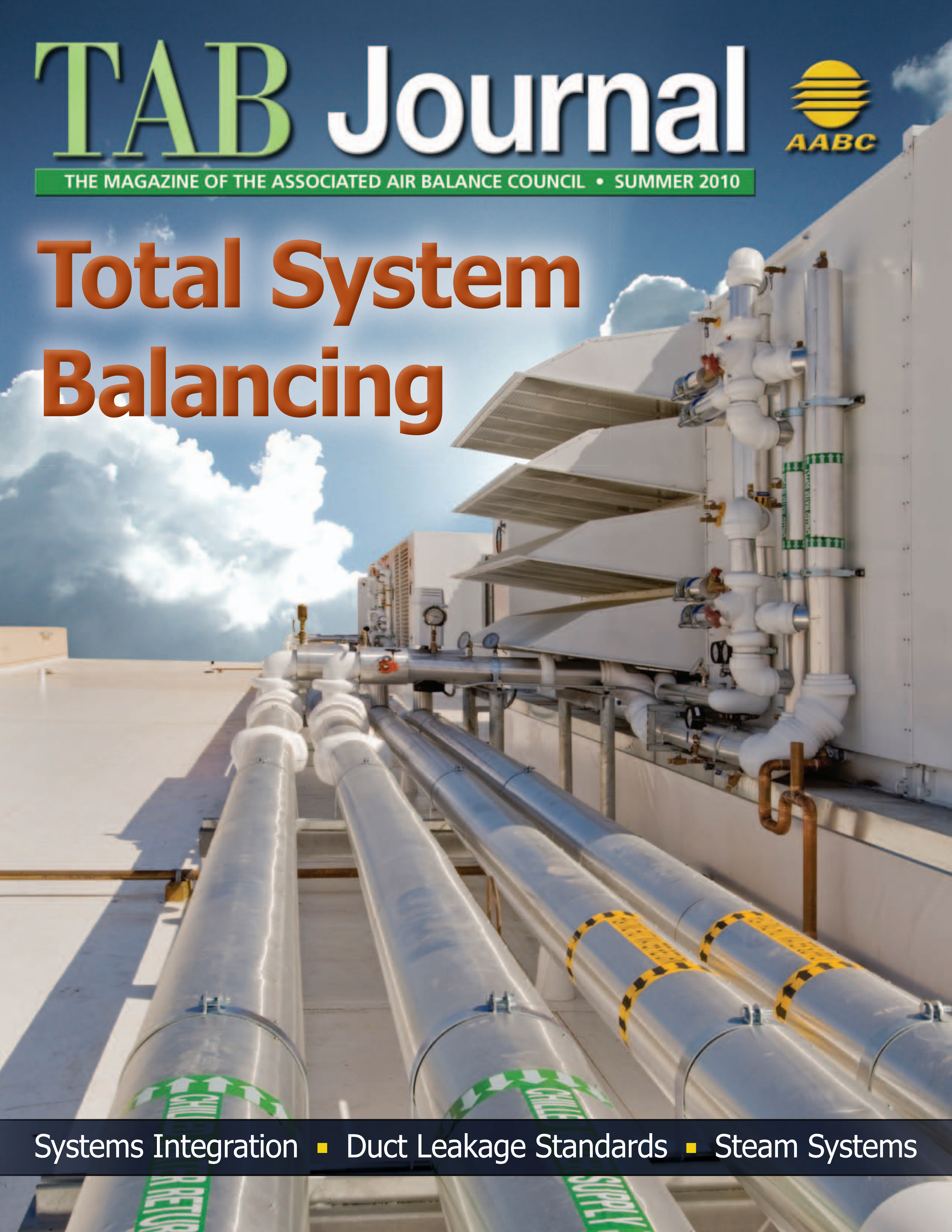
TAB Journal

AABC

THE MAGAZINE OF THE ASSOCIATED AIR BALANCE COUNCIL • SUMMER 2010

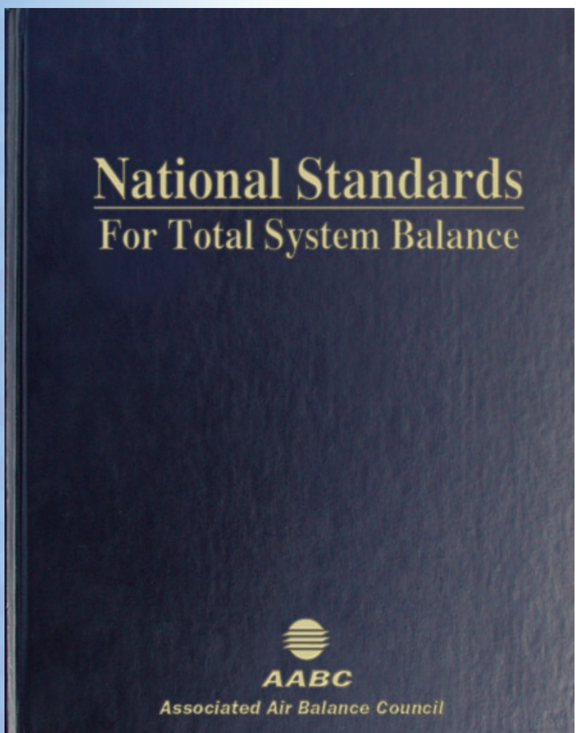
Total System Balancing



Systems Integration ▪ Duct Leakage Standards ▪ Steam Systems

A MUST-HAVE RESOURCE FOR INDUSTRY PROFESSIONALS!

The AABC National Standards for Total System Balance



The AABC National Standards for Total System Balance, 2002 edition, is a comprehensive manual detailing the minimum standards for total system balance.

Each chapter covers a specific area in the test and balance process, enabling the design professional to select those items that are best suited for a particular project.

Additionally, the Standards will assist the design professional in achieving design intent, provide a better understanding of the scope of work required of the TAB agency, and ensure that proper methods and procedures are followed in the test and balance process.

New features of the Standards include:

- Illustrative tables and charts
- Equations and examples
- Sample specifications
- Expanded section of sample report forms
- New technologies, such as DDC
- Updated testing procedures
- Appendix with equations in both English and Metric formats

AABC believes that by promoting the concept of Total System Balance, the industry will be encouraged to adopt more consistent practices, thus ensuring greater success for all parties involved in the design, installation, start-up, operation and testing of HVAC systems.

For additional information on the Associated Air Balance Council or the new AABC Standards, visit our website at **www.aabc.com**, or contact AABC National Headquarters at **202-737-0202**.

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TAB Journal is published quarterly by the Associated Air Balance Council. It is distributed free to AABC members and by subscription to non-members at $24 per year. *TAB Journal* is an open forum for the free expression of opinions and information. The views expressed are not necessarily those of AABC, its officers, directors, or staff. Letters, manuscripts, and other submissions are welcome. However, *TAB Journal* accepts no responsibility for unsolicited material.

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From the Publisher

The Summer 2010 of *TAB Journal* discusses a variety of topics dealing with total system balancing.

The issue's feature article, *"Coordinating Building Systems for Total System Testing,"* by Gerald Ketter of AIR Engineering and Testing, Inc., describes the importance of integrating various sub-systems to ensure proper, total functionality, using a process that can facilitate the interconnections of systems such as fire sprinklers, electrical and emergency power, fire alarms, and energy management systems.

In *"Balancing Exhaust Airflow for Bio-Safety Cabinets,"* Christopher Burnette of The Phoenix Agency of N.C., Inc., provides a case study detailing the steps taken to properly balance two BSCs and the factors that one must consider when selecting the test method.

Another case study is described in *"In-Place HEPA Filter Test,"* by Christopher White of System Analysis. It discusses testing a new installation and the tools that are used to successfully accomplish this task.

Engineered Air Balance Co., Inc.'s Thomas Schlachter suggests a plethora of useful troubleshooting tips for operating and installing steam systems in his article *"Tips for Testing Steam Systems."* Bret Privitt of Air Balancing Company, LTD, also offers helpful tips on implementing informal, but practical technician training in his article, *"Hip Pocket Training."*

This issue features an extended *Tech Talk*, covering preferred fan positioning in a specific scenario, suggested tools to be used during air flow measuring, fiberboard ductwork standards, guidelines governing test and balance on a Core & Shell building, and a discussion of specifications vs. standards with respect to air balance tolerances.

As always we thank the contributors to this issue, and remind you to write us at info@aabc.com if you have comments, article ideas, or questions to be answered in *Tech Talk*.

Coordinating Building S

Gerald J. Kettler, P.E., TBE
AIR Engineering and Testing, Inc.

Building testing involves the verification that the facility is designed and constructed to meet the owner's project requirements. Since facilities are assembled from many sub-systems, the integration of these systems is critical to total functionality. This integration process cannot wait until final testing without creating many delays and added costs. This article describes an integration and coordination process that is used to assure that the interconnected building systems are installed, tested and ultimately perform for total facility functionality.

Buildings are designed and constructed by assembling and integrating many subsystems. Each of these subsystems has unique requirements from site preparation to structural, building shell, mechanical, plumbing and electrical. In addition to these basic systems there are often specialty systems such as building automation, fire sprinkler and alarm, communication, and information systems. The design of most of the specialty systems is done with performance specifications, that is, the resulting performance of the system is described but not all the specific equipment and interconnections.

The ultimate use and function of the building depends upon the successful interconnection of these many systems. Each one of the specialty systems and usually the basic systems are installed by a separate contractor. Many of the systems are also designed by the subcontractor. Although each contractor understands their equipment, they often do not consider the interconnections with other systems.

The function of testing and commissioning is to assure the successful performance of the building systems and the conformance to the owner's project requirements. The ultimate performance depends upon the integration of these systems and the testing and demonstration of the results.

This integration function can be facilitated by the following procedures. At the point and time when the building systems and specialty contractors have been selected and the project management and trades personnel are beginning to install their systems, a series of meetings is conducted to facilitate, or in some cases force, communication between the various trades and systems. The function of these sessions is not to get into the basics of each system but to 1) define the interconnection points, locations, and methodologies between all systems, 2) clarify code and sequences of operation that require interconnection and 3) define system and integration testing.

Each physical system must be located in a space of sufficient size and located to facilitate installation and maintenance. This often requires added shop drawings and coordination drawings. Responsibility for these plans must be assigned and coordinated. This function often involves the design team for clarifications and possible changes in function and location.

Systems for Total System Testing

The process described here is divided into sections for fire sprinklers, specialty systems, electrical and emergency power systems, fire alarm systems, mechanical-life safety-refrigerant systems, energy management systems, and integrated testing. Each section includes items on installation locations, interconnections, and testing by contractor, local authority and commissioning team.

Fire Sprinklers

The fire sprinklers must share space with the mechanical and electrical systems. The controls and monitoring of the fire systems must connect the fire sprinklers with the alarm system, the elevator systems (if present) and fire department alarms and connections. Fire systems including a fire pump may also need interface with emergency power systems. The file alarm contractor needs a copy of the approved sprinkler shop drawings to find the locations of flow and tamper switches, and the zone locations. The type of sprinkler flow alarm device will need a power source if it is an electric bell and strobe light. Dry pipe and pre-action systems must be located and power provided as required. In some locations separate heating is required to prevent potential freezing. Approval and testing by local or other authorities and integrated testing must be coordinated.

"The ultimate use and function of the building depends upon the successful interconnections of many systems, which are usually each installed by different contractors."

Specialty Systems

Specialty systems can include: elevators, escalators, telephone, technology (computers), public address, medical systems, etc. Elevators require one or two dedicated telephone lines that are often forgotten. The elevator codes usually require shaft venting that is not covered in the building or mechanical codes. The elevator code smoke relief vent only requires an opening in the top of the elevator shaft. No damper is required so the opening often becomes a permanent source of hot air in the summer and cold air in the winter. High rise elevators require location panels adjacent to the fire alarm system. Alarm recall systems must be integrated with the alarm system as well as with the elevator lobby smoke detectors.

Telephone and technology systems often have continuous cooling requirements that are not covered by building HVAC systems that are turned off after normal operating hours. Remote monitoring systems must be accommodated, as well as special fire protection, power quality and emergency power for some systems. Testing and commissioning of each system must be coordinated.

Electrical and Emergency Power

The electrical and lighting systems are essential for building operation. Space must be available for installation and maintenance. Emergency power must be organized and provided for all emergency systems. Elevators, fire pumps and emergency lighting are usually connected to emergency generators if required by codes. Other systems also have unique requirements. For example if the building has smoke dampers and a smoke control system, emergency power is required for damper operation as well as the smoke exhaust or control fans and the entire mechanical control system. Transfer switches, annunciator panels and controls must be coordinated with power and alarm systems.

Fire Alarm

Fire alarm panels must be approved and situated according to local fire department requirements. Alarm and signal devices are required for resident safety and emergency responder notification. Dedicated telephone lines are usually required as well as a contract with a monitoring company in many localities. Connections to the fire sprinkler systems, and the mechanical systems are essential to proper building operation. The location and connection of the air handler smoke detectors present problems regarding which contractor will provide and connect the devices and what type of alarm function is required. Emergency power and/or battery backup are usually required. Local inspection of these systems is usually very detailed and must be arranged with the other building systems.

Mechanical- Life Safety – Refrigerant Systems

Mechanical systems are often installed in locations or limited spaces that make maintenance very difficult. This coordination requires interface with the design team preferably early in the design phase. The sequence of operation particularly for emergency and smoke control operations must be checked and all required controls installed. The timing of alarms, damper operation and equipment control can be problematic and should be resolved in this coordination stage. For example, if fast acting smoke dampers are activated before the fans have been turned off and ramped down, the ductwork may be in danger of overpressure and damage.

Refrigerant exhaust systems must be on emergency power, if available. These systems must meet the code requirements and also ASHRAE Standard 15 where required. This requires refrigerant sensors, exhaust fans and control panels as well as shut-off switches and available emergency breathing equipment.

"At the point and time when the project management and trades personnel are beginning to install their systems, a series of meetings is conducted to facilitate, or in some cases force, communication."

Testing of these systems is essential and often quite time consuming.

Energy Management Systems

The functioning of the energy management system is essential to building function and comfort. The location of the sensor and control devices must be coordinated and verified for all systems. If the controls are used for emergency and smoke control systems, it is essential that the control system be on emergency power. This is often forgotten. The design and final sequences of operation must be coordinated and verified. Changes to the preliminary sequences are frequent and must be approved by the design team. Sensors must be calibrated and graphics checked for accuracy.

Systems Testing and Commissioning

The function of testing and commissioning is to verify that the operation conforms to the owner's project requirements. The sub-systems are first checked independently, and then the entire system is functionally checked. After the individual systems are verified, the integrated functions are verified.

Each system should have a testing plan developed by the designers, contractors and commissioning authority. The plan as well as the records and results become a part of the facility commissioning report.

Balancing Exhaust Airflow for Bio-Safety Cabinets

Christopher T. Burnette, TBE
The Phoenix Agency of NC., Inc.

At times after the exhaust airflow is balanced on a biological safety cabinet (BSC), the hood certification company later informs the test and balance agency that the exhaust CFM is low.

As standard procedure in air balance, the pitot tube traverse is always the preferred method for determining airflow. This article uses EF-723/1 as the test fan, serving two BSCs at 425 CFM each for a total of 850 CFM.

The inlet of the fan was traversed and the fan speed was set for 892 CFM. Each BSC was traversed in the 10” diameter stainless duct serving the BSC.

BSC 1 was set at 437 CFM and BSC 2 was set at 451 CFM, for a total flow of 888 CFM. The total CFM measured at the BSCs agreed with the traverse CFM at the fan. All tests met the design criteria so this completed the fan testing, allowing the test and balance technicians to proceed to other tasks on the project.

The next day, the contractor hired to certify the hoods arrived. He concluded that the BSCs were low on air, based on the NSF/ANSI/.49.2007 method of measurement. He used a 12” x 24” top on a flowhood, taking a direct CFM measurement at the opening of the hood, using no backpressure compensation or A_k factor. The cabinet opening was 70” wide by 8” tall and each end of the cabinet was taped up and sealed except for the 24” opening in the center.

His reading on cabinet #1 was 393 CFM, and 386 CFM on cabinet #2. Both readings were 12% lower than the traverse readings taken by the TAB team. Because these hoods had to be certified, the airflow on each cabinet had to be increased for BSC 1, to 468 CFM, and to 478 CFM for BSC 2. Once this was done, the hood certifier measured 406 CFM and 413 CFM respectively. The hoods were now accepted for certification. The final traverse on the exhaust fan inlet duct was 948 CFM, which was 11% higher than the design flow.

The AABC National Standards section 16.10 states the TAB agency is to determine the exhaust airflow by pitot tube traverses where accurate traverses can be obtained. Any other method of air flow measurement is to be corrected to correlate with the pitot tube traverse. Therefore, the test method employed for certifying the biological safety cabinets on this project in accordance with NSF/ANSI.49.2007 should have been revised.

If a new construction project has multiple BSCs, setting all of them 10% high on exhaust may result in a negatively pressured building and increased make-up air requirements. Running the exhaust fans 10-12% high on CFM, combined with the additional make-up air necessary to compensate for the increased exhaust air, may result in unnecessarily higher energy costs.

Photo: www.wright.edu

Tips for Testing Steam Systems

Thomas P. Schlachter P.E., TBE
Engineered Air Balance Co., Inc.

How often have you worked with a steam system? How experienced are you at troubleshooting problems with air handling unit steam coils? How about steam heat exchangers used in heating water systems? Can you look at an installation and see potential problems?

The following is a list of common installation and operating issues that may be helpful in your work with steam systems.

Gauges

- Gauges are required for troubleshooting operational and capacity problems and to record operating conditions.
- Gauges need to be installed both entering and leaving temperature control valves.
- Gauges need to be installed both entering and leaving pressure reducing valves.

Pressure Reducing Valves

- Many times a building is supplied with high pressure steam from a remote location, and the pressure is reduced one or more times to match the building components' operating pressure. You may have 125 psi steam from your remote source that is reduced to 70 psi for sterilization equipment and reduced further to 15 psi for HVAC equipment.
- During submittal review, verify that each Pressure Reducing Valve (PRV) station's pressure (psi) and capacity totals (lb./Hr.) matches the buildings requirements.
- Under light loads, pressure control using a single steam pressure reducing valve is difficult; a 1/3 – 2/3 PRV station with the valves piped in parallel is preferred.
- Try to be present when the contractor is setting up the 1/3 & 2/3 pressure reducing valves. A load on the system will be required to verify the 1/3 PRV is fully open before the 2/3 valve begins to open. To achieve the load required, steam may have to be vented to the atmosphere. To ensure the 1/3 & 2/3 valves operate in series consider having the 1/3 valve adjusted 1-2 psi greater than the 2/3 valve.
- Verify each PRV will fully close and stop any amount of steam from leaking by. A steam leak with reduced demand will cause the downstream pressure to equal the upstream pressure.

Temperature Control Valves (AHU Coils and HW Heat Exchangers)

- During submittal review, verify the control valve capacities for each coil match the scheduled coil capacity (lb./Hr.).
- During submittal review, verify the control valves pressure drop matches the pressure being supplied and the scheduled operating pressure of the coil or heat exchanger. Example: PRV set to supply 15 psi and coils selected for 10 psi would require a control valve with a 5 psi pressure drop; at the specified capacity (lb./Hr.).
- Verify the actual valves installed are the valves specified.
- Verify the temperature control valves action is correct and the failed position is correct. The majority of the time normally closed (N.C.) is specified. The few times a normally open steam control valves are utilized, damage can be caused by overheating when there was a control signal failure.

- Verify the control valve will fully close and stop any amount of steam from leaking. A steam leak with reduced or no secondary flow (air or water) can increase temperatures quickly and dramatically.
- Under light loads, temperature control using a single steam control valve is difficult, a 1/3 – 2/3 valve control valve piping arrangement is preferred.

Steam Coils

- Verify the submittal matches the scheduled pressure (psi) and capacity (lb./Hr.).
- Verify the coil size matches the submittal; this includes face area, tube size, connection size, header size and number of Fins per inch.
- Many coil manufacturers do not tag their coils.
- Verify the edges around the coil are blanked off and air is not bypassing the coil.
- Prior to testing verify the trip temperatures for fire or fire/ smoke dampers. While many fire links melt/trip at 160°F, it can also happen at 140°F and 180°F.
- Prior to testing, calculate the expected temperature rise. You may need to limit the temperature to prevent fire and fire/ smoke dampers from closing. It would be prudent to limit the temperature to 40°F.
- To test capacity measure airflow, entering and leaving air temperatures and the steam pressure entering the coil.
- It is good practice to perform a temperature traverse on the leaving side of the coil. This traverse will identify any cold spots.
- Cold spots observed during full loads can be caused by a flooded coil, poor mixed air conditions, too wide of a distance between the rows of tubes, to large of a distance between the tubes internal nozzles, or a coil that does not slope back to the condensate drain.
- Cold spots observed during partial loads may also be caused by too long of a coil, and the steam condensing before it can reach the end of the coil.
- It has been observed that larger air handling unit steam coils produce a more even discharge temperature under partial loads when vertical tubes are utilized, rather than the conventional horizontal tubes.

Heat Exchangers

- During plan review, determine if your heat exchanger (HX) is to have a water isolation valve. Whether the isolation valve is installed in the entering or leaving side of the HX is not an issue. It would be preferable to have a mass of water between the HX and water isolation valve.

  Note: A system has been observed with a leaking HX steam valve and the water isolation valve located only 2' above the HX. The heat was trapped in the HX by the isolation valve, causing water temperatures to exceed 260°F. When the isolation valve was opened, the thermal shock shook the entire hot water piping system.

- Verify the submittal matches the schedule pressure (psi) and capacity (lb./Hr.).
- Verify the tag on the heat exchanger matches the submittal model and size.
- Verify the water is piped as noted in the submittal.
- If a HX has a water isolation valve verify the valve action is correct and the valve fails in the position required. A normally open valve may be more desirable, as a manual valve can be closed if needed.
- Verify the building automation system (BAS) temperature sensors are accurate before capacity testing.
- Verify thermometers are installed per plans and are accurate before capacity testing.
- To test capacity measure water flow, entering and leaving water temperature and the steam pressure entering the HX.

Strainers

- Verify that plan details indicate a strainer upstream of all control valves, pressure reducing valves and condensate traps.
- Sometimes you can screw a gauge into the strainer blow down, if there is no other gauge taps installed in the steam system.
- If capacity testing indicates a deficiency, request the contractor to pull the strainer. Try to be available whenever a contractor is inspecting a strainer.
- Blowing down a strainer will not remove all debris; the trash from the blow down only serves to reinforce the need to pull the strainer basket.

Condensate Traps

- Verify plan details indicate a minimum vertical distance between the coil/ heat exchanger condensate outlet. A common minimum height is 12"; this height will ensure the column of water will provide the pressure required to open the trap's internal float.
- Verify the actual vertical height between coil/heat exchanger condensate connection and the trap. Insufficient height may cause condensate to accumulate in the coil. A flooded coil will have cold spots and a loss of capacity.
- Verify the traps submitted match the required capacity (lb./ Hr.).
- Verify the actual traps installed match the type, model and size submitted.
- When a flooded coil is suspected try opening the strainer blow down upstream of the trap and re-test the leaving air temperature.

The design engineers and contractors have significant roles in ensuring a steam system is operational. Although the tips presented are numerous, these may be but a few of the problems you have encountered when working with steam heating. Don't forget the condensate receiver pumps must be operating correctly. Good testing and be safe!

In-Place HEPA Filter Testing

Christopher White, P.E., TBE
Systems Analysis, Inc.

A new installation of HEPA filter ceiling modules in a cleanroom project had to be tested. The purpose of the testing was to certify the integrity of the filtration system with all the designed components installed. All tests were performed following the protocols outlined in the applicable IEST (Institute of Environmental Sciences and Technology) standards.

Prior to any HEPA filter installation and testing, all construction in the actual cleanrooms must be complete because any residue dirt and debris will significantly diminish the life of the HEPA filters. To conduct the tests, all HVAC systems and controls must be operational and testing and balancing must be completed. Since the HEPA filter is located in each supply outlet, design airflows must be maintained in order for accurate testing of the filter integrity.

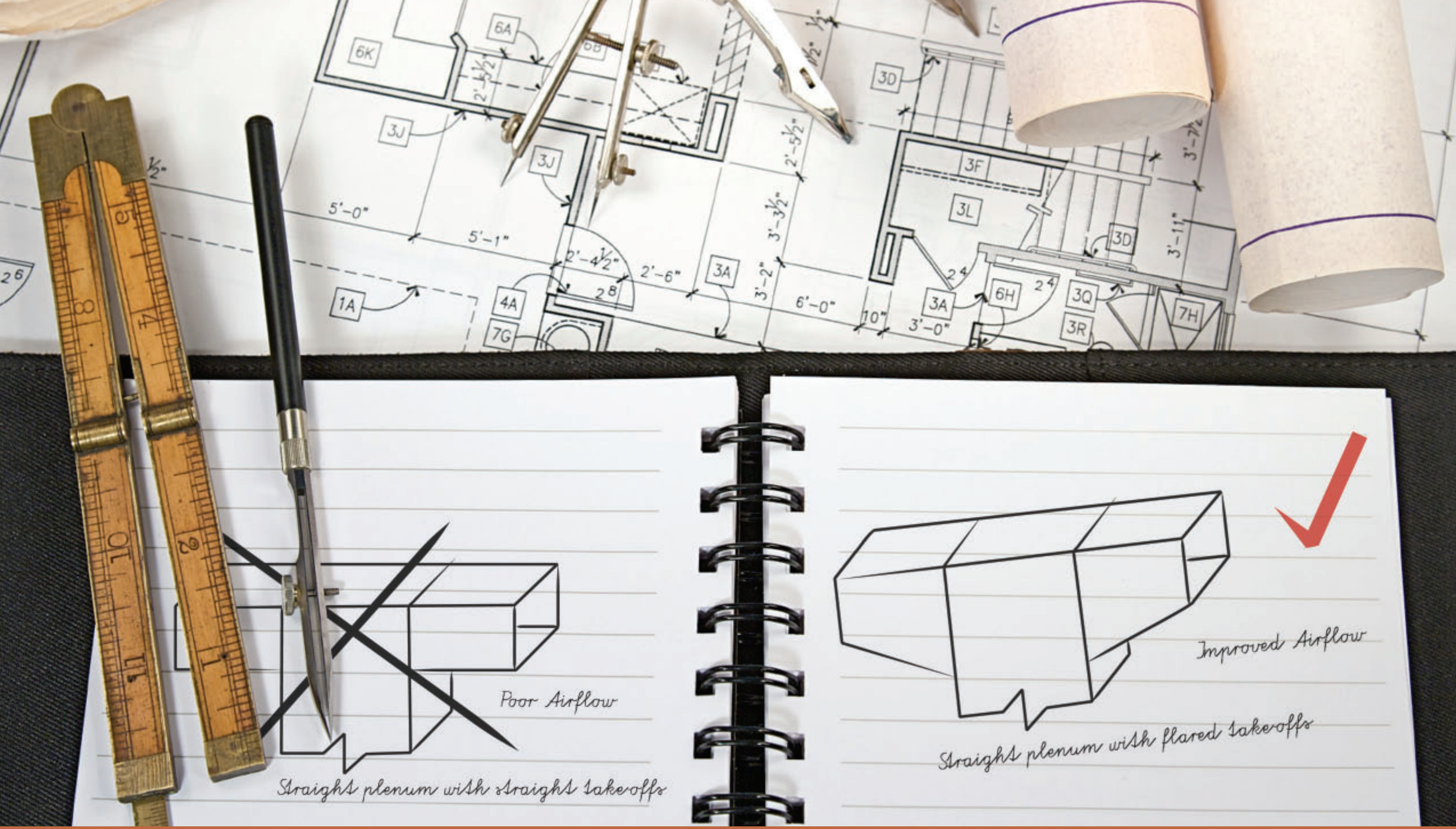
To establish the integrity of each HEPA filter module, an aerosol challenge agent called PAO (Poly Alpha Olephin) was used to generate a statistically large amount of particulate matter upstream of the HEPA filter. The filter housing provided a threaded connection that allowed the challenge agent to properly disperse above the filter. An aerosol photometer was used to measure the concentration of PAO upstream of the filter using the upstream tube of the photometer connected to the STATIC port on the filter. The aerosol challenge was adjusted until the photometer measured between 10 ug/l and 100 ug/l above the filter. This established the 100% baseline concentration of particles before the HEPA filter as a reference.

Downstream concentrations were also measured using the scanning probe attachment from the aerosol photometer. The entire surface of the HEPA filter was scanned with the probe at a rate of 2 in./sec using overlapping passes checking for leakage directly under the head of the probe.

The display on the aerosol photometer shows the percent leakage of aerosol agent penetrating the HEPA filter based on the upstream 100% baseline concentration established before the filter. All scanning must remain less than 0.01% leakage for the filter to pass. The frame edge of the filter is also scanned at 2 in./sec and must remain less than 0.01% leakage. Any leakage greater than 0.01% must be identified, repaired and rescanned. If the filter cannot be repaired to a leakage less than 0.01%, then the filter must be replaced.

This cleanroom project required testing 220 HEPA filters in place. Of those tested, 28 filters could not be repaired. These were found to have some physical damage to the filter surface caused by handling during installation or shipping. These 28 filters were replaced and rescanned with passing results.

Aerosol Generator (left) and Photometer (right).



Hip Pocket Training

Bret Privitt, TBE
Air Balancing Company, LTD

The term "hip pocket training" originated in the army, and most that have served in the military will recall the term. This is informal training that can convey necessary information in a short period of time. The use of this training assists field technicians and assistants in obtaining quality information quickly. Hip pocket training (or HPT) can be applied to any subject in just about any environment.

Hip pocket training differs from on-the-job training, which is performed while actively working on a task. HPT is training that is performed prior to a task.

This is how it works. Approach a subject with real examples and explain the subject matter and how it was or is to be applied to a situation. A new technician can ask a question or a seasoned tech who previously encountered an unfamiliar challenge can describe his experience. The subject matter is usually outside of any formal study guide or study course.

A helpful tool is a small notebook used to record information from HPT, which technicians then bring with them out in the field. The notes in the book help with memory recall when a situation similar to one previously discussed arises, especially if they include sketches and formulas when taking notes.

A normal HPT session should only last up to 15 minutes. Since the training is informal, it is usually not planned far in advance and should not detract from an already busy schedule. Usually the information from a 15-minute discussion is retained and can be easily conveyed from one technician to another.

An example of a HPT opportunity: While rounding up the necessary data for a project, a technician notices the drum louver outlets depicted on the mechanical duct drawings. The technician asks how to accurately measure the outlets. A supervisor, a senior technician, or another technician who has been working on gymnasiums should take a few minutes with the tech to explain the options available to measure the outlets. A sketch showing the airflow pattern out of the drum louver, traverse locations, and the formulas used to proportion the outlets should be used and noted in the technician's notebook.

The busy environment of testing and balancing does not always allow for formal training on all subjects that are found in the field. Utilizing brief informal training helps eliminate lost time due to uncertainty and provides technicians with information and confidence necessary to perform TAB tasks with success.

ASHRAE 62.1 – MEP Roundtable

This excerpt has been reprinted, with permission, from Consulting-Specifying Engineer Magazine.

An expert MEP Roundtable panel discusses the major changes to the 2010 edition of ASHRAE 62.1 and how these modifications will alter mechanical system design, building performance, and energy codes compliance.

CSE: Describe the major changes to the 2010 edition of ASHRAE 62.1.

Cascia: The major changes to the 2010 edition of ASHRAE 62.1 compared to the 2007 edition include several modifications. Revisions to the IAQ procedure and the additional requirements for natural ventilation systems, clarification of the ventilation rate procedure for multiple zone systems (especially VAV systems) in a rewritten Appendix A, and the addition of a section addressing demand control ventilation (DCV) to clarify the circumstances when ventilation during operations can be reduced from the zone design ventilation rates are among the major updates.

MEP Roundtable Participants:

David P. Callan, P.E., Environmental Systems Design Inc.

Mark A. Cascia, P.E., Siemens Industry Inc.

Roger Hedrick, Architectural Energy Corporation, and chair of ASHRAE SSPC 62.1.

Hedrick: Taken from the foreword to 62.1-2010:

- Deletes Section 6.2.9, which had addressed ventilation in areas with smoking. Ventilation for such spaces is no longer covered by the standard.

- Provides minimum requirements to clarify when ventilation systems must be operated.

- Relocates natural ventilation requirements to a new Section 6.4, adding a prescriptive natural ventilation procedure to the existing ventilation rate procedure in Section 6.2 and IAQ procedure in Section 6.3. The standard also now requires that most buildings designed to meet the natural ventilation requirements include a mechanical ventilation system designed to meet the VRP or IAQ procedure requirements; mechanical system operation must be activated whenever conditions preclude operation of the natural ventilation system (e.g., due to thermal comfort, noise, security, or other issues).

- Relocates Table 6-4 and other requirements related to exhaust systems to a new Section 6.5, since exhaust requirements apply to all buildings, regardless of the procedure used to determine outdoor air intake flow rates.

"The standard also now requires that most buildings designed to meet the natural ventilation requirements include a mechanical ventilation system designed to meet the VRP or IAQ procedure requirements."

- Revises the IAQ procedure to make it more robust. In informative Appendix B, provides a table of volatile organic compounds that designers might want to consider as possible contaminants of concern. To encourage designers to consider "additively" (a basic consideration in the prescriptive VRP) when applying the IAQ procedure, some guidance from the ACGIH has been included in the informative text.

- Adds additional requirements related to the design of demand-controlled ventilation systems.

- Revises requirements for separation of outdoor air intakes from exhaust and relief air outlets by using classes of air already defined in the standard rather than descriptions of the air quality.

- Adds some occupancy categories to the ventilation rate table (Table 6-1) and revises ventilation rates for a few occupancy categories.

- Deletes ventilation requirements for health care spaces since they are now covered by ASHRAE/ASHE Standard 170-2008, Ventilation of Health Care Facilities.

- Adds minimum filtration requirements related to PM2.5, and changes minimum air cleaning requirements related to ozone to reflect changes in the U.S. EPA's ozone reporting procedures. Table 4-1 is moved to an informative appendix to facilitate updates when the EPA makes changes to the NAAQS.

CSE: How will the modifications to the natural ventilation rate procedure alter the mechanical system's design?

Cascia: Since mixed mode (natural and mechanical) ventilation systems are becoming more attractive design options, ASHRAE Standard 62.1-2010 establishes a new requirement that natural ventilation systems shall include mechanical ventilation, with only a couple of exceptions. In most cases, mechanical ventilation will now be required to supplement natural ventilation. Therefore, mechanical system designers will now be required to make provisions to supplement natural ventilation with mechanical ventilation. The only exceptions are:

- a natural ventilation system has been engineered as such and is approved by the authority having jurisdiction

- the natural ventilation system complies with the requirements in section 6.4 of the standard and the openings cannot be closed during periods of occupancy

- the zone is not served by heating or cooling equipment.

CSE: Explain the updated clarification for exhaust system requirements. How will this apply to all building types and classifications?

Hedrick: Table 6-4, which provides requirements for exhaust airflow from certain space types, was previously located in Section 6.2, which describes the ventilation rate procedure for designing a ventilation system. If the ventilation system was defined using the IAQ procedure or natural ventilation, then compliance with Table 6-4 was not required. In 62.1-2010, Table 6-4 moved to Section 6.5 in the standard. As a result, the exhaust requirements defined in the table must be met, regardless of the ventilation system design procedure used.

Cascia: Exhaust ventilation is now a stand-alone section in the standard (section 6.4) and applies to all zones or systems, regardless of the design procedure used (a natural ventilation design, the ventilation rate procedure, or the IAQ procedure).

Callan: This revision is primarily administrative and clarifies the confusion that exhaust requirements apply to all designs, despite the method of compliance chosen.

CSE: What types of energy-efficiency requirements for ventilation systems are included in ASHRAE 62.1? How is this different from previous editions of the standard?

Cascia: A new section to Standard 62.1 was added in the 2010 edition addressing DCV. Compared to a system that ventilates at the design airflow during all occupied hours, a DCV system can save significant amounts of energy. Standard 62.1-2010 now defines DCV as "any means by which the breathing zone outdoor airflow (Vbz) can be varied to the occupied space or spaces based on the actual or estimated number of occupants and/or ventilation requirements of the occupied zone." Addendum G was also changed to require documentation of assumptions, sequences, and setpoints for any DCV system. In addition, for multiple zone systems, in order to reduce energy consumption, Standard 62.1-2010 adds clarification language to reinforce the requirement that VAV systems should be designed to use the minimum expected primary airflow in the critical zone.

"Exhaust ventilation is now a stand-alone section in the standard and applies to all zones or systems, regardless of the design procedure used."

CSE: What changes will be required to the BAS controls to ensure compliance?

Hedrick: The standard does not require the use of a BAS to comply with the standard. Use of a BAS may make it easier to use dynamic reset of outdoor air intake flow rates, but this is not required.

> **"To maximize energy savings potential in DCV systems, CO_2 sensing of the outside air and in each DCV zone will be required."**

Cascia: To ensure compliance, maintaining the minimum prescribed airflow rates in each zone is required. Although zone CO_2 sensing is not required to implement DCV, and there continues to be some concern in the literature about CO_2 sensor accuracy and its affect on control, CO_2-based DCV methods continue to persist in the industry due to their increased energy savings potential. There are published equations that can calculate dynamic CO_2 setpoints required for each zone to maintain minimum ventilation, based on dynamically changing variables. These variables are the number of people in the zone, the activity level of the people in the zone, the zone area, and zone-air-distribution effectiveness. BAS DCV control programs will be required to implement these equations using CO_2 sensors to ensure that minimum airflow compliance conditions are met with minimal energy consumption as these variables change over time.

CSE: A series of prescriptive rules about natural ventilation openings have been added, whereas older versions of the standard did not provide this guidance. Do you think that engineers are more likely to apply natural ventilation now that the guidance is embedded in the code as compared to having to justify an engineered system?

Hedrick: Previous versions of the standard included prescriptive requirements for opening sizes. However, the standard now recognizes that the ventilation provided by a given opening will vary based on the presence or absence of openings on opposite sides of the space. Therefore, the standard now allows natural ventilation openings to serve larger floor areas in a cross-flow situation compared to when openings are on one side of the space only. These new requirements are actually more permissive than previous requirements.

Cascia: Actually, prescriptive rules regarding the size and location of wall or roof openings to the outside air existed in ASHRAE Standard 62.1-2007 (see paragraph 5.1.1). ASHRAE Standard 62.1-2010 merely adds additional prescriptive rules about natural ventilation openings. Engineers will be increasingly specifying natural ventilation systems primarily because operation of these systems consumes less energy and there is a current push in the industry toward green buildings, and ultimately net-zero-energy buildings. For example, many of the [U.S. Green Building Council] LEED green building rating systems give credits (LEED points under the Energy and Atmosphere category) for natural ventilation systems.

Callan: No, because I think designers who were interested in designing naturally ventilated buildings simply have better guidance. Designers who shy from naturally ventilated buildings would not typically be swayed by the standard. The designer should be primarily concerned with the building, its climate, the application, and the ability for that climate to provide an acceptable passive design in all anticipated weather conditions.

CSE: Will the new requirements require a change to manufactured components of an air handling unit or system, such as inlet dampers or outside air measuring?

Cascia: To maximize energy savings potential in DCV systems, CO_2 sensing of the outside air and in each DCV zone will be required, as well as assurance that the baseline airflow will be no less than the building component (outdoor airflow rate multiplied by the area of the zone, Ra multiplied by Az), and the fan system will provide each zone with no less than the breathing zone outdoor airflow for the current zone population. This implies that total outdoor air intake for each air handler must be measured and that each DCV zone must have a means of varying the total airflow and calculating the percentage of outdoor air into the zone. Such a means can be accomplished by a BAS networked to a DDC-controlled VAV box with a damper, or a variable-speed fan-powered VAV box with an air measuring sensor and special programming to control the amount of airflow into the zone.

For the full roundtable article, please search for "ASHRAE Standard 62.1" on www.csemag.com

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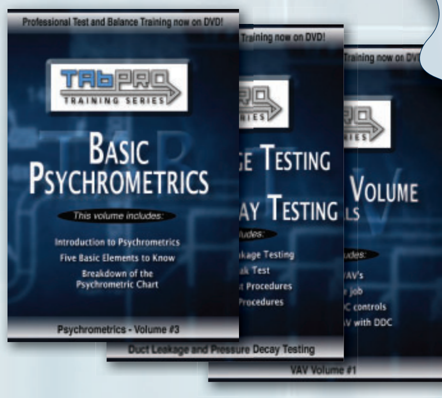

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Tech Talk

Better communication and understanding of proper balancing procedures has been part of AABC s mission for more than 40 years and helps to produce buildings that operate as designed and intended. Tech Talk is a regular feature in which AABC shares questions we ve received and the responses from the association s experts. We hope that others have had similar questions and, therefore, will benefit from the answers. Readers are encouraged to submit their own questions about test and balance issues.

Static Losses & Fan Positioning

QUESTION: ***We have two smoke extract fans connected in series. At any one time, only one fan is in operation while the other is shut down. When the fan in operation fails, the fan that had been shut down will start to operate automatically. (See Figure 1).***

At any one time, the shutdown fan will have a windmill effect. What kind of static losses will such a series configuration and operation scenario create? When Fan 1 is running and Fan 2 is shut down, what would be the static losses? When Fan 2 is running and Fan 1 is shut down, what would be the static losses?

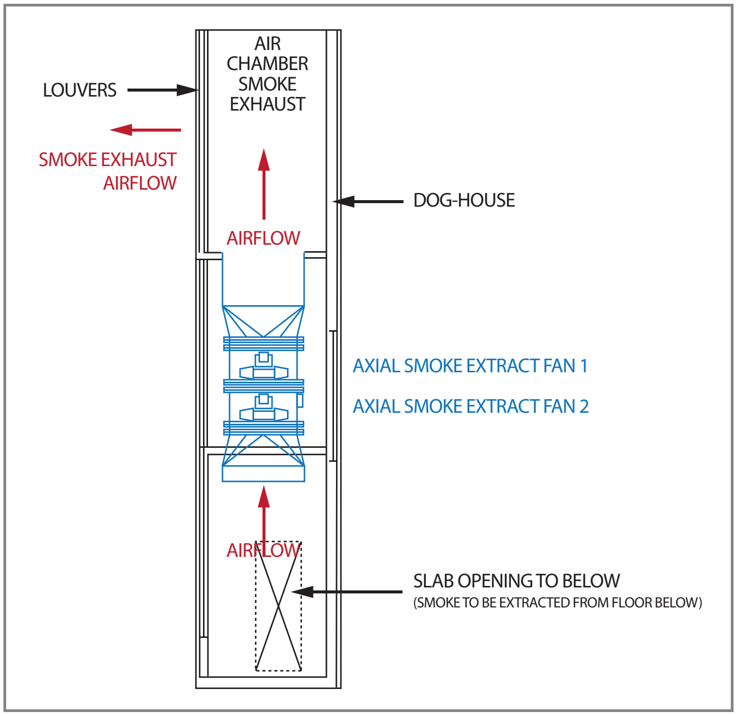
AABC: It is best they consult the fan manufacturer for those questions and how that configuration and operation will affect the performance of their fans. They should mount the fans in parallel if one is to be a standby.

— *Joseph E. Baumgartner, III, P.E., TBE, Baumgartner, Inc.*

The fans shown are some type of tube axial that are not rated for more than 1.5" static pressure. The real question is at what temperature the fan will operate in a smoke removal scenario. The blades and motor on the non-operating fan could restrict the flow by 50% and could double the static pressure losses, which could cause a stall condition. I agree that the best solution is to put the fans in a parallel arrangement.

— *Gaylon Richardson, TBE, Engineered Air Balance Co., Inc.*

Figure 1.



Air Flow Measuring Recommendations

QUESTION: ***Please comment regarding your experience and recommendations for measuring air flow from a perforated diffuser described as follows:***

1. *Diffuser size 48" x 24" with HEPA filter size 42" x 20" installed just upstream of perforated diffuser.*
2. *Air volume requirement: 125 CFM*
3. *Velocity range at diffuser discharge: 20 FPM to 40 FPM*

Would you use:

- *a) Calibrated air flow capture hood*
- *b) Hot wire anemometer*
- *c) Other*

AABC: I would use an Alnor EBT721 Balometer with a 2' x 4' Hood. Range is 25 to 2500 CFM. Accuracy is +/-3% of reading +/- 7 FPM at flows > 50 CFM. At 100 CFM you could be off by 10 CFM.

— Gaylon Richardson, TBE, Engineered Air Balance Co., Inc.

AABC: While that is a rather low flow for that size HEPA diffuser, it is within range of the Shortridge digital meter. Personally, we only use the digital flow hoods now. Measurement would be made with a 2 x 4 skirt using the two-part back pressure compensation method. A duct traverse would also be taken as verification or establishment of a flow factor.

— Joseph E. Baumgartner, III, P.E., TBE, Baumgartner, Inc.

AABC: The digital hood reads better at the low flow, but a traverse should be made for a correction factor as well. We have tested several applications and do not use the back pressure compensation. We would just close the flaps.

— Gaylon Richardson, TBE, Engineered Air Balance Co., Inc.

Have a Question?

To submit a question for Tech Talk, email us at info@aabc.com, or visit the Tech Talk section of the AABC website at www.aabc.com/techtalk

The Associated Air Balance Council frequently fields technical questions from engineers, contractors, owners and others regarding proper air and water balancing procedures.

These questions are answered by the most qualified people in the industry: **AABC Test & Balance Engineers (TBEs).**

Fiberboard Ductwork

QUESTION: ***How much static pressure would you recommend to set as maximum for fiberboard ductwork?***

AABC: It depends upon the construction methods used. Refer to SMACNA's fiberglass duct standard.

— Steve Young, TBE, Phoenix Agency, Inc.

AABC: SMACNA has construction standards for fiberboard duct just as they do for metal ducts. Fiberboard ducts were used for low pressure applications and have not been very prevalent in the last decade.

— Joseph E. Baumgartner, III, P.E., TBE, Baumgartner, Inc.

Test and Balance on Core & Shell Building

QUESTION: ***What guidelines are available for TAB for a Core & Shell building? The system is intended to be VAV. The AHUs have VFDs but ductwork is very limited and there are no VAV boxes; these will be added later. For some AHUs with VFDs, no ductwork has been installed.***

Please advise how this situation is normally handled:

- ***AHUs with VFDs and very limited ductwork which is to be extended with VAV boxes in FF&E (fit out phase) later on***
- ***AHUs with VFDs with no ductwork which is to be added with VAV boxes during the fit out phase of the project***

AABC: Generally if the AHU could not be tested at the factory we balance the water to the coils but cannot do anything to prove the AHUs until the ductwork system is complete. We have put the dampers in the duct and simulated a pressure and determined the airflow. But we have found that when some systems were built out, they have greater and less pressure than designed.

— Gaylon Richardson, TBE, Engineered Air Balance Co., Inc.

AABC: The situation described often leaves a gap in the balance since the tenant upfit does not include the base building unit. Generally all that can be accomplished is the water balance, outdoor air and core exhaust balance. If ductwork and dampers are included, the unit performance and capacity could be verified to meet the design intent.

— Steve Young, TBE, Phoenix Agency, Inc.

AABC: AHUs with limited ductwork should be operated at 100% VFD speed or top (motor nameplate) amps and verified for electrical performance below rated amps. Ductwork should be traversed for capacity airflow, which may exceed the design tolerance since there is no restriction. Exercise caution in manually ramping the VFD to full speed to avoid tripping on potential overload condition since there is little static pressure.

At either top amps or 100% VFD speed (60 Hz), measure and record amps, voltage and rpm. Calculate and record brake horsepower at the allowable maximum condition, which is when the duct traverse is made. Inlet and outlet fan static pressures should be taken for the fan to determine total static pressure. A static pressure profile of the unit would also be useful information to document internal static pressures and external static pressure.

The same process applies for the non-ducted condition. Instead of a duct traverse, a velocity grid profile of a coil or filter bank can be used to measure the airflow. If this is not accessible, plotting brake horsepower versus rpm can determine approximate airflow. Excess airflow or overloading of the fan motors can be expected, but if design airflow capacity is not achievable corrections will be needed. The HVAC designer should be involved in determining the appropriate TAB procedures.

— James Magee, LEED AP, CxA, Facility Commissioning Group

Air Balance Tolerances

Q

QUESTION: ***A project's specifications reference, among others, AABC Standards, AIA Healthcare Guidelines, and State of Missouri Health Care Regulations.***

The AABC National Standards state that the total air quantity to each space shall be within +/- 10% of design. The State of Missouri's General Pressure Relationship and Ventilation of Certain Hospital Areas specifies the minimum total air changes per hour supplied to specific hospital rooms. AIA Healthcare Guidelines table 2.1-2, Ventilation Requirements for Areas Affecting Patient Care in Hospitals and Outpatient Facilities, also specifies the minimum total air changes per hour to specific hospital rooms.

Does the AABC National Standards's +/- 10% tolerance apply to the minimum total air changes per hour specified in the State of Missouri regulations and the AIA guidelines? In other words, if the design supply CFM for a patient room equates to 325 cfm to meet the 6 air changes per hour, is 325 cfm x 90% = 293 cfm an acceptable air quantity for this room? This would mean the minimum air changes per hour specified by the State of Missouri regulations and the AIA guidelines are not being met.

A

AABC: Specifications always supersede the Standards if they are more stringent.

There may be an argument if the contract documents did not specify to balance to achieve specific room air changes. Codes and Guidelines may be referenced, but it is the design consultants who are responsible for accepting the building and ensuring codes are being met. I cannot imagine an engineer who would indicate a design airflow that is the minimum required to meet a code. If they did they should have specified balance tolerances of 0 to +.

— Joseph E. Baumgartner, III, P.E., TBE, Baumgartner, Inc.

Correction: In the Spring 2010 issue, Tech Talk Topic "Return Balancing" should have shown the first two paragraphs of the answer as part of the question. We regret any confusion.

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(519) 259-1581

Controlled Air Management Ltd.
Moncton, New Brunswick
(506) 852-3529

D.F.C. Mechanical Testing & Balancing, Ltd.
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Designtest & Balance Co. Ltd.
Richmond Hill, Ontario
(905) 886-6513

Dynamic Flow Balancing Ltd.
Oakville, Ontario
(905) 338-0808

Griffin Air Balance Ltd.
Dartmouth, Novia Scotia
(902) 434-1084

Groupe Danco Televac, Inc.
Sherbrooke, Quebec
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Kanata Air Balancing & Engineering Services
Ottawa, Ontario
(613) 592-4991

Pro-Air Testing, Ltd.
Toronto, Ontario
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Scan Air Balance 1998 Ltd.
Moncton, New Brunswick
(506) 857-9100

Scotia Air Balance 1996 Ltd.
Antigonish Co., Nova Scotia
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Source Managment Limited
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VPG Associates Limited
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39-043429661