2015 Kansas Pipeline Safety Seminar

Odorization Program and Odorizer Updates
Regulator Station Updates

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Tyler E. Enloe, P.E.
Odorization Program and Odorizer Updates
Product Representation Disclosure

- USDI DOES NOT represent any manufacturer of odorizers or odorant detection instruments.
- USDI DOES represent Chevron Phillips and is the exclusive microbulk delivery partner for Chevron Phillips Natural Gas Odorants in the Midwest.
OBJECTIVES

- Why Odorize?
- Do I have to Odorize?
- What does Part 192 say about Odorization?
- What type of Odorizer do I need?
- What type of Odorant do I use?
- How do I know I have an effective odorization program?
- Troubleshooting Odorizer issues.
- Filling Odorizers.
Simply so People Can Detect a Leak

Natural Gas

This stuff stinks like rotten eggs!
Do I Have to Odorize?

- You DO IF:
  - You are an LDC or Master Meter Operator
  - You operate a Transmission Pipeline in a Class 3 or Class 4 Area.
  - Your health, safety, legal or insurance coverage provider tells you to.

- Exemptions
  - Transmission Operators in Class 1 or 2
  - Some additional specific exemptions
Part 192.625

- 192.625 (a) Odorize to 1/5 of the LEL, detectible by a person with a “normal” sense of smell.
- 192.625(b) makes up about half of the section and VERY specifically describes EXACTLY who must odorize and who doesn’t have to.
192.625

- 192.625 (c) and (d) describe the properties odorants must possess.
192.625

- 192.625 (e) “Equipment for odorization must introduce the odorant without wide variations in the level of odorant.”
192.625 (f) Periodic sampling of the gas using an instrument capable of determining the percent gas in air at which the odor becomes readily detectable.
Subpart P, Distribution Integrity Management

- Is a poorly performing odorizer a threat to your system?
- My answer would be a resounding YES.
- Not really, at least according to Subpart P.
- Will dollars for odorization improvements, upgrades etc. suffer as gas companies are forced to address the threats identified through their Integrity Management Programs?
Odorizers

- Home Made
- Simple Wick (Farm Tap Odorizer)
- Bypass (King Tool and Peerless)
- Pulse Bypass
- Pump Injection
Odorizer Lifecycle

- Bypass – 1 year to 50 years
- Injection – Average 20 years
- Example Injection Odorizer Cost/Year
  - New Odorizer $30,000.00
  - $30,000 / 20 = $1,500.00
  - Maintenance = $1,500 every two years
  - Total Cost per year = $2,250.00 plus odorant
- Has to be done, has to be done well, cost of doing business
Odorants

- Odorant Components are Usually Blended to Achieve Desirable Traits.
- Typical Odorant Blends Used in Gas Utilities are 75-80\% TBM and 20-25\% DMS
- Know what Kind you are Using
- Take Care in Changing Blends, Odorants are NOT “All the Same”
Monitoring for Effectiveness

- **Calculating an Odorant Injection Rate**
  - Determine Odorant Use in lbs (App. 6.8 Lbs/Gallon)
  - Obtain gas use for the Same Period in MMCF
  - Divide the Odorant Used by the MMCF to Obtain a Rate
  - There is no Required Minimum or Maximum. This Number will Vary from System to System.
Monitoring for Effectiveness

- Performing Sniff Tests Using an Instrument
  - Odorometer, DTEX, Odorator
  - Use a Properly Calibrated Instrument, Replace Hoses
  - Vary the Locations
  - System Extremities
  - Normal Sense of Smell
  - More than One Person
  - Limit the Number of Tests in a Given period
  - Documentation
Monitoring for Effectiveness

- Tracking and Trending Customer Leak Calls

**ILLINOIS GAS COMPANY**

**CUSTOMER LEAK/ODOR COMPLAINT**

**2011**

<table>
<thead>
<tr>
<th>MONTH</th>
<th>NUMBER OF CALLS</th>
<th>LEAKS FOUND</th>
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<tbody>
<tr>
<td>JANUARY</td>
<td>27</td>
<td>21</td>
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<tr>
<td>FEBRUARY</td>
<td>20</td>
<td>9</td>
</tr>
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<td>MARCH</td>
<td>23</td>
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<td>MAY</td>
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<td>SEPTEMBER</td>
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<td>OCTOBER</td>
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<td>NOVEMBER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DECEMBER</td>
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</tr>
</tbody>
</table>

![Graph showing number of calls and leaks found over months](image_url)
Monitoring for Effectiveness

- Look at Data from all Sources
- Maintain your Odorizers
- Replace Odorizers that are not Getting the Job Done with the Right Odorizer for the Application
- Maintain your Sniff Testing Instruments
- Know what Odorant Blend you are Using and Why
- Make Sure Your Records are Accurate and Meaningful
Common Issues With Bypass Odorizers

- Is the differential pressure in the acceptable range?
  - 30 in. W.C. to 80 in. W.C.

- Odorant tank almost empty
- Odorant tank too full
- Gauge or Float stuck or not operating correctly
Troubleshooting Odorizers

- “These odorizers are highly efficient and economical, as they have no moving parts and present almost no mechanical problems.“

  - KingTool Company

- Although the bypass odorizer has no mechanical parts there are many more issues that can cause problems with odorization of the system.
Filling Odorizers

- Methods of Delivery
  - Bulk delivery
  - Drums
  - DOT Cylinders
  - Cans
Filling Odorizers

- Bulk Delivery
  - Closed Loop System
  - Cheapest, Safest
  - No disposal of cans or drums
- Small Trailer – up to 80 gallons
- Large Trailer – up to gallons
- Tanker – up to gallons
Filling Odorizers

- Drums
  - More expensive than bulk delivery
  - Issues with disposal
Filling Odorizers

- DOT Cylinders
  - More expensive due to low volume and high cost of shipping
  - Better for low volume usage
Filling Odorizers

- Cans
  - Extremely expensive
  - Hard to dispose of
Regulator Station Updates

Safety ● Security ● Partnership ● Performance
Natural Gas Delivery System

• Regulator Locations
  • Transmission Pipeline Regulators
  • Town Border Stations
  • District Regulator Stations
• Industrial and Commercial Meter Sets
• Residential Meter Sets
Transmission Regulator Stations

- Protecting your system from overpressurization
- Inlet pressures as high at 900 psig.
- Regulator Station or Relief Valve can be used.
Town Border Stations

- Main pressure reduction from high pressure to town distribution system.
District Regulator Station

- Serving subdivisions, industrial parks, etc.
District Regulator Station (Farm Taps)

- Farm Taps serving more than two customers must be inspected annually at same standards as town border station.
Regulator Station Configurations

- Regulator and Relief
Regulator Station Configurations

- Dual Run Regulators and Relief
Regulator Station Configurations

- Multistage pressure reduction and Relief
- Cut from 800 psig to 200 psig
- 200 psig to 100 psig
- 100 psig to 20 psig
- Relief Valve Set at 35 psig
Regulator Station Configurations

- Worker Monitor with or without Relief
Making Inspections Easy

- Need to be able to perform lock up on each regulator at station.
- Control lines inside upstream block valves.
- Ports for gauges inside upstream block valves.
Making Inspections Easy

- Relief Valve Inspection
  - Pup between Relief Valve and Block Valve with port to introduce gas to test relief valve pressure setting.
  - Can easily install a TEE to attach gauge and connect nitrogen bottle to test relief valve.
Overpressure Protection

- Relief Valve
  - Relieves pressure off of system when pressure exceeds set point.
    - Warning Relief Valve vs. Full Capacity Relief Valve
- Monitor Regulator
  - Regulates the pressure downstream when the pressure exceeds it’s set point.
Underpressure Protection

- **Dual Run Stations**
  - Having a second regulated run at the station protects against loss of pressure if working regulated fails closed.

- **Monitor Regulator**
  - Passes gas downstream when the pressure drops below it’s set point.
Station Bypasses

- Could have a high pressure differential across valve.
- Regulated Bypasses allow for a second layer of under-pressure protection without the issues of an unregulated bypass.
Sizing of Regulators and Relief Valves

- Station Requirements
  - 100 MCFH or 100,000 CFH
  - 30 psig outlet
  - 200 psig inlet
  - Inlet MAOP of 250 psig
  - Outlet MAOP of 40 psig

FLOW COEFFICIENTS AND CONSTANTS

<table>
<thead>
<tr>
<th>Percent Capacity</th>
<th>Cv</th>
<th>C1</th>
<th>Cg</th>
<th>1.5:1</th>
<th>2:1</th>
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</thead>
<tbody>
<tr>
<td>100%</td>
<td>13.4</td>
<td>37</td>
<td>500</td>
<td>0.96</td>
<td>0.93</td>
</tr>
<tr>
<td>75%</td>
<td>10.7</td>
<td>30</td>
<td>320</td>
<td>0.97</td>
<td>0.95</td>
</tr>
<tr>
<td>50%</td>
<td>9.1</td>
<td>27</td>
<td>245</td>
<td>0.98</td>
<td>0.96</td>
</tr>
<tr>
<td>35%</td>
<td>5.5</td>
<td>26</td>
<td>144</td>
<td>1.00</td>
<td>0.99</td>
</tr>
</tbody>
</table>

NOTE: Allow a 5% factor of safety when calculating relief capacity.

Table 5. Orifice Sizes and Flow and Sizing Coefficients

<table>
<thead>
<tr>
<th>TRIM CONSTRUCTION</th>
<th>ORIFICE SIZE</th>
<th>FOR RELIEF SIZING WIDE-OPEN Cg</th>
<th>REGULATING Cg</th>
<th>C1</th>
<th>K_m</th>
<th>IEC SIZING COEFFICIENTS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>INCHES / mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X_T</td>
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<tr>
<td>Restricted capacity trim, Straight bore — Elastomer disk seat only</td>
<td>1/2 / 13</td>
<td>200</td>
<td>155</td>
<td>330</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/4 / 19</td>
<td>425</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restricted capacity trim, Stepped bore — Elastomer disk seat only</td>
<td>7/8 x 3/8 / 22 x 9.5</td>
<td>115</td>
<td>110</td>
<td>35</td>
<td>0.79</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>7/8 x 1/2 / 22 x 13</td>
<td>200</td>
<td>190</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/8 x 5/8 / 22 x 16</td>
<td>300</td>
<td>280</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full capacity trim, Elastomer disk, or C-ring seats</td>
<td>7/8 / 22</td>
<td>550</td>
<td>408</td>
<td>35</td>
<td>0.79</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>1-1/8 / 29</td>
<td>850</td>
<td>686</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. 1/2-Inch / 13 mm is the only orifice size available for 1000 psig / 69.0 bar maximum inlet pressure.
Sizing of Regulators and Relief Valves

- Calculating Capacity of Regulator using $C_g$

\[
\text{Capacity} = (\text{inlet pressure} + 14.7 \text{ psi}) \times C_g \times 1.29
\]

Capacity = 214.7 * 500 * 1.29 = 138,481.5 CFH = 138.4 MCFH

If a worker monitor set up,

Capacity = 138.4 * 0.80 = 110.72 MCFH

<table>
<thead>
<tr>
<th>TRIM CONSTRUCTION</th>
<th>ORIFICE SIZE</th>
<th>FOR RELIEF SIZING WID-E-OPEN $C_g$</th>
<th>REGULATING $C_g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted capacity trim, Straight bore — Elastomer disk seat only</td>
<td>1/2(1) 3/4</td>
<td>13(1) 19</td>
<td>200 425</td>
</tr>
<tr>
<td>Restricted capacity trim, Stepped bore — Elastomer disk seat only</td>
<td>7/8 x 3/8 7/8 x 1/2 7/8 x 5/8</td>
<td>22 x 9.5 22 x 13 22 x 16</td>
<td>115 200 300</td>
</tr>
<tr>
<td>Full capacity trim, Elastomer disk, or O-ring seats</td>
<td>7/8 1-1/8</td>
<td>22 29</td>
<td>550 850</td>
</tr>
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NOTE: Allow a 5% factor of safety when calculating relief capacity
Sizing of Regulators and Relief Valves

- Pressure Differential Concerns
- With lower pressure differentials, it is more difficult for regulator to operate at 100% capacity.

Table 3. Maximum Inlet Pressure, Allowable Pressure Drop, and Minimum Differential Pressures

<table>
<thead>
<tr>
<th>MAXIMUM ALLOWABLE INLET PRESSURE / PRESSURE DROP</th>
<th>WIDE VALVE SPRING</th>
<th>MINIMUM DIFFERENTIAL PRESSURE FOR FULL STROKE</th>
<th>DISK MATERIALS</th>
<th>MAXIMUM ORIFICE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>psig</td>
<td>bar</td>
<td>inches</td>
<td>inches</td>
<td>inches</td>
</tr>
<tr>
<td>25</td>
<td>1.7</td>
<td>0.168</td>
<td>3.79</td>
<td>6</td>
</tr>
<tr>
<td>50</td>
<td>3.4</td>
<td>0.156</td>
<td>3.96</td>
<td>7.13</td>
</tr>
<tr>
<td>100</td>
<td>10.3</td>
<td>0.187</td>
<td>4.76</td>
<td>6.63</td>
</tr>
<tr>
<td>175(2)</td>
<td>12.1</td>
<td>0.187</td>
<td>4.75</td>
<td>6.63</td>
</tr>
<tr>
<td>250</td>
<td>17.2</td>
<td>0.187</td>
<td>4.75</td>
<td>6.63</td>
</tr>
<tr>
<td>300</td>
<td>20.7</td>
<td>0.281</td>
<td>7.22</td>
<td>6</td>
</tr>
<tr>
<td>400</td>
<td>27.8</td>
<td>0.281</td>
<td>7.22</td>
<td>6</td>
</tr>
<tr>
<td>1000</td>
<td>69.0</td>
<td>0.281</td>
<td>7.22</td>
<td>6</td>
</tr>
</tbody>
</table>

1. Can use all orifice sizes up to maximum size listed. See Table 5.
2. CL 125 FF forged body only.
3. 1/16 inch / 2 mm is the only orifice available for 100 psig / 6.9 bar maximum inlet pressure regulators.
4. 1/8 inch / 3 mm is the only orifice available for 250 psig / 17.2 bar maximum inlet pressure regulators.
5. O-ring seal construction is only available for 7/8 and 1-1/8 inch / 22 and 29 mm orifice sizes.
Sizing of Regulators and Relief Valves

• Sizing Relief Valve

For Relief Valve sizing the capacity of the regulators are,
Capacity = (MAOP + 14.7 psi) * Cg * 1.29
Capacity = 264.7 * 500 * 1.29 = 170,731.5 CFH = 170.7 MCFH
If a worker monitor set up,
Capacity = 170.7 * 0.80 = 136.6 MCFH

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<td>155</td>
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<td>3/4</td>
<td>19</td>
<td>330</td>
</tr>
<tr>
<td>Elastomer disk seat only</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Restricted capacity trim.</td>
<td>7/8 x 3/8</td>
<td>115</td>
<td>110</td>
</tr>
<tr>
<td>Stepped bore —</td>
<td>7/8 x 1/2</td>
<td></td>
<td>120</td>
</tr>
<tr>
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<td>7/8 x 5/8</td>
<td></td>
<td>280</td>
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<tr>
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<td>7/8</td>
<td>550</td>
<td>408</td>
</tr>
<tr>
<td>Elastomer disk,</td>
<td>1-1/8</td>
<td>850</td>
<td></td>
</tr>
<tr>
<td>or O-ring seats</td>
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<td>0.98</td>
<td>0.96</td>
</tr>
<tr>
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<td>5.5</td>
<td>26</td>
<td>144</td>
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<td>0.99</td>
</tr>
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</table>

NOTE: Allow a 5% factor of safety when calculating relief capacity
Sizing of Regulators and Relief Valves

- Sizing Relief Valve

Capacity of Regulators = 136.6 MCFH

Capacity of Relief = (Set point + Buildup + 14.7) * Cg * 1.29
Capacity of 2” = (38 + 1.7 + 14.7) * 2280 * 1.29 = 124.0 MCFH
Capacity of 3” = (38 + 1.6 + 14.7) * 4630 * 1.29 = 324.3 MCFH
Sizing of Regulators and Relief Valves

- Sizing Relief Valve

<table>
<thead>
<tr>
<th>MAIN VALVE SIZE</th>
<th>PILOT TYPE</th>
<th>MAIN VALVE SPRING COLOR</th>
<th>PILOT SPRING RANGE, PART NUMBER, AND COLOR</th>
<th>SET PRESSURE</th>
<th>BUILDUP OVER SET PRESSURE NEEDED TO BEGIN OPENING MAIN VALVE</th>
<th>BUILDUP OVER SET PRESSURE NEEDED TO FULLY OPEN MAIN VALVE</th>
<th>PRESSURE DROP BELOW SET PRESSURE NEEDED TO RESET PILOT</th>
<th>CAPACITIES(1) OF 0.6 SPECIFIC GRAVITY NATURAL GAS WITH 2:1 LINE SIZE TO BODY SIZE PIPING</th>
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<tbody>
<tr>
<td>NPS DN</td>
<td></td>
<td></td>
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<td>Psig bar</td>
<td>Psig bar</td>
<td>Psig bar</td>
<td>Psig bar</td>
<td>SCFH Nm³/h</td>
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<tr>
<td>6358</td>
<td>Yellow</td>
<td></td>
<td>10 to 40 / 0.69 to 2.8 1E392527022 Yellow</td>
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<td>0.69</td>
<td>3.5</td>
<td>0.24</td>
<td>9.0 0.62 185 000 4958 203 000 5440 260 000 6958</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td></td>
<td>35 to 125 psig / 2.4 to 8.6 1K748527202 Red</td>
<td>40</td>
<td>2.8</td>
<td>2.0</td>
<td>0.14</td>
<td>2.5 0.17 324 000 8683 302 000 10 238 439 000 11 765 555 000 14 874 670 000 17 856 812 000 21 762</td>
</tr>
<tr>
<td>6358B</td>
<td>Yellow</td>
<td></td>
<td>10 to 30 / 0.69 to 2.1 1B788327022 Silver</td>
<td>10</td>
<td>0.69</td>
<td>3.5</td>
<td>0.24</td>
<td>9.0 0.62 185 000 4958 203 000 5440 260 000 6958</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td></td>
<td>30 to 60 / 2.1 to 4.1 1B788427022 Blue</td>
<td>30</td>
<td>2.1</td>
<td>2.8</td>
<td>0.14</td>
<td>2.5 0.17 263 000 7048 322 000 8630 379 000 10 157 436 000 11 685</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>60 to 125 / 4.1 to 8.6 1K748527202 Red</td>
<td>60</td>
<td>4.1</td>
<td>4.1</td>
<td>0.17</td>
<td>4.1 0.17 439 000 11 765 553 000 14 820 670 000 17 956 812 000 21 762</td>
</tr>
<tr>
<td>3 80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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</table>
Issues Noticed

- Valves on control lines
- Ability to perform a lock up test.
Issues Noticed

- Adequate protection of the station.
  - Bollards

- Buildings
Questions