THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA

# The University of Newcastle

## Infrastructure and Facilities Services

Project Briefing Document

# Scientific Gas Design Standards

July 2024

*Version 1.0*

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## CONTENTS

## 1 PURPOSE

The IFS Project Briefing Document – Scientific Gas Design Standards sets out the University of Newcastle's (UoN) minimum requirements for the design, construction, and maintenance of scientific gas infrastructure services. It ensures new and refurbished systems are fit-for-purpose, made from durable good-quality materials, contain no or minimal environmentally harmful substances, and are cost efficient to operate and maintain.

Applicable requirements documented in Workplace Health and Safety legislation, Disability Discrimination legislation, State Environmental Planning legislation, Commonwealth and State legislation, National Construction Codes (NCC), the Building Code of Australia (BCA) and Australian and New Zealand Standards (AS/NZS) are the minimum and mandatory compliance requirements.

Where any ambiguity exists between this standard and the mandatory requirements then:

a. the highest performance requirements must apply.
b. applicable requirements must follow this order of precedence:
    i. Workplace Health and Safety legislation.
    ii. Disability Discrimination legislation.
    iii. State Environmental Planning and Assessment legislation.
    iv. All other Commonwealth and State legislation.
    v. NCC, BCA and PCA.
    vi. AS/NZS.
    vii. This standard and other University of Newcastle standards.

## 2 SCOPE

These standards describe the minimum requirements for the design, construction, and maintenance of all gas infrastructure services throughout all buildings owned, operated, and managed by the University of Newcastle.

The standards apply to all planners, project managers, consultants, contractors, sub-contractors, tenants, managing agents and University staff involved in the design, construction and maintenance of existing, new, and proposed University buildings and facilities.

All scientific gas infrastructure products and services provided or specified by designers, consultants, staff, and contractors must conform to this standard.

Where specific applications are not explicitly covered or ambiguity exists, the intent of the design standard must be satisfied. In such cases a return design brief must be provided for review and approval by the issuer of this standard or their appointed delegate who must have relevant technical competence in the subject matter. Additional more stringent requirements to those listed in this standard may apply on a project-specific basis dependent upon risk management and insurance requirements.

Any deviation from this standard must be approved by University of Newcastle engineering staff prior to completion.

The Standard provides:

a. A reference document to enable consistency with the design and engineering objectives.
b. Details of the minimum performance requirements for Planning, Architectural Design, and maintenance.

c. Support of the Strategic Asset Management Plan for the built environment and best practice.

The Standard addresses key objectives:

a. Quality design which responds, enhances, and complements the environment.
b. Appreciation of the heritage context and cultural history of the campuses.
c. Value for money in all aspects of the project.
d. The design of low maintenance buildings and environments.
e. Longevity of construction approach to design.
f. Standardization of key flashing and ancillary details.
g. Flexible design, to future proof building usage for expansion or adaption to new uses.
h. Safety in design.

### 2.1 NEW BUILDINGS

As a minimum, the scientific gas infrastructure services provided in University of Newcastle buildings must be designed and installed in accordance with the minimum legislative requirements incorporating all Statutory Regulations, Australian Standards, Local Council, Fire & Rescue NSW, Work Health & Safety (WHS) and SafeWork NSW requirements.

The consultant/contractor will consult with IFS, UoN Health and Safety Team and Project User Groups, to discuss any additional essential gas requirement measures that must be included in the design, in order to suit the proposed occupancy, associated hazards, and the overall gas infrastructure risk. Additional measures will be determined via a risk hazard assessment process, incorporating details and issues relating to the gas infrastructure within the building, including business continuity, consequence of loss and likelihood of loss.

### 2.2 EXISTING BUILDINGS

The requirements for the refurbishment of existing scientific gas infrastructure services within existing buildings will often be the same as for new buildings. However, there are a number of existing buildings in the University that have been constructed under regulations current to the time of construction, due to the ever-changing nature of Building Regulations and Australian Standards.

Whilst every endeavour is made to comply with regulations during refurbishments and upgrades, it is unlikely that the full extent of the building regulations can always be met. Therefore, in many cases involving existing building refurbishment, a performance review for all existing scientific gas infrastructure services must be undertaken by the consultant/contractor for compliance with the current Australian Standard requirements. The details of this performance review together with a proposed scientific gas infrastructure services upgrade strategy must be submitted to IFS for approval during the initial design development. These details will assist in the determination of the extent of modification and upgrade to existing essential scientific gas infrastructure services, required to be incorporated into the refurbishment works.

## 3 GLOSSARY OF TERMS

| | |
|---|---|
| ADGC | Australian Dangerous Good Code |
| AS | Australian Standard |
| ASE | Alarm Signalling Equipment |
| BCA | Building Code of Australia |
| BEP | Best Environmental Practice |
| BMS | Building Management System |

| | |
|---|---|
| CRTC | Chemical Radiation Technical Committee |
| ESD | Emergency Shut Down |
| EWIS | Emergency Warning Intercommunication System |
| FFL | Finished Floor Level |
| FIP | Fire Indicator Panel |
| FRL | Fire Resistance Level |
| GFA | Gross Floor Area |
| GHS | Globally Harmonised System |
| HAZOP | Hazard Operability |
| HDPE | High-Density Polyethylene |
| IFS | Infrastructure & Facilities Services |
| ISO | International Organisation for Standardisation |
| LEL | Lower Explosive Limit |
| NCC | National Construction Code |
| NOD | Notice of Disruption |
| O&M | Operations & Maintenance |
| PCA | Plumbing Code of Australia |
| PCP | Post Completion Period |
| SK | Surrogate Key |
| STEL | Short Term Exposure Limit |
| SV | Stop Valve |
| TWA | Time Weighted Average |
| UoN | University of Newcastle |
| UPS | Uninterruptible Power Supply |
| WHS | Work Health & Safety |

# 4 AUTHORITIES AND RESPONSIBILITIES

This standard is issued by IFS. It is approved by the Senior Facilities Manager, IFS. The IFS Operations team are responsible for maintaining the Standard and keeping it up to date. The Standard must be reviewed biennially.

# 5 TECHNICAL REQUIREMENTS

## 5.1 DESIGN AND DOCUMENTATION

All design and documentation for Scientific Gas Infrastructure Services, Compressed Air and Vacuum Systems must be undertaken using Australian Standards as seen under Heading 12 References.

### 5.1.1 Design Approach

The University expects consultants and designers to provide designs that meet the project briefs. The following are priorities that consultants and designers are required to be aware of and consider in their designs:

a. Take a long-term balanced view of capital costs, energy costs, maintenance costs and longevity.
b. As education and research both progress at rapid rates, usage of buildings and areas within buildings can change several times within the life of a building. Systems must be designed to be adaptable for such changes.

c. Ensure that fittings, equipment and storage is designed with access and visual impact in mind.

### 5.1.2 Design Inputs and Processes

The University expects consultants and contractors to proactively inform, advise and contribute to the design process. In particular the following aspects:

a. Building Efficiencies - provide advice to the project team, including other design team members that would improve the inherent building performance, which may lead to reductions in both capital and energy costs. This may initially take the form of simple advice relating to existing infrastructure capacity and location. The process may take a number of iterative steps. The consultant or designer is expected to advise, contribute and if necessary, lead such processes.
b. Planning and Architecture – Provide advice on the appropriate location of storage rooms and reticulation strategy to assist in both the planning of the building and the facilitation of better maintenance in the future. Such advice must be provided in the early stage of the design and planning process so that this is taken into consideration of the architect's design, such that it can be incorporated into his planning. Late advice will lead to poor location of storage and lack of maintenance access, thus a building of poor quality that will suffer from either poor or lack of maintenance and high operational costs to the University. All scientific gas infrastructure with reticulation requirements is to be planned to be housed in external storerooms or under protective roofs regardless of whether equipment may be external rated. This requirement is based on the reduced life expectancy of externally housed equipment.
c. UoN Requirements – Provide advice on the availability of options, assist in assessing the advantages and disadvantages, provide analysis of life cycle costs and life expectancies, offer recommendations, and assist in making decisions.

### 5.1.3 Engineering Process

Depending on the scale of the project, the reviews of the following may need to be undertaken in detail:

a. the capacity-capability of the existing system to be modified.
b. the site services supplying the facility.

The University expects consultants and designers to be fully qualified, experienced, and capable of carrying out all engineering design, equipment selection and construction/installation quality checks.

In selecting equipment, the University expects consultants and designers to select products and system configurations of proven and reliable quality and compatibility with existing systems.

In the designing of all systems, the University expects consultants and designers to follow good industry practice.

### 5.1.4 Equipment Selection & Sizing

In selecting equipment, the University expects consultants and designers to select products of proven and reliable quality, with reputable support and after sales service.

The provision of spare capacity for future use must be provided when designing and sizing all scientific gas services infrastructure, pipework, and equipment. In making such considerations careful analysis of spare capacity against the application of diversity and balance must be considered.

For critical equipment, the University of Newcastle has developed a pre-approved equipment list for the following:

| Equipment Type | Brand | Model Number |
|---|---|---|
| Gas Alarm Control Panel | MSR | DGC06 |

Any change of equipment must be approved in writing from IFS. It must not be assumed that a change of equipment will be approved.

## 5.2 DESIGN AND CONSTRUCT CONTRACTS

### 5.2.1 General

This section outlines the extent of the services to be provided by the contractor under a Design and Construct contract.

The contractor shall be fully responsible for the complete design of the scientific gas infrastructure services installations, including the selection, sizes and quantity of equipment, and shall provide calculations and drawings and other documentation as necessary to demonstrate conformance with the design parameters, industry practice, IFS requirements, codes, regulations and standards. This includes all calculations required to confirm that existing infrastructure is enough to supply the proposed systems and equipment installed under the project.

The contractor shall allow to fully co-ordinate the documentation with the Architect, Structural Engineer, and all other services consultants / contractors. Please refer to **ATTACHMENT 1** - **Design and Construct Checklist for Consultants.**

### 5.2.2 Calculations

As part of the contractor's design, it is expected that the following design calculations as a minimum are produced for review by IFS for approval prior to finalising design:

a. Equipment selections based on the overall capacities calculated.
b. Gas supply calculations
c. Pipe sizing calculations.
d. All other calculations necessary to illustrate equipment reticulation and components have been selected fully in accordance with the project requirements and this specification.

### 5.2.3 Drawings and Documentation

The contractor shall provide design, construction, and as-built drawings, which may be either design drawings produced by the contractor or shop drawings produced by equipment manufacturers.

The contractor is responsible for producing all design and as-built documentation, including, but not limited to:

a. Concept Design documentation (as required).
b. Detailed Design documentation, including:
    i. Layout Drawings
    ii. Details
    iii. Schematics
    iv. Design certification
    v. Equipment details
    vi. Testing / commissioning procedures
c. Workshop drawings, including drawings for the purpose of system manufacture.
d. As built drawings, including detailed drawings demonstrating the as installed system.
e. Operations and Maintenance manuals.
f. Training manuals.

All design documentation shall be approved by IFS prior to any works progressing onsite.

Workshop, As-Built drawings, and O&M manuals shall be submitted for review prior to final sign off.

### 5.2.4 Technical Submittals

Technical submittals shall be provided with the full technical and spatial requirements of each proposed plant item. The technical submissions shall include, where applicable, but not be limited to:

a. Certified shop drawings of each item complete with sectional weights and pressure ratings.
b. Electrical requirements including starting current, running current, operational voltage, power consumption, recommended protection devices, wiring diagrams, connection, and terminals details. Also, detail of how cables are terminated to the equipment item and earthing requirements shall be provided.
c. Recommended spares schedules and projected future availability (to ensure that redundant components are not used).
d. Requirements for specialist tools to maintain the equipment item.
e. Maintenance zones and requirements including weights of any replaceable components.
f. Manufacturer's recommendations for installation including ventilation and thermal requirements.
g. Confirmation of product lifespan assuming maintained to manufacturers recommendations.
h. Where equipment model numbers / references are stated, these are indicative only and the Contractor MUST ensure the selected equipment fully complies with the standard.
i. Documentation to indicate equipment complies with Australian Standards.

## 5.3 GAS MONITORING SYSTEMS

### 5.3.1 General

The installation of gas monitoring systems will be identified during the briefing process created out of the detailed risk assessment for the works required. The gas monitoring system looks to put in risk control measures for the following:

a. Oxygen depletion
b. Toxic gases
c. Flammable gases
d. Corrosive gases

The approach to monitoring of gas and the associated infrastructure is centred on, but not limited to, the relevant Australian Standards, Reference and Rational for the requirement as outlined in the below table.

| Australian Standard | Reference | Rational |
|---|---|---|
| AS 4332-2004 | 2.7.2.1 (g) | The area where cylinders are held shall have natural or mechanical ventilation sufficient to maintain the oxygen level at or above 18% if the largest cylinder fully discharges. |
| AS 2243.2:2021 A1 | 3.3.2 (c) | The use of chemicals in an area with restricted or low ventilation shall be monitored where it cannot be avoided, as it can result in oxygen depletion, a hazardous area or unnecessary exposure of personnel. |

| | | |
|---|---|---|
| AS 2243.2:2021 A1 | 4.3.2 | The concentration of toxic or flammable gas in the atmosphere of the area of use shall be monitored based on a risk assessment. |
| AS 2243.2:2021 A1 | 4.3.2 | Appropriate hydrocarbon monitoring (high level for light gases (methane and ethane), low level heavy gases (propane and butane)<br><br>Monitoring for hydrogen shall not be via LEL hydrocarbon monitoring but through an appropriate sensor for hydrogen and be Ex rated |
| AS/NZS 2982:2010 | 3.7.5 | Where there is a risk of oxygen displacement or depletion in a laboratory, adequate ventilation shall be provided. Appropriate fail-safe, monitoring and alarm mechanisms shall be provided. |
| AS 2243.1:2021 | 2.7.1 | The capacity of the laboratory ventilation shall be appropriate to the nature of the work being carried out, the nature of the hazards (chemicals, gases and other hazardous materials) at the workplace.<br><br>Where unsafe concentrations of airborne contaminants are generated or there is a risk of oxygen depletion in a laboratory, ventilation or fume extraction facilities shall be available that ensure the efficient removal of contaminants or treatment of air quality. Fail-safe or alarm mechanisms shall be provided. |
| AS 2243.2:2021 A1 | 4.3.2 e | For Class 2.1 flammable gases in cylinders, the cylinder shall be held vertically in a well-ventilated area. Where flammable gases that are lighter than air are used or stored in cylinders, high level ventilation shall be provided to prevent accumulation of a flammable gas concentration of gas. |
| AS 2243.2:2021 A1 | 9.3.2 | When lighter than air gases are stored in a room or space, ventilation shall also be provided at the highest point in the room |
| AS 4332-2004 | 5.2.3.2 (e) | Where oxygen could escape into a confined space, the oxygen content of the atmosphere shall be monitored, with an alarm set to respond at 23%. |
| AS 4332-2004 | A5 | Any gas other than air or oxygen will displace oxygen when entering the atmosphere. Any depression of the oxygen content of the breathable atmosphere from its normal 21% to below 18% is a threat to life, by asphyxia |

### 5.3.2 Gas Monitoring Installation

**Sensor Location**

Gas sensor locations need to be in a configuration that considers the behaviour of gas, potential points of release and the use of the respective area (laboratory, kitchen, storeroom). The determining of an appropriate location must rely on an appropriate risk evaluation taking into consideration:

a. The operational aspects of the respective area.
b. Monitoring for ambient air concentrations or monitoring for point source release.
c. Specific air ventilation and its influence on how it may draw gases towards it.

The basic principles for ambient air or environmental monitoring area:

a. Lighter than air flammable gas sensors should be mounted at high level – approximately 200mm below ceiling level.
b. Heavier than air sensors should be mounted at low level – minimum 300mm above FFL.
c. Gases with a similar density to air must have the sensors mounted within the "breathing zone" for the space, considered to be between 900mm – 1200mm above FFL.

Static air monitoring targeting a potential point source release should be located in close proximity to the potential leak point.

Sensors should have a warranty period of 3 years for each unit.

**Control Panel Location**

All gas sensors are required to be connected to a control panel. The control panel must be operated by mains power and located in a safe environment external to the area being monitored to ensure it can be easily accessible for reading and evaluation without the need to enter the potentially dangerous environment. The location should also consider the operational factors adjacent to ensure its not at risk of damage.

The control panel must display the following:

a. Identification of all gases which are being monitored.
b. The gas concentration being monitored.
c. Location of which alarm sensor has been triggered and the concentration detected.
d. Any faults being detected to identify and distinguish between alarm and fault.

**Alarm Monitoring**

Alarm monitoring will need to have the following functions:

a. Visual alarm via strobe lighting within the room (visible from the entry door).
b. Visual alarm via strobe lighting outside the room near the entry door.
c. Audible alarm within the room with sensors.
d. Audible alarm near the entry to the room with sensors.

Alarms need to be connected to the UON's BMS to allow for both Security and IFS notification.

**NOTE:** Depletion of the gas bottle is to be configured for users only and not configured to the BMS.

**Alarm Set Points**

Alarm Set points are to be set up with the following configuration:

a. Oxygen depletion: 19.5% (Visual) and 18% (Both Visual and Audible) oxygen by volume.
b. Oxygen enrichment: 23.5% oxygen by volume.

c. Flammable gases and vapours: low alarm set at 5% of the LEL and high alarm set at 10% of the LEL.
d. Toxic and corrosive gases and vapour: low and high alarm set point for toxic gases set at 50% of the STEL or TWA, whichever is lower.

## 5.4 EMERGENCY SHUT-OFF

### 5.4.1 Emergency Stop Buttons

As identified in *AS/NZS 2982:2010 Laboratory design and construction* services that reticulate flammable or hazardous materials shall have provision for emergency shut-off for both gas and electrical services.

Emergency gas shut-off and electrical shut-off must be installed in any laboratory where flammable gases are reticulated, and it is recommended to be installed where other gases are reticulated based on the outcome of the risk assessment.

The installation of emergency stop buttons must be appropriately worked through a HAZOP study prior to being installed and commissioned. The HAZOP must consider:

a. The location of the manually operated button (recommended to be located near the main entrance / exit to the laboratory.
b. The impact of shutting down gas and power to the laboratory and other areas / equipment that may be impacted by the gas and power being turned off.
c. The connection of an emergency stop button to be connected and operated automatically as part of the gas monitoring system.

Any emergency shut-off must be appropriately labelled as per Australian Standards to identify what will be shut off if pressed.

Where a gas shut-off device is present it shall be isolated through activation of double block (fail-safe) solenoid valves fitted to each zone for each service. Gas shut-off devices (solenoid valves) must be interlocked with the gas detector and mechanical ventilation systems that serve the laboratory/workspace.

**NOTE:** Typically, a single laboratory emergency stop should only be configured to isolate supply to the specific lab that the E-stop has been activated for, otherwise building wide interruptions will occur.

### 5.4.2 Isolation Valve Boxes

Each individual lab with fixed reticulated gas infrastructure should be able to access a gas service manual isolation valve box external to the laboratory adjacent to the entry-exit location. The Valve Box will:

a. Match existing valve boxes in the building / on campus.
b. Include pressure gauge indication supply pressure for each service.
c. Be manufactured of gas specific compatible materials and carry the manufacturer's serial number or identification and sizes, and the product batch number.
d. Open and close with a 90 degree turn of the lever, the valve to be closed' when the lever lies at right angles to the pipe run.
e. Have a manufacturer's certificate supplied for each valve or batch of valves stating that they have been:
    I. Pneumatically pressure tested to establish their suitability for working at pressure up to 18 bar.
    II. Cleaned and degreased and that any solvents have been completely removed.
f. Consist of bellow sealed valve(s).
g. Have ease of access for fitting the valve(s) and pipework and for maintenance.
h. Have means of gaining access in an emergency without the use of the key.

i. Have means of physically isolating and blanking off the service(s) both upstream and downstream of the valve(s) by means of removable sections and replacement blank plates. One blank plate to be provided for each valve(s) of a design which:
   I. Blanks both the pipe and valve port;
   II. Is immediately visible when deployed;
   III. Is capable of deployment without complete removal of the clamping screws.
j. Have boxes of metallic or substantial plastic construction, capable of withstanding damage from blows or abrasions, and having no sharp edges.
k. Be of a flush style finish when installed.

E-stop solenoids are to be installed adjacent to the valve box on the load side to allow maintenance-service of laboratory pipework / solenoid devices whilst maintaining supply to other laboratories.

### 5.4.3 Identification of Valves

Identification should be a permanent indication on or adjacent to each Valve Box as follows:

| **In Red Lettering** | **Typical Engraving Required** |
|---|---|
| Service(s) | OXYGEN (or other as appropriate) |
| Emergency Instruction | IN EMERGENCY CLOSE VALVE |
| **In Black Lettering** | **Typical Engraving Required** |
| Valve(s) Code No(s) | VB 1-1 (or other as appropriate) |
| Area Isolated | NIERC145 Laboratory (or other as appropriate) |

Where there are multi-service valve boxes, the identification and valve code should be on or adjacent to each valve within the box.

## 5.5 PIPEWORK INSTALLATION

### 5.5.1 General

Pipework is to be installed in straight lines and uniform grades without sags. Pipework joins can be undertaken via either welding or Swagelok connectors. Pipework is to run adjacent to and horizontally parallel with adjoining pipework, walls and beams. All pipework should be at least 150mm above ground surface if under suspended ground floors. Pipework spacing should be at least 25mm from adjacent pipes and 50mm spacing from electrical cables, measured clear of any pipe insulation. Long radius elbows or bends are to be used where practical in preference to short radius elbows. Mitred fittings are not to be used without approval from the UON.

Pipework concealed in walls or floors must have their route clearly marked on “as fitted” drawings. Pipes passing through walls shall be provided with sleeves, a flange for pressure sealing, have cover plates fitted over the sleeves where exposed to view and meet *AS4072.2005 Components for the protection of openings in fire-resistant separating elements, Part 1: Service penetrations and control joints*.

Pipework supports are subject the following interval matrix:

| **Outside Diameter (Millimetres)** | **Maximum Intervals for Vertical Runs (Metres)** | **Maximum Intervals for Horizontal Runs** |
|---|---|---|
| 12 | 1.2 | 1.0 |
| 15 | 1.8 | 1.2 |

| | | |
|---|---|---|
| 20 | 2.4 | 1.8 |
| 25 | 2.4 | 1.8 |
| 32 | 2.5 | 2.0 |

All pipework supports must:

- Comprise, except for vertical drops to terminal units, secondary fixing brackets or supports of a suitable metallic, non-ferrous material of a ferrous material suitably treated to prevent corrosion and electrolytic action.
- Comprise for vertical drops to terminal units, secondary fixing brackets or supports of a suitable metallic, non-ferrous material or a non-metallic material.
- Ensure that the pipework does not come into contact with any treated timber contained in the building structure.

All pipework must be clearly labelled and identified in compliance with *AS 1345-1995 Identification of pipes, conduits and ducts*.

### 5.5.2 Pipework Materials

All pipework material should be seamless tube, chemically cleaned, annealed stainless steel tubing manufactured to *AS 4041-2006 Pressure piping*. Insulation is to be installed on all pipework whose temperature is likely to fall below the dew point of the surrounding air.

All fittings are to be stainless steel to suit scientific gas services.

All line valves should:

a. Be manufactured of gas specific compatible materials and carry the manufacturer's serial number or identification and sizes.
b. Be capable of withdrawal without cutting the pipework.
c. Be of bellows-sealed type.
d. Open and close with a 90 degree turn of the lever, the valve to be 'closed' when the lever lies at right angles to the pipe run.
e. Have a manufacturer's certificate supplied for each valve or batch of valves stating that they have been:
    I. Pneumatically pressure tested to establish their suitability for working at pressure up to 18 bar;
    II. Cleaned and degreased and that any solvents have been completely removed.

## 5.6 GAS STORAGE AND RETICULATION

### 5.6.1 General

Gas stores should be external to or be external facing of a building in a secure facility with a roof protecting fixed infrastructure from sunlight and the elements. Reticulation to the respective building for gas use should be on the basis that there is no impact to normal operations around the facility.

Where storage / reticulation cannot be undertaken external to the building the minimum requirement for gas storage is appropriate fire rating levels of the space and ventilation ensuring that all relevant standards are achieved and has the approval of the UON's WHS and CRTC units. Other considerations for this practice will include:

a. Total capacity of gas cylinders being used including those not in use.
b. Concentration of cylinders in one particular location within the space.
c. Separation and segregation between gases as per Australian Standards.
d. Hazardous zones with the space.
e. Gas cylinder restraints to be used within the space.

### 5.6.2 Construction Requirements

As per *AS4332-2004 The storage and handling of gases in cylinders* the following design requirements need to be allowed for in the construction of gas storage:

a. Classes of gases shall be segregated within the store but need not be separated.
b. Ventilation is required at all times either via natural or mechanical system.
c. Areas in which cylinders are kept shall be:
   (i) away from any artificial sources of heat.
   (ii) kept clear of combustible materials, vegetation and refuse for not less than 3 m from any cylinder.
d. The base or floor shall be constructed of non-combustible material and be level or where appropriate suitably sloped to ensure adequate drainage without compromising cylinder stability.
e. The walls and roof shall be clad with non-combustible materials. The supporting structure shall also be constructed of non-combustible materials.
f. A minimum FRL of 120/120/120 be maintained where stores are located adjacent to a building.
g. The doors in gas cylinder stores shall open outwards or be of a ventilated roller type that can be opened from inside the store.
h. Allow for the required reticulation system to be installed with capacity increase available.
i. Gas cylinder restraints must be installed to store cylinders in an upright position. Restraints must be such that their use does not damage or scratch the cylinder. See Attachment 2 for Securing Gas Cylinders.
j. Ignition sources shall not be in a store containing flammable gases.
*k.* Electrical equipment to be used within a store containing flammable gases shall comply with and be installed in accordance with *AS/NZS 3000:2018 Electrical installations (known as the Australian/New Zealand Wiring Rules)*.
l. Bollards, crash barriers or other suitable protective devices shall be installed where there is a risk of cylinders being damaged by vehicular impact.

## 5.7 GAS SUPPLY INSTALLATION SYSTEMS

Gas manifolds headers must be installed with the following requirements:

a. Be wall mounted.
b. Incorporate an automatic changeover device.
c. Incorporate a renewable non-return valve to allow removal and replacement of any cylinder.
d. Incorporate a non-return valve to prevent discharge of a bank of cylinders in the vent of tail pipe rupture.
e. Regulators must meet the requirements for intended purpose.
f. Have a gas specific connector for the attachment of tail pipes.
g. Have an isolation valve between the bottle connection and the manifold.
h. Have a flashback arrestor installed on all oxygen and flammable gas systems.

Gas identification with respect to cylinder supply systems must:

a. Comply to Australian Standards *AS 1345-1995 Identification of the contents of pipes, conduits and ducts* and *AS 4484-2004 Gas cylinder for industrial, scientific, medical and refrigerant use – Labelling and colour coding*.
b. Be on the front of automatic changeover panels.
c. Be adjacent to each reserve manifold.
d. Use traffolyte labels clearly stating the gas serviced by each regulator system.

Pressure indicators must be incorporated in all gas supply systems. Pressure indicators must:

a. Conform to *AS 1349-1986 Bourdon tube pressure and vacuum gauges*.
b. Consist of visible pressure gauges;
    I. High pressure gauges indicating the pressure in each cylinder bank.
    II. Low pressure gauge indicating the pressure in the outgoing distribution pipework.
c. Be graduated in bars.
d. Carry the warning "USE NO OIL OR GREASE".
e. Include monitoring / alarm system for gas cylinder level.

### 5.8 BULK STORAGE ON CAMPUS

The UON does have bulk gas storage tanks on campus owned and controlled by 3rd parties. Gas infrastructure from these units remains the responsibility of the UON and as such is subject to the standards and compliance set out in this document. Where design incorporates multiple buildings using bulk storage facilities, isolation valves per building will be required. All site services drawings will need to be updated to reflect any new above and below ground infrastructure.

### 5.9 EQUIPMENT ASSET CAPTURE AND LABELLING

All equipment subject to planned or statutory maintenance will require labelling for asset capture and identification. Labelling (via a barcode) is available from IFS and is to be included as the responsibility of the contractor to install as part of any works contract.

## 6 COMMISSIONING

Comprehensive pre-commissioning, commissioning and quality monitoring must be specified by the consultant/designer. A project specific commissioning plan is to be developed and provided to the University for review and approval.

Detailed testing and commissioning records must be provided for each system and each component as appropriate. All such records must be witnessed and verified by the project consultant/head contractor. Project hand over inspection and testing plans (ITPs) must be developed by the consultant/contractor to allow the system to be handed over to the University.

## 7 SAFETY IN DESIGN

The contractor must consider risk during the design. A design safety report must be submitted to the relevant IFS Project Manager for every design project. Contractors must confirm, so far as is reasonably practicable, that the structure is without risks to health and safety.

Design risks must be considered for the asset lifecycle covering construction, operation and maintenance, refurbishments, and decommissioning.

The design safety report must include the following:

a. Description of design element.
b. Description of potential risks and hazards associated with the design element.
c. A low/medium/high risk assessment considering likelihood and consequence.
d. Proposed measures to eliminate risks where practicable.
e. Control measures to mitigate and manage design risks.
f. Nominating responsibilities for managing the design risks.

This may be provided as a design risk register where appropriate and must include results of any calculations, testing and analysis etc.

# 8 DOCUMENTATION & RECORDS

All documentation must be provided by the consultant / contractor in electronic format and approved by the UoN.

## 8.1 DESIGN DOCUMENTATION

Prior to commencing construction of new or refurbishment projects, the consultant/contractor must fully investigate and document the requirements for each gas infrastructure service required to be installed, altered, or modified as part of the project works.

This must include:

a. Return Brief defining the systems proposed and any deviations from this standard.
b. Calculations to be provided on the sizing of the pipe work. Future allowances are to be included in these calculations\sizing.
c. Calculations & selections on the proposed equipment.
d. Budget calculations.
e. Provision of any required Design Certification.
f. Requests for all variations to this Standard submitted in writing.
g. Complete the Design and Construct Checklist.

This documentation must be provided by the consultant/contractor in electronic format and approved by the University.

## 8.2 COMPLETION DOCUMENTS

At the completion of all projects, the following documentation must be provided for each gas infrastructure service installed or altered as part of the project works:

a. O&M manual(s).
b. As-built drawings (including schematics).
c. Asset schedules and labelling (as per the Asset Identification and Labelling Standard).
d. Commissioning test results and certificates for all installations.
e. Product manufacturer specific information.
f. Warranty schedules for all fittings and equipment.
g. Maintenance requirements for all items of equipment
h. Building User Guide
i. Installers Statutory certificates

This documentation must be provided by the contractor in electronic format and approved by the University prior to Practical Completion being granted.

# 9 OPERATIONS

## 9.1 MATERIALS AND EQUIPMENT SELECTION

Only new materials, equipment and components will be installed, and these must be of good quality, fit for purpose and selected to minimise life-cycle costs and maximise efficiency. All products must be supported locally and internationally by factory trained service networks. All spare parts must be available ex-stock factory for a period of 10 years from purchase date. Equipment and materials that are obsolete, discontinued, about to be discontinued or superseded, must not be installed. Selected equipment must have the ability to be backwards compatible.

Uniformity of the type of materials must be consistent throughout all individual installations and must match or be fully compatible with the existing equipment.

Details of all major items of gas fittings and equipment proposed to be installed during new or refurbishment projects must be submitted to IFS for approval prior to installation. This will include, but is not limited to, pipe material selection, manifolds, regulators, etc.

Identification of a proprietary item of fittings and equipment will not necessarily imply exclusive preference for the item identified but indicates a deemed-to-comply item and provides the baseline of quality, function, and performance. It will be at the discretion of the University of Newcastle as to whether alternatives will be considered, and adequately detailed information will be required to prove equivalence with nominated products.

## 9.2 SERVICE ACCESS REQUIREMENTS

The following servicing and access requirements must be provided:

a. Position all fittings and equipment and arrange access provisions at equipment, to optimise future maintenance and repairs.
b. Doors for storage rooms must use UoN standard Lock Hardware, Cylinder and Key Standards.
c. Plant located above 3m height will have permanent stair/ladder access provisions with permanent workable platform.
d. Trip hazards to be identified and painted in yellow.
e. Electrical hazards must be identified and labelled appropriately.
f. Confined spaces to be noted and appropriate signage applied.
g. Access to fittings and equipment must comply with all WHS regulations.

## 9.3 REDUNDANT EQUIPMENT

All redundant gas infrastructure, fittings and equipment must be removed as part of the project. Building surfaces and finishes must be made good wherever redundant services are removed. Where a service is unable to be removed appropriate tags and labelling shall be installed to indicate the service is redundant.

## 9.4 MAINTENANCE & STATUTORY TESTING

Any details which will affect the future maintenance and performance of the new or upgraded equipment must be supplied by the installation contractor at Practical Completion.

For all scientific gas infrastructure services installed as part of a new build or refurbishment project of an existing building, regular statutory and planned maintenance and testing must be carried out by the works contractor during the Post Completion Period (PCP). Coordination with the UoN will be required to ensure

service interruptions during this period are advised to building occupants, within the UoN's guidelines for NOD's, to limit operational impact.

All defects arising from regular statutory maintenance and testing performed during the PCP will be documented and rectified by the works contractor using the guidelines for NOD's outlined above.

Prior to the completion of the PCP, the works contractor will perform all annual maintenance procedures in the presence of the University essential services maintenance contractor and provide documentation confirming the provision of all statutory maintenance has been performed during the PCP.

## 10 AUTHORISATION OF VARIATIONS

Project managers, consultants, contractors, commissioning agents and facilities maintenance personnel must ensure compliance with these requirements is achieved.

Variations to this standard must only be considered where:

a. the University Standard's requirement cannot physically or technically be achieved.
b. the alternative solution delivers demonstrated and proven superior performance for the same capital and life cycle cost or better.

Consultants and contractors must identify and justify requirements of the standard that do not apply to the project, or which need to be varied. The issuer of this standard or their delegated authority must review and consider requirements of stakeholders from clients, projects, and facilities management before deciding whether to approve variations. Their formal sign-off is required for acceptance of any non-compliances and departures from this standard's requirements.

## 11 QUALITY CONTROL

### 11.1 DESIGN STANDARD COMPLIANCE

Compliance with requirements of this standard must be checked throughout the design, construction and commissioning phases of projects by IFS' services consultant. Any issues or deviations from this standard must be reviewed and approved in writing by the issuer of this standard.

Competent IFS consultants and representatives must check compliance with this standard during design reviews and formal site inspections. Any non-conformances with requirements of this standard must be documented and provided to the IFS Project Manager for issue to contractors and their consultants.

Project Managers must maintain a formal register of non-conformances and manage close out of outstanding non-conformances. Contractors and their consultants issued with non-conformances must take appropriate corrective actions. The IFS Project Manager must ensure:

a. proposed corrective actions are implemented.
b. close out of non-conformances in relation to this standard is formally approved and signed off by the author of the standard or their delegate.

### 11.2 DESIGN STANDARD CERTIFICATION

Contractors and consultants must certify compliance to the design standard at each of the following project phases:

a. Design and Documentation
b. Tender

c. Construction

Notwithstanding IFS' internal quality control processes, contractors and their consultants must implement their own robust quality assurance and control procedures to ensure compliance with requirements of this standard.

### 11.3 CONSTRUCTION COMPLIANCE

Consultants and contractors are expected to include check sheets for each system component detailing each item that needs to be checked, tested, and verified during the installation process. Such check sheets must be completed and verified by the project consultant/contractors, including the identification of any defects and the closing out of such defects.

### 11.4 ACCEPTANCE

The University will only accept projects as complete when all the above have been carried out, submitted, and verified.

## 12 REFERENCES

Design and documentation utilising these standards are to incorporate the requirements of the following current standards and requirements as a minimum:

a. National Construction Code
b. Environmental Planning & Assessment Regulation
c. Work Health & Safety Act
d. All IFS Standards
e. AS 1345-1995 Identification of the contents of pipes, conduits and ducts
f. AS 1349-1986 Bourdon tube pressure and vacuum gauges
g. AS 1530.4:2014 Methods for fire tests on building materials, components and structures, Part 4: Fire resistance test of elements of construction
h. AS 1668.2-2012 The use of mechanical ventilation and airconditioning in buildings, Part 2: Mechanical ventilation in buildings
i. AS 1894-1997 The storage and handling of non-flammable cryogenic and refrigerated liquids
j. AS 2243.1:2021 Safety in laboratories Part 1: Planning and operational aspects
k. AS 2243.2:2021 Safety in laboratories Part 2: Chemical aspects and storage
l. AS/NZS 2243.6:2010 Safety in Laboratories Part 6: Plant and equipment aspects
m. AS/NZS 2982:2010 Laboratory design and construction
n. AS 2896:2021 Medical gas systems – Installation and testing of non-flammable medical gas pipeline systems
o. AS/NZS 3000:2018 Electrical installations (known as the Australian/New Zealand Wiring Rules)
p. AS 4041-2006 Pressure piping
q. AS 4072.1-2005 Components for the protection of openings in fire-resistant separating elements, Part 1: Service penetrations and control joints
r. AS 4267-1995 Pressure regulators for use with industrial compressed cylinders
s. AS 4289-1995 Oxygen and acetylene gas reticulation systems
t. AS 4332-2004 The storage and handling of gases in cylinders
u. AS 4603-1999 Flashback arrestors – Safety devices for use with fuel gases and oxygen or compressed air
v. AS/NZS 5601.1:2022 Gas installations, Part 1: General installations
w. AS/CA S009:2013 Installation requirements for customer cabling – Wiring rules

x. National Code of Practice for the Safe Removal of Asbestos (NOHSC:2002 - 1988)

The above standards are not an exhaustive list of the relevant requirements. The consultant/contractor must incorporate all relevant standards and Authorities requirements into project specific design, documentation, and installation.

In addition to the above standards the consultant / contractor should also consult the UoN's Guideline for the Use of Gases in Laboratories and the IFS BMS Design Standard.

Consideration must be given by the consultant/contractor to the original standard of performance relevant to the construction date of the individual essential fire safety measures.

## 13 ATTACHMENTS

ATTACHMENT 1 Design and Construct Checklist for Consultants

ATTACHMENT 2 Securing Gas Cylinders

## ATTACHMENT 1 DESIGN AND CONSTRUCT CHECKLIST FOR CONSULTANTS

**Design and Construct List**

The following is a list of fire documents which IFS require the building service consultant and contractors to provide as part of their package.

This is a guide for the consultant/contractor to ensure they meet minimum design components in all projects. These documents will be reviewed by the relevant IFS Services Engineer or their delegate during the design phases.

This list does not alleviate the building services consultant's responsibility to design to the online IFS Design standards.

| Design Input - Provided by all Fire Services Consultants on all Projects | | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Item Required** | **Detail of the Design Item to be Completed** | **Project Planning and Assessment** | **Approved Project Initiation** | **Design and Documentation** | **Tender** | **Construction** | **Post Construction and DLP** | **Compliance Achieved** | **Building Services Consultant Comments** |
| Specifications (Where applicable) | Complete a scientific gas specification for the project. Include schedules for all major items of equipment including regulators, pipework, valves etc. | | | x | | | | Yes / No or N/A | |
| Plan Layout Drawings | Design drawings in AutoCAD (and Revit 3D model where applicable) format including plans, schematics, and single line diagrams. | | | x | | x | | Yes / No or N/A | |
| Room Spatial Allowances with Gas Equipment | Confirm all equipment proposed will fit within the room/riser/ceiling spaces with enough access for maintenance and egress. | | | x | | x | | Yes / No or N/A | |
| BMS Connections | Proposed connections, interfacing, system programming, graphic upgrades, and network communications between building systems and BMS to be submitted for approval. | | | x | | x | | Yes / No or N/A | |
| Supply of statutory design certifications and certifications of compliance to the University standards and other relevant standards. | Complete the design certificate in line with the relevant standards and requirements including NCC, Australian Standards, IFS Standards. | | | x | x | x | | Yes / No or N/A | |
| Safety in Design Documentation | Provide a Safety in Design document for review and approval by the Services Engineer. | | | x | x | x | x | Yes / No or N/A | |
| Asset List | Proposed final asset list to be submitted for approval | | | | | x | | Yes / No or N/A | |
| Inspection, testing and maintenance | Confirm all inspection, testing and preventive maintenance to be performed during Post Completion together with proposed dates when the tasks will be performed | | | | | | x | Yes / No or N/A | |

Note that the different phases of design and construct project timelines are to be determined by the University project manager.

## ATTACHMENT 2 SECURING GAS CYLINDERS

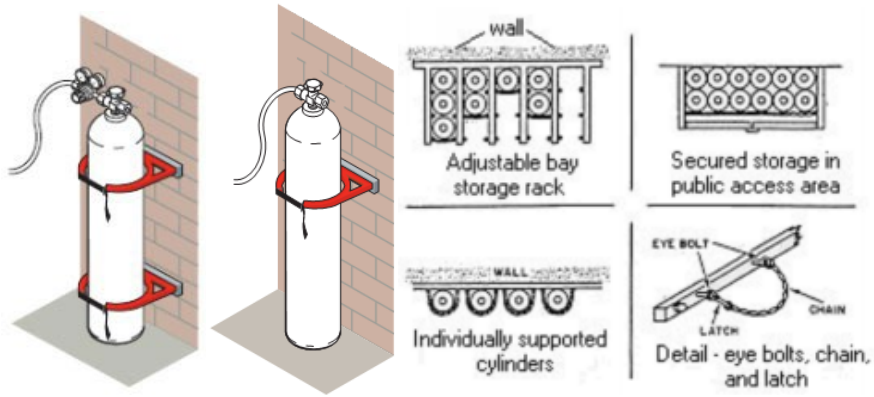


*Figure 2a Correct Securing*

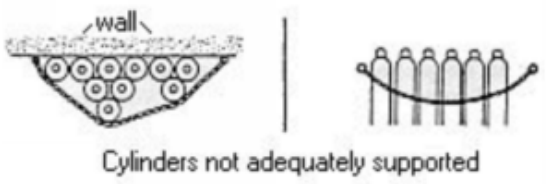


*Figure 2b Incorrect Securing*