

## **PART C. THE METHANE MONITORING PROGRAM**

Methane gas produced by decomposing solid wastes can become an explosion hazard (see Section 6A - Solid Waste Decomposition). Methane monitoring is required at every Wyoming sanitary landfill to ensure that elevated methane concentrations are detected **before** they present an explosion hazard to landfill workers and the general public. The primary goal of the methane monitoring program is public and worker safety. Wyoming's sanitary landfill regulations require that landfill operators:

- monitor methane at the site perimeter
- monitor methane inside any on-site buildings
- conduct methane monitoring at least quarterly
- control methane below the allowable limit **of 25% of the Lower Explosive Limit**

### **What is the Lower Explosive Limit ?**

The Lower Explosive Limit (LEL) for any gas is the lowest concentration of that gas in air that can result in an explosion if an ignition source is present. The LEL for methane is 5% in air (by volume). When this critical concentration of methane is reached, we say that 100% of the LEL has been reached and that there is immediate concern that an explosion could occur, particularly if the concentration develops inside a building or other confined space where ignition sources could be present. When methane concentrations are below 100% of the LEL (concentration is still less than 5% in air), then there is not enough methane in the air to create an explosion hazard. Concentrations of methane that fall between the LEL and the **Upper Explosive Limit** are explosive whenever there is an ignition source.

### **What is the Upper Explosive Limit?**

The Upper Explosive Limit (UEL) is the highest concentration of gas that will cause an explosion if an ignition source is present. The UEL for methane is 15% in air (by volume), or 300% of the LEL. At methane concentrations above the UEL, the methane concentrations are so high (also called rich) that there is insufficient oxygen to cause an explosion hazard. However, this situation can change rapidly if air or oxygen are introduced, or if the methane concentrations drop. Therefore, any concentration of methane that approaches or exceeds the LEL is considered dangerous.

### **How Do You Read a Methane Meter?**

Methane concentrations are measured using portable gas detection instruments, usually a methane meter or explosimeter which has a readout in either

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%LEL or % by Volume. That means that if you have a meter that reads in %LEL, gas levels less than 25% are within the regulatory limit. If the meter reads in % by Volume, then only gas levels less than 1.25% are within the regulatory limit. A table showing the appropriate conversion between %LEL and % by Volume is shown below.

**Equivalent Methane Gas Measurements (\*Explosive Concentrations)**

<b>%LEL</b>	<b>%Volume</b>	<b>%LEL</b>	<b>%Volume</b>
0	0	25	1.25 (regulatory limit)
1	0.05	50	2.5
5	0.25	100	5.0*
10	0.50	300	15.0*
20	1.00	400	20.0

**Methane Monitoring Tip:**

Many methane meters have two scales, one for detecting trace amounts of methane and one for detecting higher concentrations. Sometimes the low range scale operates by a different mechanism than the high range scale, requiring combustion of gas in order to function properly. If methane levels are high, the low range scale may indicate 0% methane because the combustion mechanism is simply not working. To avoid misreading the meter, always take a reading using the high range scale first. Switch to the low range scale for more precise results when the initial readings indicate that methane levels are low. Similarly, if you are using a combustible gas indicator with an oxygen meter, be aware that at least 10% oxygen is necessary for the combustible gas indicator to work properly.

**Where Must You Sample for Methane?**

Check your landfill operating plan for the locations of **permanent methane monitoring points**. Perforated wells placed around the site perimeter and near any on-site buildings usually provide the primary sampling points for a landfill gas monitoring system. These permanent test wells allow you to test soil for methane on a routine basis (at least quarterly) with relatively uniform test conditions. The atmosphere within any on-site building, particularly any basements or crawlspaces, must also be monitored for methane accumulation if they are not supplied with continuous monitoring and alarm systems. Simply follow the testing protocol outlined in the procedures section below.

### **Where Else Should You Monitor For Methane?**

Although not specifically required by law, it is also advisable to check the following locations for build-up of methane gas:

- monitoring wells
- conduits
- manholes
- trenches
- leachate collection systems
- methane vent systems
- any other on-site structures that could collect landfill gas
- areas of stressed or dead vegetation
- soil cover

### **In Summary, the Main Components of the Methane Monitoring Program Are:**

1. permanent sampling locations at the landfill perimeter - data from these locations can be used to demonstrate compliance with the maximum 25% LEL standard and provide evidence that methane is not migrating off-site to any significant extent
2. defined sampling locations within on-site buildings (unless the buildings are equipped with a continuous monitoring and alarm system) - data from these locations can be used to demonstrate compliance with the maximum 25% LEL standard within on-site buildings and verify a safe working environment
3. optional sampling locations, temporary or permanent, based on general safety concerns and operator judgement (suggested locations near on-site buildings and others listed above)

### **How Can You Quickly Collect Methane Measurements from the Subsurface?**

Depending on your observations and/or results of your routine quarterly methane monitoring program, it may be necessary or desirable to collect subsurface methane measurements from temporary test holes or from methane monitoring stakes. These measurements can typically be performed using your methane meter and tools available through your municipal maintenance shop or local hardware store. The basic techniques for collection of shallow subsurface methane measurements are illustrated on Figures 6C-1 and 6C-2. The important aspects of both techniques are that the measuring device be sealed from ambient air at the surface to prevent dilution and that the test hole or stake penetrate below the frost line. Care should also be taken to prevent water or moisture from entering the methane meter; in-line traps can be installed between the meter and the monitoring probe or stake to prevent this.

*Note: The added moisture content of soil gases during subsurface methane measurements will typically decrease the life expectancy of combustion filaments in most "hot-wire" methane meters. Therefore, you should check and calibrate your meter frequently to be sure it is functioning correctly (once at the beginning and once at the end of your sequence of measurements).*

### **When is a Good Time to Measure Landfill Gas?**

Local climatic conditions can effect the level of gas measured at the time that methane monitoring is conducted. For example, low barometric pressure may cause landfill gas to expand and rise in the landfill while high barometric pressure may cause landfill gas to compress. You are likely to detect maximum methane levels if you elect to conduct methane sampling:

- just after a low pressure system like a thunderstorm has passed through the vicinity. Gases will rise through the landfill more readily at that time.
- during extended periods of snow cover or freezing temperatures since gases may buildup in the subsurface below the frost line or in enclosed spaces.

### **Methane Monitoring Procedures:**

The specific methane monitoring protocol and locations applicable to your landfill will be described in your permit application/operating plan. The general steps that you will follow are listed below.

1. Check that the batteries in the combustible gas meter are fully charged. Many meters will be equipped with a battery charge indicator.
2. Check the instrument for leaks in the pump circuit and repair if necessary. You can check for leaks by attaching all hoses, probes and other air-drawing devices to the instrument and then blocking the gas inlet opening(s) with your finger or tape. After blocking the inlet openings, operate the pump or squeeze the aspirator bulb. A leak-free bulb will remain collapsed and a pump will labor (don't let it labor too long to avoid damage).
3. Calibrate the meter in accordance with manufacturer's instructions. Calibration should be conducted before and after each day's round of sampling and more frequently if your measurements are unusual or you are uncertain if the meter is functioning properly. When calibrating your instrument, use only the equipment and procedures recommended by the manufacturer and use only certified calibration check gas at the recommended concentration.

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4. Obtain representative samples by placing the inlet end or probe in the sampling device or atmosphere to be sampled and either operate the aspirator bulb at least five times, or if equipped with a pump, look for needle deflection or steady-state meter readings, typically within 30 seconds after pumping begins.
5. Read the meter and record the maximum percentage of the LEL that you observed (see Meter Reading above).
6. Notify landfill manager immediately of any measurements that exceed the regulatory limit of 25% LEL.
7. Before monitoring the next location, purge the instrument with clean air by aspirating the bulb five times or by pulling in clean air until the needle drops back to zero and is stable.

**How Do You Report Your Data?**

Transcribe the readings you obtain from your monitoring instrument (methane meter/explosimeter) in the field and enter the information on the appropriate methane monitoring report form. These forms are usually provided in an addendum to the approved landfill operating plan. Always be sure to indicate whether the readings are %Volume or %LEL. For locations within on-site buildings, be sure to record the exact location inside the building where the atmosphere was sampled. Use the same sampling location each time you perform routine monitoring so that results can be compared from time period to time period.

Be sure to place a record of the results of all analyses (original methane monitoring report forms) in the facility operating record to be available for review by the Department. Type I sanitary landfills will also need to use this data to compile their required annual environmental monitoring report. The report summarizes and interprets the results of the methane monitoring program.

**What Do You Do If Your Data Shows Methane Levels above the Allowable Limit?**

Always compare your data with the regulatory limit and immediately notify the solid waste manager if you believe that your data indicates that the limit has been exceeded. If the methane regulatory limit (25% of the lower explosive limit (LEL)) has been exceeded at the facility boundary:

- immediately notify the DEQ Administrator
- immediately take steps to protect human health (such as limiting access, cordoning off the affected area, notifying adjacent property owners if imminent danger, etc.)

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- within 7 days: place a copy of the methane test data in the operating record with a written description of steps taken to protect human health
- within 60 days, unless an alternate date has been approved by DEQ: implement a DEQ approved remediation plan and place a copy of that plan in the operating record

If you are required to submit a methane gas remediation plan to DEQ, what should you include? A summary of the applicable methane data, a discussion of the potential source and path of migration, a proposed management plan or engineering design for methane control (see Section 5E - Methane Control Systems), a proposal for post-remediation methane monitoring and any other site-specific information requested by WDEQ/SHWM.

If your data indicates that methane levels have exceeded the regulatory limit within any on-site structures:

- immediately notify the DEQ Administrator
- immediately take steps to protect human health and welfare  
(Ventilate the area, evacuate the building!)

There are some special concerns about high methane levels in indoor environments. High methane levels could cause exposure of workers to atmospheres lacking sufficient oxygen due to displacement of air by landfill gas. Workers could be exposed to high concentrations of hydrogen sulfide or other toxic gases whenever there is a high concentration of landfill gas (as indicated by high methane levels) in an indoor environment. In addition, ignition sources are more likely to be present inside a building, particularly one that houses any electrical equipment which can cause sparks. Explosions can be triggered by something as seemingly harmless as static electricity!

Remember! Methane explosions from landfill gas are not restricted to the wetter areas of the country - landfills in our arid Rocky Mountain region have had their share - Denver (1977) - 2 dead, 4 injured; Englewood, CO (1976)- 3 seriously injured.