



JOSOP 408 – Gas Detection Standard

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1.0 Purpose, Objectives and Scope

1.1 Purpose

This standard is to establish minimum requirements within Joint Operations for portable Gas Detection instruments and their use.

1.2 Objectives

The objective of this standard is ensure that portable gas detection instruments are correctly selected for the tasks to be performed and that all relevant gas tests that must be conducted to ensure worker safety are performed.

Strict adherence to the testing procedures provided in this standard ensures that:

- Tests prior to work in an area where hazardous atmosphere might be present
- Hot Work and Confined Space Entry is conducted safely Workers are not exposed to hazardous atmospheres above permissible exposure limits for airborne contaminants

1.3 Scope

This standard applies to all Joint Operation's employees and/or contractor personnel performing portable Gas Testing at Joint Operations.

This standard describes the selection of portable gas detection instruments and the minimum tests that must be conducted in the following situations:

- Before performing hot work
 - Before entering a confined space
- This standard does not apply to fixed gas detection devices or systems

2.0 Requirements

1. Qualified Gas Testers must be trained in accordance to this standard and demonstrate competency.
2. Equipment must be field calibrated monthly, calibrated according to the manufacturer, and bump tested before use.
3. Qualified Gas Testers must use the appropriate PPE before entering a confined space.

3.0 Terms and Definitions

The following terms and definitions apply to this JO – Joint Operation’s Standard Operating Procedure (JOSOP) – Gas Testing Standard.

Area Controller – A competent individual who is responsible for the equipment in the area where the work is to be performed.

Bump Test (Response Check) – A functional check on test instruments prior to use. Test instrument sensors are briefly exposed to manufacture’s approved test gas concentrations to confirm that instrument is within calibration range and alarms work at appropriate set points. Bump tests may also be conducted after conducting gas tests, in addition to the prior to use test, to confirm the functionality of the instrument. If the instrument does not respond correctly it must be Field Calibrated. All tests must be documented.

Classified Hazardous Area – Any area classified as a hazardous zone area (Zone 0, 1, 2 or Class I, Division 1 or 2) in accordance with API RP 505/API RP 500 or other equivalent local standards.

Combustible Gas Indicators – Meters using a filament heated or coated with a catalyst that reacts with flammable vapor. The reaction causes a change in the filament temperature, which registers on the meter’s readout. Typical instruments using the combustible gas indicator method include instruments normally known as “LEL explosion meters/vapor testers”.

Competent Person – Is a person who has the knowledge and experience, and is able to perform the specific work requirements of this standard and relevant regulatory requirements. The competent person may be a different person for different elements of the standard.

Continuous Gas Testing – A process whereby the required gas tests are continuously monitored. Continuous gas testing is normally required where there is a high likelihood of changing gas concentrations and/or there is a high risk to workers if the gas concentration changes unexpectedly.

Field Calibration – A periodic physical test of gas testing equipment to ensure that the testing element sensors and alarms are working within prescribed limits. Field calibration tests differ from Bump Tests in that the instrument is reset to the ‘optimum’ reading as opposed to ensuring the instrument is within the calibration range. Field calibration should be done at least monthly and documented. Field calibration shall be done by an Authorized JO Instrument Technician, or Qualified Gas Tester. (‘self tests’ do not constitute field calibration)

Follow Up Testing – Performed after initial testing at intervals sufficient to ensure that the atmosphere remains safe for the work being performed. Follow-up tests must be performed whenever work has been stopped for more than 30 minutes, whenever operating conditions change, or at least every four hours.

Gas Testing – Use of portable detection equipment, including detector tubes and combustible gas indicators, to determine levels of oxygen and flammable or toxic vapors and gases.

Hazardous Atmosphere – An atmosphere that exposes personnel to the risk of death, incapacitation, impaired ability to self-rescue, injury, or acute or chronic illness that may be caused by any of the following:

- An atmospheric concentration of any substance in excess of the permissible exposure limit (PEL) that could result in employee exposure; for example, to benzene or hydrogen sulfide
- Flammable gas, vapor or mist in excess of 10 percent of its lower explosive limit (LEL)
- An atmospheric oxygen concentration less than 19.5 percent or above 23 percent
- Any other atmospheric condition that is immediately dangerous to life or health (IDLH)

Initial Gas Testing – Gas test or tests conducted prior to personnel beginning work to determine the following:

- Requirements for entry
- Whether the area is safe for the planned work

The tests may be performed in two parts:

- Testing a confined space from the outside, and then
- Testing the inside to determine if it is safe for work to commence

Job Safety Analysis – A hazard analysis that is performed immediately before work is started. It is a tool used to identify and minimize risk associated with all job tasks. When used in conjunction with other JO processes, a JSA enables workers to minimize exposure to conditions that may cause injuries. The JSA is an analysis of hazards associated with a specific job.

LEL Explosion Meter – An instrument used to measure in percent of the lower flammable limit or explosive limit (LEL) of a flammable substance. *See also Combustible Gas Indicator*

Manufacturer’s Calibration – A periodic physical test of gas testing equipment conducted by the equipment manufacturer or nominated representative to ensure that testing element sensors are working within prescribed limits and check other critical instrument operations. Manufacturer calibration should be done according to manufacturer’s specifications as described in the owner’s manual or at least annually, whichever is the lesser. Manufacturer’s calibration shall be done when instrument does not pass Field Calibration.

Oxygen Monitor – A device containing an electrochemical sensor that detects oxygen and is used for measuring the percentage of atmospheric oxygen. As the amount of atmospheric oxygen increases or decreases, the electrical current fluctuates and produces a signal, which is sent to the instrument’s meter.

Permissible Exposure Limit (PEL) – An exposure limit to a chemical. May be either a:

- Time weighted average limit (e.g. TWA or STEL)
- Maximum concentration exposure limit (e.g. Ceiling)

Permit Approver - A competent individual who has been trained and authorized by the company (or contractor company) to review and, where applicable, sign and approve relevant forms.

Permit to Work – A written authorization from the person responsible for the work area, facility, or process to the people requesting permission to perform work.

Qualified Gas Tester – A person who is trained and has been tested in the use of portable gas-testing equipment and has successfully demonstrated use of the equipment in the field. This person must also be trained to recognize hazards inherent in hot work and confined space entry.

Safe Atmosphere – An atmosphere that meets all the following requirements:

- Is safe for a person to work in without wearing supplied air respiratory protection (i.e. no toxic or hazardous vapors and sufficient oxygen)
- Where no flammable vapors are detected within 15 meters (50 feet) of a site where hot work will be performed.

Subject Matter Expert (SME) – For the purpose of the standard, the SME is the Joint Operation’s employee who has been assigned responsibility for the technical support of this JOSOP within Joint Operations.

4.0 Roles, Responsibilities and Training Requirements

Roles must be clearly defined, and personnel must meet the training and competency requirements of this standard prior to starting work. JO or country regulations may specify additional training and competency requirements.

A single individual may fulfill more than one role as long as he or she meets the competency requirements and is able to fully meet multiple responsibilities.

The following roles and responsibilities are specific to Gas Testing and are further defined in the JO – Training Requirements Tool:

- Qualified Gas Tester
 - Conduct necessary tests as required in accordance with the SWP Gas Detection Standard (tests may be required as part of permit process, JSA requirements or from other business needs)
 - Be familiar with the instrument they are using and the instrument handbook
 - Inspect and zero the instrument before each use
 - Conduct instrument field calibration checks
 - Anticipates where gases and vapors may occur and/or accumulate
 - Enter Gas Test results on the relevant documentation, including the date and time, and then sign the permit in the gas testing section
 - If required to enter a confined space to conduct gas tests, must also meet all the requirements of an Authorized Entrant
 - Stops the work if unsafe conditions develop

Note: Only qualified gas testers are permitted to conduct gas tests

For updates refer to [JO_MSW_TrainingRequirementsTool.doc](#)

4.1 Company Authorization

All Qualified Gas Testers shall be so authorized in writing by the appropriate management. For contractor employees to Joint Operations, copies of gas testing related training records. Joint Operations shall maintain an up-to-date list of those Contractors approved as gas testers.

Gas Testers shall only be authorized by management after they have successfully completed a Qualified Gas Tester competency evaluation. Results of such evaluations shall be valid for a 3 year period from date of completion of the competency evaluation provided that the Qualified Gas Tester is observed on an annual basis using the Gas Detection Competency Observation, and any questionable observations are corrected. At the conclusion of the 3 year period the Qualified Gas Tester shall be required to retest on the competency evaluation.

4.2 Initial Training

Personnel must meet the competency requirements of this JOSOP prior to starting work. Refer to the JO – Training Requirements Tool.

4.3 Refresher Training

Refresher training must be provided as follows:

- As required by applicable regulations or JO policy
- As needed when identified by: verification, inspections, incidents or audits
- Whenever an individual demonstrated insufficient knowledge of the Gas Detection JOSOP Standard
- Whenever an incident has occurred where the root cause indicates a lack of knowledge of the proper gas detection process
- At least every 3 years for all Qualified Gas Testers

5.0 Standard Instructions

5.1 Situations Requiring Gas Testing

This section describes general gas testing requirements and situations that require gas testing:

- tests prior to work in an area where hazardous atmospheres may exist
- tests prior to hot work in a classified hazardous area
- tests prior to confined space entry
- follow-up tests
- continuous testing
- any other situation where the need for a gas test has been determined

General Requirements

Only personnel qualified in the use of gas detection equipment, or personnel under the direct observation and control of a Qualified Gas Tester and undertaking gas testing training, are permitted to conduct gas tests at Joint Operations.

Qualified Gas Testers must be trained and conversant with the specific type of gas detection equipment that they are using.

Before initial gas tests are taken, equipment and controls must be properly isolated, if required, in accordance with the Isolation of Hazardous Energy JOSOP.

Personnel (contractor or employee) performing work tasks subsequent to the gas testing shall be given the opportunity to observe the initial testing and any subsequent follow-up testing or monitoring. If these personnel have reason to believe that the gas testing may be inadequate then they may request a retest be performed before they commence work.

Where contractors are required under their JSA to undertake initial gas tests, these should be verified by a Joint Operation’s employee competent in gas testing. This is done by reviewing results obtained by the contractor and being assured that the contractor’s equipment has been properly serviced, calibrated, and bump tested.

Gas Testing for General Work or Hot Work

Tests for flammable vapour and/or other hazardous vapours/gases must be undertaken before any hot work is performed in a classified hazardous area and before any general work is performed within a classified hazardous area where there is a risk that a hazardous atmosphere may exist. (*Test for H2S, combustible gases and CO2)

Work shall not be allowed to proceed if gas levels exceed those specified in the Hot Work JOSOP or those contained in Appendix D of the Confined Space Entry JOSOP.

Refer to the Permit to Work JOSOP Standard for full details on Permit to Work requirements.

Gas Testing for Confined Space Entry

NOTE: Refer also to the Confined Space Entry JOSOP for full details on confined space entry requirements.

A Qualified Gas Tester is responsible for taking the initial and follow-up gas tests and for seeing that the atmosphere remains within the safe limits for entry as specified in the Confined Space Entry Standard.

A confined space is considered hazardous until the initial gas tests are taken and the requirements for entry are determined. Therefore the Qualified Gas Tester must wear supplied air respiratory protection or SCBA (Self Contained Breathing Apparatus) when they enter the confined space to conduct the initial gas testing.

After testing has been performed the results shall be recorded on the confined space entry certificate as required by the Confined Space Entry Standard.

The atmosphere inside a confined space must be tested for all of the following vapours or gases in the order given below:

- Oxygen
- Flammable vapor (LEL) or combustible gases
- Toxic gases/vapors identified as requiring testing by the Work Permit/JSA.
- Temperature

Gas tests for confined space entry are generally performed in accordance with the following steps:

Step	Action
1	Gas tests requirements are determined and advised to the Qualified Gas Tester.
2	Before initial gas tests are taken operations: <ul style="list-style-type: none"> • Verify that necessary equipment and lines have been depressurized and correctly isolated • Have the equipment or space opened and ventilated • Ensure that preliminary venting/cleaning has been completed as required (NOTE – only cleaning that can be performed by personnel

	operating outside the tank is allowed at this stage)
3	The following signage or tags are affixed to the entry man-ways until gas tests have demonstrated that the space is safe for entry: <ul style="list-style-type: none"> • Do Not Enter • Confined Space
4	Mechanical ventilation may be used to remove toxic or flammable gases or vapors and to increase the oxygen content to a safe level. Use of mechanical ventilation reduces the time required to achieve a safe atmosphere and therefore should be considered as a preferred option in most cases. <ul style="list-style-type: none"> • Any ventilation equipment must be non-sparking • It shall be bonded to the vessel • Such ventilation may be an educator or blower • It should be located so as not to block emergency egress from the vessel if still fitted once entry to the vessel is being undertaken • It shall be designed to discharge vapors to a safe area • It shall be turned off at least 30 minutes prior to testing the internal atmosphere to establish safe entry conditions (to allow the internal atmosphere to reach equilibrium conditions prior to testing) Mechanical ventilation should be continued to be used while work is being performed inside the confined space where practicable.
5	The Qualified Gas Tester takes initial and follow-up tests and sees that the atmosphere remains within safe limits for entry, as specified in the Confined Space Entry Standard.

Follow-up Tests

The Qualified Gas Tester must perform follow-up tests on jobs involving hot work and confined space entry as specified below:

- Immediately after any work break of 30 minutes or greater
- At the commencement of a new work shift
- At any time operating conditions change

If hot work is disrupted or must be shut down due to operational changes or an emergency, gas tests are required to be redone before the work can restart.

When in doubt if follow-up testing is required, always retest.

All retest results shall be recorded on the relevant work permit documentation.

Continuous Gas Tests

Continuous gas testing is required whenever workers are wearing supplied air respiratory protection or SCBA inside a confined space, and at any other time as required by the work permit and/or JSA. It may be stopped if the worker is performing activities that will affect the instrument such as water washing, steam cleaning or sand blasting. However periodic testing must still be carried out.

Where continuous monitoring is required the gas testing instrument shall be set up by a Qualified Gas Tester. The Qualified Gas Tester does not have to remain in the immediate vicinity of the work task, but must be available at the installation where the work is being performed and must ensure all workers are aware of what actions to take should the gas test instrument alarm activate.

NOTE: Even if continuous monitoring is required, the initial gas test must be conducted manually.

Additional requirements for continuous testing may be specified in the Permit to Work, Hot Work, or Confined Space Entry Standards.

Changing Conditions

When conducting gas tests and follow-up tests the Qualified Gas Tester must be aware of changing conditions that may impact the atmosphere at the test location. Changing conditions may include, but are not limited to, the following:

- A change of wind direction
- Increasing ambient temperature
- Other work activities that may commence in the vicinity such as welding

5.2 Requirements for Contractors

Introduction

This section describes the following categories of requirements for contractors:

- General Requirements
- Gas Testing
- Verification of Gas Testing

General Requirements

Contractors are required to follow Joint Operation's permitting requirements as defined in the Permit to Work, Hot Work and Confined Space Entry Standard. These include:

- Taking initial gas tests
- Taking follow-up tests at the intervals required by the permit or by the nature of the work being performed

Gas Testing Requirements for Contractors

Only contract personnel qualified in the use of gas detection equipment are permitted to conduct gas tests at Joint Operations.

Contractors must provide certification that the person taking the tests meets the requirements of a Qualified Gas Tester.

Contractors must provide and use their own gas testing equipment whenever they perform gas tests, and the Qualified Gas Tester must be trained in the specific gas detection equipment being used.

Contractors must ensure that their gas testing equipment:

- Is calibrated (as a minimum, in accordance with the requirements of this standard) and provides accurate readings
- Operates correctly
- Is complete (i.e. contains all necessary components)

Contractors must maintain written records of calibration for their gas detection instruments and if requested, provide a copy of these records.

Contractors must record the results of gas tests they undertake, including date and time of the tests on the appropriate certificate.

At a minimum, contractors must follow the guidelines and procedures contained in this standard when performing gas tests. Additional requirements relating to the job may be contained in other JOSOP standards or external standards.

5.3 Portable Gas Testing Instruments

Introduction

This section:

- Defines equipment specifications for portable gas detection equipment
- Describes the equipment used for gas testing
- Defines response check and calibration requirements
- Prescribes equipment inspections that must be performed before using equipment

Gas Testing Equipment

As a minimum, all portable gas detection equipment systems in use within Joint Operations shall comprise all of the following components:

- The instrument handbook
- The manufacture's accessories (e.g. sampling line(s), probe(s), water trap, hand aspirators, instrument cover) as appropriate
- The manufacturer's calibration kit (or bump test/response check kit)
- Spare, fresh batteries of the approved type, and/or the approved battery charger
- Consumable spares (as appropriate) – e.g. filters
- The gas detection instrument

Where a Joint Operations is replacing gas detection equipment, new equipment shall be purchased in accordance with the specification as maintained by EHS.

When selecting gas detection instruments these should be purchased with the relevant sensors required in the operating facility where the instrument will be used. Over specification of sensors (e.g. specifying H₂S sensors for an instrument to be used only around light hydrocarbon products with ultra low sulphur content) can result in significant increased cost of ownership over the lifetime of the instrument.

Contractor Qualified Gas Testers shall use portable gas testing equipment provided by their own companies. Joint Operations only provides gas testing equipment for use by its own employees. Joint Operations gas testing equipment must not be loaned to a contractor.

EHS Department shall designate a person(s) to be responsible for overseeing the gas detection program, maintaining and calibrating Joint Operations gas testing equipment.

Gas testing equipment must be maintained in accordance with the following:

- Bump Tested
- Monthly Field Calibration requirements
- Manufacturer's Calibration requirements (annual, or more frequent if defined by the manufacturer).

Calibration

Gas detection instruments shall be Bump Tested (Response Check) daily, or each time they are used if use is less than daily, to ensure they are functioning correctly. A Daily Response Check Sheet, refer Appendix A, shall be completed by the person performing the bump test.

A Field Calibration of the instrument should be performed every month. The Field Calibration should be in accordance with the manufacturer’s instructions and results recorded on the Monthly Field Calibration Record Sheet, maintained with each detector.

A Manufacturer’s Calibration should be performed at least annually, or at the manufacture’s recommended frequency if this is more frequent than annual, on the instrument and the manufacture’s calibration record sheet retained with the gas detection equipment until its expiry or the next manufacture’s calibration is performed, whichever is sooner.

NOTE: It is the responsibility of the person to whom the gas detector is assigned to ensure that all relevant daily response, field and manufacture’s calibrations are completed and recorded in a timely manner.

Test gases, as specified by the manufacturer, shall be used to bump test and to calibrate the instrument. Where a selection of calibration gases are recommended by the manufacturer for testing the LFL/LEL sensor the preference shall be to calibrate on a methane in air mixture using the relative response curve (from the instrument manufacturer) or calibrate on an adjusted methane concentration, based on the relative response (sometimes referred to as a pentane simulant) rather than use pentane as the calibration gas as methane provides a greater protection against false reading from sensor decay.

The following shall never be used to bump test or calibrate instruments:

- Gasoline
- Naphtha
- Crude Oils
- Test gases of unknown concentration

Test gases should be checked prior to use to ensure they are within their service life. Expired test gases shall not be used for calibration tests.

Contractors must provide their own calibration equipment (or engage the services of an external calibration agency) and keep calibration logs for their gas testing equipment. If requested they should provide a copy of the log to the Company prior to the job start and monthly thereafter for any jobs that exceed one month duration.

Equipment Inspection Before Use

The Qualified Gas Tester must, as a minimum, perform the following inspections before using any portable gas detection equipment:

Step	Action
1	Ensure all equipment is present/
2	Check the battery has sufficient charge.
3	Check the Daily Response Check Sheet. If not available or no test done for the day, perform a Bump Test (Response Check) and record.
4	Check the Field Calibration Record Sheet. If not field calibrated within the last month, have a field calibration done /
5	Check the Manufacture’s Calibration Record. If not current, do not use

	the instrument and arrange for a manufacture's calibration.
6	Check the instrument, and all accessories to ensure they are in good condition.
7	Check the filter (if fitted) and water trap (if fitted) for cleanliness. Clean or replace if necessary.
8	Check the probe and sampling lines (if used) to ensure they are connected properly, washers fitted, not leaking, free of obstruction and the required length.

5.4 Performing Gas Tests

Introduction

This section describes:

- Testing techniques
- Precautions for gas testing
- Interpreting readings
- Documentation requirements
- Detector tubes

Testing Techniques

Tests for Oxygen should be conducted prior to tests for LFL/LEL. Many instruments require a minimum amount of oxygen to function correctly, typically around 15% or higher, otherwise the instrument may read incorrectly.

Tests must be performed in all areas where hot work or confined space entry permits are required. In addition, there may be other situations where the responsible party identifies a need to conduct gas testing (e.g. for operational requirements, general work permits, etc.).

Refer to Appendix C for samples of testing procedures. These samples are provided as guidelines only and do not replace the need for the Qualified Gas Tester and permit issuer to assess each situation and determine the most appropriate tests and test methodology to be used.

Precautions for Gas Testing

When using a gas detection instrument adopt the "read and run" process. The instrument should be constantly monitored and upon detecting any reading of toxic or flammable gases the tester should retreat to a safe atmosphere until the reason for the reading can be ascertained.

Avoid exposing the gas detection instrument to chemicals or substances that may poison the detection filament. Refer to manufacturer's literature for examples of such filament poisons.

Only use manufacturer approved accessories with your instrument as incorrect accessories can compromise the operation of the instrument, e.g. a non-approved sampling line may contain silicone compounds which may poison the detection filament.

Avoid drawing liquid into the probe. Where there is a risk of drawing liquid into the probe, ensure a water trap or water protection filter (if available for the instrument used) is installed.

Ensure that sample line length is considered when drawing sample to ensure sufficient sampling time is allowed to draw a representative sample from the end of the sampling line to the instrument sensor. Refer to manufacturer's handbook.

Avoid situations where the sampling atmosphere is at a significantly different temperature than the gas detection equipment (instrument and sampling line/probe). If the sampled air has a significant temperature difference to the instrument and/or sample line then the sample can condense on the sampling lines and/or instrument internals which will result in false readings. Examples of such situations may include drawing samples of heated gases or vapour (e.g. sampling from a tank still hot with steam or heated heavy hydrocarbon vapours) or using equipment which has been taken from a cool environment to a warmer environment (e.g. from an air conditioned office to outside on a warm day).

LFL/LEL instruments are designed to measure flammable/explosive limits based upon the unit's response to a calibration reference gas. Pentane simulates a reasonable instrument response for most hydrocarbons present at Light Product facilities. However, pentane may not accurately simulate the flammable/explosive potential for other flammable vapours, such as paints, coatings, etc. Methane will over respond in comparison to most hydrocarbons present at Light Product facilities, but this over response is normally compensated for during the calibration process in the manufacturer's response curves for the calibration gas. Methane will also reveal potential problems with sensors at an early stage as this is one of the first gases to lose response as a filament is poisoned. For this reason, methane should be a preferred calibration gas where allowable by the instrument manufacturer.

- This is based on relative responses between methane and the C5 and C6 hydrocarbons. These relative sensitivities vary a bit from instrument type to instrument type, or more correctly on their designed sensor type, or model, and the energizing current used
- However, new sensors will always read higher on 50% LFL/LEL methane than on 50% LFL/LEL pentane, typically by a factor between 1.5 and 2 and therefore relative response curves must be used if using a 50% methane calibration gas.
- Some manufacturers use response curves or factors to advise how to give a sensible reading on pentane while calibrating on a methane test gas, i.e. they might say calibrate using 1.5% v/v methane in air and adjust to read 50% (pentane)
- Other manufacturers provide a methane test gas and call it a "simulated pentane". Typically this will be a mixture between 25 and 33 % LFL/LEL methane (1.25 – 1.67% v/v) and is required to be adjusted to read "50% LFL/LEL pentane", **on their nominated instruments**
- Any variation **with time or usage** in the relative response assumed for this method will cause the calibrated instrument to over read on the C5 C6 hydrocarbons (i.e. err on the safe side) as more sensitivity will be lost to methane than to other hydrocarbons, and so the recalibration will over-compensate for the latter

If in doubt about gas detection instruments response to chemicals other than typical light product hydrocarbons, consult the corresponding MSDS and/or your Safety Engineer.

When monitoring for entries involving a descent into atmospheres that may be stratified, test the atmospheric envelope approximately four feet in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of speed should be slowed to accommodate the sampling speed and detector response.

Gas detection equipment should be stored in a dry dust free environment away from chemical vapours. Storage locations should ideally be at the same, or similar, temperature to the location where the instrument is to be used. When an instrument is stored at a temperature significantly different ($\pm 5^{\circ}\text{C}$ ($\pm 10^{\circ}\text{F}$)) to the temperature where the testing is to be performed then the user must ensure sufficient time for the instrument to temperature stabilize prior to use. This

stabilization time may vary from 5 minutes to more than 30 minutes depending on the instrument design and construction materials.

Interpreting Readings

On most (but not all) digital readout instruments, an alarm sounds to indicate high levels of any of the following:

- Flammable vapors
- Hydrogen sulfide (if sensor fitted)
- Oxygen
- Carbon monoxide (if sensor fitted)

An alarm should also sound for a low oxygen level on digital readout instruments.

When an alarm sounds, anyone in the work area must immediately stop all work and move to a safe area and the reason for the alarm must be determined.

The following steps should be used if follow-up gas test differs significantly (increase of more than 5% LFL/LEL or change in oxygen of more than 2%) from previous test results:

Step	Action
1	If follow-up tests differ significantly from the initial tests, assess the situation and determine if work should be stopped immediately and the area evacuated. (Any unexplained significant increase in LFL/LEL levels should result in an immediate stop work and evacuation to a safe area until the reason for the increased levels is determined).
2	Increase the frequency of follow-up readings.
3	If readings do not return to the original levels, stop the job until it is safe to continue.

Documentation Requirements

When performing gas tests, results shall be recorded on the relevant documents in accordance with the JO Permit to Work, JO Hot Work and JO Confined Space Entry Standards.

Where continuous tests for Confined Space Entry are undertaken, relevant records must be recorded at a regular frequency as defined in the Confined Space Entry JOSOP Standard.

Record sheets shall be maintained for the following periods:

- Daily Response Check Sheets – one year or retained with the relevant work permit in event of a recordable incident.
- Monthly Calibration Sheets – one year
- Manufacture’s Calibration record – until it expires, or a new manufacturer’s calibration record is issued, whichever is sooner.

Detector Tubes

Detector tubes, also called “colorimetric tubes”, are another method to detect chemical vapours where a gas detection instrument is unable to detect a particular vapour of concern, or an instrument with the relevant sensors is not available.

Detector tubes may be used to test for the presence and concentration of specific toxic constituents present in hydrocarbon vapours (e.g. benzene, total hydrocarbons), or for other chemicals-of-concern.

Detector tubes are only suitable for taking ‘spot’ samples and are not suitable where continuous monitoring of the chemical is required. Care must be taken when selecting detector tubes to ensure tubes with the correct detection range are selected, e.g. benzene tubes with a detection range of 20 – 100 ppm would not be suitable if trying to detect if more than 1ppm benzene is present.

Detector tubes are used with a squeeze-type or pull-type hand pump for measuring toxic gases such as:

- Aromatics
- Benzene
- Carbon monoxide
- Light hydrocarbons
- Hydrogen Sulfide

Qualified Gas Testers using detector tubes to sample shall be trained and assessed competent in understanding the correct use and care of the detector tube sampling equipment they will use.

Detector tubes should be used in accordance with the manufacturer’s instructions.

In general terms, they operate according to the following procedure:

Step	Action
1	A chemical reagent is housed in a closed glass tube.
2	Clip off both ends of the glass tube.
3	Insert one end of the tube into the hand pump (ensure tube is orientated correctly i.e. correct direction of flow).
4	Squeeze the hand pump (or pull the sample pump) a specified number of strokes as defined by the manufacturer’s instructions.
5	The reagent inside the detector tube reacts by changing color when brought into contact with the specific gas or vapor for which the tube was selected.
6	Wait for the defined period of time, as per manufacturer’s instructions, and determine the concentration of the substance directly from a scale printed on the glass tube (typically in parts per million – ppm).
7	Ensure that you take sufficient samples to adequately characterize conditions within the area being tested.

Detector tube sampling pumps should be leak tested by inserting a sealed tube (ends not broken off) and pull a vacuum to test the seal.

Detector tubes should be stored in accordance with the manufacturer’s recommendations and stored below 25°C (75°F).

Detector tubes should only be used with the equipment they were designed for. Tubes from a different manufacturer are not normally interchangeable between different tube sampling pumps.

Detector tubes have expiration dates beyond which they do not give reliable readings. Expired tubes should be discarded in a safe manner.

5.5 Responsibilities of the Qualified Gas Tester

- Be familiar with the instrument they are using, and the instrument handbook.
- Check the testing equipment before each use
- Conduct Necessary Tests, as required, in accordance with this standard. Test requirements may be identified as part of the permit issuing process, Job Safety Analysis requirements, or from other business needs.

6.0 Records

6.1 Required Records

The following records will be kept:

- Copies of permits, certificates and associated documentation shall be maintained in accordance with the JO Permit to Work Standard.
- Daily Response Check Sheets (refer Appendix A)
- Monthly Calibration Sheets (refer Appendix B)
- Manufacture's Calibration certificate

Electronic computer based equivalents are acceptable alternatives to the above, provided they are readily accessible to relevant personnel to ensure the necessary checks and calibrations have been completed.

6.2 Retention Requirements

Documentation shall be retained as required by local regulation, JO policy or for a minimum of six months, whichever is greater.

Records shall be retained for the periods as specified below:

- Daily Response Check Sheets – one year or retained with the relevant work permit in event of a recordable incident
- Monthly Calibration Sheets – one year
- Manufacture's Calibration record – until it expires, or a new manufacturer's calibration record is issued, whichever is sooner

7.0 References

The following is a complete list of the documents referenced by this standard:

Table 1. Document List

Title	File Name
Joint Operations – Permit to Work Standard	JO_MSW_PermittoWorkStandard.doc
Joint Operations – Isolation of Hazardous Energy Standard	JO_MSW_IsolationofHazardousEnergyStandard.doc

Joint Operations –Training Requirements Tool	JO_MSW_TrainingRequirementsTool.doc

8.0 Other Guidance Documents

Table 2. Document List

Title	File / Link Name

9.0 Document Control

Table 1: Document Control Information

Description	GU Common	SBU-Specific
Approval Date	NA	Sept 16 2009
Next Revision Due	NA	Sept 16 2012
Control Number		

Table 2: Document History

Version Number	Date	Notes
1.0	September 16 2009	Initial Release
1.0.1	Oct 05 2009	JO Version
1.0.2	April 13 2010	Add Multi Gas Settings (Appendix D)



Appendix A: JO Daily Response Check Sheet

Daily Response Check Sheet

Detector Model: _____ Detector Serial #: _____

Manufacture's Last Calibration Date: _____

DO NOT USE ANY TESTING EQUIPMENT WITHOUT VERIFYING CALIBRATION.

1. ZERO THE INSTRUMENT IN FRESH AIR
2. CHECK BATTERY.
3. CHECK INTERNAL PUMP (If Fitted).
4. EMPTY AND CLEAN LINE TRAP (If Fitted).
5. VERIFY CALIBRATION O₂ METER AT 20.8% or 20.9%
6. VERIFY COMBUSTIBLE METER ZERO.
7. VERIFY H₂S METER (If Fitted).
8. RESPONSE TEST COMBUSTIBLE METER WITH TEST GAS. (Ensure reading within target range)
9. CHECK ALARM(S) (If Fitted).
10. CHECK LIGHT (If Fitted).
11. RESPONSE CHECK H₂S METER WITH TEST GAS (If Fitted and H₂S Test is required)
12. RECORD SIGNATURE (INITIALS) IN RESPONSE CHECK TABLE BELOW

NOTE: Testing equipment that fails any check must be immediately taken out of service. Affix a "Danger – Do Not Operate" tag, and contact the Manufacturer's Representative to arrange equipment service.

Year: 20.....		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DAY	1												
	2												
	3												
	4												
	5												
	6												
	7												
	8												
	9												
	10												
	11												
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Appendix B: Monthly Field Calibration Sheet

Monthly Field Calibration Sheet
(to be retained with the gas detector instrument)

Detector Model: _____ Detector Serial #: _____

Manufacture’s Last Calibration Date: _____

Response Gases & Target Range (blanks to be completed from details in instruments instruction manual)

Calibration	Test Gas	Optimum (target) Reading	Acceptable Range
Oxygen			
Combustible (LFL/LEL)			
H ₂ S			
CO			
Other (specify)			

INSTRUCTIONS

This field test is to be conducted on a monthly basis by the designed person responsible for the gas detection equipment. Each of the following steps is to be performed and results recorded in the table below.

1. Zero in fresh air.
2. Check battery.
3. Check internal pump operation (if fitted).
4. Empty and clean line trap (if fitted).
5. Verify calibration of oxygen (O₂) meter at 20.8% or 20.9% (adjust if necessary) in fresh air
6. Verify combustible meter zero (adjust if necessary).
7. Zero H₂S meter (if fitted).
8. Calibrate combustible meter with test gas (adjust if necessary – record amount of adjustment).
9. Check alarm(s) (if fitted).
10. Check light (if fitted).
11. Calibrate H₂S meter with test gas (adjust if necessary – record amount of adjustment).
12. Calibrate other sensor(s) with test gas (es) if fitted (adjust if necessary – record amount of adjustment).
13. Check sampling probe when fitted to ensure that there is no infiltration of air that would dilute the sample.
14. Record all final calibrated meter readings, amount of any adjustments, and sign off field calibration.

Year: 20.....	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oxygen												
Initial Reading												
Adjustment												
Final Reading												
Combustible												
Initial Reading												
Adjustment												
Final Reading												
H₂S												
Initial Reading												
Adjustment												
Final Reading												
CO												
Initial Reading												
Adjustment												
Final Reading												
Other												
Initial Reading												
Adjustment												
Final Reading												
Signature (initials):												

NOTE: Testing equipment that fails any check must be immediately taken out of service. Affix a “Danger – Do Not Operate” tag and contact the Company Representative to arrange equipment service.

Appendix C: Sample Test Procedures

The following are some samples of typical test procedures that may be undertaken when gas sampling. These samples are provided as guidelines only and do not replace the need for the Qualified Gas Tester and permit approver to assess each situation and determine the most appropriate tests and test methodology to be used.

Follow these steps for hot work gas testing:

Procedure for hot work testing

Step	Action
1	Prior to testing, cover all sewers and drains within 15 meters (50 ft).
2	Prior to testing, either: <ul style="list-style-type: none"> • Cover vents (ensure sufficient safeguards for pressure/vacuum relief if tank vents are covered) • Pipe vents to a safe area as appropriate
3	Gas test all of the following locations within 15 meters (50 ft) of where hot work will take place: <ul style="list-style-type: none"> • Drains • Vents • Low spots • Flange joints • Valve stems • Sumps • Suspect excavations or trenches
4	Gas test at grade level in the immediate vicinity where the hot work is to be performed

NOTE: as some oils have high flash points the gas testing instrument may not give a reading, however if there is residue there is the potential for hot work (such as welding) to raise the temperature above the auto-ignition temperature of the product and a fire or explosion will result.

Follow these steps when performing gas tests for entry:

**Procedure
for entry
testing**

Step	Action
1	Consider all spaces being tested for entry as “hazardous” confined spaces until tests indicate otherwise.
2	If using an instrument without a built in oxygen sensor ensure the environment contains sufficient oxygen for the LFL/LEL sensor to function correctly.
3	Test from outside the opening first. Then test as far inside as possible without physically going inside the space.
4	When entering the space to test, the following requirements must be met: <ul style="list-style-type: none"> • The person entering must wear supplied air respiratory protection or SCBA and a harness attached to a lifeline • A standby wearing SCBA and ready to don the mask must stand outside the space • The standby must maintain in contact with the tester at all times
5	Test all areas, giving special attention to all of the following: <ul style="list-style-type: none"> • Low spots • Sumps • Pockets where vapors can accumulate • Suspect excavations or trenches
6	Test all the following apparatus (as fitted): <ul style="list-style-type: none"> • Coils • Pipes • At drains and water draws • Floating suction swivels
7	Test any crack or opening in a tank bottom.
8	Test as high up as possible, including around the edges of floating roof seals and around pontoons where a floating roof is fitted. If possible, test within the pontoon itself.
9	If tests show an oxygen deficiency or unsafe levels of flammable or toxic vapors, do the following: <ul style="list-style-type: none"> • Stop the tests • Leave the confined space • Ventilate the space until subsequent tests indicate that the atmosphere inside is safe
10	If a space cannot be ventilated sufficiently it must remain a “hazardous” confined space with no allowable entry, see Appendix D.

NOTE 1: Although a confined space may show acceptable levels for oxygen and flammables (% LFL/LEF) for entry using a Combustible Gas Indicator and/or Oxygen Monitor it could still be toxic. If the instrument is unable to determine toxicity levels for the chemical-of-concern then additional equipment must be used. An example is colorimetric tubes for benzene or total hydrocarbons.

NOTE 2: Care must be taken when using a Combustible Gas Indicator as many do not function correctly if the oxygen level is below 15%.

Appendix D: JO Multi Gas Monitor Settings

	Low Alarm	High Alarm	TWA 8 Hours	STEL 15 Mins
H₂S	10	15	10	15
CO	25	200	35	200
O₂	19.5	23	N/A	N/A
% LEL	10%	20%	N/A	N/A

Appendix E: Testing, Acceptable Limits for Confined Space

Level of Entry ⇒	Safe to Enter	Respiratory Protection Required		No Entry Allowed	Comments
Contaminant ↓		Chemical Cartridge/Canister	SCBA or Airline		
Oxygen	19.5 to 23%	Not Allowed	16.5 ≤ 19.5	<16.5%	
LEL * <u>1</u>	0%	N.A.	≤10%	> 10%	
H ₂ S	≤ 5 ppm	Not Allowed	5-100 ppm	>100 ppm	
Benzene	≤ 0 ppm	Greater than 0 to 5 ppm	≥6 ppm	N.A.	Skin protection required to prevent contact
Toluene	≤ 50 ppm	51 to 250 ppm	>251 ppm	N.A.	Skin protection required to prevent contact. Use chemical goggles or full face piece for eye protection.
Xylene	≤ 100 ppm	>101 to 300 ppm	>301 ppm	N.A.	Skin protection required to prevent contact. Use chemical goggles or full face piece for eye protection.
Hydrocarbons	≤ 150 ppm	>150 - 1000 ppm	>1000 ppm (2% LEL)	> 10% LEL * <u>2</u>	Skin protection required to prevent contact
Carbon Monoxide	≤ 25 ppm	Not Allowed	>26 - 400 ppm	> 400	
Sulfur Dioxide	≤ 2 ppm	>2 to 20 ppm	21-100	≥100 ppm	Skin protection required to prevent contact. Use chemical goggles or full face piece for eye protection.
Ammonia	≤ 25 ppm	>25 to <300 ppm	≥300	N.A.	Skin protection required to prevent contact. Use chemical goggles or full face piece for eye protection.
Chlorine	0	Not Allowed	>0 to 9 ppm	≥10 ppm	Skin protection required to prevent contact. Use chemical goggles or full face piece for eye protection.

ppm: parts per million

Entry into a space where the temperature is:

- Greater than 27° C (> 80° F) requires heat stress monitoring
- Greater than 32° C (> 90° F) requires medical monitoring and control
- *1: Hot work is not allowed inside a confined space unless there is a zero percent LEL reading in the space.
- *2: No entry allowed if LEL is greater than 10 percent (> 10%).
- Although the table shows that it is safe to enter an atmosphere that registers between 19.5 and 23 percent oxygen, it must be determined why the oxygen levels are changing from the normal percentage of oxygen in the air (20.9 percent).
- Inert atmosphere entry by specialist contractors may be permitted outside the ranges shown in the oxygen and LEL rows.