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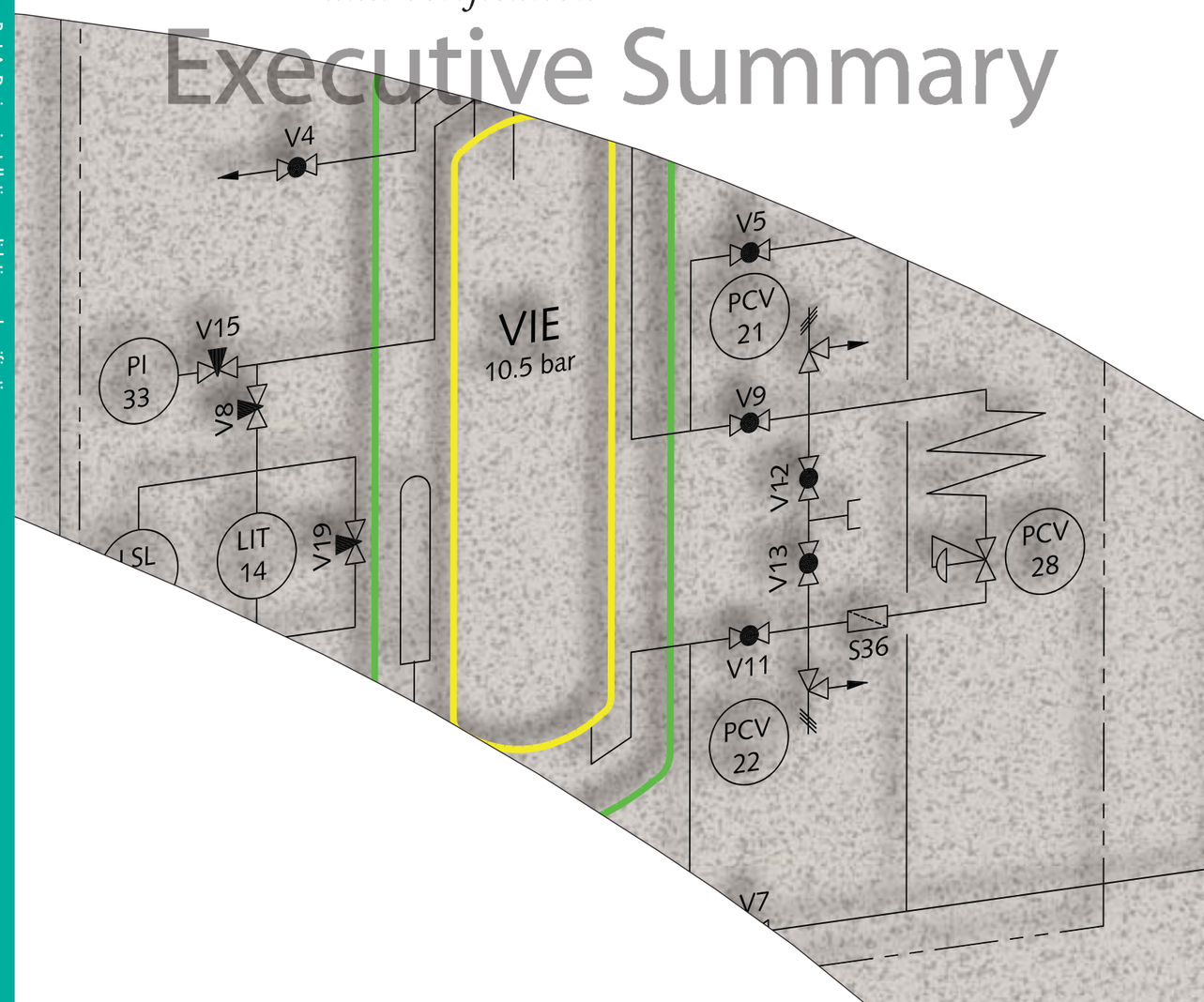
Medical gases
Health Technical Memorandum 02-01: Medical gas pipeline systems

Part A: Design, installation, validation and verification

Executive Summary



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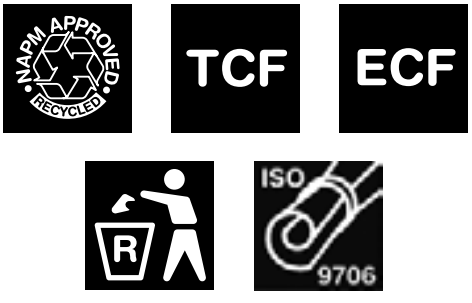


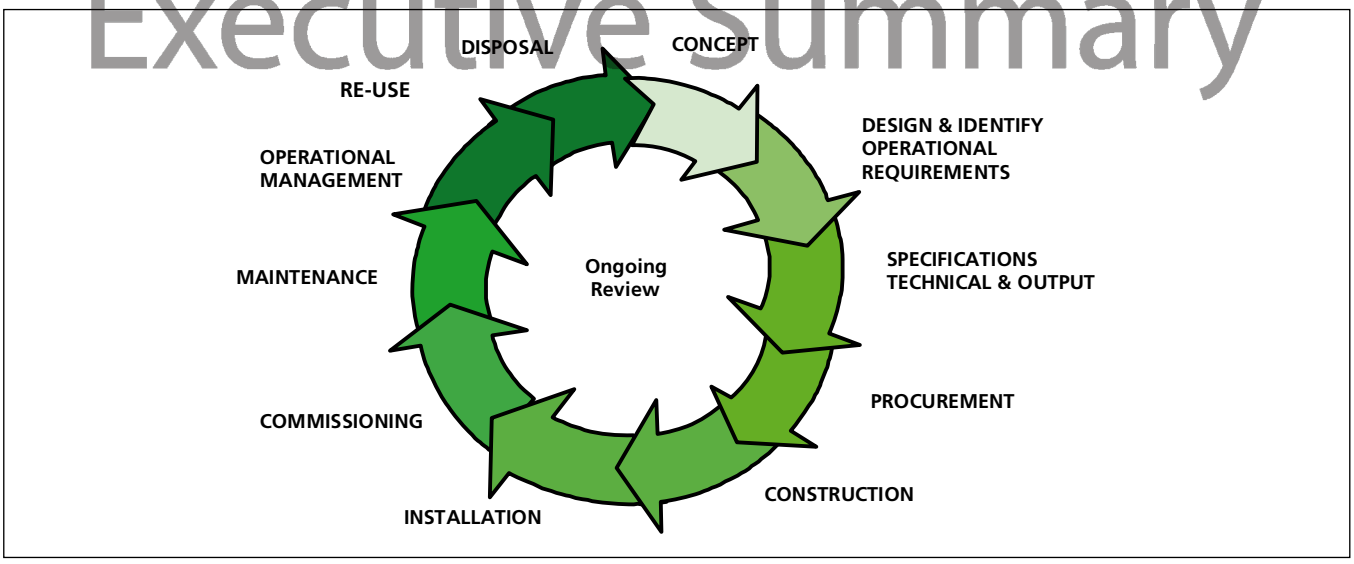
Preface

About Health Technical Memoranda

Engineering 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:

Figure 1 Healthcare building life-cycle



Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to unnecessarily repeat international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals.

The new core suite of nine subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering;
- provides a structured reference for healthcare engineering.

Structure of the Health Technical Memorandum suite

The new series of engineering-specific guidance contains a suite of nine core subjects:

Health Technical Memorandum 00
: Policies and principles (applicable to all Health Technical Memoranda in this series)

Health Technical Memorandum 01
: Disinfection and sterilization

Health Technical Memorandum 02
: Medical gases

Health Technical Memorandum 03
Ventilation systems

Health Technical Memorandum 04
Water systems

Health Technical Memorandum 05
Fire safety

Health Technical Memorandum 06
Electrical services

Health Technical Memorandum 07
Environment and sustainabilty

Health Technical Memorandum 08
Specialist services

Some subject areas may be further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Health Technical Memorandum 06-02 Part A will represent:

Electrical Services – Safety – Low Voltage

In a similar way Health Technical Memorandum 07-02 will simply represent:

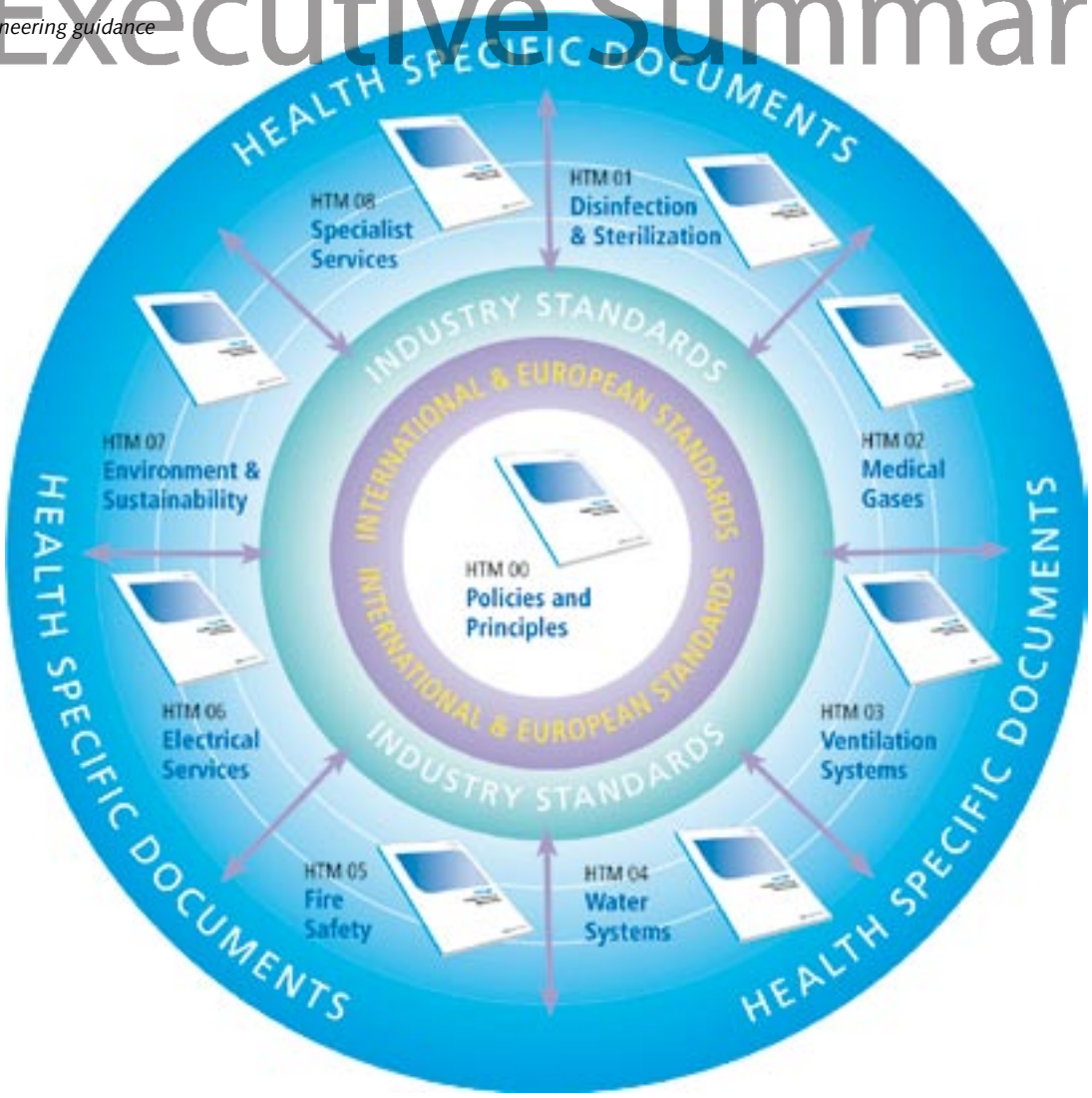
Environment and Sustainability – EnCO_2de.

All Health Technical Memoranda are supported by the initial document Health Technical Memorandum 00 which embraces the management and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.

DH Estates and Facilities Division wishes to acknowledge the contribution made by professional bodies, engineering consultants, healthcare specialists and NHS staff who have contributed to the review.

Figure 2 Engineering guidance



Executive summary

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 clinical and nursing staff at the point-of-use. It reduces the problems associated with the use of gas cylinders such as safety, porterage, storage and noise.

This Health Technical Memorandum is divided into two parts. Guidance in this part (Part A) covers piped medical gases, medical and surgical air, and medical vacuum installations: it applies to all medical gas pipeline systems installed in healthcare premises and anaesthetic gas scavenging disposal systems. Specifically, it deals with the issues involved in the design, installation, and validation and verification (testing and commissioning) of an MGPS. Part B covers operational management.

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

It is not necessary to apply the guidance retrospectively unless patient or staff safety would be compromised. In this case, the guidance given in this document should be followed.

Existing installations should be assessed for compliance with this guidance document. A plan for upgrading the existing system should be prepared, taking account of the priority for patient safety. Managers will need to liaise with medical colleagues and take account of other guidance published by the Department of Health in order to assess the system for technical shortcomings.

Health Technical Memorandum 02 supersedes all previous versions of Health Technical Memorandum 2022.

Sources of supply for pipeline installations

Oxygen

Oxygen is generally supplied from:

- a liquid source such as a large vacuum-insulated evaporator (VIE);
- liquid cylinders or compressed gas cylinders; or
- a combination of these to provide the necessary stand-by/back-up capacity.

Oxygen can also be supplied from an oxygen concentrator (pressure-swing adsorber). Such systems are usually installed where liquid or cylinders are expensive, unavailable or impracticable.

Medical air

Medical air is usually supplied from a compressed air plant that includes high-quality drying and filtration equipment. Blending oxygen and nitrogen on-site to provide a high-quality product with minimum maintenance can also provide medical air. Where such systems are installed to provide both oxygen and medical air, nitrogen can be used for the power source for surgical tools.

Other gases

All other gases are supplied from cylinders.

(On-site blended oxygen/nitrous oxide mixture is a possibility if bulk liquid supplies of nitrous oxide are available, although this system is unlikely to be adopted in the UK.)

Basic principles of design

Patient safety is paramount in the design, installation, commissioning and operation of medical gas pipeline systems. The basic principles of safety are achieved by ensuring quantity of supply, identity of supply, continuity of supply and quality of supply.

Quantity of supply

This is achieved by ensuring that the design of the pipeline installation and capacity of the supply plant is sufficient to provide the required flows of gases and vacuum for the intended number of patients to be treated

at any one time. Adequacy of supply is established 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 connectors. Such connectors are also identified by symbol and often 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 and providing additional means of supply provision in the event of failure of the primary and secondary plant or supply system. Systems are also connected to the essential electrical supply.

Quality of supply

Quality of supply is ensured by the use of gaseous or liquid sources that are provided to an appropriate product specification, usually a recognised European Pharmacopoeia (Ph. Eur.) monogram. 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. There are strict Ph. Eur. requirements for medical gases.

General uses of gas and pipeline installations

- Oxygen is one of the most extensively used gases for respiratory therapy and life-support and is additionally used in anaesthetic procedures.
- Medical air is mainly used in respiratory therapy as a power source for patient ventilators, and for blending with oxygen. It is also used as the driving gas for nebulised drugs and chemotherapy agents.
- Surgical air (of medical air quality) is also used, at a higher pressure, to power a variety of surgical tools and other devices such as tourniquets. (As an alternative, nitrogen can be used for this purpose.).
- Nitrous oxide is used for anaesthetic and analgesic purposes, being mixed with air, oxygen, and nebulised agents.
- Pipeline systems for a 50% mixture of oxygen and nitrous oxide are widely installed in the UK for analgesic purposes, particularly in maternity departments.
- Helium/oxygen mixture is used to treat patients with respiratory or airway obstruction and to relieve symptoms and signs of respiratory distress; guidance on pipeline systems is now included.
- Carbon dioxide is used less commonly now as a respiratory stimulant, and for insufflation during surgery. Pipeline systems for respiratory use have not been installed in the UK but they are now being installed for this latter purpose.
- Piped vacuum is provided in most clinical areas by means of centrally sited vacuum pumps.
- The control of occupational exposure to waste anaesthetic gas (nitrous oxide) and nebulised agents is a legal requirement under the Control of Substances Hazardous to Health (COSHH) Regulations 2002. Where nitrous oxide is provided for anaesthetic purposes, scavenging systems are installed.

Acknowledgements

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Executive Summary

Contents