

Basis of Design

This section applies to the pressure testing of ductwork and HVAC piping systems.

Design Evaluation

The following information is required to evaluate the design:

- Design Development Phase: Provide an outline specification of HVAC duct and piping pressure testing.
- Construction Document Phase: Provide a final specification of HVAC duct and piping pressure testing.

Construction Submittals

- Not applicable.

Related Sections

- Facilities Services Design Guide – Mechanical - Heating, Ventilating and Air Conditioning
 - Ductwork and Duct Accessories
- Facilities Services Design Guide – Mechanical - Piping, Valves & Accessories
- Facilities Services Design Guide – Mechanical - Commissioning

Products, Material and Equipment

- Duct test apparatus consists of portable high pressure blower with volume adjustment; flow measuring assembly consisting of a calibrated orifice mounted in a straight tube with straightening vane and pressure taps; U-tube manometer; and calibration curve for orifice assembly.

Installation, Fabrication and Construction

Duct Pressure Tests

- Pressure test all ductwork in shafts, all plenums, fume exhaust ductwork, snorkel exhaust ductwork and all ductwork with a pressure rating of more than 2 inches (negative or positive). For ductwork with a pressure rating of 2 inches or less (negative or positive), two selected supply ducts shall be tested on each floor, and one selected exhaust or return duct. Allow Owner's representative to select the ducts.
- Demonstrate to an Owner witness that the ductwork passes the following pressure tests before it is insulated or covered by walls or ceilings. Test ductwork after all smoke/fire dampers, fire dampers, pressure relief doors, and access doors for that portion of the ductwork have been installed.
- Discuss test pressures applied to each system with Campus Engineering.

- All pressure testing shall be witnessed and documented with results approved and signed off by a University representative.
- Before testing, provide the Owner-witness with the table or curve of pressure drop versus flow for the orifice being used to measure leakage. Provide data that is certified and an orifice that is clearly labeled so that a correlation between the orifice and table can be established.
- Maintain a set of drawings for recording and sign-off of each tested section.
- After each day of testing, submit to the Owner a copy of the paperwork recording the raw test data, calculating the duct areas, designating the duct category, and comparing the allowable and actual results.
- Maintain pressure testing records on site. Provide a copy of current pressure test results if requested by an Owner Representative.
- Complete test reports.

Test Procedure – General Environmental Supply, Return, Exhaust, and Outside Air Ductwork

- Close off and seal openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
- Test for leaks as follows:
 - 1) Start blower with its control damper closed.
 - 2) Gradually open the control damper until the duct pressure reaches 2 inches W.G. in excess of designed duct-operating pressure.
 - 3) Survey joints and seams for leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.
 - 4) After leaks have been sealed, retest failed sections of ductwork until satisfactory results are obtained. Contact the Construction Coordinator to schedule an Owner's Representative to witness re-tests.

Test Procedure – Fume Exhaust Ductwork

- Connect a blower to the duct specimen through a shutoff valve. Provide a magnehelic gage or inclined manometer with 0 inches to 10 inches W.G. range on the duct side of the shutoff valve.
- Provide temporary seals at all open ends of the ductwork.
- Average test pressure shall be 6 inches w.g. Initial pressure shall be 7 inches w.g.
- All fume duct joints from the fume hood collar to the fan inlet flex connection, not inclusive, shall be tested.
- To prevent over-pressurizing the ducts, start the blower with the variable inlet damper closed. Controlling pressure carefully, pressurize the duct section to the required level. When the pressure of the duct reaches 7 inches W.G., close the shutoff valve.
- Using a stopwatch, measure the time elapsed from when the duct is at 7 inches w.g. to 5 inches w.g. Use the formula $t = 6.23D$ to determine if the duct passes the test. ("D" is the nominal duct diameter, measured in inches; "t" is the MINIMUM allowable elapsed time, measured in seconds.)

- If the test fails to meet the allowable rate, make necessary repairs and retest until satisfactory results are obtained. Contact the Construction Coordinator to have Owner's Representative witness the test.
- Complete test reports.
- Comply with precautions listed in the current SMACNA HVAC Air Duct Leakage Test Manual.

Pressure Relief Doors or Panels

- With an Owner witness, demonstrate that the ductwork is not damaged during a fire alarm test.

Piping Pressure Tests

- Pressure test all piping.
- Demonstrate to an Owner witness that the piping passes the following pressure tests before it is insulated or covered by walls or ceilings. Test piping after all fittings, and valves for that portion of the piping have been installed.
- All pressure testing shall be witnessed and documented with results approved and signed off by a University representative.
- Repair leaks discovered during pressure testing. Retest failed sections of piping until satisfactory results are obtained. Contact the Construction Coordinator to schedule an Owner's Representative witness the test.
- Maintain a set of drawings for recording and sign-off of each tested section.
- After each day of testing, submit to the Owner a copy of the paperwork recording the raw test data, designating the piping system and Pipe Code, and comparing the allowable and actual results.
- Complete test reports.

Pipe Testing Methods

- Hydrostatic pressure testing: Use clean, fresh city water for test. On compressed gas piping remove water from piping systems after testing and dry by blowing dry, oil-free air or nitrogen through lines.
- Pneumatic pressure testing: Perform testing with dry, oil-free air or nitrogen on piping systems.
- The following table lists typical piping systems and the corresponding recommended test method and test pressure.

Piping System	Pipe Code	Test Method	Test Pressure, lb/in2 gage
Central Cooling Water	P-4	Hydrostatic	250
Condenser Water	P-1	Hydrostatic	60
Heating Hot Water	P-1	Hydrostatic	1.5 x max.
Process Chilled Water	P-1	Hydrostatic	1.5 x max.
Refrigerant Liquid	P-7	Pneumatic	350
Refrigerant Suction	P-7	Pneumatic	125

Piping System	Pipe Code	Test Method	Test Pressure, lb/in2 gage
Steam (Low Pressure)	P-4	Hydrostatic	25
Steam (Medium Pressure)	P-4	Hydrostatic	90
Steam (High Pressure)	P-4	Hydrostatic	280
Steam Condensate	P-4	Hydrostatic	1.5 x max.

END OF DESIGN GUIDE SECTION