TAB Journal

AABC

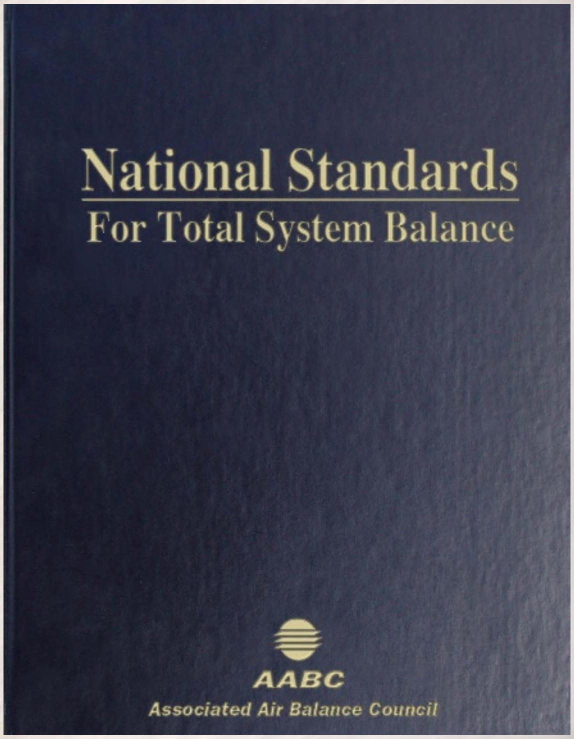
THE MAGAZINE OF THE ASSOCIATED AIR BALANCE COUNCIL • SPRING 2015

Troubleshooting and Safety Considerations

IN THIS ISSUE:

- Fire Damper Inspections
- Electrical Safety
- Encountering Deficiencies

A MUST-HAVE RESOURCE FOR INDUSTRY PROFESSIONALS!



Over 350 pages of standards for total system balancing. Order your copy of the AABC National Standards for Total System Balance today!

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.

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**.

Payment Information:

Non-Member Cost: $75.00

AABC National Standards 2002 @ $75 each x _______= $___________

Name

Company

Shipping Address

City State Zip

Phone Fax

Email

Payment Type (Check one)

❑ Check Enclosed ❑ MasterCard ❑ Visa ❑ American Express

Card Number Expiration Date

Name on Card

Signature

Please complete order form and return along with payment to:

Associated Air Balance Council

1518 K Street, N.W., Suite 503 • Washington, D.C. 20005

Credit card purchasers may fax orders to: (202) 638-4833 or order online at www.aabc.com/publications

TAB Journal

Editorial Director
Ray Bert

***TAB Journal* Editor**
Ashley Weber

Technical Advisor
Joseph E. Baumgartner, III, P.E.

Editorial Office
1518 K Street, N.W., Suite 503
Washington, D.C. 20005
(202) 737-0202 • FAX: (202) 638-4833
E-mail: info@aabc.com
Website: www.aabc.com

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.

ECO BOX

TAB Journal magazine text and cover pages are printed on SFI-certified Anthem Gloss paper using soy ink.

PRINTED WITH SOY INK · SUSTAINABLE FORESTRY INITIATIVE Certified Sourcing www.sfiprogram.org SFI 00284

SFI standards conserve biodiversity and protect soil and water quality, as well as wildlife habitats.

The SFI certified sourcing label is proof AABC is using fiber from responsible and legal sources.

SFI participants also plant more than 650 million trees each year to keep these forests thriving.

From the Publisher

The spring 2015 issue of *TAB Journal* explores the issues encountered when troubleshooting and the safety considerations to keep in mind when balancing different systems. In "Catching Hidden Costs: A Commissioning Story," Professional System Analysis, Inc. looks at how commissioning services can eliminate problems that would lead to additional operating expenses.

Victor Lakoseljak of VPG Associates Limited discusses at the high-speed construction industry and how that can lead to deficiencies that hinder testing and balancing.

Environmental Test & Balance Company's Sean Green, TBE, goes over a case study where an automatic flow control valve was malfunctioning.

Zohar Davidovich of Airdronics Inc. presents the case for how crucial proper fire damper inspection is in the safety of a building.

Justin Garner, P.E., TBE, CxA, of Engineered Air Balance Co., Inc., discusses electrical hazards that may be present when performing TAB and commissioning work.

Griffin Air Balance's Shawn Griffin, TBS, presents a case study that involved fume hood testing for a multi-story science building.

Kane Lassiter, TBE, of Engineered Air Balance Co., Inc., looks at a project that required balancing several variable volume grease hoods and fan systems.

And finally, American Testing, Inc.'s Jeremy Johnson, TBE, discusses a balancing project for a university teaching amphitheatre.

We would like to thank all of the authors for their contributions to this issue of *TAB Journal*. Please contact us with any comments, article suggestions, or questions to be addressed in a future Tech Talk. We look forward to hearing from you!

"...the commissioning process prevented temperature and control problems that the owner or building occupant would have found objectionable after occupancy."

CATCHING HIDDEN COST$: A Commissioning Story

Professional System Analysis, Inc.

Commissioning services were provided for an Army Reserve Center in the Chicago area. During the course of completing the commissioning process, several problems were identified and corrected that benefited the project. The problems included dampers that would not open when the fan was operating, improper shut-down sequences, incomplete alarm programming, and occupancy sensors that would not activate VAV boxes. Thus, the commissioning process prevented temperature and control problems that the owner or building occupant would have found objectionable after occupancy.

Also found was an issue that may not have been discovered if it were not for the commissioning process. The site included a maintenance building with a large work bay for vehicle repairs. This bay had five large overhead doors and was heated by a makeup air unit, seven infrared burners, and an in-floor hot water heating system. The makeup air unit was equipped with a variable fire, natural gas burner that was designed to provide 100% outside air at a minimum temperature of 68° F at all times.

The unit was located near the ceiling about 25 feet above the floor with the duct and grilles at the same level. There was no cooling coil installed in this unit, and it was engaged with a push button or through an interlock with any one of the five vehicle exhaust fans. Exhaust fans were also manually started by the user. The makeup air unit had a self-contained control package, so the energy management system was only monitoring status, temperatures, volume, and alarm conditions.

The mechanical contractor completed the startup of the system and the controls contactor was ready to begin functional testing. During the commissioning process, it was discovered that the temperature of the unit rose by eight degrees even though there was no need for heat. The initial outside air temperature reading was 81° F with an 89° supply air temperature. Further investigation revealed that every time the unit was started, the burner was operating at a low fire condition. This was not found during the startup procedure by the mechanical contractor or the EMS contractor. Considering the location of the unit and the supply grilles, it is doubtful that this condition would have been discovered if the owner had chosen not to include commissioning services.

If this issue had not been discovered, the low fire operation of the burner when there was no call for heat would have resulted in higher costs for the building owner that had been projected at $419 annually or $8,380 over the expected 20-year lifetime of the equipment in natural gas usage alone. The amount was calculated by assuming that the unit would operate at maximum CFM for 40 hours per week (Monday through Friday).

No determination could be made regarding the number of hours the unit would operate at a reduced volume, so this was disregarded when making calculations. The Illinois Citizens Utility Board website reported the average cost of natural gas was 58 cents per therm at the time. Average high and low temperatures for the area were obtained from Weather.com and a period of 116 days was subsequently determined to be the annual amount of time the unit would operate with no call for heat. The remaining days were determined to result in either no increased cost or were unoccupied hours. This number was only an approximation based on the projected use provided by the owner and could change depending on total hours of operation.

While this particular estimated expense was not extreme, it did illustrate how commissioning services can eliminate problems that would lead to additional operational expenses. Project architects and engineers benefit from the inclusion of commissioning services on their projects. Ultimately, however, it is the owner who will benefit the most from commissioning all the building's systems due to the potential long-term costs it can reduce. On this particular building, the owners who benefitted the most from commissioning were American taxpayers.

DEFICIENCIES
a Growing Problem

Victor Lakoseljac
VPG Associates Limited

The construction business has become increasingly competitive over the years. The increase could be attributed to more contractors, tighter cost margins and fewer projects to go around. As a result larger and smaller projects are being completed with tighter schedules. This unfortunately does not come without consequences especially in the mechanical portion of a project. Improper cooperation between the subtrades can add to the problems and confusion. This high speed construction results in unfortunate deficiencies that hampers testing and balancing

Some of the above deficiencies can be corrected or bypassed by our own forces; however, if they are not corrected can present themselves as major problems as the project goes along. If these deficiencies are not corrected the contract will be compromised.

To prevent these items from becoming major issues the following steps can be followed to minimize future problems.

Step1 *Early identification of the problem is essential, notify the appropriate people (your client) immediately on site.*

Step2 *Follow up the verbal site notification by fax or email (on a weekly or biweekly basis for large projects)*

Step3 *Follow up the fax or email with a phone call & site inspection after the problem has been corrected. This step may have to be repeated along with step 2 updated lists.*

The idea here is early detection and written confirmation to avoid any back charges or late penalties from a contractor. Furthermore, if these are items that are not in the original contract, complete lists may help recover the cost spent to identify the problems in the first place. These items must be corrected as soon as possible before the trades are off the project to prevent obstacles when completing testing and balancing.

DEFICIENCIES SHOW UP FROM ALL SIDES

Electrical: fans not running, motors tripping out, DDC boxes not powered

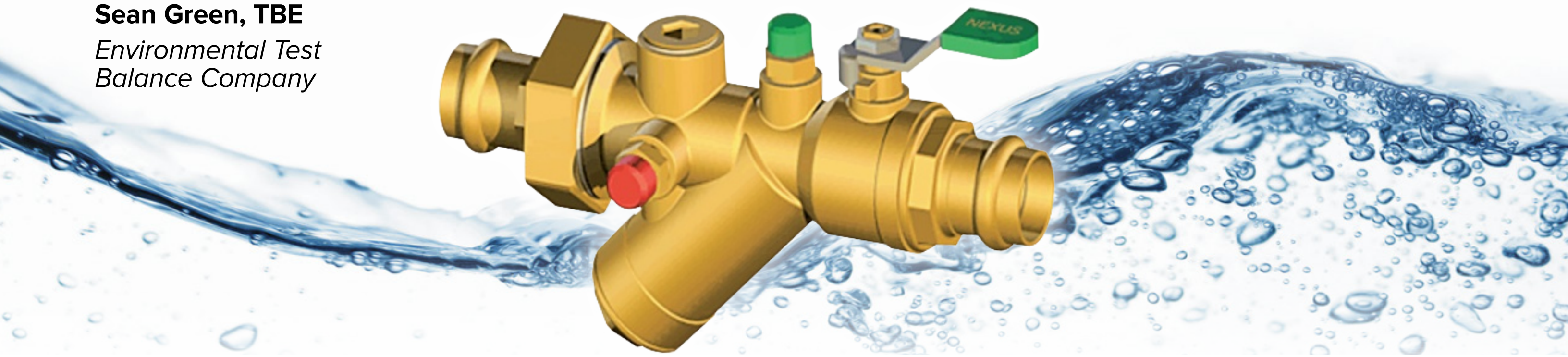
Controls: boxes not programmed, boxes not communicating, pneumatic lines not connected, control sequences not communicating

Mechanical: Pumps not running, pumps running backwards, valves not installed or installed backwards

Sheet Metal: Dampers not installed, diffusers not installed or installed in the wrong location, holes not cut into ductwork

TROUBLESHOOTING
Nexus Automatic Flow Control Valves

Sean Green, TBE
Environmental Test Balance Company



Environmental Test and Balance Company accepted a project balancing a condensing water system at a large educational facility for the Arkansas Army National Guard located in Little Rock. The referenced system consisted of 70 water source heat pumps served by system circulating pumps, a plate and frame heat exchanger, and a separate cooling tower loop. Each water source heat pump was furnished with a Nexus UltraMaticTM automatic flow control valve preset from the factory at a specified flow rate (GPM). The valve body houses a spring-loaded flow control cartridge that maintains a desired flow rate. The cartridge spring range is 2 to 45 PSID (0.14-3.10 Bar). The first number, 2 (0.14), of this spring range is the minimum differential pressure (DP) required to maintain constant flow and the second number, 45 (3.10), is the maximum DP the cartridge can absorb and still maintain the specified GPM.

To begin, all manual and temperature control valves were opened, the total pump flows were set, and an initial system differential pressure setpoint was established. This system was designed for future expansion and the pumps were oversized and rated 80% higher than the collective coil design. The total pump flows were determined by temporarily adjusting the pump VFD to 60 Hz to plot the full-flow and no-flow readings. The triple duty valve was adjusted to obtain the required flow and a system differential pressure setpoint was established. The VFD was then placed in the automatic mode and the valve was reopened allowing the VFD to control to the DP setpoint.

During the coil balancing phase the technician reported that the automatic flow valve differential pressure readings were not falling within the manufacturer's specified range of 2 to 45 PSID on the larger valves. An acceptable pressure differential of roughly 5 to 10 PSID was measured on the ¾" valves, although the larger valves (1", 1 ¼", and 1 ½") all yielded differential pressures of approximately 0.3 to 0.8 PSID; an indication of low flow rate.

Several checks were made to ensure that this was not an isolated problem, and typical readings were found at valves throughout the system. A cursory check of the pump settings indicated that it was still delivering the design GPM. It was confirmed that the coils were piped correctly, the valves were installed in the correct direction, and the temperature control valves were fully open. Adding to the confusion, past field experiences have indicated that the Nexus valves are highly reliable and will typically maintain the tagged flow rate when the design pressure range is achieved.

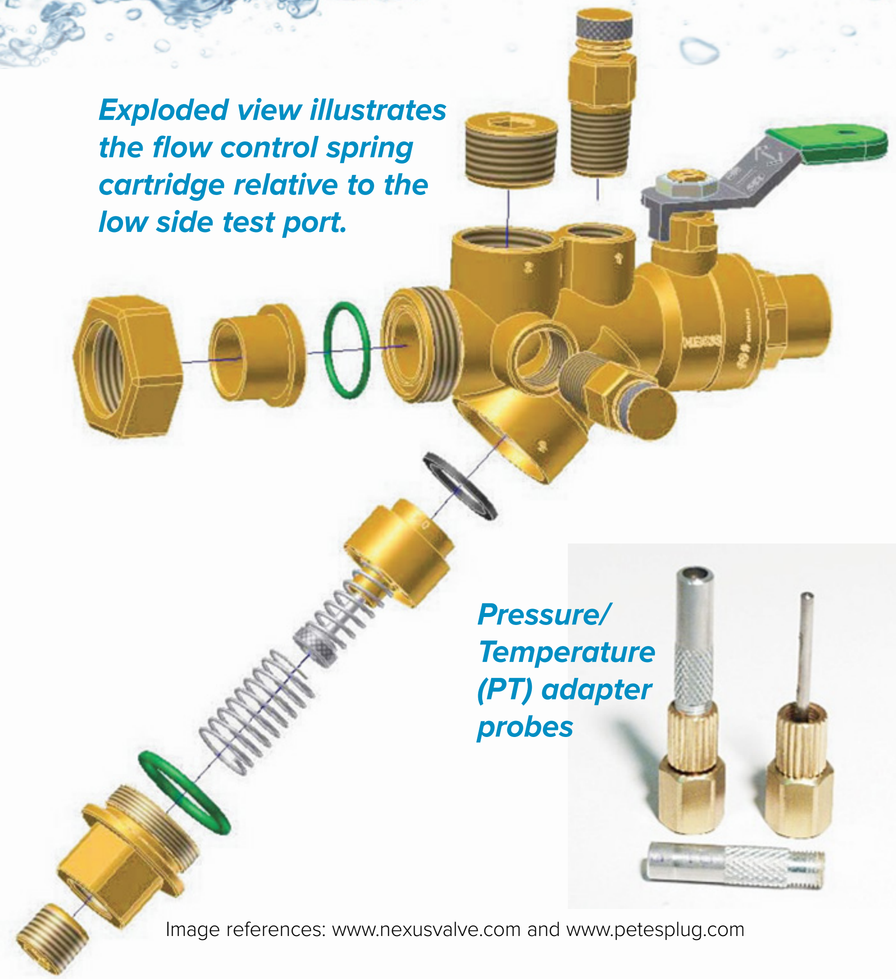
Working with this information, and knowing it was highly unusual, it was concluded that the valves were malfunctioning. All of the tests indicated that the UltraMatic TM flow valves were not throttling the flow to the manufacturer's setting. This assumption was based on...

1. Confidence in the pump settings.
2. An obviously high flow rate at the coil (water could be heard rushing through the coil).
3. A secondary flow measurement by coil pressure drop could not be obtained due to the gauge tap placements (entering side located before the strainer and the leaving side was located after the temperature control valve). Nevertheless, the pressure drop was measured and found to be approximately two times higher than the design coil pressure drop. Although not a reliable flow reading, this was another indication of a high water flow rate.
4. Recalling that the pump was oversized, the full pump flow could not be obtained if the valves were holding the flow to design. The valve differential pressures were under 1.0 PSIG even when operating the pump at full capacity with the triple duty valve fully open.

The spring cartridges can be easily removed on valve bodies ½” to 2” in size. Several cartridges were removed from the valve bodies to verify there no was no presence of trash that could possibly be holding the spring open.

At this point the manufacturer’s local vendor and Nexus technical support were contacted, and neither had experienced a problem similar to this and they were unable to provide immediate support. They did agree to send a new valve cartridge, and shipped the part overnight. After receiving and replacing the cartridge, the results were no different and a differential pressure of less than 1.0 PSID was still measured.

Feeling a little discouraged, a second look was taken at the differential pressure meter, hoses, and fittings. The meter was connected to the valve again and a slight difference in the pipe noise was noticed. The pump triple duty valve was fully reopened so these noise changes were more distinct. When the test probe was re-inserted into the low side PT plug (green cap) the noise level at the temperature control valve increased, indicating a higher flow rate.



Exploded view illustrates the flow control spring cartridge relative to the low side test port.

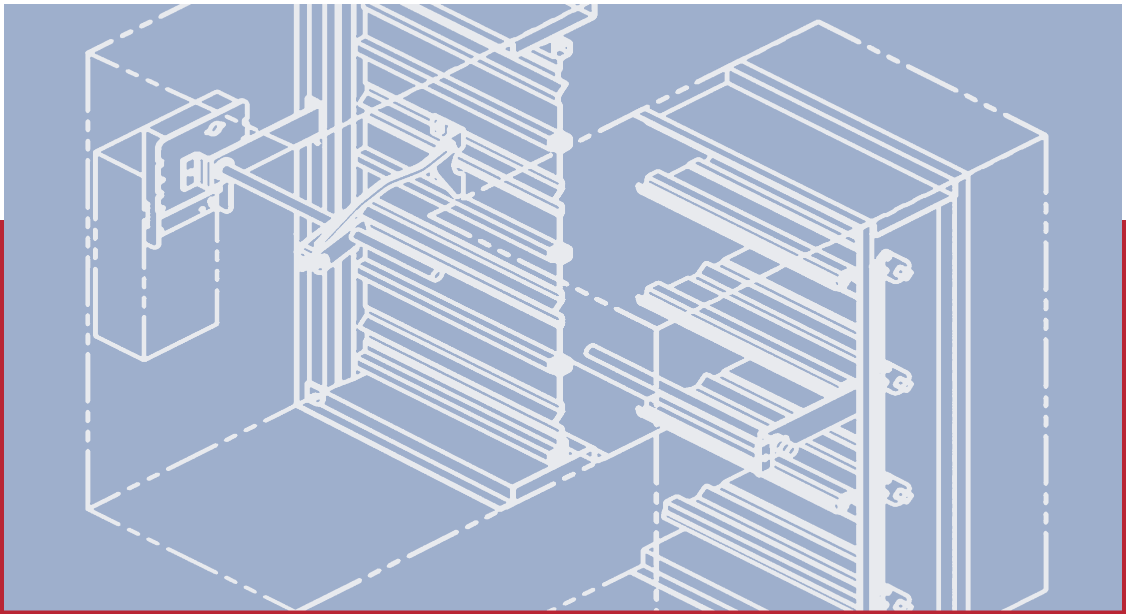
Pressure/ Temperature (PT) adapter probes

Image references: www.nexusvalve.com and www.petesplug.com

The PT probes being used were slightly too long for the PT plug, but it was not realized that the probes were long enough to actually reach the spring cartridge and open the valve when the fitting was installed into the valve body. Depressing the spring allowed a high flow rate through the valve with little to no pressure drop (on the single valve under test). Switching to smaller PT probes yielded pressure drop of roughly 3 to 10 PSID.

Technical note: The pressure drops were actually exceeding the maximum 45 PSID when the pump was operating at full flow. This fully depresses the spring cartridge to a fixed orifice.

The low pressure drop was indicating a high flow rate, and not a low flow rate; the problem was caused by using a probe that was too long. Nexus was contacted and informed of the situation. The manufacturer’s representatives were not familiar with this situation and their operating and maintenance manuals do not reflect a potential problem arising by using an improperly sized test probe. The PT test probes should not exceed 1.5 inches in length to avoid this issue.



PROPER FIRE DAMPER INSPECTION

Zohar Davidovich
Airdronics Inc.

A The proper inspection of fire dampers is crucial for any building standing today in North America. These engineered pieces of equipment may be easily overlooked, but nevertheless they save lives in cases of emergency. Fire dampers are usually found in the ducts where they penetrate fire rated walls or ceilings. Every duct that goes through a fire rated wall or ceiling must have a fire damper installed. There are several types of fire dampers such as fire/smoke dampers, fire stop flaps, and the mechanical fire damper. Each building may have a combination of these depending on the application, and where the ducts are installed.

Fire stop flaps are most commonly used in fire rated ceilings where the duct penetrates the ceiling, these fire stop flaps are usually spring loaded. Mechanical fire dampers are most commonly used in fire rated walls, and simply fall down when the link is melted resulting in the restriction of air through the duct. Fire/Smoke dampers are electronically controlled dampers that are connected to the main alarm system, and only close when the alarm is engaged.

> Proper inspection of a fire damper may include a visual inspection of a mechanical damper to ensure nothing obstructs it from fully closing.

Proper inspection of a fire damper may include inspecting that the fire damper has been installed properly, inspecting that the fire damper has angles around it, a visual inspection of a mechanical damper to ensure nothing obstructs it from fully closing, and inspecting the heat-activated link that holds that damper in the open position. Letting the fire damper fall down as if the link has been melted is also a critical inspection procedure, thus verifying that nothing obstructs the damper from closing smoothly. When inspecting a fire/smoke damper the alarm has to be triggered for the damper to close—this may require the assistance of an electrician. Depending on company policy, the manufacturer of the fire damper, model number, and size of fire damper may need to be included in the final report. The final and most important step of inspecting a fire damper is to not hesitate to fail a fire damper if the technician inspecting it fears that it might not be fully up to standards and will not do the job it was designed to in an emergency situation.

What's all the FUSS about ARC FLASH and Electrical Safety?

Justin Garner, P.E., TBE, CxA
Engineered Air Balance Co., Inc.

There has been a lot of emphasis on electrical safety both within our company and the construction/operations industry in general within the last couple of years. All of this emphasis is attributed to NFPA Standard 70E that was significantly revised in 2012. NFPA 70E is not a law, but rather a standard methodology for compliance with OSHA regulations stating that every employer must protect its employees from electrical hazards. It is not THE standard, but is widely accepted throughout the construction, operations and maintenance industries. It is important to realize that a standard must be black and white, but cannot always cover the gray areas that a worker encounters on a daily basis. Therefore, a thorough understanding of hazards as well as appropriate training is needed to keep every worker safe.

Let's begin this discussion with a very simple explanation of electrical hazards that may be present while performing TAB and Commissioning work. Everyone is aware of the shock hazard that is present with electrical equipment, but how aware are you of the arc flash hazard that may be present? While a shock hazard exists from coming into contact with live energized conductors, an arc flash hazard may be present just being in the same room with electrical equipment, whether or not the conductors are exposed.

An arc flash is caused by an electrical arcing fault or short between two energized conductors or an energized conductor and neutral or ground. The first component of an arc flash, the available energy in the arcing fault (measured in kilo-amperes or kA), is determined by the available short circuit current or bolted fault current at the location of the fault. There are a number of factors that determine this value including the available utility short circuit at the building source, the voltage of the system, the size of transformers and their associated impedance (or resistance to current flow), and the length and size of conductors in the system up to the point of the fault.

The second component of an arc flash is the duration of the arc. This is the most important factor in determining the intensity of an arc flash. A common misconception is that higher voltage equipment or higher amperage busways have a higher arc flash hazard. This may or may not be true. Often, the higher voltage and amperage systems produce arcing faults that have very high arcing fault currents, but the upstream overcurrent protection devices open and clear these faults very quickly. Therefore, the overall arc flash energy level (measured in calories / square centimeter) is relatively low for the energy that is available. Conversely, many points that are further along in an electrical distribution system, such as a motor control center or motor starter, can have relatively low available arc fault currents, but the overcurrent protection device settings do not clear the fault quickly. This results in longer arc fault duration and a much higher arc flash energy level. An example of these two scenarios is shown in the figures on the right and on page 12.

In Figure 1, an open air 1000 Amp fault on a 40 Amp primary service is illustrated downstream of a 12,460 (12.kV) fused switch. The Y axis of the chart is time in seconds and the X axis of the chart represents fault current in Amperes. The arc flash incident energy in this situation is only 0.25 cal / sq. cm, which equates to a Hazard Risk Category (HRC) of 0. The prohibited boundary (36”) to prevent a shock hazard is actually greater than the arc flash hazard boundary (6”).

Figure 2 shows both a bolted fault and the arc fault that could be generated in a motor control center for a chiller. As noted, the bolted short circuit fault current is approximately 100,000 Amps. If that fault were to occur, the upstream overcurrent protective device (OPD) would trip in approximately 0.05 seconds. The maximum arc fault current is actually calculated based upon the minimum short circuit current available which is 40,000 amps. At this level, the OPD trip time is approximately 7 seconds resulting in an arc flash energy level of 299 cal. / sq. cm at a boundary of 505 inches. This is a HRC of DANGEROUS—or no arc flash PPE is available for protection of personnel—within a radius of 42 feet from the equipment.

Most people would say this hazard level is only applicable if the panel door is open with the live conductors exposed. This reasoning is incorrect. The equipment manufacturers test their equipment to withstand the short circuit current rating and contain any products of combustion to prevent a fire. They do not rate their standard cabinets to withstand arc faults. Therefore, an arc fault incident could cause the enclosure to rupture and subject personnel to high arc flash energy levels in addition to flying shrapnel and other hazards. Only electrical equipment specifically rated for arc flash hazards can guarantee protection. Furthermore, while a greater chance of an arc flash exists when equipment is being switched, all electrical equipment can fail even under normal operation.

FIGURE 1: *12,160 V Busway Fault*

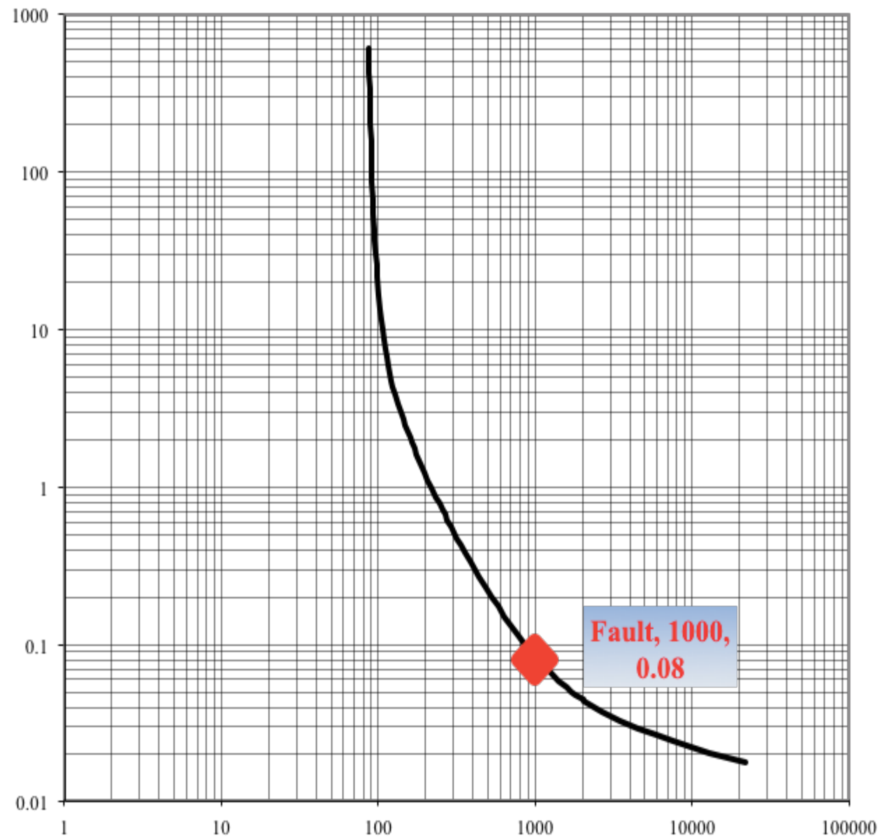
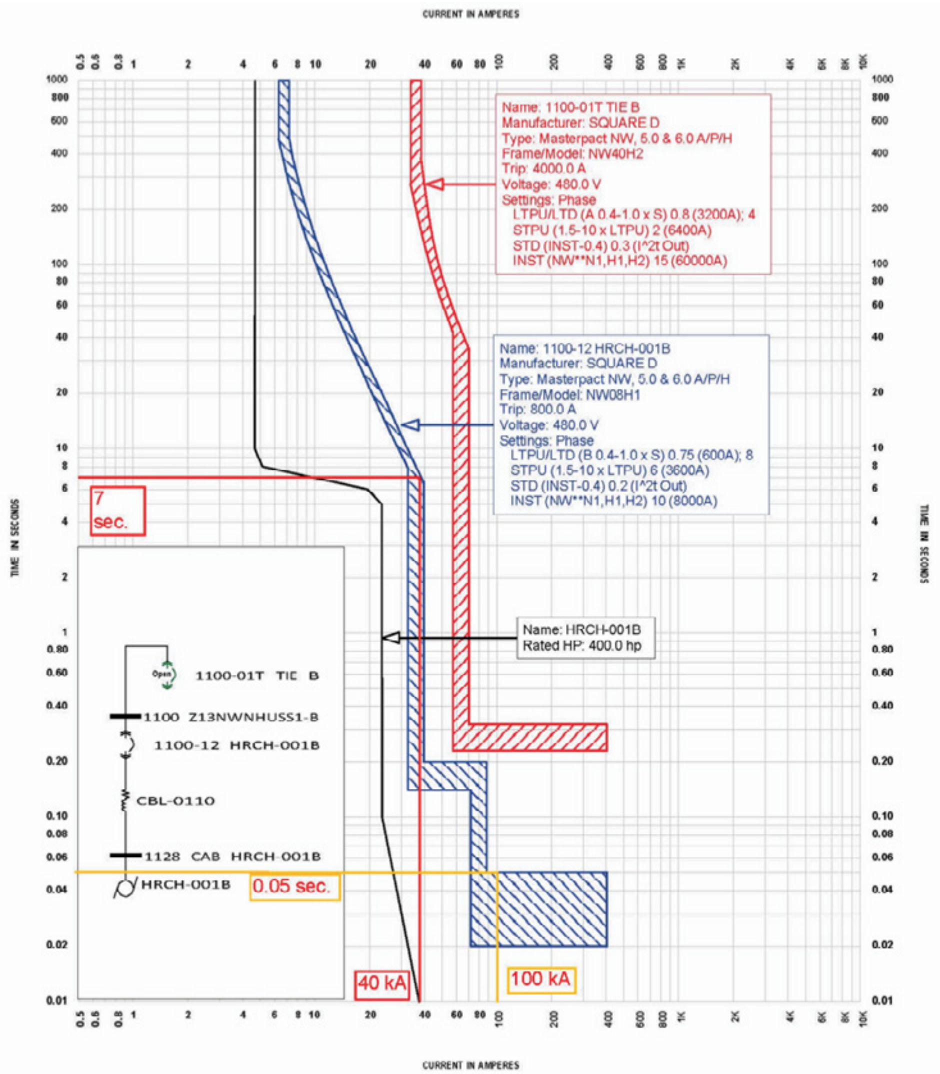


FIGURE 2: *Chiller Motor Starter Fault (Arc vs. Short Circuit,*

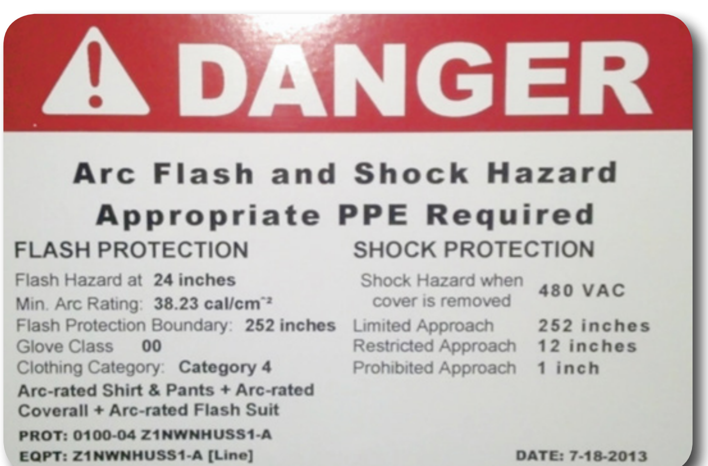


Therefore, it is imperative that personnel are always aware of their surroundings and are diligent in mitigating hazards while performing their daily tasks. Work tasks should be performed away from energized equipment whenever possible and proper precautions should be taken when working near energized equipment.

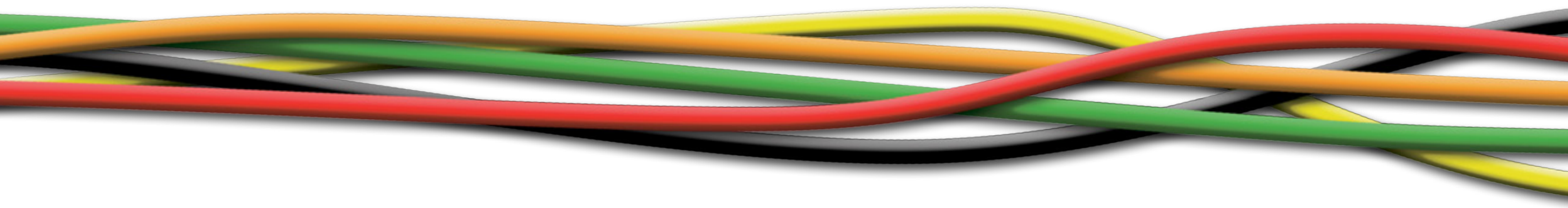
So what does this mean for Test and Balance and Commissioning personnel? First and foremost is to understand the hazards that may be present around electrically energized equipment. While a large motor control center is typically more dangerous, do not discount the 10 HP motor starter disconnect switch that is commonplace in many facilities. Personnel must search out the facts and understand the hazards. To do this, a person must be able to read an Arc Flash Warning Label that should be posted on most new equipment. An example is shown in figure 3.

This label provides all of the required information in order to determine what is needed to be safe around a piece of equipment. The Flash Protection Boundary indicates the distance from the equipment where an arc flash could cause a second degree burn to bare skin (1.2 cal. / sq. cm.). Within this boundary, the stated HRC must be utilized to determine arc flash PPE as shown on the label. The shock hazard is also listed. The limited approach for un-qualified personnel will typically be the same as the arc flash boundary. The restricted approach is determined by the voltage of the energized conductors. The minimum insulated glove class will be provided on the label if work within the restricted approach boundary is required (i.e. voltage and current measurements). The prohibited approach should never be entered except utilizing test instruments or insulated tools along with the proper PPE (i.e. voltage rated gloves).

FIGURE 3: *Arc Flash / Shock Hazard Label*



If a detailed hazard label is not provided, there are other options. The electrical coordination and arc flash study can be obtained from the Owner or Engineer and referenced to determine the arc flash hazard and shock



HRC LEVEL	MIN. CLOTHING ARC RATING / MAXIMUM INCIDENT ENERGY LEVEL *(CALORIES /SQ. CM.)*	REQUIRED PPE
0	None	Non-melting or un-treated natural fiber long sleeve shirt and pants, hard hat, safety glasses, leather boots, ear protection, leather gloves
1	4	Arc rated long sleeve shirt and pants or coveralls, arc rated face shield, hard hat, safety glasses, leather boots, ear protection, leather gloves
2	8	Arc rated long sleeve shirt and pants or coveralls, arc rated face shield and balaclava or hood, hard hat, safety glasses, leather boots, ear protection, leather gloves
3	25	Arc rated long sleeve shirt and pants or coveralls, arc rated flash suit , arc rated hood, hard hat, safety glasses, leather boots, ear protection, arc rated gloves
4	40	Arc rated long sleeve shirt and pants or coveralls, arc rated flash suit , arc rated hood, hard hat, safety glasses, leather boots, ear protection, arc rated gloves
DANGEROUS	No PPE Available	No PPE is available for protection above HRC4.

hazard boundaries as well as the HRC or incident energy (cal. / sq. cm.) levels. Once these values are known, the following table from NFPA 70E can be utilized to determine the appropriate arc flash PPE for protection.

It is important to understand the purpose of arc rated clothing. An arc flash incident can produce extremely bright light, intense heat, a large concussion or blast, vaporized particles, shrapnel, and poisonous gases. The arc rated clothing is meant to protect the human body from sustaining life threatening injuries. This does not mean that a person will not get burned or otherwise injured, but the clothing should sustain the arc flash energy without catching fire and causing more serious burns. Most serious workplace injuries from arc flash are not a result of the flash or blast itself, but are caused by secondary burning of a person's clothing or burns to exposed skin. Therefore, flame retardant clothing is the first line of defense in protection from an arc flash incident.

The following table describes the voltage rated insulted glove classes for protection from shock hazards. All rubber insulated gloves must be used with protective leather outer gloves and visually inspected before each use for holes, tears or abrasions.

VOLTAGE RATED GLOVE CLASS	MAXIMUM WORKING VOLTAGE
00	500 Volts AC / 750 Volts DC
0	1,000 Volts AC / 1,500 Volts DC
1	7,500 Volts AC / 11,250 Volts DC
2	17,000 Volts AC / 25,500 Volts DC
3	26,500 Volts AC / 39,750 Volts DC
4	36,000 Volts AC / 54,000 Volts DC

If the arc flash or shock hazard levels cannot be determined, personnel should not perform energized work on equipment or be in close proximity to equipment that could exhibit an arc flash hazard. If possible, all equipment energy sources should be de-energized and locked out following appropriate lockout / tagout procedures, unless diagnostic testing is required or de-energizing the equipment poses a greater risk to employees or building operations (e.g. healthcare facilities).

In conclusion, proper safety procedures must always be followed even when personnel are not working directly on a piece of equipment. Always be aware of surroundings and identify hazards. If there are any questions about the safety of a situation, stop immediately, leave the area and consult someone with experience to determine the proper course of action to perform work tasks. No task is worth risk of death or injury to complete.

FUME HOOD TESTING

Shawn Griffin, TBS
Griffin Air Balance Ltd.

Griffin Air Balance was contracted for the air and water balancing for a multi-story science building renovation. The contract included setting the flows for fume hoods; however, the controls contractor was responsible for certifying the hoods.

The fume hood system consisted of three exhaust fans, two operating and one standby, on a common plenum. Each fume hood had its own digital VAV controller in the penthouse to control the maximum/ minimum airflows (which depend on the sash height of the fume hood).

Due to the lack of sufficient lengths of duct on the floors it was decided to traverse the VAV boxes in the penthouse. With all of the maximum/minimum set points set, the controls contractor proceeded to certify the fume hoods.

There were a number of fume hoods that initially could not be certified. The VAV boxes in question were checked and confirmed to be within spec. The face velocities at the fume hoods were measured and the readings matched those taken by the controls contractors.

The mechanical contractor was advised that duct leakage was suspected in the system. They argued that as it was welded stainless steel, that could not be possible. Copies of calibration certificates and traverse procedures were provided when the mechanical contractor questioned the instrumentation and procedures.

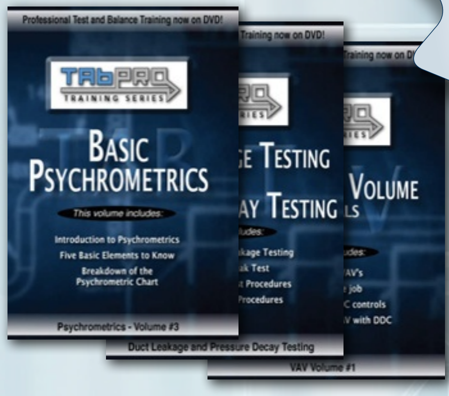
In an attempt to confirm the airflows the controls contractor again tried to find acceptable traverse locations on the floors. This proved difficult due to the cramped ceiling space and the lack of long runs of duct. Eventually the fume hoods were traversed and a difference of up to 25 percent was found when the floor traverses and the penthouse traverses were compared. The mechanical contractor still did not accept that there must be duct leakage and continued to insist that as it was welded stainless steel duct, the results must be wrong.

In the end, an inspection of the ductwork confirmed that while all visible seams looked fine, seems that could not be seen had not all been welded. These seams were accessible only by cutting holes in walls. Once welded, the respective fume hoods passed certification.

TABPRO
TRAINING SERIES

Save 10% when you order all three TABpro DVDs!

You'll get lessons on standard VAVs, parallel fan-powered VAVs, standard duct leakage testing, pressure decay leakage testing, and basic psychrometrics.



Bundle (VAV, Duct Leakage & Psychrometrics)

3 DVDs
Total run time 106 minutes
List price: $468.00
Member price: $351.00

Basic Psychrometrics

DVD format
Run time: 19 minutes
List price: $120.00
Member price: $90.00

This volume contains one lesson on basic psychrometrics. This provides the viewer with an introduction to psychrometric fundamentals and takes you through five of the basic elements found on the psychrometric chart. This lesson will break down these elements on the chart and provide fundamental concepts of chart usage.

Duct Leakage and Pressure Decay Testing

DVD format
Run time: 42 minutes
List price: $200.00
Member price: $150.00

This volume consists of two lessons covering standard duct leakage testing and pressure decay leakage testing. These lessons take the viewer through an introduction to leakage testing, essential job preparation, instrumentation used during testing, general procedures for leakage testing, multiple calculations used during testing and final reporting.

Variable Air Volume (VAV) Terminals

DVD format
Run time: 45 minutes
List price: $200.00
Member price: $150.00

This volume consists of two lessons covering standard VAVs and parallel fan-powered VAVs, both using DDC controls. These lessons take the viewer through an introduction to VAV terminals, essential job preparation, instrumentation used during testing, general procedures for testing and balancing, and final reporting.

Quantity	Title	Price Non-Member	Member
_______	Psychrometrics	$120	$90
_______	Duct Leakage	$200	$150
_______	VAV Terminals	$200	$150
_______	Bundle of all 3 DVDs	$468	$351

Total: $____________

Payment Information

Payment Type (Check one)
❑ Check Enclosed ❑ MC ❑ Visa ❑ AMEX

Card Number ______________________

Expiration Date ______________________

Name on Card ______________________

Signature ______________________

Please complete order form and return along with payment to:

Associated Air Balance Council
1518 K Street, N.W., Suite 503
Washington, D.C. 20005

Credit card purchasers may fax orders to: (202) 638-4833 or order online at www.aabc.com/publications

Shipping Information

Name ______________________ Phone ______________________

Company ______________________ Fax ______________________

Shipping Address ______________________ E-mail ______________________

City/State/Zip ______________________

VARIABLE VOLUME GREASE HOODS

Kane Lassiter, TBE
Engineered Air Balance Co., Inc.

A recent project involved several variable volume grease hoods and fan systems. There were four systems, each one consisting of one exhaust fan with a VFD and two or three grease hoods, each with integral modulating damper and flow sensor. Each hood also had a temperature sensor in the duct and infrared sensors in the hood. The system concept is to vary the exhaust air flow as required by the activities in the hood, thereby reducing the energy required to exhaust and the energy required for outside air make up. The separate BAS system varies the outside air delivered to the space based on the total kitchen exhaust. This required an interface between the BAS and the hood systems which was done through Bacnet. For this system there were three touchscreen display consoles where hood variables such as damper position and airflow could be viewed. There was no proprietary software on hand to interface with the hood system controls.

The system operates as follows. If the infrared hood sensor detects heat at the cooking surface, the exhaust fan is energized and the hood damper and fan flow control is enabled. The system enters what it refers to as idle mode. In idle mode the system operates at 60% of the design capacity. Upon increased cooking activities sensed by the infrared sensor and the duct mounted temperature sensor, the air volume is increased using the modulating damper to maintain the duct temperature in a predetermined range. The fan VFD modulates the fan speed to maintain one of the hood control dampers near 100% open.

Balance of the hoods is simple when using the manufacturer's method for determining air flow. The hood has a pressure measuring tip in the panel next to the grease filters where measurements of the exhaust plenum pressure can be taken. The

> Balance of the hoods is simple when using the manufacturer's method for determining air flow.

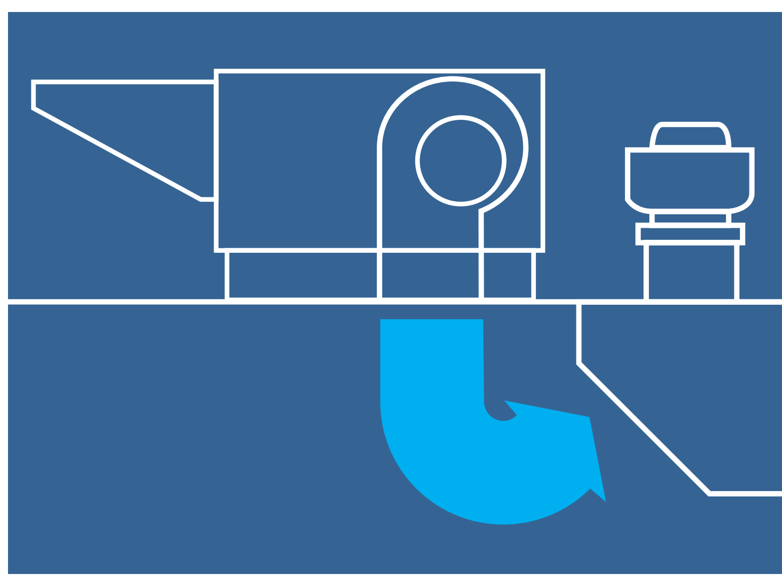
submittal data provides the design airflow and pressure required at the port. A chart with different airflows and pressures is also available but not necessary to have if the design conditions are known. Their chart airflow is based on the formula (CFM2/CFM1)2=Sp2/Sp1. The pressure was measured with neutral temperature air and calculated using this formula.

Some problems encountered:

1. The control damper would not provide 100% closure when hood was not in use. In some cases substantial airflow was being wasted. This required the startup technician to return and make adjustments.
2. System "hunting". The fan speed would modulate and the multiple hood control dampers would also modulate causing large swings in air flow. After unsuccessful attempts by the manufacturer's field technician to fix the issue, the manufacturer's operations manager in cooperation with EAB was able to successfully tune the loops. This took time and patience to verify the systems would react quickly and remain stable.
3. Inaccurate air flow readings. There were several instances where the airflow calculated based on the submittal did not match the controls displayed value. Again the operations manager was able to make the necessary corrections. In one instance there was a large discrepancy between the readings that could not be rectified thru the controls. It was discovered that the hood design had been changed but corrected data had not been submitted. Once the correct design data was acquired the hood airflows were verified to match the controls reading.
4. Inaccurate alignment of the infrared sensors. These sensors require removal for occasional cleaning and if they are not aligned correctly they will not detect heat and the system will not energize and/or react quickly. This was proven when the owner was cooking and smoke was pouring out of the hood and setting off smoke detectors.

Some other features of this system are alarms for clogged, missing or misaligned filters, VFD faults, fire suppression, sensor failures and high temperatures. The hood also has the ability to be overridden to maximum airflow for five minutes or one hour with the push of a button. A room temperature sensor is also installed near the hoods and provides input to the system.

This was the first system of this type encountered by individuals working the project, and the first for this specific jobsite. Overall the system seemed to work satisfactorily but it will be monitored with input from the owner to see if long term operational satisfaction is achieved.



Cx/TAB VERIFICATION

Jeremy Johnson, TBE
American Testing, Inc.

American Testing was contracted directly by the owner to balance a university teaching amphitheater. The scope of the project was to rebalance one existing AHU, one VAV terminal with hot water reheat coil, and six supply air devices.

Even though this project was very small in scope, there were several challenges to overcome to successfully balance the systems. The balancing of the air devices had to be performed with scaffolding installed over the seating area while other aspects of the HVAC systems were incomplete.

The six air devices consisted of four 20" round diffusers and two 20x14 supply side wall registers. The balancing devices for the sidewall grilles installed were opposed blade dampers (OBD's) and the 20" round diffusers had manual volume dampers. The supply ductwork was arranged so that the two sidewall registers were the closest to the VAV. With the low design duct velocity, these air devices received a substantial amount of the airflow upon initial testing. The OBD's for both side wall grilles ended up being throttled nearly 75%. The position of OBD's could not be permanently marked and unfortunately their balance position was not noted on our field sheets. It was mentally noted the noise level was acceptable at this position.

During testing and balancing, it was observed that one of the 20" diffuser damper handles was installed in the closed position with the actual damper position open. This was a mental note that failed to make it to the TAB report. The remaining air devices were balanced with at least one volume damper 100% open.

The TAB report was completed and submitted for review. The engineer accepted the TAB report while the commissioning authority requested TAB verification during the functional performance testing. We met the commissioning agent onsite after the space was completely finished and begin to repeat our readings of the VAV duct traverse, AHU performance, and return air plenum readings in the mechanical equipment room. All of the readings repeated within tolerances.

Readings were then verified in the amphitheater. Due to the fact the scaffolding was removed, a lift was used to measure two of the 20" round supply diffusers. The other two 20" round diffusers in the middle of the space could not be measured without scaffolding. The two sidewall registers could be measured off a 6' ladder. The two 20" round diffusers were measured with an airfoil probe. The K factor for this diffuser was previously established by duct traverse. The end diffusers tested at approx. 85% of design (within limits as established within an open area).

It was then necessary to measure the sidewall grilles, which tested much higher than the original TAB data (approximately 200% of design). It was found that the OBD's were 100% open. Between the time of the original testing and balancing and TAB verification, the OBD'S were disturbed from the previous TAB

setting. As any experienced TAB professional knows, balancing in general with OBD's is very subjective. Most OBD's have no means of marking the position and can easily be tampered with. Substantial changes in system static pressure can also affect the position of OBD's, as in the starting and stopping of fans, filter change-outs during operating modes, equipment panels accessed during operating mode. As anyone who has been in this position before, it is very frustrating trying to explain or assume what could have happened to these OBD's. These OBD's were adjusted back to their original TAB settings and the remaining readings were repeatable. It is possible, however, that the OBD's positions could move again.

In cases such as this, provide documentation in the TAB report to better substantiate the work if needed. Mental notes need to be converted to documented notes. In this example, the OBD's approximate damper position should have been noted as it corresponds to each air device in the report. Additionally, the damper with the handle installed improperly should have been noted. Documentation would not have changed the actual situation but it would have revealed a better detailed understanding of how the TAB was successfully completed.

Customizing the TAB Reports to reflect and represent the final balance conditions with exceptional detail is something industry professionals should all be striving for in the expanding world of Cx/TAB verification.

ALABAMA

Performance Testing & Balancing Co., Inc.
Cleveland, Alabama
(205) 274-4889

Southeast T&B, Inc.
Cleveland, Alabama
(205) 559-7151

Superior Tabs International, Inc.
Pelham, Alabama
(205) 620-2801

Systems Analysis, Inc.
Birmingham, Alabama
(205) 802-7850

ARIZONA

Arizona Air Balance Company
Tempe, Arizona
(480) 966-2001

ETB Arizona, LLC
Glendale, Arizona
(602) 861-1827

General Air Control, Inc.
Tucson, Arizona
(520) 887-8850

Precisionaire of Arizona, Inc.
Phoenix, Arizona
(623) 580-1644

Southwest Testing & Balancing, LLC
Goodyear, Arizona
(602) 370-6601

Systems Commissioning & Testing, Inc.
Tucson, Arizona
(520) 884-4792

Tab Technology, Inc.
Mesa, Arizona
(480) 964-0187

Technical Air Balance SW, Inc.
Phoenix, Arizona
(623) 492-0831

CALIFORNIA

Air Balance Company, Inc.
Diamond Bar, California
(909) 861-5434

American Air Balance Co., Inc.
Anaheim, California
(714) 693-3700

Los Angeles Air Balance Company, Inc.
Upland, California
(800) 429-6880

Matrix Air Balance, Inc.
Torrance, California
(310) 320-9020

MESA3, Inc.
San Jose, California
(408) 928-3000

MESA3, Inc.
Roseville, California
(916) 803-0268

National Air Balance Co., Inc.
Fremont, California
(510) 623-7000

Pacific Test and Balance, Inc.
Napa, CA
(707) 696-2444

Penn Air Control, Inc.
Cypress, California
(714) 220-9091

Penn Air Control, Inc.
Springbrook, California
(760) 451-2025

Penn Air Control, Inc.
San Francisco, California
(510) 509-4005

RSAnalysis, Inc.
El Dorado Hills, California
(916) 358-5672

San Diego Air Balance, Co., Inc.
Escondido, California
(760) 741-5401

Winaire, Inc.
Huntington Beach, California
(714) 901-2747

COLORADO

Proficient Balancing Company, LLC
Arvada, Colorado
(303) 870-0249

CONNECTICUT

CFM Test & Balance Corporation
Bethel, Connecticut
(203) 778-1900

James E. Brennan Company, Inc.
Wallingford, Connecticut
(203) 269-1454

FLORIDA

Air Balance Unlimited, Inc.
Sorrento, Florida
(407) 383-8259

Air Proserv, Inc.
Boca Raton, Florida
(561) 208-3882

Bay to Bay Balancing, Inc.
Lutz, Florida
(813) 971-4545

Bay to Bay Balancing, Inc.
Orlando, Florida
(407) 704-8768

Gregor Hartenhoff, Inc.
Pompano Beach, Florida
(954) 786-3420

Palmetto Air & Water Balance, Inc.
Ft. Myers, Florida
(800) 295-9806

Perfect Balance Inc.
Jupiter, Florida
(561) 575-4919

Precision Balance, Inc.
Orlando, Florida
(407) 876-4112

Southern Balance, Inc.
Milton, Florida
(850) 623-9229

Southern Independent Testing Agency, Inc.
Lutz, Florida
(813) 949-1999

Test and Balance Corporation
Lutz, Florida
(813) 909-8809

The Phoenix Agency, Inc.
Lutz, Florida
(813) 908-7701

Thermocline Corp.
Merritt Island, Florida
(321) 453-3499

GEORGIA

Addison Energy Technologies, LLC
Toccoa, Georgia
(706) 244-0383

Augusta Air Balance Company, LLC
Martinez, Georgia
(706) 799-2254

Southern Balance Company
Marietta, Georgia
(770) 850-1027

TAB Services, Inc.
Norcross, Georgia
(404) 329-1001

Test and Balance Corporation
Roswell, Georgia
(678) 393-9401

GUAM

Penn Air Control, Inc.
Tamuning, Guam
(671) 477-0325

HAWAII

Test and Balance Corp. of the Pacific
Honolulu, Hawaii
(808) 593-1924

ILLINOIS

United Building & Energy Services, LLC
Wheaton, Illinois
(630) 790-4940

INDIANA

Fluid Dynamics, Inc.
Fort Wayne, Indiana
(260) 490-8011

Synergy Test & Balance, Inc.
Indianapolis, Indiana
(317) 222-1828

IOWA

Systems Management & Balancing, Inc.
Waukee, Iowa
(515) 987-2825

KENTUCKY

Thermal Balance, Inc.
Ashland, Kentucky
(606) 325-4832

Thermal Balance, Inc.
Nicholasville, Kentucky
(859) 277-6158

Thermal Balance, Inc.
Paducah, Kentucky
(270) 744-9723

LOUISIANA

Coastal Air Balance Corp.
Jefferson, Louisiana
(504) 834-4537

Tech-Test Inc. of Louisiana
Baton Rouge, Louisiana
(225) 752-1664

MARYLAND

American Testing Inc.
Ellicott City, Maryland
(410) 461-6211

Baltimore Air Balance Co.
Bowie, Maryland
(301) 262-2705

Baumgartner, Inc.
Hunt Valley, Maryland
(410) 785-1720

Chesapeake Testing & Balancing Engineers, Inc.
Easton, Maryland
(410) 820-9791

Environmental Balancing Corporation
Clinton, Maryland
(301) 868-6334

Protab, Inc.
Hampstead, Maryland
(410) 935-8249

Test & Balancing, Inc.
Laurel, Maryland
(301) 953-0120

Weisman, Inc.
Towson, Maryland
(410) 296-9070

MASSACHUSETTS

Thomas-Young Associates, Inc.
Marion, Massachusetts
(508) 748-0204

MICHIGAN

Aerodynamics Inspecting Co.
Dearborn, Michigan
(313) 584-7450

Airflow Testing, Inc.
Lincoln Park, Michigan
(313) 382-8378

MINNESOTA

Air Systems Engineering, Inc.
Minnetonka, Minnesota
(952) 807-6744

Mechanical Data Corporation
Bloomington, Minnesota
(952) 473-1176

Mechanical Test and Balance Corporation
Maple Plain, Minnesota
(763) 479-6300

SMB of Minnesota
Blaine, Minnesota
(763) 398-3284

MISSISSIPPI

Capital Air Balance, Inc.
Terry, Mississippi
(601) 878-6701

Coastal Air Balance Corp.
Terry, Mississippi
(228) 392-8768

MISSOURI

Miller Certified Air, Inc.
St. Louis, Missouri
(314) 352-8981

Precisionaire of the Midwest, Inc.
Grain Valley, Missouri
(816) 847-1380

Senco Services Corporation
St. Louis, Missouri
(314) 432-5100

Testing & Balance Co. of the Ozarks, LLC (TABCO)
Ozark, Missouri
(417) 443-4430

NEVADA

American Air Balance Co., Inc.
Las Vegas, Nevada
(702) 255-7331

Mechanical Test and Balance Corporation
Las Vegas, Nevada
(702) 737-3030

National Air Balance Company, Inc.
Las Vegas, Nevada
(702) 871-2600

Penn Air Control, Inc.
Las Vegas, Nevada
(702) 221-9877

Raglen System Balance, Inc.
Reno, Nevada
(775) 747-0100

RSAnalysis, Inc.
Las Vegas, Nevada
(702) 740-5537

NEW JERSEY

Airology
Bedminster, New Jersey
(908) 310-1776

Effective Air Balance, Inc.
Totowa, New Jersey
(973) 790-6748

National Air Balance Company LLC
Paramus, New Jersey
(201) 444-8777

NEW YORK

Mechanical Testing, Inc.
Waterford, New York
(518) 328-0440

Precision Testing & Balancing, Inc.
Brooklyn, New York
(718) 994-2300

NORTH CAROLINA

Building Environmental Systems Testing, Inc. (BEST, Inc.)
Wilson, North Carolina
(252) 291-5100

e-nTech Independent Testing Services, Inc.
Winston-Salem, North Carolina
(336) 896-0090

Palmetto Air & Water Balance, Inc.
Charlotte, North Carolina
(704) 587-7073

Palmetto Air & Water Balance, Inc.
Greensboro, North Carolina
(336) 275-6678

Palmetto Air & Water Balance, Inc.
Raleigh, North Carolina
(919) 460-7730

Palmetto Air & Water Balance, Inc.
Wilmington, North Carolina
(910) 202-3850

The Phoenix Agency of North Carolina, Inc
Winston-Salem, NC
(336) 744-1998

NORTH DAKOTA

Design Control, Inc.
Fargo, ND
(701) 237-3037

OHIO

Air Balance Unlimited, Inc.
Gahanna, Ohio
(614) 595-9619

Kahoe Air Balance Company
Cleveland, Ohio
(440) 946-4300

Kahoe Air Balance Company
Liberty Township, Ohio
(513) 248-4141

Kahoe Air Balance Company
Lewis Center, Ohio
(740) 548-7411

PBC, Inc.
(Professional Balance Co.)
Willoughby, Ohio
(440) 975-9494

Precision Air Balance
Company, Inc.
Cleveland, Ohio
(216) 362-7727

R.H. Cochran and
Associates, Inc.
Wickliffe, Ohio
(440) 585-5940

OKLAHOMA

Eagle Test & Balance
Cushing, Oklahoma
(918) 225-1668

OREGON

Northwest Engineering Service, Inc.
Tigard, Oregon
(503) 639-7525

Pacific Coast Air Balancing
Newberg, Oregon
(503) 537-0826

PENNSYLVANIA

Butler Balancing Company, Inc.
Thorndale, Pennsylvania
(610) 873-6905

Flood and Sterling Inc.
New Cumberland,
Pennsylvania
(717) 232-0529

Kahoe Air Balance Company
McMurray, Pennsylvania
(724) 941-3335

WAE Balancing, Inc.
Mercer, Pennsylvania
(724) 662-5743

PUERTO RICO

Penn Air Control, Inc.
Naguabo, Puerto Rico
(787) 465-7839

SOUTH CAROLINA

Palmetto Air & Water
Balance, Inc.
Greenville, South Carolina
(864) 877-6832

Palmetto Air & Water
Balance, Inc.
Charleston, South Carolina
(843) 789-5550

TENNESSEE

Environmental Test & Balance
Company
Memphis, Tennessee
(901) 373-9946

Systems Analysis, Inc.
Hermitage, Tennessee
(615) 883-9199

Thermal Balance, Inc.
Nashville, Tennessee
(615) 768-5461

United Testing & Balancing, Inc.
Nashville, Tennessee
(615) 331-1294

United Testing & Balancing, Inc.
Knoxville, Tennessee
(865) 922-5754

TEXAS

Aerodynamics Inspecting Co.
Houston, Texas
(313) 584-7450

Aerodynamics Inspecting
of Texas, LLC
Weslaco, Texas
(956) 351-5285

Air Balancing Company, Inc.
Fort Worth, Texas
(817) 572-6994

AIR Engineering and Testing, Inc.
Dallas, Texas
(972) 386-0144

Austin Air Balancing
Corporation
Austin, Texas
(512) 477-7247

Delta-T, Ltd.
Garland, Texas
(972) 494-2300

Engineered Air Balance
Co., Inc.
Richardson, Texas
(972) 818-9000

Engineered Air Balance
Co., Inc.
San Antonio, Texas
(210) 736-9494

Engineered Air Balance
Co., Inc.
Spring, Texas
(281) 873-7084

National Precisionaire, LLC
Houston, Texas
(281) 449-0961

Online Air Balancing Company
Houston, Texas
(713) 453-5497

PHI Service Agency, Inc.
San Antonio, Texas
(210) 224-1665

PHI Service Agency, Inc.
Austin, Texas
(512) 339-4757

PHI Service Agency, Inc.
Alamo, Texas
(956) 781-9998

PHI Service Agency, Inc.
Corpus Christi, Texas
(361) 248-4861

Professional Balancing
Services, Inc.
Dallas, Texas
(214) 349-4644

TAB Solutions, Inc.
Lakeway, Texas
(720) 220-1062

Technical Air Balance, Texas
Spring, Texas
(281) 651-1844

Texas Test & Balance
Houston, Texas
(281) 358-2118

UTAH

Mechanical Testing
Corporation
Leeds, Utah
(435) 879-8714

RSAnalysis, Inc.
Sandy, Utah
(801) 255-5015

VIRGINIA

Arian Tab Services
Herndon, Virginia
(703) 319-1000

C&W-TESCO, Inc.
Richmond, Virginia
(804) 379-9345

Mid-Atlantic Test &
Balance, Inc.
South Boston, Virginia
(434) 572-4025

WASHINGTON

Eagle Test & Balance
Bellevue, Washington
(425) 747-9256

TAC Services, LLC
Bellingham, Washington
(360) 224-8555

WISCONSIN

Professional System
Analysis, Inc.
Germantown, Wisconsin
(262) 253-4146

AABC CANADIAN CHAPTER

MANITOBA

A.H.S. Testing &
Balancing Ltd.
Winnipeg, Manitoba
(204) 224-1416

Air Movement Services Ltd.
Winnipeg, Manitoba
(204) 233-7456

AIRDRONICS, Inc.
Winnipeg, Manitoba
(204) 253-6647

D.F.C. Mechanical Testing
& Balancing Ltd.
Winnipeg, Manitoba
(204) 694-4901

NEW BRUNSWICK

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

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

Source Management Limited
Fredericton, New Brunswick
(506) 443-9803

NOVA SCOTIA

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

Scotia Air Balance 1996 Limited
Antigonish Co., Nova Scotia
(902) 232-2491

ONTARIO

Accu-Air Balance Co.
(1991) Inc.
Windsor, Ontario
(519) 256-4543

Air & Water Precision
Balancing, Inc.
Toronto, Ontario
(647) 896-5353

Airwaso Canada Inc.
London, Ontario
(519) 652-4040

Caltab Air Balance Inc.
Tecumseh, Ontario
(519) 259-1581

Designtest & Balance Co. Ltd.
Richmond Hill, Ontario
(905) 886-6513

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

Kanata Air Balancing &
Engineering Services
Ottawa, Ontario
(613) 832-4884

Pro-Air Testing Inc.
Toronto, Ontario
(416) 252-3232

Vital-Canada Group Inc.
Mississauga, Ontario
(905) 848-1000

VPG Associates Limited
King City, Ontario
(905) 833-4334

AABC INTERNATIONAL MEMBERS

SOUTH KOREA

Awin ENC Co., Ltd.
Soengdong-gu, Seoul
SOUTH KOREA
+82-2-2117-0290

Energy 2000 Technical
Engineering Co., Ltd.
Songpa-gu, Seoul
SOUTH KOREA
+82-2-408-2114

KYUNGMIN FNE
Gangbuk-gu, Seoul
SOUTH KOREA
+82-2-7077-9447-33

Penn Air Control, Inc.
Gangbuk-gu, Seoul
SOUTH KOREA
+82-2-982-0431

ITALY

Studio S.C.S. Ingegneri
Scarbaci-Cuomo
Pordenone, ITALY
+39-0434-29661

An interesting case study? A new method? Tell us about it.

TAB Journal welcomes submissions for publication. TAB Journal is published quarterly by the Associated Air Balance Council. Send letters or articles to:

Editor • TAB Journal
1518 K Street, NW, Suite 503
Washington, DC 20005 • info@aabc.com

ACCURATE. DEPENDABLE. VERSATILE.

Only TSI-Alnor EBT731 Balometer® Capture Hood can:

+ Provide most accurate measurement
+ Enable easy, efficient one-person operation
+ Offer innovative accessory choices

New Added Features and Accessories Include:

+ Detachable auto-zeroing micromanometer with duct traverse mapping application
+ Accessory probe options (pitot, thermoanemometer, temperature and humidity)
+ Remote display and logging via LogDat™ Mobile Android™ Software
+ Labor-saving capture hood stand

There's never been a better time to buy–Bundle and Save:

BUNDLE WITH TSI & SAVE **A savings of $365 then if purchased separately**	
Model	Bundle Contents
EBT731-STA	+ EBT731 Balometer Capture Hood + Capture Hood Stand + Smart Tablet* loaded with LogDat™ Mobile App and Instruction Videos

Choose the EBT731 Balometer to drive your efficiency and performance while increasing revenue.
www.tsi.com/ebt731

Designed and assembled in America

*TSI has the discretion to change the brand and model of tablet at any time.

TSI® UNDERSTANDING, ACCELERATED