

News to Use

Design Requirements Manual

The formulae $\frac{\partial U_i}{\partial x_j} + \frac{\partial (\rho U_i)}{\partial x_j} = \frac{\partial \rho}{\partial x_j} + \rho \frac{\partial U_i}{\partial x_j} + \rho U_i \frac{\partial x_j}{\partial x_j}$ for building $\frac{\partial (\rho U_i U_j)}{\partial x_k} = \frac{\partial \rho}{\partial x_k} + \rho \frac{\partial U_i U_j}{\partial x_k} + \rho U_i U_j \frac{\partial x_k}{\partial x_k}$ state of the art $\frac{\partial (\rho U_i U_j)}{\partial x_k} = \frac{\partial \rho}{\partial x_k} + \rho \frac{\partial U_i U_j}{\partial x_k} + \rho U_i U_j \frac{\partial x_k}{\partial x_k}$ 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

Animal Clinical Compressed Gas Systems

Compressed gas systems are utilized to serve clinical applications within animal research facilities for a variety of inhalation and sedation procedures, typically utilizing oxygen and carbon dioxide, but additional gasses such as nitrous oxide, nitrogen, and various special gas mixtures are sometimes required. Closely related are the dedicated Animal Surgical Vacuum and Anesthetic Gas Scavenging systems (see the August 2012, News to Use). This article will focus specifically on gas systems as intended to serve animal-clinical applications for respiration, anesthesia/analgesia, and life support. These systems are distinctly different, and should be independent of common laboratory, medical and process gas systems which may not meet the necessary quality, cleanliness, or reliability requirements, or may be otherwise subject to risks of cross contamination.

Animal clinical compressed gas systems are generally designed in accordance with NFPA-99/ISO 7396-1, and must reliably deliver gasses that meet medical gas standards (designated as USP/NF Grade). Systems must be designed and installed to ensure the requirements for reliability, redundancy, cleanliness, and purity are met as described in these documents. It is especially important that systems undergo careful construction and materials handling procedures to maintain system cleanliness including the use of only qualified medical gas system installers (such as ASSE 6010), medical gas brazer/welder qualification reports, maintaining sealed systems and inert gas purge, and the use of CGA G-4.1/ASTM B819 oxygen clean piping and oxygen clean individually bagged fittings. Prior to placing in service, systems should be certified for cleanliness, purity, and free of cross connections in accordance with NFPA-99 Category 1. The use of a qualified medical gas system verification process (such as ASSE series 6030) is required.

While the needs of protecting research and animal safety require systems that meet "NFPA-99 Level-1" (now called "Category 1"), a number of differences may occur unique modes of operation and physical arrangement of animal facilities. The arrangement of valves, alarms, terminal outlets, and even system sizing criteria may be permitted to differ, so long as the basic intent to ensure system safety, purity, and continuity are reliably maintained.

It is not permissible to intertie animal clinical gas systems with medical gas systems serving humans. Medical gas systems for human life support and medical procedures are kept completely independent to preclude any risk of cross contamination and to maintain conformance with regulatory standards. It is therefore poor practice to refer to Animal Clinical Gas systems as "Medical Gas" (and even risky in the case of shared research/healthcare facilities) even though the applications and quality requirements are similar. Animal clinical gas systems must also not be interconnected with laboratory gas systems, though for certain applications (such as carbon dioxide for euthanasia, nitrogen/ high pressure air supplies for powering surgical tools, or air for non-respiratory purposes) the use of shared laboratory gasses may be acceptable provided the system

incorporates appropriate quality and reliability. Oxygen systems (used for respiration) shall always be separate from other applications.

Animal clinical gas systems are typically sourced from dedicated compressed gas cylinder manifolds and must be located in appropriately secure areas (often a dedicated "closet") in accordance with NFPA-99, and frequently in close proximity to the vivarium or point of gas delivery. Fully automatic supply manifolds are utilized to automatically switch over and alarm when reserve supplies are in use and to provide remote alert where supply pressure is low or pressures are abnormal. Primary supply systems are sized to provide at least 2-weeks supply capacity, and reserves must provide not less than 3 days capacity (and greater where required by the program or for remote sites). For certain gasses such as CO2 (which may be required for euthanasia), it is important to consider facility disaster mitigation and emergency response plans to ensure adequate gas supplies are available for abnormal surge demands.

Valves are provided as for other pressurized gases, however must be locked open, monitored, or otherwise secure. Oxygen must typically include an emergency valve box for conformance with fire code. System pressure is monitored at significant mains/risers downstream of the supply manifold, and large facilities may require more than one monitoring point. A single "combined-type" alarm panel may serve both area alarm and master alarm functions and should be located in the vivarium corridor at a location where an alarm is likely to be monitored by responsible personnel. Alarms shall also alert to BAS and the vivaria monitoring system where such systems are provided, and/or to remote telemetry as necessary.

While the DRM provides minimum requirements to ensure programmatic flexibility, the program should always be consulted in determining the necessary locations and quantities for animal clinical gas outlets (often referred to as "terminal units"). Outlet requirements may be similar to those as described in the AIA Guidelines for Hospital Design and Construction. In many cases additional outlets may be required for programmatic flexibility and to facilitate work with multiple animals, and some services (such as animal clinical air) is not always needed. The maximum quantity of outlets that could be in simultaneous use in any given space (whether under normal or emergency conditions) must be discussed with the program, as well as loads from any ventilators.

The use of bold color coded faceplate DISS outlets is recommended as these can be easily adapted to accommodate a variety of instruments, and maintain protection from accidental connection to the wrong gas. Conventional serrated outlets are not utilized for oxygen or other life support gasses, though quick connect medical outlets can be used where coordinated with the program and not common to human clinical equipment needs within the facility. In shared hospital/research facilities, the outlet type should be distinctly different from outlets used to serve human patients.