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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* $\frac{\partial}{\partial x_j}(\rho \overline{U_i U_j}) = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j}\left(\mu \frac{\partial U_i}{\partial x_j} - \rho \overline{u_i u_j}\right) + g_i(\rho - \rho_0)$ *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

Central Vacuum Systems

Laboratory vacuum is typically required for each biomedical research facility, and is generally provided as a dedicated and central system that is piped to terminal inlets within each laboratory. Such systems are utilized for numerous applications, including transfer of liquids (aspiration), filtering, solvent extraction and degassing, gel electrophoresis, and samples desiccation to name a few.

Animal surgical vacuum is often required to serve vivarium areas where surgical procedures occur. Animal surgical vacuum systems may not be required when serving procedures for small rodents, but are usually necessary for procedures with larger animals. The program should always be consulted to determine need for services and to ensure designs incorporate appropriate programmatic flexibility.

Waste Anesthetic Gas Disposal (WAGD)/Animal anesthetic gas scavenging systems are often necessary for certain clinical areas (anesthetizing locations), but may not automatically be required for all vivaria. For example, in certain applications of small scale where only halogenated volatile anesthetics are utilized, the use of portable systems (such as charcoal canisters) may be acceptable if approved by the program veterinarian, project officer, and safety authority. Portable charcoal systems are often undesirable for routine applications, and are ineffective with some anesthetics (such as nitrous oxide). Passive systems are generally ineffective, and should be avoided. A variety of techniques are utilized in animal anesthesia, both with and without intubation, including various types of anesthesia machines with and without ventilators, induction boxes, and face masks; it is therefore important that users be provided with flexible systems that maintain safety without stress on the respiratory circuit. The proper operation and reliability of these systems is an important element to assuring the safety of program staff.

Regardless of the application, each vacuum system must be evaluated for the type of substance or products being evacuated. The design of systems must consider influencing factors such as the types of traps, the potential for ingestion of chemicals or solvents, operating conditions at vacuum pumps compatibility to withstand ingestion of liquid slugs, and even the potential for creating oxygen enriched or hazardous conditions at pump equipment and exhausts.

All vacuum systems shall comply with the following:

- The exhaust from the vacuum systems shall be discharged outdoors above the roof a minimum of 7.6 m (25 ft.) from air intakes or other building openings and areas where persons may congregate.
- The system design criteria shall be for 100% of the system peak load to remain upon failure of any one pump.
- Local control systems with system operating status and alarm condition readout shall be provided at the equipment. A fault signal to BAS shall be provided.

Laboratory Vacuum:

- Pumps, whenever possible, shall be of the single-stage, liquid ring type, with components designed for use in chemical laboratory applications.
- The vacuum system should be insensitive to occasional ingestion of liquid slugs as may occur from improper trapping or ingestion from vacuum inlets.
- The use of partial or fully recirculating systems should be provided to minimize water consumption.
- Systems are typically designed to provide 480 mm (19" HgG/ 275 Torr/ 65% vacuum) at the remote terminal inlet. Where vacuum levels deeper than 22" HgG are required, the use of localized vacuum pumps should be considered unless such demand is justified and widespread.

Animal Surgical Vacuum:

- Surgical vacuum systems for vivaria shall be completely independent of other systems (including medical systems serving humans), and shall be designed to be compliant with NFPA-99.
- A single alarm panel may serve both the master and area alarm functions, provided the alarm is appropriately located and provides alert to responsible personnel and BAS.
- Sufficient valving is required, and may be arranged per NFPA-99 or per the DRM. Drops to individual spaces are not required to be individually monitored by alarms where valves are located in secure locations.
- Where human medical/surgical vacuum systems are used in the same facility, distinctly different terminal outlet patterns should be utilized. The use of DISS connections is often recommended.

Animal Anesthetic Gas Scavenging/WAGD Vacuum:

- Scavenging requirements for animal applications shall be determined through consultation with the program veterinarian, and shall be based on low vacuum or high vacuum type active systems.
- Terminal units are typically required in procedure rooms and surgery areas.
- Systems are designed as active type, in accordance with either NFPA-99 WAGD systems, or in conformance with ISO 7396-2.
- Source equipment is typically liquid ring pumps or regenerative blowers. Small systems may choose to utilize compressed air driven active venturi type terminal units to eliminate the need for additional piped systems all together.
- Alarms are required per NFPA-99.
- High vacuum systems typically operate at approximately 5-inch HgG. Low pressure systems should comply with ISO 7396-2, and include source vacuum flow regulation.
- Systems are typically designed to provide 50 to 80 LPM (1.75 to 3.0 SCFM) per inlet.
- Effective anesthetic gas scavenging can also be accomplished through procedures performed within ducted biosafety cabinets and downdraft tables, or where similar controlled active means of capturing anesthetic are provided.

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 9