IEC TC31 (Explosive Atmospheres) – Gas Detection as Method of Protection

Jon Miller
Detector Electronics Corporation
Approvals Engineering Manager

Convener of IEC TC31 MT60079-29 (Gas Performance)
IECEx USNC voting member (ISA Representative)
Chairman of UL STP 60079 SP12.13 (Gas Performance)
Chairman of ISA SP92 (Toxic Gas Performance)
Agenda

Combustible Gas Detection – Method of Protection

1) Codes & Standards
2) Technologies
3) Applications
But, First the Basics

1) Process Control
   Gas concentration monitoring only

2) Risk Area Protection (IEC 60079-29)
   - Alarm Notification
   - Equipment Shut-down
   - Ventilation Actuation

Courtesy of Det-Tronics
‘Risk Area Protection’ using Gas Detection

DOES
mitigate risk of ignition in the classified area

DOES NOT
change the area classification

Courtesy of Det-Tronics
# Codes of Practice

<table>
<thead>
<tr>
<th>Description</th>
<th>International</th>
<th>Australia</th>
<th>Canada</th>
<th>China</th>
<th>European Union</th>
<th>Russia</th>
<th>United States</th>
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</thead>
<tbody>
<tr>
<td>Codes of Practice</td>
<td>IEC 60079-14</td>
<td>AS 2865</td>
<td>C22.1</td>
<td>____</td>
<td>EN 1127-1</td>
<td>GOST IEC 60079-14</td>
<td>NFPA 70, API RP 14F</td>
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</tbody>
</table>

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Gas Detection as Method of Protection

\{gas detection + action = mitigation\}

Courtesy of Det-Tronics
# Product Standards

<table>
<thead>
<tr>
<th>Description</th>
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<tbody>
<tr>
<td>Combustible Gas Performance</td>
<td>IEC 60079-29-1</td>
<td>AS/NZS 60079.29.1</td>
<td>C22.2 #152</td>
<td>JJG 693 GB 15322.1</td>
<td>EN 60079-29-1</td>
<td>GOST IEC60079-29-1 GOST 13320</td>
<td>ANSI/ISA-60079-29-1 (12.13.01)</td>
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<td>Open Path Performance</td>
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<td>AS/NZS 60079.29.4</td>
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<td>EN 60079-29-4</td>
<td>GOST R 52350.29.4 GOST 13320</td>
<td>ANSI/ISA-12.13.04</td>
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<td>Oxygen Performance</td>
<td>IEC 60079-29-6 (draft)</td>
<td>AS/NZS 4641</td>
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<td>JJG 365</td>
<td>EN 50104</td>
<td>GOST 13320</td>
<td>ANSI/ISA-92.04.01</td>
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<tr>
<td>Toxic Gas Performance</td>
<td>IEC 60079-29-5 (draft)</td>
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<td>JJG 9155</td>
<td>EN 45544</td>
<td>GOST 13320</td>
<td>ANSI/ISA-92.00.01</td>
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<td>EMC</td>
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<td>see above</td>
<td>EN 50270</td>
<td>see above</td>
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<td>Software</td>
<td>see above</td>
<td>see above</td>
<td>C22.2 #152</td>
<td>see above</td>
<td>EN 50271</td>
<td>see above</td>
<td>see above</td>
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<tr>
<td>Safety Instrumented System</td>
<td>IEC 60079-29-3</td>
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<td>EN 50402</td>
<td>GOST IEC60079-29-3</td>
<td>ISA-TR84.00.07</td>
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<tr>
<td>Recommended Practice</td>
<td>IEC 60079-29-2</td>
<td>AS/NZS 60079.29.2</td>
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<td>EN 60079-29-2</td>
<td>GOST IEC60079-29-2</td>
<td>ANSI/ISA-60079-29-2 (12.13.02)</td>
</tr>
</tbody>
</table>
Agenda

Combustible Gas Detection - Method of Protection

1) Codes & Standards
2) Technologies
3) Applications

Courtesy of Det-Tronics
<table>
<thead>
<tr>
<th>Technology</th>
<th>Principle of Operation</th>
<th>+</th>
<th>−</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalytic Sensor</td>
<td>Oxidation of flammable gas</td>
<td>Detects all flammable gases</td>
<td>Requires sufficient O₂ content &amp; prone to poisoning</td>
</tr>
<tr>
<td>Thermal Conductivity Sensor</td>
<td>Heat loss by conduction</td>
<td>Detects individual gas with high or low relative thermal conductivity up to 100% v/v</td>
<td>Requires low variance of background gases</td>
</tr>
<tr>
<td>Infrared Sensor</td>
<td>Absorption of light energy</td>
<td>Extended life expectancy with self-diagnostic measures</td>
<td>No H₂ response &amp; sensitive to pressure variance</td>
</tr>
<tr>
<td>Semiconductor Sensor</td>
<td>Electrical conductance by chemisorption</td>
<td>Sensitivity at very low concentration</td>
<td>Vulnerable to humidity change &amp; interfering gases</td>
</tr>
<tr>
<td>Electrochemical Sensor</td>
<td>Electrolyte chemical reaction</td>
<td>Detects H₂ &amp; CO at LFL levels &amp; O₂ at 25% v/v</td>
<td>Electrolyte lasts for short period</td>
</tr>
<tr>
<td>Flame Ionization Detector</td>
<td>Electrical charging of burnt organic compound</td>
<td>High sensitivity, wide measuring range, small measuring uncertainty, poison resistance &amp; fast response time</td>
<td>Signal critically dependant upon flow rate &amp; no environmental sensitivity</td>
</tr>
<tr>
<td>Flame Temperature Analyzer</td>
<td>Flame temperature rise on constant flow of combustion</td>
<td>Fast response to total flammable gas at LFL levels</td>
<td>Requires fuel gas &amp; O₂ for flame.</td>
</tr>
<tr>
<td>Photo Ionization Detector</td>
<td>Ionization by ultraviolet radiation</td>
<td>High sensitivity, poison resistance &amp; fast response time</td>
<td>No detection of compounds with higher ionisation potential than lamp energy (eg. H₂, CH₄, CO)</td>
</tr>
<tr>
<td>Paramagnetic Oxygen Detector</td>
<td>Proportion of oxygen paramagnetic force</td>
<td>Measurement selectivity, long term stability &amp; poison resistance</td>
<td>Shock and/or vibration sensitive</td>
</tr>
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</table>

Courtesy of Det-Tronics
Technologies (Catalytic, Point)

1) Concentration measurement at detector

2) Detector must be in the gas cloud for detection

3) %LFL output

4) K-factor for target gas

5) Flow consideration with detector position

Product images courtesy of New Cosmos Electric Co., Dräger, General Monitors, Honeywell, Det-Tronics
Technologies (Infrared, Point)

1) Concentration measurement at detector

2) Detector must be in the gas cloud for detection

3) %LFL output

4) Linearized for target gas

5) Flow consideration with detector position

Product images courtesy of Dräger, General Monitors, Honeywell, Det-Tronics
Technologies (Infrared, Open Path)

*** Intended to supplement (not replace) Point Detection ***

1) Concentration measurement between two points

2) Detector need NOT be in the gas cloud for detection

3) LFL-meter output (NOT actual concentration)

4) Linearized for target gas

5) Perimeter detection (air flow coverage)

Product images courtesy of Det-Tronics, General Monitors, Dräger
# Technologies Summary

<table>
<thead>
<tr>
<th>Technology</th>
<th>Catalytic, Point</th>
<th>Infrared, Open Path</th>
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<tr>
<td><strong>Advantages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Low initial cost</td>
<td>• Large area coverage</td>
<td>• Environmental superiority</td>
</tr>
<tr>
<td></td>
<td>• Hydrogen detection</td>
<td>• Fail safe</td>
<td>• Fail safe</td>
</tr>
<tr>
<td></td>
<td>• Versatile, broad range</td>
<td>• Infrequent calibration</td>
<td>• Low cost of ownership</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Low maintenance</td>
<td>• High reliability</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Frequent calibration cycle</td>
<td>• Alignment challenges</td>
<td>• No hydrogen detection</td>
</tr>
<tr>
<td></td>
<td>• Susceptible to poisoning</td>
<td>• LEL-m read out</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Not fail safe, monthly degradation</td>
<td>• Expensive</td>
<td></td>
</tr>
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Combustible Gas Detection - Method of Protection

1) Codes & Standards
2) Technologies
3) Applications

Courtesy of Det-Tronics
Application (Control Panel)

Zone 2 Room

Control Panel (non-hazardous)

- * Zone 1 Point Detector
- * Zone 1 Point Detector
- * Zone 1 Point Detector

Safe Area

- Visible alarm
- Audible alarm
- IEC 60079-29-1 Gas Controller

1. As counter measure, increased ventilation activated
2. Upon detection of 20% LFL inside control panel de-energize control panel
3. As counter measure, de-energize control panel when 40% LFL is detected within Zone 2 room

A spill evaporates or process piping leaks

Courtesy of Dräger & Det-Tronics
A spill evaporates or process piping leaks

1. As counter measure, increased ventilation activated when 20% LFL detected in Zone 2 area.

2. Upon detection of 20% LFL inside non hazardous room, de-energize equipment.

3. As counter measure, de-energize equipment when 40% LFL is detected within Zone 2 room.

Clean Air

Non hazardous Room
- Analyzer Room
- Control Room
- Office

Equipment

* Zone 1 Point Detector

* IEC 60079-29-1 Gas Detector

Available in the market:

IEC 60079-29-1 Gas Controller

 Courtesy of Dräger & Det-Tronics
Application (Low Ventilation Rate)

Zone 1 Room

Ex

Zone 2 Equipment EPL G_c
- Variable speed drive
- Control equipment
- Power supply
- Transformer

* Zone 1 Point Detector

* IEC 60079-29-1 Gas Detector

A spill evaporates

Safe Area

Audible alarm

Visible alarm

IEC 60079-29-1 Gas Controller

1. As counter measure, ventilation activated

2. As counter measure, power switched OFF

 Courtesy of Dräger & Det-Tronics
Application (Gas Detection + Action = Mitigation)

Risk – ignition from non-Ex rated equipment

Existing Condition

Gas Detection

Increase Ventilation

De-energize

residual risk

risk reduction

actual risk reduction

necessary risk reduction

tolerable risk

Courtesy of Dräger & Det-Tronics
Application Summary

Ventilation ‘ON’

Gas concentration decreases - countermeasure is effective

Power ‘OFF’

Gas concentration still rises - countermeasure not effective

Gas detector signal

%LEL

20

40

2nd Alarm

1st Alarm

Courtesy of Dräger & Det-Tronics
Questions

Combustible Gas Detection - Method of Protection

1) Codes & Standards
2) Technologies
3) Applications

THANK YOU!