



UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

SCOPE OF WORK AND TECHNICAL SPECIFICATION

FOR SERVICING/REPAIR OF COMPRESSED GAS SYSTEMS

AT

UNIVERSITY OF THE WITWATERSRAND

JOHANNESBURG

DATE: 24 APRIL 2026

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Abbreviations

SAGA – Southern Africa Gas Association

SACGA - Southern Africa Compressed Gases Association

SAQCC - South African Qualifications Committee

LPGSA - Liquid Petroleum Gas Association of South Africa

EN – European Norm

OEM – Original Equipment Manufacturer

OFMD – Operations and Facilities Management Department

SANS – South African National Standards

OHS - Occupational Health and Safety

1. EXECUTIVE SUMMARY

This maintenance specification addresses the complex gas infrastructure at the University, covering industrial, laboratory, medical, and fuel gases. Managing such a diverse range of gases requires strict adherence to both general safety standards and gas-specific protocols.

Given the inclusion of Ammonia (toxic/corrosive) and Methane/Hydrogen (highly flammable) alongside medical and inert gases, this system falls under high-level regulatory scrutiny.

The purpose of this document is to describe the scope of works required for the Assessment, Maintenance, Validation and Asset Management of gas bottles used in various faculties, which include the following gasses:

- (a) Hydrogen
- (b) Helium
- (c) Argon
- (d) Air Tech (O₂/N₂)
- (e) Carbon Dioxide
- (f) Medical Carbon Dioxide
- (g) Carbon Dioxide Tech
- (h) Oxygen
- (i) Nitrogen
- (j) Nitrogen Tech
- (k) Acetylene
- (l) Methane
- (m) Synthetic Air
- (n) Ammonia
- (o) Mix Gas
- (p) LPG

within the University's facilities, located within all three campuses.

The objective of the works is multifaceted and may be summarised as follows:

- To verify and maintain the structural integrity of the gas bottles.
- To establish a structured maintenance framework.
- Continuous asset management program.
- Ensure compliance with applicable standards, and
- Support safe and reliable operation of gas bottles and equipment through a five-year maintenance plan.

This document must be read in conjunction with the bill of quantities.

The successful Service Provider must ensure that they are able to meet the program schedule of the University including commissioning and hand-over timelines.

2. SCOPE OF WORKS

2.1. Project Objective

The objectives are to:

- To verify and maintain the structural integrity of the gas bottles and ensure no leaks exist at the maximum design pressure.
- Establish a clear and structured maintenance strategy for gas bottles installed within the University
- Define preventative and corrective maintenance requirements as per relevant standards such as SACGA, LPGSA, SANS, EN, etc, and OEM maintenance requirements. The Service Provider is to provide a reference standard for the maintenance being performed on a particular piece of equipment.
- Maintain all equipment according to maintenance strategies including decommissioning and replacement where applicable.
- Ensure compliance with applicable health, safety, and operational standards
- Ensure compliance with relevant standards and OEM maintenance requirements
- Provide for validation of equipment.
- Maintain accurate asset and maintenance records over the contract period and following each intervention.
- Provide a list of spares to be held by the University, if applicable, per equipment being maintained.

2.2. Project Scope

2.2.1. Scope Inclusions

The Scope of Works includes, but is not limited to, the following gas bottles and equipment:

Equipment and gas bottle types:

- (a) Hydrogen
- (b) Helium
- (c) Argon
- (d) Air Tech (O₂/N₂)
- (e) Carbon Dioxide
- (f) Medical Carbon Dioxide
- (g) Carbon Dioxide Tech
- (h) Oxygen
- (i) Nitrogen
- (j) Nitrogen Tech
- (k) Acetylene
- (l) Methane
- (m) Synthetic Air
- (n) Ammonia
- (o) Mix Gas
- (p) LPG

Activities:

- Conduct a detailed inspection of the gas bottles installations, including cylinders, valves, discharge nozzles, control panels, detectors, manifolds, gauges, colour coding, etc.
- Identify any damaged, faulty, or non-compliant components.
- Perform regular, and ongoing maintenance to manage corrosion and leaks.
- All maintenance, repairs, and safety of the gas bottles and appliances.

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- Once-off asset assessment and verification of the existing asset register, including the capture and upload of all asset data onto the prescribed asset register template.
 - The Service Provider shall obtain all applicable OEM operation, maintenance, and technical manuals for the installed equipment. Copies shall be submitted to the University.
 - Preventative routine maintenance in accordance with defined schedules according to OEM maintenance requirements and applicable regulatory and compliance standards. Not completing the OEM recommended maintenance requirements shall place the University at risk of negatively affecting warranties, guarantees and or insurance claims.
 - Corrective maintenance, including call-outs and fault-finding, and repairs.
 - Validation of equipment at prescribed intervals.
 - Continuous asset management, reporting, and record keeping throughout the contract period.
 - Determining if decommissioning of gas bottles and equipment that is deemed unsafe, obsolete, or beyond economical repair is required and providing recommendation to the University.
 - Providing quotations for the replacement parts for gas bottles and equipment, where necessary.
 - Maintenance of newly installed equipment that the University may have introduced during the contract period, only upon written confirmation from the University once the warranty period of the equipment has ended.

2.2.2. Scope Exclusions

The following activities do not form part of this contract unless specifically instructed in writing by the University:

- Installation of new equipment.
- Building works and structural modifications.

2.2.3. Scope Assumptions

- All work required for maintaining the assets listed in the asset register shall be included in the SOW.
- The maintenance scope shall cover all maintenance, repairs, and safety of the gas bottles within the University and shall include the equipment and all associated auxiliary components necessary for its safe and intended operation.

2.3. Site Location

The scope of works applies to the aforementioned equipment across the University's campuses, namely:

- Braamfontein Campus – East and West campus
- Parktown Campus – Health Sciences and Education campus, and

The Service Provider shall make provisions for works across the above listed sites. The physical address of the sites is as follows:

- Braamfontein Campus: 1 Jan Smuts Avenue, Braamfontein 2000, Johannesburg, South Africa.
- Parktown Campus:
 - Health Science campus: 7 York Rd, Parktown 2193, Johannesburg, South Africa
 - Education campus: 27 St Andrews Rd, Parktown 2193, Johannesburg, South Africa

3. CODES AND STANDARDS

Compliance is mandatory under the **Occupational Health and Safety Act (Act 85 of 1993)**. Maintenance shall conform to the following applicable and regulatory SANS Standards.

All works shall be carried out in accordance with applicable local and international standards according to regulations and OEM's requirements, including but not limited to:

Standard	Scope of Application
SANS 10087-1	LPG installations (Kitchens and Labs).
SANS 10019	Transportable gas containers (Cylinder care, storage, and testing).
SANS 10223	Marking and labelling of gas cylinders.
SANS 10147	Specific to Ammonia (Refrigeration/Toxic gas handling).
SANS 7396-1	Medical Gas Pipelines (Medical Carbon Dioxide, Air Tech).
SANS 10234	GHS (Globally Harmonised System) for hazardous chemical labelling.

SANS 501417

Flashback arrestors for flammable gas systems.

The latest applicable editions of standards shall apply at the time of execution.

4. SYSTEM MAINTENANCE

4.1. Overview

System maintenance shall include the planned preventative maintenance and unplanned corrective maintenance of gas bottles and associated auxiliary equipment. The objective of system maintenance is to ensure the safe, reliable, and compliant operation of gas bottles and equipment throughout the contract period.

All maintenance activities shall be carried out by trained, competent, and accredited personnel in accordance with this Scope of Works, applicable regulatory and compliance standards, and OEM requirements.

All daily maintenance activities to be performed by Lab Technicians, Chefs, or Workshop Managers.

All monthly maintenance activities to be performed by the Service Provider.

All annual maintenance activities to be performed by the Service Provider.

4.2. Preventative Maintenance

Preventative maintenance activities shall be planned, proactive, ensure continued compliance and intended to minimise equipment downtime and reduce the likelihood of failure.

Preventative maintenance shall be performed in accordance with applicable regulatory and compliance standards and OEM guidelines. This shall include any inspections, tests, servicing procedures, calibrations, consumables, cleaning or verifications specified by the OEM for the relevant gas bottles installations, including cylinders, valves, discharge nozzles, control panels, detectors, manifolds, gauges, colour coding, etc. The Service Provider shall identify any damaged, faulty, or non-compliant components.

Preventative maintenance schedules for all maintenance categories shall be developed and implemented by Service Provider in accordance with OEM guidelines and applicable regulatory and compliance standards.

The Service Provider shall develop and submit a preventative maintenance schedule to the University after the initial asset assessment has been conducted., detailing the planned dates and scope of maintenance activities for each category across all assets and sites.

4.2.1. Maintenance Frequency Categories

Preventative maintenance shall be categorised as follows:

- Category A – Mandatory Maintenance
- Category B – Monthly Maintenance
- Category C – Annual Maintenance

Categories A to C shall be performed by the Service Provider in accordance with OEM guidelines and applicable regulatory and compliance standards throughout the full contract period.

4.2.2. Category A to C Maintenance

Categories A to C shall be performed by the Service Provider strictly in accordance with OEM maintenance manuals and applicable regulatory and compliance standards.

Preventative maintenance activities shall include, but not be limited to:

4.2.3. Monthly Maintenance Checklist

To be performed by the appointed maintenance Service Provider.

Item	Checkpoint	Status (Y/N)
Leak Test	Perform a "Snoop" or soapy water test on all manifold joints and pigtails.	
Pigtails	Inspect flexible hoses for cracks, kinking, or "bulging" under pressure.	
Sensors	Test Oxygen Depletion and Flammable Gas alarms (Battery/Function test).	
Ventilation	Ensure air bricks and extraction fans are clear of dust and operational.	
Labels	Ensure all cylinders have GHS-compliant labels and pipes are color-coded.	

Segregation	Verify that O ₂ and Flammables are still separated by 3m or a fire wall.	
Ammonia	Inspect Ammonia fittings for signs of green/blue corrosion (replace immediately if found).	

4.2.4. Annual Technical Maintenance Checklist

To be performed by the Service Provider.

Item	Checkpoint	Status (Y/N)
Pressure Test	Conduct a static pressure drop test at 1.5 x design pressure for 60 mins.	
Regulators	Check for "creep" (internal seat leakage) and recalibrate gauges.	
Flashback	Test and certify all Flashback Arrestors (Hydrogen, Methane, LPG).	
Earthing	Test electrical continuity and grounding of manifolds to prevent static.	
Valves	Strip and service (or replace) main isolation and non-return valves.	
Compliance	Issue a valid Certificate of Conformity (CoC) for the entire installation.	
Cylinder Age	Check "Hydro-test" dates on the cylinder necks; return expired bottles to supplier.	

Where any component is identified during preventative maintenance as likely to fail before the next scheduled maintenance cycle, the Service Provider shall notify the University in writing and recommend early replacement in order to minimise downtime and ensure continued safe operation of the equipment.

The Service Provider shall verify all tasks against the applicable OEM maintenance manuals for the specific equipment models installed on site and shall update the schedule accordingly once the asset register has been verified. Where OEM requirements or applicable standards prescribe additional or different tasks, those

requirements shall take precedence and be implemented. Any material deviations from the indicative schedule, including the time and cost implications, shall be submitted to the University for review and acceptance.

The Service Provider shall complete inspection sheets for each maintenance visit.

4.2.5. Daily and Weekly Visual Inspection Checklist

To be performed by Lab Technicians, Chefs, or Workshop Managers, or appointed Service Provider.

Item	Checkpoint	Status (Y/N)
Securing	Are all cylinders upright and chained/strapped securely?	
Pressure	Are cylinder pressures within the operating range (not empty)?	
Odour	Is there any smell of gas (especially "Rotten Eggs" for LPG/Methane or "Pungent/Bleach" for Ammonia)?	
Environment	Is the area around the bottles clear of combustible materials (paper, wood, oil)?	
Access	Are emergency shut-off valves and exit paths unobstructed?	
Leaks	Are there any audible hissing sounds from regulators or valves?	

4.2.6. Maintenance Intervals and activities table

Frequency	Task	Responsibility
Daily (Refer to maintenance checklist 4.2.6 for details)	Visual check of "High/Low" pressures and cylinder securing. Check cylinder body for any signs of rust, dents, gouges, cuts, bulges, or corrosion . Any cylinder with structural defects or wall thickness below 90% of the design must be removed from service.	Lab Supervisor/Chef

	Ensure the protective valve cap is present when not in use. Verify the supplier's seal (e.g., Afrox red seal) is intact upon receipt of a full cylinder. Inspect all hoses, tubing, and connections (regulators, pigtails) for cracks, perishing, or brittleness.	
Monthly (Refer to maintenance checklist 4.2.3 for details)	Leak testing of manifolds and pigtails; sensor calibration check.	Registered Practitioner
Bi-Annually	Service of regulators, changeover manifolds, and flashback arrestors.	Registered Practitioner
Annually (Refer to maintenance checklist 4.2.4 for details)	Full system pressure test (1.5 x OP) and CoC validation.	Registered Practitioner
5-10 Years	Hydrostatic cylinder testing (usually handled by gas supplier).	Afrox / Air Liquide

4.3. Inspection Sheets and Reporting

4.3.1. Inspection Sheets

The Service Provider shall develop and provide standardised inspection sheets and maintenance checklists for all preventative maintenance categories defined in this contract (Categories A–C). These inspection sheets shall be aligned with the applicable OEM guidelines, maintenance procedures, and regulatory and compliance standards for the relevant equipment.

Inspection sheets shall clearly record the following as a minimum:

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- Date of inspection and equipment identification
 - Required maintenance tasks with completion confirmation
 - Observations, faults, or defects identified
 - Name and signature of the person performing the activity

Hard copies of the completed Category C inspection sheets shall be retained on site and copies shall be submitted to the University via email on a weekly basis. The University shall review all completed sheets, follow up on any reported observations.

4.3.2. Documentation and compliance

All maintenance must be documented. A maintenance file for each **University** campus building must be kept on site.

To pass a Department of Labour audit, the following must be kept in the "On-Site Gas File":

- **Inventory List:** Maximum number of bottles permitted per faculty.
- **Safety Data Sheets (SDS):** Available in English for every gas listed above.
- **SAQCC Gas Licenses:** Proof of competency for the maintaining Service Provider.
- **Pressure Test Certificates:** Documenting the 1.5 x design pressure hold for 60 minutes.

4.3.3. Reporting

The Service Provider shall maintain a two-tier reporting structure consisting of a service report per maintenance intervention and a monthly summary report.

Service Report (Per Intervention)

All maintenance must be documented. A maintenance file for each University campus building must be kept on site.

Following each preventative or corrective maintenance intervention performed by the Service Provider, a service report shall be generated and submitted to the OFMD within 24 hours of attendance. The service report shall include, but not be limited to:

- A Maintenance report detailing parts replaced.
- Pressure Test Certificates.
- An updated Certificate of Conformity (CoC) if any modifications were made.

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- Equipment identification and location.
 - Date and time of attendance.
 - Description of maintenance activities performed.
 - Test results or verification checks where applicable.
 - Details of any faults identified.
 - Components replaced or repaired, including part numbers.
 - Recommendations for corrective actions where required.

Monthly Summary report

The Service Provider shall compile and submit a monthly maintenance report to the OFMD summarising all maintenance and validation activities carried out during the reporting period. This shall be submitted no later than the fifth (5th) working day of the following month. The monthly report shall include, but not be limited to:

- Summary of preventative maintenance performed (by category and site).
- Summary of corrective maintenance interventions, including status (resolved or pending).
- Equipment currently out of service or awaiting parts, with estimated resolution dates.
- Outstanding recommendations requiring University decision/approval.
- Confirmation of any non-conformances or compliance concerns identified during the reporting period.
- Quotations shall be included in the monthly reports where necessary, detailing the reason for repairs and spare parts.
- Copies of Inspection sheets.

4.4. Corrective Maintenance

4.4.1. Scope of Corrective Maintenance

Corrective maintenance shall be carried out in accordance with applicable regulatory and compliance standards and OEM requirements.

Corrective maintenance shall be undertaken on an as-required basis in response to:

- Equipment failures.
- Performance issues identified by the Service Provider or reported by the University.
- Faults identified during preventative maintenance.
- University-reported malfunctions.
- Defects identified during the initial asset assessment.

Corrective maintenance shall aim to restore the equipment to its original operational and safety performance standards. The scope shall include, but not be limited to:

- Call-Out attendance and fault-finding
- Repairs and replacement of defective or failed components.
- Cleaning where required as part of fault rectification.
- Obtaining written University approval before removal of any equipment or parts.

Where maintenance identifies defects that cannot be corrected immediately, the Service Provider shall:

- Record the defect
- Report to the University
- Track the item until resolved

No item shall be considered complete until the defect is closed out or formally accepted by the University.

4.4.2. Initial Restoration Phase

Following the completion of the asset register verification, any corrective maintenance identified during the initial assessment shall be scheduled and executed to restore all equipment to full operational condition.

The Service Provider shall submit a consolidated defect list to the University upon completion of the asset assessment, detailing all pre-existing defects identified per asset.

4.4.3. Spare Parts and Lead Times

Certain equipment within the scope may require imported or specialist spare parts, which may result in extended lead times. The Service Provider shall be aware of the university's service level requirements relating to response times and shall communicate anticipated delays to the University.

Where equipment is awaiting spare parts, and cannot be operated safely, such equipment may be placed out of service in accordance with the university's procedures. The asset status will be updated accordingly, and the University shall be notified in writing.

The contactor shall maintain a documented parts tracking log for all outstanding orders, recording the date of order placement, expected delivery date, and status. This log shall be included as part of the monthly maintenance report where applicable.

All replacement components and spare parts used for corrective maintenance shall be new, undamaged, fit for purpose, and compatible with the existing equipment. Where OEM parts are mandatory, these shall be procured accordingly. Spare parts shall not be procured or installed without prior written approval from the University. The Service Provider shall provide a quotation to the University for each spare part prior to procurement, and proof of purchase shall be submitted to the University upon delivery. Quotations shall be included in the monthly reports where necessary, detailing the reason for repairs and spare parts. Payment for spare parts shall be certified at the approved markup as defined in the Bill of Quantities.

4.5. Gas Bottles Storage

Gas bottles shall be stored and segregated according to their contents.

4.5.1. Gas Segregation & Compatibility Matrix

To ensure compliance with **SANS 10019** and **SANS 10087-1**, different gas types must be separated to prevent chemical reactions, fire acceleration, or toxic contamination in the event of a leak.

The following table dictates how to store the specific gases used at **WITS University**:

Gas Type	Included Gases	Segregation Requirement
Flammable	Hydrogen, Methane, LPG	Store 3m away from Oxidisers or use a 30-min fire wall.
Oxidising	Oxygen, Air Tech	Keep separate from flammables and all oils/greases.
Toxic/Corrosive	Ammonia	Isolate from all other gases; requires dedicated ventilation.
Inert/Non-Flammable	Nitrogen, Argon, Helium,	Generally compatible; can be used as a buffer between O ₂ and H ₂ .
Medical	Medical	Store in a clean, dry area ; keep separate from industrial gases.

4.5.2. Detailed Segregation Rules for WITS Gas Stores

- **Toxic Isolation (Ammonia):**

- Ammonia should ideally be stored in its own dedicated, externally ventilated cabinet. It must **never** be stored with Flammables or Oxidisers as it can react violently.
- **The "3-Metre Rule":**
 - **Hydrogen/Methane/LPG** must be separated from **Oxygen/Air Tech** by at least **3 metres** or a 2-metre high, 30-minute fire-rated masonry wall.
- **Inert Buffering:**
 - You can use "Inert" gases (Nitrogen, Argon, Helium, Carbon Dioxide) as a physical spacer between Flammable and Oxidising cylinders if space is limited.
- **Empty vs. Full:**
 - Always mark and separate empty cylinders from full ones to prevent confusion during emergencies or lab procedures.
- **Corrosive Awareness:**
 - Ammonia is corrosive to copper and brass. Ensure no brass fittings or copper pipes from other systems are in the immediate vicinity of Ammonia storage.

4.5.3. Storage Checklist for Campus Safety

1. **Signage:** Ensure the **Hazchem** symbols for "Flammable Gas" (Red), "Non-Flammable Non-Toxic" (Green), "Oxidising" (Yellow), and "Toxic" (White) are clearly posted on the store entrance.
2. **Flooring:** The floor must be level, non-combustible, and well-drained.
3. **Fire Protection:** Ensure dry chemical powder (DCP) or Carbon Dioxide fire extinguishers are mounted **outside** the gas store entrance, not inside.
4. **Security:** All gas stores must be locked and access restricted to authorised personnel/lab technicians only.

4.6. Decommissioning

If, during the course of maintenance, any equipment is determined to be beyond economical repair or incapable of being restored to safe and compliant operating condition due to asset age, failure mode status and risk exposure, the Service Provider shall:

- Provide a written technical assessment outlining the reasons for such determination
- Submit a formal recommendation for decommissioning to University

- Obtain written approval from the University prior to undertaking any decommissioning activity.
- Decommissioning shall include safe isolation ONLY. The Service Provider is not to remove the asset from the university premises.
- The asset register shall be updated accordingly, including the reason for decommissioning and reports and supporting documentation shall be submitted to the University.

Once formally decommissioned and recorded in the asset register, the equipment shall be removed from the active maintenance schedule. The Service Provider shall adjust maintenance planning and associated cost provisions accordingly, with no additional charge to the University for assets no longer in service.

5. VALIDATION

Validation shall be undertaken to confirm that equipment operates safely and in compliance with applicable compliance standards and regulatory requirements.

The Service Provider shall carry out validation procedures for the compressed gas bottles in accordance with the requirements of this Scope of Works.

The Service Provider is responsible for monitoring certification due dates and planning certification activities to ensure continuous compliance.

5.1. Validation Requirements and Frequency

Validation shall be carried out at the following minimum frequencies, unless otherwise required by applicable standards or OEM guidelines,

It must be noted that **“The 5-Year Rule”** applies universally and it stipulates that: Even if no changes are made, a new **CoC** should be issued every **5 years** to ensure the installation still meets the latest SANS revisions.

Where manufacturer manuals or applicable regulatory and compliance standards prescribe specific validation procedures, test methods, or validation intervals, such requirements shall take precedence and be strictly followed.

5.2. Validation Procedures

Validation procedures shall be carried out by trained, competent, and accredited personnel using appropriate methods and equipment.

Where applicable, validation shall be performed in accordance with OEM guidelines, as well as relevant SANS standards etc. Equipment shall only be deemed compliant where test results meet the measurable acceptance criteria defined in, but not limited to applicable SANS requirements, or OEM performance specifications.

Calibration performed as part of compliance testing for validation purposes shall form part of validation activities.

5.3. Validation Records and Reporting

Upon completion of validation activities, the Service Provider shall issue validation records and update the University's asset register to reflect the validation status of each item of equipment. The Service Provider is to issue validation labels for the equipment.

Validation records shall include, as a minimum:

- Date of validation
- Equipment identification details
- Outcome of validation
- Any limitations, non-compliances, or recommendations identified
- Proof of accreditation and calibration certificates of testing instruments shall be provided upon request.

6. MANDATORY MINIMUM REQUIREMENTS

6.1. Gas specific maintenance requirements

A. Toxic & Corrosive Gases (Ammonia)

- **Leak Detection:** Must use sulphur sticks or electronic sensors specifically calibrated for Ammonia.
- **PPE:** Maintenance must have immediate access to full-face respirators and chemical-resistant gloves.
- **Ventilation:** Ensure dedicated scrubbers or extraction fans are operational.

B. Flammable Gases (Methane, Hydrogen, LPG)

- **Flashback Arrestors:** Must be tested bi-annually. Replace every 5 years regardless of condition.

- **Static Grounding:** Ensure all manifold systems are bonded to earth to prevent static ignition.
- **Ex-Rating:** Verify all electrical switches in the vicinity remain "Flameproof."

C. Oxidizers (Oxygen, Air Tech)

- **Hydrocarbon-Free:** Absolute "No Oil/Grease" policy. Maintenance tools must be degreased.
- **Seal Integrity:** Only use PTFE tape specifically approved for Oxygen use (Green/Yellow).

D. Inert & Medical (Nitrogen, Argon, Helium, Medical Carbon Dioxide)

- **Oxygen Depletion Sensors:** Monthly battery and calibration checks in poorly ventilated lab basements.
- **Purity Checks:** For "Tech" and "Medical" grades, ensure regulators are dedicated to prevent cross-contamination.

6.1.1. Comprehensive Maintenance Checklist

1: Storage & Physical Security

- **Securing:** All cylinders (full or empty) must be chained or bracketed at 2/3 height.
- **Segregation:** Flammables (Hydrogen/Methane) must be separated from Oxidisers (Oxygen) by a 3m distance or a 30-minute fire-rated wall.
- **Cylinder Dates:** Check "Test Dates" on cylinder necks; report expired bottles to the supplier immediately.

2: Manifolds & Distribution

- **Pigtails:** Inspect flexible high-pressure hoses for "bulging," fraying, or kinking.
- **Non-Return Valves (NRV):** Verify NRVs are functional to prevent back-filling of cylinders.
- **Corrosion:** Inspect copper and stainless-steel piping for oxidation, especially in chemistry labs.

3: Regulators & Gauges

- **Diaphragm Check:** Ensure no gas is venting from the regulator "bonnet" hole.

- **Creep Test:** Close the downstream valve; if the low-pressure gauge continues to rise, the regulator is faulty.
- **Labelling:** Ensure gauges are clearly marked for the specific gas type.

4: Emergency Procedures (SOP)

1. Leak Detected:

1. **Inert:** Evacuate (Asphyxiation risk).
 2. **Flammable:** Eliminate ignition sources, evacuate, call Fire Dept.
 3. **Toxic (Ammonia):** Don PPE, isolate supply, activate emergency extraction.
2. **Cylinder Fire:** Do not attempt to extinguish a flame if the gas supply cannot be shut off (explosion risk).
3. **Reporting:** All incidents must be logged in the WITS OHSE Incident Register.

All maintenance, validation, calibration, and related services under this contract shall be performed by trained, competent, and OEM accredited personnel.

For the purposes of this contract, trained and competent personnel shall be defined as individuals who:

- The Service Provider to have one SAQCC (Compressed Gas) registered technician
- Have received formal training relevant to the specific gas bottles and equipment type
- Hold any required accreditation, validation, or competency registration applicable to regulated gas bottles.
- Are authorised and/or recognised by the OEM, where such authorisation is required, and are deemed competent by the OEM to perform maintenance, servicing, or validation activities on the relevant equipment.

The Service Provider shall ensure that all personnel remain appropriately qualified and accredited for the full duration of the five (5) year contract period. Qualifications, accreditations, and certifications shall be reviewed and renewed annually, and proof of renewal submitted to the University.

6.2. Service Provider Requirements

Site assessments shall include but not be limited to the following:

- a) Conduct a detailed inspection of the gas bottles installations, including cylinders, valves, discharge nozzles, control panels, detectors, manifolds, gauges, colour coding, etc.
- b) Identify any damaged, faulty, or non-compliant components.

6.2.1. Documentation and Record Keeping

All documentation generated during specialist or corrective maintenance shall be submitted to the University and captured in the prescribed asset register template within 24 hours of completion of each intervention. Documentation shall include, but not be limited to:

- Service reports
- Calibration certificates
- Validation records and compliance certificates
- Proof of authorisation used for the intervention
- Parts replaces, including OEM part numbers and proof of purchase.

The Service Provider shall obtain all applicable OEM operation, maintenance, and technical manuals for the installed equipment. Copies shall be submitted to the University.

6.3. Response Time and Performance Requirements

The Service Provider shall respond to reported failures in a timeous and professional manner.

Response times shall take into consideration:

- The safety risk posed by the failure
- The impact on laboratory operations
- The availability of hazardous materials within the affected equipment
- The University's operational requirements

All corrective maintenance requests shall be formally logged and issued by the OFMD, who shall assign the applicable priority level.

6.3.1. Maintenance response times

The required response time for Call Outs and other events is as follows:

- **Priority 1** (Emergencies) – within 1 hour. The requirement is that the Service Provider is on site within 1 of an emergency condition to provide support. This would typically entail a scenario where a system is not available, or a condition which is life threatening.
- **Priority 2** (Urgent) – within 3 hours. This condition would typically require attention but it is not an emergency.
- **Priority 3** (General) – within 6 hours.

Any work / event requiring extended repair time shall be discussed and agreed between the University and the Service Provider.

6.3.2. Performance requirements

The Service Provider shall, in terms of performance requirements:

- Minimise equipment downtime
- Ensure that preventative maintenance is completed within scheduled windows
- Service reports shall be submitted within 24 hours of attendance.
- Maintain accurate and up-to-date asset records following each intervention.
- Ensure that certified equipment remains compliant with applicable standards at all times

6.3.3. Working Hours

The Service Provider shall be available 24 hrs a day, 7 days a week including holidays. All planned work shall be carried out during normal working hours (7:00 am to 5:00pm) on days and times agreed with the University.

The University shall issue the Service Provider with the Academic Calendar for each year. This document shall contain key dates that may limit the nature of the work that may take place.

6.4. Site Safety and Emergency procedures

To comply to the Department of Employment and Labour (DOEL) audit at the University, the Gas Safety File (often called the "Red File") must be organized, indexed, and readily available for each faculty.

6.4.1. University Gas Safety File: Master Index Template

Section	Content Description	Requirement / Standard
1.0	Appointment & Competency	
1.1	Copy of current SAQCC Compressed Gas Registration Card (for all Service Providers).	Mandatory (PER)
1.2	Letter of Appointment for the Responsible Person (WITS Staff).	OHS Act Sec 16.2
2.0	Compliance Documentation	
2.1	Original Certificate of Conformity (CoC) for the installation.	SANS 10087 / 10019
2.2	Most recent Annual Pressure Test Certificate.	SANS 827 / 329
2.3	Design Drawings / P&ID (Piping & Instrumentation Diagram).	As-Built Layouts
3.0	Safety Data Sheets (SDS)	
3.1	GHS-compliant SDS for Ammonia, Methane, Hydrogen, LPG.	SANS 10234
3.2	GHS-compliant SDS for O ₂ , N ₂ , Ar, He, CO ₂ (Industrial/Medical).	SANS 10234
4.0	Maintenance Logs	
4.1	Daily Visual Checklists (signed by Lab/Kitchen staff).	WITS Internal SOP
4.2	Monthly Inspection Reports (signed by Facilities).	WITS Internal SOP
4.3	Annual Service Records (signed by Registered Practitioner).	PER Requirement
5.0	Equipment Calibration	
5.1	Calibration certificates for Gas Leak Detectors / Oxygen Sensors.	Manufacturer Spec

5.2	Test certificates for Flashback Arrestors (H ₂ , Methane, LPG).	SANS 501417
6.0	Emergency & Risk Management	
6.1	Site-Specific Risk Assessment (HIRA).	OHS Act
6.2	Emergency Response Plan (Specific to Ammonia/Flammable leaks).	WITS OHSE Policy
6.3	Incident / Near-Miss Register.	COID Act

The Service Provider shall compile, maintain and work in accordance with a Safety File for the duration of the contract in compliance with the Occupational Health and Safety Act (Act 85 of 1993) and all regulations promulgated thereunder. The Safety File shall be made available to the University upon request and updated throughout the contract period to reflect current site conditions, risk assessments, and method statements.

The Service Provider shall comply with all applicable site health and safety requirements, University compressed gas bottles' procedures, and any permit-to-work, decontamination requirements or access control requirements in force at the time of each visit.

The Service Provider shall provide, maintain, and correctly use all personal protective equipment (PPE) appropriate to the hazards associated with compressed gas bottles.

6.5. Site Coordination and Access

The Service Provider shall coordinate all maintenance, validation, corrective works, and planned shutdowns with the OFMD.

No work affecting building services, access, or operations shall proceed without prior notification and approval from OFMD where required.

All corrective maintenance call-outs shall be formally initiated and authorised by OFMD. The Service Provider shall not respond to direct requests from maintenance personnel or other departments. All requests are to be officially logged and approved through OFMD.

7. ASSET MANAGEMENT

7.1. Asset Assessment and Register Verification

A once-off assessment of all equipment within the scope shall be undertaken to verify the provided asset register. This shall include, but not be limited to:

- Verification of asset existence and location
- Confirmation of operational status
- Verification of model numbers, serial numbers and asset tags
- Identification of missing, obsolete, or decommissioned equipment
- Tagging of assets to indicate verification has been completed.

Verified asset data shall be captured in the prescribed template by the Service Provider

Currently, the asset register lists the following equipment:

- Gas bottles within the university

7.2. Asset Register

Verified asset information shall be captured in the prescribed asset register template.

The Service Provider shall be responsible for ensuring that asset information provided by the University is accurate, complete, and aligned with the physical equipment installed on site. Service Provider to update and capture details on prescribed asset register template where necessary with the correct information.

The Service Provider shall be responsible for updating the prescribed asset register template following each maintenance, repair, validation, or corrective intervention over the contract period of 5 years.

Prescribed asset register template updates shall include, but not be limited to:

- Date of intervention
- Type of work performed (preventative, corrective, validation)
- Description of work carried out
- Parts replaced or installed (including part numbers where applicable)
- Changes in operational status
- Name and details of Service Provider

The Service Provider shall update the asset register template and submit the relevant maintenance records within 24 hours of completion of any maintenance, repair, validation, inspection, or decommissioning activity. The relevant work shall not be regarded as complete until the records have been submitted to the University.

7.3. Decommissioning of Assets

Where equipment is decommissioned, the Service Provider shall perform the following duties, but not limited to:

- Update the asset register template to reflect the decommissioned status
- Record the reason for decommissioning
- Record the date for decommissioning
- Identify whether the equipment is removed, isolated or retained
- University approval before decommissioning

7.4. Introduction of New Equipment

Where new or replacement equipment is installed by the University, such equipment shall only be incorporated into the maintenance programme following expiry of the manufacturer's warranty period and upon written agreement between the Service Provider and the University. The Service Provider shall have no obligation to maintain, service, or validate equipment that remains under active manufacturer's or installer's warranty unless specifically instructed to do so in writing by the University.

8. SUBCONTRACTING

The University prefers to contract directly with all Service Providers, and the Service Provider must not subcontract any of its responsibilities or obligations.

9. DELIVERY AND STORAGE OF SPARE PARTS

- The Service Provider shall be responsible for the supply, delivery and management of all spare parts required for all maintenance activities.
- Spare parts shall not be procured or installed without prior written approval from the University.
- All spare parts supplied shall be new, fit for purpose, compatible with the existing equipment, and compliant with applicable safety and compliance standards and OEM requirements.
- Where OEM-specific parts are mandatory, these shall be supplied accordingly.
- Service Provider to provide a quotation to the University for each spare part.
- For generic or non-proprietary parts, the Service Provider shall obtain a minimum of three (3) competitive quotations prior to procurement and submit these to the University for approval. The University reserves the right to select the preferred supplier.

- Where OEM-specific or proprietary parts are required, the Service Provider shall clearly identify this in the quotation and provide the applicable OEM part number and recommended supplier. Substitution of OEM parts with non-OEM equivalents shall not be permitted without prior written approval from the University.
- All spare parts shall be supplied at cost plus the approved markup rate as tendered in the Bill of Quantities.

10. GAS SEGREGATION AND COMPATIBILITY MATRIX

To ensure compliance with **SANS 10019** and **SANS 10087-1**, different gas types must be separated to prevent chemical reactions, fire acceleration, or toxic contamination in the event of a leak.

The following table dictates how to store the specific gases used at **WITS University**:

Gas Type	Included Gases	Segregation Requirement
Flammable	Hydrogen, Methane, LPG	Store 3m away from Oxidisers or use a 30-min fire wall.
Oxidising	Oxygen, Air Tech	Keep separate from flammables and all oils/greases.
Toxic/Corrosive	Ammonia	Isolate from all other gases; requires dedicated ventilation.
Inert/Non-Flammable	Nitrogen, Argon, Helium,	Generally compatible; can be used as a buffer between O ₂ and H ₂ .
Medical	Medical	Store in a clean, dry area ; keep separate from industrial gases.

101 Detailed Segregation Rules for WITS Gas Stores

- **Toxic Isolation (Ammonia):**
 - Ammonia should ideally be stored in its own dedicated, externally ventilated cabinet. It must **never** be stored with Flammables or Oxidisers as it can react violently.

-
- **The "3-Metre Rule":**
 - **Hydrogen/Methane/LPG** must be separated from **Oxygen/Air Tech** by at least **3 metres** or a 2-metre high, 30-minute fire-rated masonry wall.
 - **Inert Buffering:**
 - You can use "Inert" gases (Nitrogen, Argon, Helium, Carbon Dioxide) as a physical spacer between Flammable and Oxidising cylinders if space is limited.
 - **Empty vs. Full:**
 - Always mark and separate empty cylinders from full ones to prevent confusion during emergencies or lab procedures.
 - **Corrosive Awareness:**
 - Ammonia is corrosive to copper and brass. Ensure no brass fittings or copper pipes from other systems are in the immediate vicinity of Ammonia storage.

10.2 Storage Checklist for Campus Safety

5. **Signage:** Ensure the **Hazchem** symbols for "Flammable Gas" (Red), "Non-Flammable Non-Toxic" (Green), "Oxidising" (Yellow), and "Toxic" (White) are clearly posted on the store entrance.
6. **Flooring:** The floor must be level, non-combustible, and well-drained.
7. **Fire Protection:** Ensure dry chemical powder (DCP) or Carbon Dioxide fire extinguishers are mounted **outside** the gas store entrance, not inside.
8. **Security:** All gas stores must be locked and access restricted to authorised personnel/lab technicians only.

11. Annexure C – Gas Bottles Asset Register

BUILDING	GAS LOCATION	SUPPLY AREA	TYPE OF GAS	MAKE	SIZE OF BOTTLE in kg	QTY
Post Grad Club	Outside Cage	Kitchen	LP Gas	Unknown	9	2
			LP Gas	Unknown	4,5	1
Matrix	Back Cage	Shops	LP Gas	Afrox	unknown	4
Sanctuary	Kitchen	Kitchen Stove	LP Gas	Unknown	4,5	1
Humphrey Raikes	Outside Cage	Lab 113, Lab 117, Lab 112	Hydrogen	Afrox	0,74	12
			Helium	Afrox	1,51	11
			Argon	Afrox	17,4	15
			Air Tec(O2/N2)	Afrox	8,5	14
			Carbon Dioxide	Afrox	31,3	2
			Mix Gas	Afrox	8,378	3
			Oxygen	Afrox	10,2	16
			Acetylene	Afrox	8	4
			Nitrogen	Afrox	11	16
			Methane	Afrox	8,1	1
			Synthetic Air	Afrox	11,6	1
			No name	Afrox		2
Humphrey Raikes	Lab B18DA	B18D, B18E, B18F	Hydrogen	Afrox	0,74	3
			Helium	Afrox	1,51	1
			Argon	Afrox	17,4	2
			Air Tec(O2/N2)	Afrox	8,5	2
			Mix Gas	Afrox	8,378	3
			Oxygen	Afrox	10,2	1
			Nitrogen	Afrox	11	3
Humphrey Raikes	113 Catalysis Lab	113 (Fume hoods)	Hydrogen	Afrox	0,74	2
Humphrey Raikes	115 3rd Year Lab	115 (bench and Fume hood)	Air Tec(O2/N2)	Afrox	8,5	1
			Mix Gas	Afrox	8,378	1
			Nitrogen	Afrox	11	1
Humphrey Raikes	Lab 115 B	115 B Equipment on Table	Nitrogen	Afrox	11	1
			Hydrogen	Afrox	0,74	3
Humphrey Raikes	117 Research Lab	117 (Fume Hood)	Ammonia	Afrox		1

			Mix Gas	Afrox	8,378	3
			Synthetic Air	Afrox	11,6	1
Humphrey Raikes	Lab 117 B	117B	Argon	Afrox	17,4	1
			Mix Gas	Afrox	8,378	2
Humphrey Raikes	122 Organo metallic Lab	122 Fume `Hoods	Nitrogen	Afrox	11	10
			Mix Gas	Afrox	8,378	3
			Argon	Afrox	17,4	3
			Carbon Dioxide	Afrox	31,3	1
			Ethylene	Afrox	18,5	1
			Hydrogen	Afrox	0,74	2
			Helium	Afrox	1,51	1
Humphrey Raikes	Lab 119 B	119 Fume Hoods	Nitrogen	Afrox	11	6
			Mix Gas	Afrox	8,378	1
			Carbon Dioxide	Afrox	31,3	1
			Hydrogen	Afrox	0,74	1
			Oxygen	Afrox	10,2	1
Humphrey Raikes	Lab 328	328 Equipment	Argon	Afrox	17,4	2
			Helium	Afrox	1,51	1
Humphrey Raikes	Lab 328 B	328 B	Nitrogen	Afrox	11	3
			Air Tec(O2/N2)	Afrox	8,5	3
			Hydrogen	Afrox	0,74	2
			Helium	Afrox	1,51	1
Humphrey Raikes	313 Analytical lab	313 Equipment	Nitrogen	Afrox	11	1
Humphrey Raikes	Lab 317	315 Fume hoods	Nitrogen	Afrox	11	5
Humphrey Raikes	Lab 318	318 Fume Hoods	Nitrogen	Afrox	11	6
Humphrey Raikes	Lab 322	322 Fume hoods	Nitrogen	Afrox	11	2
			Hydrogen	Afrox	0,74	2
Humphrey Raikes	Lab 324	324	Oxygen	Afrox	10,2	1
Humphrey Raikes	Lab 329	329 Fish Tank, fume hoods	Nitrogen	Afrox	11	10
Humphrey Raikes	Lab 330 A	330 A	Nitrogen	Afrox	11	4
			Oxygen	Afrox	10,2	2
			Argon	Afrox	17,4	2
			Carbon Dioxide	Afrox	31,3	2
Humphrey Raikes	Lab 330 B (No Gas Detector)	330 B Fume hood and Equipment	Mix Gas	Afrox	8,378	3
			Argon	Afrox	17,4	5
			Helium	Afrox	1,51	1
			Oxygen	Afrox	10,2	1
			Hydrogen	Afrox	0,74	1

			Air Tec(O2/N2)	Afrox	8,5	1
			Ammonia	Afrox		1
			Nitrogen	Afrox	11	4
			Carbon Dioxide	Afrox	31,3	1
			Balance(H2/N2)	Afrox		1
Hillman	Outside Cage	Lab H2 and H3 Lab Instruments	Synthetic Air	Afrox	11,6	3
			Argon	Afrox	17,4	2
			Nitrogen	Afrox	11	5
			Hydrogen	Afrox	0,74	2
			Acetylene	Afrox	8	5
			LP Gas	Unknown	48	1
			Helium	Afrox	1,51	3
			Carbon Dioxide	Afrox	31,3	1
Hillman	Workshop 1	Workshop Welding Equipment	Argo shield	Afrox	17,8	1
			Oxygen	Afrox	10,2	1
			Acetylene	Afrox	8	1
			Argon	Afrox	17,4	2
			Nitrogen	Afrox	11	1
Hillman	Workshop 2 PSA ROOM	Workshop Equipment	Helium	Afrox	1,51	1
Hillman	Carbonation Room	Instruments	Carbon Dioxide	Afrox	31,3	1
Hillman	Concrete Durability Lab	Durability lab	Oxygen	Afrox	10,2	1
Hillman	Concrete Creep Room	Creep room	Nitrogen	Afrox	11	1
Hillman	Room 224	224	Synthetic Air	Afrox	11,6	1
			Nitrogen	Afrox	11	1
Hillman	235 Workshop	235	Air Tec(O2/N2)	Afrox	8,5	1
			Carbon Dioxide	Afrox	31,3	1
Oppenheimer Life Sciences	Outside Cage Basement	B035 & B036 CO2 chamber	Carbon Dioxide	Afrox	31,3	8
Oppenheimer Life Sciences	G016 LAB	G016	Carbon Dioxide	Afrox	31,3	2
Oppenheimer Life Sciences	2010 Plant LAB	2010 Lab	mix gas	Afrox	1,6	1
Oppenheimer Life Sciences	2020 LAB	2020 lab	helium	Afrox	1,51	2
Richard Ward	Outside Cage	Lab 203 Atomic Absorption Lab	Nitrogen	Air Liquid	11	10
			Nitrogen	Afrox	11	7
			Carbon Dioxide	Air Liquid	37	9
			Nitrogen Tech	Afrox	11	3
			Air dry	Afrox	8,5	1
			Synthetic Air	Afrox	11,6	14
			Medical Nitrous Oxide	Afrox		4
			Acetylene	Afrox	8,6	7

			Argon	Afrox	17,4	8
			Air Tec(O2/N2)	Afrox	8,5	7
			Liquid Sulphur Dioxide	Afrox	78	1
			mix gas	Afrox	9,7	4
			Methane	Afrox	7,5	2
			Oxygen tech	Afrox		8
			helium	Afrox	1,51	5
			Mix gas Small	Afrox	1,382	1
			mix gas	Afrox	7	1
Richard Ward	Outside Small Cage 1	Lab 101, lab 136, lab 134A	Carbon Dioxide	Afrox	31,3	1
			Nitrogen	Afrox	11	2
			Argon	Afrox	17,4	3
			Air Tec(O2/N2)	Afrox	8,5	2
			mix gas	Afrox	9,7	1
			Oxygen	Afrox	10,2	3
			Hydrogen	Afrox	0,74	4
Richard Ward	Outside Small Cage 2	Lab 329	Carbon Dioxide	Afrox	31,3	3
			Nitrogen	Afrox	11	1
			Air Tec(O2/N2)	Afrox	8,5	1
			Oxygen	Afrox	10,2	1
Richard Ward	3rd year chemical Lab	machine	Carbon Dioxide	Afrox	31,3	1
Richard Ward	Peter King Lab	Equipment	Nitrogen	Afrox	11	1
Richard Ward	202 Biochemical Lab	Fume hoods	Carbon Dioxide	Afrox	31,3	3
			Air Tec(O2/N2)	Afrox	8,5	1
			helium	Afrox	1,51	1
Richard Ward	Peter King Lab	205 Catalysis Lab	Nitrogen	Air Liquid	11	2
			Nitrogen	Afrox	11	1
			Synthetic Air	Afrox	11,6	1
			Hydrogen	Afrox	0,74	1
			Carbon Dioxide	Afrox	31,3	1
			Mix Gas	Afrox	8,378	6
Richard Ward	512 Material Prep Room	Equipment	Argon	Afrox	17,4	2
Richard Ward	7th floor Bio-oil Lab	Equipment	Argon	Afrox	17,4	1
			Hydrogen	Afrox	0,74	1
			Nitrogen	Afrox	11	2
			helium	Afrox	1,51	1
			Carbon Dioxide	Afrox	31,3	2
			Air dry	Afrox	8,5	2
Richard Ward	239 Coal & Carbon Research	Equipment	Mix Gas	Afrox	8,378	2
			Nitrogen	Afrox	11	1
			Carbon Dioxide	Afrox	31,3	1

Richard Ward	Lab 109	Equipment	Argon	Afrox	17,4	1
			Carbon Dioxide	Afrox	31,3	1
Richard Ward	Lab 102	Equipment	Oxygen	Afrox	10,2	1
			Argon	Afrox	17,4	1
			Carbon Dioxide	Afrox	31,3	1
			Argo shield	Afrox	17,8	1
Richard Ward	Lab 101	Equipment	Mix Gas	Afrox	8,1	1
			Nitrogen Tech	Afrox	11	2
			Air IGO	Afrox		1
Richard Ward	Room 122	Equipment	Nitrogen	Afrox	11	1
			Air Tec(O2/N2)	Afrox	8,5	1
Richard Ward	Lab 136 Hot Press	Equipment	Argon	Afrox	17,4	2
			Nitrogen	Afrox	11	1
Richard Ward	Room 134A	Machine (Electron Microscope)	Nitrogen	Afrox	11	1
Richard Ward	5th floor Fuel & Petrochemical Lab	Equipment	Nitrogen	Air Liquid	11	1
			Air Tec(O2/N2)	Afrox	8,5	2
			Hydrogen	Afrox	0,74	1
			Mix Gas	Afrox	8,378	2
Richard Ward	509 Hardness Testing Lab	Equipment	Air Tec(O2/N2)	Afrox	8,5	1
			Methane	Afrox	7,5	1
Gate house	LAB GH511	Equipment	Carbon Dioxide Tech	Afrox	31,3	1
Gate house	LAB GH514	Equipment	Carbon Dioxide Medical	Afrox	31,3	1
Gate house	LAB GH517	Equipment Fume hood	Carbon Dioxide	Afrox	31,3	1
Gate house	ROOM GH524	GH523, GH522, GH521	Carbon Dioxide Tech	Afrox	31,3	7
			Carbon Dioxide IG0	Afrox	31,3	1
Gate house	LAB GH526	Equipment	Carbon Dioxide Tech (Wet)	Afrox	31,3	11
Gate house	LAB 427	Equipment	Carbon Dioxide Tech	Afrox	31,3	4
			Nitrogen	Afrox	11	4
Gate house	ROOM GH612	Equipment	Carbon Dioxide Tech	Afrox	31,3	1
Gate house	LAB GH619	Fume hoods	Carbon Dioxide Tech	Afrox	31,3	1
Gate house	ROOM GH708	Equipment	Carbon Dioxide	Afrox	31,3	4
Gate house	7th floor passage	GH713	Carbon Dioxide Tech	Afrox	31,3	2

Gate house	GH 209	Equipment	Carbon Dioxide Tech (Wet)	Afrox	31,3	3
Gate house	GH 206	Equipment	Carbon Dioxide	Afrox	31,3	2
Gate house	GH 211	GH201	Carbon Dioxide Tech	Afrox	31,3	3
Gate house	GH 202	Lab Bench	Air dry	Afrox	8,5	1
			Hydrogen	Afrox	0,74	1
			Nitrogen	Afrox	11	1
			Carbon Dioxide	Afrox	31,3	1
Biology	Lab 204	Equipment	mix gas	Afrox	9,7	1
			Argon	Afrox	17,4	2
Biology	Lab 209	Equipment	Carbon Dioxide Tech (Wet)	Afrox	31,3	3
Biology	Lab 211	Equipment	Carbon Dioxide	Afrox	31,3	1
Biology	Lab 215	Incubator	Nitrogen	Afrox	11	1
			mix gas	Afrox	9,7	1
Biology	220 Postgrad Lab	Equipment	mix gas	Afrox	9,7	1
			Carbon Dioxide Tech	Afrox	31,3	3
Biology	1st Floor 105	Equipment	Nitrous Oxide 1	Afrox		1
Biology	ROOM 17	Equipment	Nitrogen Tech	Afrox	2,2	2
Biology	Room 22	Equipment	Oxygen tech	Afrox	11,5	1
			Nitrogen	Afrox	11	1
			mix gas	Afrox	1,703	1
Biology	Room 24	Equipment	Carbon Dioxide	Afrox	31,3	2
			mix gas	Afrox	12,3	1
			Nitrogen	Afrox	11	1
			mix gas	Afrox	1,6	1
			Sure Mix	Afrox	1,6	1
Biology	Room 118	Equipment	Nitrogen	Afrox	11	1
Biology	Room 118	Equipment	Nitrogen Tech	Afrox	2,2	2
			Carbon Dioxide	Afrox	31,3	1
			Nitrogen Tech	Afrox	2,2	1
Geo Science	Outside Gas Room	Mass Spectrometry Lab	helium	Afrox	1,51	11
			Synthetic Air	Afrox	11,6	16
			Oxygen	Afrox	10,2	2
			Argon	Afrox	17,4	26
			Argon	Air Liquid	17,4	10
			Nitrogen	Afrox	11	6
			Nitrogen	Air Liquid	11	12
			PCC Tank Argon	Afrox	220	1
			P10 Mix	Afrox	16,6	1
Geo Science	X-Ray Fluorescence Furnace Lab	Equipment	P10 Mix	Afrox	16,6	2

Geo Science	basement floor	010 OSL LAB	Nitrogen	Air Liquid	11	6
	Passage		Nitrogen	Afrox	11	16
Ithemba Lab	Outside Cage	Graphitisation Lab	Nitrogen	Afrox	11	3
			Oxygen	Afrox	10,2	2
			Hydrogen	Afrox	0,74	1
			LPGas	Unknown	48	2
Ithemba Lab	B6 EIL	Equipment	LPGas	Unknown	48	1
Ithemba Lab	Graphitisation Lab	Equipment	helium	Afrox	1,51	1
Ithemba Lab	Workshop	Equipment	Argon	Afrox	17,4	1
			Argon	Afrox	17,4	1
Ithemba Lab	ROOM AC8	Equipment	helium	Afrox	1,51	1
			Argon	Afrox	17,4	1
			Carbon Dioxide	Afrox	31,3	4
			Nitrogen	Afrox	11	1
Ithemba Lab	ROOM AC9	Equipment	mix gas	Afrox	1,6	1
			Liquid Nitrogen	Unknown	30	1
Physics	P15 Furnace Room	Equipment	mix gas	Afrox	1,703	1
			Oxygen	Afrox	10,2	1
			Nitrogen	Afrox	11	1
			mix gas	Afrox	7,4	1
			Argon	Afrox	17,4	2
Physics	P14 Mechanical Workshop	Equipment	Acetylene	Unknown	0,9	1
			Acetylene	Afrox	8,6	2
			Oxygen	Afrox	10,2	1
			LPGas	Unknown	11,8	1
			Argon	Afrox	17,4	1
			helium	Afrox	1,51	1
			Carbon Dioxide	Afrox	31,3	1
			Oxygen	Afrox	10,2	1
			Argon	Afrox	3,5	2
			Oxygen tech	Afrox	1,43	1
Physics	P13 Novel Quantum	Equipment	Air Tec(O2/N2)	Afrox	8,5	1
			Hydrogen	Afrox	0,74	1
			Oxygen tech	Afrox	11,5	1
			mix gas	Afrox	7,4	1
			Argon	Afrox	17,4	3
Physics	P6A Nano Scale Lab	Equipment	Liquid Nitrogen	Unknown		1
			Nitrogen	Afrox	11	3
			helium	Afrox	1,51	1
			Hydrogen	Afrox	0,74	2
Physics	P6D	Equipment	Liquid Helium	Unknown		1
			Nitrogen	Afrox	11	3
Physics	Room P5 (no gas detector)	Equipment	helium	Afrox	1,51	1

			Nitrogen	Afrox	11	1
Physics	P1 Fabrication Lab	Equipment	Oxygen	Afrox	10,2	1
			Argon	Afrox	17,4	1
Physics	P20 Laser Spectroscopy Lab	Equipment	Nitrogen	Afrox	11	1
			helium	Afrox	1,51	1
			Argon	Afrox	3,5	1
Physics	P22 Measurement System	Equipment	helium	Afrox	1,51	1
Physics	P24 Propulsion Lab	Equipment	Acetylene	Afrox	8,6	1
			Oxygen	Afrox	10,2	1
			Argon	Afrox	17,4	1
Physics	P10B Thin Films Lab	Equipment	Methane	Afrox	7,5	1
			Argon	Afrox	17,4	2
			mix gas	Afrox	7,4	1
			Oxygen	Afrox	10,2	1
			Nitrogen	Afrox	11	3
Physics	P11 Material Prep Room	Equipment	Nitrogen	Afrox	11	1
Physics	P16 Mossbauer Lab	Equipment	Liquid Nitrogen	Unknown		1
			Nitrogen	Afrox	11	1
Sanctuary	Kitchen	Gas Stove	LPGas		4,5	1
Genmin	Mechanical Bay Workshop	Equipment Welding	Argo shield	Afrox	17,8	2
			Hydrogen	Afrox	0,74	1
			Oxygen	Afrox	10,2	1
			Acetylene	Afrox	8,6	1
			Argon	Afrox	17,4	2
White Tower	Kitchen	Gas Stove	LPGas	Unknown	11,8	1
Jimmy West	Kitchen	Gas Stove	LPGas	Unknown	48	3
Health Science	6N03	Incubator	Carbon Dioxide Tech	Afrox	31,3	1
			Medical Carbon Dioxide	Afrox	31,3	8
Health Science	6M14	Freezers	Liquid Nitrogen	Unknown	50	2
			Carbon Dioxide Tech	Afrox	31,3	14
Health Science	7A01	Equipment	Synthetic Air	Afrox	7	1
			Oxygen	Afrox	12,3	1
			Carbon Dioxide Tech	Afrox	31,3	1
Health Science	6A03 Molecular Lab	Equipment	mix gas	Afrox	10,418	2
Health Science	Workshop Ground Floor	Equipment	mix gas	Afrox		1
			mix gas	Afrox	10,418	1
			Oxygen	Afrox	12,3	1
			no name	Unknown		2
Health Science	6Q06	Equipment	Acetylene	Afrox	8,6	2
			Oxygen	Afrox	12,3	2

Health Science	10th Floor Outside Cage	10C15 LAB	LPGas	Unknown	48	5
Health Science	3N27	Incubator	Carbon Dioxide	Afrox	31,3	1
Health Science	10C15 LAB	Incubator	Carbon Dioxide	Afrox	31,3	1
Health Science	2P19B	Equipment	Carbon Dioxide	Afrox	31,3	1
Health Science	2P19	Equipment	Medical Carbon Dioxide	Afrox	31,3	5
Health Science	2P16 Cell Biology	Incubator	Medical Carbon Dioxide	Afrox	31,3	2
Health Science	2B31A	Incubator	Carbon Dioxide Tech (Wet)	Afrox	31,3	1
			Medical Carbon Dioxide	Afrox	31,3	1
Health Science	Animal Unit Passage	Theatre Area	Medical Carbon Dioxide	Afrox	31,3	4
Health Science	Animal Unit 1506	Incubator	Carbon Dioxide	Afrox	31,3	1
Health Science	Animal Unit 1A04 AUTOPSY	Equipment	Medical Carbon Dioxide	Afrox	31,3	1
Health Science	8005 LAB 05	Equipment	Argon	Afrox	17,4	1
Health Science	8003 LAB 03	Equipment	Nitrogen	Arox	11	1
			Argon	Afrox	17,4	1
Health Science	8002 LAB 02	Equipment	Oxygen	Afrox	12,3	3
Health Science	4F01 Tissue Culture	Incubator	Medical Carbon Dioxide	Afrox	31,3	1
Health Science	401A Biochemistry & biology Lab	Equipment	Medical Carbon Dioxide	Afrox	31,3	4
Health Science	8006 LAB 06	Equipment	mix gas	Afrox	1,852	1
Health Science	8001 LAB 01	Equipment	Liquid Nitrogen	Unknown	40	1
			Carbon Dioxide Tech	Afrox	31,3	3
			Hydrogen	Afrox	0,74	1
			Nitrogen	Arox	11	6
			Argon	Afrox	17,4	1
			Liquid Nitrogen	Unknown	30	1
			Liquid Nitrogen	Unknown	20	1
			helium	Afrox	1,51	2
Health Science	8008 LAB 08	Incubator	Medical Carbon Dioxide	Afrox	31,3	3
			Nitrogen	Arox	11	1
Health Science	10Q12 LAB 10	Equipment	helium	Afrox	1,51	1
			Medical Carbon Dioxide	Afrox	31,3	1
Health Science	Jimmy Medical	Gas Stove	LPGas	Unknown	19	3
Health Science	8N06 PHARMACOLOGY	Fume hoods	Mix gas and CO2	Afrox	8.378 & 31.3	2