Division of Technical Resources
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News to Use
Design Requirements Manual
The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U_j U_i)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U_i}\overline{U_j})=-\frac{\partial \overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U_i}}{\partial x_j}-\rho\overline{u_i u_j}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho U_i H)=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial T}{\partial x_i}-\rho\overline{u_i h}\right)$ biomedical research facilities.

'Design Requirements Manual (DRM) News to Use' is a monthly ORF publication featuring salient technical information that should be applied to the design of NIH biomedical research laboratories and animal facilities. NIH Project Officers, A/E's and other consultants to the NIH, who develop intramural, extramural and American Recovery and Reinvestment Act (ARRA) projects will benefit from 'News to Use'. Please address questions or comments to: ms252u@nih.gov

Compressed Gas Systems for Medical Use

Compressed gas systems for medical use require special attention to detail. Medical gas systems shall comply with the latest edition of NFPA Standard 99. Bulk systems over 566,335 L (20,000 scf) shall comply with the latest edition of NFPA Standard 50. Services for animals shall be completely independent of medical gas systems (including separate source supply tanks). All medical gas and vivaria systems and alarms shall be served by the emergency power system.

A separate compressed-air system independent of the laboratory compressed air system shall be provided and shall contain oil-free air compressors, desiccant air dryers, air filters, and line pressure controls. Air compressors and equipment shall be not less than duplex configuration and shall be in full accordance with the current edition of NFPA 99. Only desiccant-type dryers shall be utilized for medical air systems. MA systems shall be equipped with a duplex purification package capable of removing particulates 0.01 micron and larger. 100% redundancy of this equipment shall be provided.

MA compressors shall take their source of air from filtered outside atmosphere (or air already filtered for use in operating room ventilating systems). Air shall not contain contaminants in the form of particulate matter, odors, or other gases. MA systems shall have continuous dew point monitors, CO monitors, duplex air dryers, redundant controls, and duplex storage tanks. The MA system pressure shall be 345 kPa (50 psi) at the most remote outlet. Except for very limited demands and with prior NIH project officer approval, medical air shall be produced by central, dedicated medical air compressors in conformance with the latest edition of NFPA-99.

Where oxygen is required to serve animal research facility spaces, it shall be provided from a separate system than that of the medical oxygen for patient use. Oxygen can be supplied by large outdoor bulk storage tank or from cylinder manifold systems.

Nitrous oxide shall be supplied by a cylinder manifolded central system and piped at a terminal unit pressure of 345 kPa (50 psi) in all operating, cystoscopy, cardiac catheterization, and angiography rooms, and other locations as required by program. Nitrous oxide gas manifolds shall not be located in unheated spaces.

Nitrogen for medical, or vivarium applications (typically tool use) is normally provided by dedicated high-pressure cylinders located in a medical gas closet, with distribution at pressures in the range of 1380 kPa (200 psi) and provision of local gas control panels. Where nitrogen is required for inhalation therapy, it shall be provided from a dedicated manifold gas supply system (380 kPa (55 psi) medical gas). Specialty medical gasses shall be provided as local manifold cylinder systems (unless otherwise supported by demand requirements), dedicated for medical gas use.

The use of intertied medical gas redundant risers and mains to preclude catastrophic single point failure, incorporation of backfeed insertion points, and service valving provisions is required and shall be thoroughly reviewed during system design to ensure system reliability and facilitate future renovation and maintenance with minimal disruption. Master and local area alarm panels to monitor line pressures and the status of supply equipment shall be provided for all medical gas systems. Master alarm panels shall be placed in two separate locations: the office or work area of the individual responsible for maintenance of the system, and at a second location monitored 24 hours per day, i.e. a switchboard or security office.

Medical and vivaria gas systems shall be tested in accordance with NFPA-99, and in addition, all piping shall be tested at 20% above normal line pressure for a 24 hour period. Conventional laboratory gas systems shall be tested at not less than 1035 kPa (150 psi) for 24 hours. The A/E shall specify additional tests for specialized systems to insure system integrity. The only allowable pressure changes shall be those caused by temperature variations.

The required quantity of medical gas and vacuum outlets shall be verified on a per-program basis. In no case shall the minimum outlet quantity or locations be less that that specified in the most current edition of NFPA-99 or as recommended in the AIA Guidelines for Design and Construction of Health Care Facilities and ASPE Design Handbook 3, Chapter 2.

Pressurized gas systems shall be sized so that at maximum demand the gas pressure at the outlet is not less than 21 kPa (3 psi) below the normal design pressure, except that pressure drop not to exceed 10% of system nominal operating pressure may be used for systems operating at or above 690 kPa (100 psi). Minimum pipe size for any service shall be 13 mm (1/2 in.). Specific project specifications requirements are detailed in the DRM. The type and style of outlet should be designed to meet the needs of the medical staff.

Sufficient service and emergency shut-off valves shall be provided in accordance with NFPA-99, and as required to permit independent isolation of each building, floor, and major building wing. Valves shall be appropriately located, including use of locking and monitoring as appropriate. The use of three-valve capped bypass arrangements to permit emergency backfeeding and continuity of service during future maintenance and renovations is encouraged and should be coordinated with ORF during facility design.

Only licensed plumbers or pipe fitters, certified as medical gas installers in accordance with the ANSI/ASSE Series 6010 Professional Qualification Standard for Medical Gas System Installers, by a qualified agency shall install medical and Animal Research Facility (ARF) gas systems.

Further details on this month's topic are available on the DRM website
http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/DesignRequirementsManualPDF.htm
DRM Chapter 8, Section 8