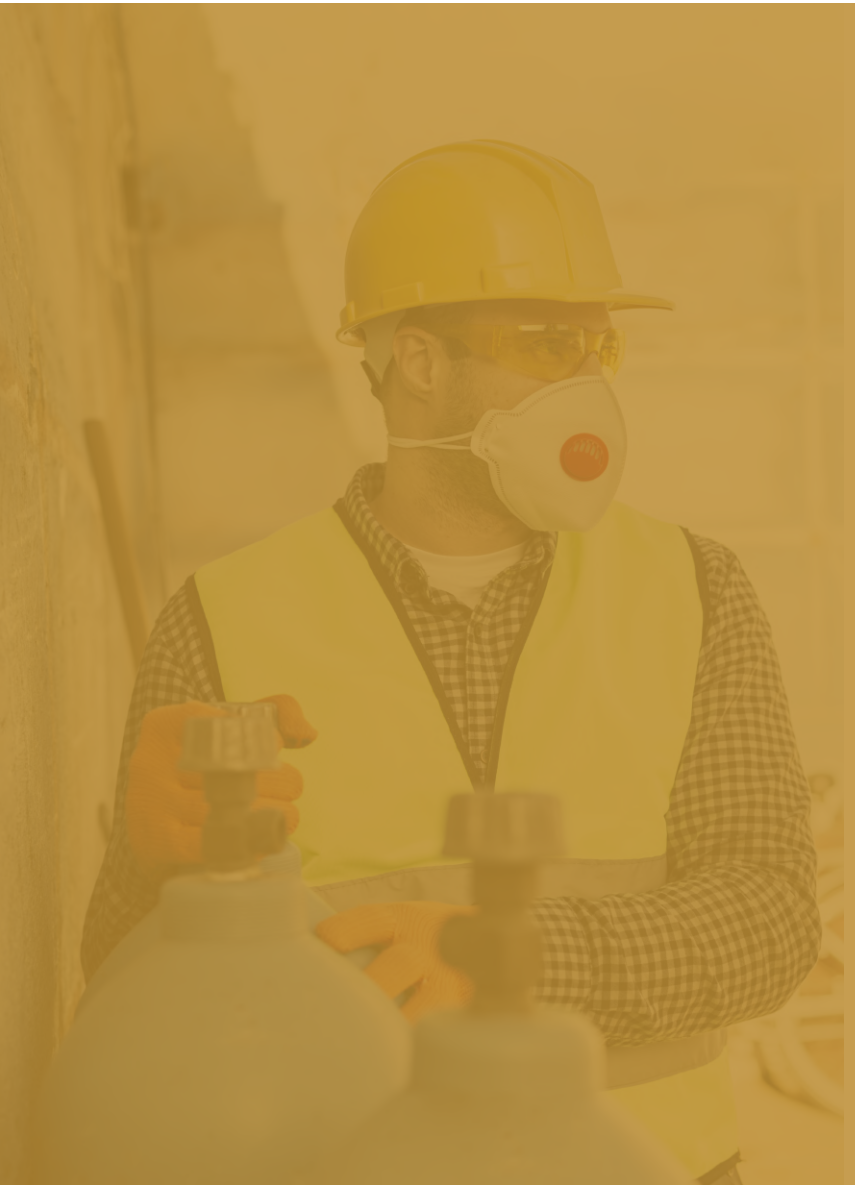
NCMT
المركز الوطني للإدارة والتدريب
National Centre for Management & Training



AUTHORIZED GAS TESTER (AGT)

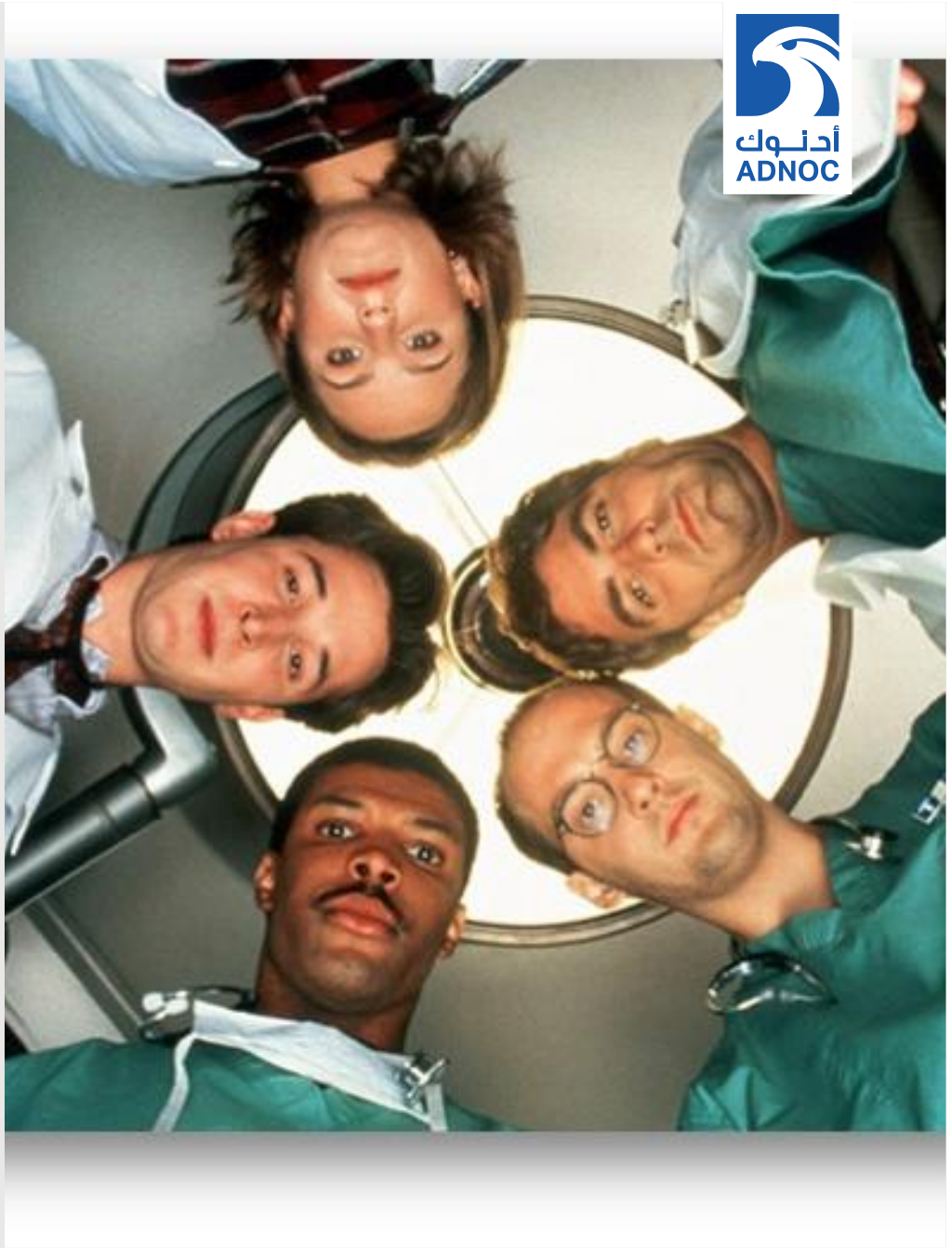
Course Material

EMERGENCY PROCEDURES

Be Aware

Emergency Exits

Fire Alarm



INTRODUCTION

LET'S GET TO KNOW EACH OTHER…

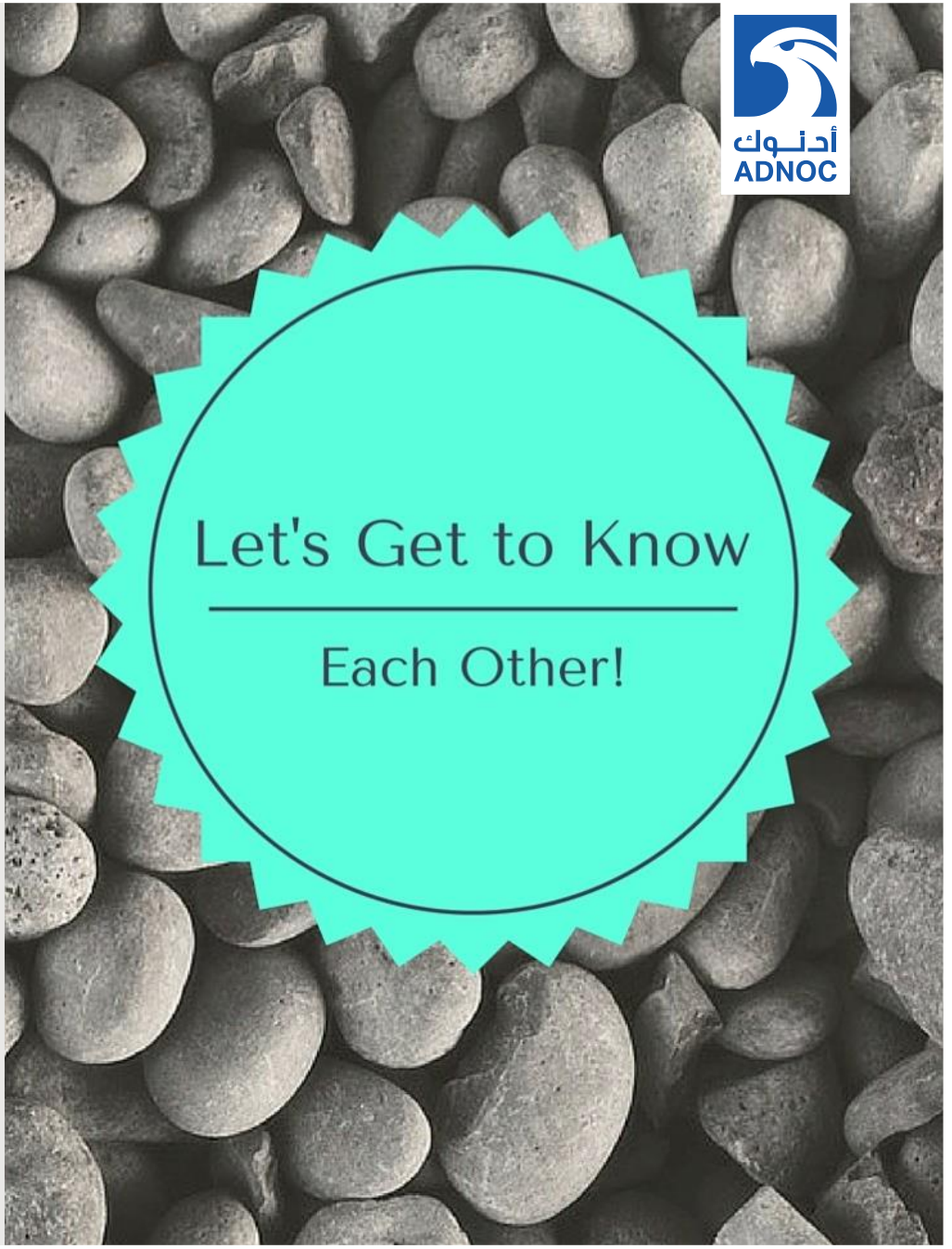
Would you kindly tell us your:

Name

Job

Experience

Experience of CSE



COURSE RULES

Mobile Phone usage

(please be courteous)

Breaks

Prayers

Participation

No Smoking

Toilets

ADNOC UNIFIED HSE POLICY

Embedding a 100% HSE culture that empowers employees and contractors to intervene and stop any unsafe work

ADNOC GROUP
HEALTH, SAFETY & ENVIRONMENT (HSE) POLICY

The Abu Dhabi National Oil Company (ADNOC) and its Group of Companies (together the ADNOC Group) are committed to the highest standards of HSE excellence by protecting our people, communities and the environment; ensuring effective security and business continuity measures; and following sustainable business practices.

The ADNOC Group is committed to:

1 Pursuing the goal of no harm to people and the community.
2 Protecting the environment and supporting the UAE's commitment to address the global challenge of climate change.
3 Implementing cost-effective measures to improve energy efficiency and promote the use of renewable energy.
4 Ensuring compliance with all applicable laws, regulations, policies and procedures relating to HSE.
5 Having world-class emergency response, crisis management and business continuity measures in place.
6 Managing risks through effective controls and minimizing impacts to our businesses.
7 Focusing on incident prevention by managing process safety and the integrity of our assets.
8 Promoting sustainability, corporate social responsibility and the welfare of our workforce.
9 Embedding a 100% HSE culture that empowers employees and contractors to intervene and stop any unsafe work.
10 Developing and sustaining HSE critical competencies in our employees.
11 Holding all levels of management, supervisors, and employees accountable for HSE performance.
12 Setting targets for HSE performance and continuous improvement.
13 Engaging business partners who are also committed to 100% HSE.

The ADNOC Group will implement this Policy through a comprehensive HSE management system.

مجموعة أدنوك
سياسة الصحة والسلامة والبيئة

تلتزم شركة بترول أبوظبي الوطنية (أدنوك) ومجموعة شركاتها (مجموعة أدنوك) بتحقيق أعلى المعايير العالمية للتميز في الأداء في مجالات الصحة والسلامة والبيئة وذلك من خلال حماية الموظفين والمجتمعات والبيئة، كما تلتزم باتخاذ تدابير فعالة تضمن الأمن واستمرارية الأعمال واتباع ممارسات مستدامة لمزاولة أعمالها وأنشطاتها.

تلتزم مجموعة أدنوك بما يلي:

1 السعي لتحقيق هدف عدم إلحاق الأذى بالأفراد والمجتمع.
2 حماية البيئة ودعم التزام دولة الإمارات العربية المتحدة بالتصدي لظاهرة التغير المناخي التي تواجه العالم.
3 تطبيق تدابير فعالة من حيث التكلفة لتحسين كفاءة الطاقة وتشجيع التوسع في استخدام الطاقة المتجددة.
4 الامتثال للقوانين واللوائح والسياسات والإجراءات المطبقة ذات الصلة بالصحة والسلامة والبيئة.
5 تبني خطة ذات معايير عالمية للاستجابة لحالات الطوارئ وإدارة الأزمات واستمرارية الأعمال.
6 إدارة كافة المخاطر من خلال منهجية تعتمد على تطبيق تدابير فعالة تحد من تأثيرات تلك المخاطر على العمليات.
7 التركيز على منع وقوع الحوادث من خلال إدارة إجراءات السلامة وحماية الأصول.
8 تعزيز الاستدامة والمسؤولية المجتمعية ورعاية كوادرنا.
9 ترسيخ ثقافة الصحة والسلامة والبيئة (100%) لتمكين كافة الموظفين والمقاولين المتعاملين معنا من التدخل لمنع أي أعمال تشكل خطراً على السلامة.
10 التطوير والمحافظة على القدرات الأساسية في مجال الصحة والسلامة والبيئة لدى موظفينا.
11 عدم التهاون في محاسبة المسؤولين والمشرفين والموظفين في كافة المستويات على أدائهم في مجالات الصحة والسلامة والبيئة.
12 وضع أهداف للأداء في مجالات الصحة والسلامة والبيئة والعمل على تطويره بصورة مستمرة.
13 التعاون مع شركاء الأعمال الذين التزموا بميثاق 100% صحة وسلامة وبيئة.

ستقوم مجموعة أدنوك بتطبيق هذه السياسة من خلال نظام شامل لإدارة الصحة والسلامة والبيئة.

د. سلطان أحمد الجابر، الرئيس التنفيذي لمجموعة أدنوك
Dr. Sultan Ahmed Al Jaber, ADNOC Group Chief Executive Officer

April 2018

AUTHORIZED GAS TESTING (AGT)

HSEMS STANDARDS

- **ADNOC Confined Space Standard (HSE-OS-ST08)**
- **ADNOC Permit to Work Standard (HSE-OS-ST02)**
- **ADNOC Management of Hydrogen Sulfide (H2S Standard) (HSE-OS-ST21)**

KEY CONTENTS

- Life Saving Rules
- Introduction, Case Study and Gas Test History
- Hazardous Atmosphere
- Oxygen Deficiency/Enrichment
- Flammable & Explosive Gases
- Toxic Gases
- Gas Test Practices – Record Form
- Terminology and Definitions
- Relative Density & Gas Dispersion
- Gas Testing locations and Practices
- Authorised Gas Test (AGT) & Area Authority (AA) Responsibilities Within Safe System of Work
- Gas Monitoring (Fixed/Portable/Personal)
- Bump Test and Calibration
- BW – Gas Alert Micro 5
- Assessment


LIFE-SAVING RULES
WORK AUTHORIZATION
Work with a valid permit when required
SAFE MECHANICAL LIFTING
Plan lifting operations and control the area
CONFINED SPACE
Obtain authorization before entering a confined space
TOXIC GAS
Follow the rules for working in toxic gas environments
ENERGY ISOLATION
Verify isolation and zero energy before work begins
DRIVING
Follow safe driving rules
BYPASSING SAFETY CONTROLS
Obtain authorization before overriding or disabling safety controls
LINE OF FIRE
Keep yourself and others out of the line of fire
WORKING AT HEIGHT
Protect yourself against a fall when working at height
HOT WORK
Control flammables and ignition sources
ADNOC
100% HSE
This is THE ADNOC WAY

LIFE SAVING RULES (LSRS)

AUTHORIZED GAS TESTING (AGT)

LIFE SAVING RULES (LSRS)

	Work Authorization		Driving
	Safe Mechanical Lifting		Bypassing Safety Controls
	Confined Space		Line of Fire
	Toxic Gas		Working at Height
	Energy Isolation		Hot Work

AUTHORIZED GAS TESTING (AGT)

WORK AUTHORIZATION

WORK WITH A VALID WORK PERMIT WHEN REQUIRED

- I have confirmed if a permit is required
- I am authorized to perform the work
- I understand the permit
- I have confirmed that hazards are controlled and it is safe to start
- I stop and reassess if conditions change

Section 7.9 in the Standard shall be referred for Work Authorization

CONFINED SPACE

OBTAIN AUTHORIZATION BEFORE ENTERING A CONFINED SPACE

- I confirm energy sources are isolated
- I confirm the atmosphere has been tested and monitored
- I check and use my breathing apparatus when required
- I confirm there is an attendant standing by
- I confirm rescue plan is in place
- I obtain authorization to enter

Section 7.2 in the Standard shall be referred for the Confined Space

TOXIC GAS

FOLLOW THE RULES FOR WORKING IN TOXIC GAS ENVIRONMENTS

- I follow safety precautions before entering toxic gas environments
- I inspect my gas detector and respiratory protection equipment before use
- I stay alert and prepare myself for emergency evacuation
- I take action whenever toxic gas protection control barriers are compromised

Section 7.8 in the Standard shall be referred for Toxic Gas

LIFE SAVING RULE VIOLATION: TOXIC GAS

Case#1	
Title of Incident	Exposure to Toxic Gas
Date	03rd February 2009 at 07:35 hrs.
Location	Corrosion Coupon Pit (Near Sha-1 Station) on Shah-Asab transfer line (Mile-58)
Severity	Three Fatalities and One Serious Injury
Life Saving Rules (LSRs) Requirements Violated	• Crew member entered inside the pit without obtaining valid Permit to Work (PTW) **"Work Authorization: I am authorized to Perform the Work"** • Crew entered without **confirming that atmosphere has been tested and monitored (Confined Space entry requirement)** • **Safety Precautions were not followed before entering toxic gas environments (Toxic Gas requirement)**

EXPOSURE TO TOXIC GAS IN SHAH FIELD

What happened:

On 3rd February 2009 at 07:35 hrs, Four employees in Shah Field were exposed to H2S while draining a transfer line inside a corrosion coupon pit. The pit was approximately 12 feet deep (confined space).
Three fatalities and one serious injury occurred from this incident. The injured person was air evacuated to hospital where he was treated, recovered and subsequently discharged from the hospital.

Why it happened:

- Violation of Procedure (PTW & Confined Space Entry Certificate).
- Breathing apparatus was not used and personal H2S detector was switched
- off. Exposure to lethal concentration of H2S in confined space.
- Inadequate identification of job hazards.
- Inadequate reinforcement of procedures.
- Inadequate Identification of Training Needs.
- Inadequate reinforcement of critical safe behavior.
- Inadequate Guards &Warning Systems.

Lessons Learnt:

- Provide personal H2S detectors to all personnel including laborers/helpers working in H2S exposed areas.
- Ensure all helper/laborers are fully trained for performing their assigned tasks.
- Establish Access Control on all confined spaces with effective markings, signs & tagging; and locking, where applicable.
- Ensure PTW is issued based on task risk assessment (TRA) and the high risk TRA has been endorsed by a safety professional (Safety & Loss Prevention Engineer (SLPE) as minimum).
- Confined space entries cannot be made unless a SLPE has signed off the Confined Space Entry Certificate and he has reviewed the emergency plan
- Include practical element (step test) and confined space entry in H2S/BA training course and for all operation/ production and HSE staff.
- Empower laborers/workers to STOP unsafe activities and initiate contractual arrangements to protect/encourage individuals exercising ADCO STOP Policy.

HOT WORK

CONTROL FLAMMABLES AND IGNITION SOURCES

- I identify and control ignition sources
- Before starting any hot work:
  - I confirm flammable material has been removed or isolated
  - I obtain authorization
- Before starting hot work in a hazardous area, I confirm:
  - A gas test has been completed
  - Gas will be monitored continually

Section 7.5 in the Standard shall be referred for Hot Work

LIFE SAVING RULE VIOLATION “HOT WORK”

Case#1	
Title of Incident	Rumaitha CPP Fire Incident
Date	20th August 2016 at 14:21 hrs.
Location	Rumaitha CPP Heating Medium Area
Severity	Major damage to the Plant equipment, piping and structure
Life Saving Rules (LSRs) Requirements Violated	Flammable sources were not controlled

RUMAITHA CPP FIRE INCIDENT

What Happened :

On 20th August 2016, oily water leak was observed from a Glass Reinforced Epoxy (GRE) pipe joint connected to the oil inlet of the 2nd stage desalter in Rumaitha CPP. While the GRE contractor was collecting information in preparation for repair, they heard a noise and observed that the GRE line ruptured from the joint. Subsequently, hot crude oil (600C) splashed over the GRE team members (3 people), which resulted in first degree burns to one of them. On hearing the sound they evacuated the site immediately. The released hydrocarbon near the pipe rack caught fire spontaneously. Fire and Gas Detectors in the heating medium area activated the Emergency shutdown (ESD-1), resulting in automatic total plant shutdown. Desalter' deluge system activated automatically. Deluge system for the stabilization column was activated manually. Plant was depressurized manually by activating blowdown system (ESD-0). Entire Plant was evacuated and emergency teams were mobilized.

Why It Happened:

- No provision of NRV on the GRE line that is connected to the oil inlet line to prevent reverse flow.
- Poor workmanship has resulted in wrong installation of backing ring on the GRE stub joint.
- Operations manually increased the flow across the leaking GRE flange. This has caused vibration on the GRE line resulting in the failure of flange.
- The decision to shut down was delayed by underestimating the potential consequences of the leak.

Lessons Learnt:

- Water leaks from the GRE line in hydrocarbon process facilities should not be considered as routine and the potential consequences of such leaks shall be assessed and control measures shall be initiated immediately.
- Critical operations decisions shall be based on risk assessment and timely action to be taken.
- Design and constructability of GRE lines in hydrocarbon handling and processing facilities shall be reviewed considering the increased number of leaks due to GRE line failures.
- Review the existing operations pre-fire plans to cover all potential scenarios and conduct more frequent exercises accordingly to ensure effective preparedness and response.
- Headcount system in all ADCO locations shall be reviewed and strengthened.

INTRODUCTION

WHY GAS TEST?

Most times people seem to forget that the atmosphere is what's keeping us alive and if not sufficiently monitored can lead to catastrophic injuries, damaged assets, environmental pollution and fatalities. There have been abundant fatalities recorded from failures to detect gas and minimize its harmful effects.

Organizations would need to apply learned lessons to prevent gas releases by putting in place the right measures to detect gases and control them if a leak occurs to avoid any catastrophic event.

Gas testing is a very sensitive operation and should be conducted with extreme care, due to its importance of testing and checking the atmosphere's Air quality where our colleagues will enter and perform a task in areas where there is a potential health and flammable/explosive hazard.

LOSS OF CONTAINMENT RESULTING IN FATAL VEHICLE FIRE

Area	Incident Description	Root Causes
BUH 07.05.2011	After the normalization of Central Degassing Station (CDS) following an instrumentation failure induced Emergency Shut Down (EDS), operation teams were dispatched to the field to open closed-in wells. A fire was observed at Bu-407 flow line, approx. 200 m away from the well head and the well was isolated at the wellhead. A field services team (driver and four crew members) proceeded to RDS-3 to de-spade the Bu-407 drain line. Approx. 300 m from RDS3 on the main access (Gatch) track, there had leaked oil from Bu-570 flowline on the track. Upon crossing the oil pool, the oil and/or crude oil vapors ignited and the vehicle caught fire. **Outcome:** The vehicle fires resulted in four fatalities. One crew member escaped unhurt.	• **Inadequate Identification of Worksite/Job Hazards (** Risks associated with external corrosion of flowlines & inadequate corrosion inspection, flowline replacement and location of flowlines were not adequately assessed) • **Inadequate Job Placement** (Staff were not sufficiently familiar with maintenance of the ESD system and long time taken to resolve the ESD problem)

Lesson Learned

1. Revise flowline design specifications; and integrity assurance practices to consider flowline leaks as an "abnormal" occurrence.
2. Amend procedures & instructions such that night operation is considered as an abnormal and higher risk activity.
3. Review design philosophies and over pressure protection from the well head through RDSs all to the CDS in view of changing reservoir conditions, flowline aging and recent enhanced design practice
4. Review emergency response procedure to consider an ESD on the plant as an 'emergency' event.
5. Review specifications for coveralls with respect to fire resistance for both ADCO and contractor staff.

AUTHORISED GAS TESTER (AGT)

A Gas Tester authorized in writing by Asset Owner following satisfactory completion of formal training and assessment of competence to carry out atmospheric tests and interpret the results obtained in terms of flammability or toxicity.

Only Authorized Gas Tester (AGT) with valid certificates shall conduct the tests.

Personnel involved in atmospheric testing shall undergo a training and formal certification in the use of atmospheric testing equipment.

Only those who completed the training and declared competent shall be included in the list of Authorized Gas Tester.

AUTHORISED GAS TESTER (AGT)

Every Gas tester must have clear Idea on

What he is Testing,

Why he is Testing &

How to Test.

AGT must understand

- Risk from gases & vapors
- Their potential to cause Fire & explosion
- Effects of the on Human body
- How gases reacts
- Where to test the atmosphere to locate them
- Risk involved during testing

AUTHORISED GAS TESTER (AGT)

NEVER RUSH & PUT YOUR OWN LIFE IN RISK

- Plan the test
- Asses the Risk
- Consider what must be done to reduce the Risk as ALARP

Remember

The life of your colleagues depends on your readings.

NORMAL AIR COMPOSITION

NAME	SYMBOL	PERCENT BY VOLUME
Nitrogen	N2	78.084%
Oxygen	O2	20.9476%
Argon	Ar	0.934%
Carbon Dioxide	CO2	0.0314%
Neon	Ne	0.001818%
Methane	CH4	0.0002%
Helium	He	0.000524%
Krypton	Kr	0.000114%
Hydrogen	H2	0.00005%
Xenon	Xe	0.0000087%

The table gives the sea-level composition of air (in percent by volume at the temperature of 15° C and the pressure of 101325 Pa).

OPERATIONS BEING TESTED FOR FLAMMABLE AND TOXIC GASES

Types of Operations being tested includes but NOT limited to:

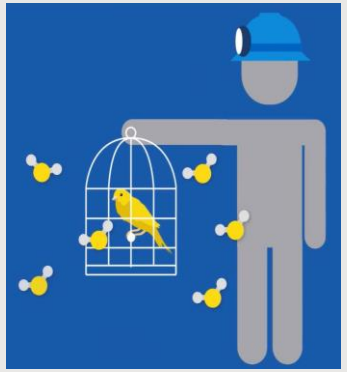
1. Entry into a confined space
2. Hot work to be carried out in hazardous area
3. Vehicle entry to hazardous area
4. Breaking containment
5. Gas leak

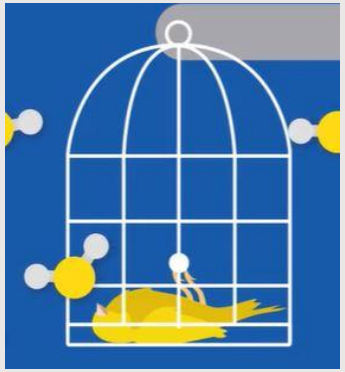
GAS TESTING HISTORY

Canary in cage.

Flame safety lamp

Catalytic combustion sensor





HAZARDOUS ATMOSPHERE

ABU DHABI NATIONAL OIL COMPANY

EX-OX-TOX DANGER

Basically there are three categories of risk

- Risk of explosion by flammable gases
- Oxygen (Risk of asphyxiation by oxygen displacement)

  Risk of increase of flammability by oxygen enrichment
- Risk of poisoning by toxic gases

Without auxiliary tools humans are not able to recognize these dangers early enough to initiate appropriate counter measures. With only some exceptions our nose has turned out to be an extremely unreliable warning instrument.

Even harmless gases such as argon, helium or nitrogen may become dangerous when the vitally important oxygen is displaced by a sudden release. Danger of suffocation!

OXYGEN DEFICIENCY-ENRICHMENT

The hazard in the atmosphere can vary from being toxic or oxygen deficient to being flammable or explosive. It is imperative to fully understand the difference between the hazards, what type of hazard can be present and the most likely situations to appear:

Oxygen Deficiency:

Risk of Suffocation, Oxygen can be consumed or displaced by another gas

Oxygen Enrichment

Risk of fire, High levels of O2 increase the flammability of material and gases – at levels such as 24%, items such as clothing can spontaneously combust!

OXYGEN DEFICIENCY-ENRICHMENT

Oxygen deficiency may be caused by the following:

1. Oxygen displacement by other gases and vapors, such as inert gases or by evaporating liquids.

2. Oxygen consumption through rusting metals (oxidation), combustion, respiratory consumption by workers, or organic decay of aqueous molasses or drying of paints

3. Oxygen absorption or adsorption, where molecules adhere to the surface of a solid body such as damp carbon.

OXYGEN - BETWEEN 19.5% - 23.5% IS ACCEPTABLE IN ADNOC STANDARDS

AN OXYGEN READING OF OVER 23.5% IS OXYGEN ENRICHED

AN OXYGEN READING OF UNDER 19.5% IS OXYGEN DEFICIENT

OXYGEN DEFICIENCY

CONCENTRATION LEVEL	EFFECTS
19.5%	Minimum Permissible Level
15-19%	Decreased Ability To Work Strenuously (hard)
12-14%	Increase In Pulse & Respiration
10-12%	Lips Blue. Further Respiration Increase
8-10%	Fainting, Mental Failure, Nausea & Vomiting
6-8%	8 Minutes -100% Fatal. 6 Minutes -50% Fatal, 4-5 Minutes - Recovery With Treatment
4-6%	Coma In 40 Seconds. Convulsions, Respiration Ceases-Death

Enhanced oxygen concentrations (e.g. more than 25 Vol%) cannot be sensed by people, but have severe consequences in respect to the flammability characteristics of materials, and may even cause auto-ignition. This is the reason why explosion protection measures are only related to the atmospheric oxygen concentration

FLAMABLE / EXPLOSIVE

Flammable/explosive atmospheres, which may be caused by the following:

1. Vaporization of flammable liquids
2. By-products of chemical reactions
3. Flammable gases
4. Elevated airborne concentrations of combustible dust
5. Gases from decomposition

Flammable & Explosive Gases - e.g. Methane, Butane, Propane - Risk of fire and/or explosion

Remember: It's not just gas that holds a potential threat – dust can also be explosive!

Examples of explosive dusts include polystyrene, cornstarch and iron.

FLAMABLE / EXPLOSIVE

Sources of Ignition

- Welding/ Cutting Torch
- Friction
- Grinding Sparks
- Hot Surfaces
- Static Charges
- Smoking
- Open Flame
- Using Mobile Phones
- Electrical Short or Arcing
- Pyrophoric Materials

EXPLOSIVE AND FLAMMABLE LIMITS

AUTHORIZED GAS TESTING (AGT)

CH4 (Methane)

Gas lean
will not burn

Gas rich
will not burn

0%
CH4

Explosive Range

100%CH4

5%Lower Explosive limit

15%Upper Explosive limit

EXPLOSIVE AND FLAMMABLE LIMITS

H_2S (Hydrogen Sulphide)

Do Not use flammability sensor to measure toxicity of H_2S.

Gas lean
will not burn

Gas rich
will not burn

0%
H2S

Explosive Range

100%H2S

4.3%Lower Explosive limit

(43,000 PPM)

46%Upper Explosive limit

(460,000 PPM)

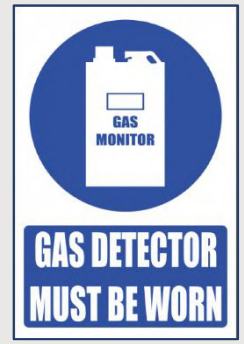
TOXIC GASES

Toxic Gases

Risk of Poisoning

e.g. Carbon Monoxide, Hydrogen Sulfide , SO2

(It should be noted that there is a large group of gases which are both combustible and toxic, so that even detectors of toxic gases sometimes have to carry hazardous area approval).



The main reason for treating flammable and toxic gases separately is that the hazards and regulations involved and the types of sensor required are different.

COMMON GASES

Common toxic gases in the oil and gas industry include:

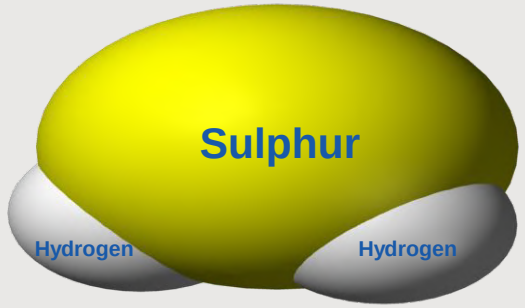
- Hydrogen Sulfide (H2S)
- Carbon Monoxide (CO)
- Oxygen Depletion (O2)
- Carbon Dioxide (CO2)
- Sulphur Dioxide (SO2)
- Ammonia (NH3)
- Benzene (C6H6)

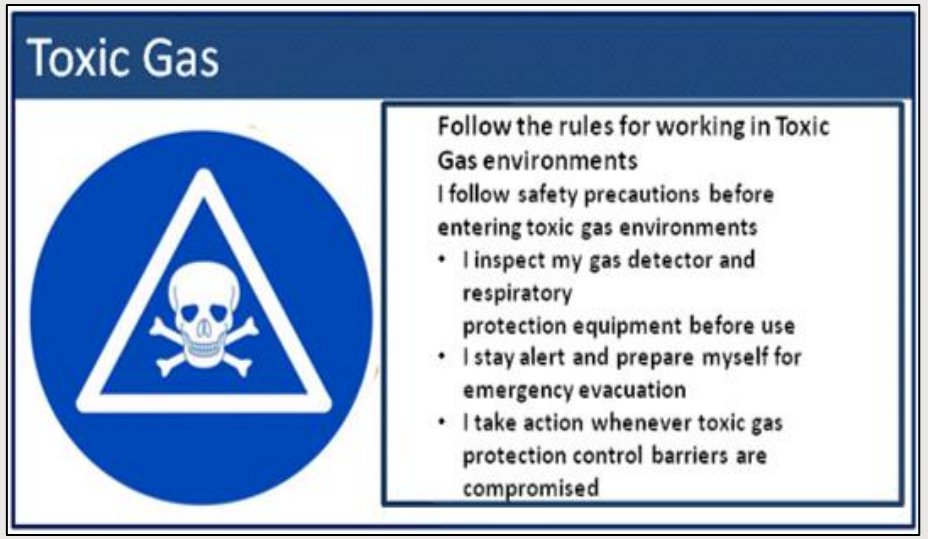
Some of these poisonous gases may be easily identifiable by an individual upon exposure while others are not. For instance, hydrogen sulfide has an odor similar to that of a rotten egg, whereas carbon monoxide is a colorless, odorless, and tasteless toxic gas. By the time a person may or may not realize they are in the presence of a toxic gas they may have already been exposed at a life-threatening level.

HYDROGEN SULPHIDE (H2S)

Extremely toxic, ranking second to Hydrogen Cyanide (HCN) and five (5) to six (6) times more toxic than Carbon Monoxide (CO)

- Colourless
- Smells like rotten eggs in low concentrations
- Heavier than air SC=1.189
- Readily disperses by the wind
- Highly corrosive to certain materials
- Soluble in both Water & Hydrocarbons
- Ignition temperature 260 deg. C
- Burns with a blue flame and produces SO_2





HYDROGEN SULPHIDE (H2S)

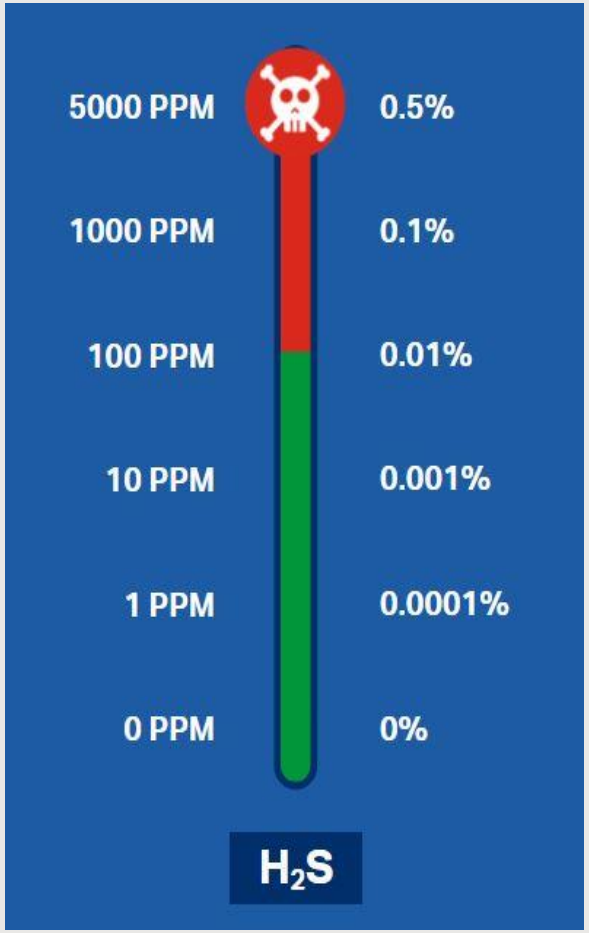
The oil \ gas industry is usually concerned with H_2S The presence of H2S in hydrocarbon is usually termed as sour crude.

H2S is a high toxic gas, if you detect its presence in concentrations exceeding Permissible Exposure Limit you must Evacuate the area, alert others and call for a gas test.

GAS PARTS PER MILLION (PPM)

- If a million parts of air by volume contains one part of H2S it is 1PPM H2S in air

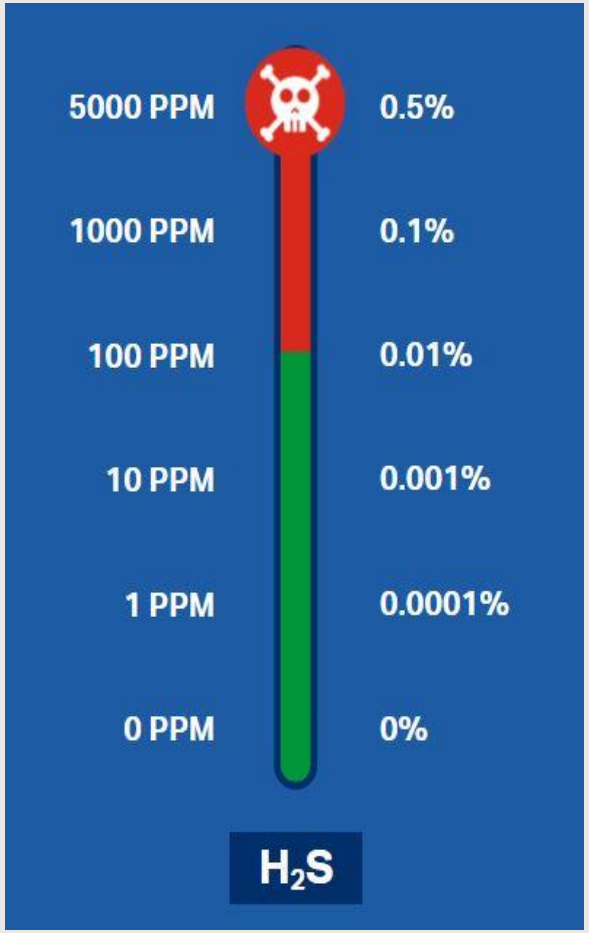
- 1PPM = 0.0001%
- **10 PPM = 0.001%**
- 100 PPM = 0.01%
- 1000 PPM = 0.1%
- 10,000 PPM = 1%



GAS PARTS PER MILLION (PPM)

- Change from PPM to volumetric percentage % and vice versa
  - 700 PPM = ? %
  - 9000 PPM = 0.9%
  - ? PPM = 4.3%
  - ? PPM = 27%

- 5% of LEL of H2S is safe or unsafe?



THE TOXICITY OF H2S GAS WAS RESPONSIBLE FOR

BUHASA, 11TH MAY 2002

Three men died in the back of a truck at GASCO's BuHasa plant.

ADGAS - Das Island, 22nd November 2008

One fatality

ADCO - Shah, 3rd February 2009

Three fatalities due to H2S release

CARBON MONOXIDE

Carbon Monoxide (CO) is colorless, odorless and a by-product of incomplete combustion.

CO is flammable and has an Lower Explosive Limit (LEL) of 12.5%.

CO is very toxic it can be absorbed 200-300 times faster than oxygen by the hemoglobin

CONCENTRATION LEVEL	EFFECTS
50 PPM	Permissible Exposure Level (8 Hours)
200 PPM	Slight Headache & Discomfort(3 Hours)
400 PPM	Headache & Discomfort (2 Hours)
1000-2000PPM	Confusion, Headache, Nausea (1/2 Hour)
2000-2500 PPM	Unconsciousness (1/2 Hour)
4000 PPM	Fatal less than 1 hour

AMMONIA

NH3 is colourless gas with a suffocating odour. NH3 is flammable with an LEL level of 15%. However it is difficult to burn. NH3 is extremely toxic.

Harmful Effects of Ammonia (NH3)

PPM	EFFECTS
0-25	Minor irritation of eyes and respiratory tract
25	Permissible exposure level TWA
35	Short Term Exposure Level (STEL)
50-100	Swelling of eye lids, vomiting, irritation of the throat
100-600	Very dangerous, potential deadly from prolonged exposure

ALARM LEVELS

TYPE OF ALARM	O2	LEL	H2S
Low Alarm	19.5%	5%	10 PPM
High Alarm	23.5%	10%	15 PPM

GAS TEST PRACTICES

ABU DHABI NATIONAL OIL COMPANY

ATMOSPHERIC TESTING

Atmospheric tests, where required by the permit, shall be carried out as appropriate to cover all activities within the designated area.

The atmospheric testing shall be carried out as close as possible to commencement of work.

The responsibility to determine the atmospheric testing requirements (location of tests, frequency, gases to be tested and other requirements as specified on the Atmospheric Test Record Form) shall lie with the Area Authority

DOCUMENTATION

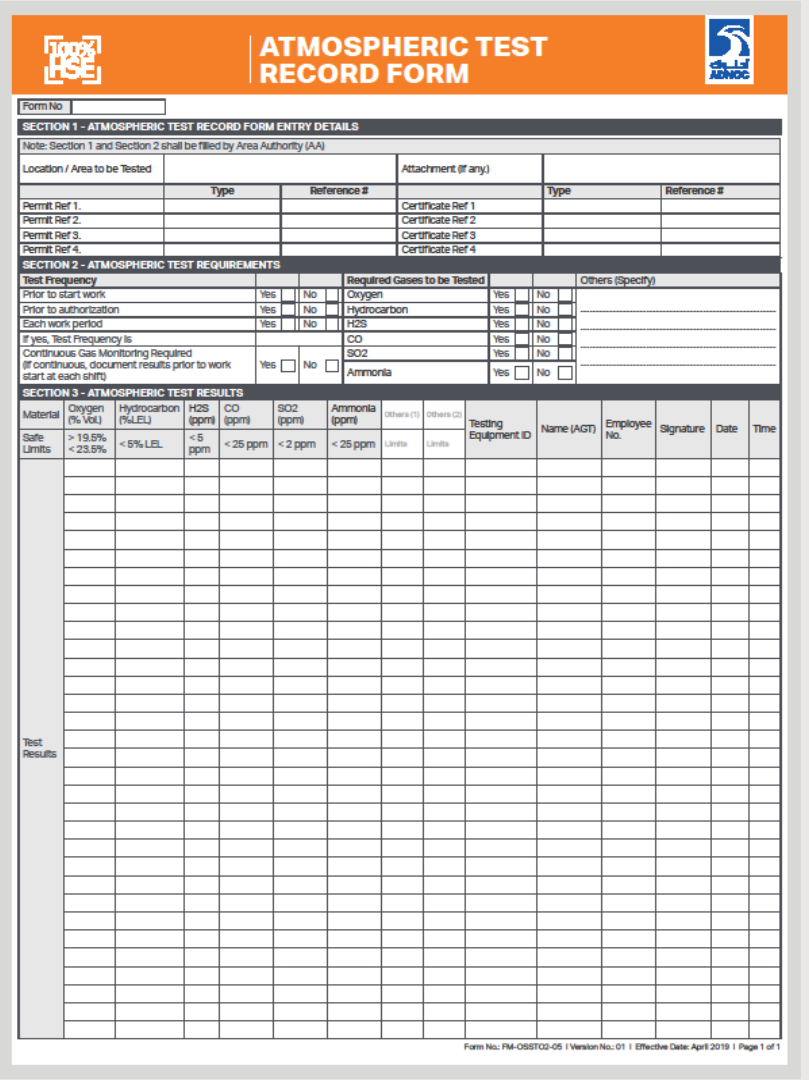
ATMOSPHERIC TEST RECORD FORM .
The ‘Atmospheric Test Record’ form is located on the reverse side of the permit form.

For continuation of test records, a new form can be attached to the permit pack.

Personnel involved in atmospheric testing shall undergo a training and formal certification in the use of atmospheric testing equipment.

Personnel must be aware of the existing standards for the relevant airborne contaminants and be able to interpret the results of the test.

Validity - Not applicable / Re-validation - Not applicable



ATMOSPHERIC TEST RECORD FORM

Form No

SECTION 1 - ATMOSPHERIC TEST RECORD FORM ENTRY DETAILS

Note: Section 1 and Section 2 shall be filled by Area Authority (AA)

Location / Area to be Tested			Attachment (if any)		
	Type	Reference #		Type	Reference #
Permit Ref 1.			Certificate Ref 1		
Permit Ref 2.			Certificate Ref 2		
Permit Ref 3.			Certificate Ref 3		
Permit Ref 4.			Certificate Ref 4		

SECTION 2 - ATMOSPHERIC TEST REQUIREMENTS

Test Frequency			Required Gases to be Tested			Others (Specify)
Prior to start work	Yes ☐	No ☐	Oxygen	Yes ☐	No ☐	
Prior to authorization	Yes ☐	No ☐	Hydrocarbon	Yes ☐	No ☐	
Each work period	Yes ☐	No ☐	H2S	Yes ☐	No ☐	
If yes, Test Frequency is			CO	Yes ☐	No ☐	
Continuous Gas Monitoring Required (If continuous, document results prior to work start at each shift)	Yes ☐	No ☐	SO2	Yes ☐	No ☐	
			Ammonia	Yes ☐	No ☐	

SECTION 3 - ATMOSPHERIC TEST RESULTS

Material	Oxygen (% Vol.)	Hydrocarbon (%LEL)	H2S (ppm)	CO (ppm)	SO2 (ppm)	Ammonia (ppm)	Others (1)	Others (2)	Testing Equipment ID	Name (AGT)	Employee No.	Signature	Date	Time
Safe Limits	> 19.5% < 23.5%	< 5% LEL	< 5 ppm	< 25 ppm	< 2 ppm	< 25 ppm	Limits	Limits						
Test Results														

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AUTHORIZED GAS TESTING (AGT)

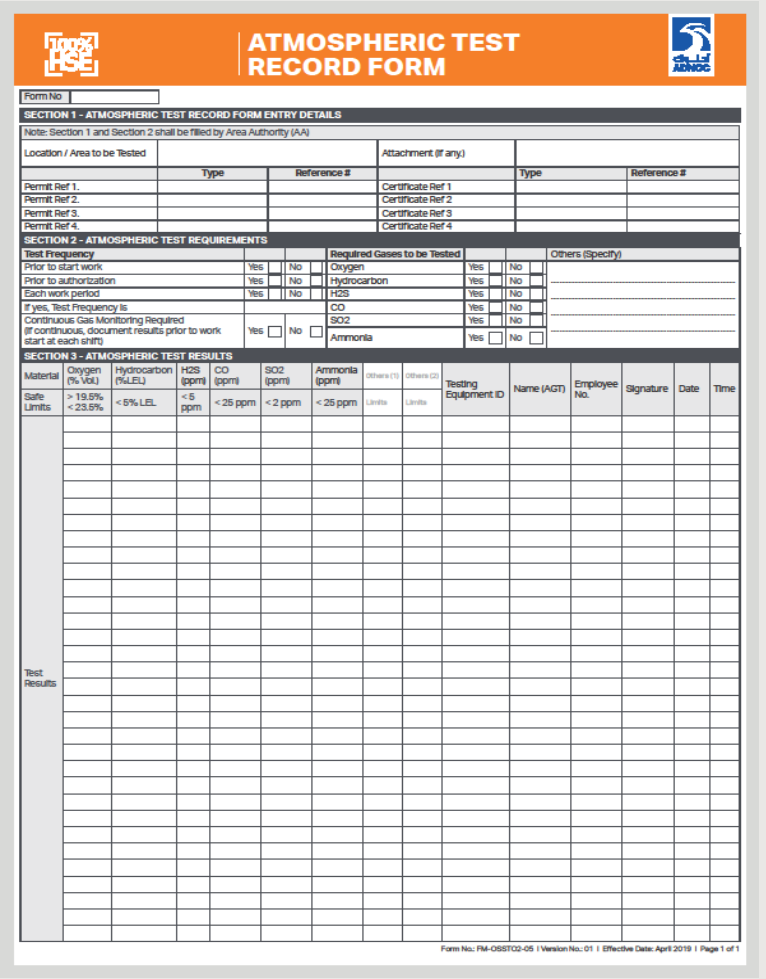
ATMOSPHERIC TEST RECORD FORM

Atmospheric Tests shall always be conducted by an Authorized Gas Tester (AGT) and results recorded on an Atmospheric Test Record Form.

Atmospheric test shall be considered as per the nature of the work basis the controls identified in the permit/certificates.

AGT must Communicate abnormal atmospheric test information to the AA.

Records must be kept-retained for minimum 12 months



ATMOSPHERIC TEST RECORD FORM

Form No

SECTION 1 - ATMOSPHERIC TEST RECORD FORM ENTRY DETAILS

Note: Section 1 and Section 2 shall be filled by Area Authority (AA)

Location / Area to be Tested			Attachment (if any)		
	Type	Reference #		Type	Reference #
Permit Ref 1.			Certificate Ref 1		
Permit Ref 2.			Certificate Ref 2		
Permit Ref 3.			Certificate Ref 3		
Permit Ref 4.			Certificate Ref 4		

SECTION 2 - ATMOSPHERIC TEST REQUIREMENTS

Test Frequency			Required Gases to be Tested			Others (Specify)
Prior to start work	Yes ☐	No ☐	Oxygen	Yes ☐	No ☐	
Prior to authorization	Yes ☐	No ☐	Hydrocarbon	Yes ☐	No ☐	
Each work period	Yes ☐	No ☐	H2S	Yes ☐	No ☐	
If yes, Test Frequency is			CO	Yes ☐	No ☐	
Continuous Gas Monitoring Required (If continuous, document results prior to work start at each shift)	Yes ☐	No ☐	SO2	Yes ☐	No ☐	
			Ammonia	Yes ☐	No ☐	

SECTION 3 - ATMOSPHERIC TEST RESULTS

Material	Oxygen (% Vol.)	Hydrocarbon (%LEL)	H2S (ppm)	CO (ppm)	SO2 (ppm)	Ammonia (ppm)	Others (1)	Others (2)	Testing Equipment ID	Name (AGT)	Employee No.	Signature	Date	Time
Safe Limits	> 19.5% < 23.5%	< 5% LEL	< 5 ppm	< 25 ppm	< 2 ppm	< 25 ppm	Limits	Limits						
Test Results														

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SECTION 1 – ATMOSPHERIC TEST RECORD FORM ENTRY DETAILS

ATMOSPHERIC TEST RECORD FORM

Form No	

SECTION 1 - ATMOSPHERIC TEST RECORD FORM ENTRY DETAILS

Note: Section 1 and Section 2 shall be filled by Area Authority (AA)					
Location / Area to be Tested			Attachment (if any.)		
	Type	Reference #		Type	Reference #
Permit Ref 1.			Certificate Ref 1		
Permit Ref 2.			Certificate Ref 2		
Permit Ref 3.			Certificate Ref 3		
Permit Ref 4.			Certificate Ref 4		

The Area Authority (AA) shall enter the following details on the Atmospheric Test Certificate:

1. Location / Area to be atmospheric tested;
2. Permit Work Title as stated on permit for which atmospheric test is required;
3. Details of associated certificates i.e. Confined Space Entry, Isolations, etc.

SECTION 2 – ATMOSPHERIC TEST RECORD FORM ENTRY DETAILS

SECTION 2 - ATMOSPHERIC TEST REQUIREMENTS						
Test Frequency			**Required Gases to be Tested**			Others (Specify)
Prior to start work	Yes ☐	No ☐	Oxygen	Yes ☐	No ☐	
Prior to authorization	Yes ☐	No ☐	Hydrocarbon	Yes ☐	No ☐	.....
Each work period	Yes ☐	No ☐	H2S	Yes ☐	No ☐	.....
If yes, Test Frequency is			CO	Yes ☐	No ☐	.....
Continuous Gas Monitoring Required (if continuous, document results prior to work start at each shift)	Yes ☐	No ☐	SO2	Yes ☐	No ☐	.....
			Ammonia	Yes ☐	No ☐	

(AA) shall also determine the frequency of the atmospheric tests to be conducted.
The Risk Assessment associated with the permit/ Confined Space Entry/ Vehicle Entry shall be used as a basis for determining atmospheric testing requirements / frequency.
The following instructions entered by the AA on the Atmospheric Test Record Form:

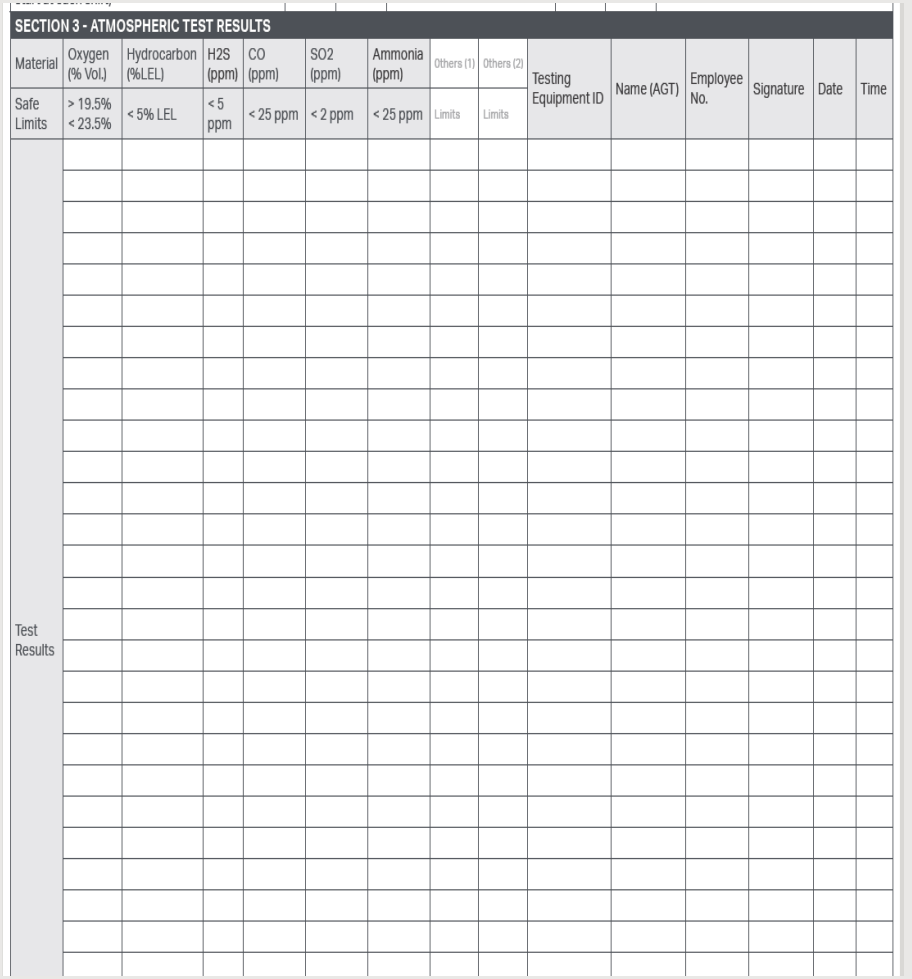
1. Whether an atmospheric test is required prior to commencement of work;
2. Whether an atmospheric test is required at beginning of each work period. If yes, then frequency (in hours) shall be specified;
3. Whether continuous atmospheric testing is required; and
4. Required gases to be tested.

SECTION 3 – ATMOSPHERIC TEST RESULT

Section 3 – Atmospheric Test Record Form Entry Details:

The AGT shall record the details of atmospheric test on the Atmospheric Test Record Form.

The Forms shall be retained at the worksite at all times.



SECTION 3 - ATMOSPHERIC TEST RESULTS														
Material	Oxygen (% Vol.)	Hydrocarbon (%LEL)	H2S (ppm)	CO (ppm)	SO2 (ppm)	Ammonia (ppm)	Others (1)	Others (2)	Testing Equipment ID	Name (AGT)	Employee No.	Signature	Date	Time
Safe Limits	> 19.5% < 23.5%	< 5% LEL	< 5 ppm	< 25 ppm	< 2 ppm	< 25 ppm	Limits	Limits						
Test Results														

DOCUMENTATION

AUTHORIZED GAS TESTING (AGT)

HOT WORK PERMIT

Permit No:		Previous Permit No:		Work Order No:	

SECTION 1: PERMIT REQUEST

1. (a) Nature of Work (tick as appropriate)

Hot Work (Naked Flame)	Grit Blasting	Explosives	Heat Generation	Grinding	Internal Combustion Engines
☐	☐	☐	☐	☐	☐

1. (b) Work Title

Planned Start Date	
Planned Finish Date	

1. (c) Location / Equipment

		Area	Process / Restricted ☐	Non - Process / Unrestricted ☐			
Location / Area		H2S Zone	R ☐	A ☐	Y ☐	G ☐	NC ☐
Equipment ID / Tag No.		HAC Zone*	0 ☐	1 ☐	2 ☐		NC ☐
Equipment Description		Dust Zone*	20 ☐	21 ☐	22 ☐		NC ☐

* HAC: Hazardous Area Classification

1. (d) Description of Work

1. (e) Work Equipment Details

		Job Performer (JP) Details:		
Tools to be used		Discipline / Department		
		Name (s)		
Sources of Ignition		Planned No. of workers		
		Contractor	Yes ☐	No ☐
Hazardous Materials Involved		Work Planning (IWAP)	Planned ☐	Break-in / Emergency ☐

1. (f) Work Permit Request by Performing Authority (PA)

I confirm that the details in the permit and associated attachments provide a clear description of the work to be performed including tools, materials and any specialist skills required. I declare that the JP identified for the work activity is competent to conduct the specified work activity.

Name (Performing Authority)	Company	Employee ID	Position	Date & Time	Sign

SECTION 2 - WORKSITE CONTROLS AND SUPPORTING DOCUMENTS

Certificates:	(If reqd.)	No #	Attachments:	(If reqd.)	No #	Other Details		
1. Electrical Isolation	☐		1. Method Statement	☐		JSA (Ref. No.)		
2. P / I / M Isolation	☐		2. Lifting Plan	☐		Remote Field Operation (RFO)	Yes ☐	No ☐
3. Temp. Defeat	☐		3. P&ID	☐		Planned SIMOPS	Yes ☐	No ☐
4. Atmospheric Test	☐		4. Rescue Plan	☐		PA Worksite Presence Required? (If yes, specify details below)	Yes ☐	No ☐
5. Confined Space Entry	☐		5. Journey Management Plan	☐		Special Precautions		
6. Ionizing Radiation	☐		6. Hazard & Control Sheet	☐				
7. Vehicle Entry	☐		7. Job Safety Analysis (level)	☐				
8. Excavation	☐		8. Associated Permits	☐				
9. Diving	☐		Other:	☐				
10. Road Closure	☐		Other:	☐				
11. Easement	☐		Other:	☐				

2. (b) Work Permit Validation by Area Authority (AA) * This section applies if endorsements, isolations etc. is required.

I confirm that the details in the permit and associated attachments is clear, valid and can proceed further in the PTW process.

Name	Company	Employee ID	Position	Date & Time	Sign

SECTION 3 - PERMIT ENDORSEMENT

I have reviewed the workscope and the controls identified to mitigate interface / concurrent activities agree that the work described may be carried out during the proposed period.

Name	Company	Employee ID	Position	Date & Time	Sign

Original copy (JP) ; 1st copy (AA or PCF or point of issuance) ; 2nd copy (Control Room if different from PCF)

SECTION 4 - PERMIT APPROVAL

I have reviewed the permit and the attachments and confirm that the described controls are adequate to reduce the risks associated with the work to ALARP. I confirm that permit can proceed to authorization and work can commence when all the specified controls and precautions are in place.

Validity of Approval * _____ Days — *Mention days if less than maximum limit of consecutive 7 calendar days

Name (Asset Approval Authority-AAA)	Company	Employee ID	Position	Date & Time	Sign

SECTION 5 - PERMIT AUTHORIZATION

I have reviewed the permit and the attachments and confirm that the described controls are adequate to reduce the risks associated with the work to ALARP. I confirm that all pre-requisite worksite controls have been implemented as per the requirements of the permit. All precautions will be communicated to the Job Performer (JP) before start of the work by the PI. There is no geographic or timing conflict with any other Work Permit or activity.

Zero Energy Demonstration	(✓If required) ☐	(✓If not required) ☐	Authorization Delegation	(✓If delegated to PI for RFO) ☐

Validity of permit* _____ Days

Valid From**: _____ Date _____ Hrs Valid Till**: _____ Hrs

*Mention days if less than maximum limit of consecutive 7 calendar days
**Date Stamp for first issue only (Specify time slot if required)

Note: In the case of Remote Field Operations (RFO), the zero energy demonstration will be done by delegated personnel with the assistance of other Isolating Authorities. Further AA authorization requirements shall be done by PI as delegated.

Name (Area Authority)	Company	Employee ID	Position	Date & Time	Sign

SECTION 6 - WORKSITE ISSUE & SUSPENSION

6a. Worksite Re-Validation - Required every shift / work period

6b. Permit Suspension

Area Authority (AA)	Permit Issuer (PI)	Job Performer (JP)	Job Performer(JP)	Asset Owner Rep
I confirm that all Worksite Controls are still in place and effective as per the requirements of the permit. There is no geographic or timing conflict with any other Work Permit or activity.	I have checked worksite controls specified on the permit, demonstrated Zero Energy (as applicable) & informed on-site emergency instructions to JP. I confirm work site is safe to commence work.	I accept the worksite as safe to commence work and have witnessed Zero Energy (as applicable). I will communicate the hazards, permit controls and conditions to work party members including the JSA/ Risk Assessment or SHCS requirements via TBT and remain at workplace for the duration of work. I understand the work scope and precautions to be taken. I agree to abide by the controls and requirements described in the permit. I agree to not commence work until clearance has been provided by the Permit Issuer (PI).	I have examined the worksite and confirm that it has been left in safe condition. I hereby suspend the Permit and confirm that my personal lock has been removed.	If not suspended by JP* I have examined the worksite and confirm that it has been left in safe conditional hereby suspend the permit.

Date	Shift / Extension	Validated Time From	Validated Time To	Name & Initials	Time	Name & Initials	Time	Name & Initials	JP Lock No.	Time	Name & Initials	Time	Name & Initials
		Not Applicable for first issue											

SECTION 7 - PERMIT CLOSURE

7. (a) Permit Return

Worksite clear	Yes ☐ No ☐	Work Complete	Yes ☐ No ☐		
Housekeeping is satisfactory	Yes ☐ No ☐	Permit Cancelled	Yes ☐ No ☐		
Equipment left in safe condition	Yes ☐ No ☐	Remarks	If work is not complete or permit is cancelled, please specify reason		
Equipment ready to return to service	Yes ☐ No ☐				

Name (Performing Authority)	Company	Employee ID	Position	Date & Time	Sign

7. (b) Permit Closure

Worksite clear	Yes ☐ No ☐	Equipment left in safe condition	Yes ☐ No ☐
Housekeeping is satisfactory	Yes ☐ No ☐	Work Continuing under Permit No.	

Name	Company	Employee ID	Position	Date & Time	Sign
(Permit Issuer):					
(Area Authority):					

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ATMOSPHERIC TEST REQUIREMENTS FOR CONFINED SPACE ENTRY

- An atmospheric test shall always be conducted prior to Confined Space Entry.
- Initial testing should be done from outside the confined space by inserting a sample probe and/or portable gas detection device at appropriately selected access holes, nozzles and openings.
- Because contaminants can settle at different levels, each part of the confined space should be tested – side to side and top to bottom. For example, some gases (such as H2S) are heavier than air and in unventilated areas will settle to the bottom of the space, while other gases (such as CH4) are lighter than air and will collect at the top of the space

ATMOSPHERIC TEST REQUIREMENTS FOR CONFINED SPACE ENTRY

- Testing should be carried out on a sufficient number of points to accurately reflect areas of the space that is likely to be accessed.

- Re-testing and continuous monitoring of the air may be necessary if the risk assessment indicates that conditions may change due to the work being done or due to disturbance of hazardous material in the confined space.

- The conditions should also be continuously monitored, for example, when forced ventilation is being used or when the work activity itself could give rise to changes in the atmosphere.

ATMOSPHERIC TEST REQUIREMENTS FOR CONFINED SPACE ENTRY

- Continuous gas monitoring shall be maintained for any Confined Space entry activity.

- Man entry into vessels is allowed only when Continuous monitoring of LEL, O2 and SO2 inside the vessel.

Consideration for Inert Gas CSE

- Continuous oxygen monitoring shall be ensured and the Authorized Entrant shall be alerted to evacuate the Confined Space if the oxygen level inside is exceeded.

- An audio-visual oxygen alarm set at 5% is recommended which should be carried in a way that Authorized Entrant is able to see or feel or hear the alarm while wearing the breathing apparatus.

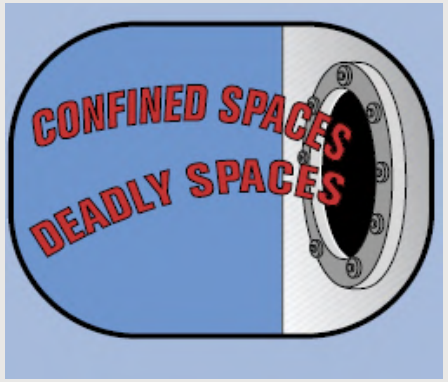
ATMOSPHERIC TEST REQUIREMENTS FOR CONFINED SPACE ENTRY

- The frequency of subsequent testing shall be stipulated on the Atmospheric Test Record Form based on the Risk Assessment.
- A confined space located within H2S classified area shall be monitored continuously.
- While work is being carried out in a confined space, it is required to ensure that the concentration any flammable gas, vapor or mist in the atmosphere of the space is less than 5% of its LEL, so far as is reasonably practicable.

ATMOSPHERIC TEST REQUIREMENTS FOR CONFINED SPACE ENTRY

If it is not reasonably practicable, and the concentration of any flammable gas, vapor or mist in the atmosphere of the confined space:

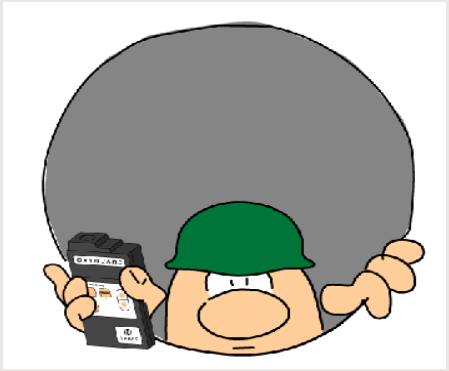
- Is equal to or greater than 5% but less than 10% of its LEL—the person must ensure that any worker is immediately removed from the space unless a suitably calibrated, continuous monitoring flammable gas detector is used in the space;
- Or is equal to or greater than 10% of its LEL—the person must ensure that any worker is immediately removed from the space.
- Where a flammable atmosphere may exist in a confined space and there is a risk of fire and explosion, all ignition sources in the vicinity must be eliminated.



TERMINOLOGY AND DEFINITIONS

Some abbreviations are used constantly in the process of gas testing.

The abbreviations and chemical properties of the gases and vapours commonly found in the industry must be understood by all concerned.



TERMINOLOGY AND DEFINITIONS

Threshold Limit Value (TLV)

Is a level to which a worker can be exposed per shift in the worktime without adverse effects.
TLV is a reserved term of the American Conference of Governmental Industrial Hygienists (ACGIH).

Threshold Limit Value -Time-Weighted Average (TLV-TWA):

The concentration of a hazardous substance in the air averaged over an 8-hour workday and a 40-hour workweek to which it is believed that workers may be repeatedly exposed, day after day, for a working lifetime without adverse effects.

Threshold Limit Value -Short-term exposure (TLV STEL):

A 15-minute time weighted average exposure that should not be exceeded at any time during a workday, even if the overall 8-hour TLV-TWA is below the TLV-TWA. Workers should not be exposed more than four times per day to concentrations between TLV-TWA and TLV-STEL.

TERMINOLOGY AND DEFINITIONS

Immediately Dangerous to Life or Death (IDLH)

An atmospheric concentration of any toxic, corrosive, or asphyxiate substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

The IDLH for H2S is 100 ppm

TWA / STEL FOR H2S

Workplace monitoring limit (Personal H2S Detector) 10 ppm.

Occupational Health Use (Chronic effects)

Workplace Exposure Limit [8-hr TWA] 5 ppm
Workplace Exposure Limit [15-min STEL] 10 ppm

RELATIVE DENSITY

With the exception of Gases such as, Methane, Carbon Monoxide and Hydrogen most flammable gases have a density greater than air.

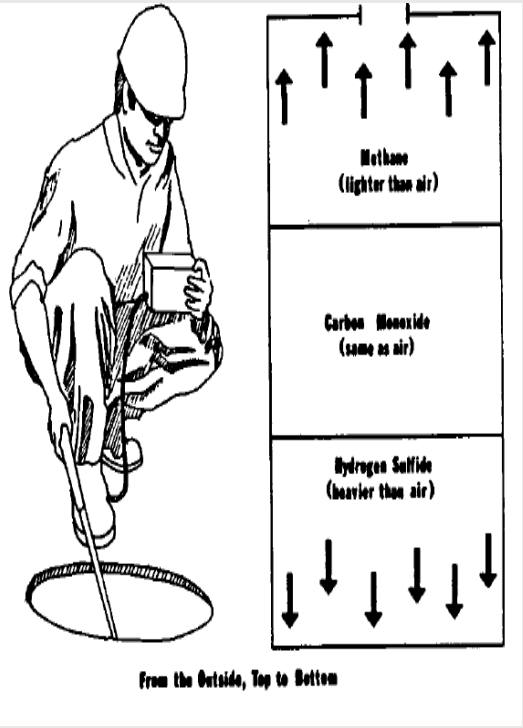
This is important because it can result in a layering effect where a flammable mixture is present at one level and not at another.

THE HIGHER THE RELATIVE DENSITY THE HEAVIER THE SUBSTANCE

e.g. (H2S) density =1.19 and (AIR) density = 1.0

RELATIVE DENSITY

Lighter than Air		Heavier than Air	
Acetylene	**0.9**	**Argon**	**1.38**
Ammonia	0.59	Arsine (AsH_3)	2.69
CO	0.966	CO_2	1.518
Helium (He)	0.138	SO_2	2.264
H_2	0.069	Propane	1.521
CH_4	0.553	Ozone (O_3)	1.660
N_2	0.972	Oxygen (O_2)	1.104
		H_2S	1.19

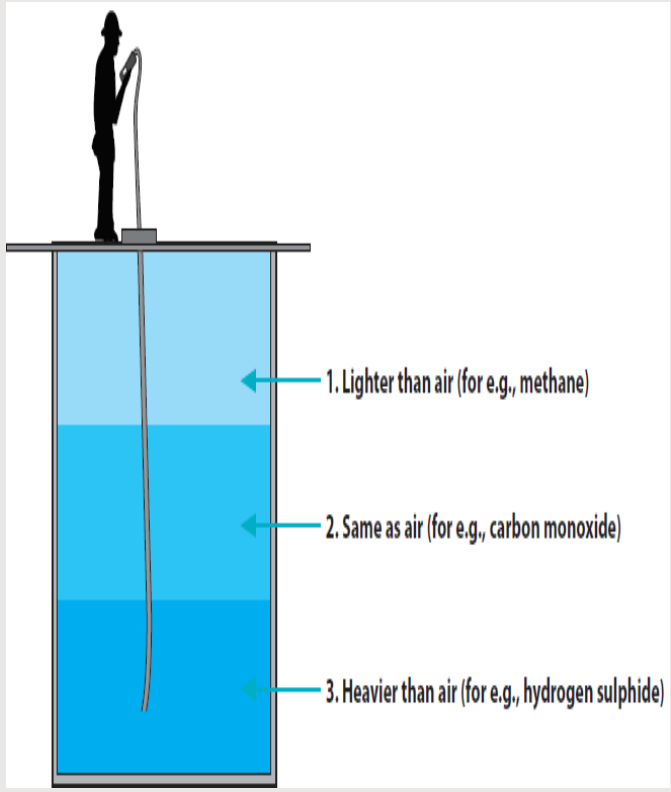


RELATIVE DENSITY

If you want to test H2S where you can find it?

CO2
CO
H2S
SO2
CH4
H2

1……
2……
3……
4……
5……
6 ……



GAS DISPERSION

Factors influencing gas dispersion:

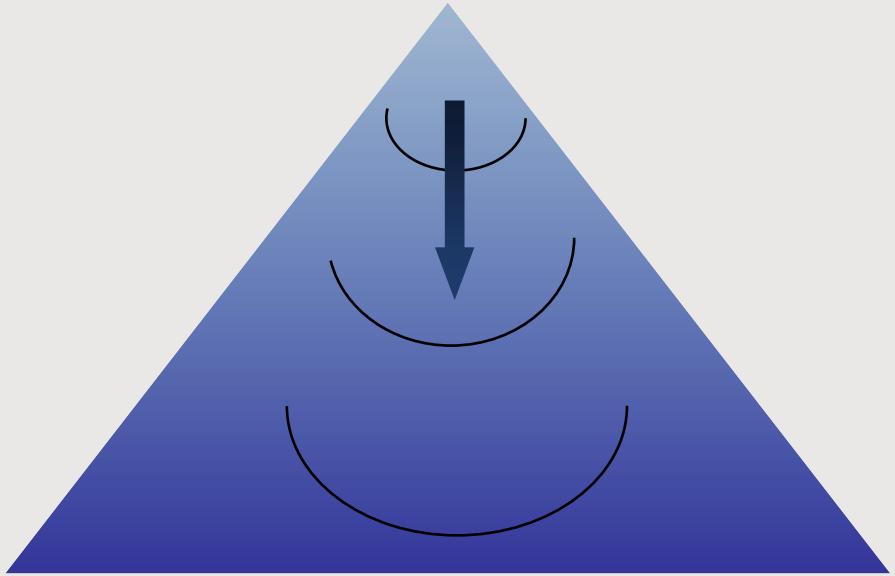
Gravity / Air current

Plumes / gas leak at high pressure

Wind speed

Heat

Humidity



GAS TESTING LOCATIONS

Where you can find gases?

- Pits
- Sumps
- Manholes
- Flanges
- Valves gland/ stem
- Roof Seal of Floating Roof Tank
- Points, gages, etc…
- Pump Casing
- Drains
- Sewers
- Cellars
- Christmas tree
- well- head
- Casings
- Sludge
- Vents

GAS TESTING PRACTICES

The GAS TESTER is usually first on the scene. He must take precautions. Do not neglect your personal safety and therefore the safety of others who come after you whilst doing gas tests.

AGT

Must be aware of the gases that the instrument can detect.

Must also be aware of that the presence of other gases can adversely effect the readings.

When testing in an area it must be considered that gases may be stratified rather than uniformly mixed, spot checks must be carried out for precise readings.

Assessment must be made of the exact location, type of gas, the wind direction and the strength of the wind.

RESPONSIBILITY

THE CARRYING OUT OF GAS TESTS IS A JOB WHICH CARRIES A GREAT DEAL OF RESPONSIBILITY

Workmate lives may depend upon YOUR readings!

Gas Testing must be done with extreme care and understanding of the characteristics of the gases and vapours which could be present.

The course will not only look at how to carry out the tests but also will discuss interpretations of the readings and limitations of the instrument.

AGT - RESPONSIBILITIES

- Assess the work location and identify (in liaison with Area Authority) all atmospheric testing requirements for the safe execution of work.
- Verify that acceptable conditions exit to perform the proposed activity by performing atmospheric tests and documenting the information on the Atmospheric Test Record Form as required.
- Ensure testing equipment is fit-for-purpose, calibrated, and functional.
- Communicate abnormal atmospheric test information to the Area Authority.

- The AGT shall record the details of atmospheric test on the Atmospheric Test Record Form.

AGT - RESPONSIBILITIES

AGT shall be competent to:

- Demonstrate ability to operate atmospheric testing equipment and its care;
- Understand requirements of filling atmospheric test record forms;
- Demonstrate actions to be taken if gas detector alarms.

All efforts shall be made to conduct Atmospheric Test within 1 hour prior to the commencement of the work.

Job Performer (JP) and Authorized Gas Tester (AGT) shall not be the same person for the subject PTW

A person's senses should never be used to determine if the air in a confined space is safe. Many toxic or flammable gases and unsafe oxygen levels cannot be detected using one's senses

AA - RESPONSIBILITIES

- Location / Area to be atmospheric tested
- Whether an atmospheric test is required prior to commencement of work;
- Whether an atmospheric test is required at beginning of each work period.

  If yes, then frequency (in hours) shall be specified;
- Whether continuous atmospheric testing is required; and
- Required gases to be tested.

GAS MONITORING

TYPE OF DETECTORS

Fixed Detector: is permanently installed in a chosen location to provide continuous monitoring of plant and equipment. useful where there is the possibility of a leak into an enclosed or partially enclosed space where flammable gases could accumulate.

Portable Detector: usually refers to a small, handheld device that can be used for testing an atmosphere in a confined space before entry, for tracing leaks or to give an early warning of the presence of flammable gas or vapor when hot work is being carried out in a hazardous area.

Transportable Detector: not intended to be hand-carried but can be readily moved from one place to another. One of its main purposes is to monitor an area while a fixed gas detector is undergoing maintenance.

FIXED DETECTORS

STRENGTH	WEAKNESS
Continuous Detection	Accurate detection is limited to gas that diffuses into the sensing inlet – requiring strategic placement of detectors
Site wide Alarms	Demand constant power supply
Events can be recorded	Capital installation cost can be expensive depending on the amount of equipment required
Data can be logged	Requires regular service checks – just like a fire alarm system
Clear Unambiguous alarm	Needs strategic locations
Used indoor or outdoor	Limited area typically 5M radius
Zone classified	

PORTABLE DETECTORS

STRENGTH	WEAKNESS
Easily to carry	Monitoring only when the unit is on.
Multi gas detection	Needs charging
Presence of pump	User must be trained
Presence of probe	Need bump test
Cab be used remotely	Costly if used as the only gas detection system for large areas.
Transportable	Each Worker requires their own unit.
Used for tracing leaks	

PERSONAL DETECTORS

STRENGTH	WEAKNESS
Easy to carry	Warning device only
Self powered	Individual protection only
Can be tracked centrally	The detector alarm/activated when the wearer is in hazardous contaminated area
Intrinsically safe	Operator must be trained
Light weight	Need daily self test Need bump test every 3 months
Cost effective	

BUMP TEST

- A short exposure of a detector to a test gas to an expected concentration that is greater than the alarm set points which demonstrates that the sensor and alarm are operational, without carrying out a calibration.

- Bump testing is the only way to ensure proper sensor and alarm functionality.
- The purpose of the bump test is to check for sensor and alarm functionality. However, it does not check for accuracy.

- It is important to note that accuracy is ensured through calibration, which is a completely different process than bump testing.

- The bump test for personal gas detectors shall be done once in a month or according to manufacturer's recommendation whichever comes earlier.
- However, for portable gas monitors used by Authorized Gas Tester shall be bump tested before every use.

- Records for the bump testing shall be maintained.
- Any gas monitor that fails to respond properly during a functional bump test shall be sent for troubleshooting or further maintenance as required.

CALIBRATION

The equipment used for monitoring the exposure levels of H2S shall be serviced and tested at intervals recommended by the manufacturer, and possibly more frequently under extreme humidity, temperature, dust or other adverse environmental operating conditions.

Status calibration shall be checked before every use of portable gas monitors in accordance with the manufacturer's recommendation.
Records of device testing and maintenance shall be kept for verification and audit purposes.

CALIBRATION

Calibration is a quantitative test utilizing a known traceable concentration of test gas to demonstrate that the sensor(s) and alarms respond to the gas within manufacturer's acceptable limits. It is the adjustment of the baseline and sensitivity of the sensor/electronics circuit, that is, it is based on an exposure to a known gas in which the sensor/instrument is adjusted to that concentration.

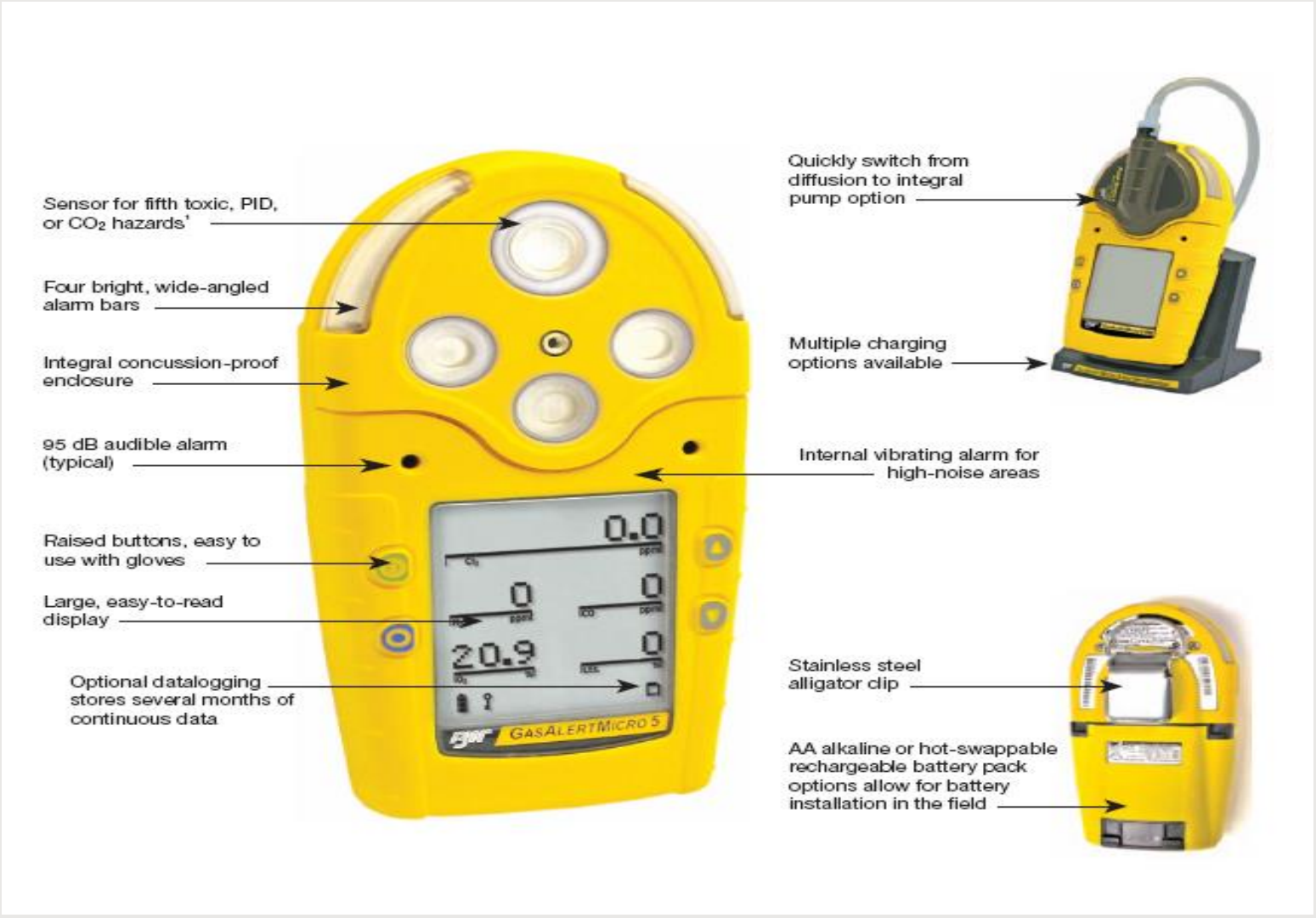
Calibrations are required on a periodic basis. All sensors regardless of the operational principle, will drift over a period of time and require adjustments. Sensors may also experience drift after an over-exposure to the targeted gas, or after exposure to extreme environmental conditions, after a severe physical jolt, or if a Function Test produces a less than satisfactory result. It is important to observe the response times of the sensors, the stability of the sensor signal, and the recovery times of the sensors during this period.
The calibration interval for each of these sensors from the different makers of the instruments may be different.

The frequency of calibration shall be governed as per the manufacturer's recommendation as indicated in the instruction manual for the routine test and re-calibration interval.

RECOMMENDED BUMP TEST & CALIBRATION FOR THE GAS MONITORS & GAS DETECTORS

Gas Detector/ Monitor	Personal H2S Monitors		Portable Multi-Gas Detectors	Area Monitor (Stand Alone) Gas Detectors	
Brand	BW	Crowcon	BW	Crowcon	OLDHAM
Model	Gas Alert Clip 2 Extreme	Crowcon Clip	Gas Alert Miro5	Detective	BM 25
Bump Test Frequency	• At least every 90 days (3 Months) • Bump test to be conducted by Assets HSE. • Each Asset to arrange and ensure availability of bump test kit with the necessary training of use. • Functional self-test to be performed by users prior to daily use.		• Daily or prior to use. • Bump test to be conducted by Assets HSE.		
Calibration Frequency	• Not required (dispose after 2 years operating life). • Calibration is required if the monitor failed the bump test and to be conducted by Assets HSE.		• Recommend every 3 months (quarterly) due to the work environment. • Assets HSE to send the units to the GSD Mussafah Safety Work Shop on quarterly basis for calibration		
Maintenance Tracking Process	• All types of H2S Detectors/Monitors to be tracked by using Safety Equipment Tracking System.				

BW – GAS ALERT MICRO 5



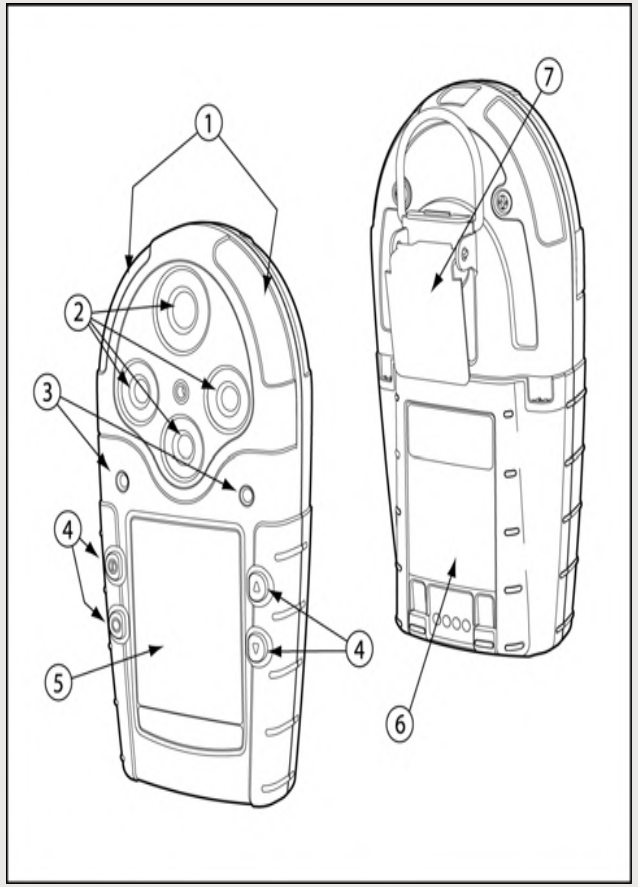
BW – GAS ALERT MICRO 5

Instrument model differences	GasAlertMicro 5
Gases Detected	H_2S, CO, O_2, SO_2, PH_3, NH_3, NO_2, HCN, Cl_2, ClO_2, O_3 and combustibles (LEL)
Sensors	Plug-in, electrochemical cell (toxic and oxygen); catalytic (LEL)
Typical battery life[2]	
AA Alkaline	20 hours
Rechargeable	20 hours

GasAlertMicro 5	
Industry or Application	Sources of 5th Atmospheric Hazards
Confined Space Entry	Various sources - industrial chemicals
Wastewater Plants	Cl_2, NH_3, ClO_2 from treatment
Steel / Iron Production	NO_2
Pulp and Paper	Cl_2 from bleaching
Food and Beverage	NH_3 from refrigerants, ice production PH_3 from fumigation
Construction	Confined space entry, trenching, and NO_2 from diesel exhaust

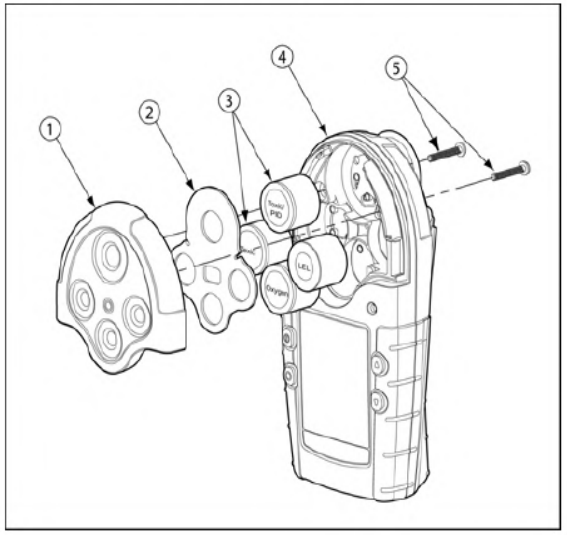
Sensor Specifications	
Gas	Measuring Range (ppm)
H_2S	0-500
CO	0-999
TwinTox (H_2S)	0-500
TwinTox (CO)	0-500
O_2	0-30.0%
SO_2	0-150

BW – GAS ALERT MICRO 5



Item	Description
1	Visual alarm bars (LED)
2	Sensors
3	Audible alarm
4	Pushbuttons
5	Liquid crystal display (LCD)
6	Battery pack
7	Alligator clip

To replace a sensor or sensor filter, refer to Figure 8, Table 19, and the following procedures.



Electrochemical and catalytic bead sensors available for:

H_2S	CO	O_2
SO_2	Cl_2	ClO_2
NH_3	PH_3	HCN
NO_2	O_3	Combustibles (LEL)

BW – GAS ALERT MICRO 5 - ATTACHMENTS

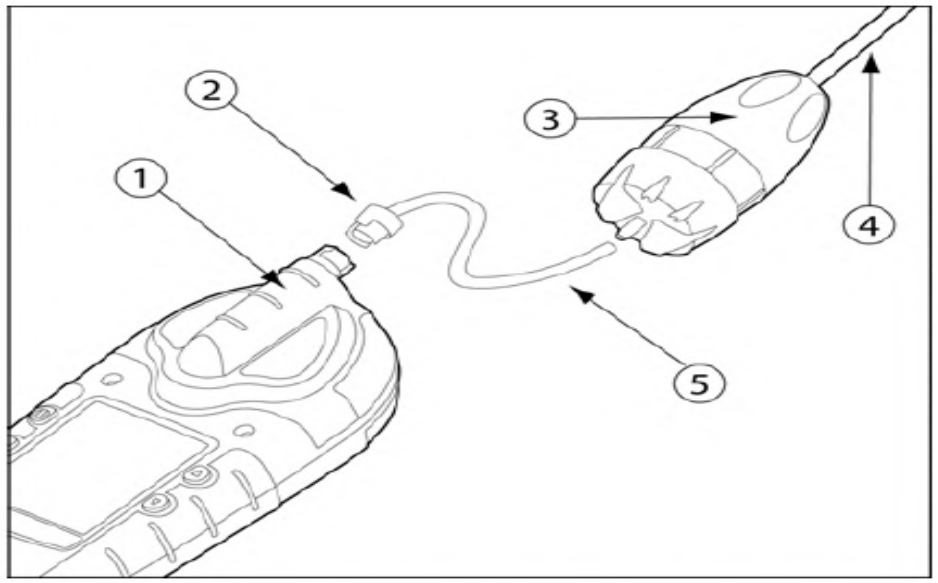


Figure 5. Attaching the Sample Probe

Item	Description
1	Motorized pump module
2	Connector
3	Sample probe
4	Sample probe 10 in. tubing (custom lengths can be ordered)
5	Flexible connector hose

Insert the sample probe tubing into the confined space.

Depending upon the length of the tubing and the type of gas in the confined space, allow a minimum of 3 seconds per ft. of hose to ensure the readings stabilize before entering the area.

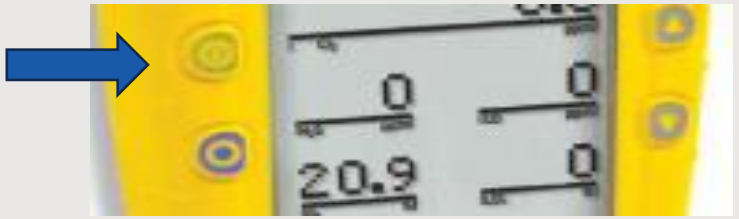
Example: 50 ft. = 2.5 minutes

⚠ Warning

The sample probe must be used with the pump module only. Ensure that all connections are secure before sampling.

BW – GAS ALERT MICRO 5 - ACTIVATION

To activate the detector, press ⓘ in a normal atmosphere (20.9% oxygen).

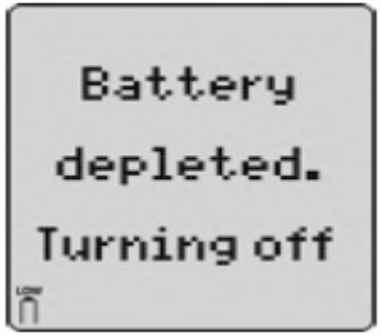


Self-Test

Once the detector is activated, it performs several self-tests. Confirm the following tests occur.

The detector performs a battery test during start-up.

If the battery has insufficient power to operate, the follow screen displays before deactivating.



Replace the batteries and reactivate the detector.

1. All of the LCD elements display simultaneously as the detector beeps, flashes, vibrates, and briefly activates the backlight.

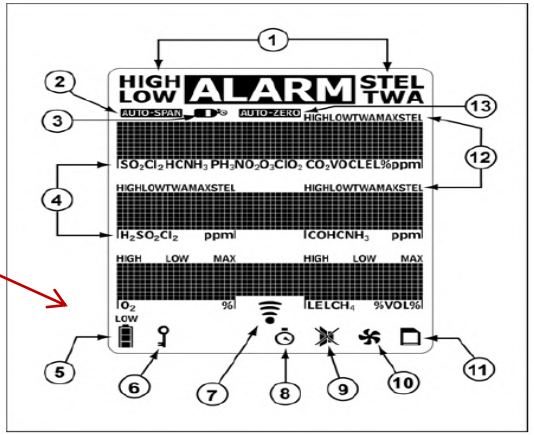


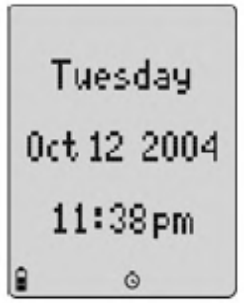
Figure 2. Display Elements

AUTHORIZED GAS TESTING (AGT)

BW – GAS ALERT MICRO 5: SELF TEST

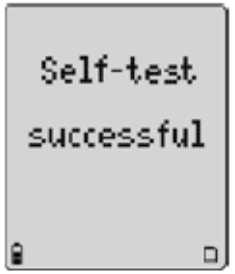
2. The version and serial number of the detector displays.

3. The date and time displays.



5. The detector then runs a self-test to verify the sensors and power supply.

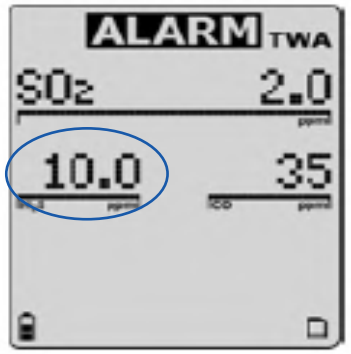
Self-test Successful: If successful, the following screen displays.

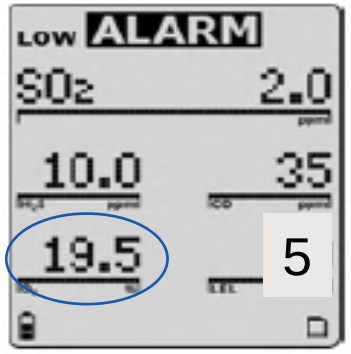


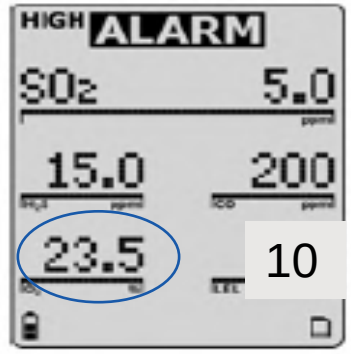
BW – GAS ALERT MICRO 5: SELF TEST

Self-test Unsuccessful: If a sensor fails the self-test, a warning displays indicating which sensor(s) has failed.

7. The TWA, STEL, low, and high alarm setpoints then display in the following order.







BW – GAS ALERT MICRO 5 – PUMP TEST

Pump Test (Optional)

8. If the pump module is attached to the detector, the following screens display.

When the following screen displays, block the pump inlet.

BW – GAS ALERT MICRO 5 – PUMP TEST

If the pump inlet is not blocked within 10 seconds or the pump test fails, the following screens display.

If ◯ is not pressed or the pump is not removed within 25 seconds, the detector performs the pump test again.

If the pump test is successful, the following screen displays and the self-test continues.

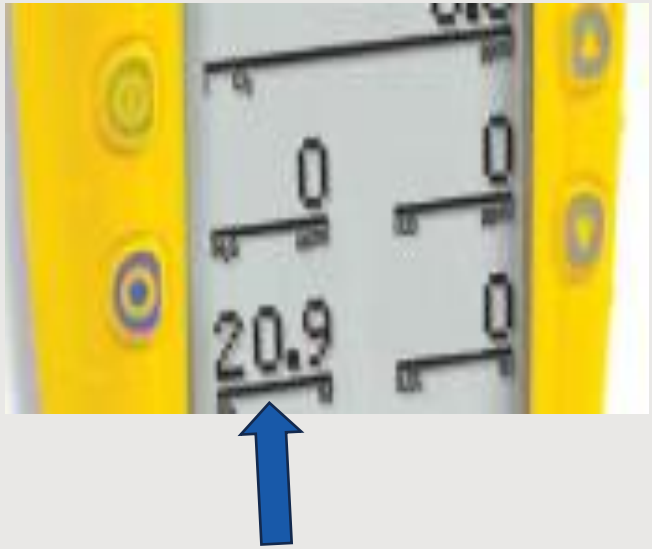
BW – GAS ALERT MICRO 5 – O2 CALIBRATION

9. Unless disabled in user options, the oxygen (O_2) sensor is calibrated automatically.

If the span is successful, the detector beeps twice.

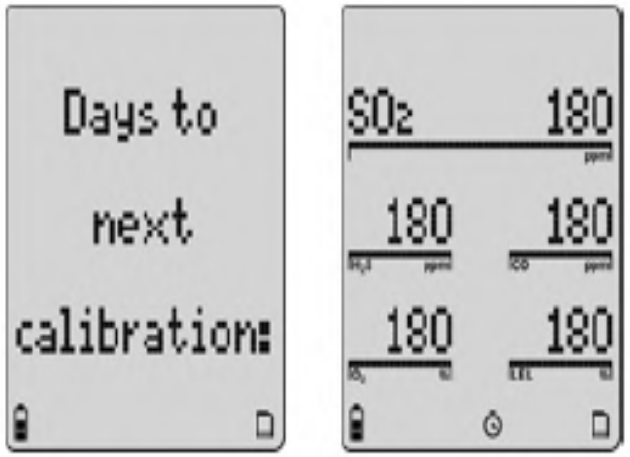
Note

If the automatic O_2 calibration feature has been disabled, **Automatic O_2 span disabled** displays.

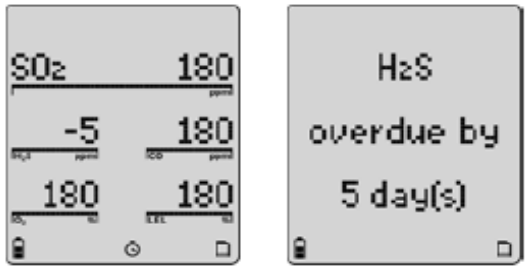


BW – GAS ALERT MICRO 5 – DUE DAYS FOR CALIBRATION

10. Lastly, the number of days remaining before calibration is due displays for all sensors.



If any sensor is past due for calibration, the name of the sensor and the number of days past due display.



Note

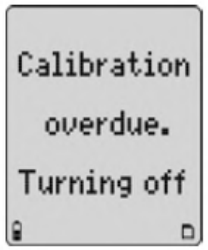
If any sensor is overdue, ⏱ displays continually until calibration is performed.

BW – GAS ALERT MICRO 5 – FORCED CALIBRATION

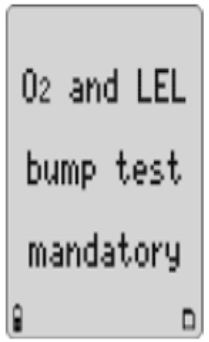
Force Calibration Is Enabled

If **Force cal** is enabled in the user options menu, calibration is mandatory before the detector enters normal operation.

If ◯ is not pressed to start calibration, the following screen displays and the detector deactivates.



BW – GAS ALERT MICRO 5 – BUMP TEST



The mandatory daily bump test is applicable only to the LEL and O_2 sensors. The bump test must be performed otherwise the detector will deactivate.

Both the diffusion and pumped configurations are compatible with the MicroDock II - automatic bump test and calibration system

BW – GAS ALERT MICRO 5 – BUMP TEST PASSED

11. When the following screen displays, apply the test gas. Ensure the cylinder icon is flashing before applying gas.

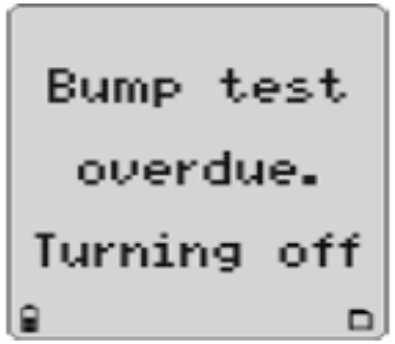
Note

If the bump test is not performed, the detector deactivates.

Successful Bump Test: If the bump test passes, the following screens display.

BW – GAS ALERT MICRO 5 – BUMP TEST FAILED

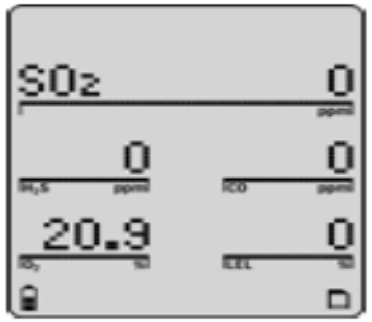
Unsuccessful Bump Test: If the bump test is unsuccessful or the bump test is not performed, the following screen displays and the detector deactivates.



BW – GAS ALERT MICRO 5 – SELF TEST PASS/ FAIL

Self-Test Pass

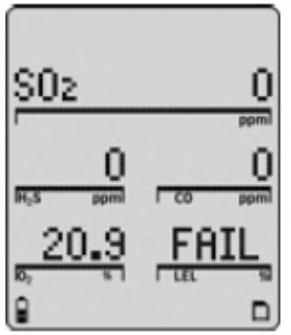
If the detector passes the self-test, it enters normal operation displaying the ambient gas readings.



The detector begins recording the maximum gas exposure (MAX) and calculating the short-term exposure level (STEL) and time-weighted average (TWA) exposures.

Self -Test Fail

If a sensor fails, FAIL displays above that sensor on normal operating screen.



BW – GAS ALERT MICRO 5 – BATTERY TEST

Battery Test

The batteries are tested when the detector is activated and continuously thereafter. The battery power icon displays continually during normal operation. If battery power is low, LOW flashes.

BW – GAS ALERT MICRO 5 – DETECTOR DEACTIVATION

Deactivating the Detector

To deactivate the detector, press and hold ⓘ while it beeps and flashes to the corresponding countdown.

At the end of the countdown the detector emits an extended beep and flash, and displays **0** before deactivating.

Note

If ⓘ is not held down for the complete countdown, the detector remains activated.

COMMON FAILURES

PROBLEM	POSSIBLE CAUSE	SOLUTION
The detector does not activate.	Depleted battery Damaged or defective detector	Charge battery. Refer to Charging the Battery. Sent for service/ repair
The detector enters alarm immediately when activated.	Sensor needs to stabilize	Used sensor: wait 60 seconds New sensor: wait few minutes
The detector enters alarm immediately when activated.	Low battery alarm	Charge battery.
The detector enters alarm immediately when activated	Detector requires calibration	Calibrate the detector.
The detector enters alarm immediately when activated	Hazardous environment	Leave the area immediately. Deactivate and reactivate in a safe area that is free of hazardous gas, in an atmosphere of 20.9% oxygen.

COMMON FAILURES

PROBLEM	POSSIBLE CAUSE	SOLUTION
The activation self-test fails.	General fault	Sent for service/ repair
The activation self-test fails.	Sensor failure	Replace the sensor. Refer to Replacing a Sensor or Sensor Filter.
Detector automatically deactivates during startup.	Battery power too low to operate	Charge battery.
Detector automatically deactivates during startup.	Force Calibration When Overdue option is enabled and calibration is not attempted	Calibrate the sensor(s) immediately.
Detector automatically deactivates during startup.	Force Bump When Overdue option is enabled and a bump test is not attempted	Bump test the sensor(s) immediately..
Detector does not enter into alarm.	Alarm setpoint(s) defined incorrectly Alarm setpoint(s) set to zero	Reset alarm setpoints.
Detector does not respond to pushbutton.	Battery is depleted Detector is performing operations that do not require user input	Charge battery. Pushbutton operation restores automatically when the operation ends.

NCMT

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