

FRG 7../6
Ratio Regulator / Zero Governor
Installation Instructions

SPECIFICATIONS

FRG/6 Spring-loaded ratio regulator/zero governor with adjustable setpoint spring and defined counterspring. Internal sensing of output pressure; air impulse line connection is standard.

Body size	Size	
FRG 705/6	1/2"	NPT
FRG 707/6	3/4"	NPT
FRG 710/6	1"	NPT
FRG 712/6	1 1/4"	NPT
FRG 715/6	1 1/2"	NPT
FRG 720/6	2"	NPT
FRG 725/6	2 1/2"	NPT
FRG 730/6	3"	NPT

Gases
Dry, natural gas, propane, butane; other noncorrosive gases. Suitable for up to 0.1% by volume, dry H₂S.
A "dry" gas has a dew point lower than +15 °F and its relative humidity is less than 60 %.

Maximum Operating Pressure
7 PSI (500 mbar)
5 PSI (350mbar) applies to CSA Certification.

Optimal Inlet Pressure Range
Ratio regulator: 3 to 82 in. W.C. (7 to 200 mbar).
Zero Governor: 3 to 20 in. W.C. (7 to 50 mbar)

Output Pressure Range
Ratio regulator: 0 to 60 in. W.C. (0 to 150 mbar)
Zero Governor: -2 to 2 in. W.C. (-5 to 5 mbar)

Breathing Plug / Air Impulse Line Connection
For gas-air ratio applications at pressure ratio of approximately 1:0.95 (air/gas), the existing breather plug connection can be backloaded with air impulse line from the blower. See additional details on page 2.

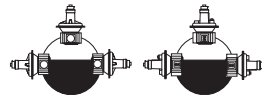
Low Fire Bypass (Optional)
Field mountable low fire bypass: only for FRG 705/6 to FRG 720/6, and mounts to either side.

Materials in Contact with Gas
Housing: Aluminum
Seals and diaphragms: NBR-based rubber

Test Port
1/4" NPT on both sides of the inlet section and on both sides of the outlet section. When low fire bypass is used, only test ports on one side can be used.

Ambient / Fluid Temperature
• +5 °F to +150 °F for up to 7 PSI for regulating behavior (+/- 10% of setpoint).
• -40 °F to +150 °F: Diaphragms are suitable for the low temperature, but there may be out of range regulating behavior.
• CSA Certified for -40 °F to +150 °F for up to 5 PSI

Mounting Position
Regulator dome vertically upright or lying horizontal.



Vent Limiter
All FRG regulators incorporate a factory installed vent limiter that limits the escape of gas to the ambient to less than 0.5 ft³/hr @ 5 PSI in case of diaphragm failure. Venting required unless otherwise accepted by the authority having jurisdiction.

Approvals
CSA Certified to ANSI Z21.18/CSA 6-3: File No. 1135455.
Commonwealth of Massachusetts Approved Product.
Approval code G1-1107-35.



ATTENTION

- Read these instructions carefully.
- Failure to follow them and/or improper installation may cause explosion, property damage and injuries.
- Installation must be done with the supervision of a licensed burner technician.
- The system must meet all applicable national and local code requirements such as but not limited to NFPA 86, CSD-1, ANSI Z21.13, UL 795, NFPA 85, or CSA B149.3.
- Check the ratings in the specifications to make sure that they are suitable for your application.
- Never perform work if gas pressure or power is applied, or in the presence of an open flame.
- Once installed, perform a complete checkout including leak testing.
- Verify proper operation after servicing.

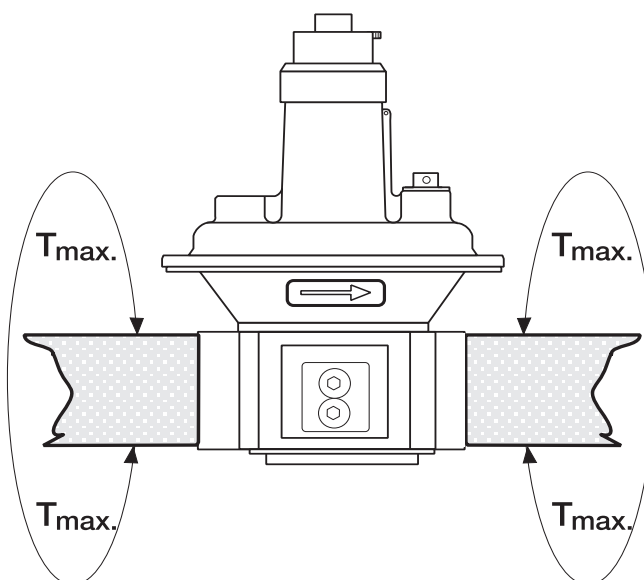
MOUNTING

Recommended Preparation

- The main gas supply must be shut off before starting the installation.
- Read these installation instructions carefully.
- Carefully examine the FRG/6 for shipping damage.
- Remove the two red plastic covers from the FRG/6 body.
- Remove all dirt and debris before installing the FRG/6. Failure to remove dirt/debris could result in damage or improper performance.

Recommended Procedure to Mount the FRG/6

- Install the FRG/6 with the gas flow matching the direction indicated by the arrows on the casting.
- Mount the FRG/6 with the regulator vertical or horizontal.
- Use new, properly reamed and threaded pipe free of chips.
- Apply good quality pipe sealant, putting a moderate amount on the male threads only. If using LP gas, use pipe sealant rated for use with LP gas.
- Do not thread pipe too far. FRG/6 distortion and/or malfunction may result from excess pipe in the valve body.
- Apply counter pressure with a parallel jaw wrench only to the flats of the FRG/6 when installing pipe.
- Do not overtighten the pipe. Follow the maximum torque values listed.
- After installation is complete, perform a leak test.



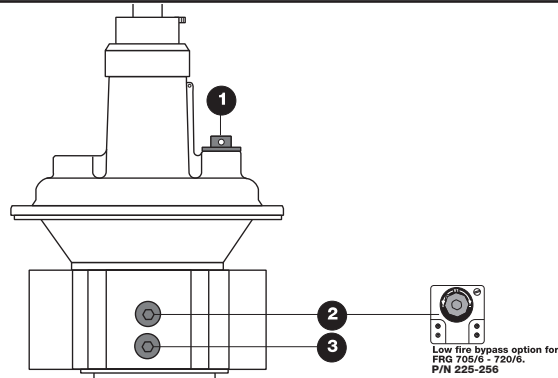
NPT	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2 1/2"	3"
Tmax [lb-in]	443	752	1106	1770	1991	2213	2876	3540



CAUTION: If the flow is not in the same direction as the arrows, the FRG/6 will not operate properly.

Pressure Taps / Air Impulse Line / Vent Connection

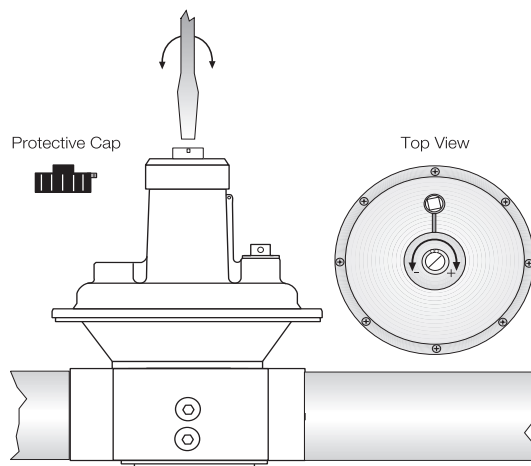
- As a proportionator, this is an air impulse line connection. As a zero governor, this is a breathing plug or a vent connection. NOTE: All FRGs have a factory installed vent limiter under the regulator housing. Connection is G 1/4 for FRG 705/6 to FRG 710/6 and G 1/2 for FRG 712/6 to FRG 730/6. G thread to NPT thread adapters are available. G 1/4 to 1/4"NPT adapter (part number 231-944) and G 1/2 to 1/2 NPT adapter (part number 231-945).
- Pressure tap connection in inlet section, both sides 1/4" NPT.
- Pressure tap connection in outlet section, both sides 1/4" NPT.



Outlet Pressure Adjustment

Adjusting the FRG/6

1. Remove the black protective cap.
2. To increase outlet pressure turn the adjustment spindle clockwise, to decrease the outlet pressure turn the adjustment spindle counterclockwise.
3. Always use an accurate pressure gauge connected downstream from the regulator to measure the actual outlet pressure.
4. Reinstall the black protective cap.
5. After adjusting the set point for normal operation check to see that the gas pressure regulator operates as intended.
6. Use holes in the black cap and the side of the regulator to secure a lead seal to prevent unauthorized adjustment.



ZERO GOVERNOR APPLICATION

Application - Zero governor

For use with gas engines or premix burners, the FRG controls flow by reducing upstream gas pressure to zero or adjustable to slightly above or below atmospheric pressure.

The outlet pressure is adjustable with the setpoint spring.

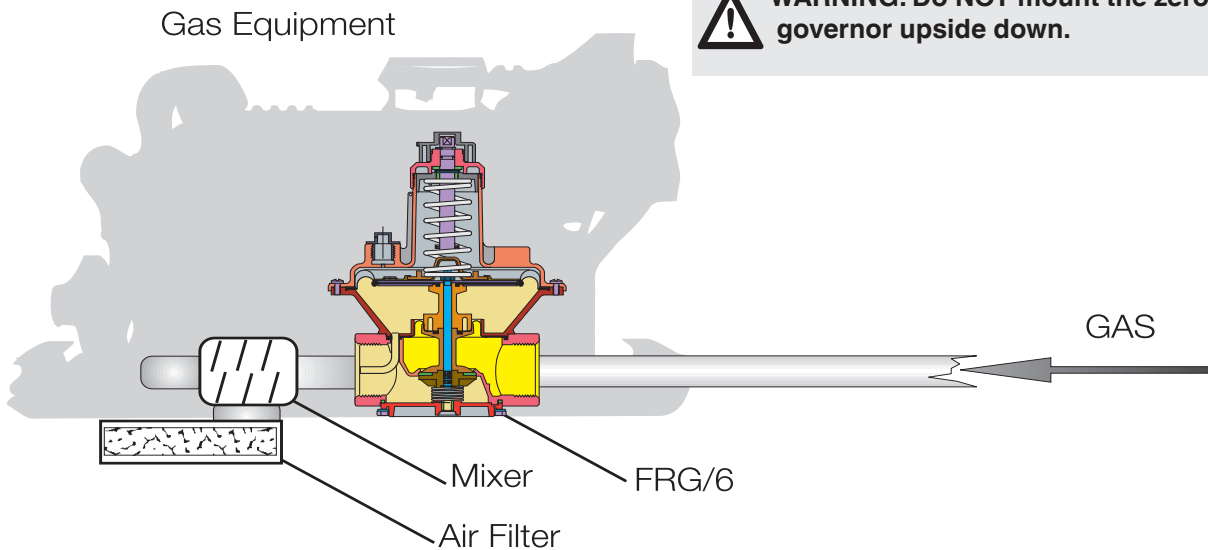
For \dot{V}_{\max} see flow diagram on page 6.

Adjusting the FRG/6

1. For zero governor applications, the FRG should be adjusted at low fire only.
2. If the FRG is not flowing enough gas at the maximum air flow rate, the gas flow can be increased by any of the following:
 - a.) Increase the negative signal to the FRG.
 - b.) Install a larger FRG.

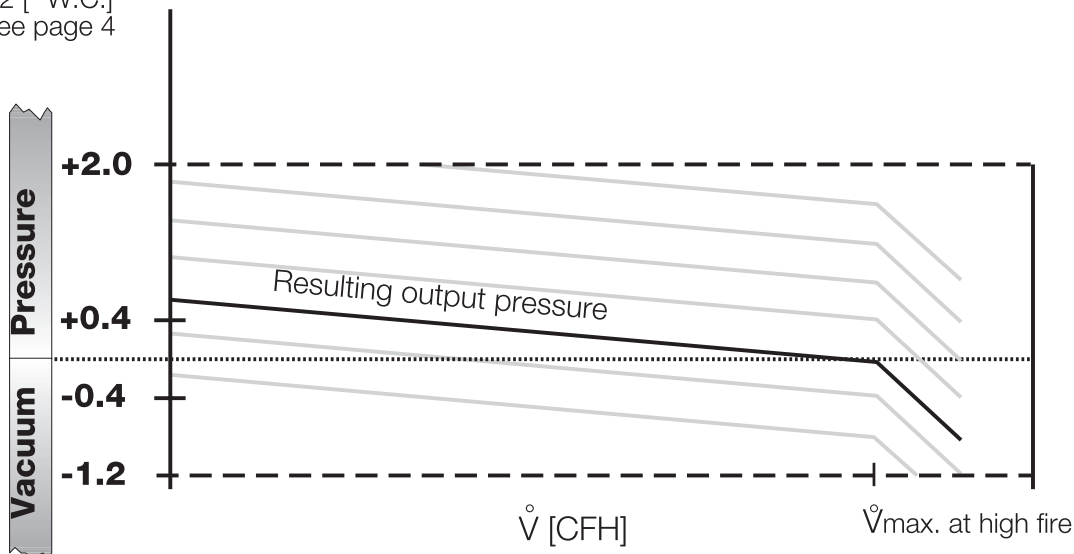


WARNING: Do NOT mount the zero governor upside down.



Zero governor outlet pressure

Outlet pressure
p2 [” W.C.]
see page 4



The above illustration shows adjustability (fuel biasing) of the FRG/6 when used as a zero governor. Refer to page 6 for sizing FRG/6 at maximum flow rate.

RATIO REGULATOR APPLICATION

Application - Ratio Regulator

The FRG holds a constant gas/air ratio during turndown by varying gas flow to the burner in proportion to the combustion air flow. Adjustable for excess air or gas.

Setup Procedure

When setting up the FRG/6 and burner for proper ratio at all firing rates, follow the burner manufacturer's instructions. The following procedure contains recommended guidelines only, and they do not supersede the burner manufacturer's procedures for setting up and adjusting the FRG/6 to the burner.

Low Fire Adjustment

The adjustable top loading spring on the FRG/6 is a low fire adjustment (see outlet pressure adjustment on page 2). If the tension on this spring is at a minimum and there is still too much gas flow at low fire, achieving a lower flow rate is possible by reducing the air impulse line pressure to 2"WC or less. If the air impulse line pressure cannot be reduced, a lower flow rate can be achieved by installing a smaller FRG/6.

In order to achieve a low fire flow rate in the range of 20-100 CFH, a field mountable low fire bypass restrictor (225-256) is recommended. See "Flow curve for Low fire bypass" on page 5 for more details. When using the low fire bypass restrictor, it is recommended that the

top loading spring be adjusted so that the FRG/6 regulating disc opens just as the impulse line increases during the ramp-up cycle. If the loading spring tension is too small, there will be a delayed increase of fuel flow as the air flow increases until the loading line pressure is greater than the counterspring force, and the result can be a lean burner over a small range of inputs near low fire.

CAUTION: Multiple burners and low fire adjustment. It is not recommended to use a control scheme or gas piping scheme that does not equally distribute the gas pressure to each burner at low fire. Examples of such schemes could include using one FRG/6 to control the gas flow to more than one burner, or using one air control valve to feed two FRG's and a second air control valve to feed three FRG's. Such a control scheme will likely not allow for optimal low fire adjustment at each burner.

CAUTION: Purge and low fire start

A burner (or set of burners) that lights immediately after a purge that is longer than 60 seconds can cause a 5-20 second (depending on the purge pressure) slightly fuel rich condition at the low fire start. If such a case occurs, it is recommended that the loading line pressure during the purge be vented, or that light off be delayed just long enough to eliminate the slightly fuel rich condition at the low fire start.

High Fire Adjustment

Additional adjustments might be needed at high fire, depending on the type of burner, piping arrangement, flow, air impulse line pressure, and the model of FRG/6 installed on the burner. **NOTE:** The burner might have an integrated gas limiting valve or an air balancing valve (see illustration below). If these are not provided on the burner, installing them might be needed in order to achieve the correct ratio at high fire. In cases where the high fire rate is fuel rich, partially close the gas limiting valve located downstream of the FRG/6 in order to achieve proper ratio. This adjustment reduces the gas pressure in the burner without affecting the air pressure. Re-adjust the low fire ratio if needed. In cases where the high firing rate is fuel lean, first verify that the inlet gas pressure to the FRG/6 is and remains at least 2"WC higher than the air impulse line pressure at high fire. If there is suitable inlet gas pressure to the FRG/6, then more fuel to the burner can be accomplished by either installing a larger FRG/6 or by partially closing the air balancing valve located downstream of the control valve to achieve proper ratio; this adjustment reduces the air pressure in the burner and increases the impulse line pressure on the FRG/6. Re-adjust the low fire ratio if needed.

Adjusting the FRG/6

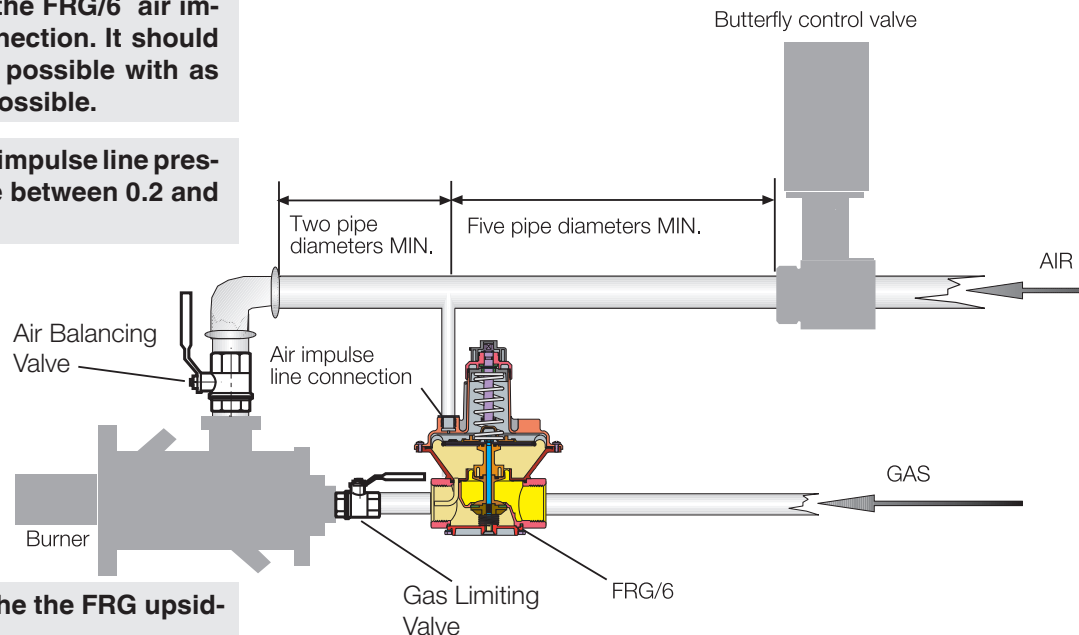
See outlet pressure adjustment on page 2.



The size of the air impulse line should match the FRG/6 air impulse line connection. It should be as short as possible with as few bends as possible.

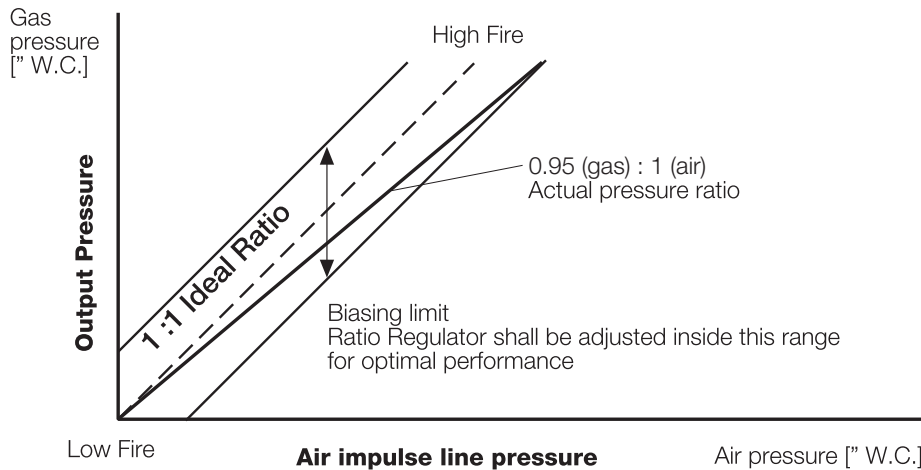


The low fire air impulse line pressure should be between 0.2 and 1.0 In. W.C.



Do NOT mount the the FRG upside-down.

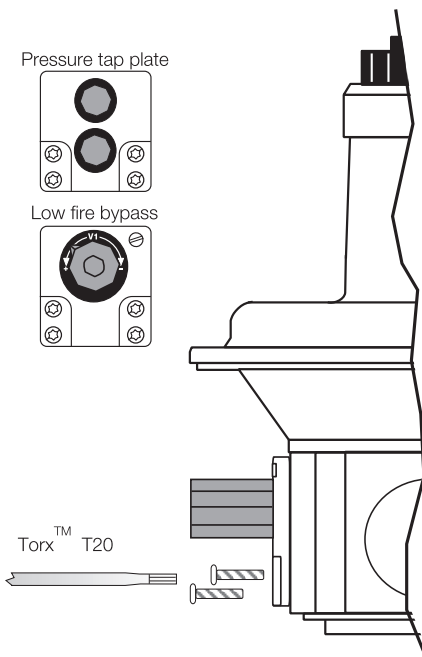
RATIO REGULATOR BIASING CURVE



The above illustration shows that the air impulse line can be adjusted to achieve excess air, excess gas, or on ratio at low fire. However, the air impulse line slightly exceeds the gas outlet pressure at high fire rate.

LOW FIRE BYPASS

Mounting of low fire bypass

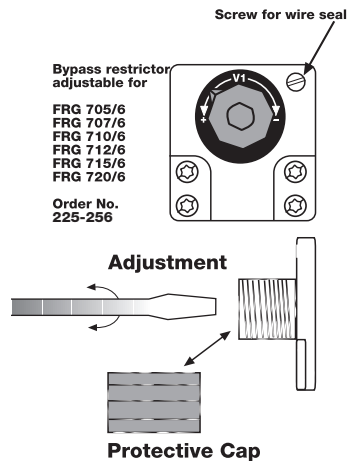


Low fire bypass Max. Torque
1.85 Lb-in.

Mounting the Low Fire Bypass

1. Remove the pressure tap plate with a Torx™ driver size T20.
2. Line up the low fire bypass making sure that the O-ring is seated correctly. Reinstall with the screws from the pressure tap mounting plate.
3. Perform a leak test after torquing the low fire bypass.

Low fire bypass Flow adjustment

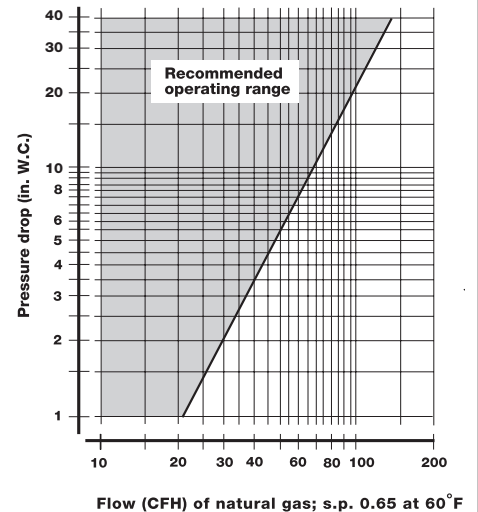


The low fire bypass is factory set for maximum flow.

Adjusting the Low Fire Bypass

1. Remove the black cover
2. With a slotted screwdriver turn the adjustment screw clockwise for LESS gas and counter clockwise for MORE gas flow.
3. Secure cap with a wire seal.

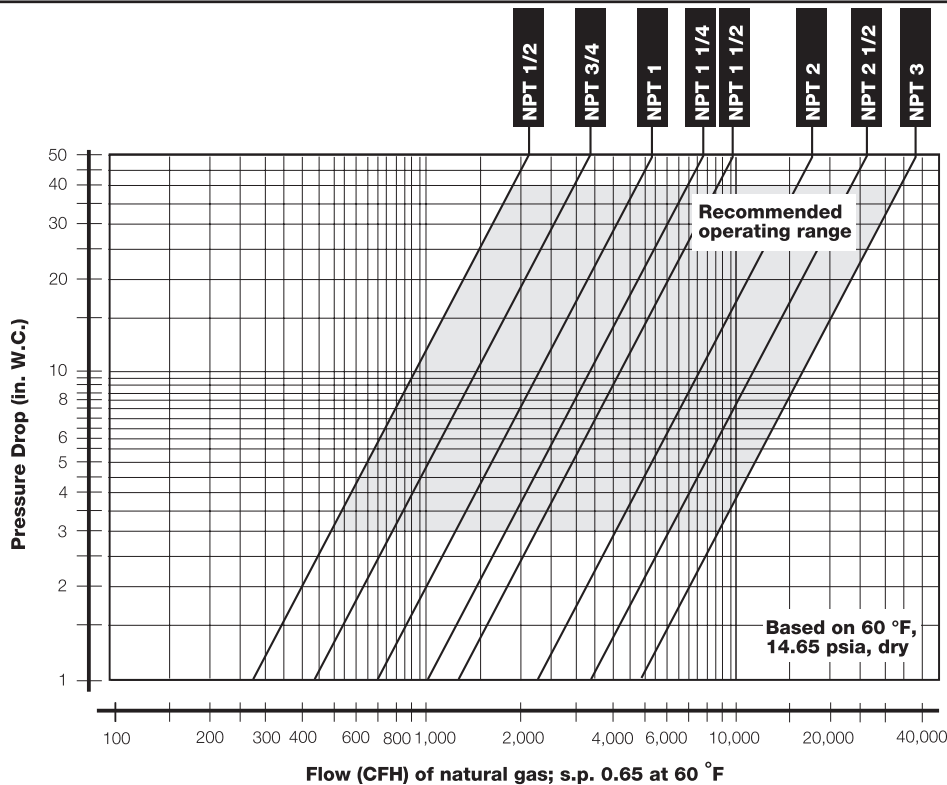
Flow Curve for Low fire bypass



REPLACEMENT FRG AND FRNG REPAIR KITS

Description	Diaphragm Repair Kit P/N
FRG 705/6	Not available
FRG 707/6	Not available
FRG 710/6	Not available
FRG 712/6 & 715/6	Not available
FRNG 5040	Not available
FRNG 5050 & FRG 720/6	229-658
FRNG 5065 & FRG 725/6	229-659
FRNG 5080 & FRG 730/6	229-660
FRNG 5100	229-661
FRNG 5125	229-662
FRNG 5150	229-663

FRG/6 FLOW CURVE



A minimum of 3 in. W.C. Δp is required when sizing at maximum flow capacity for optimal control on high turndown applications (40:1). A 2 in. W.C. Δp can be applied for sizing if a lower turndown (in the range of 10:1) is required. Sizing the FRG/6 using a 1 in. W.C. Δp or less is not recommended for most applications.

To determine the pressure drop when using a gas other than natural gas, use the flow formula below and f value located in the chart below to determine the “corrected” flow rate in CFH through the valve for the other gas used. For example, when using propane, divide the volume (CFH) of propane required for the application by the calculated value f ($f = 0.66$ for propane). Use this “corrected” flow rate and the flow curve above to determine pressure drop for propane.

$$\dot{V}_{\text{gas used}} = \dot{V}_{\text{Natural Gas}} \times f$$

Use this formula to calculator the f factor for other gases not listed on the table.

$$f = \sqrt{\frac{\text{Spec. gravity of Natural Gas}}{\text{Spec. gravity of gas used}}}$$

Type of gas used	Density [kg/m ³]	sg	f
Natural gas	0.81	0.65	1.00
Butane	2.39	1.95	0.58
Propane	1.86	1.50	0.66
Air	1.24	1.00	0.80