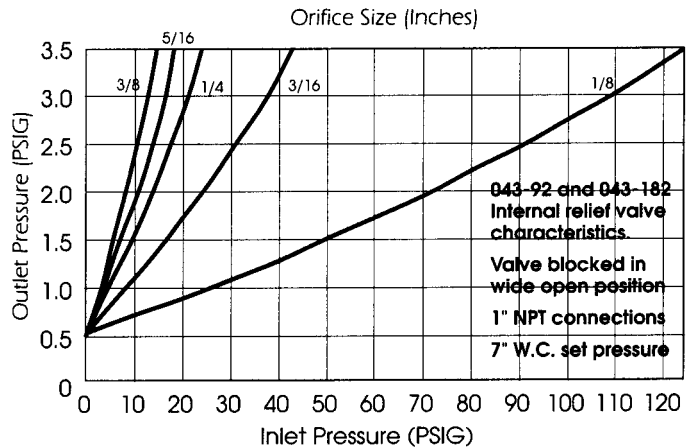
P1 = absolute inlet pressure (psia)

P0 = absolute outlet pressure (psia)

ORIFICE	3/8"	5/16"	1/4"	3/16"	1/8"
K	292	206	132	74	33

Note: When sizing relief valves for use with 043 regulators, use full open capacity.

Typical Internal Relief Valve (IRV) Performance Curves



Other Gases

The 043 Service Regulator is mainly used on natural gas services; however, this regulator will perform equally as well on other gases. When using the 043 Regulator on other gases, the regulator capacities must be adjusted using the following correction factors.

Type of Gas	Correction Factor
Air (specific gravity 1.0)	0.77
Propane (specific gravity 1.53)	0.63
1350 BTU Propane-Air Mixture (specific gravity 1.20)	0.71
Nitrogen (specific gravity 0.97)	0.79
Dry CO ₂ (specific gravity 1.52)	0.63

For other non-corrosive gases use the following formula:

$$\text{Correction Factor} = \sqrt{\frac{0.60}{\text{Specific gravity of the gas}}}$$

For use with gases not listed above, please contact your Equimeter representative or Industrial Distributor for recommendations.