RESIDENTIAL AND COMMERCIAL REGULATORS FOR ABNORMAL OPERATING CONDITIONS (AOC) WITH 3 FOOT CLEARANCE INSTALLATION REQUIREMENTS DUAL STAGE / OPSO PRESSURE REGULATORS

1 / 2022
Where did they come from?
3 FOOT ABNORMAL OPERATING CONDITIONS (AOC)
REGULATOR INSTALLATION AND REQUIREMENTS

DOT 192 § 192.353 Customer meters and regulators: Location

• (c) Each meter installed within a building must be located in a ventilated place and not less than 3 feet (914 millimeters) from any source of ignition or any source of heat which might damage the meter.

• In 2009 the NFPA 54 changed Sec. 5.7.2.3, which now states, “there shall be a minimum of 3 feet of clearance from a door, window, or an ignition source” and a gas meter or gas regulator relief vent.
WHY NOW?

1. At first, inspectors and Utilities were not aware of enforcing the code.

2. Regulatory agencies put pressure on Public Service Commissions (PSC) to begin enforcing this code.

3. PSC’s began to pressure Utilities to come up with a solution.

4. PSC’s & Utilities had to work to agree on an economical, totally safe & esthetic solution.
1. Washington Gas Light

2. Virginia Public Service Commissions (PSC).

3. National Grid, Virginia Natural Gas, NiSource, Atlanta Gas Light in the background.


5. CSA as a second party testing and witness to the regulator’s operation.
REASONS FOR THE CODE?
As Allowed by Local Codes, Regulations and Company Policies

THE FOLLOWING ARE EXAMPLES OF THE METER SET IN VIOLATION OF THE CODE!
The electric meter is classified as an ignition source and there shall be a minimum of 3 feet of clearance between an ignition source and a gas regulator relief vent.

The picture below shows inadequate clearances between the gas service and electric meter.
Location and the Local Code
Venting of Indoor Installations

Hi! I’m your gas vent.
Venting of Outdoor Installations
MULTIPLE PROBLEMS!
Historic Areas, Apartments & Condo
These types of installations have caused many problems for Utilities and cost thousands of dollars to fix including:

1. Relocating services.
2. Running expensive & unsightly vent lines.
3. Vent lines can affect the performance of the regulator.
4. Sometimes retrofitting buildings, such as condominiums and row houses provide no options for either of the above.

2. Did preliminary Field & Lab tests from August to October of 2013.

3. Other Utilities and PSC’s were involved in the background, but we preferred to work with only 1 Utility company during this period.

4. First Field trial was installed in December of 2013.

5. To date, over 600,000 installed in the US.
DESIGN CRITERIA AGREED UPON BY ALL PARTIES TO SATISFY THE PSC AND EVERYONE INVOLVED

1. There is no US code to compare this standard to for zero clearance.
2. We decided the requirement needed to meet the CSA/ANSI Z21.80a-2019 / CSA 6.22a-2019 line regulator vent limited standard is < 2.5 cu. Ft./Hr.
3. We felt redundant safety was important and required.
4. Everyone had to agree it would meet the requirements.
5. MOST IMPORTANT: PF wanted to have a 3rd party (CSA) certification to ensure our product met the standards.
The Solution:
The FE Series of Residential & Commercial REGULATORS
Why the FE REGULATOR?
SOLUTION!
SOLUTION!
SOLUTION!
Pietro Fiorentini has always been a leading player in the long path of oil and gas. We never stopped innovating in our 80 years of experience and now we are extremely proud and excited to announce the first permanent Pietro Fiorentini USA factory in North America.
FE REGULATOR – Main features

- **Two Stage Regulation and Balanced Valve**
  - **Accuracy** – The First Stage Regulation negates upstream pressure variation and its effect on downstream Pressure
  - **Safety** – if a stage should fail the remaining stage acts as a monitor and limits downstream pressure

- **Dual Diaphragm**
  - **Safety** – In case of main diaphragm failure, the double safety diaphragm with internal vent limiter ensures a controlled leak rate. Regulator may continue to operate and have the ability to control downstream pressure.

- **Single Orifice Size**
  - Meets MAOP up to 125 psi
• **Over Pressure Safety Shut-off (OPSO)**
  - Meets the challenges presented by Codes and Regulations as they pertain to building openings and sources of ignition
  - Provides options for new installations and relocating existing sets vs. the use of regulators with full capacity internal relief.
  - Provides Enhanced Downstream safety
  - Eliminate or reduce the cost of Venting indoor installations
  - Eliminate or reduce the cost of Venting outdoor installations
FE REGULATOR FEATURES

• FE is ANSI B109.4 / CSA 6.18 certified
• Two Stage Pressure Reduction
• Fully Balanced Valve
• Internal Safety Diaphragm with Vent Limiter
  • The safety diaphragm serves as a vent limiter, therefore in case of working diaphragm failure it will limit the volume of gas vented to less than 1 CFH. By contrast standard IRV type service regulators may vent, in case of catastrophic failure, up to 500 times more volume of gas.
• Safety Shutoff Options
  – Over Pressure
  – Under Pressure
  – Excess Flow
  – Thermal
FE REGULATOR ADVANTAGES

• Inlet Strainer
• Single Orifice
• Token Relief Valve
• Inlet and Outlet Pressure Tap Option
• One or Two Outlets
• External Vent Limiter
• Anti-Flooding
• H2 Ready (Hydrogen blend)
FACTORY SETTINGS OF THE REGULATORS

Low Pressure Residential & Commercial Service

Outlet Pressure: 7" W.C
Token IRV: 13" W.C.
Slam Shut: 19" W.C.

High Pressure Residential & Commercial Service

Outlet Pressure: 2 PSIG
Token IRV: 2.7 PSIG
Slam Shut: 3 PSIG
PF IS A CSA-APPROVED & CERTIFIED TESTING LABORATORY & FACTORY
# FE Regulators Capacities

## Main Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet Pressure Range</strong></td>
<td>2.2 – 125 psi</td>
</tr>
<tr>
<td><strong>Max Allowable Pressure</strong></td>
<td>PS 125 psi</td>
</tr>
<tr>
<td><strong>Outlet Pressure Range</strong></td>
<td>BP: 5.2” wc – 2.6 psi</td>
</tr>
<tr>
<td></td>
<td>TR: 2.6 psi – 7.5 psi</td>
</tr>
<tr>
<td><strong>Over Pressure Shut-Off Setting Range</strong></td>
<td>BP: 14” wc - 4,3 psi</td>
</tr>
<tr>
<td></td>
<td>TR: 4.3 psi- 11.6 psi</td>
</tr>
<tr>
<td><strong>Accuracy Class</strong></td>
<td>up to AC5</td>
</tr>
<tr>
<td><strong>Lock Up Pressure Class</strong></td>
<td>up to SG10</td>
</tr>
<tr>
<td><strong>Operating Temperature</strong></td>
<td>-4°F/140°F</td>
</tr>
<tr>
<td></td>
<td>-40°F/140°F</td>
</tr>
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</table>

## Pipe Size

<table>
<thead>
<tr>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 x 3/4</td>
</tr>
<tr>
<td>3/4 x 1</td>
</tr>
<tr>
<td>1 X 1-1/4</td>
</tr>
<tr>
<td>1 x 1-1/2</td>
</tr>
<tr>
<td>1-1/4 X 2</td>
</tr>
<tr>
<td>2 x 2</td>
</tr>
</tbody>
</table>

## Nominal Capacity

<table>
<thead>
<tr>
<th>Model</th>
<th>SCFH</th>
<th>Minimum Inlet Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE 10</td>
<td>353</td>
<td>2.9</td>
</tr>
<tr>
<td>FE 25</td>
<td>875</td>
<td>3.3</td>
</tr>
<tr>
<td>FES 50</td>
<td>1,500</td>
<td>8.7</td>
</tr>
<tr>
<td>FEXF 50</td>
<td>1,500</td>
<td>5.8</td>
</tr>
<tr>
<td>FEX 75</td>
<td>2,648</td>
<td>7.5</td>
</tr>
<tr>
<td>FEXS 100</td>
<td>3,500</td>
<td>8.7</td>
</tr>
</tbody>
</table>
## CAPACITY

### Nominal CAPACITY  Low Inlet Pressure
**White is in inches W.C. Red is in PSIG**

<table>
<thead>
<tr>
<th>Pu (&quot;w.c. PSI&quot;)</th>
<th>FE (SCFH)</th>
<th>FEX (SCFH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.5</td>
<td>140</td>
<td>425</td>
</tr>
<tr>
<td>12</td>
<td>240</td>
<td>475</td>
</tr>
<tr>
<td>16</td>
<td>350</td>
<td>500</td>
</tr>
<tr>
<td>1.08</td>
<td>460</td>
<td>820</td>
</tr>
<tr>
<td>1.45</td>
<td>550</td>
<td>1,130</td>
</tr>
<tr>
<td>2.89</td>
<td>700</td>
<td>1,540</td>
</tr>
<tr>
<td>4.34</td>
<td>875</td>
<td>2,030</td>
</tr>
<tr>
<td>5.78</td>
<td>885</td>
<td>2,275</td>
</tr>
<tr>
<td>7.25</td>
<td>885</td>
<td>2,635</td>
</tr>
</tbody>
</table>
FE REGULATOR

Model FE
875 CFH

Model FEX
3500 CFH
Compact Meter Sets
Flexible Installation!
FE FEATURES
INLET FILTER

TO KEEP DEBRIS OUT OF THE REGULATOR

Inlet filter: area (0.775 inch$^2$) 100 μm efficiency
FE REGULATOR

- Operating and Safety Diaphragms & Internal Vent Limiter
- Outlet Pressure Spring
- EXCESS FLOW REARMING PUSHBUTTON
- OPSO REARMING KNOB
- OPSO REGULATION NUT
1. Over Pressure Shut-Off device (OPSO)
2. Optional Under Pressure Shut-off (UPSO) OPTIONAL
Overpressure slam-shut device (OPSO)
SLAM SHUT FOR ULTIMATE PROTECTION

Slam Shut device:
- OPSO
- UPSO (optional)
- Manual reset
- Shut off for lack of feeding
- Slam shut positions

ARMED

UNARMED
SLAM SHUT FOR ULTIMATE PROTECTION

New cover has a slot to use as a tool to reset the slam shut!

Yellow cover "w.c / Red cover PSIG
Excess flow valve / UPSO (optional)
ADDED SAFETY WITH DUAL DIAPHRAGM

SAFETY DIAPHRAGM

WORKING DIAPHRAGM

INTERGAL VENT LIMITER
Pietro Fiorentini

Amando Annadini
Research & Development Department
Via Faustinielli, 13 • 25015 Desenzano D/G (BS)

October 17th 2014

Re: FE6, FE10 & FE25 – Vent Limiting Function of the Safety Diaphragm

CSA witnessed the following test at Pietro Fiorentini.

Background: The above regulators are currently certified to CSA 6.18-02(R2006) and ANSI B109.4-1996. The below tests were performed at the request of Pietro Fiorentini to measure the safety performance of the vent limiting function during a catastrophic rupture of the working diaphragm. There is no coverage for vent limiting devices in the above standards. This letter does not imply certification, it is only meant as a statement of test and results.

Test:

1. An FE25 was modified with an approximately 1.5 inch cut in the diaphragm. The body and diaphragm construction are identical to the FE6 and FE10. The cut was aligned with the limiting hole in the safety diaphragm to represent the worst possible case.
2. A Pressure of 4 PSI/G was applied to the outlet of the regulator, to bypass the first stage and the pressure cut off device.
3. On application of the test pressure the flow through the safety diaphragm hole was initially measured at the equivalent of .66 cu.ft./hr. of natural gas, this flow reduced within one second to .34 cu.ft./hr.

Conclusion: At an inlet pressure of 4 PSI/G the maximum flow through the safety diaphragm bleed hole was initially the equivalent of .66 cu.ft./hr. of natural gas and then reduced to .34 cu.ft./hr. after one second.

Regards,

Richard Clark

Richard Clark
Certification Engineer
CSA Group

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T 416 747 2331
richard.clark@csagroup.org
1. The FE was modified with an approximately 1.5 inch cut in the diaphragm. The cut was aligned with the limiting hole in the safety diaphragm to represent the worst possible case.

2. A Pressure of 4 PSIG was applied to the outlet of the regulator to bypass the first stage and the pressure cutoff device.

3. An application of the test pressure, the flow through the safety diaphragm hole was initially measured at the equivalent of .66 cu. ft./hr. of natural gas, this flow reduced within one second to .04 cu. ft./hr.
At an inlet pressure of 4 PSIG the maximum flow through the safety diaphragm bleed hole vent was initially the equivalent of .66 cu.ft. / hr. of natural gas and then reduced to .04 cu.ft. / hr. after one second.

Regards,
Richard Clark
Richard Clark Certification Engineer CSA Group
How does the FE WORK?
TWO STAGE REGULATOR

Two-stage gas pressure regulators have two main advantages compared to single-stage regulators:

1. **Safety:** In case of failure of the 2\(^{nd}\) stage, the 1\(^{st}\) stage acts as a regulator to limit the pressure at the outlet; the over pressure shut-off device is a further safety feature.

2. **Accuracy:** The balanced 1\(^{st}\) stage regulation limits the pressure variation to the 2\(^{nd}\) stage, so it is possible to reach high accuracy of the regulated outlet pressure.
First Stage

Inlet Pressure → Intermediate Pressure → Balanced Valve Design

1st Stage

2nd Stage
Equals Outlet pressure Accuracy!

1st Stage
- Inlet Pressure Balanced Valve Design

2nd Stage
- Intermediate Stage Design
- Outlet Pressure Accuracy
FE VS. FEX DIFFERENCES

LEVER ACTING

DIRECT ACTING
FE REGULATOR

REGULATOR

FE25 sample 5 - 2PSI - inlet 3/4 NPT termal valve - outlet 3/4"NPT

excess flow

<table>
<thead>
<tr>
<th>Pd</th>
<th>psi</th>
<th>AC</th>
<th>abs</th>
<th>SG</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00</td>
<td>psi</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.70</td>
<td>psi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.30</td>
<td>psi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Issued by:
Marco BRENA

Office: LABORATORY
Date: 16/07/2019

Note:

Outlet pressure (psi)

Flow rate (SCFH NG)

- Pu 10 psi - with termal valve 3/4"
- Pu 60 psi - with termal valve 3/4"
### FEX Accuracy 2 PSIG setpoint!

#### REGULATOR

<table>
<thead>
<tr>
<th>REGULATOR</th>
<th>FEX MP - 2PSI - inlet 1”1/4 NPT termal valve - outlet 2”NPT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pd</strong></td>
<td>2.00 psi</td>
</tr>
<tr>
<td><strong>AC</strong></td>
<td>2 abs</td>
</tr>
<tr>
<td><strong>SG</strong></td>
<td>20</td>
</tr>
<tr>
<td><strong>RELUFS</strong></td>
<td>psi</td>
</tr>
<tr>
<td><strong>OPSQ</strong></td>
<td>0 psi</td>
</tr>
<tr>
<td><strong>UPSO</strong></td>
<td>1 psi</td>
</tr>
</tbody>
</table>

**Issued by:**
Marco Brena

**Office:**
LABORATORY

**Date:**
19/06/19

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**Note:**
Q=80SCFH

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**Graph:**
- **Outlet pressure (psig):**
  - 3.00
  - 2.50
  - 2.25
  - 2.00
  - 1.75
  - 1.50
  - 1.30
  - 1.00

**Flow rate (SCFH NG):**
- **Pu 10 psi**
- **Pu 15 psi**
- **Pu 20 psi**
- **Pu 40 psi**
- **Pu 60 psi**
The FE is Epoxy Painted

Standard FE: Phosphate protective Coating
All painted products
PREPARATION: Shot blasting with 800 microns diameter micro sphere steel shot
PRIMER: Phosphate Coating
FINAL COAT: Epoxy polymeric powder paint 356° F final thickness 30-40 micron
COLOR: Grey 9006

Exceeds the 1,000 hour salt-spray test in accordance with ASTM Method B-117, "Salt Spray (Fog) Testing." After exposure, experts examine the sample for the presence of oxides and evaluate its corrosion-resistance performance!
• Use of the FE allows for a vent line of 3/8” O.D. tubing for up to 40 feet
• 100 feet with ½" pipe without any regulator performance detriment.
• Lower Material Cost
• Ease of Handling
• Ease of Mounting
• Aesthetics
**Underground version:** regulator works properly even in case of complete flooding.

**Thermal valve:**
Optional. To increase operation safety in case of fire. Melting at a temperature comprised between 212 °F and 320 F based on the valve selection.
FEX Installed a Residential Meter Set
Indoor Installation & Vent Limiters

• In case of main diaphragm failure, the safety diaphragm with internal vent limiter insure a controlled leak of gas to atmosphere. The leak rate will not exceed 0.86 CFH.

• Where building codes in North America allow the use of vent limiters on regulators installed indoors they must meet CSA 6.22/ANSI Z21.80 – line pressure regulators. Leak rate is limited to 2.5 CFH. This is commonly known as an external vent limiter and is separate from the vent limiter in the safety diaphragm.

• CSA B149.1- 2007 (5.2.3.2) allows for service regulators certified to CSA 6.18 and equipped with OPCO and vent limiters to be installed indoors.
Compact Installation
FE & FEX Failure Matrix

A. Failure of 1st stage diaphragm
   2nd stage takes overtakes over and regulator still operates!

B. Failure of slam shut diaphragm
   Increase in outlet pressure & Slam Shut trips!

C. Failure of main diaphragm
   Safety diaphragm takes over!

D. Failure of safety diaphragm
   Slam shut will trip!

E. Line breaks downstream
   Low pressure cut off engages shuts off!
A. Make sure the meter nut is loose or test point is open to purge air from the system
B. Turn Gas on
C. Pull out OPSO slam shut reset stem
D. Push in low pressure reset button (IF USED)
E. Adjust outlet pressure
F. Close the purge fitting
QUESTIONS
Thank You