Classification: Official

Publications approval reference: PRN02238

NHS England

Health Technical Memorandum 02-01: Medical gas pipeline systems Part B: Operational management

Preface

About Health Technical Memoranda

Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

The focus of HTM guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle.

Language usage in technical guidance

In HTMs and HBNs, modal verbs such as "must", "should" and "may" are used to convey notions of obligation, recommendation or permission. The choice of modal verb will reflect the level of obligation needed to be compliant.

The following describes the implications and use of these modal verbs in HTMs/HBNs (readers should note that these meanings may differ from those of industry standards and legal documents):

- "Must" is used when indicating compliance with the law.
- "Should" is used to indicate a recommendation (not mandatory/ obligatory), i.e. among several possibilities or methods, one is recommended as being particularly suitable – without excluding other possibilities or methods.
- "May" is used for permission, i.e. to indicate a course of action permissible within the limits of the HBN or HTM.

Typical usage examples

- "All publicly-funded organisations must ensure that all contracts established to collect and treat waste conform to the Public Contracts Regulations." [obligation]
- "All low voltage (LV) distributions should be configured as TN systems." [recommendation]
- "Alcohol hand gels that do not contain siloxanes may be rinsed out and the packaging recycled or placed into the municipal waste stream." [permission]

"Shall", in the obligatory sense of the word, is never used in current HTMs/HBNs.

Project derogations from the Technical Guidance

Healthcare facilities built for the NHS are expected to support the provision of high-quality healthcare and ensure the NHS Constitution right to a clean, safe and secure environment. It is therefore critical that they are designed and constructed to the highest and most appropriate technical standards and

guidance. This applies when organisations, providers or commissioners invest in healthcare accommodation (irrespective of status, e.g. Foundation and non-Foundation trusts).

Statutory standards plus technical standards and guidance specific to NHS facilities:

- Health Building Notes
- Health Technical Memoranda

A complete list of NHS estates-related guidance can be found on the NHS England website.

The need to demonstrate a robust process for agreeing any derogation from Technical Guidance is a core component of the business case assurance process (see published derogations guidance).

The starting point for all NHS healthcare projects at Project Initiation Document (PID) and/or Strategic Outline Case (SOC) stage is one of full compliance.

Derogations to standards will potentially jeopardise business case approval and will only be considered in exceptional circumstances. A schedule of derogations will be required for any project requiring external business case approval and may be requested for those that have gone through an internal approvals process.

While it is recognised that derogation is required in some cases, this must be risk-assessed and documented in order that it may be considered within the appraisal and approval process.

Derogations must be properly authorised by the project's senior responsible owner and informed and supported by appropriate technical advice (irrespective of a project's internal or external approval processes).

Sustainability and net zero carbon targets

The UK is leading the way on tackling climate change and improving sustainability, and the NHS is leading the way in England.

In 2019, the UK became the first major economy to commit to net zero emissions by 2050. In 2020, the NHS set out its intent to support this ambition through its 'Delivering a "Net Zero" National Health Service' report. The report sets a clear target for achieving a net zero health service for direct emissions by 2040 and indirect emissions by 2045.

In 2023 NHS England published the 'NHS Net Zero Building Standard'. This applies to all new building projects and major upgrades across the NHS estate. It provides technical guidance to ensure new or refurbished buildings are sustainable, resilient, energy-efficient, and built with reduced "whole-life carbon" (i.e. upfront, operational and embodied carbon).

The NHS estate has a critical role to play in achieving net zero carbon emissions. It is vital that every opportunity is seized across the NHS to do so, and the NHS estate is an area where direct and cost-effective action can be taken with a high degree of confidence.

This guidance is not mandatory (unless specifically stated). However, any departures/ derogations from this HTM – including the measures implemented – should provide a degree of safety not less than that achieved by following the guidance set out in this HTM.

Context and background

Introduction

A medical gas pipeline system (MGPS) is installed to provide a safe, convenient and cost-effective system for the provision of medical gases to the point-of-use. It reduces the problems associated with the use of gas cylinders such as safety, transport, storage and noise.

This Health Technical Memorandum (HTM) is divided into two parts. Guidance in this document (Part B) covers operational management of the MGPS and cylinders. Part A covers all supplies of medical gases. It applies to all MGPS installations in healthcare facilities including anaesthetic gas scavenging disposal systems (AGSS), mobile vehicles and dental medical gas systems. This document covers the design, installation, and validation and verification (testing and commissioning) of the MGPS.

The guidance given in this document should be followed for all new installations and refurbishment or upgrading of existing installations.

Existing installations should be assessed for compliance with this guidance document taking account of the priority for patient safety. Any upgrades to the existing system should be assessed and a plan for upgrading the existing system should be prepared where required. It is not necessary to apply the guidance retrospectively unless patient or staff safety would be compromised.

All new installations or modifications to the MGPS should be overseen by the Medical Gas Safety Group (MGSG).

This 2026 edition of HTM 02-01 supersedes all previous versions and HTM 2022.

Basic principles of design

Patient safety is paramount in the design, installation, commissioning and operation of all supplies of medical gases. The basic principles of safety are achieved by ensuring adequacy, identity, continuity and quality of supply.

Adequacy of supply

This is achieved by ensuring that the design of the MGPS and capacity of the supply plant are sufficient to provide the required flow of gases and vacuum for the intended number of patients to be treated at any one time. Adequacy of supply is confirmed during commissioning of the systems.

Identity of supply

This is achieved by ensuring that all points to which the user can connect medical equipment (terminal units) and user-replaceable components are provided with gas-specific connections. Such connections are also identified by symbol and colour. The gas specificity is maintained by comprehensive tests and checks during installation and commissioning, and during any work or maintenance on the systems.

Continuity of supply

This is achieved by installing, as a minimum, duplex components. Additional means of supply provision should also be available, in the event of failure of the primary and secondary plant or supply system. Continuity of supply is assured by continued operation in single fault conditions. Systems should also be connected to the essential electrical supply.

Quality of supply

Medical gases are medicines and as such must comply with the Human Medicines Regulations 2012 (as amended) and the relevant monographs of the British Pharmacopoeia.

Quality of supply is ensured by the use of gaseous or liquid sources that are provided in accordance with an appropriate product specification, usually a recognised monograph of the British Pharmacopoeia. Medical gases are subject to the same regulations as other forms of medicine. Licensed medicines holding a UK marketing authorisation (MA) should be used in preference to unlicensed medicines wherever possible. In the case of compressor-based systems, filtration equipment to a known and agreed standard is installed. To ensure that the product is not adulterated in the distribution system, pipeline installations and components are required to meet agreed specifications. Medical gases are required to comply with the relevant monographs of the British Pharmacopoeia.

Healthcare Safety Investigation Branch reports

The Healthcare Safety Investigation Branch (HSIB) launched a national investigation into the provision of piped oxygen gas supplies to hospitals during the COVID-19 pandemic. As part of this investigation, two interim bulletins were published, followed by a final report (Healthcare Safety Investigation Branch, 2021a, 2021b, 2021c). The recommendations of the final report are taken account of in this revision of HTM 02-01.

It made the following safety recommendations:

- Safety recommendation R/2021/132: that the key roles, responsibilities and competencies of individuals identified in HTM 02-01 are further reviewed, including identifying how the appointment and training of designated officers may be supported.
- Safety recommendation R/2021/133: that a process is implemented to provide ongoing assurance on the qualifications and experience of individuals identified in HTM 02-01, including how Authorising Engineers (MGPS), or their subcontractors, are appointed by healthcare organisations.
- Safety recommendation R/2021/134: that an updated HTM 02-01 should reinforce multidisciplinary team working and include:
  - updated advice on the type and design of MGPS infrastructure recommended for healthcare organisations
  - enhanced processes to encourage shared working between clinical and non-clinical teams on MGPS issues
  - specifications for the relevant levels of competence and training for healthcare staff on MGPS
  - any updated processes or guidance generated in response to the other safety recommendations specified in this report (R/2021/120, R/2021/132, R/2021/133).

Major changes since the 2006 edition

Introduction

This 2026 revision of HTM 02-01 focuses on risk-based design, clear governance, staff competency, system resilience, sustainability and overall assurance. The core engineering principles remain the same as the previous edition, but the document has moved away from a mainly prescriptive engineering approach and now provides a broader framework for designing and verifying systems that are safe, reliable and fit for the future.

Informed design process

One of the most important changes is the introduction of an informed design process (IDP). The design of medical gas systems should be based on a clear understanding of clinical need, operational risk, technical requirements and future resilience, rather than relying solely on historic norms or prescriptive formulas. It requires research, investigation, risk assessment, development of design options and multidisciplinary decision-making, with clear justification that the chosen design is appropriate for the clinical context.

Medical Gas Safety Group (MGSG)

This edition promotes a collaborative, multidisciplinary approach to the design and operational management of MGPS and cylinder supplies. It introduces the Medical Gas Safety Group (MGSG), aligning with other HTMs which adopt a similar “safety group” structure. It advises that the MGSG should be part of the healthcare organisation’s governance structure and report to the Board. It provides guidance on the remit and membership of the Group, advocating that it should be led and chaired by the Senior Operational Manager or Chief Pharmacist.

Project-specific MGSG

It also advises that, where large or complex projects are being undertaken by a healthcare organisation, a project-specific medical gas safety group (PMGSG) should be established. This is a multidisciplinary team that reports to the main MGSG. Its purpose is to ensure the safety of all future MGPS installations used by patients and staff within a new build or refurbishment project, and to minimise associated risks.

Stronger governance, accountability and competency requirements

The 2026 edition places much more weight on governance and people. It links the design and management of MGPS to the MGSG and states that all new installations or modifications should be overseen by the MGSG. It provides more guidance on the role of the Authorised Person and the Authorising Engineer (MGPS), and places emphasis on competency as a combination of skills, knowledge, experience and behaviours.

Integration of post-2006 legislation and building safety requirements

The 2026 draft introduces a new section on the Building Safety Act 2022, including dutyholder obligations, gateway approvals and the “golden thread” of information. It also sets out how these provisions affect healthcare facilities and their estates and infrastructure.

Explicit incorporation of COVID-19 and HSIB learning

The revised draft incorporates lessons from the COVID-19 pandemic, including findings from the Healthcare Safety Investigation Branch (HSIB) report on piped oxygen supply. It recognises that, while bulk oxygen supply was generally sufficient, the limiting factor was often the ability of the MGPS to deliver the required flow to patients. Increased demand

from modern therapies and the concentration of high-dependency patients exposed constraints in pipeline capacity and system configuration. In response, the guidance places greater emphasis on designing for peak and surge demand, understanding system-wide flow and pressure limitations, and ensuring coordinated, multidisciplinary management of oxygen use across healthcare facilities.

Sustainability and net zero

The revised draft introduces sustainability and net zero as explicit design considerations. It requires that the method of delivering medical gases is as low carbon as reasonably practicable, while maintaining patient safety as the overriding priority. Designers are expected to consider energy consumption and the life-cycle environmental impact of systems, and to align with NHS net zero commitments. The guidance also highlights the environmental impact of certain gases, particularly nitrous oxide, and reflects this in system design choices.

Nitrous oxide infrastructure

Leading anaesthetic organisations have recommended that piped nitrous oxide systems should no longer be considered in modern anaesthetic practice, and that transition to point-of-use cylinders should be completed by the end of 2026/27 where access remains desirable. The revised HTM includes amendments to reflect these changes.

Inclusion of dental systems

In the 2006 edition, dental compressed air and vacuum were treated separately in HTM 2022 Supplement 1 rather than being embedded as dedicated chapters in Part A. The 2026 draft brings dental systems fully into the main body of the document, with separate chapters for dental air systems and dental vacuum systems. It gives dental provision much greater visibility and status within the main MGPS guidance.

New stand-alone content for decommissioning, signage, quality control and mobile vehicles

The revised structure contains several major stand-alone chapters that either did not exist in this form in 2006 or were handled differently. The 2026 contents include separate chapters on decommissioning of piped medical gas systems, signage requirements, engineering validation and verification, medical gas quality control testing and mobile vehicles. (In the 2006 edition, decommissioning did not appear as its own chapter, signage sat in an appendix, pharmaceutical and quality testing sat within the broader validation and verification chapter, and there was no dedicated chapter for mobile vehicles.)

Dedicated chapter on quality control testing criteria for medical gases

Content on the quality control testing of medical gas systems, previously covered in paragraphs 15.109–15.184 of Chapter 15 (validation and verification) of Part A, has been revised and relocated to a dedicated chapter to provide clearer separation and emphasis. Tables 29–31 from that chapter have also been consolidated into a single table, now presented as Table 34 in this edition.

Technical file

The 2026 draft requires a technical file for the MGPS, containing design details, components used, material certificates and pressure test validation, and it states that this file should be updated whenever modifications or extensions are made. The revised draft also links system documentation to auditability and to the wider building safety “golden thread” concept.

Updated approach to quality of supply and pharmacopoeial references

The 2026 draft emphasises that medical gases are medicines and that they must comply with the Human Medicines Regulations 2012. It standardises references throughout to the relevant monographs of the British Pharmacopoeia.

Updated standards framework and technical references

All references have been updated.

Digital delivery and modern construction methods

The 2026 draft includes content on building information modelling (BIM), BS EN ISO 19650 and modern methods of construction (MMC). It explains that BIM should provide the basis for design coordination and installation, and that MMC strategies and digital documentation should be considered.

Pressure management and system configuration

The revised guidance provides greater clarity on pressure management within the MGPS, including the explicit use of pressure-reducing stations (PRS), reflecting a more structured and risk-based approach to system design.

Resilience

The revised guidance emphasises that system resilience should be established through risk assessment, with consideration given to patient groups, anticipated procedures, possible future changes and emergency scenarios such as a pandemic. It also introduces stronger language around system resilience, tertiary supplies, emergency support arrangements and the need to document the decision-making process behind supply configuration. Resilience should be treated as a broader operational and design problem tied to service risk.

Proportionality and wider applicability across healthcare settings

The revised draft broadens applicability while recognising proportionality. It states that the guidance is intended for all healthcare facilities and specifically notes that, in smaller dental practices, a degree of proportionality should be applied to design and management while patient safety remains paramount.

Downloadable test forms

The test forms (referred to as “B-forms” in this edition) used during the testing and commissioning of medical gas systems can now be downloaded as separate Excel files from the same webpage as the HTM PDF. This allows users to enter their own data directly.

Acknowledgements

NHS England would like to thank the following individuals and organisations for their valuable contributions to the development of this guidance. Titles reflect roles held at the time of contribution:

Richard Maycock, Managing Director, MES Ltd (Lead technical author)

Robert McCrea, Technical Director, Medical Gas Consultancy Limited (Co-author)

Alan Mulvey, Hard FM Lead, NHS England

Gary Bettison, Deputy Head of Estates (SJUH Ops Engineering), Leeds Teaching Hospitals

Jack Hughes, Senior Technical Manager and Mechanical Authorising Engineer, Equans

James Harris, Pharmacy Group Director, University Hospitals Tees

Jason Wong, Chief Dental Officer England, NHS England

Lucy Hennessy, Chief Pharmacist and Controlled Drugs Accountable Officer, Airedale NHS Foundation Trust

New Hospital Programme

NHS Pharmaceutical Quality Assurance Committee - Medical Gas Subgroup

Simon Picking, Head of Hard FM, NHS England

NHS England would also like to thank all those who took the time to comment and send contributions during the scoping and technical engagement phases of this document.

Contents

1 Scope

Note:
Throughout this document, the phrase “Part A” is used as a generic term to describe the “Design, installation, validation and verification” part of Health Technical Memorandum 02-01.

References to pharmacopoeial standards have been standardised throughout the document. Where appropriate, references now refer to the relevant monographs of the British Pharmacopoeia (British Pharmacopoeia Commission, 2026) to reflect the UK regulatory framework for medicinal products. The British Pharmacopoeia provides the only comprehensive collection of authoritative official standards for UK pharmaceutical substances and medicinal products, including all the monographs and texts of the European Pharmacopoeia.

Guidance in this document

1.1 This Health Technical Memorandum (HTM) 02-01 is divided into two parts. It applies to all medical gases used in healthcare premises. This document (Part B) covers operational management including roles and responsibilities, training requirements and permits to work (PTWs). Part A focuses on the issues involved in the design, installation, and validation and verification (testing and commissioning) of an MGPS.

1.2 Parts A and B should be used in conjunction with each other and not used as stand-alone documents.

1.3 The guidance provided in this document should be used for all new installations and refurbishments including the upgrading of existing systems.

1.4 While this guidance is intended for all healthcare facilities, for smaller dental practices (for example, five chairs or fewer), a degree of proportionality should be applied to both the design and management of the system. For example, while a group of practices may have a Medical Gas Safety Group (MGSG) or an Authorised Person (MGPS), a smaller dental practice may discuss medical gases as part of routine team meetings. If further advice is required on the application of this guidance, it should be sought from an Authorising Engineer (MGPS). In all circumstances, patient safety must remain a priority.

1.5 An MGPS is intended to be a safe, convenient and cost-effective alternative to the use of portable cylinders, portable compressors and portable suction units, providing gas or vacuum for clinical needs without the associated problems of porterage, noise and space wastage.

1.6 It is not necessary to apply the guidance retrospectively unless patient or staff safety would be compromised or environmental sustainability could be optimised. In this case, the guidance given in this document should be followed. It should be supplemented by risk assessment tools and processes and other supporting information (such as the annual Authorising Engineer (MGPS) audit).

1.7 Existing installations should be assessed for compliance with Part A as part of a compliance audit and risk assessment (CARA). The standard of safety of the existing installation should be to the same level that is given in Part A. A plan for upgrading the existing system should be prepared if required, taking account of the priority for patient safety. Managers should liaise with clinical staff and take account of the latest guidance. For very small MGPS systems in non-acute settings, an assessment for the ongoing need of a piped system compared to bottled or local provision should take place.

1.8 Whenever appropriate, European/British Standards specifications should be used.

1.9 Throughout this document, the term "medical gas pipeline system(s)" is abbreviated to MGPS.

Operational management

1.10 Part B on operational management covers such issues as statutory requirements, functional responsibilities, operational policies (OPs), operational procedures, training and communications, cylinder management, general safety, maintenance and risk assessment, and control of exposure to anaesthetic agents, giving definitions and working practices throughout.

1.11 It is intended to be used by operational managers, engineers, Quality Controllers (MGPS), technicians, finance officers and other professionals involved in the day-to-day running of an MGPS.

1.12 The primary objective of this Part is to ensure the provision of safe and reliable MGPS and cylinder management for efficient operation and use. This objective will only be achieved if the medical and nursing users and estates staff participate in the introduction of an OP designed to minimise the hazards likely to arise from misuse of the system.

Other guidance

1.13 Guidance on provision of MGPS installations is also given in Health Building Notes.

2 Governance and risk management

This chapter should also be read in conjunction with HTM 00 – 'Policies and principles of healthcare engineering'.

Introduction

2.1 This chapter deals with medical gas governance, the assessment of risk and the need to provide safe medical gas pipeline systems (MGPS) in healthcare facilities through the design, operation and maintenance of the medical gas pipeline infrastructure to adequately protect the end-user, particularly patients, from medical gas pipeline failures. It promotes a collaborative multidisciplinary approach to both the design and operational management of the MGPS and cylinder supplies. It introduces the Medical Gas Safety Group (MGSG) (which includes medical professionals, clinicians and engineering and operational staff) to the design process and the overall management of medical gas pipeline safety.

2.2 Most organisations may already have a medical gas committee or similar group in place to manage medical gas safety, which should now be referred to as the MGSG. It is important that anyone who has any interaction with medical gases is considered and represented in the MGSG to ensure they not only focus on technical compliance but also focus on patient safety, staff training, risk management and integration with other healthcare systems.

2.3 Healthcare organisations have an explicit duty under the Health and Safety at Work etc. Act 1974 and the Pressure Systems Safety Regulations 2000 to assess and manage the risks posed by medical gases on their premises. They should make use of risk assessments and safe methods of operation, to ensure the safety of patients, staff and visitors with regard to medical gases. Ensuring these elements are in place will assist the organisation to fulfil its duties in relation to the provision of a safe and robust MGPS. A programme of audit should be in place to ensure that key policies and practices are being implemented appropriately. This will inform the organisation's assurance framework.

2.4 Responsibility and, more specifically, the duty of care within a healthcare organisation are vested in the board of directors or equivalent and its supporting structure. Though compliance with this guidance may be delegated to staff or undertaken by contractors (including PFI), accountability cannot be delegated.

Healthcare Safety Investigation Branch (HSIB) reports

2.5 The HSIB launched a national investigation into the provision of piped oxygen gas supplies to hospitals following two interim reports (https://www.hsib.org.uk/investigations-and-reports/oxygen-issues-during-covid-19-pandemic/) on oxygen supply during the

COVID-19 pandemic. The recommendations of the final report are taken account of in this revision of HTM 02-01.

2.6 It made the following safety recommendations:

- Safety recommendation R/2021/132: that the key roles, responsibilities and competencies of individuals identified in HTM 02-01 are further reviewed, including identifying how the appointment and training of designated officers may be supported.
- Safety recommendation R/2021/133: that a process is implemented to provide ongoing assurance on the qualifications and experience of individuals identified in HTM 02-01, including how Authorising Engineers (MGPS), or their subcontractors, are appointed by healthcare organisations.
- Safety recommendation R/2021/134: that an updated HTM 02-01 should reinforce multidisciplinary team working and include:
  - updated advice on the type and design of MGPS infrastructure recommended for healthcare organisations
  - enhanced processes to encourage shared working between clinical and non-clinical teams on MGPS issues
  - specifications for the relevant levels of competence and training for healthcare staff on MGPS
  - any updated processes or guidance generated in response to the other safety recommendations specified in this report (R/2021/120, R/2021/132, R/2021/133).

Note:
Where the provision of estates and facilities services are part of a contract (including PFI), it is essential that these providers participate fully in all those aspects of estate and facilities management that can affect the safety of patients. This includes responding to specific requests from the MGSG, which may be in addition to relevant guidance and documentation.

Medical Gas Safety Group (MGSG)

2.7 Each healthcare organisation, through its MGSG, should be able to demonstrate that they have suitable governance, competence and accountability arrangements in place to provide safe medical gases in healthcare facilities.

Note:
Competence: where a person is required to be competent, they should be able to demonstrate through skills, knowledge, experience and behaviours that they have the ability to undertake their role.

2.8 The MGSG is a multidisciplinary group formed to assess and monitor all aspects of medical gases and resilience required for the safe development and operation of healthcare facilities.

2.9 The MGSG, through engagement with specialist medical gas designers, should inform the development of safe and resilient medical gas pipeline distribution systems used within the healthcare environment, including redundancy and duplication as necessary. It should oversee the maintenance and operation of the system by monitoring, recording and acting on all medical gas pipeline safety issues in accordance with the appropriate legislation and guidance.

2.10 The MGSG should have clearly defined roles and responsibilities, should be part of a healthcare organisation's governance structure and should report to the board. It should be

led and chaired by a person who has appropriate management responsibility, knowledge, competence and experience. This should be the Senior Operational Manager or Chief Pharmacist.

2.11 The MGSG should provide assurance to the board of directors that appropriate expertise and relevant personnel are available so that policies and actions agreed by the group are being fully implemented. This will also require assurance to the MGSG from specialist medical gas designers, installers, maintainers and Authorising Engineers (MGPS) with regard to the safety of the medical gas pipeline infrastructure.

2.12 It is important that decisions affecting the resilience, safety and integrity of medical gas pipeline distribution and supply systems and associated equipment do not go ahead without being agreed by the MGSG. In that regard, the MGSG should ensure that sufficient, appropriate expertise and competence are always available when making such decisions.

2.13 Contribution made by the MGSG to a design, assessment or maintenance consideration should be documented and held on record.

2.14 The MGSG may typically comprise (see Figure 1):

- estates (operations and projects) staff
- the Chief Pharmacist and pharmacy staff
- an Authorising Engineer for MGPS
- the Authorised Person(s) for MGPS
- several senior nursing representatives from different clinical areas
- the portering manager
- staff from clinical engineering services, also referred to as the medical equipment service unit (MESU), electro-biomedical engineering (EBME), medical engineering, medical electronics or medical physics
- clinicians working in or representing specialist departments (for example, radiology, radiotherapy, community and dental services)
- the Fire Safety Adviser or Fire Safety Manager.

2.15 Members to be co-opted on the MGSG may include:

- the Quality Controller (MGPS)
- designers who are conversant with the design principles and the requirements of MGPS in healthcare settings
- personnel from the finance department with accountability for capital and revenue evaluation
- health and safety
- learning and organisational development
- other stakeholders as appropriate.

From time to time, certain projects may require specific expert knowledge. The terms of reference should permit the chair of the MGSG to co-opt members for the specific task reviews as appropriate.

Remit of the Medical Gas Safety Group

2.16 The MGSG should provide a forum in which people with a range of competencies can be brought together to share responsibility and take collective ownership:

- of the assessment of existing premises
- of determining the most effective use of available resources, including finance and people
- of the appointment process and verification of qualifications for designated personnel
- for supporting and providing assurance to the board of directors regarding the safe provision of medical gas pipeline

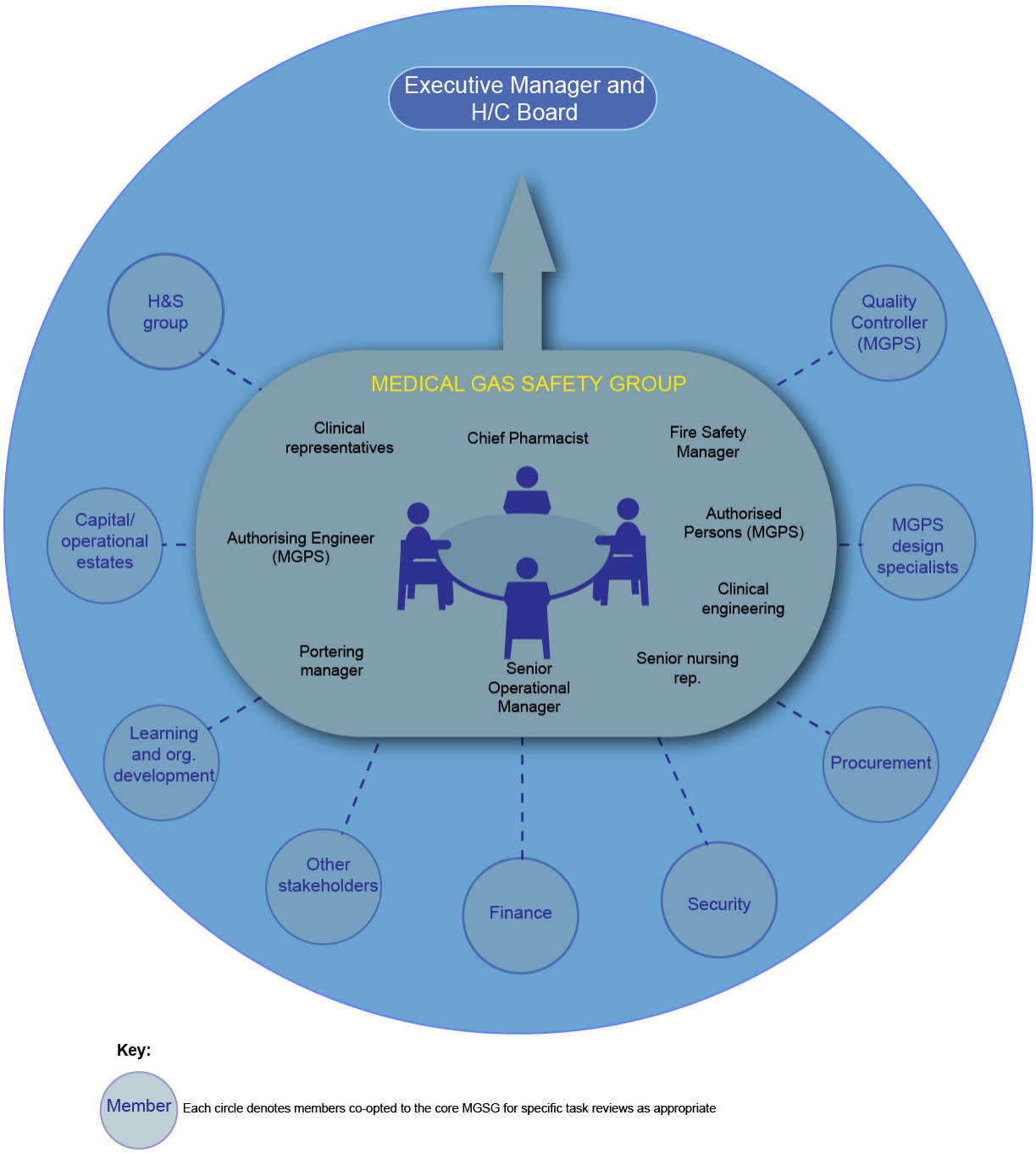

Figure 1 Example of a typical Medical Gas Safety Group

services across the healthcare organisation's premises

- of monitoring the effective operational management of medical gases and informing relevant business continuity risk assessments
- for ensuring that the medical gas pipeline operational and management policy is regularly reviewed including the associated risk register and supporting documentation
- for ensuring all tasks indicated by the risk assessments have been allocated and accepted
- for ensuring new builds, refurbishments, modifications and equipment are designed, installed, commissioned and maintained to the required medical gas

pipeline standards and the needs of the healthcare organisation

- for reviewing any proposed developments, considering whether they minimise the risk to patients – especially those treated in critical care areas – by maintaining resilience and ensuring they are compliant with all current legislation and NHS England policy and guidance.
- for overseeing the safe decommissioning and removal of MGPS equipment
- for ensuring that appropriate maintenance and monitoring procedures are in place
- for ensuring that any risks pertaining to medical gas pipeline safety and quality of the supply are addressed
- for reviewing safety, environmental and exposure-related issues associated with the MGPS, connected equipment and medical gas cylinders
- for monitoring the training and communication of relevant staff groups on medical gas pipeline-related issues
- for ensuring adequate monitoring of the status of MGPS and their associated alarms (for example, plant, telemetry, and local and central alarm systems)
- for reviewing the implementation of control measures and incident protocols
- for understanding how gases and associated equipment are used in clinical areas in order to assess risks associated with their use, the impacts of supplier shutdowns or changes, and the training needs of both clinical and non-clinical users.

2.17 Detailed minutes of the group meetings should be recorded, distributed and retained in accordance with the management policy to demonstrate good management, appropriate and timely actions and good governance.

2.18 The MGSG should always act in an appropriate and timely manner. The MGSG should meet quarterly. However, individual responsibilities should not be restricted by the need to hold formal meetings.

Project-specific MGSG

2.19 Where large or complex projects are being undertaken by a healthcare organisation, a project-specific medical gas safety group (PMGSG) should be established.

2.20 The PMGSG is a multidisciplinary team that reports to the main MGSG. Its purpose is to ensure the safety of all future MGPS used by patients and staff within a new build or refurbishment project, and to minimise associated risks. A defined terms of reference should be developed by the healthcare organisation's MGSG to govern the work of the PMGSG. The MGSG and project team should retain oversight of the project and ensure that appropriate governance processes and policies are in place. This should include establishing defined milestones for risk assessment and review, and the undertaking of a formal lessons-learned exercise on project completion.

Need for risk assessment

2.21 Healthcare organisations are required to comply with the Health and Safety at Work etc. Act 1974, the relevant monographs of the British Pharmacopoeia, the Management of Health and Safety at Work Regulations 1999, the Pressure Systems Safety Regulations 2000, and applicable guidance issued by the British Compressed Gases Association (BCGA), among others. In carrying out a risk assessment process involving all key partners, the organisation can demonstrate its understanding of its duties in relation to these regulations.

2.22 The risk assessment process should identify any residual risks from the design which should be added to the healthcare organisation's risk register. The overall

assessment will enable the healthcare organisation to manage its collective ownership of risk management and hence make appropriate medical gas pipeline or medical cylinder operational and emergency contingency plans in accordance with Health Building Note 00-07 – 'Planning for a resilient healthcare estate'. The risk assessment outcome should provide the necessary information to meet the requirements of the Construction (Design and Management) (CDM) Regulations.

2.23 Risk management carefully balances the approach to a design strategy with the cost-benefit relationships, where cost represents investment, business continuity, operational risk and patient safety. An inappropriate level of resilience or response to a failure may compromise patient safety. When conducting risk assessments for new and existing MGPS, specialist designers and the MGSG need to be aware of the impact of climate change on medical gas pipeline infrastructure (for example, environmental impacts such as flooding, water adsorption and condensation, and the ambient temperature of spaces in which plant and cylinders are installed). Where environmental characteristics of the installation have changed, the risk assessment needs to be reviewed accordingly. A report by the Committee on Climate Change (2017) draws together and interprets the evidence regarding current and future threats (and opportunities) for the UK posed by the impacts of climate up to the year 2100.

2.24 The risk assessment should be reviewed regularly by the MGSG, especially when a room or space is to undergo a change in function or clinical activity.

Ownership and design

2.25 Medical gases are medicines and, as such, it is recommended that, regardless of operational infrastructure, the Chief Pharmacist should take an active role in the management of medical gases.

2.26 The duties of the stakeholders involved in the design, assessment, operation and maintenance of a new or an existing infrastructure should ensure (so far as reasonably practicable) that all risk levels and the likelihood of a medical gas pipeline failure are balanced against the consequences of such failures for each site within the organisation.

2.27 Designers, stakeholders and the MGSG should understand and accept the intended operation, limitations and possible failure of the MGPS. Where necessary, they should implement contingency arrangements where risks of medical gas pipeline failures cannot be, or are not, mitigated within or by the MGPS. These residual risks should include those inherent from the design strategy.

2.28 In accordance with the CDM Regulations, designers should ensure their designs can be maintained safely and that foreseeable risks to the health and safety of maintenance personnel are eliminated or reduced. The design should consider and facilitate equipment maintenance/replacement with minimum disruption to continuity of supply.

2.29 If healthcare organisations, PFI management, contractors and their designers, and estate operation managers choose not to implement some of the recommendations of HTM 02-01, the residual risks that arise from this approach should be recorded and managed appropriately. Any proposed departures, including any equivalent or mitigating measures to be applied, should be discussed with the relevant stakeholders including the MGSG. Any departures – including the measures implemented – should provide a degree of safety that is not less than that obtained by compliance with this document. Any such departures should be recorded in the operating and maintenance manuals and on the medical gas pipeline installation certificate, as appropriate, and should include the details and reasoning for the intended departure along with the associated measures applied. Significant

residual risks should be recorded on the healthcare organisation's risk register.

2.30 For new or modified facilities, the final design option, including any residual risks, should be agreed with, and signed off by, all stakeholders involved in the commissioning, design and operation of healthcare facilities. This should include the MGSG on behalf of the healthcare organisation.

3 Basic description of an MGPS

3.1 An MGPS is a purpose-designed installation that supplies and distributes medical gases safely and efficiently throughout the healthcare facility to the point of use.

3.2 Medical and dental vacuum and anaesthetic gas scavenging systems (AGSS) are included within the scope of medical gases, regardless of their operation under negative pressure or flow conditions.

3.3 The methodology behind the installation of the systems and requirements of these systems is described in Part A.

3.4 An MGPS typically comprises three sources of supply. The primary and secondary supplies are generally provided from centralised sources, delivering gases through a pipeline distribution system controlled by a series of valves. The tertiary supply should be determined through the informed design process (IDP) and may comprise a fixed pipeline supply system, a portable manifold system for connecting into the system, or individual cylinders connected directly to patients or equipment (see Chapter 1 in Part A for further information on IDP). The system terminates at the point of use with terminal units or non-interchangeable screw-threaded (NIST) connectors, to which medical equipment is connected.

3.5 The whole system, including the supply systems, is monitored by a warning and alarm system, which is categorised into two types: plant alarms and local alarms. These are described in Chapter 14 of Part A.

3.6 The medical gases covered in this document are shown in Table 1.

3.7 Other medical gas systems may be designed, installed, tested and commissioned in accordance with the principles outlined in Part A, where applicable.

3.8 The requirements for MGPS, including pipeline installation and control valve arrangements, are detailed in Part A.

3.9 Details of the quality requirements for all medical gases are given in Chapter 20 of Part A.

3.10 All sources of supply are subject to a risk assessment that considers the operational requirements of the system and the long-term sustainability and resilience of the supply infrastructure.

Gas	Abbreviation
Oxygen	O_2
Nitrous oxide	N_2O
Oxygen/nitrous oxide mixture 50%/50%	O_2/N_2O
Medical air	MA4
Surgical air	SA7
Dental air	DA
Vacuum	VAC
Dental vacuum	DVAC
Carbon dioxide	CO_2
Anaesthetic gas scavenging	AGS

Table 1 Medical gases covered in HTM 02-01

3.11 All sources of supply are covered in detail in Part A.

3.12 A number of factors should be considered as part of the risk-based design approach to ensure that the adequacy, continuity, identity and quality of the systems and gases are not compromised. In addition, the use of modern technologies should be evaluated to minimise the carbon footprint and support the delivery of a sustainable system:

- **Adequacy**: the source equipment can provide enough volume of gas/vacuum to meet the design flow rate based on clinical needs and the pipework is sized to ensure the pressure is maintained at full design flow.
- **Continuity**: the primary source of supply has duplex components to ensure flow continues in the event of a single-point failure; a secondary* supply is also provided to support the system in the event of a double fault, although it may operate at a reduced overall flow rate.
- **Identity**: all source equipment connections – such as those used for refilling (liquid oxygen), cylinder changes (manifolds) and system inlets – as well as pipeline identification and outlets (terminal units), are all gas-specific; this ensures that only the correct gas can be connected to the appropriate system and that only compatible equipment can be attached – this design feature eliminates the risk of cross-connection and the inadvertent supply of the wrong gas.
- **Quality**: the system uses materials and installation techniques that have been specifically selected to prevent contamination in the system. For systems that manufacture medical, surgical or dental air on-site, regular quality control (QC) testing of the plant is required to ensure that the gas supplied meets the necessary quality standards.

* Excludes vacuum and AGSS where a separate system may not be in place

3.13 Table 1 in Part A provides guidance on the recommended locations for the installation of terminal units. However, these recommendations are not prescriptive. A risk-based design approach, informed by both current and anticipated clinical needs, should be used to determine the appropriate type and location of medical gas terminal units.

4 Medical gas pipeline standards

Standards relevant to medical gases

BS EN ISO 7396-1. Pipelines for compressed medical gases and vacuum

4.1 ISO 7396-1 specifies requirements for the design, installation, function, performance, documentation, testing and commissioning of compressed medical gas and vacuum pipeline systems in healthcare facilities to ensure the continuous delivery of the correct gas from the pipeline system.

4.2 It applies to:

- pipeline systems for the following medical gases: oxygen; oxygen-enriched air; nitrous oxide; air for breathing; carbon dioxide; oxygen/nitrous oxide mixtures; air for driving surgical tools; nitrogen for driving surgical tools; and vacuum pipeline systems
- pipeline distribution systems for oxygen-enriched air connected to supply systems with oxygen concentrators complying with BS 7634 and ISO 10083
- extensions and modifications of existing pipeline systems.

4.3 It does not apply to:

- gas-specific connectors on mobile or stationary cryogenic vessels or on transport vehicles, or on the inlet/outlet of cylinders for non-cryogenic liquid or gas
- MGPS supplying hyperbaric chambers.

BS EN ISO 7396-2. Medical gas pipeline systems. Anaesthetic gas scavenging disposal systems

4.4 This part of BS EN ISO 7396 specifies requirements for the design, installation, function, performance, documentation, testing and commissioning of an AGSS to ensure patient safety and to minimise exposure of the operator and other persons to anaesthetic gases and vapours. It includes requirements for the power device, pipeline system, performance, non-interchangeability between key components and avoidance of cross-connections between AGSS and medical gas and vacuum pipeline systems.

BS EN ISO 7396-3. Medical gas pipeline systems. Proportioning units for the production of synthetic medical air

4.5 This document specifies requirements relating to the construction and operation of devices producing air through the blending of oxygen and nitrogen for use as sources of supply in supply systems for medical gases.

4.6 It is applicable to proportioning units intended to produce synthetic medical air and air for driving surgical tools by mixing in defined proportions oxygen and nitrogen.

4.7 It is also applicable to proportioning units intended to be components of a medical gas supply system for medical air which supplies a medical gas pipeline distribution system complying with ISO 7396-1.

BS EN ISO 9170-1. Terminal units for medical gas pipeline systems. Terminal units for use with compressed medical gases and vacuum

4.8 This standard discusses terminal units for MGPS. It is intended specially to ensure the gas-specific assembly, mechanical resistance, flow, leakage and pressure drop of terminal units to prevent their interchange between different gases and services.

4.9 It applies to terminal units intended for use in MGPS in accordance with BS EN ISO 7396-1, as pressure outlets on pressure regulators in accordance with BS EN ISO 10524-1, and as pressure outlets on pressure regulators integrated with cylinder valves (VIPR) in accordance with BS EN ISO 10524-3.

BS EN ISO 11197:2019. Medical supply units

4.10 Medical supply units are defined as “prefabricated, permanently installed equipment intended to supply electric power and/or medical gases and/or liquids”. Booms, ceiling pendants, wall systems and bedhead trunking systems are typical devices of this kind, which are frequently incorporated into gas pipeline systems.

BS EN ISO 10524-1:2019. Pressure regulators for use with medical gases. Pressure regulators and pressure regulators with flow-metering devices

4.11 This standard specifies the design, construction, type-testing and marking requirements for pressure regulators intended for the administration of medical gases and their mixtures in the treatment, management, diagnostic evaluation and care of patients or for gases used for driving surgical tools.

4.12 Examples of gases include oxygen, medical air and oxygen/nitrous oxide mixtures.

BS EN ISO 10524-2:2019. Pressure regulators for use with medical gases. Manifold and line pressure regulators

4.13 This specifies requirements for manifold and line pressure regulators used in MGPS. It outlines design, construction, testing, and marking criteria for these regulators. It covers regulators intended for connection to cylinders with specific filling pressures and those used in pipeline systems for various medical gases.

BS EN ISO 10524-3:2019. Pressure regulators for use with medical gases. Pressure regulators integrated with cylinder valves (VIPRs)

4.14 This document specifies design, type-testing, and marking requirements for cylinder valves with VIPRs.

BS EN ISO 10524-4:2008. Pressure regulators for use with medical gases. Low pressure regulators

4.15 This applies to low pressure regulators (maximum 1400 kPa) that are used in many different types of medical device.

BS EN ISO 14971:2019. Medical devices. Application of risk management to medical devices.

4.16 This document outlines the principles and processes for risk management, especially during design, installation and use of gas systems and associated devices. It supports the risk-based approach advocated by HTM 02-01.

BS EN ISO 5359:2014+A1:2017 Anaesthetic and respiratory equipment. Low-pressure hose assemblies for use with medical gases

4.17 This specifies requirements for low-pressure hose assemblies used with medical gases. These hoses are intended for use with various medical gases like oxygen, nitrous oxide, medical air, helium, carbon dioxide, xenon, and specified mixtures. The standard also covers vacuum systems and hoses for driving surgical tools. It focuses on ensuring gas specificity and preventing cross-connection between different gas systems.

BS EN ISO 21969:2009. High pressure flexible connections for use with medical gases

4.18 This applies to the flexible connections used to connect medical gas cylinders to manifolds, and states that non-metallic hoses should not be used, in addition to requirements for gas-specific connections and ignition and other safety-related items.

BS EN ISO 15001:2011. Anaesthetic and respiratory equipment. Compatibility with oxygen

4.19 This standard specifies requirements for the oxygen compatibility of materials, components and devices for anaesthetic and respiratory applications, which can come into contact with oxygen in normal condition or in single fault condition at gas pressures greater than 50 kPa. It is applicable to anaesthetic and respiratory equipment such as MGPS, pressure regulators, terminal units, medical supply units, flexible connections, flow-metering devices, anaesthetic workstations and lung ventilators.

BS EN ISO 14114:2018. Gas welding equipment. Acetylene manifold systems for welding, cutting and allied processes. General requirements

4.20 This covers the design and manufacture of acetylene manifolds for welding and cutting.

4.21 The standard is not retrospective, but all repairs or modifications to existing systems should meet the new standard's requirements wherever possible.

4.22 The standard applies to acetylene manifold systems extending from the cylinder valve outlet connection to the connection of the flame arrestor. It applies to cylinder manifolds in which up to 16 single cylinders or two banks of eight cylinders are coupled for collective withdrawal.

BS 1710:2014. Specification for identification of pipelines and services

4.23 This covers colour coding and labelling standards for medical gases.

Statutory obligations and other important documentation

4.24 Some of the more important documentation relating to medical gas systems is presented below. With much current work on standards, it is always wise to search the websites of the governing bodies to

ensure that you possess the latest version of a particular standard.

The Pressure Equipment (Safety) Regulations 2016

4.25 These regulations govern the design, manufacture, and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure above 0.5 bar (50 kPa). These regulations aim to ensure safety by requiring manufacturers to meet specific essential safety requirements and follow appropriate conformity assessment procedures before placing such equipment on the market or putting it into service.

The Pressure Systems Safety Regulations 2000

4.26 These regulations apply mainly to the in-service aspects of pressure systems such as operation and periodic examination. They also deal with design and construction aspects of systems that are outside the scope of the Pressure Equipment Regulations 1999.

4.27 The Pressure Systems Safety Regulations 2000 cover pressure systems containing a relevant fluid that is:

- a gas above 0.5 bar (50 kPa)
- a liquid with a vapour pressure of 0.5 bar (50 kPa) or greater at either its working temperature or 17.5°C
- steam at any pressure.

4.28 The Health and Safety Executive's (HSE) (2014) 'Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice L122' supports the requirements of the regulations.

4.29 The requirements contained within a Health and Safety Executive Approved Code of Practice are not law, but the Code does have special legal status.

Basic MGPS requirements

4.30 A written scheme of examination for the MGPS is required by the Regulations. The scheme defines the type, frequency and extent of examination of specific parts of the medical gas system, particularly those classified as pressure vessels, for which a two-yearly internal visual inspection is usually required.

4.31 A competent person is required to prepare this written scheme. The competent person may be an organisation and will usually be a nominated person from the insurance company that carries out periodic pressure vessel inspections. (This is not the Competent Person (MGPS) defined under the permit to work (PTW) system in this HTM.)

4.32 Pressure safety valve replacement scheme (five-yearly). This advice arises from the inherent lack of corrosion of these components when used with the very dry gases in the MGPS and is an alternative to pressure testing, which requires MGPS shutdowns and could be dangerous if line pressures were to be increased during patient use. Details of the procedure should appear in the written scheme.

The Control of Substances Hazardous to Health (COSHH) Regulations 2002

4.33 These regulations are the main piece of legislation covering control of the risks to employees and other people arising from exposure to harmful substances generated out of, or in connection with, any work activity under the employer's control. The main objective of the regulations is to reduce occupational ill-health by setting out a simple framework for controlling hazardous substances in the workplace.

4.34 COSHH requires employers to ensure that the exposure of their employees to substances hazardous to health is either prevented or, where this is not reasonably

practicable, adequately controlled to ensure that exposure standards are not exceeded.

4.35 Essential to the COSHH process is the performance of a risk assessment, or review of an existing one, identifying the anaesthetic agents used, staff most likely to be exposed, and existing exposure control methods.

4.36 Combinations of general ventilation, AGSS and local exhaust systems may be required in extreme cases to ensure compliance with COSHH.

4.37 Anaesthetic agents were assigned occupational exposure standards (OESs) by the Health and Safety Executive. These are listed below:

Anaesthetic agent	OES ppm over an 8-hour time-weighted average (TWA) reference period
Nitrous oxide	100
Enflurane	50
Isoflurane	50
Halothane	10

Legal requirement

4.38 Exposure to anaesthetic agents should be prevented or where this is not reasonably practicable, adequately controlled. Exposure can only be treated as adequate when any workplace exposure limit (WEL) for those agents is not exceeded and the principles of good practice set out in COSHH Schedule 2A are applied. The Health and Safety Executive is empowered to enforce the standards, taking into account attempts to comply as soon as is reasonably practicable.

4.39 Staff should be reminded of the need to reduce leaks from the MGPS and anaesthetic equipment to a minimum.

4.40 The 'Control of Substances Hazardous to Health Regulations 2002. Approved Code of Practice and guidance L5' also applies.

Note 1
Although the OES values quoted are extant, there is a possibility that the OES for nitrous oxide exposure may be reduced. It is not clear which level will be adopted, but both 50 ppm and 25 ppm eight-hour TWAs (time-weighted averages) have been suggested.

Note 2
OESs for nitric oxide, nitrogen dioxide and sulfur dioxide were removed from EH40 in the 2003 supplement. Levels for these are now suggested as being no greater than 1 ppm, and limits for SO_2 exposure as being less than 1 ppm for both 8-hour TWA OES and 15-minute STEL.
These limits are, of course, in excess of the respective contaminant levels specified in the relevant monographs of the British Pharmacopoeia.

Management of Health and Safety at Work Regulations 1999

4.41 These regulations necessitate formal risk assessment by employers in relation to the health and safety of their employees and others, arising from work activities.

Workplace (Health, Safety and Welfare) Regulations 1992

4.42 Accidents in the workplace arising from lack of a safe working environment resulted in the production of these regulations, which are particularly relevant to maintenance and access provision.

Provision and Use of Work Equipment Regulations 1998

4.43 These regulations relate to another aspect of accidents in the workplace – those related to the provision of safe equipment and safety in its use – and will apply, for example, to accidents resulting from improperly serviced test equipment used with an MGPS.

Manual Handling Operations Regulations 1992

4.44 These regulations (as amended by the Health and Safety (Miscellaneous Amendments) Regulations 2002) cover the handling and transportation of medical gas cylinders.

4.45 A risk assessment should be performed for all situations. Manual handling training is essential for all staff handling medical gas cylinders.

4.46 The BCGA's Guidance Note GN3 – 'Safe cylinder handling and the application of the Manual Handling Operations Regulations to gas cylinders' defines the principles of safe practice for the handling of compressed and liquefied gas cylinders. It explains how compliance with the Manual Handling Regulations may be achieved.

Personal Protective Equipment at Work Regulations 1992 (as amended by the Personal Protective Equipment at Work (Amendment) Regulations 2022)

4.47 These regulations apply to MGPS operation and maintenance (for example, the use of special clothing when working with cryogenic plant and replacing bacteria filters on central medical vacuum plant). Protective equipment used when handling cylinders is also covered. Operatives must be trained in the correct use of safety equipment.

Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013

4.48 These regulations are applicable to all work areas and will encompass an MGPS if, for example, the system delivers the wrong gas to a patient. Forms F2508 and F2508A may be applicable.

Electromagnetic Compatibility Regulations 2016

4.49 These regulations apply to the protection of electrical equipment from electromagnetic fields and other interference, and of equipment designed to prevent or reduce such emissions.

BS EN ISO 13485: 2016+A11:2021. Medical devices. Quality management systems. Requirements for regulatory purposes

4.50 A standard required by MGPS equipment suppliers and installers. It ensures quality control in supply chain and service.

The Medicines Act 1968

4.51 Under the Medicines Act 1968, medical gases are classified as medicinal products and are therefore subject to the same procurement and quality procedures as all other medicinal products.

4.52 The pharmaceutical quality controller is responsible for quality control of medical gases.

4.53 Medical gases and vacuum systems must not be used for non-medical purposes, other than as a power source for medical equipment or for testing medical equipment.

Human Medicines Regulations 2012

4.54 This is a key piece of legislation in the UK that governs the development, testing, authorisation, and distribution of medicines, ensuring their safety and efficacy.

Defect and failure reporting for non-medical equipment, engineering plant, installed services and building fabric

4.55 NHS England's Estates and Facilities Division has produced DH (2006) 01 – 'Reporting defects and failures and disseminating Estates and Facilities alerts'. The purpose of this document is to remind healthcare organisations of the importance of reporting defects and failures involving non-medical devices. All staff working in a healthcare environment have a responsibility to report defects or failures that occur at work to the Department of Health and Social Care.

4.56 This HTM provides guidance on:

- actions required
- what defects and failures are reportable
- definition of reportable defects and failures
- how reporting should be carried out
- what should happen to defective/failed items
- what actions estates and facilities will take.

5 Functional responsibilities

5.1 This chapter describes the roles and responsibilities of key personnel involved in the operation, maintenance and use of an MGPS. The job titles given are generic; they are not intended to be prescriptive job titles for terms of employment. Indeed, some of the personnel referred to may not be resident staff but be people employed by outside bodies and working on contract (for example, those employed by a facilities management organisation or PFI consortium).

5.2 Some staff will have other responsibilities unconnected with an MGPS, and in some cases the same individual may take on more than one role.

5.3 In all cases, however, it is essential to identify an individual who will take on the responsibility for the day-to-day management of the MGPS and become the Authorised Person (MGPS). In a healthcare facility with one MGPS serving multiple organisations, the organisation responsible for the MGPS should provide the Authorised Person (MGPS). This arrangement should be clearly defined in the MGPS policy.

5.4 In order to avoid confusion with other Authorised Persons (such as the Authorised Person for high-voltage installations), the Authorised Person for the MGPS is referred to as the “Authorised Person (MGPS)” throughout this HTM.

5.5 There should be an adequate number of Authorised Persons (MGPS) to provide cover to enable the MGPS to function effectively at all times. The maintenance contractor providing Competent Persons should not be used to provide Authorised Person cover.

5.6 This HTM recommends that Authorised Persons (MGPS) should be vested with responsibility for ensuring that the MGPS is operated safely and efficiently.

5.7 An Authorised Person (MGPS) in liaison with the Quality Controller (MGPS) should decide whether an MGPS should be taken into or out of use based on potential failure or quality issues.

Key personnel

5.8 The following are the key personnel who have specific responsibilities within the MGPS OP:

- Executive Manager
- Designated Person
- Senior Operational Manager
- Chief Pharmacist
- Authorising Engineer (MGPS)
- Authorised Person (MGPS)
- Competent Person (MGPS)
- Quality Controller (MGPS)
- Designated Clinical Officer (MGPS)
- Medical Gas Porter
- Clinical staff.

Executive Manager

5.9 The Executive Manager is defined as the person with ultimate responsibility, including allocation of funding and resources and the appointment of personnel, for the management and organisation in which the MGPS is installed.

5.10 This person has overall responsibility for the healthcare organisation. Depending on the nature of the organisation, this role may be filled by the general manager, chief executive, laboratory director, senior partner, principal or other person of similar authority.

5.11 The overall formal responsibility for the MGPS rests with the Executive Manager. The Authorised Person (MGPS) retains effective responsibility for day-to-day management of the MGPS.

5.12 The Executive Manager is responsible for the implementation of an OP for the MGPS. They should ensure that the MGPS OP clearly defines the roles and responsibilities of all personnel who may be involved in the use, installation and maintenance of the MGPS. The Executive Manager is also responsible for monitoring the implementation of the policy.

5.13 The Executive Manager may delegate specific MGPS duties to key personnel; the extent of such delegation should be clearly set out in the MGPS OP together with the arrangements for liaison and monitoring. The ultimate responsibility remains with the Executive Manager irrespective of any delegation.

5.14 The Executive Manager is responsible for ensuring that the MGPS OP is kept up to date and approved by the MGSG. The Authorised Person (MGPS) and Chief Pharmacist should take responsibility for the preparation, implementation and monitoring of the MGPS OP on their behalf, and should involve senior medical, nursing, EBME and portering personnel.

Designated Person

5.15 The Designated Person holds responsibility for the integrity of the MGPS and delivery of medical gases to patients. This role should have clear line management responsibilities and overall responsibility for the management and governance of the MGPS.

5.16 The Designated Person is responsible for the selection, assessment and appointment of the Authorising Engineer (MGPS).

5.17 The Designated Person should appoint all Authorised Persons (MGPS) on the recommendation of an Authorising Engineer (MGPS).

Senior Operational Manager

5.18 The Senior Operational Manager holds responsibility for the Authorised Persons who manage the day-to-day operation of the MGPS.

5.19 Where estates services are provided by a PFI/FM consortium or other organisation, it should be ensured that a function is identified within the organisation that is equivalent to the Senior Operational Manager.

5.20 The Senior Operational Manager should monitor the implementation of the MGPS OP. In particular, the MGPS should comply with the requirements of this HTM and relevant standards. All work should be carried out in accordance with the PTW procedures.

5.21 The Senior Operational Manager should have completed an Authorised Person (MGPS) training course and should be familiar with the MGPS requirements for the site or sites to which they are appointed.

5.22 The Senior Operational Manager should carry out due diligence on the contracted Authorising Engineer (MGPS) to ensure they meet the necessary criteria for the role and should retain copies of the Authorising

Engineer's (MGPS) certificates and relevant records.

Chief Pharmacist

5.23 The Chief Pharmacist holds responsibility for medical gases as medicines including their supply to patients via both the pipeline system and cylinders.

5.24 They have overall responsibility for the governance of the MGPS and medical gas cylinder use.

5.25 The Chief Pharmacist should have a good understanding of the medical gas systems installed on site, including cylinder provisions and the location of emergency equipment throughout the facility.

5.26 They should take a lead role in ensuring that appropriate governance arrangements are in place and that effective monitoring is carried out.

5.27 The Chief Pharmacist should ensure that the MGSG is operational and functions effectively to support compliance, maintain safe systems for patient use and ensure robust governance. They should also take responsibility for managing the structure and content of its meetings.

5.28 The Chief Pharmacist should ensure that bulk and cylinder gases comply with the relevant monographs of the British Pharmacopoeia and that other gases and gas mixtures comply with manufacturers' product licences.

5.29 The Chief Pharmacist is responsible for the provision of a stock-control system that monitors cylinder location, quantity, gas type and cylinder size, and ensures that sufficient stock levels are maintained.

5.30 The Chief Pharmacist is responsible for ensuring that an annual cylinder stock check and safety audit is undertaken and for completing any actions from that audit.

5.31 It is the responsibility of the Chief Pharmacist to appoint in writing a Quality Controller (MGPS).

Authorising Engineer (MGPS)

5.32 Authorising Engineers (MGPS) should be suitably qualified in accordance with the requirements of Chapter 8 of this HTM.

5.33 They should have specialist knowledge of medical gases, including design, installation and maintenance requirements, and should be fully conversant with this HTM and relevant British Standards. They should have detailed knowledge of the MGPS at the specific sites they are appointed, enabling them to carry out investigations, resolve problems and provide technical support on complex medical gas and pipeline system issues. An appointment as Authorising Engineer in other disciplines does not qualify an individual to act as an Authorising Engineer for MGPS.

5.34 They should be independent of, and be employed separately from, the organisations or parent bodies submitting candidates for appointment as Authorised Persons (MGPS). They should have relevant knowledge of the MGPS for which the prospective Authorised Person (MGPS) should assume responsibility on appointment.

5.35 Following the assessment of a prospective Authorised Person (MGPS), the Authorising Engineer (MGPS) should make a recommendation to the Designated Person of the submitting organisation, advising whether the person is suitable for formal employment or requires further training.

5.36 The Authorising Engineer (MGPS) should, as part of an annual audit process, review the management systems of the MGPS, including the PTW system, and monitor the implementation of the OP and procedures.

Authorised Person (MGPS)

5.37 In a typical healthcare organisation employing direct labour, there may be one or more Authorised Persons (MGPS) with clear line management responsibility.

5.38 The Authorised Person (MGPS) is the individual designated by the Executive Manager to take responsibility for the day-to-day management of medical gases and the MGPS at a particular site or sites. This includes the planning of works and issue of a PTW in accordance with the PTW procedure. The principal responsibilities of the Authorised Person (MGPS) in respect of the PTW procedure are set out in Chapter 7. The Authorised Person (MGPS) also has specific duties relating to all MGPS plant, pipelines and terminations, as well as specific tasks in relation to the installation of vacuum-insulated evaporators (VIEs).

5.39 All Authorised Persons (MGPS) should be formally appointed in writing by the Designated Person following a recommendation from an Authorising Engineer (MGPS). An assessment of the prospective Authorised Person (MGPS) by the Authorising Engineer (MGPS) is required before such a recommendation can be made.

5.40 The PTW procedure requires the full cooperation of all staff involved, along with their clear understanding of the work to be undertaken and acceptance of their responsibilities. The Authorised Person (MGPS) should take the lead in coordinating the work and explaining fully the extent and duration of any disruption to the service. They should ensure that all contractors follow the method statements, risk assessments and procedures set out in the PTW.

5.41 The Authorised Person (MGPS) is responsible for ensuring that:

- all Designated Clinical Officers (MGPS) likely to be involved are advised within a reasonable timescale of the estimated duration of the work and any required interruption to the MGPS
- all terminal units affected (that is, out of service) are appropriately blanked with “Do not use” plugs.

5.42 Arrangements should be made to ensure that cover for an Authorised Person (MGPS) is always available, particularly during holidays and other absences.

5.43 The Authorised Person (MGPS) is required to liaise closely with professionals across a range of disciplines. Accordingly, their appointment should be formally communicated in writing to all relevant stakeholders. The Authorised Person (MGPS) should maintain direct contact with the Quality Controller (MGPS), clinical staff and other key personnel.

5.44 The Authorised Person (MGPS) is responsible for assessing the competency of all Competent Persons (MGPS) employed directly by the estates/operations department and for maintaining an up-to-date register of Competent Persons (MGPS).

5.45 The Authorised Person (MGPS) is responsible for ensuring that work is carried out only by approved specialist contractors who are registered to BS EN ISO 9001 and/or BS EN ISO 13485, with a defined scope of registration that covers the specific works to be undertaken (for example, the design, installation, commissioning, validation, verification and maintenance of the MGPS or dental air and vacuum system (DAVS), as appropriate). Evidence of current registration should be verified by sight of the contractor’s certificate of registration.

5.46 The Authorised Person (MGPS) should be consulted before the purchase of any medical equipment that is to be connected to the MGPS.

Appointment of Authorised Persons (MGPS)

5.47 All Authorised Persons (MGPS) should be appointed on the recommendation of the appointed Authorising Engineer (MGPS).

5.48 An Authorised Person (MGPS) may be appointed from:

- within the directly employed workforce of the healthcare organisation with overall responsibility for the healthcare establishment
- a neighbouring healthcare organisation
- a PFI/FM contractor
- a specialist MGPS consultancy contractor offering Authorised Person (MGPS) services.

5.49 An Authorised Person (MGPS) should not be appointed from the same medical gas specialist contractor that provides Competent Persons to carry out installation or maintenance work for the healthcare organisation.

5.50 In healthcare organisations responsible for multiple healthcare establishments, an Authorised Person may be deployed across more than one site. This approach may involve providing Authorised Person (MGPS) services from a large acute hospital to smaller community hospitals, hospices or a group of non-acute hospitals within the region. It is the responsibility of the employing healthcare organisation to ensure that all relevant contractual and insurance arrangements are in place and that the peripatetic Authorised Person (MGPS) is given sufficient opportunity to familiarise themselves with the additional site(s). The Authorised Person (MGPS) should be individually assessed for each site by the Authorising Engineer (MGPS) before a recommendation for appointment can be made.

5.51 This type of arrangement may also be applied on PFI/FM sites where the contractor does not directly employ an Authorised Person (MGPS). However, if none of the healthcare organisation's properties has an employed Authorised Person (MGPS), the service should be contracted from one of the bodies listed in paragraph 5.48.

5.52 In single-site healthcare organisations, the Authorised Person (MGPS) may be employed directly by the organisation as a member of the estates staff or may be appointed from one of the sources in paragraph 5.48.

5.53 Establishments with no directly employed Authorised Person (MGPS) (for example, some community, clinic and hospice non-acute sites) may have a remote Authorised Person (MGPS) arrangement in place. These healthcare facilities should have the capability to isolate the medical gas supply in an emergency and operate on portable cylinders for a sufficient duration until the Authorised Person (MGPS) is able to attend and oversee completion of any necessary repairs. This should be clearly defined in the OP. The site should also have a senior manager identified as the person responsible for the day-to-day management of the MGPS. This individual should possess sufficient knowledge and expertise of the system to sign low-hazard PTWs. This role is referred to as the Low Hazard Authorised Person (MGPS).

5.54 The Low Hazard Authorised Person (MGPS) should receive training in the safety aspects of medical gases, the site-specific MGPS and source equipment, and the application of the PTW system.

5.55 Low Hazard Authorised Persons (MGPS) should be limited to issuing low-hazard PTWs only. All PTWs completed by them should be reviewed and countersigned by the Authorised Person (MGPS) at the earliest opportunity.

5.56 Although it may be possible for the contractor's Competent Person (MGPS) to effect emergency low-hazard repairs within a relatively short period (for example, two

hours), it may not be possible for an Authorised Person (MGPS) to attend the site during this period.

5.57 In such circumstances, the Low Hazard Authorised Person (MGPS) may raise a low-hazard PTW and grant permission and access for work to proceed. This work should be limited to tasks that do not require pipeline isolation or involve high-hazard works. In essence, a “make it safe” approach may be necessary. This should be fully documented and reviewed by the Authorised Person (MGPS) on the next working day, with any further remedial work scheduled for completion at a later date.

5.58 In smaller facilities (such as community hospitals and other non-acute facilities), the cost of these services can represent a significant proportion of the overall budget. Service providers (whether the in-house estates department, a PFI contractor or an external specialist) are responsible for doing all that is reasonably practicable to ensure cost-effective provision while maintaining the required standards of safety.

5.59 In summary, where a healthcare organisation intends to appoint an Authorised Person (MGPS), the following recommendations should be met:

- Appointments cannot be made without a recommendation from the appointed Authorising Engineer (MGPS).
- The appointment requires evidence of familiarity with the specific area(s) of responsibility.
- Appropriate professional indemnity and public liability insurance should be held.
- A contracted Authorised Person (MGPS) should not be employed by the same company that provides a Competent Person to the same healthcare organisation.

Coordinating Authorised Person (MGPS)

5.60 On a large site, there should be several Authorised Persons (MGPS). The Designated Person should appoint a Coordinating Authorised Person (MGPS) with overall responsibility for the site.

5.61 The Coordinating Authorised Person (MGPS) should coordinate the actions of all other Authorised Persons (MGPS) within their area of responsibility and should manage the PTW system and other MGPS safety aspects in that area.

5.62 The Coordinating Authorised Person (MGPS) should ensure a PTW logbook is completed by all Authorised Persons. This logbook should contain the date, PTW number, details of the work, service report reference, the current stage of the work, the Authorised Person responsible for the work, and any comments. This will support effective communication and should be reviewed by the Authorising Engineer (MGPS) during their annual audit.

5.63 The Coordinating Authorised Person (MGPS) should develop a maintenance schedule to cover inspection, testing and replacements and should ensure that as-fitted drawings and schematics are available and updated as necessary.

Competent Person (MGPS)

Note
Competence: where a person is required to be competent, they must be able to demonstrate through skills, knowledge, experience and behaviours that they have the ability to undertake their role.

5.64 The Competent Persons may be split into three main categories

- CPI: Contractor Installation of MGPS
- CPM: Contractor Maintenance of MGPS
- CPS: Healthcare employee site staff repairs and checks.

5.65 Competent Persons (MGPS) carry out installation and maintenance work on the MGPS as directed by an Authorised Person (MGPS). A list of their responsibilities and duties is set out in Chapter 7. Competent Persons (MGPS) should have received appropriate training and should be on a register of Competent Persons (MGPS). For directly employed labour, this register should be held by the Authorised Person (MGPS); in the case of contracted labour, it should be held by the contractor's company manager and a copy provided to the Authorised Person (MGPS).

Assessment of competency of Competent Persons (MGPS)

5.66 Competent Persons (MGPS) may be members of a specialist contractor's staff or of the estates department.

5.67 Competent Persons (MGPS) should be able to demonstrate skills in MGPS installation and maintenance in accordance with nationally accredited guidelines.

5.68 Where a Competent Person (MGPS) is a member of the estates department, the Authorised Person (MGPS) is responsible for assessing their competency with respect to work on the MGPS.

5.69 Where Competent Persons (MGPS) are members of a contractor's staff, the contractor is responsible for assessing the competence of those staff and maintaining a register of Competent Persons (MGPS). This register together with the Competent Person's certification and record of competence and skills matrix should be made available to the healthcare organisation's Authorised Person (MGPS).

5.70 The Authorised Person (MGPS) needs to be satisfied of the individual competency of all Competent Persons (MGPS) working on their site.

5.71 The "competent person" (lower case) as defined in the Pressure Systems Safety Regulations 2000 is not the same person as the Competent Person (MGPS) defined in this HTM. The former is responsible for drawing up a written scheme of examination for the system. The latter is the person who should carry out installation, maintenance or modifications.

Quality Controller (MGPS)

5.72 The Quality Controller (MGPS) is responsible for the verification of the identity, quality and purity of medical gases at terminal units and source plant, including medical air compressors, oxygen concentrators and synthetic air systems.

5.73 The Quality Controller (MGPS) accepts professional responsibility for carrying out the final independent check of an MGPS – a check which, if not performed correctly, could result in serious clinical consequences for patients.

5.74 The Authorised Person (MGPS), in agreement with the Chief Pharmacist, should contact the Quality Controller (MGPS) when testing of an MGPS is required. As a minimum, the Authorised Person (MGPS) should provide the Quality Controller (MGPS) with details of the gas types, the number and type of terminal units, and relevant on-site contact details. The Authorised Person (MGPS) should liaise with the Quality Controller (MGPS) before the system is brought into use, as quality testing may be necessary before medical gases are administered to patients. The specific tests and requirements are set out in Chapter 20 of Part A.

5.75 The Quality Controller (MGPS) should demonstrate a thorough understanding of the guidance set out in Chapter 20 of Part A to provide assurance that testing is undertaken in accordance with appropriate procedures and should familiarise themselves with the content of Parts A and B of this HTM.

5.76 Guidance on appointing Quality Controllers (MGPS) to carry out QC testing of the MGPS is given in Chapter 8. This chapter also includes guidance on eligibility for registration on the Quality Controller (MGPS) register maintained by the NHS Pharmaceutical Quality Assurance Committee.

5.77 The Quality Controller (MGPS) should be independent of those carrying out engineering work on the pipeline system.

5.78 In addition, the Quality Controller (MGPS) should complete relevant education and training as detailed in Chapter 8.

5.79 Only individuals who have been appointed to the Quality Controller (MGPS) register may act as a Quality Controller (MGPS). The UK register is maintained by the UK Medical Gas Group under the auspices of the NHS Pharmaceutical Quality Assurance Committee.

5.80 Inclusion on the Quality Controller (MGPS) register should normally be sufficient to qualify an individual to act as Quality Controller (MGPS) for any healthcare organisation. However, the healthcare organisation's Chief Pharmacist may choose to specify or restrict which registered Quality Controllers (MGPS) are permitted to operate within their organisation.

5.81 The Chief Pharmacist is responsible for appointing/commissioning Quality Controller (MGPS) services and should ensure that documentary evidence is provided of recent and relevant experience in MGPS testing, including Quality Controller (MGPS) certification. The Chief Pharmacist should also confirm that the proposed Quality Controller (MGPS) is included on the national Quality Controller (MGPS) register before any contract is finalised and the appointment is made.

5.82 The Quality Controller(s) (MGPS) appointed by the Chief Pharmacist within the healthcare organisation should retain a signed authorisation. The appointment should describe arrangements for testing new and modified installations and routine tests (for example, medical and dental air compressor plants). A list of sites to which the authorisation applies should be included. A statement confirming ongoing evidence of maintained competence should be provided.

5.83 The Quality Controller (MGPS) should have an understanding of the:

- MGPS within the relevant healthcare organisation
- location of primary, secondary and tertiary supplies
- operation of oxygen VIEs, medical/surgical/dental compressor plants, pressure swing adsorber (PSA) systems, synthetic air plants and cylinder manifolds as appropriate and where testing is required.

Designated Clinical Officer (MGPS)

5.84 The Designated Clinical Officer (MGPS) role is a designated clinical person within each department with whom the Authorised Person (MGPS) liaises on matters affecting the MGPS in that area; this individual is responsible for granting permission for planned interruptions to the medical gas supply, repairs to terminal units or the replacement of hoses within their department. They can be any registered healthcare professional (for example, nurse, radiographer, doctor) with responsibility for care in a defined department.

5.85 Each department where medical gases are present should have a Designated Clinical Officer (MGPS). They should be available whenever patients are being treated in the department. The MGPS OP should include a reference to the list of Designated Clinical Officers (MGPS) along with arrangements for cover during periods of absence.

5.86 In some circumstances, the Authorised Person (MGPS) may need to liaise with a more senior person responsible at site level,

such as a site manager, bed manager or similar, and is responsible for coordinating the clinical response to major incidents. The Authorised Person (MGPS) liaises with this role on any matters affecting the MGPS at a site-wide level, rather than just one ward/ department. This would include large-scale projects or planned works affecting multiple departments. This person would be responsible for granting permission for any planned interruptions to the medical gas supply across the wider area, after liaison with the Designated Clinical Officer (MGPS).

5.87 The Designated Clinical Officer (MGPS) acts as the focal point for communications related to the MGPS and advises on any special requirements for their department relating to the MGPS, such as provision of emergency cylinders and vacuum pumps.

5.88 The Designated Clinical Officer (MGPS) should give permission for any interruption to the MGPS and should sign the appropriate parts of the PTW form.

5.89 The MGPS OP should clearly set out the requirements for such permission, including the circumstances under which signature by the Designated Clinical Officer (MGPS) is required.

5.90 The Designated Clinical Officer (MGPS) and the Authorised Person (MGPS) are responsible for ensuring that all clinical staff are aware of the interruption to the MGPS and of the terminal units that cannot be used.

5.91 The Designated Clinical Officer (MGPS) is also responsible for responding to medical gas alarms within their department. In the event of a fire or local failure of the system resulting in a serious leak, they should ensure that patients are transferred to an alternative gas supply and should isolate the MGPS at the AVSU to stop the release of gas.

5.92 The Designated Clinical Officer (MGPS) would typically carry out the appropriate action in the event of an emergency (for example, isolation of a ward's medical gas supply). Such actions should be set out in the MGPS OP.

5.93 Clinical staff who use the MGPS should liaise with the Authorised Person (MGPS) to ensure that the system meets the operational and clinical requirements of the department.

5.94 All Designated Clinical Officers (MGPS), regardless of whether their role is on a single ward or whole site, should have received training on the MGPS and on the action to be taken in the event of an emergency.

5.95 The MGPS OP should set out the training requirements as defined in Chapter 8.

5.96 The Designated Clinical Officer (MGPS) should ensure that all staff, in their area, using or connecting to the MGPS or cylinders are appropriately trained in the correct connection and use of equipment.

5.97 Where an AGSS is installed, the Designated Clinical Officer (MGPS) should ensure that it is turned on and operating, that equipment is connected and used correctly, and that the AGSS is turned off when not in use.

Appointment of Designated Clinical Officers (MGPS)

5.98 All Designated Clinical Officers (MGPS) should be appointed based on successful completion of a Designated Clinical Officer (MGPS) training course from a recognised training provider with demonstrable learning outcomes and criteria for completed assessment. A record of trained Designated Clinical Officers (MGPS) should be maintained by the clinical lead or training department manager, which should be reviewed and approved by the MGSG. It should also be accessible to the site's Authorised Persons (MGPS).

Medical Gas Porter

5.99 The role of the Medical Gas Porter may be split into two tiers:

a. Tier 1 refers to the porter responsible for:

   (i) the delivery and collection of cylinders across the site

   (ii) transporting patients connected to medical gas cylinders.

b. Tier 2 refers to the porter responsible for:

   (i) receiving cylinders into the main cylinder store

   (ii) moving cylinders to and from the cylinder manifold rooms

   (iii) changing the cylinders on medical gas manifolds.

5.100 Effective liaison should be maintained between clinical staff and Medical Gas Porters to ensure appropriate cylinder stock levels within departments and that stock rotation is carried out in accordance with the expiry timescales specified by the gas supplier.

5.101 Some Medical Gas Porters may perform both Tier 1 and 2 tasks and therefore should receive appropriate training to cover all activities.

5.102 Medical Gas Porters should not connect or disconnect cylinders that are actively in use by patients. Their responsibility is to replace empty cylinders with full ones and, when necessary, prepare the cylinder for use by fitting it with the appropriate regulator or equipment. It remains the responsibility of clinical staff to connect the cylinder to the patient and administer the medical gas.

5.103 Medical Gas Porters should identify cylinder status (full, empty or faulty) and remove faulty cylinders (for example, leaking cylinders) from service. The location of such cylinders should be reported to pharmacy.

Medical Gas Porters should also assist pharmacy by undertaking weekly checks of cylinder stocks and reporting any deficiencies.

Appointment of Medical Gas Porters

5.104 All Medical Gas Porters should be appointed by the portering manager following the successful completion of a relevant training course delivered by an accredited training provider, with clear learning outcomes and defined assessment criteria. A record of trained Medical Gas Porters should be maintained by the portering manager, reviewed and approved by the MGSG, and made accessible to the site's Authorised Persons (MGPS).

Clinical staff

5.105 Clinical staff move, handle and administer medical gases to patients:

- from the MGPS
- from cylinders, or
- from cylinders attached to a specific piece of equipment.

5.106 They are responsible for the correct use and the MGPS, and the correct use and safe storage of cylinders, ensuring neither damage nor contamination occurs that could compromise patient safety or the integrity of the system.

5.107 They should follow the prescribing requirements detailed in the healthcare organisation's policies and national guidance and should be aware of the safety requirements relating to medical gases, associated equipment and pipeline alarm systems.

5.108 All clinical staff should receive appropriate training, as outlined in Chapter 8.

5.109 Clinical staff are responsible for checking local cylinder stocks level and requesting replacements.

5.110 They should ensure that, when oxygen is prescribed, they are competent to administer the prescribed flow rate and to monitor and record periodically that the patient is receiving the correct rate.

5.111 Clinical staff are responsible for ensuring that there is sufficient gas in a cylinder for the duration of the patient transfer or until such time as the patient is connected to the MGPS.

6 MGPS operating records

6.1 This chapter covers the documentation requirements of the OP and standard operating procedures (SOP).

6.2 Many of the difficulties arising from failure of medical gas supplies can be avoided if operational protocols are in place before emergencies arise. A number of documents are required to be in place that will assist the safe and effective management of the MGPS: the OP and SOP should detail and reference some of these documents.

6.3 The Authorised Person (MGPS), Chief Pharmacist and MGSG are responsible for:

- ensuring the MGPS records are correctly completed and stored in the correct place
- maintaining a fully documented MGPS CARA, in which the MGPS is assessed against current requirements, particularly those set out in this HTM.

6.4 The full MGPS CARA should be repeated every three years.

6.5 Any deficiencies highlighted in the CARA should be analysed and solutions recommended to mitigate the risks

6.6 Each risk should be attributed a priority level. High-priority risks should be summarised and used to develop a remedial action plan.

6.7 The OP and SOP should be based on the CARA, system and staff structure.

6.8 Many of the procedures that the OP contains should be aimed at minimising identified risks. Some of these risks will be mitigated as the system is brought up to the required specification.

6.9 For this reason, the OP and SOP should be seen as a dynamic document; it should evolve to reflect the needs of the staff managing and using the MGPS.

6.10 Maintaining a separate OP and SOP will facilitate ongoing updates. The OP will require sign-off by multiple stakeholders including the MGSG, whereas the SOP will not necessarily need to follow the same approval process.

6.11 Guidance on how to prepare an operational policy is given below. A sample operational policy is given in Appendix A.

Responsibilities for policy preparation and updating

6.12 The Executive Manager is responsible for the operational policy, although responsibility for policy preparation and implementation and the production of the OP will usually be delegated to the MGSG and specifically the Authorised Person (MGPS) and Chief Pharmacist.

6.13 The Authorised Person (MGPS) and Chief Pharmacist should work together with the MGSG to complete the documents required to cover the infrastructure, the distribution system and its capabilities, emergency procedures, medical gas cylinders

and the safe use of the medical gases administered to patients

6.14 To ensure that the policy is regularly updated, it should contain a defined protocol for periodic review through the MGSG.

6.15 The MGSG should meet quarterly and should review the policy annually. However, a procedure should be in place to allow immediate updates (for example, changes to contact details) regardless of meeting frequency. The Senior Operational Manager or Chief Pharmacist should chair the meetings and report the minutes and actions to the board through the relevant health and safety and medicines management (or similar) group.

6.16 Some healthcare organisations have separate procedures (for example, cylinder management) that are referenced within the OP or related procedural documents and managed by specific departments. All such documents should be formally signed off and recorded by the MGSG. This approach helps to avoid duplication and simplifies access to the relevant documents for users.

6.17 The Executive Manager is responsible for ensuring that the OP and associated procedures are kept up to date. This should be reviewed regularly, and the process for making updates should be clearly defined within the policy itself.

6.18 The responsibility for monitoring specific aspects is often delegated to appropriate key personnel. For example, the responsibility for monitoring the implementation of the PTW procedure would typically be delegated to the Authorised Person (MGPS). The details of such delegation should be set out in the OP.

6.19 Where a healthcare organisation has multiple sites, there should be one overarching OP and separate SOPs for each site. Variations in roles and responsibilities should be defined within the site-specific SOP while the overarching OP should set out the high-level roles and responsibilities.

Operational considerations

System limitations and clinical precautions

6.20 The SOP should ensure that users are aware of the capacity of the system and any particular limitations (for example, a 400 kPa medical air system supplied from a cylinder manifold system is unlikely to support the sustained use of respiratory ventilators).

6.21 This awareness is particularly important, as changes in patient ventilation regimens can significantly affect system demand and affect overall capacity. The adoption of continuous positive airway pressure (CPAP) ventilation, for instance, can lead to a significant increase in oxygen consumption.

6.22 Where PSA systems are installed, medical staff should take account of any reduced oxygen concentration when using medical equipment and be aware of potential increases in concentration if the system's emergency reserve manifold (ERM) or oxygen cylinders are brought into use.

6.23 MGPS provide gases at terminal units of a microbiological quality suitable for virtually all clinical applications. However, in exceptional circumstances (for example, patients receiving immunosuppressive therapy), additional precautions may be required. In such cases, staff should be advised that the most effective measure is to incorporate an appropriate bacteria-retentive filter into the breathing system. Medical air supplied by portable compressor units is not recommended by this HTM. If such units are used, these filters should also be incorporated, and the units should be tested by the Quality Controller (MGPS) in accordance with the relevant monographs of the British Pharmacopoeia.

6.24 If local medical air or surgical air compressors are used, full procedures for their maintenance, servicing and testing should be clearly defined in the OP and SOP.

6.25 Staff should be advised that medical gases should not be used for non-medical purposes other than as a test gas for medical equipment.

6.26 Medical air rather than oxygen should be used as the power source for medical equipment such as ventilators. The routine use of oxygen as a driving gas should be avoided.

6.27 Venturi suction devices may also be powered from a medical air system. However, large-scale connection of such devices is not recommended, as air consumption is high and there is a potential risk of generating aerosols containing viable microorganisms. A central medical vacuum system is the preferred alternative to multiple injector suction units. Oxygen should not be used to drive injector suction units except in an emergency.

System hazards

6.28 Users should be aware of the chemical hazards of the gases and gas mixtures delivered by the MGPS and of the consequences of the loss of any of the services or the formation of incorrect mixtures.

6.29 Users of 700 kPa surgical systems should be aware of the stored energy of gas in the connecting assembly (hose) and should take care to avoid the hazard of rapid ejection of probes when disconnecting tools.

6.30 Only clinical and engineering staff who have completed the required safety training should undertake tasks or responsibilities involving medical gases.

Emergencies

6.31 The SOP should set out the procedures to be followed in the event of an emergency. This should include the following:

- reporting an incident
- failure of a system or part of a system
- availability of emergency supplies
- action to be taken (for example, turning off isolation valves, use of portable emergency cylinders)
- liaison with other staff and departments
- contacting the Authorised Person (MGPS) and the Quality Controller (MGPS)
- calling out contractors.

6.32 All alarm systems should be clearly labelled, and all staff should be trained in the appropriate action to be taken if an alarm is initiated.

6.33 Staff responsible for plant operation should be aware of the activities necessary to ensure the continued safe operation of the system and what action should be taken in an emergency. The Authorised Person (MGPS) should take the lead in explaining the capability of the system to clinical staff.

6.34 Relevant staff should also be appropriately trained and familiar with the purpose of AVSUs and their correct use in an emergency.

6.35 Power supply failure, changeover to emergency power and reinstatement of the normal supply may cause control systems on plant items (such as compressors and manifolds) to revert to their default setting. When such changeovers occur, staff should verify that, for example, manifold cylinder contents correspond with the alarm signal status, and that, in the case of compressor and PSA systems, duty and standby conditions are correctly configured.

Medical equipment

6.36 The OP is not intended to apply to the use or maintenance of patient-connected equipment, except when the use of such equipment may influence the operation of the MGPS.

6.37 The Authorised Person (MGPS) and the MGSG should be consulted before the purchase of any medical equipment that will be connected to the pipeline. For example, certain ventilators can have a significant effect on the capacity of oxygen systems, particularly those operating under CPAP. This is to ensure that the MGPS has sufficient capacity and can deliver the required flows at the specified pressures.

6.38 It is particularly important that the Authorised Person (MGPS) and MGSG are consulted before any new equipment, such as patient ventilators, is purchased and connected to the medical air 400 kPa system or before additional CPAP equipment is introduced in more locations than currently supported. This is to ensure that the system's capacity is not exceeded.

6.39 The SOP should state the procedures to be followed and the personnel who need to be consulted before a new item of medical equipment is connected to the MGPS. The following examples are typical:

- where point-of-use gas blenders are used (for example, with patient ventilators), the manufacturer's instructions should be followed with regard to operation and maintenance, to prevent contamination of the pipeline in the event of equipment malfunction. Further details are given in Chapter 10
- some older types of blending equipment can allow backflow from one pipeline to another, leading to, for example, oxygen enrichment of medical air systems or the reduction of oxygen content in oxygen pipelines. When not in use, blenders should be disconnected (see BS ISO 11195)
- portable suction units should be used in areas where there is a possibility that the vacuum system could become contaminated. Such areas would include infectious disease units. The need for portable suction units should be discussed with the infection prevention and control (IPC) team.

6.40 Before maintenance work is carried out on any medical equipment, including portable suction units, the equipment should be appropriately decontaminated. A "certificate of decontamination" may be required.

6.41 In some accommodation, medical gas equipment is installed within enclosures or behind decorative panels to provide a more domestic environment. In these cases, it is essential that identification is maintained so that staff are aware that equipment is available for patient use.

6.42 Staff should also ensure that gas supplies are turned off, blenders are disconnected and suction jars removed and cleaned before any equipment is concealed.

Gas quality requirements

6.43 Medical gases supplied from cylinder or liquid sources should comply with the relevant monographs of the British Pharmacopoeia. PSA systems should comply with the recommendations given in Part A.

6.44 All other gases or medical gas mixtures should comply with the product licence specification held by the gas supplier or have a certificate of conformity against the product specification.

6.45 The Chief Pharmacist and the pharmacy department have a responsibility for monitoring the quality of all gases delivered, including PSA, compressed air and synthetic air by having oversight of the quarterly QC test results.

6.46 The on-site mixing of oxygen and nitrogen from liquid sources to produce medical synthetic air is an accepted practice; however, specific procedures and additional quality checks should be in place over and beyond the routine QC testing detailed in this HTM.

6.47 Details of site-specific testing protocols should be defined in the SOP.

6.48 Records of QC testing including test certificates should be maintained by the Authorised Person (MGPS) on-site for routine and installation works. The Chief Pharmacist should review and retain copies of the Quality Controller's (MGPS) test certificates.

Control of work

6.49 The site-specific procedures should be detailed in the SOP to ensure work involving alterations, extensions or maintenance work on the system are subject to the PTW procedure as set out in Chapter 7.

6.50 All works on the MGPS should have detailed RAMS and be under the control of the PTW managed by the Authorised Person (MGPS). RAMS for the specific works should be provided by the Competent Person's (MGPS) organisation and the Quality Controller (MGPS). The Authorised Person (MGPS) may need to provide additional RAMS to encompass the Competent Person's (MGPS) RAMS for any enabling works. No deviation to these works can be undertaken under the PTW; new RAMS will be required and a new PTW will be required to continue the works.

Record drawings

6.51 In line with this HTM and the Pressure Systems Safety Regulations 2000, the estates department must have accurate and up-to-date drawings of the MGPS.

6.52 These drawings should be used when isolating sections of the pipeline.

6.53 Drawings that are not accurate could result in the isolation of an area serving patients and put patient safety at risk.

6.54 The OP should state the current status and availability of record drawings, and it should be regularly amended to reflect progress in bringing them up to date.

6.55 The compliance audit and Authorising Engineer (MGPS) annual audit should assess the status of record drawings, and where these are found to be inadequate, a formal plan should be put in place to bring them up to date.

6.56 The Authorised Person (MGPS) is responsible for ensuring that all record drawings are kept up to date and properly maintained.

6.57 The required record drawings are:

- **As-fitted drawings**: plan drawings overlaid on architectural layouts. They should contain the following:
  - MGPS supply systems representation detailing the final valve connecting the plant to the pipeline
  - distribution pipework detailing pipe sizing
  - line valves, line valve assemblies (LVAs) and area valve service units (AVSUs) detailing normal position (i.e. normally open (NO) or normally closed (NC))
  - pressure-reducing sets detailing valves, regulators and relief valves
  - terminal units (gas outlets) shown in order
  - pendant types, shape and location with terminal units detailed
  - controls and warning alarm systems (excludes wiring runs)
  - direction of flow
  - all MGPS entities, which should be drawn using industry standard block symbols
  - all valves on the drawing, which should be uniquely identified alphanumerically

  - gases, which should be shown on separate layers and use different line types.

As-fitted drawings should be accurate to within 0.5 m; vertically stacked runs on a wall should be shown side by side with the top pipe closest to the wall. The order of the piped gases should match the actual installation; tee connections should be identified with a node to differentiate them from connected and crossing pipes.

- **Schematic drawings**: a designed representation of the elements of a system using abstract, graphical symbols rather than realistic pictures; they are not drawn to scale but are spaced to show the correct order of connections and indicate the floor level of each area. A schematic drawing for MGPS should detail each gas separately and should show the pipeline, valves and connections in order from plant to terminal units. The aim is to present the system in a simplified format so that the isolation of specific sections can easily be identified on a single, clearly visible drawing. Schematics should contain the following:
  - gas service
  - valve, LVA, AVSU and terminal unit symbols
  - representative plant details
  - direction of flow
  - pipe sizes
  - for AVSUs, the area served, valve number and key peg number
  - terminal unit symbol and quantity of terminal units on that leg.
- **Isometric drawings**: a visual representation of a three-dimensional system, drawn full size so that each pipe run is the correct length to the nearest 0.5 m. Each gas should be drawn separately. Some areas may be rotated to allow the system to be visualised without areas overlapping (the pipe runs will remain at actual size). These drawings should be used to calculate flow rates and pressure drops in sections of pipe. Isometrics should contain the following:
  - gas service
  - valve, LVA and AVSU (for AVSUs, the area served)
  - representative plant details
  - direction of flow
  - pipe sizes
  - valve numbers
  - all terminal units
  - accumulative design flow rates in each pipe run.

6.58 Industry-standard symbols should be used and be consistent across the record drawings.

6.59 A valve chart should detail the gas service, valve numbers, type of valve, valve number, key peg number, the area served, building level, valve location and, for AVSUs, the number of terminal units.

6.60 These drawings should be readily available on-site for use by any Authorised Person (MGPS). All Authorised Persons (MGPS) should know their location.

6.61 Each isolating valve should be individually identified by a unique reference number. The appropriate reference number, corresponding to that shown on the drawings, should be displayed at or on each isolating valve.

6.62 Each AVSU should individually display a unique reference number, corresponding to that shown on the drawings; this should detail the gas service, area served, valve number, key peg number and the number of terminal units.

6.63 The area served should be defined in accordance with the boundaries agreed by the clinical team to ensure it is clear which parts of the department the AVSU will isolate.

6.64 The flow rates on the isometric drawings should be used to carry out pressure-drop calculations. In a fully operational healthcare facility, it is standard practice to perform these calculations from multiple locations in order to assess local areas, main pipe runs, high flow areas, theatres and furthest points. However, all areas of the system should be risk-assessed and additional or all areas calculated.

6.65 When additions or alterations are to be made to existing installations, a risk-based design process should be instigated. The design flow and pressure drop of the system should be checked and recalculated to ensure there are no pinch points and that system pressure can be maintained for the design flow.

6.66 The Authorised Person (MGPS) should provide a copy of the area's "controlled drawings" in electronic format to the contractor. On completion of the work, the contractor should return the amended area in electronic format to the Authorised Person (MGPS), indicating any pipework alterations.

6.67 The Authorised Person (MGPS) should arrange for the master MGPS drawing to be updated; any associated costs should be included in the project works.

Locking of valves and plantrooms for the MGPS

6.68 All valves on the MGPS, except those located in locked, dedicated medical plantrooms, should be secured in such a way that they can be locked in the closed or open position.

6.69 For valves that may have to be operated in an emergency (for example, AVSUs), the locking system should be capable of being overridden.

6.70 Medical gas plantrooms should remain locked at all times, except when authorised work is actively in progress.

6.71 Plantrooms containing medical gas cylinders should remain locked, with a prominently displayed notice indicating the location of the spare key.

6.72 Valves in the liquid oxygen installation need not remain locked. The gate to the liquid oxygen installation should remain locked, and an indestructible and clear notice stating the location of the key should be securely fixed to each gate of the installation. The fire and rescue service should be informed of the location of the key or the padlock code.

6.73 All line valve and AVSU keys should be individually numbered and be located on individual key pegs in the key cabinet. Line valves that do not have a padlock should be allocated a unique number and given a key peg position.

6.74 Keys should be stored in secure key cabinets, with AVSU key sets held in one cabinet and line valve padlock keys in another. This arrangement facilitates rapid access (for example, allowing a full five-gas AVSU key set to be quickly located to isolate all gases to a specific area).

6.75 The procedure for key management, as described in the MGPS SOP, should be followed. The valve log should be stored in the locked medical gas key cabinet under the control of the Authorised Person (MGPS).

Contractors

6.76 All contractors should comply with the healthcare organisation's policy or building safety policy. This should be clearly stated in the OP.

6.77 Work on pipelines should only be carried out by specialist firms registered to BS EN ISO

9001 and/or BS EN ISO 13485, with the scope of registration defined as design, installation, commissioning and maintenance, as appropriate. The Coordinating Authorised Person (MGPS) should maintain up-to-date copies of documented evidence of registration and insurance, and any relevant training certificates for all Competent Persons (MGPS).

6.78 The operational policy should set out the responsibilities for monitoring the work of contractors. This would typically be coordinated by the Authorised Person (MGPS). The procedures for calling out a contractor, particularly in the event of a fault or an emergency, should be set out in the SOP.

6.79 The Authorised Person should retain copies of all contractor documentation related to works carried out, including RAMS, call-out worksheets, planned preventive maintenance (PPM) reports, and PPM remedial action reports.

MGPS equipment

6.80 To support the safe management of the MGPS system and to enable the specification, tendering and control of PPM, the following elements should be maintained by the Authorised Person (MGPS):

- a full asset list of the MGPS comprising:
  - all MGPS plant, including configuration, size, capability, location
  - all MGPS manifolds, including configuration, size, capability, location
  - LVs and LVAs
  - AVSUs
  - terminal units
  - alarms
  - pendant hoses
- a full asset list of the tertiary systems and local cylinder supplies including size, type, gas and location
- regulators, safety relief valves and medical supply unit (MSU) hoses with details of their location, pressure rating, serial number, date of installation and five yearly replacement due date
- all site-based test equipment together with copies of their calibration certificates
- all emergency equipment including backfeed equipment and regulator information as above.

Preparing an operational policy

6.81 The examples in Appendix A and Appendix B contain the essentials of an OP and SOP, respectively, although these will require expansion and modification to suit individual healthcare facilities.

6.82 For multi-site healthcare facilities, there should be one master OP and SOP for each site as the SOP holds the site-specific details. However, the following advice given will help provide a basic structure.

Signatories

6.83 The OP should receive final approval and sign-off from the Executive Manager.

6.84 Other signatories will be required, principally those involved in the preparation of the OP, or as a minimum the members of the MGSG.

6.85 The SOP should be a working document and should be managed by the MGSG. It should be signed off by the MGSG after each change.

Circulation

6.86 The MGSG should agree circulation of the OP and SOP. This will depend to a certain extent on the content of the documents and the structure of the healthcare facility.

Site plans

6.87 A small (A3/A4) site plan should be drawn up, showing the location of VIEs, plantrooms, manifolds, main and satellite cylinder stores, emergency backfeed kits, main buildings, Authorised Person's office, porter's lodge and roads. No pipework details need be shown, as the plan is only presented to facilitate actions in the event of an emergency. Relevant pipework drawings can be referenced on this plan but need not be included in the policy, as this will lead to a very bulky document.

Other guidance

6.88 There is little point in the MGPS policy reiterating guidance issued by other departments or staff (for example, fire practice). However, where appropriate, this documentation should be referenced accordingly and any relevant contacts listed.

6.89 Policies may become ineffective if basic information such as names and telephone numbers is not kept up to date. Personnel and contact details should be maintained in a single, easily accessible section of the OP or SOP (for example, as a separate appendix).

Emergencies

6.90 This is a critical section of the SOP, and the information should be accurate, clear, concise, up to date and, above all, written with safety as the primary consideration.

6.91 Emergency procedures for plantrooms and manifolds should be detailed within the relevant gas system sections, with a separate section addressing other potential MGPS emergencies. The emergency scenarios and procedures described are not exhaustive and may cover only the most likely events. They should be used as a guide for managing non-listed emergencies.

6.92 All staff working with the MGPS should be aware of and familiar with the OP and SOP.

Description of the MGPS

6.93 Comprehensive MGPS information should be maintained by the Authorised Person (MGPS) for estates management purposes. The SOP should only include the information necessary for safe and effective use in an emergency, presented in a clear and readily accessible format.

6.94 The SOP should have separate sections for each gas system. If, for example, there are two medical air 400 kPa plants feeding separate areas and the pipework is not interlinked, these should form two sections and should include the following items:

- location and access
- personnel/responsibilities
- configuration of the system
- capability and limitations of the primary, secondary and tertiary supplies
- pipeline system limitations
- emergency actions on failure of plant
- routine operations and safety.

Emergency actions

6.95 Actions to be taken in the event of MGPS emergencies should be summarised. The final number of defined emergencies will vary according to each system, but as a minimum should include:

- damage to a terminal unit
- major gas leaks
- interruption of the gas supply
- electricity failure

- low/high gas pressure
- pollution of the gas supply
- fire.

6.96 The following should also be given consideration:

- location and type of emergency supplies
- roles and responsibilities including those for maintaining and providing emergency supplies
- training of staff in the use of emergency equipment
- training of staff in equipment failure procedures
- communication channels in the event of an emergency:
  - Fire Safety Manager/fire and rescue service
  - estates department
  - pharmacy
  - portering staff
  - administration/press officer
  - nursing/clinical.

7 Operational procedures and the permit to work system

7.1 The purpose of a PTW system is to safeguard the integrity of the MGPS and therefore patient safety.

7.2 PTWs should be supported by RAMS and other safety rules and procedures necessary to ensure that the integrity and performance of the system are maintained.

7.3 The MGPS PTW is not intended to protect the safety of individuals operating or working on the system; additional safety procedures should be followed under the Health and Safety at Work etc. Act 1974 or COSHH.

7.4 Before any work is carried out on the MGPS, a PTW should always be issued either by an Authorised Person (MGPS), Low Hazard Authorised Person (MGPS) or Authorising Engineer (MGPS) acting on behalf of the Authorised Person. It should be issued at the point of work and just before the work commences. Retrospective PTWs should not be issued.

7.5 The PTW should have a unique identifying serial number, should identify the work to be carried out, permissions granted, tests completed and signed acceptance and should provide documentary evidence that a system is only taken back into use when all tests have been satisfactorily completed.

7.6 Managing the PTW system is one of the responsibilities of the Authorised Person (MGPS) who has day-to-day responsibility for the MGPS. The Authorised Person is responsible for the implementation of the PTW system. On sites where several Authorised Persons (MGPS) operate and issue PTWs, the Coordinating Authorised Person (MGPS) should manage the PTW system and ensure a PTW logbook is in place to record all PTWs issued.

Application of the system

7.7 The PTW system is applicable to the servicing (including PPM), quarterly QC testing of air plant, repair, alteration and extension of existing MGPS within a hospital, and any action, such as the closure of an isolating valve, which restricts the supply.

7.8 PTWs should also be issued before any major item of central plant (for example, manifold, control panel, compressor or vacuum pump (including any standby plant)) is isolated before servicing, repair or overhaul.

7.9 A PTW should be issued for all PPM work on the MGPS. This includes all examinations where no interruption to the service is anticipated and working on medical gas alarm systems and liquid oxygen systems. Specimen PTWs are given in Appendix E.

Scope of the PTW

7.10 The extent of the work and testing required should be specified on the PTW by the Authorised Person (MGPS).

7.11 The PTW should not be amended. If changes to the work are required, a new PTW should be issued. PTWs should not be written retrospectively.

Form of the PTW

7.12 PTWs may be issued in either hard copy (book) or electronic format.

Book format

7.13 These contain multiple copies, numbered consecutively. Each PTW should comprise the following:

- Copy 1 (white, top copy – permanent) remains in the PTW book and carries all original signatures (it should be retained by the Authorised Person (MGPS) on completion of the work). For legal purposes, this copy should bear all original signatures. It should be completed in black indelible ink.
- Copy 2 (pink – tear-out) is given to the Quality Controller (MGPS) on completion of the work. The Quality Controller may choose to leave this copy in the book and take an electronic copy of the original white top copy.
- Copy 3 (yellow – tear-out) is given to the Competent Person (MGPS). The Competent Person may choose to leave this copy in the book and take an electronic copy of the original white top copy.

Coding system for recording test systems

7.14 The Authorised Person (MGPS) should write a short description of the tests undertaken, accurately reflecting those required for the work carried out on the MGPS. The work description should not be used in place of the description of tests undertaken. A coding system may be used (see the commissioning tests in Chapter 19 of Part A and the inside of the PTW book cover).

Electronic format

7.15 There are many proprietary systems that have the functionality to replicate and run electronic PTW systems. These should replicate all aspects of the book format. They can include additional information and the ability to upload other relevant documents such as RAMS, photographs of work, test sheets, PPM visit sheets, and similar.

7.16 Medical gas PTWs in electronic format should ensure the following:

- All cells should be completed before moving on to the next section.
- User details and non-editable date and time stamp information should be collected.
- The Authorised Person (MGPS) should be at the point of works while completing the PTW.
- The names and signatures of all parties should be entered.

7.17 Read-only copies may be issued from the system to the Competent Person, Quality Controller or other.

Isolation of the plant and pipeline system

7.18 The Authorised Person (MGPS) is responsible for identifying the valves for isolation. The Competent Person (MGPS) is responsible for the isolation of valves, AVSUs and LVAs and for making safe the plant or system to be worked on, and this should be witnessed by the Authorised Person (MGPS). No section of an MGPS should be worked on, filled with inert shield gas or pressure tested, unless it is adequately isolated from any section in use or available for use.

7.19 Where there is a risk that higher pressure (for example, nitrogen) could be introduced into a section of pipework to be worked on and pass beyond an isolating valve, a physical isolation should be provided in addition to the valve. This should be achieved by introducing a break point or inserting a solid spade at the interface between the section under work and sections remaining in operation. This may be on the supply side or on the downstream side where backfeeding is taking place.

7.20 Physical isolation is not always necessary and should be determined by risk assessment. For example, where a pipe repair is undertaken, following a nitrogen purge (which will not be at pressure), the system should be purged with the working gas to remove residual nitrogen, and a pressure test should then be carried out at the normal working pressure using the working gas.

7.21 A physical break is also not required when carrying out a live repair of terminal units incorporating an automatic isolating valve (or check plate) within the first-fix assembly (for example, BS 5682 and BS EN ISO 9170-1 terminal units), or when isolating a ward AVSU for the servicing, conversion or repair of non-BS EN terminal units or converted terminal units that do not incorporate a check plate.

7.22 An AVSU and LVA are designed to provide a physical break. This is achieved by closing the valve, depressurising the section to be worked on and fitting a blanking spade. In older systems without AVSUs, or where line valves do not provide this feature, a physical break should be established by closing the appropriate valve and cutting and capping the pipe on the downstream side of the valve. As this introduces additional complexity when reinstating the pipework, consideration should be given to installing or upgrading line valves, valve boxes or AVSUs to provide appropriate means of isolation as part of the works.

Situations where a PTW is not required

Emergencies

7.23 In the event of an emergency such as a fire or a major medical gas leak, the clinical lead (Designated Clinical Officer (MGPS)) for that area should isolate the affected section by closing the AVSUs and inform the Authorised Person (MGPS) as soon as possible, as remedial work to rectify the leak, test the integrity of the local system and replace the AVSU emergency access feature requires the issue of a PTW.

7.24 The emergency procedures set out in the MGPS OP should be followed. There may be occasions when emergency repairs using mechanical connectors will be performed without subsequent pharmaceutical testing (for example, outside normal working hours). It is essential that a PTW be issued for this work, as it is remedial work subsequent to isolation. The Quality Controller (MGPS) should agree that such procedures may take place without full quality test routines, provided that QC testing is carried out at the earliest opportunity and not later than 24 hours.

7.25 In patient-occupied clinical areas, the isolation of medical gases during a fire or emergency should be led by the Designated Clinical Officer in charge of patient care. However, in unoccupied areas where no patients are connected to the gas supply, responsibility for isolation is often unclear. Examples are:

- areas where activities are non-clinical, technical or administrative in nature
- unoccupied out-patients departments (for example, out of hours)
- areas under refurbishment or temporarily closed.

7.26 The emergency procedures set out in the MGPS SOP should outline how these areas should be managed. Where it has been

confirmed that no patients are connected to the medical gas supply, isolation may be undertaken by:

- the Designated Clinical Officer/clinical lead
- Authorised Persons (MGPS)
- suitably trained on-call estates staff during out-of-hours periods.

7.27 In emergency circumstances, clinical staff are not required to attend or authorise isolation in these areas, provided patient use has been ruled out.

Key safeguards

- This process should not be applied to wards, theatres, critical care, diagnostics in active clinical use, or any area where patients may be connected.
- Clear signage and valve identification are essential.
- Departments should clearly identify areas where gases are installed but not used clinically, and this should be reflected in fire response plans and MGPS documentation.

Simple isolation process (fire or emergency)

a. Confirm patient status
   (i) Verify that no patients are connected to the gas supply in the affected area.
   (ii) If there is any doubt, do not isolate and escalate to the clinical lead.

b. Identify the correct isolation valve
   (i) Use MGPS valve labelling, zone plans and departmental drawings.
   (ii) Ensure isolation does not inadvertently affect adjacent clinical areas.

c. Isolate the gas supply
   (i) Close the relevant AVSU.
   (ii) Follow local MGPS safe-isolation procedures.

d. Communicate and record
   (i) Inform the Fire Incident Manager/ bronze command as appropriate.
   (ii) Notify the Authorised Person (MGPS).
   (iii) Record the isolation in the estates log.

7.28 In situations where it is unsafe for staff to access the area, responsibility for isolating the MGPS falls to the fire and rescue service. After the safeguards outlined above have been followed, the fire and rescue service should be advised of the location of the appropriate AVSU and the method of closure by the Authorised Person (MGPS) or suitably trained on-call estates staff. This may be achieved by demonstrating the theoretical operation of a similar device located outside the hazard area. The isolation process described above should be followed as closely as possible; however, the isolation should be carried out by the fire and rescue service after confirming the AVSU labelling and area served.

Replacement of cylinders/recharging of cryogenic liquid storage vessels

7.29 PTWs are not necessary for the routine replacement of cylinders on manifolds nor for the recharging of cryogenic liquid supply systems, provided there is no danger of the supply being disrupted when these tasks are undertaken. It is essential that portering or maintenance staff responsible for cylinder replacement receive appropriate training in these techniques.

Commissioning of a new MGPS

7.30 PTWs are not intended to be used during commissioning of a new MGPS installation (see Chapter 19).

7.31 When a new MGPS has passed all commissioning tests but is then modified before handover, it is essential that both the Authorised Person (MGPS) and Quality Controller (MGPS) have a record of these new works and associated test results. A PTW should be used in these circumstances for control and record purposes.

PTW-issuing authority and control of PTWs

7.32 The PTW-issuing authority should be an Authorised Person (MGPS). On a large site where several Authorised Persons (MGPS) operate, the coordinating Authorised Person (MGPS) and a nominated deputy may assume responsibility for issuing PTWs for the whole site. Such an arrangement should be documented in the MGPS operational policy.

7.33 In exceptional circumstances, the following may sign a PTW:

- an Authorising Engineer (MGPS) in the absence of an Authorised Person (MGPS); however, the Authorising Engineer must be familiar with the system for which the PTW is to be issued
- on a small site (for example, a hospice or non-acute community premises) where no Authorised Person (MGPS) is immediately available (for example, for quarterly PPM or terminal unit repairs), a site-based Low Hazard Authorised Person (MGPS) with sufficient MGPS technical expertise and training may sign.

7.34 A new book of PTWs should not be taken into use until the old book is completely used and accounted for. The PTWs should be consecutively numbered. Photocopies of a blank PTW should not be used in lieu of a new book, unless published copies are unavailable.

7.35 No additional PTW(s) should be issued for work already in force. The original work must be completed or cancelled before a new PTW is issued.

Time and place of issue

7.36 PTWs should only be signed by the Authorised Person (MGPS) and Designated Clinical Officer (MGPS) and issued to the Competent Person (MGPS) immediately before and at the point of work. This requirement does not prevent prior discussion of the work between the Authorised Person (MGPS) and Designated Clinical Officers (MGPS), as this is essential to ensure effective management of the work.

Life of PTW (active and completed copies)

7.37 The PTW should remain in force until the work is completed, the PTW fully signed and the MGPS taken back into use.

7.38 For work lasting many weeks (for example, isolation of a ward/department for refurbishment), the Authorised Person (MGPS) should decide whether the work is best covered by two PTWs (one for isolation of the system to be upgraded and another for its reconnection) or a single PTW covering all the work.

7.39 All original copies of the PTW and any accompanying safety method statements, special instructions and other relevant PTWs should be retained by the Authorised Person (MGPS) in a file dedicated to MGPS documentation.

7.40 Completed PTWs should be kept for the life of the MGPS.

Receiving authority

7.41 PTWs should only be issued to a trained Competent Person (MGPS), that is, contractors' or estates staff who have been approved for work by sight of their Competent

Person training certificate and records and who are to be engaged in work on the MGPS.

7.42 If an Authorised Person (MGPS) performs the work described on the PTW, they should sign as the Competent Person (MGPS) on the relevant parts of the PTW. One person should not sign as both Authorised Person (MGPS) and Competent Person (MGPS).

Responsibility for work

7.43 A Competent Person (MGPS) accepting a PTW is, from that moment, responsible for the safe conduct of the work within the limits of the PTW, but the work should be subject to supervision by the Authorised Person (MGPS) and relevant testing procedures on completion.

7.44 The Competent Person (MGPS) should be fully conversant with its terms and requirements and should give sufficient and clear instructions to staff working under their supervision.

7.45 Contracts should be only placed with firms who are appropriately registered as described in Chapter 5. Further guidance on contractors' competence is given in Chapter 11.

7.46 The Competent Person (MGPS) should not leave the work site during the lifetime of the PTW. However, if this is inevitable (for example, if the work is halted between shifts), the Competent Person (MGPS) should ensure that suitable precautions have been taken to ensure the safety of the system and any personnel who may enter the work area during this period. If it is necessary for further work to be carried out by another Competent Person (MGPS) (for example, during a further shift), this Competent Person (MGPS) should sign the "Competent Person (MGPS) taking over" section of the PTW.

Limits of authorisation

7.47 The PTW should provide concise and accurate information about when and where it is safe or dangerous to work. It should provide a clear statement of the work to be done. The estimated time for completion should also be given, but this is for guidance purposes only and should not prejudice the completion of the work in complete safety. A section of the PTW should provide an illustration of the isolation to be carried out or the general area of work.

7.48 The Competent Person (MGPS) should not be persuaded to break the conditions or scope of the PTW (for example, by attempting work not covered by the PTW).

7.49 The scope of the actual work done should be limited to that described in the PTW, and the description of the work should not be altered.

Cancellation of PTWs before completion of work

7.50 In the event of a change in the programme of work or any reason leading to cancellation of the existing PTW (for example, unsatisfactory engineering or pharmaceutical test results), the Authorised Person (MGPS) should delete entries as appropriate and write "cancelled" across the PTW.

7.51 The cancelled PTW should be accompanied by a written statement from the Authorised Person (MGPS) describing the stage at which the work was stopped and the reason why; this may be entered in the comments section of the PTW logbook.

7.52 The Competent Person (MGPS) and Authorised Person (MGPS) should ensure that the system is left in a safe condition.

7.53 If there is to be a delay before issue of another PTW and resumption of work, the Competent Person (MGPS) (and any assistants) should remove all tools and

equipment and leave the site in a safe condition.

7.54 The Authorised Person (MGPS) should notify the Designated Clinical Officer (MGPS) of the situation and arrange alternative supplies if necessary.

7.55 To complete the work, a completely new PTW should be issued and cross-referenced to the original PTW by suitable wording in part 1 of the new PTW.

Typographical errors

7.56 These should be crossed through, corrected and initialled by the signatory.

Maintaining contact with the Authorised Person (MGPS)

7.57 All staff involved with work on the MGPS should carry identification at all times, and the Authorised Person (MGPS) should be available for contact at any time during the work and be present for subsequent testing.

Permission for work to take place

7.58 Work on an MGPS that will lead to interruption of supplies or work in clinical areas will require a Designated Clinical Officer (MGPS) to sign the PTW before the work can take place. Minor works on plant (for example, oil changes that do not result in loss of service) will not require this signature. These procedures should be documented in the MGPS OP.

7.59 The MGPS OP should also define the extent of the Designated Clinical Officer's (MGPS) responsibility when signing PTWs. For example, a Designated Clinical Officer (MGPS) may be given responsibility for a whole hospital, multiple wards or just a single ward. The hazard level of the work may also be used to determine who gives written permission for work to proceed. These agreements should be recorded in the MGPS OP. Training in roles and responsibilities is a key element of the satisfactory application of the PTW system.

Advance notice of work

7.60 The Authorised Person (MGPS), Competent Person (MGPS), Quality Controller (MGPS) and the Designated Clinical Officer (MGPS) should agree on the length of advance notice that will be required before interruptions to gas supplies may be made. This might be (typically) seven days for fully preplanned work to allow for any necessary patient/equipment movement that may be required. These agreements should be recorded in the MGPS OP.

7.61 The Authorised Person (MGPS) should inform the Designated Clinical Officer (MGPS) of the extent to which the MGPS will be restricted or interrupted while the work is in progress and should indicate the level of hazard involved. The Authorised Person (MGPS) should also explain that the PTW requires the signature of a Designated Clinical Officer (MGPS) on duty at the start of the work before the work may proceed.

Maintaining services during the work

7.62 The Authorised Person (MGPS) should provide assistance as necessary to ensure continuity of service during disruption to the MGPS. This may require the provision of alternative gas supplies (for example, backfeed kits to supply a whole ward area, cylinder/regulator combinations or portable suction units). Additional cylinder supplies or equipment may be required for this purpose. The Authorised Person (MGPS) should liaise with the Designated Clinical Officer (MGPS) to establish patients' requirements and ensure that these are communicated to portering, pharmacy and medical engineering departments as appropriate.

Essential liaison with the Quality Controller (MGPS)

7.63 The Quality Controller (MGPS) should be informed well in advance of work that will involve quality or identity testing.

7.64 The extent of the work and any potential problems should be discussed so that the Quality Controller (MGPS) may determine the likely staffing or time requirements of the task.

7.65 The Authorised Person (MGPS) should make available all necessary as-fitted drawings of the pipework and state which gases are involved to allow the Quality Controller (MGPS) to select the appropriate test equipment.

7.66 The Authorised Person (MGPS) should ensure that all necessary engineering tests have been completed with satisfactory results before QC testing takes place.

7.67 The Authorised Person (MGPS) should arrange for the Quality Controller (MGPS) to have access to the system when testing is required, as delays will be inevitable if this cannot be provided.

7.68 The Quality Controller (MGPS), whether employed on site or external to the organisation, should introduce themselves, and any colleagues, to the senior staff in the areas they will be testing.

7.69 If testing is carried out by a specialist MGPS testing organisation, the Authorised Person (MGPS) and local Quality Controller (MGPS) or Chief Pharmacist should liaise with that organisation to ensure that appropriate protocols are followed, preferably by sight of a suitable safety method statement. Copies of test results should be retained by the local Quality Controller (MGPS) or Chief Pharmacist and the Authorised Person (MGPS) following the validation and verification process.

Accompanying documents

7.70 Depending on the work to be carried out, other documents may be attached to the PTW to ensure that all safety aspects have been considered before the work starts. These may include:

- safety method statements, describing the work methodology and accompanying safety precautions
- other PTWs related to the work, for example “hot work” and “confined spaces” (the MGPS PTW should include reference(s) to these by PTW number(s))
- an up-to-date set of as-fitted drawings of the system(s) to be worked on and any other drawings relevant to the proposed work
- any special instructions or additional safety measures relevant to the work or its environment.

7.71 These documents should be retained by the Authorised Person (MGPS) in the MGPS document file.

Levels of hazard

7.72 Whenever work is to be carried out on the MGPS, it should be assigned a level of hazard depending on the nature of the work.

7.73 The hazard level relates to the risk to the patient, not to the system maintainers or operatives, nor to the extent of system isolation or the complexity of the work.

7.74 The Authorised Person (MGPS) should assess the hazard level at the time of preparing the PTW and, if in doubt, should seek advice from their Authorising Engineer (MGPS).

7.75 Two levels of hazard are defined in paragraphs 7.76–7.78.

High-hazard work

7.76 High-hazard work is any work on any part of the MGPS that introduces hazards of pollution or cross-connection, other than the servicing of second-fix terminal unit components.

7.77 High-hazard work requires subsequent tests for gas identity, quality and purity by the Quality Controller (MGPS). Typical examples are given below:

- Installation of pipework: cutting and brazing a pipeline is classified as high hazard, as it is clear that both cross-connection and pollution are possible consequences of the work.
- There are instances when a cross-connection hazard may arise, but the risk of system pollution is very small. Examples include the servicing of terminal units with interchangeable components (that is, those not designed to BS 5682 specifications) and the moving or replacement of pendants containing flexible hoses fitted with mechanical connectors (NISTs).
- The replacement of pendant hoses also carries a risk of cross-connection and pollution should NIST fittings be incorrectly attributed to a hose or the hose material is substandard. Performance and engineering tests by the Competent Person (MGPS) and identity, quality and purity tests by the Quality Controller (MGPS) should be performed.
- By agreement with the Chief Pharmacist and Quality Controller (MGPS), which should be detailed in the site SOP, emergency temporary repairs using mechanical connectors specified in Chapter 15 in Part A can be considered as low hazard. However, efforts should be made to ensure that the section of pipework affected is purged of any debris that may have entered during either the incident or the repair process. Where multiple adjacent pipelines have been damaged simultaneously, care should be taken to ensure that the use of mechanical couplings for repair does not result in cross-connection. A high-hazard PTW should be raised followed by engineering and Quality Controller (MGPS) tests within 24 hours, and a plan should be put in place to provide a permanent repair to the affected section

Low-hazard work

7.78 This applies to all work on the MGPS that does not give rise to a high-hazard situation:

- Low-hazard PTWs cover all PPM inspections and the maintenance of terminal units either on a PPM basis or as an emergency repair (replacement of second-fix components).
- Terminal units that comply with BS 5682 and BS EN ISO 9170-1 incorporate components such as indexing pins and shapes which are gas-specific. It is therefore not possible to assemble the terminal unit in such a way that the wrong gas is delivered (other than by a wilful act). Servicing of these terminals is therefore low-hazard work. However, during reassembly, the gas-specific features should be checked to ensure that they have not been damaged. Gas-specific features should not be removed from second-fix assemblies (for example, locating pins) as a means of overcoming incorrectly installed first-fix components.
- Work may be undertaken under a low-hazard PTW on terminal units complying with BS 5682 that incorporate automatic isolating valves. Some earlier terminal units include a manual isolating valve.
- Replacement of safety relief valves and regulators, supplied as OEM (original equipment manufacturer) products by the manufacturer sealed in bags and clearly marked for their intended service.

- Replacement of printed circuit boards (PCBs) for alarms, transducers or batteries may be undertaken under a low-hazard PTW.
- When working on individual terminal units fitted with an integral isolating valve or check valve (which operates automatically when the socket assembly is removed), it is not usually necessary to interrupt the supply to other adjacent terminal units.
- Terminal unit termination blocks should not be left unattended with the socket removed, unless a blocking plate has been attached.
- Some work on plant will be of low hazard. However, work on plant that carries a potential risk of pollution to the gas supply should be discussed with the Quality Controller (MGPS) before proceeding with the work. For example, a strip down of an air compressor for parts replacement or oil change may not affect the filter dryer system quality. However, it would be unreasonable to return an extensively refurbished plant into service without QC tests by the Quality Controller (MGPS).
- Changing bacteria filters on a central vacuum plant would be classified as low hazard, as patient risk is low, even though maintenance staff should take special precautions against infection.
- A vacuum system could be crucial to patient welfare. However, complete isolation of a vacuum system or installation or removal of vacuum outlets or pipework in isolation to any other gases should be classified as low-hazard work; the only Quality Controller (MGPS) test required for a vacuum system is verification of identity. A RAMS should be in place providing sufficient detail to ensure that portable vacuum pumps and/or ejector-type vacuum units are available to maintain patient safety during the works.
- Servicing of older terminal units containing interchangeable components may also require isolation of a ward. Where work is carried out under a low-hazard PTW, the risk of cross-connection should be minimised by replacing seals on a single gas system that has been depressurised, while other systems remain pressurised. Final confirmation of correct identity should be achieved by mechanical testing using gas-specific proving tools (for example, certified gas-specific terminal unit probes) and cross-connection tests.
- Risks to personnel working on the MGPS may arise from the work procedures or work environment (for example, microbiological exposure, brazing (hot work) and work in confined spaces). Working with these risks may require issue of additional PTWs appropriate to the risks. These PTWs may run concurrently with the MGPS PTW, and they should be referenced on part 1 of the MGPS PTW.

Responsibilities of the Authorising Engineer (MGPS) for the PTW procedure

7.79 The responsibilities of the Authorising Engineer (MGPS) are as follows:

- reviewing the PTW from the last 12 months and giving recommendations
- advising the Authorised Person (MGPS) on the level of PTW when required
- completing and managing the PTW if the Authorised Person (MGPS) is not available for planned works
- coaching new and inexperienced Authorised Persons (MGPS) on the PTW process.

Responsibilities of the Authorised Person (MGPS) for the PTW procedure

7.80 The responsibilities of the Authorised Person (MGPS) are as follows:

- giving suitable advanced notice to stakeholders
- completing the PTW at the point of works
- obtaining written permission (where appropriate) from Designated Clinical Officer (MGPS) for high-hazard works, work in a clinical area, interruption of supplies and affixing “DO NOT USE” or other prohibition notices
- preparing PTWs and (where appropriate) any additional documents (for example, RAMS and hot works PTWs)
- explaining details of work to the Competent Person (MGPS)
- supplying drawings of existing sections of the installation (as-fitted drawings)
- ensuring, where used, that backfeed kits are in place and being monitored
- supervising isolation of the section on which work is to be carried out
- witnessing, supervising or accepting results of tests of completed work as appropriate
- supervising purging with a working gas
- witnessing the Quality Controller (MGPS) in final quality and/or identity testing, in the case of high-hazard work
- witnessing, supervising or accepting results of final performance tests of completed work in the case of low-hazard work
- supervising the final connection of any extension
- witnessing the restoring of the gas service(s) by the Competent Person (MGPS) operating the appropriate valves/AVSUs/LVAs
- notifying the Designated Clinical Officers (MGPS) of the completion of work and removal of “DO NOT USE” notices
- obtaining updated/corrected copies of drawings
- retaining original copies of PTWs and all PTW books
- obtaining the Designated Clinical Officer’s (MGPS) signature on the PTW, and accepting the system as fit for service
- reviewing and confirming amendments on master as-fitted drawings.

Responsibilities of the Competent Person (MGPS) for the PTW procedure

7.81 The responsibilities of the Competent Person (MGPS) are as follows:

- signing the PTW, acknowledging responsibility for the work
- obtaining and understanding instructions on work to be done
- connecting, where used, backfeed kits into the system
- isolating sections of the system on which work is to be carried out (under direct supervision of the Authorised Person (MGPS))
- carrying out the work
- carrying out system integrity tests on completed work (witnessed by the Authorised Person (MGPS) where appropriate)
- signing the PTW, declaring that the work is completed as indicated

- in the case of contractors, providing an appropriate safety method statement applicable to the work, evidence of compliance with relevant quality assurance requirements, insurance and a company health and safety policy.

Responsibilities of the Designated Clinical Officers (MGPS)

7.82 The responsibilities of the Designated Clinical Officers (MGPS) are as follows:

- signing the PTW to agree that the system can be worked on or taken out of use (this will not be necessary for some low-hazard PTWs)
- advising other clinical/nursing staff that the system is not available for use
- ensuring where used that sufficient cylinders are in place for patient use
- on completion of the work, signing the PTW and accepting the system back into use
- advising clinical colleagues and departmental heads that the system is/is not available and fit/unfit for use.

Responsibilities of the Quality Controller (MGPS)

7.83 The Quality Controller (MGPS) is involved in testing after high-hazard work and other low-hazard work following consultation with the Authorised Person (MGPS) and Chief Pharmacist. The responsibilities of the Quality Controller (MGPS) are as follows:

- identifying the test equipment required, depending on the specific service that has been disrupted (this equipment should be maintained and calibrated to accredited standards)
- carrying out final identity, quality and purity tests on the systems
- signing the PTW, declaring that the pharmaceutical testing is completed as indicated and that the system may be put into use
- (following the works) providing copies of the QC test sheets and calibration certification to the Authorised Person (MGPS) for filing with the PTW.

The PTW form

7.84 There are two PTW forms: high-hazard and low-hazard classifications.

7.85 For high-hazard PTWs, QC testing and a Designated Clinical Officer's (MGPS) signature is always required.

7.86 In some instances (for example, changing oil/filters/desiccant on plant), there will be no interruption to supplies; the work may be in non-clinical areas (for example, plantrooms) or clinical areas not in use. In these circumstances, a Designated Clinical Officer (MGPS) signature may not be required. However, QC testing may be required using a low-hazard PTW.

7.87 In other instances, although the work is of a low-hazard nature, a Designated Clinical Officer (MGPS) signature should be obtained, as entry to patient areas and the interruption of gas supplies will be required (for example, for the servicing of terminal units or the isolation of an area).

7.88 The Quality Controller (MGPS) should provide final quality and identity testing for all high-hazard works; this includes testing of replacement hoses in pendant units or for low-hazard works when required.

Description of the PTW form

7.89 The purpose of the space on the top left of the form is for entering the name of the healthcare organisation.

Part 1

7.90 This contains information on the work to be done, a sketch of the area, permission from a Designated Clinical Officer (MGPS) for it to take place if required, and an assurance that no other work will be carried out during the life of the PTW.

7.91 The system or systems affected by the work, an approximate timescale and the areas in which the work is to take place, or will be affected, are also listed here.

7.92 Wherever possible, drawing reference numbers (and their dates) should be identified on the PTW, and copies of the relevant drawings should be attached plus a sketch showing the isolation point drawn on the sheet of the PTW. If the description of the work is considerable, it can be extended to a separate sheet, referenced with the PTW number and stapled to the PTW, or kept in a specific file. A copy of any safety method statements and other PTWs (hot work and confined spaces), signed and dated by the Authorised Person (MGPS), should also be attached.

7.93 This part of the form also contains space for the predicted timescale of the work and the signature of the Designated Clinical Officer (MGPS).

7.94 Safe isolation is essential. When required, the Authorised Person (MGPS) should provide minimum details of the isolation point, as follows:

- valve box number/key peg number
- valve box location
- area/name of ward to be isolated
- gas to be isolated.

7.95 The Authorised Person (MGPS) should sign and date part 1 immediately before commencement of the works. Where required the Authorised Person (MGPS) should discuss the detail with the Designated Clinical Officer (MGPS), and the Designated Clinical Officer (MGPS) should sign part 1 to give permission for the work to take place.

7.96 Where the Designated Clinical Officer (MGPS) is not required to sign the PTW, the Authorised Person (MGPS) should detail this and sign the PTW to progress it to the next stage.

Part 2

7.97 Part 2 is for the Competent Person (MGPS) to sign at the location of the work, just before the work is due to start. The Competent Person (MGPS) should read part 1 and question anything not understood.

7.98 The Competent Person (MGPS) should provide RAMS for the works. Where necessary, these should be supplemented by an additional method statement from the Authorised Person to cover set-up works not included within the Competent Person's scope. All method statements should be reviewed and the Competent Person (MGPS) and Authorised Person (MGPS) should agree that they adequately cover the work described.

7.99 The Competent Person (MGPS) should then sign part 2, accepting responsibility for the work and any other staff working under their supervision. The Authorised Person (MGPS) should ensure that the Competent Person (MGPS) understands that no other work should be undertaken during the life of the PTW.

7.100 The Competent Person (MGPS) should be fully informed of, and be conversant with, any special safety measures and procedures which may be in force during the work (for example, the isolation of fire and smoke detectors and the operation of fire-fighting equipment).

7.101 The yellow copy, photocopy or scan of the PTW should be given to the Competent Person (MGPS) for the duration of the work.

Part 3

7.102 The Competent Person should inform the Authorised Person (MGPS) that the work has been completed and is ready for examination prior to testing.

7.103 The Authorised Person (MGPS) should inspect the completed work and sign to confirm whether it is complete and ready for testing, or whether the PTW is to be cancelled and further work is required.

7.104 The Authorised Person (MGPS) should confirm whether all other PTWs have been satisfactorily completed.

Part 4

7.105 The installation should be ready for examination by the Authorised Person (MGPS) at this stage.

7.106 The Authorised Person (MGPS) should detail the engineering tests to be carried out by the Competent Person (MGPS).

7.107 The Authorised Person should witness the appropriate tests carried out by the Competent Person (MGPS). Part 4 of the PTW should be completed by the Authorised Person (MGPS) to record the pass or fail status of each test performed.

7.108 Depending on the type of work, some low-hazard PTWs will require pharmaceutical testing. (All high-hazard work require pharmaceutical testing.)

7.109 At this stage, failure of one or more tests will usually indicate that further work on the system will be required. In these circumstances, the Authorised Person (MGPS) should sign to indicate that the system is not suitable for progression and should cancel the PTW. It is the duty of the Competent Person (MGPS) at this stage to ensure that all steps are taken to ensure that the system is left in as safe a condition as possible. In the case of serious faults (for example, extensive internal oxidation of the pipeline), it may be necessary for the Competent Person (MGPS) to leave site while the situation is resolved. In such cases, all tools and materials not required for the purposes of any investigation should be removed from site.

7.110 If all tests have passed and the system has been checked by the Authorised Person (MGPS), part 4 should be signed by the Competent Person (MGPS) and by the Authorised Person (MGPS) after witnessing the tests.

7.111 The inside cover of the PTW book contains a list of relevant tests. The code attributed to each test may be entered into the test box on part 4 (see Table 2 at the end of this chapter). A selection, or all, of these tests may follow the work, depending on its complexity.

Part 5

7.112 If QC testing is required in part 5, the Quality Controller (MGPS) should perform the tests and complete this part; only the tests carried out should be recorded.

7.113 The Authorised Person (MGPS) should witness the QC tests. When the Quality Controller (MGPS) is satisfied that the system may be taken back into use, the Quality Controller (MGPS) and the Authorised Person (MGPS) should sign part 5.

7.114 If the test results are not satisfactory, the Authorised Person (MGPS) should cancel the PTW indicating further works are required under a new PTW.

Part 6

7.115 The Authorised Person (MGPS) should inform the Designated Clinical Officer (MGPS) that the work is completed and confirm whether the MGPS is ready for use.

7.116 This part should be signed by the Designated Clinical Officer (MGPS) to confirm acceptance of the system back into use. If the system is not ready for service, the

Designated Clinical Officer (MGPS) should sign to confirm awareness of this status. It is also their responsibility to inform all appropriate staff of the service status.

7.117 Where a Designated Clinical Officer's (MGPS) signature is not required in accordance with the instructions in part 1, the Authorised Person (MGPS) should complete part 6.

Handing back systems that will not be used immediately

7.118 It is possible to install and commission a new ward or department without the need for issuing a PTW. However, connecting new pipework to the existing system requires the use of a high-hazard PTW.

7.119 Consideration should be given to delaying final testing where a system will remain out of use for a period prior to patient occupation of the area.

7.120 In the intervening period, the MGPS can either be:

a. filled with medical air as described in Chapter 19 of Part A

b. left with the working gases as a fully working system.

7.121 With regard to (a), this will provide a safer system if additional works are in progress in the area that could affect the integrity of the pipeline. Regular checks to ensure the pipelines remain pressurised should take place.

7.122 With regard to (b), a PPM should be in place for this part of the system and more frequent checks of the area and outlet purging by the Authorised Person (MGPS) or site-based Competent Person (MGPS) should be performed.

7.123 Any parts of the system left dormant should require repeat engineering and QC tests prior to use with patients. The Authorised Person (MGPS) should liaise with both the Quality Controller (MGPS) and the Designated Clinical Officer (MGPS) to establish a suitably documented handover procedure.

Use of PTW books

7.124 As mentioned previously, PTWs are divided into two hazard levels:

- High-hazard work is that involving risks of cross-connection and pollution of medical gas systems.
- Low-hazard work is all work not considered to be high-hazard work and carries no risks of pollution or cross-connection.

7.125 Where terminal units containing non-gas-specific components remain in use, and the Authorised Person (MGPS) identifies a risk of cross-connection, checks should be carried out to confirm that components are gas-specific and cannot be incorrectly connected. This should be followed by QC tests.

7.126 Some work may involve isolation of a ward's gas supply (for example, servicing non-standard terminal units, servicing terminal units known to have an inherent history of automatic isolating valve failure or changing pressure switches). The Authorised Person (MGPS) and the Competent Person (MGPS) should ensure that all possible precautions are taken to prevent unintended isolation of other parts of the system. In such cases, an up-to-date set of as-fitted drawings should be made available. This work can be completed on a low-hazard basis.

7.127 When carrying out isolations or other work, as part of the PTW, a schematic or plan diagram showing the area, gases and valves involved in the isolation should be provided. If actual drawings and schematics of the intended point of isolation are separately available as additional documents to the PTW, they may be referenced in the sketch section rather than repeating the drawing. A copy of the master drawing should be used and

annotated with the detail of the works for additional clarity to the Competent Person (MGPS).

7.128 The low-hazard level does not always require the signature of a Designated Clinical Officer (MGPS). For example, plant oil replacement and plant repairs that do not compromise the continuity of the MGPS do not require a Designated Clinical Officer's (MGPS) signature. However, if interruption of gas supplies to terminal units is part of the low-hazard work, or if the work is taking place in an occupied clinical area, the Authorised Person (MGPS) should obtain the written permission of a Designated Clinical Officer (MGPS).

Choice of engineering tests

7.129 The Authorised Person (MGPS) should determine the appropriate tests and record them on the PTW for the Competent Person (MGPS) to carry out. A list of tests is detailed in Chapter 19 of Part A and should be displayed on the inside of the PTW book cover.

Preparation and issue of a PTW

7.130 The following guidance applies to the preparation and issue of a PTW. Not all items below will be required, as this will depend on the nature of the work and the associated hazard level. The Authorised Person (MGPS) should manage the PTW process and determine which items will be required.

- The Authorised Person (MGPS) should assess the works and determine the hazard level. They should complete the PTW logbook, recording that the PTW is open, the level of PTW, a brief description of the works, the date, the Authorised Person's name and any relevant comments.
- It is the duty of the Authorised Person (MGPS) to ensure that key stakeholders likely to be required or affected by the work are fully informed of the implications of the work in terms of responsibilities, possible disruption, contingencies, safety and timescale. It may be necessary to hold a site meeting to achieve these objectives.
- For works requiring the Designated Clinical Officer's signature, the Designated Clinical Officer(s) (MGPS) should be made aware that their signatures will be required on the agreed date on which the work is due to take place; this is to ensure they are available and work is not delayed or cancelled.
- It should be determined whether backfeed kits, portable cylinders or vacuum units are required and this should be conveyed by the Authorised Person (MGPS) to the Designated Clinical Officer(s) (MGPS) with full details of the interruption.
- A further memorandum, if required, requesting the services of the Quality Controller (MGPS) and detailing the requirements for portable cylinders should be sent to the pharmacy department and the head porter, respectively.
- The Authorised Person (MGPS) arranges, through the portering, pharmacy and medical engineering departments (or a contract hire firm, if necessary), for backfeed kits, portable cylinders and regulators.
- The Authorised Person (MGPS) should advise the ward/department concerned so that they can arrange for the provision of any additional portable vacuum units.
- The Authorised Person (MGPS) should provide all details of the work to be carried out, including any other PTWs (for example, hot works or entry into confined spaces).

On the day of the work

7.131 The Authorised Person (MGPS) should complete part 1 of the PTW at the point of works and, if required, should liaise in person with the Designated Clinical Officer(s) (MGPS) of the ward(s) or department(s) concerned.

7.132 Work should only commence when the Designated Clinical Officer(s) (MGPS) for the ward(s) or department(s) is/are satisfied that no patients will be put at risk by the work on the MGPS and has/have signed part 1 of the PTW.

7.133 The Authorised Person (MGPS) should install any "DO NOT USE" or other prohibition labels to prevent connection to a part of the system that is taken out of use.

7.134 For work not requiring Designated Clinical Officer (MGPS) sign-off, the Authorised Person (MGPS) should enter "not required" and the reason it is not required in the Designated Clinical Officer (MGPS) section of part 1 to progress to the next section.

7.135 The Competent Person (MGPS) should sign part 2 of the PTW. The Authorised Person (MGPS) should then confirm the details in part 1 and supervise commencement of the work.

7.136 On completion of the work, the Competent Person (MGPS) should sign part 3 and contact the Authorised Person (MGPS) so that the installation may be examined before testing. The Authorised Person (MGPS) should sign part 3 as confirmation that the system is ready for testing.

7.137 Depending on the extent of the work, the Authorised Person (MGPS) should determine and list the tests in part 4 of the PTW.

7.138 The Competent Person (MGPS) should carry out the required engineering tests, which should be witnessed by the Authorised Person (MGPS).

7.139 The Authorised Person (MGPS) should carry out a final examination of the system(s) worked on.

7.140 On obtaining satisfactory test results, the Competent Person (MGPS) and Authorised Person (MGPS) should sign part 4 of the PTW, signifying that the work is ready for the next section.

7.141 On successful completion of the engineering tests and examination, where required, the Quality Controller (MGPS) should carry out identity and QC tests on the system(s). The Authorised Person (MGPS) should be available to assist the Quality Controller (MGPS).

7.142 On obtaining satisfactory QC test results, the Quality Controller (MGPS) and Authorised Person (MGPS) should sign part 5 of the PTW. Where QC testing is not required, the Authorised Person (MGPS) should enter "not required" in part 5 and sign to confirm, thereby progressing the PTW to the next section.

7.143 The Designated Clinical Officer(s) (MGPS) should accept the system(s) back into service by signing part 6 of the PTW and should notify relevant staff that the system is fit for use.

7.144 The Authorised Person (MGPS) should remove any "DO NOT USE" or other prohibition labels.

7.145 Where Designated Clinical Officer (MGPS) sign-off is not required, acceptance back into use by a Designated Clinical Officer is also not required. The Authorised Person (MGPS) should enter "not required" in part 5 and sign to complete the PTW and return the system, or part thereof, to use.

7.146 The Authorised Person (MGPS) should retain the completed white (top) copy in the PTW book.

7.147 The Competent Person (MGPS) should receive either the completed yellow copy of

the PTW or an electronic copy of the completed white top copy from the Authorised Person (MGPS).

7.148 The Quality Controller (MGPS) should receive either the pink copy of the completed PTW or an electronic copy of the white top copy from the Authorised Person (MGPS).

7.149 Following completion of part 2, photocopies of the white copy may be issued to the Competent Person (MGPS) on request for use on site as evidence of authorised works during the execution of the work.

7.150 The Authorised Person (MGPS) should retain the completed white copy in the PTW book. Photocopies of the white copy may be issued to the Chief Pharmacist on request.

7.151 The Authorised Person (MGPS) should complete the PTW logbook to record closure of the PTW and any relevant comments.

Table 2 List of engineering and QC tests and associated PTW codes

Tests	PTW code	Brief description: refer to Chapter 19 in Part A for more detail
Design sign-off by the MGSG	DSO	If the system has changed or has a new clinical use, check that the design has been signed off and approved by the MGSG.
Brazing inspections	BJI	Authorised Person (MGPS) requests cut out and inspection of pipeline joint to be cut open to check cleanliness and mechanical structure.
Labelling and marking	CLM	Check the pipeline ID and direction of flow tape in correct locations and any other markings on AVSUs, NISTs, outlets, etc.
Sleeving and supports	CSS	Check the sleeving is present and long enough for the intended fire-stopping or wall it will be going through.
High pressure test	HPT	These are the carcass pressure tests for each system at higher pressures than the pipeline pressure.
Verification of as-fitted drawings	VAD	This is to verify that there is a drawing marked up with the changes that represent the system for updating the master as-fitted within the next two weeks.
HTM compliance	HTMC	Check the MGPS to ensure it complies with HTM 02-01 or if not that there is a derogation in place signed off by the relevant stakeholders.
Plantroom/manifold room & cylinder stores compliance	SSRC	Check the plant, manifold and cylinder stores for compliance to HTM 02-01.
Supply system air plant	SSAP	A test to run through the functionality of the source equipment following replacement or repair; all functions of the plant that have been affected, should be tested to ensure it is fully operational.
Supply system pressure reducing sets	SSPR	
Supply system vacuum plant	SSVP	
Supply system AGSS plant	SSAP	
Supply system manifold systems	SSMS	
Supply system liquid systems	SSLS	
PSSR 2000 documentation	PSSR	For items that have been replaced or worked on, ensure there are certificates available and logged for updating or adding to the PSSR documents
Pipeline pressure leakage	PPLx or PPLF	PPLx is a 2- to 24-hour leak test on the system at working pressure or vacuum using digital gauges, where x = the number of hours on test. PPLF is a leak test using leak detector fluid. Generally used for small modifications of fewer than 20 joints where all joints are accessible.
Pipeline vacuum leakage	PVL	This test is carried out using the working vacuum by isolating the area and dropping the vacuum to a set level and monitoring with digital gauges for 15 minutes
Pipeline engineer particulate	PEP	Following pipe installation or modification, this is a particulate test performed by the engineer to confirm it is free from particles before handing over to the Quality Controller (MGPS). This does not replace the QC particulate test.
Pipeline cross-connection	PCC	Where multiple pipelines have been modified or installed, the systems should be checked to ensure there are no cross-connections.
LVA closure zoning NIST identity	VCZNI	Check that the LVA holds pressure when closed, that it feeds the area intended, that it has the correct NIST fitted and that the NIST is operational.
AVSU closure zoning NIST identity signage	ACZNIS	Check that the AVSU holds pressure when closed, that it feeds the area intended, that it has the correct NIST fitted and that the NIST is operational.

Tests	PTW code	Brief description: refer to Chapter 19 in Part A for more detail
Terminal unit flow pressure identity anti-rotation	TFPIA	Test the terminal unit design flow rate and pressure drop, its gas specificity and the anti-swivel pin is in or out in accordance with its use.
Design flow performance	DFP(V)	Test the individual terminal unit and area at design flow rates. DPFV should be used where practicable; limited design flows should be used when working on an existing system.
Plant alarm function	PAF	Test the central plant function and that signals are being transmitted to repeater panels.
Local alarm function	LAF	Test a local alarm panel function and that the set points of pressure switches or transducers are correct using digital gauges and that, where installed, signals are being transmitted to repeater panels.
Purging and filling of the system	PFS	Many tests cannot be performed without purging and filling the system or area with the working gas; each terminal unit should be purged safely to ensure the system is purged of air or nitrogen.

8 Training and communication

8.1 The Health and Safety at Work etc. Act 1974 requires every employer to provide such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the health and safety at work of their employees.

8.2 The Act also places duties on employees to take reasonable care to cooperate with employers and not to interfere with or misuse anything provided for their safety.

8.3 It is essential that personnel at all levels have a sound general knowledge of the principles and functions of an MGPS.

8.4 No person should manage, install, maintain, operate or run a project involving medical gas systems or equipment unless they are properly trained or supervised.

8.5 The required training is detailed in this chapter and should be completed by the relevant staff to perform their function safely and for some to be signed off in writing. This training should form a programme to be followed by the healthcare facility.

8.6 All training should be recorded and reviewed at MGSG meetings and monitored in accordance with the governance section.

8.7 The Executive Manager should ensure that all staff have received the training described in this section before using the MGPS and that refresher courses are arranged as detailed in Table 3.

8.8 All Authorised and Competent Persons (MGPS) should have satisfactorily completed appropriate medical gas and first-aid training courses before they are appointed.

8.9 It is essential that all training courses include practical elements (for example, brazing practice) for Competent Persons (MGPS) carrying out installation work, and terminal unit servicing for Competent Persons (MGPS) carrying out maintenance. Training in the validation and verification procedures detailed in Part A of this HTM should be included. MGPS compliance assessment and completion of MGPS PTWs by Authorised Persons (MGPS) should form part of all Authorised Person (MGPS) training courses. It is equally essential that documented assessments of practical competencies are made during the training. All training and assessments should make use of a live MGPS. Following the successful completion of any relevant training and qualification, a continuing professional development log should be maintained and reviewed on a regular basis, ideally as part of the reassessment process for Competent Persons (MGPS) and Authorised Persons (MGPS) appointments.

8.10 Authorised Persons (MGPS) are expected to satisfy themselves of the competence of any employed or contracted staff. All prospective Competent Persons (MGPS) should be able to offer documentary evidence, including Competent Person training certificates for their role, training in basic competencies and any supplementary training and relevant experience.

8.11 Contractors and their staff unable or unwilling to provide such evidence should not be allowed to work on medical gas systems.

8.12 All MGPS courses detailed in this HTM should be delivered by specialist training providers who are recognised by an awarding organisation regulated by government bodies. Courses should demonstrate elements of QC in their delivery and assessment procedures, as required for recognition as an awarding organisation-approved training centre.

8.13 Training providers should undergo annual external verification by their awarding organisation to ensure trainers and assessors deliver courses to an appropriate and consistent standard.

8.14 Training providers should ensure courses remain relevant to current needs and are kept up to date with emerging technologies and procedures.

Familiarity with systems and equipment

8.15 Personnel should be familiar with the specific systems and equipment for which they are responsible. This familiarisation process should be additional to the more generic training provided at dedicated centres or when attending training courses at other healthcare facilities, both of which may use different types of equipment and system configurations.

8.16 Familiarisation with central plant operation or local AVSUs and alarms is essential, in particular, those procedures ensuring continuity of supply in the event of failure of the plant.

8.17 It is essential that time is allocated for this familiarisation process, and personnel should not be appointed as Authorising Engineers (MGPS), Authorised Persons (MGPS), Competent Persons (MGPS), Designated Clinical Officers (MGPS) or Medical Gas Porters (MGPS) without sufficient experience and familiarisation with their particular installations and equipment.

Refresher training and reassessment

8.18 Retraining and reassessment should be carried out at regular intervals. Table 3 shows recommended intervals, but there will be occasions when additional training may be required (for example, response to changes in technology or guidance, staff moving from one site to another with different equipment, limited exposure to MGPS due to role changes, equipment failures, failure of assessment, and incidents involving risks to patients and staff).

Designation	Responsibilities	Course	Refresher training/ reassessment
Designated Person	The integrity and governance of the MGPS	Medical Gases for Healthcare Managers	3 years
Senior Operational Manager	System management and leadership	Medical Gases for Healthcare Managers	3 years
Chief Pharmacist	Overall control of medical gas administration	Medical Gases for Service Managers	3 years
Authorising Engineer	Appointment and overseeing Authorised Person (AP)	AP Comprehensive then AP Refreshers (MGPS)	5 years
Authorised Person (AP)	MGPS operational lead, high and low-hazard works	AP Comprehensive then AP Refreshers (MGPS)	3 years
Low Hazard Authorised Person	MGPS operational, low-hazard PPM works only	Low Hazard AP (MGPS)	1 year
Competent Person (CP)	Installation and PPM	CP Maintenance and/or CP Installation (MGPS)	3 years
Competent Person (minor works)	Source equipment, plant room checks and terminal unit repairs	CP Minor Works (MGPS)	1 year
Designated Clinical Officer	Department lead, MGPS emergency actions and PTW permissions	Designated Clinical Officer (MGPS)	3 years
Quality Controller	System quality assurance	QC Medical Gas Testing then QC Medical Gas Testing Refresher	5 years
Clinical staff	Anyone using medical gases or cylinders	Medical Gas Safety – Clinical Staff	1 year
Portering team	Cylinder transport, connection and stock control	Medical Gas Safety – Portering	1 year
Project Manager	Manage projects which include MGPS	AP Comprehensive then AP Refreshers (MGPS)	3 years

Table 3 Training and reassessment schedule for personnel working with medical gas systems

Appointment responsibility

Note
HTM 00 – 'Policies and principles of healthcare engineering' provides overarching guidance applicable to all healthcare building engineering services including MGPS. An updated edition of HTM 00 is currently in preparation and will provide further guidance on the key roles, responsibilities and competencies of individuals identified in all HTMs. It will outline the required skills, knowledge, experience and behaviour required for each role and the process for the appointment of Authorising Engineers, Authorised Persons and Competent Persons.

8.19 The recommendation for appointment or reappointment as an Authorised Person (MGPS) should be made by an Authorising Engineer (MGPS).

8.20 The appointment or reappointment as a Quality Controller (MGPS) should be made by the Chief Pharmacist (MGPS), whether the role is for a single project or is part of a longer-term contract.

8.21 The recommendation for appointment or reappointment as an internal Competent Person (MGPS) should be made by an Authorised Person (MGPS).

8.22 The approval for an external Competent Person (MGPS) to work on the MGPS should be made by an Authorised Person (MGPS).

8.23 Designated Clinical Officers (MGPS) do not need formal assessment. However, the MGSG should approve their training course provider to ensure it meets all criteria including assessment criteria. They should be added to the active site list of Designated Clinical Officers on completion of their training course and successful completion of their course assessment, including PTW system exercises.

8.24 Formal assessment is not necessary for clinical and other staff who will use the MGPS or medical cylinders. They should complete training with an assessment in medical gas safety, the practical use of the system (including the safe use of basic equipment such as flowmeters, regulators, demand valves and suction controllers), safety procedures and actions in the event of emergencies.

8.25 The portering manager should formally assess portering staff who are to become Medical Gas Porters (MGPS) following successful completion of a medical gas safety course and then added to the active site list of Medical Gas Porters (MGPS).

Training records

8.26 Records should be kept for all staff undertaking MGPS training. It is the responsibility of individuals to maintain copies of their own training records, but additional requirements may apply. For example, healthcare departments should maintain records of personnel training status and copies of relevant training documentation. The MGSG should oversee training requirements for the healthcare organisation.

8.27 Authorising Engineer (MGPS) records should be kept by the individual, their company and any professional body that they are part of.

8.28 Authorised Person (MGPS) records should be kept by the Authorised Person (MGPS), the healthcare organisation and the Authorising Engineer (MGPS).

8.29 Records for directly employed Competent Persons (MGPS) should be kept by the Competent Person (MGPS) and the Authorised Person (MGPS).

8.30 Contractors providing Competent Person (MGPS) services should maintain relevant records and produce these on request by the Authorising Engineer (MGPS) or Authorised Person (MGPS).

Limitation of activities

8.31 Evidence of experience and training should be used to determine both the limits of authorisation of an Authorised Person (MGPS) and the scope of work carried out by a Competent Person (MGPS).

8.32 For example, following an assessment exercise, an Authorising Engineer (MGPS) may decide that an Authorised Person (MGPS) has insufficient experience or familiarity with an MGPS to prepare PTWs for high-hazard work. In such cases, the Authorising Engineer (MGPS) should produce a written statement to this effect and make recommendations for further training and familiarisation.

8.33 The Authorised Person (MGPS) may nominate an internal person as a Competent Person (MGPS) but with their scope of work limited to only, for example, plantroom checks and second-fix terminal unit repair work.

8.34 Contractors offering Competent Person (MGPS) services may limit the extent of work performed by each employed Competent Person (MGPS). In its simplest form, this could be a division of labour into installation, commissioning and maintenance teams. However, within these teams, the company could limit work in accordance with the experience level of the Competent Person (MGPS).

8.35 A skills matrix of competence for each Competent Person (MGPS) or Authorised Person (MGPS) should be kept as evidence of these limitations and further training required.

8.36 The portering manager may nominate internal personnel as Medical Gas Porters (MGPS) with defined scopes of work. This may range from basic tasks such as moving cylinders and connecting small cylinders to regulators or equipment, to more advanced tasks including changing cylinders on manifold systems and emergency backfeed kits, or a combination of these activities.

Training course content and learning outcomes

8.37 Training course outline content and learning outcomes are presented below as a guide for providers. However, these should be regarded as the minimum inclusions in any training courses for the defined personnel.

8.38 Learning outcomes are descriptions of the specific knowledge, skills or expertise that the learner will acquire from a learning activity. These should be directly related to job responsibilities.

Authorising Engineer (MGPS)

Course content

- The requirements for implementation and management of safe systems of work.
- Implementation of guidance, codes of practice and statutory regulations.
- Understand the role of NHSE, Health and Safety Executive and CQC in healthcare.
- Roles and responsibilities of MGPS stakeholders.
- Identification of training needs, training programmes, assessments,
- Monitoring and auditing systems.
- MGPS Authorised Person (MGPS) assessment procedures and the authorising process.
- MGPS design, validation procedures and requirements.
- Objectives of literature reviews.
- Investigation and report production.
- Technical specification and contractual obligations.
- Standards/technology/procedures.

- Monitoring procedures for MGPS operational policy.

Learning outcomes

8.39 The ability to:

- make recommendations to healthcare organisation/PFI/FM company senior management where safe systems need improvement
- provide support to the Authorised Person (MGPS) to understand guidance and regulations
- understand and explain the interdependencies of governing bodies
- provide through critical assessment of the site the number of Authorised Persons (MGPS) needed
- understand appropriate training courses, for site-based/contractor staff, their required knowledge and skills for appointment
- understand the requirements for Authorised Persons (MGPS) to be reassessed every three years and to have attended a suitable training course before such reassessment
- conduct an annual audit and review of the management systems of the MGPS, including the PTW system
- categorise work into high and low-hazard PTW and justify why the “Do not use” plugs need to be fitted in an active ward that is to be isolated
- maintain such records as are necessary for the safe and efficient running of each site
- maintain a register of all Authorised Persons (MGPS) and healthcare sites within their area of responsibility
- provide Authorised Persons (MGPS) and other interested parties with technical support and advice
- be able to critically evaluate the MGPS, designs, incidents and provide a technical report
- ensure that Authorised Persons (MGPS) are acting on UK government or NHS guidance pertinent to the operation and safety of the MGPS
- understand how to monitor the implementation of the MGPS operational policy and this HTM on each site and to ensure that an annual review takes place.

Authorised Person

Course content

8.40 Theory elements:

- MGPS (including DAVS or ambulance systems) basic principles.
- Statutory obligations and safe systems operations.
- MGPS design and installation requirements.
- Structure and management of the PTW system, system interruption and contingency planning procedures, permission to work and “Do not use” plugs.
- Supervision of the Competent Person’s (MGPS) work and management of MGPS contracts.
- Assessment of internal Competent Persons (MGPS).
- MGPS equipment performance requirements (plant and pipeline).
- Technical reporting including system capacities/limitations, upgrading requirements/equipment replacement, system compliance.
- MGPS documentation.
- Emergency procedures.

- MGPS operational policy preparation, implementation and monitoring.
- MGPS testing and QC requirements.
- Management responsibilities.

8.41 Practical elements:

- Carry out critical assessment of MGPS elements.
- Complete PTWs and RAMS for a scenario.
- Specify and perform verification testing for a range of MGPS installation and repair scenarios.
- Set up, use and monitor backfeed kits.

Authorised Person learning outcomes

8.42 The ability to:

- ensure that the guidance in this HTM is implemented by all staff working on or with the MGPS
- prepare or commission a compliance survey of the MGPS, and associated risk assessment and proposals for any consequent remedial actions
- ensure the current quality assurance registration of MGPS contractors
- ensure that contractors provide appropriate method statements, risk assessments and health and safety statements
- prepare risk assessments, method statements and health and safety statements for MGPS work carried out by directly employed Competent Persons (MGPS)
- assess and record the competence levels of directly employed Competent Persons (MGPS)
- maintain a register of directly employed Competent Persons (MGPS)
- keep up-to-date records of MGPS plant and pipelines, plant and system histories, certificates of insurance, test records and commissioning/repair data for inspection by the Authorising Engineer (MGPS)
- control the storage, maintenance, issue and usage of any MGPS test or emergency supply equipment
- follow defined incident and accident reporting procedures
- control the storage, coding and issue of keys for the operation of the MGPS
- ensure that all AVSUs and LVAs are subject to a labelling system
- organise such training as is necessary for staff involved with the MGPS
- advise users on the safe use of an MGPS and associated equipment
- advise users on MGPS deficiencies and the likely effects of proposed equipment connection
- ensure that all MGPS plant is prepared for statutory inspections by a Competent Person (PSSR)
- retain copies of all as-fitted and other MGPS drawings and written schemes of examination as prepared by the Competent Person (PSSR)
- ensure that MGPS plant and pipelines are suitably signed to indicate gas type and flow direction, safety hazards, precautions and (in the case of bacteria filters) a safe filter-changing procedure
- ensure the safe and secure accommodation of MGPS plant and manifold systems and, where appropriate, emergency supplies and cylinders
- manage the MGPS PTW system in liaison with other disciplines, and issue, cancel and retain records of PTWs as required

- justify why “Do not use” plugs need to be fitted in an active ward that is to be isolated.

Low Hazard Authorised Person (MGPS)

Course content

8.43 Theory elements:

- MGPS basic principles.
- Statutory obligations and safe systems operations.
- Structure and management of the PTW system, system interruption and contingency planning procedures, permission to work and “Do not use” plugs.
- Supervision of routine work by Competent Persons (MGPS).
- Reporting faults and emergency procedures.
- MGPS testing for low-hazard works.
- Low Hazard Authorised Person (MGPS) management responsibilities.

8.44 Practical elements:

- Identify MGPS components.
- Complete PTW and RAMS for a low-hazard scenario.
- Specify and perform verification testing for a range of low-hazard MGPS repair scenarios.
- Set up, use and monitor backfeed kits.

Low Hazard Authorised Person (MGPS) learning outcomes

8.45 The ability to:

- safely oversee the routine operation and maintenance of medical gas systems
- safely oversee minor repair work to the MGPS
- report faults, cylinders, alarms and piped system
- control the storage, maintenance, issue and usage of any MGPS test or emergency supply equipment
- control the storage, coding and issue of keys for the operation of an MGPS
- ensure that all AVSUs and LVAs are subject to a labelling system
- ensure the safe and secure accommodation of MGPS plant and manifold systems and, where appropriate, emergency supplies and cylinders
- manage the MGPS PTW system in liaison with other disciplines, and issue, cancel and retain records of low-hazard PTWs as required
- justify why the “Do not use” plugs need to be fitted in an active ward that is to be isolated
- recognise the limitations of a Low Hazard Authorised Person.

Competent Person (MGPS)

8.46 Competent Persons (MGPS) are split into three groups:

- group 1: site-based Competent Persons (MGPS) who carry out plantroom checks and second-fix terminal unit replacement
- group 2: contractor Competent Persons who carry out quarterly PPM and servicing
- group 3: contractor Competent Persons who carry out installation, testing and commissioning.

8.47 There will be some overlapping responsibilities between the groups. Competent Persons should receive training

appropriate to the tasks they are required to complete. Certified training providers should provide courses for each group that includes the course contents listed below. It is essential that training providers offer training and assessment of theory, and the practical skills needed to carry out the work of a Competent Person (MGPS).

Course content group 1

8.48 Theory elements:

- HTM 02-01.
- Overview of an MGPS.
- MGPS plant and system theory.
- Medical gases identification and safety.
- The PTW system, system interruption and contingency planning procedures, permission to work and “Do not use” plugs.
- MGPS daily and weekly checks.
- MGPS testing following repair and replacement of terminal units.
- Responding to routine plant-monitoring system indications and basic fault-finding.
- Emergency procedures.

8.49 Practical elements:

- Complete PTWs and RAMS for terminal unit repairs.
- Repair and replace second-fix terminal units.
- Specify and perform verification testing for repairs to terminal units.
- Perform checks on plantroom and source equipment.
- Set up backfeed kits.

Course content group 2

8.50 Theory elements:

- HTM 02-01.
- Overview of an MGPS (DAVS or ambulance PMG)
- Medical gases identification and safety.
- MGPS maintenance requirements and fault-finding:
  - liquid oxygen systems
  - manifold systems
  - air and vacuum systems
  - AGSS installations
  - terminal units, hoses, pendants and valves
  - medical gas alarms.
- Testing of an MGPS.
- The PTW system, system interruption and contingency planning procedures, permission to work and “Do not use” plugs.
- Understanding method statements, health and safety statements and policies.
- Emergency procedures.

8.51 Practical elements:

- Carry out critical assessments of MGPS elements.
- Complete PTWs and RAMS for a maintenance scenario.
- Specify and perform maintenance testing for a range of MGPS maintenance and repair scenarios.
- Repair and replace second-fix terminals.
- Specify and perform verification testing for repairs to terminal units.
- Perform fault-finding on a range of MGPS elements.
- Perform checks on plantroom and source equipment.
- Set up backfeed kits.

Course content group 3

8.52 Theory elements:

- HTM 02-01.
- Overview of an MGPS.
- Medical gases identification and safety.
- MGPS installation principles, practices and commissioning requirements:
  - liquid oxygen systems
  - manifold systems
  - air and vacuum systems
  - AGSS installations
  - terminal units, hoses, pendants and valves
  - medical gas alarms
  - MGPS pipeline design requirements.
- The MGPS PTW system, system interruption and contingency planning procedures, permission to work and “Do not use” plugs.
- Pipe jointing procedures and safety.
- Preparation of method statements, health and safety statements and policies.
- Reading and revising pipeline drawings.

8.53 Practical elements:

- Carry out critical assessments of MGPS elements.
- Complete PTWs and RAMS for an installation scenario.
- Specify and perform verification testing for a range of MGPS installation scenarios.
- Perform practical jointing of MGPS pipework.
- Check and mark up changes to installation drawings.
- Set up backfeed kits.

Competent Person learning outcomes

8.54 The ability to:

- sign the MGPS PTW and acknowledge responsibility for the work
- justify why “Do not use” plugs need to be fitted in an active ward that is to be isolated
- obtain and understand instructions on work to be done
- carry out the work in accordance with this HTM, including the final connection, under direct supervision of the Authorised Person (MGPS)
- carry out the system tests outlined in this HTM on completed work, with the appropriate calibrated test equipment
- sign PTWs, declaring that the work is completed as indicated on the PTW
- work with due care for personal and others’ safety.

8.55 Practical compliance assessments should be documented for assessment by the training provider and theory knowledge should be assessed using a mixture of documented assignments and a final written examination.

Quality Controller (MGPS)

Course content

- Medical gas production and quality control, chemical and physical properties, and safety requirements.
- Medical gas systems – pipework and plant structure and basic principles of operation (including alarm systems and reserve supplies).
- The PTW system and the role of the Quality Controller (MGPS).
- Principles and procedures of MGPS QC testing, including test equipment application and calibration (this should

include practical use of equipment and live system testing).

- Problem systems and coping with emergencies.
- Record-keeping.
- Legal requirements and regulations (for example, Health & Safety at Work etc. Act 1974 and COSHH).
- Cylinder management.

Quality Controller learning outcomes

8.56 The ability to:

- describe MGPS structure and components, and the statutory and guidance requirements for its safe, efficient operation and management (for example, COSHH and the Health and Safety at Work etc. Act 1974)
- define the chemical and physical properties of medical gases
- define principles of testing for contaminants (including moisture) in gases and the use of gas-testing analytical equipment, including maintenance and calibration
- maintain and calibrate gas-testing analytical equipment (including "in the field" calibration)
- test a medical gas system to current QC standards and produce a report on the suitability of the system for supplying medical gases
- identify the origins and likely causes of MGPS contamination
- complete relevant sections of an MGPS PTW
- advise on the extent of QC testing pertinent to engineering work on an MGPS
- advise on the safe use and management of medical gases and medical gas cylinders
- keep and analyse records of liquid and compressed gas usage to ensure maximum efficiency of purchase (optional).

Designated Clinical Officer (MGPS)

8.57 In addition to completing the "Clinical staff and staff who use medical gases" training the Designated Clinical Officer should complete the following course.

Course content

8.58 Theory elements:

- MGPS basic principles.
- MGPS roles and responsibilities.
- MGPS equipment requirements, proper use and system capacity considerations before purchase.
- The PTW system, system interruption and contingency planning procedures, permission to work and "Do not use" plugs.
- Emergency situations, including alarm system indications, emergency isolation procedures and fault reporting.
- MGPS local operational policy.
- AGSS installations.

8.59 Practical elements:

- Unplanned emergencies and isolation of AVSUs.
- Complete PTW exercises including temporary supply requirements.
- Local piped system appraisal and cylinder storage.

Designated Clinical Officer learning outcomes

8.60 The ability to:

- cope with and prevent medical gas emergencies by:
  - distinguishing between “normal” and “fault” medical gas alarm indications
  - coping with damage to terminal units and serious gas leaks
  - using an AVSU for emergency isolation of a medical gas supply
  - reacting correctly in the event of a fire
  - reacting correctly in the event of total electricity supply failure
  - reacting correctly in the event of total or partial gas supply failure
  - identifying a contaminated gas supply
- plan effective remedial actions to deal with shutdown or failure of medical gas systems to maintain patient safety
- give permission to isolate a medical gas system in accordance with the MGPS PTW system and the application of “Do not use” plugs
- accept an MGPS back into service following maintenance, repair or modification by correct use of the MGPS PTW system
- use and maintain effectively an active AGSS in an operating environment
- identify fault conditions on an active AGSS and take appropriate remedial action to ensure operating staff and patient safety.

Clinical staff and staff who use medical gases

Course content

- MGPS, cylinder safety and hazards.
- Colour and labelling identification of gases.
- Operation of cylinders.
- Safe storage and handling.
- Practical session (preparation of cylinders for use).
- Fault reporting.
- MGPS basic principles.
- Warning alarm actions and isolation valves.
- Gas conservation.
- The safe use of pipeline-connected equipment and “Do not use” plugs.
- Why a PTW system is in place.

Learning outcomes

8.61 The ability to:

- define a medical gas, especially in the context of its role as a medicine
- list medical gases in common use
- describe the dangers of medical gases and take appropriate precautions to ensure patient and staff safety during their use
- identify a range of medical gas cylinders by size, valve type and colour-coding
- handle, move and, where relevant, store medical gas cylinders safely
- prepare a medical gas cylinder for use, connect it to a piece of medical equipment and, when empty, take the cylinder out of use, with due regard to any relevant local labelling requirements

- identify a faulty cylinder and take appropriate action
- identify medical gas pipeline terminal units and flexible, colour-coded hoses, when to use “Do not use” plugs and what they are used for
- use terminal units safely and carefully, their probes and flexible hose assemblies
- prevent the pollution of piped medical vacuum systems
- distinguish between “normal” and “fault” medical gas alarm indications
- use and effectively maintain an active AGSS in an operating environment.

Medical Gas Porter (MGPS)

8.62 Medical Gas Porters may perform various roles on site covering some or all the activities performed. Course content should be adapted for the activities they are responsible for.

Course content

8.63 Theory elements:

- Hazards of compressed and cryogenic gases.
- Cylinder colours and labelling.
- Operation of cylinders.
- Actions on finding defective cylinders.
- Receipt of, safe storage and handling of cylinders.
- Preparation of cylinders for use.
- Selection of appropriate equipment and its connection and disconnection to/from cylinders respectively.
- A general introduction to piped medical gas systems and safety including warnings on pressure, use of isolating valves and fire precautions:
  - a general introduction to plant that portering staff may be involved with when changing cylinders, that is, cryogenic plant, compressed- air systems and general medical gas manifolds
  - operation of emergency reserve supplies to medical gas systems
  - alarm systems, and actions to be taken on alarm initiation
  - why a PTW system is in place and the prevention of unauthorised work on the medical gas system
  - an overview of pipeline-connected equipment
  - emergency backfeed kit monitoring.

8.64 Practical elements:

- Preparation and connection of a cylinder for use.
- Changing cylinders on equipment.
- Changing cylinders on manifolds.

Medical Gas Porter learning outcomes

8.65 The ability to:

- list the properties and hazards of a range of medical and pathology gases
- identify a range of medical gas cylinders by colour code, size and other labelling, and select cylinders in accordance with the needs of clinical/medical/engineering staff
- identify and describe the major components of pressurised gas systems and, in particular, a hospital MGPS
- handle and transport pressurised gas cylinders safely
- identify a range of patient-connected equipment requiring pipeline and/or cylinder supplies of gas

- connect and disconnect safely pressurised gas cylinders from manifolds and user equipment
- respond to pressurised system alarms, hazards and emergencies, and observe local reporting procedures
- replenish and operate (where required) emergency reserve supply systems or backfeed kits in accordance with local directives.

Training of project managers, consulting engineers, design engineers and contract supervising officers

8.66 Medical gas systems are specialised services requiring considerable expertise in design, installation, validation and verification, if expensive and potentially dangerous situations, project delays and non-compliances are to be avoided.

8.67 All personnel involved in MGPS activities – including the project management of MGPS systems, validation, system sign-off, commissioning and design (or specifying design intent) – should have completed specialist training appropriate to their role.

8.68 The Authorised Person (MGPS) comprehensive course should be sufficient for most roles and activities, including those involving design intent.

8.69 Where undertaking the design of an MGPS, personnel should have completed a specialist MGPS design course and hold adequate insurance appropriate to this activity.

Designated Persons and Senior Operational Managers

8.70 Designated Persons or Senior Operational Managers who have not attended an Authorised Person course or refresher should attend a Medical Gases for Healthcare Managers course.

Course content:

- The importance of medical gas safe systems of use.
- Medical gases for healthcare managers.
- HTM 02-01 overview, and roles and responsibilities.
- Medical gas source equipment and reserve supplies overview.
- MGPS walkthrough.
- The PTW system.
- Understanding previous failures.
- Medical gas training and competency, reducing risk, improving efficiency and promoting best practice.
- Quality and risk management issues.

Chief Pharmacist and pharmacy service managers

8.71 The Chief Pharmacist and pharmacy service managers should attend a Medical Gases for Service Managers course.

Course content:

- The importance of medical gases.
- HTM 02-01 overview, roles and responsibilities, training and the PTW system.
- Medical gases for pharmacy service managers.
- MGPS walkthrough.

- Medical gas source equipment and reserve supplies overview.
- Understanding previous failures.
- Medical gas training and competency, reducing risk, improving efficiency and promoting best practice.
- Quality and risk management issues.

Requirements for appointment of Authorising Engineers (MGPS), Authorised Persons (MGPS) and Competent Persons (MGPS)

Authorising Engineer (MGPS)

8.72 Being an Authorising Engineer for one discipline does not automatically qualify someone to be an Authorising Engineer for MGPS. An Authorising Engineer (MGPS) should:

- be either a chartered engineer in an appropriate engineering discipline; or have sufficient engineering and pharmaceutical knowledge and be qualified to the level equivalent to incorporated engineer
- have ten years' demonstrable experience specific to MGPS, to include the following:
  - MGPS equipment and systems configuration
  - the design of MGPS systems
  - flow/pressure-drop calculations and plant sizing
  - critical reviews of MGPS systems
  - the installation, testing and commissioning of MGPS
  - previous Competent Person (MGPS) experience or training
  - providing Authorised Person (MGPS) duties
  - the ability to use and interpret drawings and drawing systems
  - Competent Person/Authorised Person assessments
  - understanding the structure of healthcare premises
  - critical report writing.

8.73 The Authorising Engineer (MGPS) should:

- attend an accredited Authorising Engineer training course specific to the needs of the role
- attend an accredited Authorised Person (MGPS) course or provide equivalent experience within the three years before applying for appointment as an Authorising Engineer (MGPS)
- produce signed evidence of familiarisation with the MGPS for which they will assume responsibility
- provide documentary evidence of formal qualifications and experience including records of continuing professional development (CPD) attendance
- by means of a formal interview, satisfy the appointing body of their ability to perform the role safely, conscientiously and effectively.

Authorised Person (MGPS)

8.74 The Authorised Person should:

- be qualified to the level of Higher National Certificate in an electrical or mechanical engineering discipline
- possess a minimum of three years' relevant professional experience in the following:
  - previous Competent Person (MGPS) experience or training

  - MGPS equipment and systems configuration
  - shadowing Authorised Person (MGPS) duties
  - the ability to use and interpret drawings and drawing systems
  - understanding the structure of healthcare premises
  - holding a role within the healthcare premises with the authority to manage internal or external Competent Persons and issue instruction for work to be completed.

8.75 The Authorised Person (MGPS) should:

- attend an accredited Authorised Person (MGPS) course within the three years before applying for appointment
- possess an adequate knowledge of health and safety aspects of MGPS plant and components, this HTM, and other guidance and rules and regulations that are applicable to the systems and installations for which the appointment is sought
- be technically competent to carry out routine and emergency operating procedures, being able to act in an emergency to make plant and systems safe and provide alternative supplies
- provide documentary evidence of formal qualifications and experience, including records of CPD attendance
- by means of a formal interview, satisfy the Authorising Engineer (MGPS) of their familiarisation with the MGPS for which they will assume responsibility and their ability to perform the role safely, conscientiously and effectively
- have adequate knowledge of, and within the last three years, have successfully completed a course in emergency first-aid training
- be independent from the external contractor providing Competent Persons (MGPS).

Directly employed Competent Person (MGPS)

8.76 The Competent Person (MGPS) should:

- have completed relevant modules of the Advanced Modern Apprenticeship Scheme or possess recognised formal electrical/mechanical qualifications (for example, City & Guilds)
- possess a minimum of three years' relevant experience.

8.77 The Competent Person (MGPS) should also:

- have attended an accredited Competent Person (MGPS) course within the three years before applying for appointment as a Competent Person (MGPS)
- by means of a formal interview, have satisfied the appointing Authorised Person (MGPS) of their familiarisation with the MGPS on which they will work and their ability to perform the role safely, conscientiously and effectively.

Contractor's Competent Person (MGPS)

8.78 The Competent Person (MGPS) should:

- have completed relevant modules of the Advanced Modern Apprenticeship Scheme or possess a recognised formal electrical/mechanical qualifications (for example, City & Guilds)
- possess a minimum of three years' relevant experience in the following:
  - previous Competent Person MGPS experience working under the direction of an appointed Competent Person (MGPS)

  - MGPS equipment and systems configuration
  - have completed PTW and documentation for the group level they are to assume
  - understanding the structure of healthcare premises.

8.79 The Competent Person (MGPS) should also:

- attend an accredited Competent Person (MGPS) course within the three years before applying for appointment as a Competent Person (MGPS)
- by means of a formal interview, satisfy the appointing company manager of their familiarisation with the MGPS on which they will work and their ability to perform the role safely, conscientiously and effectively
- provide training and appointment details to the Authorised Person (MGPS) responsible for the MGPS at the healthcare premises on which they intend to work.

Requirements for appointment of Quality Controllers (MGPS)

8.80 Only individuals who have been appointed to the Quality Controller (MGPS) register may act as Quality Controller (MGPS).

8.81 Inclusion on the register will normally be sufficient to qualify an individual to act as Quality Controller (MGPS) for any healthcare organisation. However, the healthcare organisation's Chief Pharmacist may exercise the option to specify, or otherwise limit, those registered as Quality Controllers (MGPS) who may operate on their site.

8.82 The Quality Controller (MGPS) should:

- be a graduate (degree in relevant science subject) who is eligible for membership of the Royal College of Pharmacy, the Royal Society of Chemistry (RSC) or Royal Society of Biology (RSB) or
- have successfully completed an approved course, with the Master of Science (MSc) in Pharmaceutical Technology and Quality Assurance recognised as an approved course for this purpose
- have successfully completed an accredited training course for QC testing of medical gases and piped medical gas systems
- have had extensive practical experience of QC testing of medical gases and piped medical gas systems
- be familiar with the requirements of this HTM
- undertake regular CPD in medical gases and MGPS. This would normally involve attending a refresher course at least every five years.

8.83 The Quality Controller (MGPS) should:

- possess an adequate knowledge of health and safety aspects of MGPS plant and components, this HTM, and other guidance and rules and regulations that are applicable to the systems and installations for which the appointment is sought
- by means of a formal interview, satisfy the Chief Pharmacist (MGPS) of their familiarisation with the MGPS for which they will assume responsibility and their ability to perform the role safely, conscientiously and effectively.

Requirements for appointment of Designated Clinical Officers (MGPS)

8.84 Following successful completion of a Designated Clinical Officer training course, the MGSG should approve the appointment of Designated Clinical Officers for inclusion on the site list. The MGSG has the authority to remove a Designated Clinical Officer from that list if they cannot or do not demonstrate sufficient knowledge of the MGPS during governance monitoring.

8.85 It is recommended that such appointments are discussed with the MGSG to arrive at a structure which is workable in routine and emergency situations.

8.86 Persons nominated to these roles should receive training in accordance with this HTM and attend refresher training at regular intervals.

Requirements for appointment of Medical Gas Porters (MGPS)

Medical Gas Porter (MGPS)

8.87 The Medical Gas Porter (MGPS) should:

- have had practical experience of the handling and storage of medical gas cylinders under supervision
- be familiar with the requirements of safe storage of medical cylinders
- have successfully completed a training course for medical gas safety for the role they are to undertake
- possess an adequate knowledge of health and safety aspects of MGPS
- by means of a formal interview, satisfy the portering manager of their familiarisation with the area of cylinder safety, handling and connection and their ability to perform the role safely, conscientiously and effectively.

Independence of roles

8.88 It is feasible that any one person could be suitably qualified and experienced to act in two or more of the above roles. However, in the interests of patient safety, it is essential that independence of functional responsibilities is maintained. For example, it is not acceptable that a person acting as a Quality Controller (MGPS) also acts as Authorised Person (MGPS) and/or Competent Person (MGPS) for the same job.

8.89 An Authorised Person (MGPS) engaged as a contractor should not oversee or sign off work carried out by a Competent Person from the same organisation, nor should they undertake conditional surveys that may lead to additional commercial work. This does not preclude a contracted Competent Person, as part of routine PPM activities, from identifying and reporting any required remedial works to the healthcare organisation or an independent Authorised Person.

8.90 Commercial and financial interests should not be permitted to compromise the independence of these roles.

Communications

8.91 All staff who are involved in the use, installation or maintenance of MGPS and cylinders should be aware of the MGPS OP and their specific responsibilities defined within it.

8.92 The MGPS OP should set out the means of communication between the various key personnel. It should, for example, define those departments that need to be informed of work on the MGPS, the personnel to be notified and whether such information is to be verbal or in writing.

8.93 Records of responsible personnel and communication links within the MGPS OP should be kept up to date. The person responsible for the annual policy review should ensure that such information is communicated to all relevant personnel as soon as practicable.

9 Cylinder management

Introduction

9.1 Medical gases are medicines and, as such, it is recommended that, regardless of operational infrastructure, the Chief Pharmacist should take an active role in the management of medical gas cylinders. In facilities where there is more than one healthcare organisation, the operational policy should detail who is responsible for ordering and managing cylinders.

9.2 It is essential that risk assessments are carried out as part of the cylinder management process along with comprehensive annual auditing of the cylinders, storage, signage and usage.

9.3 Only trained and certificated personal should be involved with pressurised cylinders and medical gases. Dependent on the required levels of involvement, guidance on appropriate training is given in Chapter 8.

9.4 Safe cylinder management is important for the following reasons:

- It is particularly important that documentation needed to establish conformity of identity and quality with the relevant monographs of the British Pharmacopoeia is retained for possible inspection.
- Stock control issues are important in
  - maintaining adequacy and continuity of supply
  - preventing theft
  - preventing cylinder storage issues which may give rise to health and safety risks.

Classification of gases by physical type

Permanent gases

9.5 These are gases that remain in the gaseous state in the cylinders at normal temperatures. The volume of the contents of the cylinder is directly related to the pressure of the gas; for example, at a quarter of the filled pressure, the cylinder is a quarter full. Such gases include oxygen and medical air.

Liquefiable gases

9.6 These are gases that are supplied as a liquid at normal temperatures (for example, nitrous oxide and carbon dioxide) or gases supplied as a liquid at a cryogenic temperature, that is, below –40°C (for example, liquid nitrogen and liquid oxygen).

9.7 The pressure of the gas remains constant as the liquid is vaporised and only falls (often dramatically) when the cylinder is nearly empty.

9.8 Accurate measurement of cylinder contents is possible only by weighing the whole cylinder and deducting from it the tare weight of the cylinder (usually stamped on the cylinder shoulder).

Classification of gas cylinders

9.9 In this document, gas cylinders are classified into two main categories – medical and non-medical. Cylinders from these two categories must never be mixed, either in storage or in use.

9.10 Gas cylinders are subdivided into groups, depending on the risk associated with the cylinder contents as follows:

- group 1 – flammable
- group 2 – oxidising
- group 3 – toxic or corrosive (the contents may also be flammable or oxidising)
- group 4 – others (including inert gases).

9.11 The most common gases, grouped as above, likely to be used in health buildings are shown in Table 4.

Labelling/marking of cylinders

9.12 Cylinders should be colour-coded and marked in accordance with BS EN ISO 407, the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2004, and European Directive 2004/27/EC. Each cylinder should have:

- a batch label to include a unique batch number, filling branch code, cylinder code and product, filling date and expiry date
- a product identification label which includes:
  - the product licence number or certificate of conformity
  - the name and chemical symbol of the gas or gas mixture contained in the cylinder. Additionally, in the case of gas mixtures, the proportion of constituent gases should be shown
  - a hazard warning sign
  - a substance identification number
  - specific product and cylinder handling precautions
  - particular instructions to the user where necessary
  - safety information
  - a serial number
  - test mark, year and quarter of test.

9.13 Cylinders, pressure-reducing regulators and pressure gauges should be conspicuously marked “use no oil, grease or hand creams” or with the appropriate symbol.

9.14 Cylinder yokes, screwed connectors, pressure-reducing regulators and pressure gauges should be clearly and indelibly marked with the designation of the gas or gas mixture for which they are intended. BS EN ISO 407 may be used as guidance.

9.15 Pressure gauges should be in accordance with BS EN 837-1, with the appropriate standard for the particular type of medical equipment.

Cylinder colour codes

9.16 Cylinder colours may change in line with regulatory updates; however, the colour of the cylinder shoulder remains constant either as a solid colour or a quartered multi-colour section.

9.17 Refer to cylinder suppliers for the latest up-to-date charts. These are available online or directly from suppliers.

Cylinder sizing and naming

9.18 Types of cylinders and sizes are regularly introduced, and special care should be taken when ordering or using cylinders to ensure that they are compatible with the equipment

Group classification of gas cylinder contents	Medical gases	Non-medical gases
1 Flammable (red diamond on label)		• Acetylene • LPG (for example, propane, butane) • STG (synthetic town gas) • Methane • Natural gas • Hydrogen
2 Oxidising and/or supports combustion (yellow diamond on label)	• Oxygen • Nitrous oxide • Oxygen/nitrous oxide • Oxygen/carbon dioxide • Oxygen/helium mixtures	• Oxygen • Nitrous oxide • Oxygen/nitrous oxide mixtures
3 Toxic and corrosive:		
3.1 Toxic and/or corrosive and flammable		• Ammonia • Ethylene oxide (C_2H_4O) • Carbon monoxide • Ethylene oxide/carbon dioxide mixtures >6% C_2H_4O
3.2 Toxic and/or corrosive and oxidising		• Nitric oxide mixtures • Sulfur dioxide • Chlorine
3.3 Toxic and/or corrosive only		• Ethylene oxide/halocarbon mixtures <15% C_2H_4O (certain conditions only) • Ethylene oxide/carbon dioxide mixtures <6% C_2H_4O
4 Others including inert, but excluding toxic or corrosive (green diamond on label)	• Carbon dioxide • Helium • Medical • Nitric oxide 1000 vpm (volume parts per million) in nitrogen	• Compressed air • Carbon dioxide • Nitrogen • Argon • Helium • Halocarbon • Refrigerants

Table 4 Classification of a sample of gas cylinders identified in healthcare facilities

they are to be connected to or for the purposes of the use.

9.19 A full list of cylinders is available from suppliers.

9.20 An annual overview of the current cylinders in use and the availability of alternative cylinders should be undertaken to ensure the most appropriate cylinder size and type are in use.

9.21 The overview required input from the MGSG including pharmacy, engineering and clinical input.

Medical gas cylinder valve types

9.22 There are five valves:

- bull-nose valve 5/8-inch British Standard pipe (BSP) (F) BS 341 No. 3
- hand-wheel 11/16-inch x 20 threads per inch (TPI) (M) BS 341 No.13
- valve with integrated pressure regulator (VIPR)
- pin-indexed BS EN ISO 407 valve
- BS ISO 5145 series valve.

9.23 Bull-nose valves are used on larger cylinders: for example, F, G and J. Gas connection is made between the spherical end (bull nose) of the pipeline or regulator and the conical seat of the valve outlet. The seal is either by direct metal-to-metal contact between the bull nose and cone or by an O-ring on the bull nose.

9.24 Some bull-nose-type connections are gas-specific; however, older F and G cylinders for different gases are interchangeable. Therefore, due to the risks of confusion, common bull-nose cylinders should not be used at the bedside.

9.25 Where commercially available, integral valve cylinders should be used to reduce the risk of cross-connections and inadvertent connection to high-pressure sources.

9.26 G-size cylinders and above are not to be used in patient areas.

9.27 The hand-wheel valve is used on F, G and J sizes of medical nitrous oxide, VF and LF sizes of carbon dioxide, and many pathology and industrial gas cylinders. A flat sealing washer (a Bodok seal) fits between the cylinder connector and valve. The cylinder is usually provided with a metal valve-protection guard, and the gas outlets are fitted with a plastic or metal blanking cap. Plastic caps should be discarded before use, but metal screw-on valve covers should be retained and replaced before the empty cylinder is returned to the supplier. If fitted, the valve guard should not be removed.

9.28 The VIPR valve combines a regulator and valve as a single unit. These are similar in construction to integral cylinders which are fitted with a combined regulator and flow control device. They are operated by a single hand-wheel and incorporate gas-specific probe connections and a built-in click-stop flowmeter with a fir-tree outlet connector, providing a range of output flow rates.

9.29 Some VIPR-valved cylinders will require hand-wheel operation to open the cylinder before the click-stop flowmeter can be used, while some will utilise the click-stop flowmeter, which will also open the cylinder. It is important that staff are trained to understand the difference.

9.30 Pin-index valves (with a top spindle or knurled knob) are fitted to all E-size and smaller cylinders, and to F- and G-size oxygen/nitrous oxide mixture cylinders. If the knurled-knob version of the pin-index valve is fitted to smaller sizes of nitrous oxide cylinders, it should not be used to carry the cylinder, as it is possible for the valve to be opened accidentally. This could result in the discharge of high-pressure gas into the hand;

as the gas expands and cools, this may cause frostbite.

9.31 Pin-index valves with a side spindle (J-size oxygen and medical air for manifolds) should be operated with the correct key.

Cylinder safety – main principles

9.32 The main hazards associated with gas cylinders are:

- inappropriate storage, handling, dropping or impact which can cause physical or personal injury. These hazards should be minimised:
  - by the correct design, siting and construction of cylinder storage areas
  - by the provision of suitable storage and handling equipment and
  - by the adoption of safe operating practices
- leakage of gas where the cylinder contents may be flammable, oxidising, asphyxiant, anaesthetic, toxic or a combination of these characteristics. In the event of leakage, gas may collect in a confined space and cause or contribute to a fire, explosion or health hazard.

Cylinder storage

9.33 This section is concerned with the operational aspects of medical gas cylinders, including storage and general safety, and applies also to the storage of pathology and industrial cylinders. Attempts should be made to reduce manual handling of cylinders and excessive levels of storage.

9.34 Existing storage facilities should be risk-assessed for compliance to this HTM.

9.35 The decanting and filling of medical gas cylinders is subject to the Pressure Systems Safety Regulations 2000 and the Health and Safety at Work etc. Act 1974 and should not be carried out on a healthcare site.

9.36 The management of cylinder storage should be documented, and the number, size and location of the required cylinders within these stores should be audited and clearly documented under the medical gas policy document.

9.37 The Authorised Person (MGPS) with the Authorising Engineer (MGPS) in partnership with the pharmacy department should review the supplies every two years.

9.38 An annual audit of all tertiary supplies (medical gas cylinders and electric suction), cylinder brackets on all transport trolleys, wheelchairs and ward cylinder parking locations should be completed and documented and submitted to the MGSG on an annual basis.

9.39 All tertiary supplies should be agreed via a risk assessment process with clinical staff, the Chief Pharmacist, the Authorised Person (MGPS) and the Authorising Engineer (MGPS) and be presented to the MGSG for sign off.

Cylinders stores (main and satellite stores)

9.40 Guidance on the construction and use of these stores is given in Part A, and this should be applied to all other storage areas where possible.

9.41 Stockpiling should be avoided at all times; six monthly auditing of these stores should highlight any changes.

9.42 The volumes of cylinders to be held in these stores should be risk-assessed and this should be included within any medical gas policy documentation.

9.43 These stores should have adequate segregation for full and empty cylinders.

9.44 Combustible materials should not be kept within the store.

9.45 Cylinders should be individually secured when they are stored in racks.

9.46 Sufficient space should be provided for manoeuvring cylinders on and off trolleys. Adequate means of securing all cylinders should be provided to prevent falling.

Main stores

9.47 Main stores are where most cylinders are stored to ensure efficient cylinder management and emergency distribution.

9.48 This store should be on the ground floor with external access for return and delivery of cylinders.

9.49 The main store is used to replenish the satellite stores, manifold rooms and local cylinder parking areas.

Satellite stores

9.50 In some areas, it will be essential to hold a small number of spare cylinders for immediate use for connection to anaesthetic machines, ventilators and resuscitation equipment and to meet sudden, unanticipated demand.

9.51 Such areas include operating departments, emergency departments, coronary care units, central delivery suites of maternity departments, special care baby units and critical care areas.

9.52 A procedure should be in place to ensure all empty cylinders are returned to the main cylinder store daily.

9.53 Attempts should be made to reduce the number of cylinders within the department for the essential cylinders only.

9.54 The number of cylinders held should be kept to a minimum. Under normal circumstances, a 24-hour supply should be sufficient; however, for gas mixtures, this should be increased to 48 hours to provide a safety margin where cylinders may be affected by low-temperature separation. This period may have to be extended for weekends, bank holidays and other operational requirements.

9.55 These cylinders should be kept in a specially designated room. This should comply with the requirements in Part A. The room should be clearly labelled with the types of cylinder contained and “no smoking” and warning signs.

9.56 Cylinders connected to regulators may be returned to these stores, checked for leaks and reused as required until the cylinder is deemed empty. When empty, the cylinder valve should be closed and the regulator contents vented before disconnecting it from the cylinder.

9.57 A good stock of cylinder keys should be kept in or near the store.

Local storage (cylinder parking area)

9.58 In some circumstances, small storage areas may be established within a of ward or department corridors. These usually consist of a cylinder cradle system and a “cylinder parking” notice identifying the safety aspects and signifying the location of the cylinders.

9.59 These should be positioned so that clinical staff can oversee the area, as the cylinders are vulnerable to mechanical damage and tampering. Efforts should be made to provide appropriate safe storage and reduce the risks of collision.

9.60 Cylinders of medical air/oxygen mounted on trolleys or secured in cylinder cradles are used as emergency gas supplies in ward areas. Designated parking areas should be sought for these trolleys, and the area should be provided with signage to indicate its purpose. All staff should be made aware of the location and function of these cylinders.

Manifold rooms

9.61 Manifold rooms should not be used as general cylinder storage areas.

9.62 Only cylinders of the gases required for connection to the manifold should be kept in the manifold room. The manifold room should not be used for any other purpose.

9.63 All manifolds may be sited together in the same manifold room. It is therefore essential that cylinders of different gases stored within this room are segregated to ensure the efficient changeover of manifold cylinders.

9.64 The number of cylinders in manifold rooms should be restricted to the minimum required for operational and reserve purposes. This will include cylinders connected to the manifold(s) and a sufficient reserve to replenish one complete bank.

9.65 With regard to manifolds for oxygen/nitrous oxide mixtures, sufficient cylinders to replace two complete banks should be stored; however this should be based on a risk assessment of stock levels and duration of back changes to delivery schedules.

Exceptions

9.66 In small hospitals, dental units and other small sites, in the absence of a dedicated cylinder storeroom, small cylinders of all medical gas types may be stored in medical gas manifold rooms. Typically, these will be where fewer than ten cylinders are to be stored. These should be clearly segregated from the manifold, have sufficient space within the room, have suitable racking and, if required, have a locked partition to ensure general cylinder access does not give access to the manifold.

9.67 In such cases, the Authorised Person (MGPS) and Authorising Engineer (MGPS) should complete a risk assessment to validate the storage of such cylinders in the manifold room.

9.68 Care should be taken to ensure that different gas types and full and empty cylinders are segregated as clearly as possible and provided with a labelling system that clearly indicates the cylinder status.

9.69 The Authorised Person (MGPS) and Chief Pharmacist should ensure that appropriate training is being carried out on an ongoing basis (see Chapter 8).

9.70 The manifold room may be used for essential storage of oxygen/nitrous oxide mixture cylinders (on trolleys) to permit temperature equilibration before use with directly connected equipment.

Fire protection

9.71 All cylinder stores should be free from naked flames and all sources of ignition and should be designated “no smoking” areas.

9.72 Appropriate fire-fighting equipment should be provided either within the store or at a convenient (with signage) location nearby. The fire and rescue service should be notified of the location of the stores and any emergency access keys.

9.73 General fire precautions applicable to MGPS are given in Chapter 10.

9.74 In healthcare facilities with an automatic fire detection system, medical gas cylinder stores should be provided with smoke and heat detectors, in accordance with the healthcare organisation’s policy.

9.75 Where areas are identified as being at risk of ignition due to flammable gas or vapour mixed with air under normal atmospheric conditions, refer to BS EN 60079-10-1. This standard covers the classification of hazardous areas where flammable gas or vapour risk may arise. It also gives details about the protective measures that need to be applied to reduce the risk of explosions. The standard sets out the essential criteria against which the risk of ignition can be assessed. It also gives guidance on the design and control

parameters that can be used to reduce such a risk.

9.76 On a hospital site, BS EN 60079-10-1 supports the Dangerous Substances and Explosive Atmospheres Regulations 2002.

9.77 In medical gas stores containing oxygen, nitrous oxide, oxygen/nitrous oxide mixtures, medical air, medical carbon dioxide, helium/oxygen mixtures and oxygen/carbon dioxide mixtures, electrical installations do not require gas-tight fittings. However, to ensure mechanical and environmental protection, electrical installations should be completed in suitable cables, with suitable gland fittings.

9.78 Some medical gas mixtures (for example, lung function mixtures) may contain flammable agents, indicated by a red band on the cylinder shoulder. If these mixtures are stored with non-flammable medical gases in a well-ventilated store, the safety wiring techniques will still apply.

9.79 For all other flammable gases and gas mixtures (for example, pathology and industrial gases and stores combining a medical and industrial or medical and pathology function), the degree of protection of the electrical system against gas ingress should be determined by a specialist risk assessment.

Segregation of gases/cylinders

9.80 Cylinder stores for medical gases should only contain medical gas cylinders.

9.81 Industrial and pathology gases cylinders should be stored in a separate, appropriately designated store.

9.82 Separate, clearly identified bays and racking should be provided for full and empty cylinders.

9.83 Separate areas for different gases should be provided, but a physical barrier is not required unless identified as necessary by risk assessment.

Cylinder restraint

9.84 Adequate means of securing large cylinders should be provided to prevent falling. See Chapter 17 in part A.

9.85 Smaller cylinders should be stored horizontally on metal racks, suitably protected to prevent damage to cylinder paintwork or injury from overhanging cylinder valves.

9.86 Trolleys carrying cylinders may be stored in the area for immediate use, but care should be taken to ensure that cylinders are suitably restrained to the trolleys and that these do not impede access to the stored cylinders.

Personal protective equipment

9.87 Personal protective equipment and clothing should be provided and used. Any loss or damage should be reported immediately.

9.88 Protective clothing requirements should be determined by risk assessment based on the activity, size, type and environment the cylinder is to be handled or used in.

9.89 Protective boots and shoes should be clean and free from oil, grease and hand creams.

9.90 No loose clothing should be worn.

9.91 Appropriate, well-fitting safety gloves may be worn, provided they do not compromise the secure handling of the cylinder. Hands should be free from oil or grease before handling cylinders.

9.92 Additional precautions are required for handling cryogenic gases.

Store temperature

9.93 Stores are intended to be well-ventilated and therefore may not offer the degree of protection needed to prevent the separation at low temperatures of an oxygen/nitrous oxide mixture into its components. It is important that

cylinders of this gas mixture are kept above 10°C for 24 hours before use, and arrangements should be in place to ensure that cylinders of this gas mixture collected from a cold store are not used immediately for patient treatment. For cylinder stores formed as part of the building suitable heating may be provided similar to that of a manifold room.

9.94 A hazardous situation could arise if cylinders are subjected to extremes of temperature. Cylinders should be kept away from sources of heat, including steam pipes and hot, sunny positions.

Cleanliness

9.95 The store must be kept clean, dry and free from flammable material. Rubbish and chemicals must not be stored with the cylinders. The area should be swept regularly and, where necessary, weeds removed from the immediate vicinity. Flammable weedkillers should not be used.

Signage

9.96 Appropriate safety signage should be provided in all cylinder stores in accordance with Chapter 18 in Part A.

Handling of cylinders

9.97 Cylinders can be heavy (for example, an empty J-size steel cylinder weighs approximately 70 kg) and bulky. A risk assessment should be carried out that considers all cylinder sizes, weights and personnel capability.

9.98 Cylinders should be handled with care only by personnel who have been trained and are certificated in cylinder handling and who understand the potential hazards.

9.99 All cylinders should be transported in the correct trolleys. Trolleys should not be overloaded or used incorrectly, as this may create unnecessary risk.

9.100 Cylinders should not be dropped, knocked, rolled or allowed to strike each other violently.

9.101 Cylinders and valves should be kept free from oil, grease and other debris.

9.102 Oil and grease in the presence of high-pressure oxygen and nitrous oxide are liable to combustion and should not be used as a lubricant on any gas cylinder or equipment. In particular, cylinder valves, couplings, regulators, tools, hands and clothing should be kept free from these substances.

9.103 Cylinders should not be marked with chalk, crayon, paint, adhesive tape or other materials. A tie-on label indicating the cylinder contents may be attached to the cylinder.

9.104 Smoking and naked flames should be prohibited in the vicinity of all cylinders.

9.105 Cylinders should always be individually secured during transportation and in use.

9.106 Safety devices, including pressure-relief devices, valves and connectors should not be altered or bypassed.

9.107 Repairs, alterations or modifications should not be undertaken.

9.108 Markings used for identifying cylinder contents, the pressure-testing of cylinders and tare weights should not be defaced or removed. This also applies specifically to the cylinder's product labels.

9.109 Cylinders should not be painted or otherwise obscured in a manner that would prevent identification of their contents, and care should be taken to preserve their labels and surface finish.

9.110 Cylinders used for industrial purposes should not be used for medical applications. Similarly, medical gases should not be used for non-medical applications.

9.111 Cylinder valves should not be dismantled or tampered with.

9.112 Leaking cylinders should be removed from service and returned to the gas supplier.

9.113 Cylinder valves should always be closed after use and when cylinders are empty.

Trolleys, trucks and vehicles

9.114 All cylinder trolleys should be listed and included in audit documentation (the annual audit referred to in paragraph 9.41) and should be subject to six-monthly PPM inspections, which should be recorded.

9.115 Rusty, damaged trolleys or those not designed for cylinders should not be used for the storage or transportation of cylinders.

9.116 The correct size trolley, conforming to BS 2718, should be used for transporting cylinders whenever they are moved. Cylinder-supporting surfaces should be kept free from grease, oil, hand creams, and similar substances, and should be used solely for the transport of gas cylinders.

9.117 When transporting multiple small or medium cylinders, a multi-cylinder trolley designed for those sizes should be used. Non-bespoke trolleys should not be used.

9.118 For cylinders exceeding 1400 mm in height, a four-wheeled trolley should be provided.

9.119 All cylinder trolleys should be registered with an asset number and be subject to servicing and maintenance at least annually.

9.120 Precautions should be taken to prevent cylinders falling from trolleys, trucks or vehicles.

9.121 Vehicles transporting gas cylinders and using public roads should, where applicable, be appropriately marked in accordance with the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009.

Unloading equipment

9.122 The hoist or tail-loader used with the delivery vehicle should be as clean as is practicable, and mechanical parts shielded to prevent contamination of cylinders with oil, grease, hand creams, and similar. Transfer of oil, grease and hand creams from the winch to cylinders should be avoided.

9.123 Cylinders should only be lifted using an appropriate lifting cradle specifically designed for the safe handling of medical gas cylinders.

Transportation of cylinders with attached equipment

9.124 In some circumstances it may be necessary to transport cylinders with equipment attached. Unless it is essential for a patient to continue receiving a supply of gas, the cylinder valve should be closed and any gas contained in the equipment or regulator should be safely vented to atmosphere before transporting the cylinder. Where this is not possible, the cylinder and associated equipment should be protected from collision, and the cylinder should be mounted in a bracket attached to the bed and should not be laid with or on the patient. Specially designed cylinder carriers are available for both wheelchair and patient transport trolleys and beds, and these should be used.

9.125 Lung ventilators, oxygen therapy apparatus and other equipment for use with cylinders should be so designed as to render the entire assembly stable during storage, transportation and use. The support of a cylinder by the yoke alone is insufficient for transportation. If castors are used, they should conform to BS 2099.

9.126 Mobile equipment should be suitably buffered to reduce damage to equipment and the fabric of the healthcare facility.

9.127 When supplying a patient, equipment and cylinders should be secured during transportation to prevent injury and interruption of supply.

9.128 For moving large cylinders such as W- and J-size cylinders, trolleys with two front- and two rear-mounted wheels should be used.

Choosing the correct cylinders for the correct purposes

9.129 The selection of the correct cylinder for each situation requires a risk assessment on the purpose of the cylinder and the requirements for use.

9.130 Where possible, when a cylinder is supplied to a ward or department for patient connection, emergency use and transport, integral regulator design cylinders should be used. These may reduce the risks associated with the connection and disconnection of cylinders and are less prone to damage from collision and leakage when compared to cylinders with separate regulators. The PSSR 2000 requirements and regulations are the responsibility of the gas supplier; this also removes the requirements for the servicing of regulators. Benefits include cost and time savings as well as risk reduction and reduced incidents.

9.131 Where cylinders are to be attached to equipment, whether internally in the healthcare facility (such as to ventilators or anaesthetic machines) or externally on manifolds, the correct selection of cylinders is essential. They must be the correct yoke or gas-specific bull-nose fitting and hold the appropriate volume of gas for their intended use.

9.132 To determine cylinder requirements, the required volumes and flow rates should be assessed. From this, the number of cylinders required, the number of spares and the storage locations should be defined, designed, implemented and stocked.

9.133 This provides a safe and secure system with manageable volumes of cylinders which can be audited and controlled to best serve the healthcare facility's requirements.

9.134 All cylinder management decisions should be documented and agreed by the MGSG and form part of the overall medical gas system.

Management of the cylinder stock

9.135 An annual full medical gas cylinder safety audit should be implemented to manage cylinders throughout the site to ensure that cylinder stocks, cylinder security, racking, transportation, cylinder safety signage and expiry dates are all correct. A report should be provided to the MGSG.

9.136 Management of these audits should be the responsibility of the Chief Pharmacist and should be undertaken in partnership with the Authorised Person (MGPS) and portering manager, reflecting their shared responsibility for ordering, use and storage compliance. Effective delivery of these audits requires a strong working relationship between the departments, as defined in the OP.

Stock control and receipt of cylinders into stock

9.137 The objective of stock control and accounting is to ensure that the correct cylinders are received and used, and that unnecessarily large stock holdings are avoided. It is also important to avoid excessive stock holdings of empty cylinders for which rental charges continue to apply which could contribute to unnecessary costs. This may be achieved by requesting a 12-month "usage and dormant" cylinder report from the gas supplier. An annual auditing process should help to ensure an appropriate stock management process is in place and is effective.

Ordering from suppliers

9.138 Written procedures detailing the method of ordering cylinders from licensed suppliers should be made available in the pharmacy department.

9.139 Orders should clearly specify that the gas is for medical purposes. They should also specify the gas required and the cylinder size.

9.140 Ordering and stock-control records should be maintained to suit local requirements. These records, provided by the gas supplier on delivery in either hard copy or electronic format, should include the name of the gas, date of receipt, expiry dates, cylinder sizes, batch numbers and quantity of cylinders received and be retained by the pharmacy department.

9.141 Automatic replenishment systems may be used in conjunction with the gas supplier, provided that an agreed procedure is defined in writing and agreed by the Chief Pharmacist. Usually termed “full for empty”, these deliveries should be goods-receipted at the time of delivery by a representative of the healthcare organisation to ensure:

- the number of empty cylinders taken are replaced with full ones
- cylinders to be returned to reduce stock are taken away and not replaced
- shortages are documented and highlighted to the Chief Pharmacist the next working day
- extra deliveries are checked against previous shortages.

Receipt of cylinders into stock

9.142 Cylinders that do not conform to the following requirements should not be accepted. They should:

- be clean and free from damage
- be the correct size and gas
- have all identification and labels attached, and these should be clear and legible
- have a product identity label and a batch label
- have a tamper-evident seal over the valve outlet.

Issue from stores

9.143 A written procedure should detail the system by which cylinders are requisitioned for use from ward and departments. A record of issues should be kept including:

- gas name
- size of cylinder
- number of cylinders
- ward or department name.

Tracking of the cylinders

9.144 Medical gas cylinder tracking may be implemented using a two-tier system:

a. tracking the cylinders on delivery and return to the supplier and

b. tracking the cylinders within the healthcare facility.

9.145 The MGSG should agree the requirements for each option, taking into account the benefits to the facility and the controls to be implemented by the pharmacy department.

Supplier to healthcare facility to supplier

9.146 All cylinders are assigned unique barcodes and, on delivery, are allocated to a specific healthcare facility by the supplier. Regardless of the location from which the cylinders are returned, they should be

deducted from the original healthcare facility's stock, once returned to the supplier.

9.147 Cylinders should not be transferred between facilities or be taken off site by patients, in order to maintain accurate stock control.

Internal tracking at the healthcare facility

9.148 Several options are available for internal tracking, including paper-based systems, RFID automatic systems and barcode reader handset systems. The MGSG should discuss all options and agree a suitable method for their facility.

9.149 Many medical gas cylinder suppliers use cylinder tracking systems designed to monitor cylinders from delivery to the healthcare facility, through internal distribution, return to stores, and back to the supplier. For these systems to be effective, cylinders should be scanned at each stage of movement and at each location, including delivery to and collection from site, internal transfers between departments and movements to and from cylinders stores. Portering staff equipped with scanning devices should be present during all cylinder movements to ensure accurate and complete recording.

9.150 At the time of writing, cylinders are not fitted with integrated automatic tracking technology. Healthcare facilities equipped with an RFID or similar systems, with readers located throughout the site, including department entrances and building exits, may utilise this approach. By attaching an RFID tag to each cylinder on receipt, the system can provide tracking within the facility, including location and reporting information. Such systems are limited to on-site use.

9.151 Tracking systems do not replace the need for annual full cylinder management audits, but provide a supplementary control measure.

Return of cylinders to stores

9.152 In-use cylinders in a local cylinder parking area or a satellite store, once empty, should be returned to the main store in accordance with written procedures, ready for return to the supplier. Local and satellite stores should not retain empty cylinders longer than necessary (maximum 24 hours) for economical collection and replacement.

9.153 Cylinders placed in or returned to medical gas main stores should be checked for leakage and to ensure that the cylinder valve is closed.

Returns to suppliers

9.154 Cylinder replacement arrangements with the gas supplier should be agreed with the healthcare facility to ensure sufficient stock is maintained while optimising cylinder rental cost. Cylinders no longer needed should not be retained longer than necessary in the main store but returned at the earliest opportunity to the supplier to avoid unnecessary rental charges. The ordering and returning process should be followed.

Procedures for the rotation of stock

9.155 A written procedure should be prepared, detailing the rotational stock-control system.

9.156 The main store should be appropriately sized and designed to enable effective stock rotation. Stacking cylinders more than two deep may restrict rotation, although it may be necessary for efficient use of space. In such cases, provision should be made for a spare bay to support stock rotation.

Cylinder contents – status labels

9.157 Labels indicating the status of a cylinder's contents, during movement between

the cylinder store and manifold (or equipment), may provide a basic level of manual tracking and visual identification. However, labels may be removed prematurely or in error, potentially resulting in full cylinders being returned to the supplier. Cylinder status should therefore be verified by checking the contents gauge and following established operating procedures.

Preparation of cylinders for use

9.158 To ensure patient and staff safety:

- porters and users should ensure a high standard of cleanliness when storing, transporting or connecting medical gas cylinders to regulators or other medical devices, particularly with respect to the presence of oil, grease, hand creams, and similar (for example, barrier creams)
- users should open medical gas cylinders slowly: when equipment is coupled to a cylinder, the cylinder valve should initially be opened as slowly as possible, as rapid opening can cause a sudden increase in downstream gas pressure. The consequent temperature rise may result in ignition of combustible material in contact with the hot gas downstream. Only regulators designed for oxygen use should be used for this service, as they are constructed to prevent this occurrence
- if resistance to opening of the cylinder is excessive, the cylinder should not be used and should be returned to the manufacturer/supplier with a label to indicate the problem (pharmacy should be informed)
- users should read, understand and follow all instructions and labelling.

9.159 Cylinders and their associated equipment should be protected from contact with oil, grease, hand creams and similar products, bituminous products, acids and other corrosive substances. Equipment should be subject to PPM.

9.160 Defective equipment should be notified to the appropriate body in accordance with the appropriate defect reporting system.

9.161 Prior to use of a cylinder:

- Check the cylinder label to ensure the correct gas has been supplied.
- Check the batch label to ensure that the gas on both labels match.
- Check the expiry date.
- Check the tamper-evident seal is in place (for a new cylinder).
- Cylinders should only be used in conjunction with equipment designed for their use.
- Cylinder identification labels should not be removed or obscured. No permanent marking or painting should be made on the cylinder shell except by the manufacturer/supplier.
- Lubricants, sealing or jointing compounds should not be used when connecting cylinders to pressure-reducing regulators or equipment.
- The cylinder valve, regulator and associated equipment should always be clean and free from oil, grease, hand creams and similar products, and other debris.
- Cylinder and equipment connection interfaces and their washers or O-ring seals should be inspected to make sure that they are in good condition. Damaged sealing washers and O-rings should be replaced. No more than one sealing washer should be used at each interface.
- Portable oxygen/nitrous oxide cylinders should ideally be stored at above 10°C for 24 hours before use if cylinders are stored at temperatures lower than 0°C

for long periods before use; they should be placed in an area/room above 10°C for 24 hours. Under no circumstances should cylinders be immersed in water before use, and they should not be warmed using direct heat sources.

- In the case of large (G-size) oxygen/nitrous oxide cylinders, they should be stored upright within the manifold room at a minimum temperature of 10°C for a period of 24 hours before connection to the manifold.
- Cylinder operation should follow the manufacturer's directions.
- Only trained personnel should move or use a medical gas cylinder.

Operating cylinder valves

9.162 Undue force should not be used to open or close cylinder valves, or to attach connectors to cylinders.

9.163 All cylinder valves should be opened gently. If it is obvious that injury or damage could arise from trying to open a sticking valve, the cylinder should be removed from service and returned to the supplier as a faulty cylinder.

9.164 Cylinder valves should be opened slowly to prevent rapid pressurisation of the system. During this phase, components are subject to the greatest stress, and ignition may occur as a result of adiabatic compression, particularly in the presence of contaminants such as oil, grease or hand-cream residues.

9.165 The cylinder valve should be fully opened (slowly, anticlockwise) using the appropriate cylinder key, or hand-wheel where fitted, and then turned clockwise a half turn to ensure that the valve does not stick in the open position due to thread stretch under force.

9.166 If there is any leakage of gas from the cylinder valve spindle, the cylinder should be removed from service and returned as faulty.

9.167 The tightening of gland nuts should not be attempted, as this may cause damage to the valve.

9.168 To close the valve, the spindle or hand-wheel should be turned clockwise. Hand pressure only should be used to close the valve.

Connection and disconnection of cylinders

9.169 Only porters and clinical staff with specific medical gas safety training should have contact with medical gas cylinders.

9.170 Only persons who have had specific training in the safety of medical gases, manual handling techniques and cylinder changing procedures should be allowed to change cylinders on medical gas manifolds or medical equipment.

9.171 The following is an example of a typical procedure that may be posted on the manifold room wall adjacent to the manifold:

Manifold cylinders: changing procedure (for Medical Gas Porters (MGPS))

- Ensure that hands are clean and grease-free before handling any medical gas cylinders or equipment and, where large cylinders are handled, safety footwear is worn.
- Use eye and face protection.

Important – when a bank of cylinders requires changing, all cylinders in that bank should be changed.

- Check the name of the gas on the collar of each cylinder, the expiry date and the cylinder colour code. If in doubt, refer to

the cylinder data sheet displayed in the manifold room.

- Remove the plastic seal and dispose of it in the correct receptacle but always retain the valve cover caps on cylinders where they are hinged or have a retaining strap to cover the cylinder valves after use.
- Loose caps on the floor cause a serious risk to slips, trips and falls.
- Follow procedures for venting header lines if applicable.
- Remove empty cylinders from the medical gas manifold one at a time, and secure in the spare cylinder rack position and secure.
- Inspect the Bodok seal in the yoke or O-ring on the bull nose connection for wear or damage; change if necessary, taking care not to expose the surfaces to grease, oil, hand creams and similar products; use only one seal on each cylinder connection.
- Replace each empty cylinder with a full cylinder in turn, never leaving a cylinder unrestrained.
- Connect the cylinder to the manifold and tighten firmly by hand or with an appropriate spanner. Do not put undue strain on the manifold tailpipe and do not use any lubricant or sealing compounds.
- The handles attached to the nitrous oxide tailpipes are not spanners. They are used to restrain the tailpipe while the appropriate spanner is used to tighten the connecting nut. Using the handle as a spanner will cause serious damage to the tailpipe and may result in personal injury.
- Using the correct cylinder key (or hand-wheel/knurled knob where fitted), slowly open the cylinder valve anticlockwise to its fullest extent and then turn it back by a half turn. This ensures the valve does not jam on the end stop of the threads.
- Check that there are no leaks between the cylinder valve and the manifold. This can usually be determined by listening. If in doubt, the correct oxygen compatible leak-detection fluid can be used; always wipe off excess fluid with a clean damp cloth.
- If there is a leak from a tailpipe connection to the cylinder, close all cylinders on that bank and disconnect the leaking tailpipe, recheck the seals, replace if necessary and reconnect the cylinder (follow procedures for venting header lines if applicable to allow disconnection).
- Once the bank has been fully changed, check that the contents gauge is reading the correct pressure and the cylinder contents gauges read full.
- Check the manifold control panel; some require the reset button to be pressed.
- Remove the empty cylinders from the manifold room to the empty cylinder store and replace with full cylinders on to the spare rack.
- Sign the register to state how many cylinders were replaced from which bank, on which day and by whom.
- If a problem or fault is detected or suspected, inform the estates department immediately.
- Ensure that any faulty cylinders (for example, any that are leaking or damaged) are not left in the manifold room. They must be labelled “faulty” and kept separate from all other cylinders. Pharmacy should be notified.

Example procedure for changing cylinders on medical equipment

9.172 In this operation, the equipment is connected to the cylinder via a pressure regulator, a high-pressure flexible hose and/or a cylinder yoke or, in the case of star valves (or other integral flow-controller type valves), a flexible low-pressure hose.

9.173 Only equipment designed for the specific gas should be connected. Oxygen and medical air flowmeters read differently if interchanged.

9.174 The threads connecting different gas flowmeters to a regulator may be identical (for example, oxygen and medical air); therefore, these components should be treated as a single assembly (piece of equipment) and should not be taken apart by the user. A normal ward flowmeter (0–15 L/min) should not be used where a paediatric flowmeter (0–1.5 L/min) is required.

9.175 Where fitted to protect downstream systems, pressure-relief valves should be indelibly marked with their relief pressure setting. Regulators should be indelibly marked with the maximum outlet pressure range. Bourdon pressure gauges should be in accordance with BS EN 837-1.

9.176 Needle valves or similar devices should not be used in place of pressure-reducing regulators, as excessive pressure may develop downstream of such devices and result in possible injury to personnel and damage to equipment.

9.177 The connection procedure is as follows:

- Prepare the cylinder for use as above.
- Check the sealing washer/O-ring at the valve and connector interface.
- Connect the cylinder to the equipment and tighten firmly with the correct spanner or by hand (as appropriate). Do not use excessive force.
- Before opening the cylinder, check that the equipment and other flow control valves are turned off.
- Using the correct key (or knurled valve knob), open the cylinder valve slowly, fully anticlockwise, and then back a quarter turn.
- Check for leaks, either by using a leak-detection fluid or by closing the cylinder valve and observing to see whether the high-pressure gauge on the regulator starts to fall.
- If a leak occurs between the cylinder valve and equipment:
  - close the cylinder valve and vent any gas trapped within the equipment
  - carefully tighten the connecting nut and open the cylinder valve slowly; if the leak persists, turn off the cylinder valve, vent any gas safely to atmosphere and detach the cylinder from the equipment
  - where the connection incorporates a seal (either O-ring or Bodok seal), this should be replaced and the cylinder reconnected to the equipment, following the procedure outlined above.
  - If a leak still persists, the equipment may need to be replaced. The manufacturer or electro-biomedical equipment (EBME) department should be informed, as appropriate, in accordance with the operational policy.
- If a leak occurs via any part of the valve or between the valve and the cylinder, and where the leak appears to be caused by the cylinder valve, notify the supplier of the faulty cylinder and retain for return under the gas supplier's faulty cylinder procedure.

- Slowly adjust the pressure regulator or flow controller to the correct setting. (Some regulators are pre-set and not adjustable.)
- Open the equipment flow control valve(s) slowly, checking for correct equipment operation.

9.178 The disconnection procedure is as follows:

- Turn off the cylinder valve and vent excess gas from the equipment regulator and connecting hoses by opening the equipment flow control valves for a few seconds. On a manifold, gas from the tailpipe will vent as the cylinder connection is loosened.
- Shut off any equipment control valves.
- Using the correct spanner (or by hand), disconnect the cylinder from the equipment or tailpipe.
- Do not vent the cylinder or leave the cylinder valve open.
- Replace plastic valve covers on cylinders with a hinged or retained cover/cap.
- The cylinder should be returned to the empty rack in the cylinder store as soon as possible.
- if a separate tie-on contents status label is in use, ensure it has been amended as appropriate.
- If an RFID tagging system is in place, ensure the healthcare organisation's RFID tag is removed after the cylinder is inside the empty cylinder store.

Precautions

- A naked flame or lighted cigarette should not be used to detect leaks.
- Only oxygen-safe leak-detection fluids should be used.
- Excessive leak spray solution should be wiped off with a clean damp cloth after use to avoid possible contamination of the fittings.
- Defective pressure-reducing regulators, gauges and equipment may be hazardous in use.
- A system should be set out in the operational policy to ensure that defective items are withdrawn from use and repaired or replaced as necessary.
- No attempt should be made to repair, alter or modify any cylinder or its valve.
- Sealing or jointing compound should not be used to rectify leaks.
- Cylinders with damaged or very stiff valves should be labelled appropriately and returned to the supplier.

Defective cylinder classification

9.179 Gas suppliers usually classify defective cylinders as either "faulty" or "incident".

Faulty cylinders

9.180 These are described as those where the complaint is minor and they do not pose a risk to patient safety. Examples are:

Contents	Cylinders supplied empty or partially empty.
Cylinders	Faulty valve operation. Damaged valve outlet or damaged cylinder body. Minor leaks from valve.

Incident cylinders

9.181 These are described as those where the complaint is serious and the patient is considered to have been or could have been put at risk. Examples are:

Contents	Wrong gas in cylinder or wrong gas specification. Gas contamination in cylinder. Abnormal patient reaction to gas. Doubts about gas identity. Incorrect labelling.
Cylinders	Shell failure/damage. Ignition of shell or valve. Discharge from safety valve or bursting disc. A serious cylinder valve leak

Dealing with defective cylinders

9.182 The MGPS OP should contain an appropriate procedure for defective cylinders.

9.183 The general procedure outlined in this section can be used as the basis for the policy entry.

General procedure

9.184 On identifying a defective cylinder, it should be located and, if safe to move, taken back to its respective cylinder store in a quarantine section specific for defective cylinders, ready to be collected.

9.185 The gas supplier should be contacted and given:

- the customer's name and address
- the name of the person who is to receive the investigation report, if required
- the number of cylinders involved
- the batch number, expiry date, cylinder size code and gas for each affected cylinder
- a description of the fault.

9.186 The cylinder should be stored away from all other cylinders and have a label attached stating the defect. These can be made locally and agreed within the policy document.

9.187 An incident report should be completed and reported directly to pharmacy, who may wish to undertake their own investigation prior to the return of the cylinder to make an informed decision of the level of risk and the correct routes for the reporting of the defect. More serious defects, such incorrect or contaminated gas, should require a higher level of reporting than minor faults, such as a stiff valve.

9.188 The cylinder(s) should not be allowed back into general circulation.

9.189 A replacement should be provided when the defective cylinder is collected.

9.190 Upon delivery of the replacement cylinder, the driver should provide a delivery note and retain the faulty or incident cylinder label for internal use.

9.191 The cylinder fault label details should be verified for accuracy and signed as required.

9.192 The driver should ensure the label is attached to the correct cylinder.

9.193 Where the defective cylinder is not available for return, the reason should be recorded on the reverse of the label and the label returned to the driver.

9.194 A copy of the investigation report, along with a covering letter, should be sent to a nominated person, usually the Chief Pharmacist.

Handling of cryogenic liquid equipment

9.195 For full safety instructions on liquefied atmospheric gases, the BCGA's (2024) Code of Practice 30 (CP 30) should be followed.

9.196 A full method statement and risk assessment along with annual training should be implemented and agreed by the MGSG.

9.197 Areas allocated for the storage of cryogenic liquids should be specifically designed, dedicated, well-ventilated and clearly signed.

9.198 Dewars and larger vessels should not be stored in medical gas cylinder stores.

Protective clothing

9.199 Protective clothing is only intended to protect the wearer from accidental contact with liquefied atmospheric gases or parts in contact with it.

9.200 Specific clothing requirements should be agreed and supplied by the healthcare facility and included within the policy document.

9.201 Non-absorbent leather gloves should always be worn when handling anything that is, or has recently been, in contact with liquefied atmospheric gases. The gloves should be loose fitting so that they can be removed easily. Sleeves should cover the ends of gloves. Gauntlet gloves should not be used, as liquid may enter the glove and become trapped against the skin. Woven materials are best avoided, but if they are used for protective clothing, they should not become saturated with cold liquid.

9.202 Goggles or face masks should be used to protect the eyes and face where spraying or splashing of liquids may occur.

9.203 Overalls, trousers or similar type clothing should be worn outside leather shoes. These should preferably be made without open pockets or turn-ups where liquid could collect.

9.204 If clothing becomes contaminated with liquefied atmospheric gases or vapour, the wearer should ventilate them for a minimum of five minutes by walking around in a well-ventilated area, avoiding exposure to naked flames

Safety notes – use of liquid nitrogen

9.205 In addition to its low temperature hazard, liquid nitrogen causes oxygen depletion as it vaporises in a storage area. This hazard is increased in the event of nitrogen spillage, where rapid vaporisation may create an asphyxiation risk.

9.206 Serious incidents involving liquid nitrogen spillage have occurred, and the BCGA's Code of Practice (CP 30) detailing safety requirements and procedures in the storage, use and handling of liquid nitrogen dewars should be consulted before this gas is used. This document also gives advice on the safe transport of dewars in hospital lifts.

9.207 See also the Department of Health's Estates and Facilities alert DH (2005) 13 – 'Liquid nitrogen'.

10 General safety

10.1 Medical gases are supplied for the treatment of patients in healthcare facilities and therefore the predominant requirement is for patient safety.

10.2 Medical gases should be prescribed and only used under controlled environments and clear instruction.

10.3 Patient safety is achieved by following the principles of the MGPS and is dependent on four basic principles:

- adequacy
- continuity
- identity
- quality of supply.

10.4 Adequacy of supply depends on an accurate risk assessment of demands and the selection of plant with capacity appropriate to the clinical/medical demands on the system and the size of the pipework for the layout of the systems.

10.5 Continuity of supply is achieved by the specification of systems that have a primary, secondary and tertiary means of supply. The primary supply has duplex working components, such as regulators and solenoid valves, so that the primary supply continues even with a single component fault. Alarm systems are provided to ensure that the relevant staff are aware of the status of the medical gas plant and clinical staff are aware of the status of the medical gas systems locally; additionally, medical gas systems are connected to the emergency power supply system.

10.6 Identity is assured using non-interchangeable gas-specific connections throughout the pipeline system, including terminal units and connectors, and by the adherence to strict testing and commissioning procedures of the system. Where there are no detachable requirements, connections should be formed to create permanent joints and tested for continuity and cross-connection

10.7 Quality of supply is achieved by:

- the use of gases purchased in accordance with the relevant monographs of the British Pharmacopoeia, or produced by plant performing to specified standards
- the maintenance of cleanliness throughout the installation of the system and
- the implementation of various maintenance, testing and commissioning procedures.

Modifications

10.8 Specific procedures are required when existing installations are to be modified or extended. To ensure that the supply to patients is not compromised or that any section of the pipeline system remaining in use is not contaminated, the procedures in this HTM and Part A should be followed.

10.9 Any section that is to be modified should be physically isolated from the section in use. Closure of isolating valves is insufficient for this purpose. Where AVSUs and LVAs have been installed, blanking spades (as appropriate) should be used. This isolation procedure is not required for repairs to, or replacements of, individual terminal units, provided that no brazing is required.

10.10 Any modifications to existing systems may be detrimental to the overall performance of the system. In older systems, available capacity may be insufficient to meet current flow demands. Additional flow requirements arising from modifications should be incorporated into existing design documentation and formally assessed to ensure system integrity is maintained. Where deficiencies or pinch points in pipeline sizing are identified, these should be rectified as part of the project before completion.

10.11 Any work involving the alteration, modification, extension or maintenance of an existing system should be subject to the PTW procedure (see Chapter 7).

Safety of oxygen

10.12 In the liquid state, oxygen is pale blue with a boiling point of –183°C at atmospheric pressure. In the gaseous state, oxygen is colourless, odourless, tasteless, non-toxic, non-irritant and non-flammable. It will, however, strongly support combustion, and is highly dangerous when in contact with oils, greases, tar-like substances and many plastics.

10.13 When oxygen therapy equipment is in use, fire and safety warning signs/labels should be clearly displayed at the site of administration and entrance to the area to alert the patient, healthcare staff and visitors that oxygen is being used and that appropriate precautions need to be taken.

10.14 When oxygen is being administered in paediatric departments, the text should include the precaution:

"For your child's safety, please ensure that only approved toys and devices are used while on oxygen."

10.15 Strict controls on the use of electronic cigarettes, naked flames and electronic devices that create heat and could cause ignition should be in place.

10.16 Oxygen canopies, hyperbaric chambers and tents should be labelled, advising that oxygen is in use and that safety precautions relating to its use should be observed.

10.17 Labels should be attached to the fabric of the canopy/tent in a position easily seen by the patient, and also on the exterior in a position to be seen easily by healthcare staff and visitors.

10.18 Considerations may need to be given for signs in other languages.

10.19 All users of oxygen and associated equipment should know and understand the properties of oxygen and should be trained in the use of the equipment. This applies to all staff.

10.20 The health hazards associated with liquid oxygen are:

- Cold burns and frostbite. Localised pain usually gives a warning of freezing, but sometimes no pain is felt or it is short-lived. Frozen tissues are painless and appear waxy, with a pale yellowish colour. When the frozen tissue thaws, it can result in intense pain, with associated shock. Loosen any clothing that may restrict blood circulation and seek immediate attention for all but the most superficial injuries. Do not apply direct heat to the affected parts but if possible, place the affected part in lukewarm water. Sterile, dry dressings should be used to protect damaged

tissues from infection or further injury, but they should not be allowed to restrict the blood circulation. Alcohol and cigarettes should not be given.

- The effect of cold on lungs. Prolonged breathing of extremely cold atmospheres may damage lung tissue.
- Hypothermia. A risk of hypothermia arises when liquefied atmospheric gases are released. All persons at risk should be warmly clad. Hypothermia is possible in any environment below –10°C, but susceptibility depends on length of exposure, atmospheric temperature and the individual; older people are more likely to be affected.
- The formation of mist. When liquefied gases are released and evaporation takes place, a white mist is formed by the condensation of moisture in the atmosphere. The mist formation may introduce potential hazards because of poor visibility. In the event of mist formation, extreme caution should be exercised when evacuating the area.

Material compatibility

10.21 Gaseous oxygen vigorously supports combustion of many materials that do not normally burn in air, and is highly dangerous when in contact with oils, greases, tarry substances and many plastics. Only materials approved for oxygen service should be used.

Cryogenic gases

10.22 Refer to BCGA CP 36 for all cryogenic gas requirements. Storage, monitoring and personal protective equipment (PPE) should be integral to system requirements. Operation of these systems should be restricted to trained and competent personnel.

Other medical gases

10.23 In the modern healthcare environment, an increasing range of gaseous and liquid substances is used, presenting hazards from asphyxiation to corrosive risk. It is essential that the risks associated with all substances in use are fully understood. Such gases include carbon dioxide (asphyxiant) and nitric oxide (corrosive).

10.24 The environment in which these substances are used, together with the required control measures, should be risk-assessed and the appropriate precautions implemented.

10.25 Guidance is available from manufacturers and suppliers and should be used to produce policy documents and training courses, which should be signed off by the MGSG.

Fire precautions

10.26 The general guidance on fire precautions given in the HTM 05 Firecode series of publications and should be followed. Specific guidance on fire precautions relating to cylinders is given in Chapter 9.

10.27 Guidance is also available from the gas supplier, specialist contractors and the Authorising Engineer (MGPS); any specific recommendations should be followed.

10.28 Fire can occur when the following three conditions are present:

- flammable materials
- oxidising atmosphere
- ignition.

10.29 Flammable materials should not be present in cylinder stores, manifold rooms or liquid oxygen compounds. It may not, however, be possible to avoid the presence of flammable materials in the vicinity of the patient when medical gases are being used.

10.30 Flammable materials which may be found near patients include alcohol gels, some nail-varnish removers, oil-based lubricants, skin lotions, cosmetic tissues, clothing, bed linen, rubber and plastic articles, alcohols, acetone, certain disinfectants and skin-preparation solutions. Where possible, these should be minimised and closely controlled.

10.31 An oxygen-enriched atmosphere may be present when medical oxygen or oxygen/nitrous oxide mixtures are used. Nitrous oxide also supports combustion.

10.32 Further guidance should be obtained from the HTM 05 series. The Fire Safety Manager, Fire Safety Adviser and the local fire and rescue service should be consulted.

10.33 Ignition sources are numerous and include:

- open flames, burning tobacco, electronic cigarettes, sparks (which may also be produced by some children's toys); high-frequency, short-wave and laser equipment; hair dryers; arcing; and excessive temperatures in electrical equipment. The discharge of a cardiac defibrillator may also serve as a source of ignition
- electrical equipment not specifically designed for use in an oxygen-enriched atmosphere
- some non-electrical equipment (for example, a static discharge, which may be created by friction, may constitute an ignition source if easily ignited substances such as alcohols, acetone, some nail-varnish removers, oils, greases and lotions are present).
- high-flow oxygen and rapid depressurisation, which can generate heat through adiabatic compression, potentially leading to ignition of flammable materials without an external ignition source.

10.34 A mixture of breathing gases will support combustion. In an oxygen- or nitrous oxide-enriched atmosphere, materials not normally considered to be flammable may burn vigorously. Flammable materials ignite and burn more vigorously.

10.35 Clothing may become saturated with oxygen or nitrous oxide and become an increased fire risk. When returned to normal ambient air, clothing takes about fifteen minutes for oxygen enrichment to reduce to normal conditions. Blankets and similar articles should be turned over several times in normal ambient air following suspected oxygen enrichment.

10.36 Oil, grease, hand creams, make-up and similar substances, even in minute quantities, are liable to ignite in the presence of high-pressure oxygen or nitrous oxide. No oil, grease, hand creams and similar substances should be used in any part of the MGPS. In particular, oil-based lubricants should not be used, and all fittings and pipes should be supplied degreased, sealed and labelled for the MGPS. Details of these requirements are given in Part A.

10.37 The siting and general structural principles for the design of liquid oxygen storage accommodation are stated in Chapter 6 of Part A, and for plantrooms and gas manifold rooms in Chapter 17 of Part A. Cylinder storage should be as recommended in Chapter 9.

Ventilation

10.38 Anaesthetic gas discharges from equipment are usually controlled by scavenging or ventilation to comply with the requirements of COSHH in order to protect staff from overexposure. Technologies are available for the removal and decomposition of anaesthetic gases and volatile organic compounds (VOCs).

10.39 Where oxygen is used for specific therapies (for example, in oxygen tents or in

CPAP ventilation regimes), oxygen enrichment may occur. It is essential, therefore, that adequate general ventilation be provided to avoid the hazard. Refer to HTM 03-01.

10.40 A risk assessment should be carried out to assist the need for local oxygen enrichment monitoring.

Safety of nitrous oxide and oxygen/nitrous oxide systems

10.41 Where nitrous oxide is used, it should be via a breathing circuit. The exhaled waste gas will be reliant on an AGSS to remove the waste gases to a safe location. The reduction/removal of the use of nitrous oxide will not remove the necessity for the AGSS as this also removes anaesthetic agents.

10.42 A 50%/50% mixture of oxygen/nitrous oxide is a self-administered analgesic that is inhaled and exhaled at levels above the capability of an AGSS. Therefore, three specific control measures should be considered to control the use of this mixed gas:

- a low-level non-recirculating extract connection from the central ventilation system, or similar, that is located behind the patient's head to remove spilled gases
- specialist LEV to capture exhaled gases from the face mask
- a low-level recirculating unit that decomposes nitrous oxide into harmless components.

Where mobile cylinders are used for the supply of oxygen/nitrous oxide mixture, the same ventilation requirements apply.

10.43 A risk assessment should be carried out to ascertain the methods of capture that need to be incorporated into the department.

10.44 An occupational exposure monitoring regime must be implemented throughout the areas where these gases are used, and suitable mitigation should be introduced where elevated levels are detected. This should include a risk assessment. (See NHS England's 'Guidance on minimising time weighted exposure to nitrous oxide in healthcare settings in England'). The efficacy of these mitigations must be demonstrated by monitoring exposure to N_2O in line with the following:

- Control of Substances Hazardous to Health (COSHH) Regulations 2002
- the Health and Safety Executive's (2006) 'HSG 173: Monitoring strategies for toxic substances'
- the Health and Safety Executive's (2020) 'EH40/2005. Workplace exposure limits'.

11 Maintenance

11.1 All MGPS should be subjected to a planned preventive maintenance (PPM) schedule, which should be under the responsibility of the Authorised Person (MGPS), irrespective of whether or not a full preventive maintenance scheme is being implemented in the healthcare facility as a whole.

11.2 All work should be carried out in accordance with this HTM and manufacturers' recommendations.

11.3 Where manufacturers' recommendations exceed those specified in this HTM, they should be adopted unless a risk assessment supports an alternative approach. This should be completed by the Authorised Person (MGPS) and agreed with the Authorising Engineer (MGPS). An action plan from the risk assessment should be used to add these items to the maintenance scheme.

11.4 Medical gas maintenance is undertaken to minimise the risks of unplanned interruptions of the medical gas system. Therefore, a risk assessment of all parts of the system should be undertaken to ensure that the guidance given in this chapter is adequate for the systems and its components and there are no areas at risk of failure.

11.5 Where risks have been identified, maintenance schedules and frequencies should be adapted to satisfy the healthcare facility's requirements.

11.6 The maintenance programme should be prepared by the Authorised Person (MGPS) in consultation with the Authorising Engineer (MGPS) and approved by the MGSG prior to commencement of any work.

11.7 Where a current maintenance schedule is in place, it should be risk-assessed. If any deficiencies are identified, they should be rectified and issued to the MGSG for comment.

11.8 All work on an MGPS, irrespective of whether the supply is likely to be interrupted, should only be carried out under the instructions of, and with the prior permission of, the Authorised Person (MGPS).

11.9 All work carried out should be controlled by the PTW system, managed by the Authorised Person (MGPS) and signed in accordance with the guidance in Chapter 7. This should be prepared on site and issued at the point of work. Remote PTWs should not be issued.

11.10 A PTW should be issued for all examinations, even where no interruption to the service is anticipated.

11.11 Inspections and maintenance should be carried out using one of the following methods:

a. on a contract basis by an approved specialist company

b. by properly trained hospital staff (essential for daily, weekly and other tasks)

c. by a combination of (a) and (b) with a clear division of responsibility (for

example, filter and oil changes performed by hospital staff or the remainder of the PPM work performed by contractors).

11.12 The Authorised Person (MGPS) is responsible for the day-to-day operation of the MGPS. They should decide (in liaison with the Quality Controller (MGPS) and Authorising Engineer (MGPS)) when an MGPS should be taken out of, or brought into, service.

11.13 The MGPS OP and procedure documents should clearly set out the responsibilities and the procedures to be followed for all work on the pipeline.

Selection of contractors

11.14 All maintenance work on an MGPS, including associated, connected and integral components should be undertaken only by specialist contractors certified to BS EN ISO 9001 and/or BS EN ISO 13485, with a scope of registration covering MGPS maintenance, and are able to demonstrate compliance with the guidance given in this chapter.

11.15 To avoid conflicts of interest, the maintenance company should not provide Authorised Person services as well as the Competent Person services even where the company has different divisions.

11.16 Patient safety is paramount when carrying out any work on an MGPS and should be given priority over cost, although it is recognised that contracts are managed to be as cost-effective as possible.

11.17 The PPM schedule and frequencies should not be reduced to save costs.

11.18 The contractor should provide evidence to the healthcare organisation that the maintenance tasks comply with the Pressure Systems Safety Regulations 2000.

11.19 Consideration should be given to the benefits that can be derived from longer contract terms between the client and the maintenance contractor. A five-year period is recognised as a suitable length to coincide with the PSSR 2000 component timings.

11.20 The healthcare facility's MGPS OP should include the selection and management of MGPS contractors.

11.21 Medical gas specifications for new contractors should consider the inclusion of:

- the provision of suitable technical advice
- service provision resilience
- asset management and life-cycle management
- condition-based monitoring and maintenance
- reliability-centred maintenance
- the monitoring and setting of service quality targets (for example, key performance indicators)
- the ability to propose innovative solutions
- a recognised quality assurance scheme.

Competency of contractors' staff

11.22 The healthcare facility should not be required to test the competency of contractors' staff, but it is the responsibility of the Authorised Person (MGPS) to satisfy themselves that the maintenance contractor is competent to carry out the work on the MGPS; this is implicit in the management of maintenance contracts for MGPS in order to ensure continuity of supply and patient safety.

11.23 Before any work is undertaken on site, the healthcare facility and/or the Authorised Person (MGPS) should request documentary evidence of the competency of each individual that may work on the MGPS in the form of a skills matrix. This should be relevant to the specific tasks that they will undertake and will include qualifications, experience, Competent

Person (MGPS) training certificate and other training records. This should be updated annually. Practical evidence may also be requested, such as a demonstration of brazing competency.

11.24 The company is to also supply their BS EN ISO 9001 and/or BS EN ISO 13485 registration certificates, and calibration records of test equipment, insurances and risk assessments and method statements. Practical evidence can be requested, such as a demonstration of brazing competency for installation engineers.

11.25 The contractor is responsible for ensuring that the staff working on any project are appropriately trained and qualified to carry out the work.

11.26 The contractor should not allow any staff to work unsupervised on a site unless they have received the appropriate training as detailed in this HTM.

11.27 The contractor should only employ their own staff to carry out the maintenance services. If a subcontract is to be implemented by the maintenance company, the subcontractor must comply with the same standards and requirements as the main contractor.

11.28 Where the use of subcontractors is unavoidable, the contractor should obtain prior permission in writing from the healthcare organisation.

11.29 The contractor should ensure that any subcontractors are competent and should undertake an assessment of those subcontractors. The contractor should submit the same required documentation for the subcontractor to the healthcare organisation's Authorised Person (MGPS).

11.30 The main contractors should remain responsible for all works undertaken by subcontractors and should maintain a presence on site during the works.

11.31 The contractor's representative who has overall responsibility for the maintenance services should have received specific training on the maintenance requirements of an MGPS and the duties and responsibilities of an Authorised Person (MGPS), as defined in this HTM.

11.32 The representative should complete and pass an accredited Authorised Person (MGPS) course and refresher courses at least every three years. This is for knowledge purposes only and will not qualify them to undertake the Authorised Person role.

11.33 The representative should be fully conversant with the recommendations of this HTM and should also have knowledge and experience in the implementation of relevant codes of practice, such as the Pressure Systems Safety Regulations 2000.

11.34 The project manager is responsible for ensuring that only suitably trained and experienced service engineers (Competent Persons (MGPS)) who are knowledgeable of the content of this HTM and the specialist techniques involved are employed on the maintenance contract.

11.35 Service engineers should have received at least the same training as required for a Competent Person (MGPS), as defined in this HTM.

11.36 The contractor should maintain a training programme, and the training of each employee should be recorded in a training log.

11.37 All Authorised Persons (MGPS) and Competent Person (MGPS) training should be undertaken by an independent accredited training organisation. In-house Authorised Person and Competent Person training is not permitted unless this has been accredited by an awarding organisation and they undergo annual external verification by that organisation to ensure trainers and assessors deliver courses to an appropriate and consistent standard.

11.38 The contractor should assign a skill level to each of their staff, and this should be used when selecting the appropriate staff for a particular task.

11.39 Contractors' staff deemed by the Authorised Person (MGPS) to be incompetent for any reason should not be allowed to work on the medical gas system.

General work procedures

11.40 The contractor should have made prior arrangements before each visit in order to minimise any disruption.

11.41 All contractors' staff should report to the Authorised Person (MGPS) on arrival and on departure from the premises.

11.42 Visits to the locations of supply plant and distribution equipment should not be made without the prior permission of the Authorised Person (MGPS). All access keys, fobs and passes should be signed in and out of the medical gas key cabinet.

11.43 The Authorised Person (MGPS) should ensure that the contractor's staff are fully knowledgeable of the MGPS at the site before they carry out any PPM work.

11.44 A full system walk and competency check should be undertaken for all Competent Person persons attending site.

11.45 No work should be carried out, including examination of terminal units, unless a PTW has been issued by the Authorised Person (MGPS) in accordance with the PTW procedure.

11.46 An Authorised Person (MGPS) should be available to sign PTWs for all work carried out on the pipeline.

11.47 Only in exceptional emergency circumstances, when the contractor arrives on site before the Authorised Person (MGPS) and immediate action for patient safety is required, works may be undertaken with the express permission of the clinical team. This should be documented to include details of the work, who gave access (with date and times) and any follow-on remedial works required. This document should be reviewed by the Authorised Person (MGPS) on arrival.

11.48 The extent of the contractor's freedom to proceed without the issue of a PTW in such circumstances should be documented in the MGPS OP.

11.49 While on the premises, the contractor should comply – and should ensure that their staff similarly comply – with the requirements of all relevant statutory safety legislation, such as the Health and Safety at Work etc. Act 1974.

11.50 The contractor should at all times comply with the healthcare organisation's safety policy, a copy of which should be signed by the contractor during the induction and site familiarity visit.

11.51 The contractor should provide their staff with appropriate photo identification acceptable to the healthcare organisation and displayed at all times.

11.52 The healthcare organisation should issue its own healthcare organisation pass that the contractor should display and present if so requested. These should be returned to the Authorised Person (MGPS) on completion of the work.

11.53 The contractor should supply the Authorised Person (MGPS) with a RAMS applicable to the work. The Authorised Person (MGPS) should review these prior to any works being undertaken and the Competent Person (MGPS) should retain a copy.

11.54 The contractor should supply the Authorised Person (MGPS) with a copy of the contractor's health and safety policy, which the Authorised Person (MGPS) should retain.

11.55 The healthcare organisation should provide details of its fire and health and safety

policies, and the contractor should comply with these.

11.56 The contractor should instruct their staff in the requirements of the fire policy, although when working under a PTW it is the responsibility of the Authorised Person (MGPS) to ensure that the Competent Person(s) MGPS carrying out the work is/are fully conversant with the relevant fire and safety precautions. This is particularly important in such instances as isolation of smoke detectors during hot work.

Monitoring of contractors' staff and services

11.57 To ensure that the maintenance service is being carried out in accordance with the contract, the Authorised Person (MGPS) should regularly monitor samples of the full scope of work and the performance of the contractor.

11.58 The Authorised Person (MGPS) should have responsibility for the satisfactory implementation of the maintenance service and for monitoring the maintenance work carried out by the contractor.

11.59 The Authorised Person (MGPS) should ensure that the contractor's staff and performance are checked on a random basis. On a large site, it may be desirable to carry out a maintenance audit at least every six months.

11.60 The Authorised Person (MGPS) should arrange regular site meetings to discuss progress.

11.61 Meetings will also be arranged if the healthcare organisation is not satisfied with the level or standard of service, or if changes in contract details are required.

11.62 The contractor's representative should be present at such meetings, together with the service engineers as appropriate.

11.63 The contractor's agreed attendance at progress meetings should form part of the contract.

11.64 The Authorised Person (MGPS) should ensure that the service engineer meets with them to adequately report any defects or remedial work required before leaving site. They should also highlight any additional work that will be required in the near future for compliance and patient safety reasons.

11.65 A full record of the maintenance carried out should be kept on site and updated following any work; the contractor should be given a copy of the maintenance record.

11.66 If an Authorised Person (MGPS) is of the opinion that a Competent Person (MGPS) is not carrying out work in accordance with this HTM, or is working in an unsafe manner, the Authorised Person (MGPS) should stop the work, have the equipment and/or installation made safe and have the Competent Person (MGPS) removed from the working area.

Test equipment

11.67 The contractor should provide all test equipment, having identified those items appropriate to each task in the method statement and in Chapter 19 of Part A.

11.68 It is not the responsibility of the Authorised Person (MGPS) to provide test equipment for the contractor. The consequences of loaning test instruments to a contractor must be clearly understood, particularly in terms of insurance liability and equipment calibration.

11.69 The test equipment should be constructed and used in accordance with the requirements detailed in Chapter 19 of Part A.

11.70 The test equipment should be calibrated in accordance with the manufacturers' recommendations, but in any

case against recognised national standards at a frequency of no less than annually.

11.71 Calibration records should be kept by the contractor and produced for inspection by the Authorised Person (MGPS),

11.72 When carrying out tests on terminal units, it is not sufficient to use only blank test probes. Such blank test probes should only be used for leak tests; a calibrated flowmeter and pressure gauge, together with appropriate calibrated jet, should be used to carry out flow and pressure-drop tests.

Provision of services

11.73 The contractor should submit with the maintenance contract quotation/tender a general statement on their capability to support the requirements of the healthcare organisation. This should include details of the various resources available to them; number of staff employed, levels of competence and emergency support provision; and should define the level of technical advice and support that the contractor can provide. The contractor should also identify other similar contracts being undertaken. A sample maintenance contract is given in Appendix C.

11.74 The contractor should carry out the services specified in the contract on the dates or at the intervals specified in the contract.

11.75 A schedule of minimum tasks to be carried out is given in paragraphs 11.104–11.222. This should be modified by individual healthcare organisations, as appropriate, for their particular requirements and to comply with the manufacturer's individual recommendations. The frequencies as specified in this HTM should be viewed as a minimum requirement only.

11.76 It should be recognised that works may be required outside normal working hours where access to certain areas is restricted. Such provisions should be included in the main contract.

11.77 Where possible and excluding emergency call-outs, as much of the maintenance as possible should be scheduled to take place on weekdays during the normal working hours of the healthcare organisation.

11.78 In addition to the regular maintenance, the contractor should provide service engineers to carry out additional tasks as requested by the Authorised Person (MGPS). These tasks may be routine replacement of wearing parts, non-urgent maintenance tasks or emergency call-out tasks.

11.79 For non-urgent tasks, the extent, cost, time and approximate duration of the work should be agreed between the contractor and the Authorised Person (MGPS) and confirmed in writing.

11.80 Before leaving site on completion of the tasks, the contractor should report to the Authorised Person (MGPS) to sign off the PTW and to provide any other information regarding additional work required, remedial work and faults found.

11.81 The Authorised Person (MGPS) should sign to the effect that the work has been carried out satisfactorily before the contractor leaves site.

11.82 It is the Authorised Person's (MGPS) responsibility to satisfy themselves that the work has been carried out in accordance with the contract.

Emergency call-out procedures

11.83 In addition to the planned maintenance tasks as specified in the contract, the contractor should provide an efficient and effective call-out service in the event of any breakdown or other incident occurring between planned maintenance visits.

11.84 This service should be available 24 hours per day, 365/6 days per year.

11.85 The exact procedure for initiating a call-out will vary with each healthcare organisation. They should, however, prepare appropriate procedures, which should be set out in the MGPS OP, and which should be agreed with the contractor and included in the contract documentation.

11.86 Typically, the healthcare organisation should identify the person(s) responsible for contacting the contractor (that is, the Authorised Person (MGPS)), shift engineer or duty engineer), the procedure for generating and authorising an official order for the work, and the procedures for obtaining access to the site at all times.

11.87 Within a maximum of one hour of receiving an emergency call, the contractor's Competent Person should contact the site Authorised Person (MGPS) to confirm the nature and extent of the problem and provide an estimate of the arrival time.

11.88 For emergencies where the supply has been, or will likely be, interrupted or where patient safety will be affected, the contractor should attend site within a maximum time from receipt of the initial call as specified in the maintenance contract by the healthcare organisation. The geographical location of the healthcare organisation, number of the healthcare organisation's Authorised and Competent Persons (MGPS), and availability of technical guidance are all considerations when defining the emergency response time. A maximum response time of four hours is recommended.

11.89 The attending Competent Person (MGPS) should have undertaken site familiarisation and induction and be fully conversant with the site's requirements.

11.90 It is the responsibility of the contractor to ensure that all of their on-call staff have completed induction and familiarisation of the site prior to being included on the on-call system.

11.91 The contractor should be responsible for maintaining a reasonable stock of spares to facilitate emergency call-outs. The contractor should be familiar with each site and should therefore be able to reasonably anticipate the most likely spares commonly required. On large sites it is appropriate for the contractor to hold a stock of spares on site for immediate usage by the contractor.

Method statements

11.92 A list of tasks to be carried out at specified frequencies is given in paragraphs 11.104–11.222. See Chapter 19 in Part A for specifics for each task.

11.93 The tasks are listed as generic tasks. The contractor should prepare a method statement for each of the tasks identified.

11.94 The method statement(s) should be applicable to the actual plant and equipment installed on a particular site.

11.95 The method statement should include the following information:

- the sequence of tasks to be performed
- the method of performing each task
- the procedures to be followed (for example, PTWs, obtaining permission from ward staff, safety procedures)
- the grade, competency and number of staff to carry out the tasks
- the test equipment to be used
- the approximate time to complete the tasks
- the documentation/report to be completed.

11.96 The method statements should be provided in advance of the commencement of the contract and prior to each service visit for review and comment by the Authorised Person (MGPS). Additional works may require supplementary specific method statements.

Access to systems

11.97 It is the responsibility of the healthcare organisation's estates department to ensure that access to the plant and systems are available to the contractor.

11.98 The contractor should liaise with the Authorised Person (MGPS) to arrange for such access at least one week before the due date of the visit.

11.99 It may not be practical for access to operating departments and other high-dependency areas during normal working hours. In this case, the contractor should liaise with the Authorised Person (MGPS) to ensure that the work is carried out with due regard for the clinical requirements. Where access to such departments is routinely unavailable during normal working hours, this should be specified in the contract.

11.100 No member of a contractor's staff should gain access to any part of the MGPS without prior permission of the Authorised Person (MGPS) and issue of an appropriate PTW.

Records

11.101 A signed and dated report form should be completed after every visit to the premises and after any work is carried out. It should include the following details:

- company
- time and date of start of works
- healthcare organisation order number
- PTW number
- location, number and type of plant/equipment
- details of work carried out and tasks performed (that is, planned maintenance, breakdown, emergency call-out) – details of breakdown as reported, cause of breakdown, action taken
- details of spares used
- details of any further work required, and the urgency and implications
- details of defects noted and any remedial work required
- time and date of completion of works
- name and signature of:
  - the contractor's engineers on site
  - the Authorised Person (MGPS) for the healthcare organisation – on arrival and before departure.

11.102 A maintenance log/plant history record should be maintained for each plant item and should be updated following each planned maintenance visit or any work carried out. The format of the maintenance log/plant history record should be specified by the Authorised Person (MGPS) and kept with each individual item of plant. A copy should be made available to the contractor for his records, if so requested.

11.103 Following the completion of the service, the contractor should complete the plant logbook. Stick-on plant labels should be avoided; logbooks should be used as they allow a more comprehensive level of detail to be provided. The logbook should provide the following information:

- contractor's name, address and telephone number
- name and signature of service engineer
- date of the completed works/service.

A schedule of the actual tests results for each terminal unit should be maintained and retained on the service sheets stating:

- tasks undertaken
- static and flow pressures
- any issues found
- any repairs undertaken.

Planned preventive maintenance (PPM) schedules

11.104 Appropriate PPM procedures are applied to MGPS to secure continuity of patient safety and are intended to be applicable to all MGPS, whether new or existing installations, irrespective of whether the systems comply with the recommendations in this HTM.

11.105 Recommendations for the minimum tasks at the minimum recommended frequency, including particular details of daily and weekly tests, are given in this section. Daily and weekly tasks are usually carried out by the healthcare organisation's estates team; however, the healthcare organisation may wish the contractor to carry out some or all of these tasks as an additional contract.

11.106 In conjunction with the manufacturer's recommendations, the guidance given in this section should enable a PPM schedule to be prepared or enable management to scrutinise a contractor's proposals in order to ensure compliance with these recommendations.

11.107 Suppliers should be required to provide complete as-fitted drawings, circuit diagrams, valve charts and maintenance instructions, which should be used as the foundation for the PPM programme. For new plant, the PPM programme supplied by the manufacturers should be used in conjunction with this guidance.

11.108 The terms used in the PPM programme and their definitions are as follows:

- Examine: to make a careful and critical scrutiny of an item without dismantling, by using the senses of sight, hearing, smell and touch, to verify that the plant or equipment is in working order.
- Test: to operate the plant or equipment and/or use the appropriate testing instruments to ensure that plant or equipment is functioning correctly.
- Check: to make a thorough inspection for damage, wear or deterioration, and to ascertain that the plant or equipment is correctly adjusted to conform to the required standard.

11.109 The actual frequency of maintenance routines should be established from the manuals for the equipment and plant in conjunction with this document. Practical experience with equipment of different manufacturers, coupled with risk assessments and information from plant history logs, might well result in the need to vary some frequencies and tasks in particular installations. An example of this would be the increase in inspection frequency of plant from quarterly to monthly, or even weekly, if records have indicated that a safer system and seamless operation will result from this decision.

11.110 For each of the tasks listed, where adjustments or other remedial actions are required, this should be carried out at the time. Where such action is not possible (for example, where additional parts are required), this should be noted and reported to the Authorised Person (MGPS).

Specific maintenance tasks

11.111 Details are given below for daily, weekly quarterly and annual maintenance tasks on a range of plant and systems.

Records

11.112 The results of each inspection, and any action taken to correct faults found during the inspection, should be recorded. Arrangements should be made so that action can be instituted to correct apparatus giving constant trouble caused by faulty design or by unsatisfactory conditions of any nature. Provision should be made for maintenance

tasks and their frequency to be modified when necessary.

11.113 Counters that record the hours of operation of compressors and vacuum pumps are covered in Part A. The readings of these counters can be used in conjunction with the recommendations of the manufacturers for the modification of the programme.

Equipment checklists

11.114 Installations include a great number of AVSUs, pressure-regulating valves, filters and alarms. Equipment checklists should be prepared for each of these groups of items. AVSUs and pressure-regulating valves should be referred to by number in the checklist, and this number should correspond with that on the valve itself. It is usually convenient to arrange these checklists in such a manner that a record can be made against each valve showing whether it has been "examined", "tested" or "checked" in accordance with the PPM programme.

Exclusions from the maintenance schedules

Cryogenic liquid oxygen system inspections/ maintenance

11.115 Liquid oxygen installations are typically rented from the gas supplier under a supply agreement. This agreement should detail the regular inspections and maintenance tasks considered essential for the safe operation of liquid oxygen installations. These duties should be carried out by the gas supplier's Competent Persons in line with the gas supplier's PPM programme. This programme should be reviewed by the Authorised Person (MGPS), and any works should be completed under a PTW.

11.116 The engineer undertaking the servicing works should demonstrate their competence to the same level as a Competent Person (MGPS) and provide details of their specific training and certification on cryogenic systems.

Statutory inspections of pressure vessels

11.117 Statutory inspections of pressure vessels are not covered in the PPM schedules but should be included in the PSSR 2000 written scheme of examination for the MGPS and should be under a PTW.

Pressure safety valves

11.118 It is not recommended that safety valves are lifted; every safety valve should have a test certificate in accordance with the PSSR 2000. The safety valve should be replaced every five years under a planned replacement procedure carried out by the Competent Person (MGPS) and should be under a PTW.

11.119 Statutory obligations under the Pressure Systems Safety Regulations 2000 require the periodic testing of pressure safety devices. However, it is not appropriate to test an MGPS by either raising the line pressure regulator setting or manually unseating the relief valve. Such action could result in failure of anaesthetic equipment and, in the event of failure of the safety valve to reseat, considerable gas loss and further hazard.

11.120 Medical gas pipeline line distribution systems should be provided with a pressure-relief device downstream of the line pressure regulator connected by means of a three-way cock so that the safety device can be exchanged for a "certificated" replacement in accordance with the frequency required by the Regulations.

Electrical tests

11.121 Electrical testing should be undertaken in accordance with the current edition of BS 7671 including all current amendments and associated guidance documents. Results of these tests should be documented and kept with the appropriate plant history records

Pipeline and cylinder-connected equipment

11.122 Equipment for connection to medical gas cylinders and gas distribution systems should be subject to routine inspection and maintenance in accordance with manufacturers' recommendations and, where appropriate, it should be subject to PPM (advice is given in the Medicines and Healthcare products Regulatory Agency's (MHRA) (2021) 'Managing medical devices: guidance for health and social care organisations').

Filters

11.123 Filters on MGPS should be changed at intervals recommended by the manufacturer. If the filter becomes wet, or the pressure drop across the filter exceeds the suppliers' specification, this frequency should be increased.

11.124 A filter change procedure for vacuum system bacteria filters is given in this section.

11.125 These units should be serviced in accordance with suppliers' specifications.

Blenders

11.126 Maintenance should be carried out in accordance with manufacturers' instructions. Care should be taken that a single failure of any component in a blender does not put the systems at risk of backfeeding gas from one system into another (for example, failure of a non-return valve allows the gas to be fed into the alternative supply causing a risk to the contamination of the pipeline system).

11.127 Where blenders are used, the Authorised Person (MGPS) should be informed and they should examine the possibilities of the risks of cross-contamination.

11.128 In such circumstances, the blenders should not be connected to the pipeline system but be fed from a separate cylinder supply.

Compressed-air dryers and PSA columns

11.129 Air-dryer desiccant or PSA-column molecular-sieve charges should be replaced with the appropriate material at intervals recommended by the supplier, or if the material has been proven ineffective.

11.130 A record of the type, batch number of desiccant and date of change should be kept.

11.131 It is essential that the quality of gas from PSA and medical air compressors is tested at least quarterly, in accordance with the procedures in Part A.

Terminal units

11.132 Although terminal unit maintenance is listed as a quarterly task, the actual frequency of maintenance should be specified by the healthcare organisation, taking into account the amount of daily use the terminal units undergo and also the age and design of the terminal units.

11.133 As a minimum, the work should be scheduled such that all terminal units are serviced during each service visit and extra visits are scheduled to gain access to those terminal units in use and unable to be tested.

Daily/weekly tasks

11.134 It is the responsibility of the Authorised Person (MGPS) to organise any necessary daily/weekly maintenance on the pipeline.

11.135 It will be necessary to consult equipment suppliers and/or their equipment technical data to establish daily/weekly (or any other interim) maintenance tasks required to keep systems in good running order. In the absence of such information, the Authorised Person (MGPS) should devise these tasks.

11.136 As a minimum, the following should be checked and any deficiencies or remedial action required should be notified to the Authorised Person (MGPS).

Daily – general tasks:
Check the status of all plant alarms to ensure that there are no untoward alarms.
Weekly – general tasks:
Check all local alarm panels, correct function, and display.
Check all plant and manifold pressure gauges and visual indicators for abnormal conditions, absent displays or damage.
Check all plant for unusual noises, signs of overheating, vibration etc.
Check plant oil levels and auto drains including oil–water separators.
Check that plantrooms, manifold rooms and cylinder stores are free from combustible material and have adequate access for maintenance, and natural ventilation is not obstructed and clean.
Check all manifolds for security, heating and lighting.
Check all manifolds for cylinder dates.
Check all manifolds for cylinder contents.
Check all manifolds for spare cylinders within the manifold room.
Check that all cylinders are properly stored/secured in all storage areas.
Monthly – general tasks:
Safety notices – check that appropriate notices are clearly displayed in all plantrooms and cylinder stores. “No smoking” notices – check that they are clearly displayed.
Discharge points/vents/vacuum/AGSS – check that warning notices are clearly displayed. Check that motor guards are in position and in good repair.
Notices warning of automatic start/stop – check that they are in position and legible.
Check that all cylinder batch labels are correct and in date.
Specific daily tasks for VIE plant:
Check the system for ice build-up. De-ice as required.
Check and record the vessel pressure and contents.
Check and record the pressure of the pipeline.
Check and record the pressures of the cylinders on the secondary manifold are above 50%.
Ensure that the compound is clean and secured and that lights function correctly.
Specific weekly tasks for VIE plant:
Check the system within the compound for obvious signs of leaks, and check for mechanical damage.
Check that the vessel(s) is (are) operating at normal working pressures, and record these. Check that the plant output (pipeline) pressure is at normal, and record this.
Ensure that there is no build-up of rubbish/flammable material within the vessel compound.
Specific weekly tasks for medical gas plant:
Check plant control panels to ensure there are no alarm conditions.
Check and record hours run for each compressor/pump.
Visually check all plant for security and any sign of oil leakage.
Check that oil level is correct and free from emulsification.
Manually open discharge valves on all drains in turn and leave open for a few seconds to ensure that the automatic drains are functioning correctly and that there is no build-up of fluids in the systems.
Check dryer control panels to ensure there are no alarm conditions.

Check bacteria filter and vacuum pump exhaust drainage flasks to ensure no liquid is present.
Ensure compressors/pumps are in “auto” mode.
Record running current of duty compressor.
Record compressor cut-in and cut-out levels on compressor control panel gauge. Ensure both compressors are left in “auto” mode.
Check the dryer control panel to ensure there are no alarm conditions.
Operate the dryer selector switch and ensure correct operation by monitoring while compressor is running online.
Specific weekly tasks for vacuum plant:
Check pump motor and plant control panels to ensure there are no alarm conditions. Check and record hours run for each pump.
Visually check all pumps for security and any signs of oil leakage.
Ensure vacuum pump oil level is visible between the top and bottom edges of the oil level sight glass or oil appears cloudy.
Check bacteria filter and vacuum pump exhaust drainage flasks to ensure no liquid is present. Inform the Authorised Person (MGPS) if there is liquid present.
Record vacuum cut-in and cut-out levels on duty pump gauge. Record running current of duty pump.
Ensure pumps are in “auto” mode.
Change over duty and standby pumps by use of “duty select” switch, if not automatic.

Routine testing and maintenance of VIEs/ liquid cylinder systems

11.137 Agreement between the hospital and the medical gas supplier should ensure that the VIE/liquid cylinder system and associated equipment are maintained in a safe and compliant manner.

11.138 Although the gas supplier retains the responsibility for the maintenance of the VIE/ liquid cylinder system, routine inspections are to be carried out by healthcare facility staff on a daily and weekly rota, to ensure that the system is operating correctly.

11.139 Pipework and valves carrying the cryogenic liquid may ice up. A procedure needs to be in place to ensure that the systems are kept free of ice build-up and any valves necessary to be operated to maintain safe working conditions are available for use at any time.

11.140 The de-icing frequency will vary under specific flows and temperatures. Therefore, this should be a part of the daily task list.

11.141 The alarm system should be tested regularly in accordance with the documented healthcare facility’s procedures and be subject to risk assessment.

11.142 To test the alarm system, each alarm condition should be initiated by the operation of a pressure switch. The control panel should be supplied with a built-in test facility that allows the pressure switches to be checked.

11.143 The high line pressure alarm requires specialist test equipment, and the gas supplier should normally be contacted to carry out this test.

Operational test of secondary supply system for VIE (liquid cylinder and compressed gas manifolds)

11.144 Where a cylinder manifold system is installed as the secondary system, the Competent Person (MGPS) should ensure that this is tested to come online in the event of a VIE failure in conjunction with the supplier or the Authorised Person (MGPS). This should be undertaken annually.

11.145 At a frequency agreed with the gas supplier, the primary system should be shut down by isolation of the appropriate valves such that the operation of the secondary supply system and associated alarms can be checked. The procedure should be carried out by the gas supplier and should be supervised by the Authorised Person (MGPS) under a PTW.

Operational test of compressed gas cylinder emergency supply systems for independent wards and departments

11.146 At a frequency agreed with clinical and nursing colleagues, the Authorised Person (MGPS) should perform or supervise the closure of AVSU pipeline isolation valves to areas supported by emergency supply system manifolds, and the correct operation of the manifold systems and any associated alarms should be confirmed.

11.147 Following all operational tests, the systems should be returned to normal operating mode, and levels of stock in primary, secondary and tertiary supplies checked to ensure no major loss has occurred.

11.148 All alarm systems should be checked for correct indications during and following the tests.

11.149 All operational tests should be detailed in the MGPS OP.

Operational test of "emergency supply kits"

11.150 This should be carried out on a quarterly basis.

11.151 Each kit should be capable of providing the required gas flow without excessive pressure drop or leakage.

11.152 On an annual basis, the kits should be examined for damage to hoses and fittings, and components replaced as required.

11.153 Any further tests or component replacements that may be required under the Pressure Equipment Regulations 1999 should be determined and documented in the MGPS OP.

Quarterly tasks – introduction and safety

11.154 The procedures and checklists below may be used in conjunction with manufacturers' data to prepare quarterly and annual maintenance schedules for MGPS plant and system components.

11.155 MGPS alarms will often be triggered by necessary work on the system; for example, it may be necessary to replace the transducers or batteries.

11.156 To minimise disruption to patient services, all clinical staff should be made aware of work on the pipeline and any alarms that may result. However, it is also essential that any alarms reported during the work are not dismissed as spurious, as they may represent system fault conditions unrelated to the work in hand.

11.157 All work should be covered by an appropriate PTW.

Manifold systems – introduction and safety

11.158 Work on automatic manifolds will necessitate maintaining the healthcare facility's supply from the associated ERM.

11.159 It is essential, therefore, that correct operation of the ERM is confirmed before it is used as the sole means of supply. It is recommended that the ERM should be tested in line with PPM requirements prior to being used in this scenario.

11.160 The capacity of the ERM will be much less than that of the automatic manifold it supports. Therefore, adequate stocks of replacement cylinders should be on hand during these procedures, in association with

appropriate levels of labour needed to effect cylinder changes.

Manual ERMs – general

11.161 The structure of the ERM will vary according to the age of the unit.

11.162 . If the ERM is not fitted with header-isolating valves (usually hand-wheel types), one bank of cylinder valves must be kept closed during normal operation. On exhaustion of this bank (typical changeover pressures are between 1200 and 1500 kPa), the other bank's cylinder valves should be opened and the "empty" cylinder valves should be closed. The empty cylinders can then be replaced after ensuring all cylinders are full and the valves must remain closed until required.

11.163 On ERMs fitted with header-isolating valves, both cylinder valves are kept open during normal use, and changeover is affected by use of the high-pressure valves (one being kept open and one closed).

11.164 Many manual ERMs are fitted with only one cylinder per side as the backup supply and therefore the cylinder contents should be observed throughout the time this manifold is online.

11.165 The ERM should be fitted with pressure safety, main isolating and non-return valves (NRVs). The main ERM isolating valve should be kept "open" during normal use.

Automatic ERMs – general

11.166 A fully automatic manifold in support of a medical air compressor or VIE is generally identical in construction to those manifolds used in primary supply systems. The standard manifold maintenance procedures will therefore apply

11.167 An automatic ERM should have its own full column on the alarm system to monitor the manifolds full functions rather than a single fault indication.

Manual ERM maintenance tasks

11.168 The appropriate personnel should be notified and signage displayed at plant alarms to indicate that the medical gas system is to be tested and that alarms are likely to occur.

1. Ensure that: when the duty automatic manifold is running, all manifold cylinders are full or contain sufficient gas to undertake the tests; all system pressures are normal (that is, line pressure 4 bar, cylinder pressures are either 137 bar or 200 bar, depending on cylinder supplier and manifold type); all alarms are showing green “normal”; the automatic manifold main isolating valve is open; and the manifold is supplying the hospital.
2. Close the isolating valve on the ERM slowly and confirm that there is no effect on the line pressure to the hospital. Leave for a minimum of 5 minutes. Visual inspections can be undertaken during this period.
3. Visually check all components for security, condition and wear and tear. Inspect cylinder restraints. Ensure each cylinder is individually secured. Tighten, repair or replace restraints as required.
4. Open all cylinder and header-isolating valves, and leave for 30 seconds. Check that the ERM safety valve is not passing by soap testing the exhaust. Where the exhaust is not accessible, disconnect the downstream exhaust coupling and test for gas leakage at that location.

   Replace the valve with a sealed, certificated unit if passing and repressurise the system, then re-test. Visually inspect the exhaust outlet point for security, signage and cleanliness. Ensure that the local environment has not changed in a manner that could cause the exhaust location to present a hazard.

   Check that no-smoking signs are present and clearly visible.
5. Open the line valve to the test point, remove the “Do not use” plug and connect the test gauge. Open all valves and cylinders and fully pressurise the system. Isolate the cylinders and observe the test gauge for a minimum of 10 minutes for leakage; a soap leak test may accompany this test but not replace it. Ultrasonic leak detectors can speed up the process but do not replace the need for the static test.

   Any pressure drop indicates a leak. This should be found and rectified, then the system should be re-tested.
6. Close one cylinder valve and detach the pin-index yokes in turn slowly from the cylinders. Listen for a leak from the tailpipe. A minor weep is permissible and likely, but an obvious major leak denotes failure of the tailpipe non-return valve (NRV). If the latter happens, do not totally detach the tailpipe but instead retighten it and test other tailpipes in the same way. On completion, any failed units should be replaced. Repeat this test when the new NRVs have been fitted. Close all cylinder valves.
7. Open one cylinder valve and ensure full flow through the regulator, testing the flow through the test point. Ensure that the flow does not reduce the pressure below 3.5 bar.
8. Open one cylinder valve and check the static pressure of the regulator (should be approx. 3.7 bar). Observe this pressure for 5 minutes to ensure that there is no regulator creepage. Creepage will necessitate regulator service or replacement and a repeat of this test.
9. Test the “reserve low” alarm pressure switches by operating each contents pressure switch in turn:

   Close all cylinders and, using one side of the manifold in turn, apply a flow to the test gun and observe the falling pressure on the inlet pressure gauge. When the pressure falls to 50% of the nominal full-cylinder pressure for compressed gas cylinders, or 14 bar for liquid-filled cylinders, the pressure switch should close and initiate the “Reserve low” alarm on both the automatic panel and the primary alarm system. Adjust or replace pressure switches as necessary. Repeat the procedure for each pressure switch on each bank.
11. Test the NRV by isolating the ERM supplies and drain. Observe the test gauge to ensure that there is no increase in pressure. Replace the NRV as necessary.
12. Finally, open all cylinder valves and perform a final static leak test on the complete system for 5 minutes. Remove any leak detection fluid following completion of the test.
13. With all cylinder/isolating valves in their normal operating positions, open the primary ERM isolating valve and verify that there is no effect on line pressure.
14. Isolate the test point isolator, remove the test gauge and insert the “Do not use” plug.

The ERM is now ready for use.

Automatic manifold maintenance tasks

11.169 Before proceeding with these tests, the ERM should be confirmed to be fully tested as described above.

11.170 The appropriate personnel should be notified and signage displayed at plant alarms to indicate that the medical gas system is to be tested and that alarms are likely to occur.

11.171 All manifolds should be able to supply gas with or without an electrical supply. Individual manifolds, however, may differ in the way in which this is achieved and the alarm conditions that will show in the event of a power failure.

11.172 Local variations should be noted for future reference, as it is not normal to test the manifold under power failure conditions.

1. Confirm that the ERM has full cylinders connected, that its cylinder and header-isolating valves are in the correct operating positions, and the ERM isolating valve is open. Slowly increase the pressure of the ERM to take up the line pressure feed.
2. Close the primary (automatic) manifold isolating valve slowly and ensure that the ERM output pressure (line pressure) is maintained before proceeding with the primary manifold tests. Adjust the ERM pressure as required, usually set at 0.1 bar above the ACM during servicing.

   Monitor the ERM cylinders constantly throughout the servicing of the ACM to ensure that there is no risk to the system supply. When a heavy system flow is anticipated, a second operative should be available to monitor the ERM and change cylinders as required.

   Make a note of which side of the ACM is online so as it can be returned to the correct configuration on completion.
3. Visually check all components for security, condition and wear and tear. Inspect cylinder restraints. Ensure each cylinder is individually secured. Tighten, repair or replace restraints as required.

   Some panels are fitted with heaters, usually on the high-pressure feeds to the regulators. These thermostatically-controlled units help prevent condensation and/or freezing of regulators/pipework under high gas-flow conditions.

   Liquid cylinder-fed manifolds are particularly prone to this problem and are often fitted with these heaters. Verify heater operation, taking care as exposed surfaces may be hot enough to cause burns. Note that the heater may be switched off, or the system temperature may be above the thermostat cut-in temperature. Where heater failure is suspected, confirm by appropriate electrical testing.
4. Open the line valve to the test point, remove the “Do not use” plug and connect the test gauge.
5. Open all cylinders and header-isolating valves, and leave for 30 seconds. Check that the ACM safety valve is not passing by soap testing the exhaust. Where the exhaust is not accessible, disconnect the downstream exhaust coupling and test for gas leakage at that location. Replace the valve with a sealed, certificated unit if passing and repressurise the system, then re-test.

   Visually inspect the exhaust outlet point for security, signage and cleanliness. Ensure that the local environment has not changed in a manner that could cause the exhaust location to present a hazard.

   Check that no-smoking signs are present and clearly visible.
6. Open one cylinder valve on one side of the ACM and ensure full flow through the regulator testing the flow through the test point. Ensure that the flow does not reduce the pressure below 4.0 bar. Adjust the static flow to compensate where required, drop the pressure and repeat on the other side of the ACM.
7. Open one cylinder valve on each side of the ACM and check the static pressure of each regulator (should be approx. 4.2 bar). Observe this pressure for 5 minutes to ensure that there is no regulator creepage. Creepage will necessitate regulator service or replacement and a repeat of this test.
8. Close all cylinders and using one side of the manifold in turn, apply a flow to the test gun and observe the falling pressure on the inlet pressure gauge. When the pressure falls to a maximum of 14 bar, the pressure switch should close, initiating a “change cylinders” alarm on both the automatic panel and the primary alarm system. Adjust or replace switches as necessary. Repeat the procedure for each pressure switch on each bank.
9. Test the NRV by isolating the ACM supplies and drain. Observe the test gauge to ensure that there is no increase in pressure. Replace the NRV as necessary.

10. Close all cylinder valves on both banks and observe the control panel cylinder pressure gauges and the test gauge for a minimum of 10 minutes for leakage; a soap leak test may accompany this test but not replace it. Ultrasonic leak detectors can speed up the process but do not replace the need for the static test.

    Any pressure drop indicates a leak. This should be found and rectified, then the system should be re-tested.

11. Isolate one cylinder in turn and disconnect the tailpipe to check the tailpipe NRV.

    A minor weep is permissible and likely, but an obvious major leak denotes failure of the tailpipe NRV. If the latter happens, do not totally detach the tailpipe but instead retighten it and test other tailpipes in the same way. On completion, any failed units should be replaced. Repeat this test when the new NRVs have been fitted. Close all cylinder valves.

12. Drain all gas from the manifold via the test point. On the left-hand bank, slowly open the cylinder valve nearest to the control panel sufficiently to repressurise the panel and force the manifold into “left bank running” mode, then isolate the cylinder. Momentarily open a cylinder on the right-hand bank to clear the right-bank “empty” indicator, then close the cylinder valve. Apply a small bleed via the test gauge.

    Drop the pressure until changeover occurs, and record:

    a. changeover pressure (that is, to right bank) – not to be over 14 bar

    b. correct operation of manifold panel and alarm system indicators, that is, on the manifold panel:

    - left-hand bank “running” indicator will extinguish
    - left-hand bank “empty” indicator will illuminate
    - right-hand bank “running” indicator will illuminate
    - control panel alarm status indicators and main alarm panel indicators will show “change cylinders”, accompanied by an audible alarm on the main alarm panel.

    Mute the alarm at the panel.

    Continue to drop the pressure, noting the pressure at which the manifold indicator shows “low” (yellow) on the right-hand bank and at which both the alarm status and main alarm panel indicators show “change cylinders immediately”. This will also be accompanied by an audible alarm. Mute this alarm at the panel.

    Continue to drop the pressure until the low-pressure alarm is activated. Record the pressure. This should be a minimum of 0.1 bar above the ERM final static pressure setting.

    Close the leak and slowly open up one cylinder valve. Note the pressure at which the “low pressure” indicator clears.

    Open all cylinders on the manifold and return to normal running and check that all indications return to “normal” status.

13. Repeat (12) above commencing with the right-hand bank to ensure that the manifold operation is correct on both sides.

14. With all cylinders open, ensure that the manifold is running on the correct side (the side it was on prior to commencement of the maintenance task).

15. Finally, open the primary manifold isolating valve slowly and reduce the ERM pressure so that the manifold takes over the supply to the system.

    Confirm that the manifold begins to supply gas and the ERM shuts down. Check the pressure settings of both the ERM and the ACM. The ERM should be set to come online as the low pressure of the ACM initiates.

Compressed-air plant maintenance tasks

Note:
The maintenance regime for compressors supplying air for endoscope reprocessing should equal that for other medical air compressors.

11.173 A full test of the medical compressed-air units will require isolation of plant before work. It is therefore absolutely essential that the ERM be tested for correct operation before proceeding with these tasks.

11.174 Great care must be taken to ensure adequate stocks of full cylinders are available for the ERM, and procedures should be carried out as carefully and safely as possible on the plant.

11.175 A fully automatic manifold, capable of coming online automatically in the event of plant failure, should be provided to ensure that the secondary supply is sufficient to maintain a safe gas supply, albeit at a reduced line pressure.

11.176 Compressors will stop/start automatically. The compressor being serviced during maintenance should be electrically isolated to prevent it being started by the central control unit.

11.177 The appropriate personnel should be notified and signage displayed at plant alarms to indicate that the medical gas system is to be tested and that alarms are likely to occur.

11.178 Due to the complexity and variations between compressor plant, the testing and servicing procedures supplied by the manufacturer should be followed in addition to the safety precautions below:

1. Confirm that ERM isolating valve is open and the ERM is able to supply air to the pipeline system and that adequate cylinders are available.
2. Where the ERM is located remotely, a second operative should remain with the ERM during all testing. The ERM should be manned in all cases for a minimum of 20 minutes on isolation of the plant to assure the safe supply of gas to the system.
3. The ERM pressure should be increased to ensure that the system pressure does not fall to the ERM pressures and is maintained at the nominal system pressure.
4. There may be multiple ERMs in place providing backup to compressor systems at different operating pressures. These may supply medical air, surgical air and dental air via pressure-reducing stations (PRS). Therefore, a detailed understanding of the system configuration is required before any work is commenced.

   The ERM requirements and management arrangements should be clearly detailed within the method statement.

Pressure-reducing stations (PRS):

Regulator sets attached to plant serving both surgical and medical air supplies should be provided with either regulating stations (receiver pressure to 7-bar; and 7 bar to 4 bar) in the plantroom or a regulating station (plant to 7 bar) in the plantroom and individual regulating stations (7 bar to 4 bar) situated local to areas where the 4-bar supply should be required. In all cases, these regulating stations should comprise duty and standby regulators and associated isolating valves (and possibly pressure relief valves and filter assemblies). Individual regulators should be tested for leakage, correct operation, and static and flow pressures. Ensure that only one regulator is online, or that one regulator is designated as the lead regulator and the other as the lag regulator.

Identification and correct labelling should be checked, and unit cleanliness should be maintained.

Central vacuum plant maintenance tasks

11.179 Whilst working on a central vacuum system, it will be necessary to maintain the vacuum supply to the hospital. Only one pump (or two on a three-pump unit) will be able to be isolated in any instance. Other pump(s) will stop and start automatically.

11.180 Relevant staff should be warned of the alarm indications and the need to provide standby supplies where loss of vacuum is considered critical.

11.181 If water or other liquids are detected in the bacteria filter drain flask(s), they should not be opened without first consulting the Authorised Person (MGPS) and the IPC team.

11.182 See next page for maintenance tasks.

1. Before isolation of pumps takes place:
   (i) Check running of cooling fans where appropriate.
   (ii) Examine exhaust drainage traps for oil carry-over. Clean out traps where necessary.
   (iii) Check the condition of all flexible pipework and associated electrical bonding.
   (iv) Check the receiver(s) for general external condition.
   (v) Check all pressure gauges for correct operation.
   (vi) Check all visible electrical components for damage/overheating.
2. Isolate one of the pumps and check the following (note that a “plant fault” alarm will probably be given at this stage; the other pump(s) should be selected as the “duty” plant):
   (i) Holding-down and fixing bolts – replace/adjust as necessary.
   (ii) Anti-vibration mountings bolts – replace/adjust as necessary.
   (iii) Exhausts (including labels), filters and silencers – replace/clean as necessary.
   (iv) Motor alignment – adjust as necessary.
   (v) Drive coupling or pulleys and belts – adjust/replace as necessary.
   (vi) Cooling coils/fans – clean/replace as necessary.
   (vii) Oil levels and oil filter – top up/change as necessary.
   (viii) Motor windings and bearings – clean/replace as necessary.
3. Repeat (2) for the other pump(s), making sure that the “duty selector” switch has been changed over from the pump on which work is due to commence.
4. Switch on both/all pumps in “auto” mode. Plant operation can now be tested.
5. Open receiver drain valve(s) and record the cut-in pressure and unloaded and loaded running currents of the duty pump(s) as applicable. For VSD plant, record the running current and stabilised vacuum level under normal load.
6. Isolate the duty pump(s) and confirm that a “plant fault” alarm is indicated.
7. Record the cut-in pressure and the loaded running currents of the standby pump(s) where appropriate. (On a three-pump unit, the second pump will cut in a few seconds after the first.)

   If plant is fitted with a backup pressure switch, the operation and set pressures of the switch can be checked now.

   Continue to drain receiver, check that the backup pressure switch operates, and record pressure settings.
8. Shut the receiver drain valve(s) and record the cut-out pressure of the standby pump(s).
9. Switch on the duty pump(s) isolator and put the standby pump(s) on manual control.
10. Record the cut-out pressure of the duty pump(s).
11. Switch the standby pump(s) to auto control.
12. Change the “duty selector” switch and repeat (6) to (12).
13. Open the receiver drain again and ensure that the duty pump(s) cut(s) in, then close the receiver drain(s).
14. Record the hours run for each pump.
15. Test the operation of the vacuum level “pressure fault” switch and respective alarm indicators by creating a small leak in the line to the switch. Record the pressure at which this alarm occurs and adjust the switch if necessary (should operate at 360 mmHg).

As vacuum pumps are protected from possible contamination by bacteria filters, the vacuum pump oil and condensate are classified as hazardous, not clinical, waste and can be disposed of in a similar manner to air compressor oil. To ensure that vacuum pump oil is not contaminated, it is important that the manufacturer’s recommendations for replacement of the bacteria filter(s) elements are followed. This is usually annually or after a specified number of hours, whichever comes soonest.

Work on medical vacuum

11.183 This section contains information on the following topics related to work on a medical vacuum system:

- working on vacuum terminal units, plant and pipelines, including pipeline removal
- changing bacteria filters on medical vacuum plant.

11.184 It should be noted that these procedures do not apply to any work on high-risk vacuum systems that may be installed in infectious disease units.

11.185 Piped vacuum systems should not be installed in such areas, but where they have been, special protocols for the work described in this section should be drawn up at local level by IPC teams and health and safety personnel.

11.186 These special protocols should also cover work on portable suction units used in infectious disease units.

Work on medical vacuum terminal units, plant and pipelines

11.187 The basic hygiene procedures outlined in this section will suffice for most work on medical vacuum systems, including removal of redundant pipework.

11.188 However, if pipework or plant to be removed is known to have been contaminated by aspirated blood, body fluids or toxic agents, the advice of the IPC team should be sought.

11.189 The protective measures described for changing bacteria filters may need to be used when removing contaminated plant or pipework.

11.190 Waste oil and condensate from vacuum pumps and exhaust traps should be disposed of as “hazardous waste” in accordance with hospital procedures.

Changing bacteria filters on medical vacuum plant

11.191 Before carrying out the work, advice should be sought from the user on any toxic or infectious materials that may have entered the system.

11.192 If it is apparent that occupational exposure limits (OELs) for toxic substances may be exceeded, the safety officer should be advised, and an appropriate air-fed respirator should be used.

11.193 All staff, including contractors, should observe local safety procedures as set out in the healthcare organisation’s safety policy.

11.194 The MGPS PTW procedure in this HTM may be used for general work on vacuum systems.

11.195 See also Appendix D for an additional PTW when changing bacteria filters. This second PTW allows for the intervention of the IPC team and health and safety officer in cases where additional infectious or toxic hazards have been identified.

Preparing for the work

11.196 Two heavy-duty polythene bags should be provided.

11.197 All staff should wear the following protective clothing when carrying out a filter change:

- disposable mask
- disposable apron, which should be discarded after use in the outer bag for disposal
- disposable gloves made of strong latex or other non-allergenic material
- safety goggles.

11.198 Disposable overshoes should be worn if required by the hospital.

Filter and protective clothing disposal

11.199 The used filter is placed directly into a heavy-duty polythene bag, which is then sealed.

11.200 This bag is placed, with the gloves, mask and overalls, inside a second bag, which is also sealed and labelled: “Clinical waste – to be incinerated”.

11.201 Staff carrying out the filter change should notify the waste disposal department or the Authorised Person (MGPS), as appropriate, so that bags can be collected and disposed of.

11.202 A sample SOP for filter changes and a filter change procedure suitable for posting on/near vacuum plant are shown in Appendix D.

AGSS maintenance tasks

11.203 Anaesthetic gas scavenging is the removal of waste anaesthetic gases from the patient's breathing circuit. Unnecessary exposure to the gas stream should be avoided, and maintenance should not be undertaken while the system is in use. AGSS maintenance is undertaken quarterly with annual recommissioning. The annual recommissioning procedures are covered in Chapter 19 of Part A as part of the validation and verification of the AGSS.

11.204 No part of an AGSS should be in use with patients or connected to anaesthetic equipment during testing. Such testing should confirm that the performance of the system and terminal units complies with specification.

11.205 Terminals should be fully dismantled and cleaned, and flows tested on an annual basis to coincide with the annual recommissioning of the system.

11.206 AGSS maintenance tasks include the following:

1. Ensure pump-securing bolts are tight – adjust if necessary.
2. Ensure that flexible pipework and any associated electrical bonding are in satisfactory condition. Replace as necessary.
3. Confirm operation of "mains on" and "running/normal" indicators.
4. Examine the exhaust terminals for occlusion and the exhaust drainage bottles for oil carry-over/condensation. Clean as necessary. Confirm terminal warning signage is in place.
5. Where a duplex system is fitted, isolate the duty pump and confirm that the standby pump cuts in. This action may be accompanied by a "pump failure" alarm, depending on the age and type of the system.
6. Change over the "duty select" switch and repeat (5).
7. Locate the flow-regulating valve and clean out the filter.
8. If the system is fitted with a low-flow detector, momentarily disconnect the feed pipe to the sensor and confirm that a "system failure" alarm is given.
9. In the theatre area, check for correct operation of alarm indicators as the above tests proceed. It may be possible to test the "system failure" alarm by turning off the unit at the theatre control panel for about 30 seconds. Switching on should cause a "system failure" indicator to display. This should clear within a few seconds of switching on (depends on the system).
10. Where the pump has additional controls (for example, PIRs), check the functionality of activation and deactivation including time lag.
11 Individual flow measurements should be taken and checked from all terminal units at both the high and low settings.
Note: If condensate is detected in the exhaust drain flasks, causes for its formation should be investigated and remedial action taken if appropriate. This condensate should be considered and disposed of as "hazardous waste".

Alarm panel maintenance tasks

Continuous muting

1. Check each panel and any visible connecting cables for external damage/deterioration.
2. Push the “test” button and ensure that indicators/displays are clear and visible and an audible alarm is sounding.
3. Disconnect the mains electricity supply and confirm that a “system failure” indicator is initiated together with an audible alarm.
4. With the electrical supply still disconnected, open the alarm panel and examine the interior for loose, damaged components and the external condition of the battery. Any corrosion should be removed and the source identified. Battery replacement should be in accordance with manufacturers’ instructions.
5. On closing the panel and reinstating the mains supply, all alarms should return to the “normal” condition.
6. Remote alarms should be checked such that they mirror the functionality of the master alarm.
7. Low alarm condition set-points should be checked annually.

11.207 If an alarm condition is to be present for a long time (for example, during work on a system that is depressurised), the audible alarm, which normally resets (after muting) every 15 minutes, may be disabled by opening the panel and pressing the continuous mute button (see Chapter 14 in Part A).

MGPS pipework and pipeline components maintenance tasks

11.208 When inspecting pipeline components such as valves, particularly those that are left unlocked, great care must be taken to prevent inadvertent isolation of supplies.

11.209 In the case of nitrous oxide and oxygen/nitrous oxide mixture, additional consideration should be given to detecting leaks. An annual system pressure test should be undertaken according to the criteria detailed in Chapter 19 of Part A.

General distribution system

- Only sections of pipework visible during normal PPM should be inspected within plantrooms and manifold rooms.
- When there are other tradespeople working in areas where there are exposed medical gas pipelines, a separate inspection is required following completion of the works.
- A routine inspection of the whole pipeline system is not necessary following an initial full inspection of the pipelines where a list of higher risk locations would be reported and an inspection regime put in place.
- This should be undertaken under a risk-based inspection, and a policy and procedures document should be produced listing the pipelines, locations and risks. From this the inspection, the frequency should be agreed and should be undertaken and documented.
- External exposed pipeline should be inspected at least annually.
- Internal pipeline exposed in risers or corridors should be inspected at least annually.

Check for:

- Damage, especially serious abrasion, flattening of pipework, and corrosion caused by chemicals, water leaks or bird droppings.
- Absence of, or damage to, pipework protection methods, especially damage to ductwork and sleeving/mechanical shielding.
- Security of/damage to electrical bonding.
- Leaks – in any area, from fittings, etc.
- Damage to, or removal of, fire-stopping.
- Absence of, or painting over of, exhaust/blow-down and pipeline identification labels, flow direction arrows, valve box labels, etc.
- Breaches of security to MGPS plantrooms, AVSUs, LVAs, valves, VIE compounds, etc.
- Accuracy of as-fitted drawings, identification markings, labelling, etc.

AVSUs, valves and LVAs

11.210 LVs and LVs on plant and equipment are not normally locked, but the room door should be.

11.211 Valves in plantrooms not on the plant should be locked.

11.212 Valves in ducts should be kept locked in the normal operating condition. All AVSUs should be kept locked, and keys should be subject to a key control system.

Examine cleanliness – clean as required. (AVSUs should have an agreed cleaning schedule; a five-yearly internal inspection and clean should be adequate.)

Check correct labelling – rectify, as necessary, orientation of on/off valves for ease of operation. These inspections are required following any works on the system and on a five-yearly rotation.

PRS maintenance tasks

1. Examine the condition of the complete assembly.
2. Check each regulator for leakage, creepage and flow.
3. Alternate lead and lag regulators.
4. Check the functionality of transducers, alarms and low-pressure set-points.
5. Check all valves are left in the open position.

Medical supply units

Examine security of fixings/mountings, freedom of movement (as applicable), labelling and colour-coding of hose assemblies.
Terminal units should be tested in line with the main terminal unit section.
It is not possible to ascertain the condition of hose assemblies by visible means. They should therefore be assigned a service life of five years.
Hoses should be replaced within a five-year period.
Inspection of pendant fixings and mounts should be carried out at the same time as hose replacement.
Tasks required to test the performance of pendants will depend on the design of the system. In each case, the full range of performance characteristics should be covered. For example, some pneumatically controlled pendants have rotational as well as vertical movement, and this should be tested; the braking system (where applicable) and the fail-safe devices (such as remote controllers) should also be covered. The advice of the manufacturer should be followed.

Terminal units in all locations (excluding AGSS)

11.213 Terminal unit probes, particularly those attached to high-pressure hoses, can be ejected from the terminal unit with considerable force. Therefore, pn robes and equipment should be restrained or supported during removal from a terminal unit to prevent damage or injury. All terminal units should be tested quarterly.

1. Insert a blank probe and test for gas-specificity, mechanical function and leaks. (The probe should not swivel in a wall-mounted terminal unit but must be free to rotate in a pendant or boom-mounted terminal unit, where applicable.)
2. Test the terminal unit for correct flow and pressure drop using a test instrument (see Chapter 4 in Part A for pressures to be achieved at defined terminal unit flow rates under design flow conditions).

Vacuum system decontamination

11.214 Suction controllers are fitted with integral filters and floats to prevent aspirated fluids from passing into the vacuum system pipework. Additionally, fluid drainage jars are fitted with floats and are often used in conjunction with an anti-foaming agent to prevent carry-over.

11.215 Drainage jar-to-suction controller tubing is frequently protected by the addition of a hydrophobic filter, which will effectively seal the tube should the filter become wet.

11.216 Contamination of the medical vacuum distribution system may result, however, if one or more of these features is omitted or compromised in some way.

11.217 Repetitive induction of fluids can cause a blockage of the pipeline as transported and dissolved solids dry out.

11.218 It is important that the Authorised Person (MGPS) is notified immediately of any incident involving contamination of the pipeline. Medical staff should be aware of their responsibilities in this respect, and the IPC team should also be advised of any contamination incident.

11.219 Removal of system contaminants requires the use of a detergent/disinfectant solution, which is aspirated via terminal units or NIST connectors. Teepol can be used. Satisfactory results have also been obtained by using an appropriate quantity of sodium dichloroisocyanurate sterilising tablets added.

11.220 Previous decontamination procedures have recommended circulation of the cleaning fluid towards the central plant using the system vacuum. However, if it is possible to circulate the fluid via terminal units and a local AVSU NIST connector, using a pump, this method is preferred, as it will limit contamination to the local pipework. This is particularly important in older systems employing terminal unit drops from beneath distribution pipework, rather than the up-and-over arrangement prescribed in this HTM.

11.221 In some instances, blockages may be so severe as to cause complete restriction of the pipework. In these circumstances, the risks associated with using high-pressure fluid pumps must be weighed against the disruption that will result from pipework removal and replacement.

11.222 If pumps are to be used, fluid should be fed into the system via the upstream NIST connector of the AVSU serving the area (with the AVSU isolated) and extracted via the contaminated terminal unit(s).

Procedure for vacuum system decontamination using the system vacuum

a. Inform the Authorised Person (MGPS) of the incident.
b. The Authorised Person (MGPS) raises a PTW for taking other downstream terminal units out of service if possible.
c. Establish, in consultation with surgical or clinical practitioners, the possible nature and volume of the contaminant.
d. Consult the IPC team to ascertain the level of microbiological hazard, including the pathogenicity and persistence of any infectious agents.
e. From a study of the as-fitted drawings, identify any downstream terminal units that may be flooded during the cleaning process.
f. A solution of 1% Teepol or Savlon plus sodium dichloroisocyanurate in about 10 L of hot water should be prepared.
g. Aspirate 1 L of solution through the terminal unit immediately upstream of the contaminated unit and maintain a low flow via a suction controller.
h. Aspirate 5 L of solution via the contaminated terminal and maintain a low flow.

i. Aspirate 0.5 L through each of the next ten terminal units (or as specified) and maintain a low flow.
j. Check other downstream terminal units for the presence of solution. Where found, repeat the procedure.
k. Repeat the whole procedure using clean hot water.
l. Take the system back into use.
m. Check plant filters for evidence of fluid.
n. Where present, change the bacteria filters.
o. Monitor the system for a few days, with vacuum control units fitted, for evidence of liquid.

Procedure for vacuum system decontamination using a fluid pump

a. Inform the Authorised Person (MGPS) of the incident.
b. The Authorised Person (MGPS) raises a PTW for isolation of the local AVSU.
c. Establish, in consultation with surgical or clinical practitioners, the possible nature and volume of the contaminant.
d. Consult the IPC team to ascertain the level of microbiological hazard, including the pathogenicity and persistence of any infectious agents.
e. From a study of the as-fitted drawings, identify any downstream terminal units that may be flooded during the cleaning process.
f. A solution of 1% Teepol or Savlon plus sodium dichloroisocyanurate in about 10 L of hot water should be prepared
g. Using the fluid pump, circulate disinfectant solution via the AVSU's NIST connector through the system to exit via the contaminated terminal unit (which is fitted with a suitable open probe and disposal hose).
h. Other downstream terminal units should be checked for the presence of solution. Where found, each should be flushed in a similar manner.
i. Repeat the procedure using clean hot water.
j. Ensure that the pump removes as much water as possible from the system.
k. Take the system back into use, with the cleaned terminal units maintained on low flow via suction controller regulators.
l. Check plant filters for evidence of fluid.
m. Where present, change the bacteria filters.
n. Monitor the system for a few days, with vacuum control units fitted, for evidence of liquid.

Appendix A – Sample operational policy

A1 It must be emphasised that the policy on the following pages is not definitive, being only one approach of the many possible.

A2 Where appropriate, the text is broken, and explanation or prompts for further consideration are inserted in italics.

[Premises]

Operational policy and procedures for the management of medical gas pipeline systems

Preparation date ...../xx

Review date ..... /xx

Issue no 1

This copy no 1

Hospital publication reference no .....

This copy belongs to .....

Tel no .....

Distribution list:

Contents

[To be completed on completion of body of document.]

Policy statements

This policy addresses the provision of a piped medical gas pipeline system (MGPS) in [*name of site*].

The MGPS provides a safe, convenient and cost-effective supply of medical gases to points where these gases can be used by clinical and nursing staff for patient care.

[*Premises*] management recognises its commitment to maintaining the MGPS to required standards and the training of all personnel associated with its operation.

Scope of policy

This policy is intended for use by all staff involved with MGPS in [*name of site*]. [*Further sites can be added here if within the area of responsibility of the Authorised Person (MGPS) or covered by this policy.*]

It applies throughout the [*premises*] to all fixed MGPS and [*list of plant and areas, for example dental, HSSD, where MGPS may be installed*].

Compressed gas and vacuum supplies to general engineering workshops and pathology department equipment are separate from the general MGPS, and are not included in this policy, although the general principles in this document should be followed for these departments.

MGPS terminal units define the limits of Estates' [*or other organisation*] responsibility in this policy.

Equipment connected to the terminal units is not covered by this policy other than where its mode of use may affect system operation or safety.

Medical equipment is not included other than where its mode of use may affect system operation or safety (for example, CPAP ventilators and pneumatic surgical equipment).

Medical equipment is the responsibility of the [*name of department/organisation*].

Medical gases should not be used for non-medical purposes other than as a test gas for medical equipment. Medical air should be used as the power source for ventilators; the routine use of oxygen as a driving gas should be avoided.

MGPS management responsibility for [*premises*] resides with the [*usually Estates*] department.

It is [*premises*] policy that, before work on the MGPS can commence, a PTW form signed by an Authorised Person (MGPS) must be completed, with the addition that the Designated Clinical Officer should sign it to give their permission for all works interrupting and/or being completed in clinical areas.

Responsibilities

ROLE	RESPONSIBILITY
Executive Manager	Ultimate management responsibility for the MGPS rests with the [site name] healthcare facility's Executive Manager. The Executive Manager herein delegates management responsibility for the MGPS to the Director of Estates and Facilities (Designated Person).
Designated Person	The [name/job title] is the Designated Person and they will be responsible for the selection, assessment and appointment of the Authorising Engineer (MGPS). The Designated Person appoints Authorised Persons (MGPS) on the recommendation of the Authorising Engineer (MGPS). They will work closely with the Senior Operational Manager to ensure that provision and support is made available to adequately support and ensure the governance of the MGPS.
Senior Estates/ Operations Manager	Holds responsibility for the integrity of the MGPS The SOM should also monitor the implementation of the MGPS OP The SOM should carry out due diligence on the healthcare organisation's contracted Authorising Engineer (MGPS) to ensure they meet the criteria as an Authorising Engineer (MGPS) and hold copies of the Authorising Engineer's (MGPS) certificates and records.
Chief Pharmacist	The Chief Pharmacist at [site name] will have responsibility for governance of the MGPS, prescribing and use of medical gas covering both the bulk gas as well as cylinder supplies. This includes its procurement, prescribing, handling, approving and appointing the Quality Controller and SLA: • Ensure that bulk and cylinder gases comply with the relevant monographs of the British Pharmacopoeia and that other gases and gas mixtures comply with manufacturers' product licences. • Contract for the supply of medical gases including the supply cylinders of medical gases and special gas mixtures for the wards and departments and manifolds. • Processing delivery notes for medical gases, checking invoices and passing for payment. • Provision of a system to monitor stock control including the location of cylinders, quantity available, type, cylinder size and maintaining sufficient stock levels of gases. • Ensure that medical gases as a prescriptive drug are prescribed correctly, and suitable records are maintained, working with prescribers and nursing staff to ensure that suitable provision is made for patients who need oxygen at home at discharge. • Periodically checking calibration records of QC test equipment and records of all QC tests performed for piped supplies by the Quality Controller (MGPS). • Oversight of audit, including stock, location, usage, maintenance, clinical incidents, reported via the MGSG to the Medicines Oversight Group, surveillance of prescriptions. • It is the responsibility of the Chief Pharmacist to appoint a Quality Controller (MGPS).

ROLE	RESPONSIBILITY
Authorising Engineer (MGPS)	The duties and responsibilities of the Authorising Engineer (MGPS) are: • to recommend to the Director of Estates and Facilities those persons who, through individual assessment, are suitable to be Authorised Persons (MGPS) • to ensure that all Authorised Persons (MGPS) have satisfactorily completed an appropriate training course • to ensure that all Authorised Persons (MGPS) are reassessed every three years and have attended a refresher or other training course before such reassessment • to review the management systems of the MGPS, including the PTW system • to monitor the implementation of the OP and procedures • To carry out an annual audit of compliance to HTM 02-01 and associated standards and regulations.
Coordinating Authorised Person (MGPS)	The duties and responsibilities of the Coordinating Authorised Person (MGPS) are the responsibility of the [name/position] (MGPS): • will cover the role as one of the Authorised Persons but will take the lead role in ensuring that policies and procedures are in place and maintained to cover the service • will develop a maintenance schedule to cover inspection, testing and replacements • will ensure that as-fitted drawings and schematics are available and updated as necessary • will ensure “equipment schedules” are available along with the necessary equipment operating manuals • should be the healthcare organisation’s expert for this service • should be responsible for ensuring that records are kept and maintained, and maintenance is carried out to maintain the system’s safety and integrity • should be responsible for organising and planning for approved contractors to perform work on the system • will maintain copies of the required documentation to manage the MGPS • will coordinate the actions and keep all site Authorised Persons and the Authorising Engineer (MGPS) informed.

ROLE	RESPONSIBILITY
Authorised Person (MGPS)	It is the aim to have a total of [enter no. of] Authorised Person(s) (MGPS) for [site name] and should be based on site. The Authorised Persons (MGPS) assume effective responsibility for the day-to-day management and maintenance of the MGPS. The duties and responsibilities of Authorised Persons (MGPS) are: • to ensure that the MGPS is operated safely and efficiently in accordance with the statutory requirements and guidelines • to manage the PTW system, by raising the relevant PTW (Low and High Hazard) and obtain the necessary signatures from the Designated Clinical Officer to isolate the system and its reinstatement as well as checks on the quality of the gases by the Quality Controller • to issue PTWs to Competent Persons (MGPS) for all servicing, repair, alteration and extension work carried out on the existing MGPS • to supervise the work carried out by Competent Persons (MGPS) and monitor the standard of that work (a register of Competent Persons (MGPS) must be kept) • to ensure that the [site name] MGPS maintenance specification and schedule of equipment (including all plant, manifolds, pipework, valves, terminal units and alarm systems) are kept up to date • to liaise closely with Designated Clinical Officers, the Quality Controller (MGPS) and others who need to be informed of any interruption or testing of the MGPS • to provide technical advice to those responsible for the purchase of any medical equipment which will be connected to the MGPS in order to avoid insufficient capacity and inadequate flow rates • to provide advice on the provision and/or replacement of MGPS central plant and associated equipment • to organise such training of estates staff (and other staff if requested) and/or transfer of MGPS information as is needed for the efficient and safe operation of the MGPS.
Competent Person (MGPS) External MGPS Contractor	Competent Persons (MGPS) for installation and quarterly maintenance are employed by a specialist contractor to perform the duties based on their ability to perform and having received training to enable them to carry their duties, maintenance, installation or both. Records should be kept showing their competence training and assessment. All external companies providing Competent Persons (MGPS) should be registered to BS EN ISO 9001 with clearly defined registration criteria. The duties and responsibilities of external Competent Persons (MGPS) are: • to carry out work on the MGPS in accordance with the [site name] maintenance specification • to carry out repair, alteration or extension work as directed by an Authorised Person (MGPS) in accordance with the PTW system and Health Technical Memorandum 02-01 • to perform engineering tests appropriate to all work carried out and inform the Authorised Person (MGPS) of all test results • to carry out all work in accordance with the [site name] health and safety policy.

ROLE	RESPONSIBILITY
Directly employed Competent Person (MGPS)	Internal Competent Persons (MGPS) are craft persons, employed by estates department to perform specific duties based on their ability to perform and having received training to enable them to carry their duties. Records should be kept showing their competence training and assessment. The duties and responsibilities of internal Competent Persons (MGPS) are: • to carry out medical plant and manifold room checks • to carry out cylinder changes on manifolds • to carry out work as directed by an Authorised Person (MGPS) in accordance with the PTW system and Health Technical Memorandum 02-01 • to repair terminal unit's second-fix and capsule seals • to replace AVSU windows • to perform engineering tests appropriate to all work carried out and inform the Authorised Person (MGPS) of all test results. [Add additional activities as required and trained for.]
Quality Controller (MGPS)	It is the responsibility of the Designated Person to appoint, in writing, on the recommendation of the Chief Pharmacist, a Quality Controller with MGPS responsibilities. The duties and responsibilities of the Quality Controller (MGPS) are: • to assume responsibility for the QC of the medical gases at the terminal units (that is, the wall or pendant medical gas outlets) • to liaise with the Authorised Person (MGPS) in carrying out specific quality and identity tests on the MGPS in accordance with the PTW system and the relevant monographs of the British Pharmacopoeia • to accept professional responsibility for carrying out the final independent check of an MGPS. They should have received training on the verification and validation of the MGPS and be familiar with the requirements of this MGPS OP.
Designated Clinical Officer	It is the policy of the [name site] that all MGPS are completed under the MGPS PTW system and all works in wards and departments carried out should be controlled by requesting permission from each department or ward Designated Clinical Officer (MGPS). Those appointed to carry out this role should be trained to and have the following responsibilities: • Liaise with the Authorised Person to deal with requests and be the point of contact for assessing requests to turn off the medical gases to their ward or department. • For isolations, provide the Authorised Person with details of how many patients and what flow rate they are likely to require so that cylinder or backfeed provision can be organised. • Assess each request before granting permission for all levels of hazard of work to continue; this should be by signing the medical gas PTW • Liaise with the Medical Gas Porter for backup medical gas cylinders to be provided where and when required to ensure no patient is put at risk. • Ensure all staff, in their area, using and connecting into the MGPS or cylinders are trained in connecting and the use of the equipment. • Take action should the alarms activate and there is a sudden loss of the medical gas supply. • Where installed, ensure the AGSS is turned on and operating, equipment is connected and used correctly, and the AGSS is turned off when not in use.

ROLE	RESPONSIBILITY
Clinical staff	Responsible for • Suitable and safe storage of cylinders in their area of use. • Ensuring they only connect equipment if trained in connecting and use of the equipment. • Connecting patients to the correct gas supply type and understanding how to operate the flowmeter, regulator and suction unit. • The actions to be taken should the alarms sound following a loss or reduction in pressure of the medical gas supply. • Checking local cylinder stocks level, requesting replacements. • Ensuring that when using gas cylinders, they are trained in the connection and use of the cylinder. • Changing empty cylinders when in use by a patient and reconnecting the full cylinder and re-administering to the patient. They should ensure that when patients are prescribed oxygen, they know how to administer the correct flow rate, to check periodically and record to ensure the patient is receiving the correct rate. Clinical staff are responsible for ensuring that there is sufficient gas in a cylinder for the duration of the patient transfer or until such time as the patient is connected to the MGPS.
Medical Gas Porter (MGPS)	A Medical Gas Porter (MGPS) has responsibilities for medical gas cylinder changing and movement around the site. They will have undergone specialist training in the identification and safe handling and storage of medical gas cylinders which includes cylinder manual handling training. Medical Gas Porters (MGPS) in the [site name] will undertake the following duties: • assist with the receipt of gas cylinder deliveries into the main store • deliver and collect medical gas cylinders from the cylinder store to the required areas • transfer gas delivery notes from the delivery driver to the pharmacy department • connect and remove regulators from cylinders, and change cylinders on manifolds • identify the cylinder status (full, empty, and faulty), and remove from service, faulty (e.g. leaking) cylinders and subsequently notify pharmacy of the location of such cylinders; assist pharmacy by performing a weekly check on cylinder stocks and report any deficiencies to pharmacy • ensure stock rotation so that all cylinders are used within the “expiry date” timescale specified by the gas supplier. The Medical Gas Porter (MGPS) must always work safely, using the appropriate personal protective and manual handling equipment, damage to which must be reported immediately to the portering manager.
Designated Theatre Porter (DTP) (MGPS)	A Designated Theatre Porte (MGPS) has responsibilities for medical gases within the theatre areas. They will have undergone specialist training in the identification and safe handling and storage of medical gas cylinders which includes cylinder manual handling training. Designated Theatre Porters (MGPS) in the [site name] will undertake the following duties: • attach and remove cylinders from medical equipment in the theatre area • check and identify the cylinder status, full, empty and in use and ensure cylinders connected to the equipment has sufficient for the next operations use • remove from service, faulty (e.g. leaking) cylinders and subsequently notify pharmacy of the location of such cylinders; assist pharmacy by performing a weekly check on cylinder stocks and report any deficiencies to pharmacy • ensure stock rotation so that all cylinders are used within the “expiry date” timescale specified by the gas supplier. The Designated Theatre Porter (MGPS) must always work safely, using the appropriate personal protective and manual handling equipment, damage to which must be reported immediately to the theatre manager.

ROLE	RESPONSIBILITY
Clinical Engineering Department	Responsible for the SOT and associated equipment which is connected to medical gases. They will have undergone specialist training in the identification and safe handling and storage of medical gas cylinders which includes cylinder manual handling training. They have the following responsibilities: • Ordering of regulator equipment to attach to cylinders. • Maintenance of equipment attached to cylinders and the MGPS. • Attaching regulators to the cylinder and its removal. • Attaching equipment to the wall outlet and ensuring it is the correct outlet.
All employees of the healthcare organisation	Have a responsibility to: • Support the healthcare organisation to achieve its vision. • Act always in accordance with the healthcare organisation's values. • Follow duties and expectations of staff as detailed in the NHS Constitution's staff responsibilities • Not perform any medical gas task unless suitably competent and training is in date.

Medical Gas Safety Group (MGSG)

The MGSG is a multidisciplinary group formed to assess and monitor all aspects of medical gas pipeline safety and resilience required for the safe development and operation of healthcare premises, and it should inform the following areas:

- the design process for new healthcare premises
- assessment of existing premises
- the design process for modifications to existing premises
- installation and commissioning
- operational management
- cylinder management
- training requirements and training completed
- appointments and qualifications of appointees
- maintenance
- decommissioning and removal of equipment.

The MGSG structure will follow the terms of reference TOR document [enter reference].

MGPS operational policy review

The MGPS OP should be reviewed [frequency]; the Senior Operational Manager (MGPS) and Chief Pharmacist (MGPS) should convene the review meeting and be responsible for writing and distributing the minutes of the meeting. The MGSG should review and sign off the policy and report to the executive manager.

MGPS record drawings and documentation

The Authorised Person (MGPS) holds and maintains copies of the following:

- up-to-date and accurate as-fitted record drawings
- valve/key numbers/TU identification
- any necessary MGPS insurance/statutory documentation
- MGPS safety valve, regulator and hose replacement schedule (on a five-yearly basis)
- new and completed PTW books for work on the systems
- plant history/maintenance records
- manufacturer's technical data sheets/manuals for all MGPS components
- Health Technical Memorandum 02, all latest editions of any associated supplements and NHS Model Engineering Specifications
- MGPS contractors' service contracts and ISO 9001 (or equivalent) certificates, staff training records, equipment calibration certificates (copies)

- a list of all personnel associated with the MGPS, especially the PTW system
- emergency and other useful telephone numbers
- MGPS staff training records
- calibration certificates of test equipment owned by the healthcare organisation
- the MGPS OP and SOP.

Pharmacy will maintain copies of the following:

- delivery notes for medical gas cylinders
- sales invoices for medical gas cylinders
- delivery summary form (tracks cylinder stock information)
- cylinder rental invoices
- cylinder rental reconciliation form (monitors trends in cylinder use over six months)
- delivery notes for special gas and industrial gas cylinders
- sales invoices for special gas and industrial gas cylinders
- rental invoices for special gas and industrial gas cylinders
- calibration records of QC test equipment and records of all QC tests performed
- medical gas supply contract documentation.

Training

It is essential for the safety of patients that no person should operate, or work on, any part of an MGPS unless adequately trained or supervised.

MGPS training at the [premises] for all staff is administered by [name/department(s)].

A record of those trained is kept in the [department].

It is the duty of departmental managers to ensure that all staff working with the MGPS are appropriately trained and training records and reported to and monitored by the MGSG.

The Authorised Person (MGPS) may request training records of contractors' staff.

Training on MGPS should be provided as follows:

Designation	Responsibilities	Course	Refresher Training
Designated Person	The integrity and governance of the MGPS	Medical Gases for Healthcare Managers	3 years
Senior Operational Manager	System management and leadership	Medical Gases for Healthcare Managers	3 years
Chief Pharmacist	Overall control of medical gas administration	Medical Gases for Service Managers	3 years
Authorising Engineer	Appointment and overseeing AP	AP Comprehensive then AP Refreshers (MGPS)	5 years
Authorised Person	MGPS operational Lead, high and low-hazard works	AP Comprehensive then AP Refreshers (MGPS)	3 years
Low Hazard Authorised Person (MGPS)	MGPS operational, low-hazard PPM works only	Low Hazard Authorised Person (MGPS)	1 year
Competent Person contractor	Installation and PPM	CP Maintenance and/or CP Installation (MGPS)	3 years
Competent Person internal	Source equipment, plant room checks & TU repair	CP FLD (MGPS)	1 year
Designated Clinical Officer	Department lead, MGPS emergency actions and PTW permission	Designated Clinical Officer (MGPS)	3 years
Quality Control	System quality assurance	QC Medical Gas Testing then QC Medical Gas Testing Refresher	5 years
Clinical Staff	Anyone using medical gas or cylinders	Medical Gas Safety – Clinical staff	1 year
Portering team	Cylinder transport, connection and stock control	Medical Gas Safety - Portering	1 year
Project Manager	Manage projects which include MGPS	AP Comprehensive then AP Refreshers (MGPS)	3 years

Contractors

Before contractors are employed, adequate checks are carried out to ensure that the contractors are competent to carry out the work required regarding the health and safety requirements of the healthcare organisation. Contractors must submit risk assessments and method statements (RAMS) to the Estates management team and compliance team before any work can commence. They are also subject to the safe systems of work that are in use within the healthcare organisation (for example, the PTW system) and must comply with the appropriate guidance. Contractors have a duty to work safely and manage the safety of their staff. The work activities must not, so far as is reasonably practicable, affect the Health, Safety and Welfare of anyone who comes in to contact with them or their activities.

Monitoring compliance with the document

Compliance with this policy should be monitored using the KPIs detailed below, and an annual compliance assurance report should be provided to the MGSG based on these:

- Training for internal staff is up to date, confirmed using the departmental training matrix.
- An ongoing gap analysis/action log is maintained related to issues raised with the medical gas services and progress against this can be demonstrated.
- There is an up-to-date risk register for the safe management of MGPS.
- PPM reports can be provided for both internal and external maintenance work for the MGPS.
- Maintenance reports can be provided for the MGPS.
- Records, drawings and documentation related to the implementation and management of all MGPS and plant can be accessed and provided.

This policy should be monitored via the healthcare organisation's technical services department.

This policy should be reviewed within three years, or sooner if there is a change in Regulations and after any MGPS incident occurring.

Policy signatories

This policy has been prepared and should be implemented and monitored by:

Name: .....

Signature: .....

Date: .....

This policy should be monitored annually.

Date of next review xx/xx/xx.

Training needs associated with the policy should be coordinated by [name].

The Senior Authorised Person (MGPS) for medical gas systems within the [premises] is [name].

This policy is accepted by:

Chief Executive		
Name:	Signature:	Date: .....
Designated Person		
Name:	Signature:	Date: .....
Senior Authorised Person (MGPS)		
Name:	Signature:	Date: .....
Chief Pharmacist		
Name:	Signature:	Date: .....
Senior Designated Clinical Officer		
Name:	Signature:	Date: .....
Clinical Risk Manager		
Name:	Signature:	Date: .....
Portering Manager		
Name:	Signature:	Date: .....
Infection Prevention and Control lead		
Name:	Signature:	Date: .....
Fire Safety Manager		
Name:	Signature:	Date: .....

Assistance with the interpretation of this policy, or additional copies, can be obtained by contacting [name].

Contacts

Designated Person (MGPS)

Name	Contact number

Authorising Engineer (MGPS)

Name	Company	Contact number

Authorised Persons (MGPS)

Name	Contact number

Chief Pharmacist (MGPS)

Name	Company	Contact number

Quality Controller (MGPS)

Name	Company	Contact number

Competent Persons (MGPS)

Name	Company	Contact number

Senior Designated Clinical Officers (MGPS)

Name	Company	Contact number
In addition to this list, refer to the separate list for all trained Designated Clinical Officers. List held by [name person of role]		

Other important telephone numbers

Name	Contact number	Out-of-hours contact number
Portering		
Internal Cylinder ordering number		
Pharmacy		
Gas supplier		
Risk manager (emergency)		

Appendix B – Sample SOP

Outline

This document should be read in conjunction with the [site name] operational policy for the management of medical gas systems and HTM 02-01.

The function of this document is to provide detailed guidance on the operation of all medical gas and vacuum systems at hospital level.

To comply with the healthcare organisation's policy, these procedures should be reviewed by the relevant stakeholders and submitted to the MGSG for approval.

The MGPS structure

Supplying medical gases to wards and clinical areas through a medical gas pipeline service is safe, efficient and convenient. It is the preferred method of supply where regular use of medical gas is required.

[site name] are responsible for the provision and maintenance of these systems up to the outlets on the wall or pendant. All equipment attached to these outlets are the responsibility of [name of medical equipment dept].

This section provides a short description of the plant and other components of the MGPS.

Each item should be presented in terms of a description of the plant/component/system, its location, emergency reserve provision and access arrangements.

Plant A General: oxygen

[There are two VIEs in different locations on site, each has a twin evaporator and control panel that delivers oxygen into a ring main.]

Oxygen primary supply: serving ["whole site" or list areas served]

A [make] oxygen tank with twin evaporators and control panel supplies oxygen to the [premises]. It is housed in the [location] compound.

Oxygen Secondary Supply:

A [make] Oxygen tank with twin evaporators and control panel supplies oxygen to the [premises]. It is housed in the [location] compound.

Capability description – source A	Flow rates (L/min)
The diversified design flow rate of the oxygen system	[2500]
Liquid oxygen flow capability	[3000]
Oxygen spare design capacity	[500]
The monitored average continuous demand (ACD) on the system for the last 12 months was	[600]
The primary tank is refilled from 50% to full every	[x] days
Reserve supply to source A	
Reserve standby liquid oxygen flow capability is	[3000] l/min
Based on the ACD the reserve tank, full to empty, should last approximately	[x] days

Access

The liquid oxygen and its emergency supply are in locked compounds. Competent Persons (MGPS) should be allowed, on proof of identity, to gain access by signing in to the site with the Authorised Person (MGPS)

Plant B General: [enter gas type manifold]

There are [enter no. of] [gas] manifold(s) in different locations on site; each has a main automatic control panel that delivers [gas] into the pipeline.

[gas] Primary supply manifold: Serving ["whole site" or list areas served]

A [make] fully automatic cylinder manifold has 2 banks of [6] cylinders, which supply [site] from one bank and automatically change over to the second bank, is housed in the [location] manifold room.

[gas] Secondary supply:

A [make] manual cylinder manifold has 2 banks of [1] cylinders, set to come online automatically in the event of the main cylinder manifold failure; it is housed in the [location] manifold room.

Capability description – source B	Flow rates L/min)
The diversified design flow rate of the [gas] system	[500]
Main manifold flow capability	[800]
[gas] spare design capacity	[300]
The monitored ACD on the system for the last 12 months was	[50]
One bank on the primary manifold typically is changed every	[x] days
Reserve supply to source B	
ERM flow capability is	[100] l/min
Based on the ACD, each bank of the reserve manifold, full to empty, should last approximately	[x] hours

Access

The [gas] manifold and its emergency supply are in [location] manifold room. Competent Persons (MGPS) should be allowed, on proof of identity, to gain access by signing in to the site and gaining keys from the Authorised Person (MGPS)

[Repeat above for all medical gas manifolds]

Plant D General:

There is [one combined plant] on site that supplies [both] medical air (MA4) and surgical air (SA)

MA4/SA Primary supply: Serving [“whole site” or list areas served]

A [make] [duplex/triplex/quadruplex] [medical/surgical] compressed air and duplex filter/dryer unit supplies medical compressed air to the [premises]. It is housed in the [location] and provides [both medical and surgical air].

MA4/SA Secondary supply:

A [make] fully automatic cylinder manifold has 2 banks of [10] cylinders, set to come online automatically in the event of plant failure. It is housed in the [location] manifold room.

Capability description – plant D	Flow rates (L/min)
The diversified design flow rate of the MA4 system	[1500]
The diversified design flow rate of the SA system	[850]
Combined plant flow capability	[2500]
Plant spare design capacity	[150]
The monitored ACD on the system for the last 12 months was	[600]
Reserve supply to plant D	
ERM flow capability is	[1000] l/min
Based on the ACD, each bank of 10 should last approximately	[1.8] hours

Access

The medical compressor unit and its emergency supply manifold are in locked rooms. Competent Persons (MGPS) should be allowed, on proof of identity, to gain access by signing out the relevant keys from the Authorised Person (MGPS)

Plant E General:

There is [one] vacuum plant on site that supplies the vacuum to all piped areas

Medical Vacuum primary supply: Serving ["whole site" or list areas served]

A [make] [duplex/triplex/quadruplex] medical vacuum pump and duplex filter unit supplies medical vacuum to the [premises]. It is housed in the [location] plant room.

Medical vacuum secondary supply:

[qty/none] of the vacuum pumps on the plant is fed from an independent electrical supply and the power is on the backup generator.

Capability description – plant E	Flow rates (L/min)
The diversified design flow rate of the vacuum system	[2300]
Vacuum plant flow capability	[2500]
Plant spare design capacity	[200]
The monitored ACD on the system for the last 12 months was	[700]
Reserve supply to plant E	
There is no additional backup to the vacuum plant, on total failure portable suction units should be used. There are [qty] spare suction units in the [EBME] department and 1 at each department resus station	[qty] units on site

Access

The medical vacuum plant is in a locked plant room. Competent Persons (MGPS) should be allowed, on proof of identity, to gain access by signing out the relevant keys from the Authorised Person (MGPS).

Other plant/systems

[Other plant should be described as above and will include separate descriptions for each manifold and compressor. AGSS often have multiple installations, and it may be more convenient to show these in a simple table format detailing pump type, simplex/duplex format and area served.

If the Authorised Person (MGPS) has any responsibility for dental/pathology systems, these should have been included in the “duties and responsibilities” section above. Details of plant within that area of responsibility can be detailed here.

Cylinder storage

[Each storage area (main, ready-to-use, etc.) must be addressed separately in terms of location, access and emergency use. General information common to all store types (for example, signage and storage conditions) can be added to this section. This information can be copied directly from Chapter 9 (“Cylinder management”) in Part B of Health Technical Memorandum 02-01.]

Area valve service units (AVSUs)

Summary

Locked boxes, area valve service units (AVSUs), containing isolating valves in enclosures with breakable/removable glass/plastic fronts are provided at the entrance to wards and departments.

These valves provide facilities for both routine and emergency isolation of gas supplies.

It is the responsibility of the Designated Clinical Officer to isolate in an emergency when required following confirmation that all patients are removed or safely on an alternative supply and that isolation is required.

These valve boxes contain an emergency inlet port, which is gas specific. This may be used to supply gas to a ward when the main supply fails or is shut down for essential engineering work.

The Authorised Person (MGPS) has access to the individual keys for each AVSU in the medical gas key cabinet and the use of keys to gain access to the AVSUs and any other locked LVAs should be under the control of a PTW.

[Non-NIST AVSUs should also be referenced here, but the essential message is that, regardless of type, emergency isolation can be affected by breaking the cover and closing the valve.]

General rules and conditions for control of LVAs

Pipeline valves, called lockable line valve assemblies (LVAs) in ducts, risers and ceiling spaces should be locked in the normal operating position.

Pipeline valves will normally be left unlocked if they are sited in a locked plantroom. The Authorised Person (MGPS) has access to the individual keys for each valve or plantroom.

[At this point, a diagram/photograph of an AVSU can be added, illustrating the various components]

Routine procedures

The MGPS PTW system

The aim of the MGPS PTW system is to safeguard the integrity of the medical gas system and, therefore, the safety of the patients.

PTWs are issued and controlled by the Authorised Person (MGPS) and should be written, signed and issued at the point of work.

It is the policy of [healthcare organisation] that – with the knowledge and permission of the Authorised Person (MGPS) – a PTW must be raised before any work on any part of the [premises] medical gas system can be undertaken, with the following exceptions:

- Changing of manifold cylinders
- Liquid oxygen refilling,
- QC testing of medical/surgical air
- Emergency isolation by a member of the nursing staff.

Granting of a PTW and the way in which the work is carried out must follow the directions of Health Technical Memorandum 02-01 unless otherwise defined in this policy.

Responsibilities for signing a PTW lie with the Designated Clinical Officer in each department. Designated Clinical Officers should ensure that colleagues are advised of the interruption to the gas supply and its estimated duration.

Designated Clinical Officers should also ensure that all terminal units taken out of service are appropriately labelled by the Authorised Person (MGPS) or that the area has no patients i.e. the area is closed.

Planned interruption

A planned interruption will be needed for repair, extension or modification to the existing MGPS. An Authorised Person (MGPS) should supervise any planned interruption in strict accordance with the PTW system in Health Technical Memorandum 02-01. The Quality Controller (MGPS) should be involved in any planned interruption, where QC testing is required, from the initial planning stage.

The Authorised Person (MGPS) should assess the hazard level of the work to be carried out in accordance with the definitions that are given in the following sections for high and low-hazard work.

High-hazard work

Any work on the MGPS, such as cutting or brazing, that will introduce hazards of cross-connection and pollution should be classified as high-hazard.

Tests relevant to the works carried out tests should be required before the MGPS is taken back into use.

High-hazard work should be a planned interruption and communicated in advance to the relevant stakeholders and departments for agreement. The Authorised Person (MGPS) must ensure that key personnel for each ward or department are informed; if necessary, they could hold a site meeting.

The Designated Clinical Officer(s) of the ward(s) or department(s) involved should be made aware that their signatures will be required on the date on which the work is due to take place.

The requirement for portable cylinders or vacuum units should be determined and confirmed, with details of the interruption, by a memorandum from the Authorised Person (MGPS) to the Designated Clinical Officer(s).

A copy of this memorandum should be sent to the ward(s) or department(s) concerned. A further memorandum, requesting the services of a Quality Controller (MGPS) and detailing the requirements for portable cylinders, should be sent to the pharmacy and/or portering department.

It is the responsibility of the Authorised Person (MGPS) to arrange, through the portering and pharmacy departments or an appropriate hire firm, if necessary, for portable cylinders and regulators or backfeed kits (stocks of regulators are held by [department]).

Any additional portable vacuum units to be supplied are the responsibilities of the wards/ departments concerned. The Authorised Person (MGPS) will provide all details of the work to

be carried out in part 1 of the PTW form, including any other PTWs (for example, for “hot works” or for entry into confined spaces).

Work should only commence when the Designated Clinical Officer(s) for the ward(s) or department(s) is/are satisfied that no patients will be put at risk by the shutdown of the MGPS and has/have signed part 1 of the PTW form.

The Authorised Person (MGPS) should explain the works to be completed by the Competent Person (MGPS) by:

a. confirming isolation details by consultation with the Competent Person (MGPS)

b. examining the as-fitted drawings, the sketch sheet of the PTW and any additional drawings

The Competent Person (MGPS) should sign part 2 and together with the Authorised Person (MGPS) should sign the sketch sheet of the PTW form.

The Authorised Person (MGPS) should then supervise isolation of the AVSU(s) by the Competent Person (MGPS).

The Competent Person should then commence work.

The Competent Person (MGPS) should sign part 3 of the PTW to certify that work has been completed and contact the Authorised Person (MGPS) so that the installation may be examined and tested.

The Authorised Person should inspect the completed work to ensure it is ready for testing and sign part 3 of the PTW.

Depending on the extent of high-hazard work, the Authorised Person (MGPS) should determine and write on the PTW which of the necessary tests and examination of the system(s) in accordance with Chapter 20 “Validation and verification” in Part A of Health Technical Memorandum 02-01 are required.

The Authorised Person (MGPS) should witness the Competent Person (MGPS) carrying out the tests.

When these tests have been completed, the Authorised Person (MGPS) should enter a “Pass” or “Fail” in the relevant spaces next to each test and sign part 4 of the PTW.

The work should then progress or additional work under a new PTW will be required.

The Quality Controller (MGPS) should carry out identity and quality tests on the system(s) in accordance with Chapter 19 in Part A of Health Technical Memorandum 02-01 witnessed by the Authorised Person (MGPS).

When these tests have been completed with satisfactory results, both will sign part 5 of the PTW. Unsatisfactory results may lead to cancellation of the PTW and further corrective work under a new PTW to be initiated.

The Designated Clinical Officer(s) should accept the system(s) back into service by signing part 6 of the PTW and should undertake to notify their colleagues that the system is fit for use.

The Authorised Person (MGPS) should retain the white copy, and the sketch sheet in the PTW book.

The Quality Controller (MGPS) should receive the pink copy of the PTW form from the Authorised Person (MGPS).

The Competent Person (MGPS) should receive the yellow copy, or a scan of the white copy may be issued to the Competent Person (MGPS) on request.

Low-hazard work

Any work on the MGPS which will not introduce any hazard of cross-connection or pollution should be classified as low-hazard work.

Tests relevant to the works carried out are required before the MGPS is taken back into use.

If there is any doubt as to the hazard level classification of a particular PTW, advice should be sought from the Senior Authorised Person (MGPS) or the Authorising Engineer (MGPS).

Low-hazard work on terminal units is normally the result of a leak on an individual terminal unit due to a faulty valve. Depending on the age and type of terminal unit, this may be repaired with the system live. Work in clinical areas will require a Designated Clinical Officer's signature on the PTW form.

Some low-hazard work may include work on plant which does not interrupt gas supplies to clinical areas. In these cases, the Authorised Person (MGPS) may choose not to have a Designated Clinical Officer's signature on the PTW form.

The Authorised Person (MGPS) may have to arrange portable cylinders or vacuum units so that the terminal units can be taken out of service at short notice, where work requiring isolation of a ward or department is to be carried out.

The Authorised Person (MGPS) should fill out the relevant section of part 1 of the PTW form. The Authorised Person (MGPS) should liaise with, and fully brief, the Designated Clinical Officer(s) of the ward/department(s).

If the works is in a clinical area, the work should only commence when the Designated Clinical Officer(s) for the ward(s) or department(s) is/are satisfied that no patients will be put at risk by the work or shutdown of the MGPS and has/have signed part 1 of the PTW form.

The Authorised Person (MGPS) should explain the works to be completed by the Competent Person (MGPS) by:

a. confirming the work details by consultation with the Competent Person (MGPS) and
b. examining the as-fitted drawings, and any additional documents.

The Competent Person (MGPS) should sign part 2.

If required, the Authorised Person (MGPS) should then supervise isolation of the MGPS by the Competent Person (MGPS).

The Competent Person should then commence work.

The Competent Person (MGPS) should sign part 3 of the PTW to certify that work has been completed and contact the Authorised Person (MGPS) so that the installation may be examined and tested.

The Authorised Person should inspect the completed work to ensure it is ready for testing and sign part 3 of the PTW.

Depending on the extent of high-hazard work, the Authorised Person (MGPS) should determine and write on the PTW which of the necessary tests and examination of the system(s) in accordance with Chapter 19 in Part A of Health Technical Memorandum 02-01 are required.

The Authorised Person (MGPS) should witness the Competent Person (MGPS) carrying out the tests.

When these tests have been completed, the Authorised Person (MGPS) should enter a “Pass” or “Fail” in the relevant spaces next to each test on the PTW.

When the tests have been completed with satisfactory results, the Authorised Person should sign part 4 of the PTW. Unsatisfactory results may lead to cancellation of the PTW and further corrective work under a new PTW to be initiated.

The Authorised Person (MGPS) in collaboration with the Quality Controller (MGPS) should decide if QC tests are required for low-hazard work and delete part 5 as applicable. If required, the Quality Controller (MGPS) should carry out identity and quality tests on the system(s) in accordance with Chapter 19 in Part A of Health Technical Memorandum 02-01 witnessed by the Authorised Person (MGPS).

When these tests have been completed with satisfactory results, both should sign part 5 of the PTW. Unsatisfactory results may lead to cancellation of the PTW and further corrective work under a new PTW to be initiated.

The Designated Clinical Officer(s) should accept the system(s) back into service by signing part 6 of the PTW and should notify their colleagues that the system is fit for use.

The Authorised Person (MGPS) should retain the white copy in the PTW book.

The pink copy of the low-hazard PTW form can be [sent to the Chief Pharmacist (MGPS) or kept in the book].

The Competent Person (MGPS) should receive the yellow copy, or a scan of the white copy may be issued to the Competent Person (MGPS) on request.

Actions in the event of a medical gas alarm

On detection of a local alarm indication (for example, in a ward area), the senior duty nurse (Designated Clinical Officer) should contact the Authorised Person (MGPS) via the specified

number to confirm that a fault has been signalled and provide the following information: location of alarm, department, gas, area served (if labelled on the alarm) and fault condition.

In the event of an alarm condition on the central alarm panel in the [switchboard], the duty telephonist should inform the appropriate staff. For other repeater central alarm panels, the Designated Clinical Officer for that area should inform the appropriate staff as shown in Example 1.

Disabling the alarm system, other than when due authorisation has been obtained from an Authorised Person (MGPS), is absolutely forbidden, as this may compromise patient safety.

There should always be a “normal” light. If there is no “normal” light, then there is a fault of some kind, possibly just with the alarm panel. This should also be reported to the Authorised Person (MGPS) to investigate this fault.

Example 1: Medical air/surgical air [this is to be repeated for each system central alarm channel]

Alarm indication	Action (telephonist to inform)
Normal	No action to be taken
Plant fault	NWH – Estates [tel no.] ONWH – Estates (on-call rota) [tel no.]
Plant emergency	NWH – Estates [tel no.] ONWH – Estates (on-call rota) [tel no.]
Reserve low	NWH – Porters [tel no.] ONWH – Porters [tel no.]
Pressure fault	NWH – Estates [tel no.] ONWH – Estates (on-call rota) [tel no.]
Panel indication (all alarm panels)	
Alarm indication	Action (telephonist to inform)
Power on	No action to be taken
System fault	NWH – Estates [tel no.] ONWH – Estates (on-call rota) [tel no.]
Abbreviations: NWH = Normal working hours ONWH = Outside normal working hours	

It is the responsibility of the Authorised Person (MGPS) to ensure that a procedure for each alarm indication is displayed next to the respective central alarm panel.

Cylinder management

[This section is copied (amended where appropriate) directly from Chapter 9 in Part B of Health Technical Memorandum 02-01.]

It should cover preparation of cylinders for use, cylinder storage, handling and transport, cylinder changing on manifolds and medical equipment, special instructions for manual ERMs (for example, leaving one (cylinder) valve open and one closed), delivery of gases to wards and stores, delivery of liquid oxygen.

Reference should be made to training in manual handling and inclusion of a statement that only Medical Gas Porters (MGPS) are allowed to work with cylinders.

Restrictions on the work of Medical Gas Porters (MGPS), if any, should be inserted here. For example, only estates staff may be authorised to change cylinders on a particular system.

Shutdown of the MGPS for maintenance and extensions

Pre-planned work on the MGPS requiring isolation of a plant, or part of the system, should be covered by the MGPS PTW system.

No isolation should take place without liaison between the Authorised Person (MGPS) and all other disciplines. All necessary emergency/additional gas supplies should be in place before the work starts. This may involve the provision of portable emergency supply systems and/or additional provision of cylinder regulators from [*EBME]*.

Attempts should be made to reduce gas consumption during the work.

Use of oxygen at high concentrations

Where oxygen is in use in large quantities or in higher-than-normal concentrations (for example, in oxygen tents and incubators), warning notices indicating “high concentration oxygen in use – danger of fire” should be posted at the treatment site.

The Fire Safety Adviser should be consulted regarding the use of toys and other items within oxygen tents. A notice stating: “Only toys, products or cosmetics approved by the Fire Safety Adviser are permitted in this area” should be displayed at the entrance to the treatment area.

It is the responsibility of all staff in such areas to be vigilant in all aspects of the treatment, and appropriate safety training must be given in the use of oxygen under these conditions.

Emergency procedures

Emergency supply manifolds are attached to all medical gas systems.

Failure of the primary gas supply

In the event of failure of the primary supply, the secondary supply will automatically provide the [premises] with gas. Refer to each section detailed above for specific details of the primary and secondary systems.

The Authorised Person (MGPS) should assess the failure and communicate to stakeholders what action is needed to maintain supplies to patients.

Measures to reduce gas consumption may need to be taken.

The portering department should ensure sufficient size cylinders are available to maintain the gas supply and that there is an emergency procedure in place for handling these cylinders and receiving additional cylinders from the gas supplier.

The pharmacy department will be responsible for initiating an emergency delivery of additional cylinders based on the information in the relevant gas section above and the recommendation of the Authorised Person (MGPS).

The medical vacuum system has no ERM system. Failure of the plant for any reason will result in total failure of the vacuum service.

[The following emergencies are offered as samples only. Local circumstances will dictate the amount of alteration required.]

Emergency cylinder ordering procedure

[This tends to be very site-specific. Hence a sample is included here without further comment.]

The pharmacy department should perform routine cylinder ordering based on required stock levels and weekly use. Portering should check stocks weekly and report any deficiencies to pharmacy.

For emergency ordering, the following procedure should be followed:

- Pharmacy should telephone the emergency number of the medical gas supplier.
- Pharmacy should tell the medical gas supplier that “new emergency issues” are needed, if no empties are to be returned.
- Upon delivery by the medical gas supplier, the duty porter should check the delivery against the request and sign the driver’s delivery note.
- The note should then be passed to pharmacy.

Failure of mains electricity supply

In the event of an electricity failure, medical gas supplies should be maintained by the emergency generator system (the “essential” supply).

The surgical compressed-air plant, vacuum plant, oxygen system, all manifolds and medical gas alarm systems [are] connected to the “essential” electricity supply and will continue to provide and monitor gas supplies as normal.

In the event of failure of both mains and generator supplies:

- the pressure gas systems from liquid and manifold supplies should continue to supply gas from its primary and secondary supply system
- the pressure gas systems from compressor supplies should continue to supply gas from its primary buffer vessel for a short time and then switch to the secondary supply system, which may not provide full flow, see relevant section
- the vacuum plant will not operate, and central vacuum service will be lost
- “normal” portable vacuum units can be used only if local electricity supplies are available. Ejector- or battery-driven units should be used where vacuum provision is essential for critical care

- alarm panels should display a “system failure” red warning light and give an audible alarm,;some will display all conditions for a short time.

If the electricity supply to an alarm panel only is interrupted, the panel should display a “system failure” red warning light and emit an audible alarm; gas supplies will not be affected.

In any of these events:

- the Authorised Person (MGPS) should be informed of the situation via the nursing staff/ telephonist
- portering and estates should arrange for staff to monitor manifold gas consumption, replacing empty cylinders as necessary until the electricity supply is restored
- the Authorised Person (MGPS) should arrange emergency cylinder/regulator supplies as necessary
- the Authorised Person (MGPS) should monitor the situation and confirm resetting of compressor and vacuum plant and system alarms following restoration of supply.

A serious leak of medical gases

In these events:

- the Authorised Person (MGPS) should be contacted by the telephonist/Designated Clinical Officer
- details of the leak should be confirmed: that is, the floor level, department, room number, the gas or gases involved and whether patient ventilators are in use
- outside normal working hours, the on-call engineer should notify the Authorised Person (MGPS)
- it is the responsibility of the Designated Clinical Officer to carry out isolation of medical gases to the area after ascertaining that no patients will be put at risk in any area(s) affected by the isolation
- the Designated Clinical Officer should issue appropriate instructions to make the situation safe, such as to open windows in the affected area and close doors, in accordance with the [premises] fire policy
- the duty porter should remain on standby to provide extra gas cylinders as required
- the Authorised Person (MGPS) should arrange for repairs to the system(s) affected to be carried out under the PTW system
- if required, the Quality Controller (MGPS) should carry out specific quality and identity tests on the MGPS.

Local arrangements may be in place to contact the risk manager or press officer in such an occurrence. This should be documented in the policy.

Total or partial failure of a medical gas supply

In these events:

- the person discovering the failure should inform the telephonist and Designated Clinical Officer immediately
- the telephonist should inform the Authorised Person (MGPS), senior Designated Clinical Officer, Quality Controller (MGPS) and the duty porter of the issue
- details of the failure should be confirmed: that is, floor level, department, room number(s), the gas or gases involved and whether patient ventilators are in use
- as a precautionary measure, the telephonist should also notify critical care areas that a failure has occurred on part of the system so that they are prepared in the event of the fault extending to their departments
- it is the responsibility of the Designated Clinical Officer to check which patients may have been put at risk by the failure and, if necessary, to arrange immediate emergency medical action
- depending on the reason for the failure and its possible duration, the Authorised Person (MGPS) should decide the most appropriate method of long-term emergency gas provision. This may involve establishing locally regulated emergency backfeed kit cylinder supplies at ward/department entrances
- nursing and medical staff should attempt to reduce gas consumption to a minimum during the emergency
- portering staff should be monitor/replenish cylinders at any emergency stations and at plantroom emergency supply manifolds
- pharmacy should arrange emergency cylinder deliveries as necessary
- the Authorised Person (MGPS) should liaise with the Competent Person (MGPS) to complete emergency repairs needed to reinstate the gas supply, using the PTW system
- the Quality Controller (MGPS) should carry out specific quality and identity tests on the MGPS
- when the supply is fully restored, the Authorised Person (MGPS) should complete a critical incident form and produce a full report, which should be reported to the MGSG members, and if required call a special meeting and follow the site's major incident policy.

In situations where it is envisaged that there will be long-term loss of oxygen or medical air service, the senior Designated Clinical Officer should liaise with clinical colleagues and the Authorised Person (MGPS) on the need for transfer of critically ill patients to [premises], as department closure may be warranted in extreme events.

Contamination of a medical gas supply

It is not unusual for a smell to be noticed when using "plastic" equipment hoses to deliver gas to a patient. This smell usually disappears rapidly after first use of the hose and will generally be familiar to operatives.

However, if either operatives or patients complain of any unusual or strong smells from equipment, the situation must be treated seriously and immediate action taken to ascertain the cause.

Where it is obvious that the smell is coming from the pipeline rather than a piece of connected equipment, the gas supply must not be used.

In such an event, the fault should be treated as a complete gas failure to that area and the actions described above taken immediately.

It is very important that, if such an incident occurs, the telephonist advises all departments of the problem, especially critical care areas.

Contamination of the medical vacuum system will usually be detected during routine maintenance inspection and evidenced by the presence of liquid in the online bacteria-filter drain flask. The IPC team should be informed immediately and should advise on any additional precautions to effect filter change safely.

Portable suction units may be used in areas where there is a possibility of the vacuum system being contaminated. (The need for portable suction units should be discussed with the IPC team.)

If the contamination is due to system misuse, the Authorised Person (MGPS) must complete an incident report form. The form should be sent to the [risk manager] so that the appropriate nurse manager can be informed and remedial action taken.

Decontamination of pipework (if necessary) should be carried out before filters are changed.

Failure of an AGSS

]Simplex AGSS on this site supply the following areas, on failure they do not have a secondary pump and the AGSS will be lost until the pump is repaired or replaced. These areas should be taken out of use as soon as possible on failure:]

[List areas with simplex AGSS]

Failure of an AGSS results in spillage of gaseous/vaporised anaesthetic agents into the area of use of the system.

In theatres, it is likely that staff exposure to the spilled gases will exceed the COSHH recommendations for exposure when working in the area for extended periods, even though ventilation rates are high.

A local alarm “system fail” warning and failure of the air receiver flow indicator will indicate failure of the system. Both should be inspected by operating department staff on a regular basis.

The Authorised Person (MGPS) and the theatre manager should be informed of the failure by [usually the theatre technician/ODP], and all attempts should be made to reduce staff exposure, if operations continue with a failed system.

When repairs have been completed under a PTW signed by the theatre Designated Clinical Officer, theatre staff should be made aware (by the person signing off the PTW) that the system is back in use.

Over- or under-pressurisation of one or more gas systems

Local alarms are designed to indicate when system pressure(s) is/are outside the normal operating range. Excessively high or low pressures may cause medical equipment to malfunction.

The Designated Clinical Officer should report all instances of local alarm operation to the [name/tel number].

Emergency isolation of a local area

A local area is defined as the MGPS after the AVSU at the ward/department entrance.

The AVSU containing isolating valves in enclosures with breakable/removable glass/plastic fronts are provided at the entrance to wards and departments.

In the event of a serious leak on the local system from a terminal unit, damaged pipeline or internal pendant hose, the Designated Clinical Officer for the area should assess the failure and check if the system is still functioning or if the leak of the gas poses a substantial risk to the area, staff or patients.

In the event of a genuine fire in the area and the fire representative assesses that evacuation is required and the fire is out of control, the Designated Clinical Officer should assess the need to isolate the medical gases to their area.

Procedures in accordance with the [premises] fire policy should be followed in the event of a fire involving, or likely to involve, the MGPS.

During a fire, the senior fire and rescue officer will assume full control of the area(s) affected.

Under no circumstances should medical gas supplies be isolated until the Designated Clinical Officer has confirmed that all patients likely to be affected have been evacuated and/or have alternative gas provision.

It is the responsibility of the Designated Clinical Officer to isolate in an emergency when required following confirmation that all patients are removed or safely on an alternative supply and that isolation is required.

Appendix C – Sample MGPS maintenance contract

Form of contract

There are essentially three parts to a maintenance contract:

a. An introductory section which gives the Contractor overall details on contract conditions and pricing. This is often combined with an invitation to tender for the work. For example, the sample contract presented below could be prepared as part of a tender documentation package by adding in section 1:
"Contractors are invited to submit a (fixed price) quotation for the maintenance of the MGPS installed within *** healthcare premises. The Contractor is required to undertake all works as described in this specification."

b. The "particular specification", which gives the Contractor more detail of the requirements of the maintenance requirements and expectations of the customer and may cover such detail as capability of the Contractor.

c. The "schedule of work", which lists all equipment on which the maintenance is to be performed and details the level(s) of task for each item.

Contract for the maintenance of medical gas pipeline systems installed in

_____ (premises)

1. General

1.1 The enclosed plan shows the site for which this specification is applicable. Not all buildings on this site contain medical gases.

1.2 Medical gas pipelines fitted on this site deliver:

- Oxygen
- Nitrous oxide
- Oxygen/nitrous oxide mixture
- Medical air 400 kPa

- Surgical air 700 kPa
- Medical vacuum.
- Carbon dioxide
- AGSS
- Other

1.3 The Contractor should complete and sign _____ , a copy of which is attached to this specification.

1.4 This specification is subject to the healthcare provider's "standard terms and conditions for the provision of a works service" and "Health and safety arrangements for the control of estates contractors and estates personnel", copies of which are attached.

Contract period

1.5 This maintenance contract should be for a ** calendar year period starting from *** .

1.6 This may be extended by the healthcare provider by a further ** years to a maximum of ** years.

Contract cost

1.7 The Contractor is required to submit a completed cost summary form (copy attached) and must identify costs for each calendar year period, the first year of which should be at a fixed price.

1.8 Subsequent years may be allocated a revised fixed price or a variation index, based on the first-year price.

1.9 The cost submitted by the Contractor should relate to details of work to be undertaken given in "schedule of works" at the visit frequency given below.

1.10 The contract price should allow for the additional work required to check the schedule of equipment against as-fitted equipment and identifying any deficiencies, as part of the first service visit.

Contract cancellation

1.11 At the end of the first **** months, either party giving **** months' notice in writing may cancel the contract.

1.12 Failure by the Contractor to meet the requirements set out under "particular specification" below will result in termination of the contract by the healthcare providers, by the serving of **** months' notice at any time during the contract period.

Technical standards

1.13 All works undertaken by the Contractor must comply with Health Technical Memorandum 02-01 and all latest editions.

1.14 No variations to these publications should be made, unless specifically authorised in writing by the healthcare provider.

Service visit frequency

1.15 Maintenance visits by the Contractor will take place on a **** monthly basis.

1.16 The Contractor is to state the time required to undertake these works and the number of personnel attributed to the contract to complete these works in this time period.

1.17 The maintenance schedule should be commenced within **** months and **** days of the previous visit start date.

Emergency interruptions

1.18 With the exception of unforeseen emergencies, which should be monitored by *** the healthcare provider's estates services, each contracted maintenance visit as described in the particular schedule should be undertaken as one continuous visit to site. Dedicated personnel should be assigned the task of the maintenance and are to attend without interruption.

Contractor's personnel

1.19 The Contractor should employ maintenance staff performing the work as described.

1.20 All staff should be Competent Person (MGPS) qualified and have their skills matrix up to date.

1.21 The healthcare provider's Authorised Person (MGPS) will undertake competency assessments throughout the contract for all Competent Person staff.

1.22 No subcontracted staff should be employed on the healthcare provider's premises without the express permission of estates services.

1.23 It is the duty of the Contractor to ensure the competence of personnel undertaking this work.

1.24 The healthcare provider reserves the right to request the removal of any member of the Contractor's staff who is deemed by the healthcare providers to be unsuitable to be working on healthcare providers premises. No reason need be given for this decision.

2 Particular specification

2.1 This particular specification relates to the medical gas pipeline systems as described above, and should require the Contractor to undertake the maintenance as described under "schedule of work" on the following systems:

- all terminal units, however mounted

- all plant alarm systems associated with the medical gas systems
- all local alarm systems associated with the medical gas systems
- all line valves and line valve assemblies
- all AVSUs
- all visible medical gas pipelines
- all manifolds, including emergency reserve and stand-by units
- all medical/surgical/dental air compressors and vacuum plant
- all AGSS.

2.2 The Contractor is not to include for spare parts regardless of any maintenance requirements required as part of the routine maintenance.

2.3 All work should be undertaken during normal working hours, Monday to Friday 08.00 hours to 17.00 hours. Where this is not possible because of occupation of buildings (for example, operating rooms), the Contractor should liaise with the Authorised Person (MGPS) to arrange convenient visiting times. These are to be allowed for in the contract pricing.

2.4 Call-outs for repairs during and outside of normal working hours must be quoted accordingly by the hour.

2.5 **Exclusions**. The contract price will not include:

- work required to be undertaken as a result of damage to the system, unless caused by the Contractor
- call-outs for repairs
- parts.

2.6 The Contractor should provide an emergency call-out facility for the request of work 24 hours per day for all days included within the contract per calendar year.

2.7 The call-out response time should be a maximum of ** hours at all times.

2.8 Attendance to site should not exceed **** hours from the initial call-out.

2.9 The Contractor's representative should report to the Authorised Person (MGPS) on each arrival on and departure from site.

2.10 All Contractor's staff must wear personal identity badges provided by the Contractor and visitors' badges provided by the healthcare provider at all times they are on the healthcare provider's property.

2.11 In the event of the Contractor finding defects in the medical gas systems, other than those needing minor repairs (second-fix terminal unit leak); the Contractor will draw these to the attention of the Authorised Person (MGPS) who, where appropriate, will raise the necessary order for the repair works. These will form part of the service report. In cases where immediate attention is required, this requires the Authorised Person (MGPS) to be notified immediately.

2.12 No such work should take place without the knowledge and permission of the Authorised Person (MGPS).

2.13 At the end of each service visit, the Contractor should provide the Authorised Person (MGPS) with a report detailing the work.

2.14 This report should be signed by the Contractor's representative undertaking the work and must be submitted to the Authorised Person (MGPS) within ** working days of completion of the visit.

2.15 Logbooks attached to each piece of plant are to be provided and signed on completion of each item of plant serviced.

2.16 These logbooks will contain the date of service, and the name of the service engineer.

2.17 Minor works. This contract applies only to the routine maintenance of the medical gas systems within the healthcare provider's facilities.

2.18 On occasion, the Contractor may be required to submit tenders for work associated with minor alterations and improvements to these systems.

2.19 This contract does not imply exclusivity of the Contractor for undertaking these works.

2.20 The healthcare providers will seek competitive quotations for each piece of work.

2.21 Method statement. The Contractor must submit (with the quotation) a method statement detailing in a step-by-step process how the tasks listed in this specification should be performed.

2.22 This statement should include information on the anticipated length of time needed to undertake each task and the complete maintenance visit, number of staff on site and test equipment used.

2.23 Capability statement. The Contractor should submit (with the quotation) a general statement on their ability to support the requirements of the healthcare provider.

2.24 This should include details of various resources available to the Contractor, number of staff, competence levels and emergency support provision.

2.25 Documentation. The Contractor should provide:

- details of any other similar contracts being undertaken
- a copy of the Contractor's registration certificate under BS EN ISO 9001, with relevant scope for maintenance of medical gas systems defined
- copies of calibration certificates for all test equipment used in this work
- a list of Competent Persons (MGPS) who may be employed during this contract with certification
- copies of the training records of the above Competent Persons (MGPS)
- a copy of the Contractor's company policies

- a copy of the Contractor's method statement, as well as the relevant risk assessments
- copies of the relevant test/record sheets used by the Contractor, including records of each service visit.

2.26 The healthcare provider will provide the Contractor with additional up-to-date as-fitted drawings when necessary.

3 Schedule of work

3.1 Plant/systems on which the work is required. The contractor should allow for a 10% discrepancy in the total number for the terminal units and valves.

Terminal units:

Gas	Quantity
XX	XX
XX	XX

LVs & LVAs Total Quantity = XX

Manifolds

Gas	Size	ACM/ERM
XX	XX	XXX
XX	XX	XXX

3.2 Air plant. Include a description of each of the surgical/dental/medical/combined air plants including the compressors, dryers and ancillaries including PRS.

3.3 Vacuum plant. Include a description of each of the vacuum plants including pumps and filtration systems.

3.4 AGSS. Include a description of each of the plants with relevant details.

3.5 All items listed above are to be maintained in line with HTM 02-01 requirements and manufacturers' requirements. The specifics of the tasks to be undertaken are to be clearly listed in the provided method statement.

Appendix D – Medical vacuum systems: standard operational procedure for changing bacteria filters

Warning!
The vacuum system must be considered potentially contaminated, and you must take the precautions listed below.

If you observe any suspicious contaminant, such as mucus or blood, stop work immediately and report the situation to the Authorised Person (MGPS).

Biological contamination may appear crystalline or organic. Do not be deceived by appearance; treat all foreign material as a possible hazard.

Do not commence any work on a vacuum system suspected of contamination without authorisation and guidance from the Authorised Person (MGPS).

Do not eat or smoke when working on vacuum systems or components.

Do inspect your hands carefully for cuts or abrasions before putting on waterproof gloves. Apply a waterproof dressing as necessary to effectively cover all lesions.

Do wear the waterproof gloves provided and ensure that they remain intact throughout all work stages.

Do wear standard-issue overalls and ensure that they remain fully buttoned. Do wear eye protection, the face mask and disposable plastic apron provided. Do wear all protective clothing throughout all work stages.

Do take care not to cut yourself. If you do happen to cut yourself, carry out the following procedures:

- If a glove is punctured, remove glove.
- Allow wound to bleed freely.
- The contaminated area should be washed gently under running water and not scrubbed.
- Inform the Authorised Person (MGPS) of the incident immediately.
- Seek medical advice on appropriate action.
- Report the incident in accordance with local or company rules.

Do dispose of all removed infected material and oil in accordance with hospital procedures: for example, sealed within a bag marked “contaminated” and entrusted to the hospital authorities for safe disposal.

Do request guidance from the Authorised Person (MGPS) if in doubt about disposal procedures.

Do not remove contaminated materials from site.

Do not dispose of potentially contaminated material in general waste receptacles.

Do not place contaminated tools or equipment into your toolbox.

Do immediately, on completion of work, remove any contaminated outer clothing and always wash your hands and, if necessary, contaminated tools in an approved disinfectant; then rinse under running water.

Bacteria-filter change procedure

[to be affixed on/near plant]

- Select “stand-by” bacteria filter for online use. Select the bacteria filter that is not going to be changed by fully opening the inlet and outlet isolating valves.
- Isolate the “in-use” bacteria filter. Isolate the bacteria filter that is going to be changed by fully closing the inlet and outlet isolating valves.
- Isolate the “in-use” drainage flask. Close the drainage flask’s manual isolating ball valve.
- If any liquid is present, inform the Authorised Person (MGPS) immediately; otherwise, remove the drainage flask.
- Remove the filter housing. Unscrew/unclamp the filter housing and remove.
- Remove the filter and place in a disposal bag.

Warning:
Filter elements cannot be cleaned or reused.
Dispose of in accordance with hospital procedures for clinical waste.

- Fit the filter element. Position the O-ring seal and filter element. Secure the element within the filter head seat. Position the lower O-ring seal in the element-retaining nut, locating the groove. Fit the element-retaining nut and tighten by hand.

Caution:
Do not over-tighten the filter element as distortion of the O-ring seals may occur and prevent an effective seal.

- Refit the filter housing. Ensure that the O-ring seal is correctly positioned on the filter housing. Fit to the filter head and tighten. Do not over-torque.
- Refit the drainage flask. Screw the flask back onto the adapter, ensuring the O-ring is compressed to form a seal.
- Open the flask’s manual isolating valve.

Appendix E – Specimen permit-to-work forms

MEDICAL GAS PIPELINE SYSTEM PERMIT TO WORK - In accordance with HTM02-01 Permit No: _____

Hospital/Trust/Premises: _____ Delete text as applicable* **Page 1**

Part 1: I the AP (MGPS) assess the level of this permit to be:

Description by the Authorised Person, the following work is to be carried out: **LOW HAZARD**

Additional hazards have been identified as:

The work will affect the following systems (circle systems affected and cross out systems not affected)										
O_2	N_2O	O_2/N_2O	MA4	SA	DA	DVAC	VAC	AGS	He/O_2	CO_2

Work will effect the following areas: _____

Describe if and where the system will be isolated/reinstated: _____

RAMS ref No: _____ Quantity: _____ "Do Not Use" Plugs **have*/have not*** been installed.

Sketch of work and/or isolation arrangements:

This sketch **is/is not*** from an existing drawing No: _____ drawing date: _____

The work will take place between:	Start Time	Start Date	End Time	End Date

Clinical Permission **is*/is not*** required for the work described. **Permission is granted by the DCO(s) below***

	AP (MGPS)	DCO	DCO	DCO*/ Infection Control*	AP taking over
PRINT Name:					
Sign:					
Date:					
Time:					
Dept:					

Part 2 Competent Person (MGPS) acceptance of work and conditions

I accept responsibility for the work as described. **No other work** will be carried out by me or persons working under my control. **I am fully conversant** with the work described, the relevant health and safety requirements and the Risk Assessment & Method Statement. Ref No. _____

Other Permits: Type	No.	CP (MGPS)	CP (MGPS) Taking Over
		PRINT Name:	PRINT Name:
		Sign:	Sign:
		Date:	Date:
		Time:	Time:

Original (white) copy to be retained in this book by the AP (MGPS) - Pink copy to the QC (MGPS) - Yellow copy to the CP (MGPS)

To complete this Permit continue on to page 2.

MEDICAL GAS PIPELINE SYSTEM PERMIT TO WORK - In accordance with HTM02-01 Permit No: _____

Hospital/Trust/Premises: _____ **Delete text as applicable*** **Page 2**

Part 3: I the AP (MGPS) confirm continuation of the level of this permit to be: **LOW HAZARD**

I have*/have not* completed the work as described. **No other work** has been carried out by me or persons working under my control. I have informed the AP the system is ready for examination **and testing***.	The work as described **is*/is not*** complete . The area **is*/is not*** safe and the system **is ready for testing* / is not ready for testing as further work under a new permit is required, this permit is hereby cancelled***	All other permits **have*/have not*** been satisfactorily completed. AP (MGPS) to confirm.
CP (MGPS)	AP (MGPS)	Other Permits used: Completed
PRINT Name:	PRINT Name:	type / No. Y / N
Sign:	Sign:	type / No. Y / N
Date:	Date:	type / No. Y / N
Time:	Time:	type / No. Y / N

Part 4 Engineering Testing by the CP(MGPS) witnessed by the AP (MGPS)

Engineering Tests determined by the AP (MGPS) are to be carried out by the CP (MGPS):

TEST	P/F	TEST	P/F

Engineering test results **are*/ are not*** satisfactory.

Carried out by the CP (MGPS)	PRINT Name:	Sign:
	Date:	Time:
	CP Service Report No:	

The system **is ready for*/ is not ready for* / does not require*** pharmaceutical testing. **Further work under a new permit is required, this permit is hereby cancelled***

Witnessed by the AP (MGPS)	PRINT Name:	Sign:
	Date:	Time:

Comments, Sign, Date & Time:

Part 5 Pharmaceutical Testing by the QC (MGPS)*

Pharmaceutical Tests determined and carried out by the QC (MGPS):

	Gas Identity	Gas Quality	Particulates	Odour
GAS	P/F	P/F	P/F	P/F
O_2				
N_2O				
O_2/N_2O				
MA4				
SA				
DA				
He/O_2				
CO_2				

Pharmaceutical test results **are*/ are not*** satisfactory.

Carried out by the QC (MGPS)*	PRINT Name	Sign
	Date:	Time:
	QC Report No:	

The system **may*/ may not*** be taken into use. **Further work under a new permit is required, this permit is hereby cancelled***

Witnessed by the AP (MGPS)*	PRINT Name	Sign
	Date:	Time:

Comments, Sign, Date & Time:

Part 6 Acceptance of system status by the DCO (MGPS)

I declare that all aspects of the work have been explained to me. I hereby accept that the system is **ready*/not ready*** for service and I will undertake to advise all the appropriate staff of this service status.

	DCO	DCO	DCO	AP (MGPS)
Name:				
Sign:				
Date:				
Time:				
Dept:				

Quantity: "Do Not Use" Plugs have*/have not* been removed. AP Signed:

Original (white) copy to be retained in this book by the AP (MGPS) - Pink copy to the QC (MGPS) - Yellow copy to the CP (MGPS)

Alternatively electronic copies of both pages can be sent to the QC (MGPS) and CP (MGPS). This completed permit should be retained for the life of the system.

MEDICAL GAS PIPELINE SYSTEM PERMIT TO WORK - In accordance with HTM02-01 Permit No: _____

Hospital/Trust/Premises: _____ Delete text as applicable* **Page 1**

Part 1: I the AP (MGPS) assess the level of this permit to be:

Description by the Authorised Person, the following work is to be carried out: **HIGH HAZARD**

Additional hazards have been identified as:

The work will affect the following systems (circle systems affected and cross out systems not affected)										
O_2	N_2O	O_2/N_2O	MA4	SA	DA	DVAC	VAC	AGS	He/O_2	CO_2

Work will effect the following areas: _____

Describe if and where the system will be isolated/reinstated: _____

RAMS ref No: _____ Quantity: _____ "Do Not Use" Plugs **have*/have not*** been installed.

Sketch of work and/or isolation arrangements:

This sketch **is/is not*** from an existing drawing No: _____ drawing date: _____

The work will take place between:	Start Time	Start Date	End Time	End Date

Clinical Permission **is*/is not*** required for the work described. **Permission is granted by the DCO(s) below***

	AP (MGPS)	DCO	DCO	DCO*/ Infection Control*	AP taking over
PRINT Name:					
Sign:					
Date:					
Time:					
Dept:					

Part 2 Competent Person (MGPS) acceptance of work and conditions

I accept responsibility for the work as described. **No other work** will be carried out by me or persons working under my control. **I am fully conversant** with the work described, the relevant health and safety requirements and the Risk Assessment & Method Statement. Ref No. _____

Other Permits: Type	No.	CP (MGPS)	CP (MGPS) Taking Over
		PRINT Name:	PRINT Name:
		Sign:	Sign:
		Date:	Date:
		Time:	Time:

Original (white) copy to be retained in this book by the AP (MGPS) - Pink copy to the QC (MGPS) - Yellow copy to the CP (MGPS)

To complete this Permit continue on to page 2.

MEDICAL GAS PIPELINE SYSTEM PERMIT TO WORK - In accordance with HTM02-01 Permit No: _____

Hospital/Trust/Premises: _____ **Delete text as applicable*** **Page 2**

Part 3: I the AP (MGPS) confirm continuation of the level of this permit to be: **HIGH HAZARD**

I have*/have not* completed the work as described. **No other work** has been carried out by me or persons working under my control. I have informed the AP the system is ready for examination **and testing***.	The work as described **is*/is not*** complete . The area **is*/is not*** safe and the system **is ready for testing* / is not ready for testing as further work under a new permit is required, this permit is hereby cancelled***	All other permits **have*/have not*** been satisfactorily completed. AP (MGPS) to confirm.
CP (MGPS)	AP (MGPS)	Other Permits used: Completed
PRINT Name:	PRINT Name:	type / No. Y / N
Sign:	Sign:	type / No. Y / N
Date:	Date:	type / No. Y / N
Time:	Time:	type / No. Y / N

Part 4 Engineering Testing by the CP(MGPS) witnessed by the AP (MGPS)

Engineering Tests determined by the AP (MGPS) are to be carried out by the CP (MGPS):

TEST	P/F	TEST	P/F

Engineering test results **are*/ are not*** satisfactory.

Carried out by the CP (MGPS)	PRINT Name:	Sign:
	Date:	Time:
	CP Service Report No:	

The system **is*/ is not*** ready for pharmaceutical testing.
Further work under a new permit is required, this permit is hereby cancelled*

Witnessed by the AP (MGPS)	PRINT Name:	Sign:
	Date:	Time:

Comments, Sign, Date & Time:

Part 5 Pharmaceutical Testing by the QC (MGPS)

Pharmaceutical Tests determined and carried out by the QC (MGPS):

	Gas Identity	Gas Quality	Particulates	Odour
GAS	P/F	P/F	P/F	P/F
O_2				
N_2O				
O_2/N_2O				
MA4				
SA				
DA				
He/O_2				
CO_2				

Pharmaceutical test results **are*/ are not*** satisfactory.

Carried out by the QC (MGPS)*	PRINT Name	Sign
	Date:	Time:
	QC Report No:	

The system **may*/ may not*** be taken into use. **Further work under a new permit is required, this permit is hereby cancelled***

Witnessed by the AP (MGPS)*	PRINT Name	Sign
	Date:	Time:

Comments, Sign, Date & Time:

Part 6 Acceptance of system status by the DCO (MGPS)

I declare that all aspects of the work have been explained to me. I hereby accept that the system is **ready*/not ready*** for service and I will undertake to advise all the appropriate staff of this service status.

	DCO	DCO	DCO	AP (MGPS)
Name:				
Sign:				
Date:				
Time:				
Dept:				

Quantity: "Do Not Use" Plugs have*/have not* been removed. AP Signed:

Original (white) copy to be retained in this book by the AP (MGPS) - Pink copy to the QC (MGPS) - Yellow copy to the CP (MGPS)

Alternatively electronic copies of both pages can be sent to the QC (MGPS) and CP (MGPS). This completed permit should be retained for the life of the system.

References

Note:
The publication dates provided in the references list below correspond to when this edition of HTM 02-01 was drafted. The dates give context on the currency of referenced sources at the time of writing.
Standards and other specification documents are continually being updated, and readers should ensure they consult the latest editions of such documents, including any amendments issued after publication, to ensure they remain up to date with and can react to changing requirements.

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Publication approval reference: PRN02238