UNIVERSITY OF WASHINGTON

ENVIRONMENTAL HEALTH AND SAFETY LABORATORY SAFETY DESIGN GUIDE--

APPENDIX A: ADDITIONAL FUME HOOD EXHAUST CRITERIA FOR FACILITIES NOT OWNED BY THE UNIVERSITY OF WASHINGTON

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Environmental Health and Safety
UNIVERSITY OF WASHINGTON

XII. APPENDIX A:

Additional Fume Hood Exhaust Criteria for Facilities Not Owned By the University of Washington.

A. Fume Hood Exhaust System (FHES)

1. Provide FHES fans with the following:
    a) Outboard “split” bearings
    b) Shaft Seal
    c) An access door
    d) Multiple 150 percent rated belts, or direct drive. In designing for explosion and fire control, the fan shall be of the non-sparking construction and the V-belt drive shall be non –conductive.
2. Provide a chemical resistant fan system.
3. Weld or permanently seal fan housing to avoid air leakage from the wheel shaft and discharge.
4. Choose fan type as follows:
    a) Use straight-radial fan for systems handling moderate to heavy quantities of particulate matter in air.
    b) Use backward-curved fans for systems handling relatively clean (low particulate) air.
    c) Provide perchloric acid hoods with a separate tainless steel bifurcated straight flow-through with motor outside the air stream of the fume exhaust fan and completely independent from any other exhaust.
5. Manifold fume exhaust systems shall use constant volume fans with make-up air/outside air bypass.
6. Mount the fan with vibration isolators.
7. Provide weather protected fans installed near the building roof. Fan installation in naturally ventilated penthouses is preferred. The fan shall be the last element of the system to assure that the ductwork throughout the building is under negative pressure.
8. Provide a drain to the acid resistant waste for FHES fans located in a penthouse.
9. Fans shall be installed so that they are readily accessible for maintenance and inspection without entering the plenum. If exhaust fans are located inside a penthouse, the ventilation needs of maintenance workers shall be considered.
10. Provide ducts that are round, non-combustible, inert to agents to be used, non-absorbent, and free of ay organic impregnation.

11. Choose duct material based on the compatibility with the materials handled in the hood. Basic characteristics of preferred hood and duct materials are as follows:

    a) Provide new installations to be round 18 gauge minimum thickness Type 316L stainless steel. Exceptions: Use 16 gauge stainless steel for perchloric hood systems.

    b) Use fiberglass reinforced plastic or material with similar acid resistant material for acid digestion systems. However, A/E must confirm design acceptability with both the University Fire Engineer and the local fire authority having jurisdiction prior to Design Development Phase.

    c) Leave glazed ceramic ducts and vitrified clay tile ducts in place if possible.

12. Exhaust duct must have liquid and airtight joints with smooth interior surfaces free of cracks, joints, or ledges.
13. Provide smooth, non-porous lining surfaces free of cracks, joints, or ledges.
14. Use flexible connection sections of duct, such as hypolon or neoprene-coated glass fiber cloth, between the fan and its intake duct if compatible with chemicals used in hood. Provide the transition joint from duct to fan of a seamless, constant diameter, inert, corrosion and UV-resistant materials as approved by owner. Provide the duct alignment within ½ inch at the hood collar and fan.
15. Continuously "butt" weld (use appropriate filler rod for type of stainless) for stainless steel joint construction. Provide a weld sample for A/E and UW inspection. A VanStone flange can be used if the quality of the weld may be compromised because of inaccessibility to the area.
16. Install two Petes plugs made of non-corrosive material in the exhaust duct at 90˚ to each other around the circumference for the purpose of pitot tube insertion.
17. Enclose the VAV modulating damper in a “removable spool assembly” located in the mechanical room. Variable frequency fan drives with static pressure sensors are also acceptable in some installations.
18. Provide a flanged removable spool piece (minimum of 24 inches long) at each fume hood connection. Use spool sections for leak tests, inspection, and to facilitate removal of equipment. Install acceptable gaskets at flanged joint connections.
19. All horizontal ducting shall be sloped down towards the fume hood (a recommended guideline is that the slope should equal to 1/8 inch per foot).
20. Automatic fire dampers shall not be used in laboratory hood exhaust systems. Fire detection and alarm systems shall not be interlocked to automatically shut down laboratory hood exhaust fans.
21. Exhaust fans serving chemical fume hoods should be connected to emergency standby power. The ventilation system shall supply and

exhaust at least half of the normal airflow during an electrical power failure. The design must also account for pressure differentials resulting from this condition with regard to egress from the laboratory and building.

22. Provide adequate space and easy access to facilitate inspection, repair, or replacement of exhaust ducts.
23. Provide perchloric acid FHES with a dedicated fan and duct and wash-down system that meets the following requirements.

    a) Design to provide as complete a wash down as possible with all duct at 45˚ or less from vertical.

    b) Provide fan casings and hood bottoms with continuous gravity drainage to the sanitary sewer.

    c) Design wash down to be activated by a manual valve located at the fume hood.

    d) Prior to acceptance, testing of the wash down system must be witnessed and approved by appropriate University representatives.
24. The target design velocity in each duct shall be in the range of 1200 to 1500 fpm to prevent condensed fumes or particulate from adhering to the walls of the ducts or settling out onto horizontal surfaces and to address acoustical issues. The actual value needs to consider noise and prevention of product deposition in the ducts.
25. To overcome aesthetic objection, design the exhaust stacks in the conceptual stage by incorporating an exhaust tower or a cluster of exhaust stacks as an architectural element of the building.
26. Fume hood exhaust through roofs should have vertical stacks that terminate at least ten feet above the roof or two feet above the top of any parapet wall, whichever is greater, unless higher stacks are found to be necessary according to “The ASHRAE Handbook of Fundamentals” or based on modeling.
27. Design the discharge velocity from the stack to be at least 3000 feet per minute.
28. Do not provide exhaust stacks with weather protection, such as rain caps, bird screens and goosenecks, which require the air to change direction or cause turbulence upon discharge.

B. Fume Hood Exhaust System Testing

1. Test FHES duct as follows:

    a) Connect a blower to the duct specimen through a shutoff valve. Provide a magnehelic gauge or inclined manometer with 0 to 10 inch W.G. range on the duct side of the shutoff valve.

    b) Provide temporary seals at all open ends of the duct.

    c) Average test pressure shall be 6 inches W.G. Initial pressure shall be 7 inches W.G.

    d) All fume duct joints from the fume hood collar to the fan inlet flex

connection, not inclusive, shall be tested.

e) 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.

f) 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.)

g) If the test fails to meet the allowable rate, make necessary repairs and retest until satisfactory results are obtained. Contact the Owner's Representative to witness the test.

h) Complete test reports.

i) Comply with precautions listed in the current SMACNA HVAC Air Duct Leakage Test Manual.