

The formulae $\frac{\partial \rho U_i}{\partial t} + \frac{\partial (\rho U_i U_j)}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} \right) + g_i (\rho - \rho_0)$ for building $\frac{\partial (\rho U_i \bar{U}_j)}{\partial x_j} = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} - \rho u_i' u_j' \right) + g_i (\rho - \rho_0)$ state of the art $\frac{\partial (\rho U_i \bar{H})}{\partial x_j} = \frac{\partial}{\partial x_j} \left(\lambda \frac{\partial \bar{H}}{\partial x_j} - \rho u_i' h' \right)$ biomedical research facilities.

Pipe Testing Part I

When the DRM was updated in 2016, one focus of the manual's mechanical sections was reducing the potential for flooding from piping systems. A central strategy for reducing flood potential is proper testing of piping systems at the time of installation. This article will examine testing requirements in the DRM for liquid-carrying piping systems. A future article will review testing requirements for mechanical and gas systems. The cited requirements in this article are for pressure and integrity testing only; the DRM provides references for other mandatory testing of various piping systems which ensures service quality to the points of use and the protection of researchers, maintenance personnel, and the general public. In the 2018 International Plumbing Code (IPC), Section 312 "Tests and Inspections" – which is one code referenced in the DRM – provides testing requirements for all plumbing systems. DRM Chapter 8 provides more stringent requirements for testing water supply systems and therefore supersedes the IPC.

Plumbing Water Supply Piping

According to DRM 8.3.16.B, water systems shall be tested to at least 150% of their working pressure or 150 psig (1,034 kPa), whichever is greater, for a minimum of 4 hours. Where freezing conditions may occur, a pneumatic test of 60 psig (414 kPa) may be applied to metal systems with no incompatible plastic parts. ASME warns that pneumatic testing can be dangerous due to the sudden release of stored energy in the compressed air. Because of this, the use of pneumatic tested should only be used where freezing conditions can occur.



Figure 1 Pipe Testing

Plumbing and Laboratory Drainage and Vent Systems

DRM 8.4.22 provides requirements for water testing of drain and vent piping. All joints in a system must be tested with at least a 10-foot (3 m) water column of pressure for a minimum of 1 hour. Systems may be tested in sections as they are completed, provided every joint in the system is tested to at least a 10 foot (3048 mm) of head. When testing drainage and vent systems with water, the contractor must carefully plan the test to ensure the maximum pressure on the lowest joint does not exceed the rating of the joint material. Failure to keep

the lowest joint from being overstressed can result in serious flooding that could impact the overall project, as well as occupied areas near test piping for renovation projects.

Non-Pressurized Drainage Systems

Testing requirements for storm systems are covered in DRM 8.4.22, which provides testing requirements for all drainage systems including all sanitary drains, sanitary vents, and storm drainage systems.

Shower Liner Testing

Leaks around drains in showers have been a persistent issue in the plumbing industry and are a particularly serious issue in clinical applications. DRM 8.2.9.D requires testing of shower drain membranes with a flood test of at least the curb height of the shower pan for no less than 24 hours. For shower pans that do not have a lip, like handicap accessible pans, the contractor is responsible for building a temporary dam to obtain the 2" flood level of the shower membrane.

High Purity Water Systems

Due to the critical nature of high purity water systems, pressure testing requirements are outlined in DRM Section 12.1.10.B. Systems are to be hydrostatically tested at 150% of the design operating pressure, or the maximum working pressure rating of the system, whichever is less. The minimum hydrostatic pressure shall be at least 100 psig (690 kPa). The A/E must consider the pressure ratings of any joint components which should not be subjected to this pressure and isolate or reduce pressures as appropriate. The minimum test period for all high purity water system tests shall be 8 hours.

Final Drainage Systems Testing

DRM Section 8.4.22.E provides requirements for final testing of all sanitary systems. The test requires that a U-Tube monometer be inserted into the sanitary system through a trap. The drain and vent systems should be plugged, and a pneumatic pressure applied to the system of 1 inch of water gauge (250 Pa) for 15 minutes with no loss of pressure. After successful completion of the test, all temporary plugs should be removed from the system.

Conclusion

The testing requirements referenced above are minimum requirements for these systems; the project officer has the option to increase the testing requirements for any application where critical facilities are at risk. Testing requirements for mechanical and gas systems will be reviewed in a future News to Use article.

'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:** shawm@nih.gov

Further details on this month's topic are available on the DRM website Chapter 8

<https://www.orf.od.nih.gov/TechnicalResources/Pages/DesignRequirementsManual2016.aspx>