



GENERAL ORDER

GENERAL ORDER 310.04

Incident Involving Flammable Gas

EMERGENCY SERVICES BUREAU

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1 APPLICABILITY

2 All Uniformed Personnel

3 POLICY

4 Company Officers are responsible for the safety, welfare, and accountability of the personnel
5 assigned to them. Howard County Department of Fire and Rescue Services (Department) units
6 may encounter natural and Liquefied Petroleum Gases (LPG) in a variety of situations and
7 incident types, each presenting a different set of hazards and problems. This order presents an
8 approach that will be applicable in the majority of situations. But, it cannot replace good
9 judgment and decision-making.

10 DEFINITIONS

- 11 ➤ **Corrugated Stainless Steel Tubing (CSST) Gas Line** - CSST is a flexible, stainless steel pipe
12 used to supply natural gas and propane in residential, commercial and industrial
13 structures.
- 14
- 15 ➤ **Flammable Range** - Because the flammability range varies widely between individual
16 gases and vapors, most regulatory standards express hazardous condition thresholds for
17 combustible gas in air in percent Lower Explosive Limit (LEL) concentrations. Our
18 combustible gas instruments read from 0 to 100 % LEL. Our LEL sensors are used to
19 provide a hazardous condition threshold alarms set to 10% of the LEL concentration of
20 the gases or vapors being measured. Readings are usually displayed in increments of +
21 1% LEL. 10% LEL is the default alarm set point on our instruments. When the instrument
22 exceeds 10% LEL the detector may read OR for "over range." A fire and explosion hazard
23 should always be deemed to exist whenever readings are between 1 -10 % LEL due to
24 the different characteristics and wide flammable ranges of gases. This is the least
25 conservative (or highest acceptable) alarm set point for our instruments. An important
26 consideration is that many circumstances warrant an immediate response to a more
27 conservative, lower alarm set point. Some material suggest additional factors may vary
28 from sensor to sensor with actual tolerances of +/- 25% for older sensors or units
29 operating in other than ideal environments. The presence of any detectable
30 concentration of flammable/combustible gas in a structure is an abnormal condition.



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- 31 The only completely safe concentration of combustible gas in a confined area is 0% LEL
32 readings on multiple meters.
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- 34 ➤ **Hazard Zone** - is any area or zone where there is a known or potential risk to the safety
35 of operating personnel, including but not limited to: environments that are Immediately
36 Dangerous to Life and Health (IDLH), potential collapse zones, and areas at risk for rapid
37 change in their safety profile.
38
- 39 ➤ **Liquefied Petroleum Gas or Liquid Petroleum Gas (LPG or LP Gas)** - also referred to as
40 simply propane or butane, are flammable mixtures of hydrocarbon gases used as fuel in
41 heating appliances, cooking equipment, and vehicles.
42
- 43 ➤ **Mercaptan** - Methyl Mercaptan is a flammable colorless gas with an unpleasant odor
44 described as rotten cabbage. It is used as a gas odorant.
45
- 46 ➤ **Natural Gas** - flammable gas, consisting largely of methane and other hydrocarbons,
47 occurring naturally underground (often in association with petroleum) and used as fuel.
48
- 49 ➤ **Distribution Line** - gas lines that are ¾" - 48" in diameter and used to deliver gas to the
50 community.
51
- 52 ➤ **Service Line** - a line that varies in diameter and supplies gas from a Distribution Line to a
53 structure's meter. In the LGP system, this is the line that runs from the storage tank to
54 the distribution manifold entering the structure.
55
- 56 ➤ **Transmission Lines** - a high pressure line up to 30" in diameter used for intrastate gas
57 transmissions.
58
- 59 ➤ **Explosive Limits** - The explosive range of gases, vapors, and dusts, measured in %
60 volume, when presented with an ignition source. Gases, vapors, and dusts have Lower
61 Explosive Limits (LEL) and Upper Explosive Limits (UEL). The LEL is the lowest or
62 minimum concentration or mixture range where an explosion can take place. UEL is the
63 upper or maximum concentration or mixture range where an explosion can take place.
64 Gases in quantities below the LEL are too lean to explode. Gases in quantities above the
65 UEL are too rich to explode.
66
- 67 ➤ **Lower Explosive Limit (LEL)** - The minimum concentration of a combustible gas mixed
68 with air where an explosion may occur. This concentration is expressed in % of volume.
69 For combustible gas instruments used to detect explosive atmospheres; the
70 concentration is expressed as a percentage factor of the LEL point. A reading of 100%
71 LEL corresponds to the % of volume concentration where combustion can occur.
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- 73 ➤ **Upper Explosive Limit (UEL)** - The maximum concentration of a combustible gas, when
74 mixed with air, where an explosion may occur. Also expressed as Upper Flammability
75 Limit.



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PROCEDURES

77 **SITUATIONAL AWARENESS:**

78 All incidents involving flammable gas or the report of “odors, leaks, or broken service lines”
79 shall be treated as hazardous and potentially dangerous situations.

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81 Natural Gas is much lighter than air and will travel upward through any available space. When
82 Natural Gas is leaking inside a structure it will rise through stairwells, ducts or cracks in walls
83 and floors. Gas tends to pocket, particularly in attics, under stairs, and in dead air spaces.
84 When released outside, gas can travel up through cracks in parking lots, roads, and soft ground.
85 Gas can move laterally and migrate along ceilings, enclosed spaces, trenches, and utility lines
86 until it is able to rise. The flammable range of natural gas is 3-15%.

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88 LPG (Propane) vapors are gases at normal room temperature and atmospheric pressure. LPG
89 will liquefy under moderate pressure and easily vaporize upon release. As liquid propane
90 converts to from liquid to gas it expands at a rate of 270:1. This rapid conversion of liquid to
91 vapor causes intense chilling that freezes what it comes in contact with and may slow leaks or
92 appear to have stopped lower pressure leaks. The potential fire hazard of LPG is comparable to
93 Natural Gas. LPG is heavier than air and will tend to collect in low lying air spaces: basements,
94 crawlspaces, sump basins and drains, sewer lines, storm drains, trenches, and ditches. The
95 flammable range for LPG is slightly narrower than natural gas at 2-9%.

96

- The appropriate gas service company shall be contacted through communications and requested to respond on all incidents involving flammable gas.
- The incident commander (IC) can cancel this request if the incident is stabilized and the hazard has been safely mitigated.
- Odors of gas following thunderstorms, or storm systems that have had lightning strikes associated with them, should cause the responders to evaluate the structure from top to bottom, to include the roof and/or attic and asses for the presence of CSST.

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Both Natural Gas and LPG have the odor, Mercaptan, added to them for leak detection.

Howard County also has transmission lines and facilities which do not contain the odorant.

Additionally, most natural gas and propane shipped by rail is also non-odorized. It is essential to adequately monitor the atmosphere with the appropriate meter on any reported gas leak.

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INITIAL RESPONSE LEVELS:

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- The initial response level for a residential or commercial occupancy inside gas leak shall be a Local Box.
- The initial response level for an outside gas leak shall be a Miscellaneous Alarm.
- The initial response level for an outside gas leak with fire shall be a Local Box.
- If a structure has fire involvement a Box Alarm in accordance with the occupancy type and location will be assigned.



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119 **FLAMMABLE GAS INCIDENTS – IN A STRUCTURE NO FIRE/EXPLOSION:**

120 The initial arriving Company Officer/Incident Commander is permitted enough flexibility to
121 successfully accomplish the assigned mission. When the initial arriving Company
122 Officer/Incident Commander must deviate from this order, other responding units must be
123 advised through radio communications. Emergency Response Guide (ERG) 115 should be
124 referenced for initial operations on an incident.

125
126 The first arriving suppression company on the scene shall position in a safe and defensive
127 manner away from the structure or reported incident location. If possible, the unit shall park
128 upwind from the incident and outside of the collapse zone. The collapse zone should be
129 considered at least 1-2 times the size of the structure with the leak. For example, a single
130 family home, initial positioning should be at least two houses away.

131
132 **Only a limited number of personnel shall be assigned by Command to enter the Hazard Zone**
133 **to investigate.**

- 134
135 • The first arriving company officer shall establish command, identify the hazard zone,
136 deny entry, and identify a Level 2 staging area for incoming apparatus at a minimum of
137 330 feet as referenced by ERG 115. Park emergency vehicles away and upwind from the
138 area. Be alert for locations of possible migrating gas inside and/or outside of the
139 structure and respond accordingly. Do not park over manholes and storm drains.
140 Natural gas can collect in these spaces and explode.
- 141 • A water source shall be identified and preparations made to lay a supply line, if
142 applicable.
- 143 • Atmospheric monitoring shall be continuous throughout the incident while crews are
144 operating on the scene. A second atmospheric monitor shall be used to ensure the
145 accuracy of readings.
- 146 • Personnel investigating the leak shall be in full PPE, including SCBA with cylinder valve in
147 the “on” position and PASS device activated, and performing atmospheric monitoring
148 while approaching the scene. At minimum, the crew shall carry a class B extinguisher.
149 When the atmospheric monitor indicates a presence of flammable gas, personnel shall
150 immediately don their facepiece and breathing air before continuing their investigation.
- 151 • At a reading of 10% LEL or greater, the officer shall initiate life safety procedures for
152 occupants and begin evacuation.
- 153 • When evacuating the area, be sure to knock on doors. Do not ring doorbells, use any
154 phones, electric switches, thermostats or appliance controls. All of these devices,
155 including battery-operated equipment, can cause sparks and ignite flammable gas. Be
156 alert for evacuees and bystanders who may try to turn off lights or make phone calls.
- 157 • Avoid activities that create friction such as, shuffling your feet or rubbing your hands
158 together, as your PPE could generate a spark of static electricity that could ignite the
159 gas.
- 160 • Indoor gas leaks often result from malfunctioning gas-fed appliances. If you can identify
161 a specific appliance causing the leak, shut off the gas at the appliance’s supply line. If
162 you cannot identify a specific source or when in doubt, shut off the gas at the supply,
163 and lock and tag out of service.



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- 164 • Be aware that what appears to be an indoor leak may be the result of gas migrating into
165 the structure. Once service to the structure is off, verify that the leak has been
166 eliminated.
- 167 • If the leak is due to an extinguished pilot light, Department personnel shall not attempt
168 to re-store the pilot.
- 169 • Gas concentrations will change as gas dissipates or ventilation is introduced.
 - 170 ○ Do not open doors or windows until you are certain the gas supply has been shut
171 off.
 - 172 ○ All ignition sources must be removed before ventilation proceeds.
 - 173 ○ When Natural Gas is present ventilate structures from top to bottom.
 - 174 ○ When LPG is present ventilate structures from bottom to top.
 - 175 ○ Never ventilate structures while any personnel are inside.
 - 176 ○ Crews shall ventilate the structure by natural means or from the exterior with
177 positive pressure ventilation fans.
 - 178 ○ Ventilation should occur from the exterior only. Venting gas can ignite as it
179 passes through the explosive range, within a structure.
- 180
- 181 • The Department may be requested to assist gas company responders with a stand by
182 crew. This will be considered an IDLH atmosphere.
- 183 • The gas company representative may request a backup line or a member standing by
184 with a fire extinguisher- All Department members operating in this capacity must be in
185 full PPE and breathing air from an SCBA, with a minimum Initial RIC (IRIC) available for
186 immediate response to any emergencies that should arise.

187

188 Subsequent arriving apparatus shall position in the identified staging area in a safe and
189 defensive manner. Begin atmospheric monitoring of their location. Tactical considerations
190 should include:

- 191 • Complete and support water supply for the first engine.
- 192 • Assuming the role of the IRIC.
- 193 • Deploying of hand lines.
- 194 • Supporting evacuation.

195

196 Additional responding units are to Level 2 Stage in the area identified by Command.

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198 Notification and response shall be confirmed with the appropriate gas service company. The
199 appropriate electric company should also be requested in the event the power needs to be
200 secured at an external source.

- 201 • A reading of 10% LEL will be considered a priority response request from the
202 appropriate gas service company.

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204 **FLAMMABLE GAS INCIDENTS - STRUCTURE FIRE OR EXPLOSION:**

205 The first arriving suppression company on the scene shall position in a safe and defensive
206 manner away from the structure or reported incident location. Units shall park upwind from
207 the incident and outside of the collapse zone. The collapse zone should be considered at least



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- 208 1-2 times the size of the structure with the leak. For example, a single family home, initial
209 positioning should be at least two houses away.
- 210 • The first arriving company officer shall establish command, identify the hazard zone,
211 deny entry, and identify a Level 2 staging area for incoming apparatus at a minimum of
212 330 feet as referenced by ERG 115.
 - 213 • For incidents involving flammable gas with fire, Department personnel shall not
214 extinguish the fire, so as not to create an invisible explosion hazard.
 - 215 ○ Department personnel shall place hose lines in a manner to protect life and
216 property from impingement.
 - 217 ○ Personnel shall attempt to control the source of the leak at a shut off valve.
 - 218 ○ In the event the valve is in the proximity of the fire, personnel shall be protected
219 by at least one hose line while performing the shut-off operation.
 - 220 ○ Atmospheric monitoring of the incident and exposures shall be continuously
221 accomplished as underground leaks often move along other utility supply lines
222 into the structure(s).
 - 223 ○ In the event Department personnel cannot control the gas, evacuate the area
224 and protect exposure with necessary water streams.

225
226 Incidents of gas leaks involving explosions shall be handled in a manner similar to a working
227 fire.

- 228 • Extreme caution shall be used by incoming units; give consideration of secondary gas
229 pockets and explosions.
- 230 • Atmospheric monitoring of the incident and exposures shall be continuously
231 accomplished as underground leaks often move along other utility supply lines into the
232 structure(s).

233 234 **FLAMMABLE GAS INCIDENTS— GAS LEAK OUTSIDE NO FIRE OR EXPLOSION:**

235 Gas leaks outdoors pose some different challenges than those indoors. When arriving at the
236 scene of a reported gas leak, staging and apparatus placement should be the same as if you are
237 responding to the reported gas inside (until you have confirmed the gas is not migrating into a
238 structure).

239
240 Outdoor gas leaks can be caused by construction related damage, cracks due to extreme
241 weather, pipe corrosion, or failure of joints on piping connections. Be on the lookout for
242 evidence of construction activity and severe weather as indicators of a possible leak. Be alert
243 for migrating gas. Gas can accumulate in storm drains, construction trenches, buildings, and
244 other utility lines. As gas migrates, localized concentrations will change. Flammable gas can
245 burn or explode as concentrations move through the Flammable Range.

246
247 Remember that not all Natural Gas is odorized, and conditions such as weather and gas passing
248 through dirt can make even odorized gas difficult to smell. Do not rely on smell alone to detect
249 gas leaks.

250
251 Indicators of a flammable gas leak may include:

- 252 • Familiar gas smell



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- 253 • Dirt being blown into the air
- 254 • Dead vegetation in an otherwise green area
- 255 • A dry spot in an otherwise moist area
- 256 • Fire coming from the ground or appearing to burn above the ground
- 257 • Water bubbling or being blown into the air
- 258 • Roaring, blowing or hissing sounds

259
260 A confirmation of any active gas leak will require the request for a response from the
261 appropriate gas service company.

- 262 • Evacuate the area, based on ERG Guide 115.
- 263 • Turn off gas service at meters or appliance supply lines only.
- 264 • Never attempt to bend, pinch or crimp a ruptured gas line.

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266 **FLAMMABLE GAS INCIDENTS - OUTDOOR GAS LEAK WITH FIRE AND OR EXPLOSION:**

267 Burning gas poses special risks and requires extra precautions. When responding to a fire
268 involving gas, your best and safest course of action is to let it burn. Remember that burning
269 natural gas cannot explode.

270
271 A confirmation of any active gas leak will require the request for a response from the
272 appropriate gas service company.

- 273 • Park emergency vehicles away and upwind from the area of a gas emergency. Do not
274 park emergency vehicles under overhead utility lines. Gas fed fires can burn overhead
275 lines and cause them to fall.
- 276 • Utilize monitoring and detection equipment to identify migrating or accumulating gas.
- 277 • Evacuate the area and protect exposures with fog streams and be mindful of water
278 runoff from exposure protection. Do not extinguish a gas fed fire.
- 279 • Continue to utilize monitoring and detection equipment to identify operational zones
280 and needed PPE.

281
282 **FLAMMABLE GAS INCIDENTS - VEHICLE BASED INCIDENTS:**

283 A vehicle (buses, trash trucks, over the road delivery vehicles) equipped with a natural gas fuel
284 system will have a decal on the rear of the vehicle identifying it as a compressed natural gas
285 (CNG) or Liquid Natural Gas (LNG) vehicle.



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289 **Compressed Natural Gas Powered (CNG) Vehicles**

290 If the vehicle has sustained damage or a gas leak is discovered:

- 291 • Eliminate all sources of ignition such as fire, sparks, electronics, lights, or electrostatic
292 charges. Do not smoke near the vehicle and do not light road flares.



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- 293 • Turn the ignition switch off (this will close the solenoid valve), set parking brake and
294 turn off battery at main battery disconnect.
- 295 • If it is safe to do so, close the manual shutoff valve, close the cylinder valves and check
296 the fuel system near the damaged area for leaks using smell, sight and sound. CNG is
297 odorized and can be detected by smell.
- 298 • Keep people and traffic away from the area.
- 299 • Open the doors of the vehicle to introduce fresh air.
- 300 • If the vehicle is indoors, open windows and doors to allow ventilation and avoid turning
301 on any lights or electronics which may create a spark. Pay particular attention to any
302 sources of ignition overhead because Natural Gas will rise to the ceiling.
- 303 • Beware that residual gas may still leak from the storage system even after the ignition
304 switch is off and the manual shut off valves are closed.
- 305 • Advise towing and wreckage storage operators the vehicle is fueled with CNG.

307 In Case of a Vehicle Fire – CNG Powered

308 DO NOT apply water to the cylinders because this will prevent the Pressure Relief Device (PRD)
309 from activating and can result in a catastrophic cylinder failure (high pressure gas rupture).
310 After 5-10 minutes in a fire without PRD activation, the cylinder pressure can increase to 5000
311 psi or more. Burst pressure of an intact CNG cylinder is 8000 to 9000 psi. A typical PRD on a
312 CNG tank will require 2-5 minutes to activate. Total vent-down time is approximately 5 minutes
313 from activation but may vary depending on the amount of fuel in the system. The cylinder
314 could survive in a fire for up to a total of 20-30 minutes.

- 315 • Establish a safe area.
- 316 • Allow the PRD to activate.
- 317 • If the cylinders are not involved in the fire, the fire on the vehicle can be extinguished
318 with normal response tactics.
- 319 • If fire is impinging on the cylinders, or if the cylinders are on fire, it is best to let the
320 vehicle burn and watch for secondary hazards, such as other vehicles or structures.
- 321 • When a PRD activates, the result is often a jet fire – and may go out and re-ignite several
322 times

324 LNG Powered

325 LNG is stored at cryogenic temperatures (-220°F to -212°F / -140°C to -136°C) and is odorless.
326 PPE should include gloves and face shields to prevent frostbite, a methane/flammable gas
327 detector and self-contained breathing apparatus (SCBA). LNG fuel is a multi-phase mixture of
328 liquid and gas at cryogenic temperatures: the fuel pressure inside the LNG tank is not indicative
329 of fuel level. A full tank could read zero pressure, and an empty tank could read 230 psi.
330 LNG cannot be odorized because of its very cold temperature, so methane detection systems
331 are mandatory. One sensor is located in the engine compartment and one inside the cab.

333 LNG Leak No fire

334 If the vehicle becomes damaged or a gas leak is found, use caution when handling an LNG leak.
335 LNG is stored at temperatures below -260°F and can cause first degree burns and frostbite if it
336 comes in contact with skin. It is best to remove sources of ignition and allow leaking LNG fuel to
337 vaporize and disperse into the atmosphere.



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- 338 • Establish a safe area.
- 339 • Small LNG leaks can be seen as vapor escaping from the leak, usually at fittings.
- 340 • Large liquid leaks may spill, but will vaporize and rise almost immediately. Be aware of
- 341 the extreme cold and make sure PPE is in place for any exposed skin.
- 342 • Turn the ignition switch off (this will close the solenoid valve), set parking brake and
- 343 turn off battery at main battery disconnect. If it is safe to do so, turn off the main
- 344 battery switch.
- 345 • If it is safe to do so, close the red liquid valve and check the fuel system near the
- 346 damaged area for frost, ice or condensation. This is an indicator of an LNG leak.
- 347 • If the tank is damaged or there is frost on the tank, and the sound of fuel escaping can
- 348 be heard, the gas will vaporize and rise into the air.
- 349 • Be aware the pressure gauges may indicate zero, but some residual liquid may still be in
- 350 the tank.
- 351 • Keep people and traffic away from the area.
- 352 • Open the doors of the vehicle to introduce fresh air.
- 353 • If the vehicle is indoors, open windows and doors to allow ventilation and avoid turning
- 354 on any lights or electronics which may create a spark. Pay particular attention to any
- 355 sources of ignition overhead because Natural Gas will rise to the ceiling.
- 356 • Beware that residual gas may still leak from the storage system even after the ignition
- 357 switch is off and the manual valves are closed.

REFERENCES

- 359 • Department of Transportation Emergency Response Guide (ERG) 115
- 360 • ENP Manual 084
- 361 • NFPA 55: Compressed Gases and Cryogenic Fluids Code

SUMMARY OF DOCUMENT CHANGES

363 Order moved to new GO format.

364 Definitions:

- 365 • Added CSST tubing definition this products installation has become very common in
- 366 residential structures.
- 367 • Improved differentiation of gas line types.
- 368 • Explosive limits defined.

369 Procedures:

- 370 • Updated situational awareness section with characteristics of flammable gas.
- 371 • Separated sections into
 - 372 ○ In a structure no fire or explosion
 - 373 ○ Structure fire or explosion
 - 374 ○ Outside a structure no fire or explosion
 - 375 ○ Outside a structure fire or explosion
- 376 • Addressed Compressed Natural Gas (CNG) vehicles
- 377 • Liquid Natural Gas (LNG)



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378 **FORMS/ATTACHMENTS**

- 379 • None

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381 **APPROVED**

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Christine Uhlhorn, Fire EMS Chief
Office of the Fire Chief

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Author:

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Antonio Concha, Assistant Chief
Emergency Services Bureau