CHAPTER 10

COMBUSTIBLE GAS MONITORING PROCEDURES

10-1. General. This chapter describes combustible gas indicators (CGIs), their operation, and correct monitoring procedures.

a. Purpose. Combustible gas indicators (or explosimeters) are used to determine the potential for the combustion or explosion of unknown atmospheres. Combustible gas monitoring is performed to determine when an explosion hazard exists in the UST work environment. A typical CGI determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or the upper explosive limit (UEL) by measuring the change in electrical resistance in a Wheatstone bridge circuit. A Wheatstone bridge circuit is a four-arm bridge circuit used to measure the electrical resistance of an unknown resistor by comparing it with a known standard resistance.

b. Units. CGIs provide readouts in units of percent LEL, in parts per million (ppm) combustible gases by volume, or both. The more explosive the calibration gas (the lower the LEL), the more sensitive the indication of explosivity, resulting in a greater margin of safety. The operator should be familiar with the LEL concentrations for specific gases to effectively use instruments that provide data only in ppm combustible gases (by volume).

c. Calibration. Instruments can be purchased that are factory-calibrated for gases like butane, pentane, methane, or petroleum vapors, (methane calibration is the most common). The LEL of methane is 5 percent methane by volume in air; therefore, an air mixture containing 5 percent methane will be read as 100-percent LEL and is explosive. When combustible gases other than methane are sampled, the relative response of the detector must be considered.

Recalibration to other gases may be possible (see the manufacturer's recommendations). National Institute of Standards Technology (NIST) traceable calibration gases should be used. The relative sensitivity of the detector and the differences in LEL for different gases will produce varying meter responses. *When possible, the gas used for calibration should be as similar as possible to the gas that will be*

measured. Calibrate or at least do zeroing checks under field conditions.

10-2. Precautions. During the course of UST activities, workers may be exposed to petroleum hydrocarbon liquids, vapors, and possibly other hazardous wastes. Personnel involved in combustible gas monitoring should be familiar with the potential hazards and appropriate safety and health measures. This is accomplished by reading the SSHP, consulting with the project manager, and observing good safety practices.

All analyzers and testing equipment used in locations that may have flammable atmospheres must be approved, per NFPA 70, for the hazardous location (by Class and Division) and the hazardous substance (by Group) in that location. It is important that manufacturers' recommendations be followed, including calibration procedures.

10-3. Operations, Procedures, and Instructions. Site personnel responsible for combustible gas monitoring should be familiar with all safety rules and regulations as detailed in the SSHP and the use of equipment and procedures for monitoring combustible gas.

a. Instrument Requirements. Guidelines for instrument use include the following:

(1) Use only those instruments that are certified safe for use in atmospheres containing vapors or gases in concentrations greater than 25 percent of the LEL. Some are not certified safe for operation in the atmospheres they can detect. The instrument manufacturer's operating manual should be consulted to determine safety certification in specific atmospheres.

(2) CGIs do not indicate if a given atmosphere contains hazardous or toxic compounds nor do they indicate whether an atmosphere is oxygen deficient.

(3) Do not use the CGI in atmospheres containing silicanes, silicones, or other compounds containing silicon because these substances seriously impair the instrument response.

(4) If the detector has a platinum filament, its sensitivity may be reduced by exposure to gases like leaded gasoline vapors (tetraethyl lead), sulfur compounds (mercaptans and hydrogen

sulfide), and sulfide compounds. An inhibitor filament that will nullify the effect of leaded gasoline vapors is available on some commercial units. Consult the instrument manufacturer's operating manual to determine the instrument's ability to function in leaded gasoline atmospheres.

(5) Use an oxygen detector in conjunction with a CGI. Select a unit with this feature and follow the operating manual to use the oxygen detector. This is especially important when atmospheres are monitored within enclosed spaces or where oxygen-deficient atmospheres (< 19.5 percent) may exist. A CGI may give a false "safe" reading in an oxygen-deficient atmosphere.

(6) Calibarate CGI instruments frequently using a NIST traceable calibration gas. Unusually high concentrations of sulfur dioxide, fluorine, chlorine, bromine, iodine, and oxides of nitrogen interfere with measurement. Consult the manufacturer's operating manual for calibration frequency. Also, frequent calibration will be necessary if several known organic species are present. Maximum accuracy requires a recalibration for each gas.

(7) Do calibration and zeroing checks under field conditions.

b. Instrument Preparation. Assemble the equipment and supplies listed in Table 10-1. Perform a minimal check of the CGI in the office to ensure that it is functioning properly. Obtain the CGI, its operating manual, and a supply of NIST traceable gas. Methane is the factory calibration gas, but other gases may be used for specific requirements.

Perform the equipment checks below.

(1) Make sure the instrument is clean and serviceable, especially sample lines and detector surfaces.

(2) Check the battery charge level. If in doubt, charge the battery as described in the operating manual. Some units have charge-level meters, while others have only low-charge alarms.

(3) Turn the unit to the "on" position and allow the instrument sufficient warmup time.

(4) Verify that the sample pump is operable when the analyzer is on. The pump can usually be heard when operating.

TABLE 10-1
COMBUSTIBLE GAS INDICATOR (CGI)
EQUIPMENT AND SUPPLIES CHECKLIST

	CGI
	Battery Charger for CGI
	Oxygen Sensor
	Battery Charger for Oxygen Sensor
	Spare Gas-Detector Filaments
	Spare Batteries for CGI
	Jeweler's Screwdrivers for Internal Adjustment
	Calibration Kit A) Spare gas cylinder (NIST traceable calibration gas) B) Valve attachment C) Flexible tubing (tygon) D) Cylinder to encapsulate sensor probe
	Probe Extensions

(5) With the intake assembly in combustible gas-free ambient air, zero the meter by rotating the zero control until the meter reads 0 percent LEL. For instruments with an additional oxygen meter, adjust the dial to 21 percent oxygen in nonhazardous locations.

(6) Calibrate the unit against a known concentration of a calibration gas, like methane, by rotating the calibration control (span or gain) until the meter reads the same concentration as the known standard.

(7) Some instruments require internal calibrating with a small screwdriver. Consult the operating manual before calibration. With this model, it is also necessary to maintain the proper flow rate during calibration. Connect a flow meter between the CGI and the calibration gas cylinder to monitor the flow rate.

(8) Most models are equipped with three meters that read percent oxygen, percent LEL, and ppm. The ppm dial is often not used in the field unless a photoionization detector (PID) or flame ionization detector (FID) is not available, as the PID/FID instruments are considered to be more accurate.

c. Documentation Preparation.

(1) Obtain a logbook.

(2) Record results of the equipment check in the logbook.

d. Field Preparation.

(1) Instrument Check. Before using the CGI in the field, follow the procedures described in the instrument preparation section. You may need to make additional adjustments. If necessary, adjust the alarm setting to the appropriate combustibility limit. The action level or the point when activities are halted and personnel are removed from the immediate vicinity, as detailed in the SSHP, is usually less than 25 percent of the LEL for the gases that are present.

(2) Record necessary calibration data in the logbook and include the information listed below:

- Date and time of arrival at the site.
- Site identification.
- Instrument, model number, and serial number.
- Date/time calibrated.
- Calibration gas used, including manufacturer and lot number.
- Calibration location.
- Operator's signature.

e. Field Measurements.

(1) Calibrate the CGI daily before use in the field. See the manufacturer's manual for calibration procedures.

(2) Position the CGI intake assembly close to the area in question to get an accurate reading. For readings taken downhole during drilling, there will be a slight delay between positioning the intake tubing downhole and registering accurate meter readings because of the time required for the sample to travel the length of the tube.

(3) Interpret CGI meter readings according to one of three typical instrument responses:

(a) The meter indicates 0.5 LEL (50 percent). This means that 50 percent of the concentration of combustible gas required to reach an unstable combustible situation is present.

(b) The meter needle stays above 1.0 LEL (100 percent). This means that the concentration of combustible gas is greater than the LEL and less than the UEL. Therefore, the concentration is immediately combustible and explosive.

(c) The meter needle rises above the 1.0 LEL (100 percent) mark and then returns to zero. This response indicates that the ambient atmosphere has a combustible gas concentration greater than the UEL.

(4) Evacuate the area if any of the following events occur:

(a) Sounding of the GCI alarm

(b) Readings that reach the action levels designated in the SSHP

(c) Malfunctioning of the CGI

(d) Condition encountered or suspected that indicates oxygen enrichment or depletion of the atmosphere (specially designed units are available for operation in those atmospheres).

(5) Keep in mind these important factors during CGI use:

(a) Slow, sweeping motions of intake or cell assembly will help ensure that problem atmospheres are not bypassed. Cover an area from the ground to the breathing zone and areas where maximum concentrations may be expected (for example, downhole during drilling).

(b) Operating the unit in temperatures outside the recommended operating range may compromise the accuracy of readings or damage the instrument. Check the operating manual for the temperature limitations of each particular model.

(c) Many CGIs are not designed for use in oxygen-enriched or -depleted atmospheres.

(d) Calibrate the equipment and charge the battery after each field use. See the operating manual for details.

(e) The operator should fully understand the operating principles and procedures for the specific CGI in use.

f. Post Operations.

(1) Field.

(a) Carefully clean the outside of the CGI with a damp disposable towel to remove any visible dirt when the activity is completed or at the end of the day. Return the CGI to a secure area and place on charge.

(b) Ensure that all equipment is accounted for, decontaminated, and ready for shipment.

(2) Documentation.

(a) Record any uncompleted work (such as additional monitoring) in the logbook.

(b) Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

(c) Review data collection forms for completeness.

(3) Office.

(a) Deliver original forms and logbooks to the document control officer (with copies to the project manager and files).

(b) Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment and report incidents of malfunction or damage.