

“HVAC Startup, Test & Balance, Commissioning”

by Christopher Grawburg

When an HVAC system is installed, the final steps prior to completion are startup, test & balance, and possibly commissioning. Each step is important to ensure that the system performs per the intent and design of the engineer and provide a comfortable environment for the occupants. Startup is a necessary part of completing an HVAC systems, test & balance is a needed but often neglected step, and commissioning (Cx) not usually performed unless the project is attempting to obtain a LEED award or is part of a sensitive building system (ie. laboratory, hospital, manufacturing).

Startup

When HVAC equipment is installed and electrical power wired complete, the equipment must be “started up.” The startup process is usually performed by a technician with the HVAC subcontractor, but may also be performed by technicians from the equipment manufacture itself working for the HVAC sub.

Each piece of HVAC equipment has a startup checklist provided by the manufacturer in the paperwork that comes with the item. It is very important that the startup technician follow these startup steps as noted by the manufacturer. Failure to properly startup equipment may void the manufactures warranty.

The startup process may simply be verification that a fan is spinning in the proper direction and greasing motor bearings up to checking refrigerant charge in chillers and verifying correct amp draw from pumps. Startup reports should be included in the HVAC subs project documentation (O&M’s). It is important to note the date of equipment startup as the 1 year warranty may begin on the date or startup. A unit isn’t running until it is “started up.”

Test & Balance

When HVAC equipment is started up, it will not blow the air or move the water the engineer intends for the HVAC system to work properly. The system must be “balanced” so that the correct air and water flows are present during normal system operation.

From the airside, the balancing technician will slow equipment fans up or down and may even need to change belts or pulleys to achieve the desire flow out of the equipment. The air coming out the ceiling diffusers is usually controlled by a



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damper off the rectangular duct above the ceiling. I do not recommend having a volume damper in the face of the grille itself because, although it is easier to adjust the airflow at the ceiling, volume dampers in the face of the diffusers are notorious for whistling and rattling over time.

The water side of an HVAC system must also be balanced whether from a chiller, cooling tower, or boiler. The water flow is typically adjusted at a pump and may be as simple as speeding up or slowing the pump or a complicated as replacing the internal components to the pump itself.

Test and balance is an absolutely critical step in HVAC system installation. A system designed by the world's best engineers and installed by the industry's leading craftsman will be rendered useless if it is not balanced properly. I will make two statements that some in the industry will disagree with, but my experience with projects and HVAC subs across my career proves me right:

- 1) *Every* new HVAC system should be tested and balanced by a Certified Test and Balance (T&B) technician.
- 2) If you are leaving the T&B up to the HVAC sub to perform with their own techs and **not** a certified balance contractor, at least 50% of those systems are NOT being balanced at all.

The ***only*** way to ensure that a system is balanced properly so that the occupants will be comfortable is to have the system balanced by a technician following the guidelines of the two national balancing agencies NEBB or AABC. A certified balance contractor spends years in training in the classroom and the field. A certified balance contractor will balance the HVAC system in accordance with the NEBB or AABC and provide a report that is stamped and sealed verifying proper balance. The T&B contractor may be hired by the HVAC sub, the GC, or the owner – but they need to be hired by someone.

I'm sorry to say that if left up to the HVAC sub to have one of their startup techs perform the T&B, many of those systems will never be balanced. If the occupants never complain, how will anyone know balance was not performed? On more than one occasion I have seen HVAC subs fabricate balance reports to include in their project closeout documents without ever balancing a single piece of the system. This practice is more common that I would care to admit. A *certified* contractor will lose his customer, reputation, job, and license to perform future work so the likelihood of falsehood is greatly reduced. Owners and GC's need to understand that Certified T&B may be more expensive than an in-house HVAC balance, but it's better than NO balance.

Commissioning



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“HVAC commissioning” is an expression that has taken on a wide range of definitions and has become a more common practice with the increased popularity of the LEED rating system. Simply put, HVAC commissioning is using a third party to verify that the HVAC design satisfies the owners requirements, the system is installed per the contract documents and manufacturers instructions, that the equipment is running properly, and the system performs per intent of design. A Commissioning Agent or “Cx Agent” performs HVAC system commissioning.

Commissioning is a step beyond startup and air balance and can be used as a final verification of the HVAC system. The extent of the commissioning and by whom the commissioning is performed is dependent on several things including design document requirement, owner preference, budget, and desire for satisfying the LEED Commissioning Prerequisite EA 1 or EA 3 – Enhanced Commissioning.

Here are common commissioning tasks as found on the website
www.houstoncommissioning.com/hvac.htm

Pre-Functional

Installation: Verify correct material and equipment installation; Verify that the installation meets construction details and manufacturer’s installations; Document condition of equipment

Start Up: Document pre-operation requirements; Verify that manufacturer’s startup procedures are performed; Document performance; Verify calibration of devices

Test Adjust and Balance (TAB): Review finalized TAB report; Direct quality assurance demonstration; Identify inconsistencies

Controls: Review installation of sensors; Document calibration of sensors and devices; Document remote control of equipment

Functional

Automatic Equipment Operation: Witness automatic startup and shutdown; Verify that equipment sequence of operations is correct

Automatic System Operation: Witness automatic startup and shutdown of integrated systems; Verify that system sequence operation is correct

Alarms and Safeties: Verify that systems alarms are active; Verify sequence of operation under alarm; Verify equipment safeties are active



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Training and Documentation

Training: Verify that adequate training is provided to building maintenance personnel; Witness portions of the training; Identify additional resources for use after training ends

Report of Commissioning: Document commissioning activities; Document issues resolved during the commissioning process; Identify a plan to resolve any issues remaining after construction.

Systems Manual: Document operations and maintenance manuals for equipment included in the commissioning process; Create a useable sequence of operations of systems; Document the design intent for use during renovation or Retro-Commissioning

In addition to problems found by air balance, a Cx agent is equipped to find design and installation issues owners are unaware of, the design engineers never bother to investigate, the general contractor and architect don't know to look for, or the HVAC sub doesn't want to reveal. Other than in buildings desiring a LEED award, those with critical systems such as laboratories, hospital, R&D, or specialized manufacturing are prime candidates for HVAC commissioning to ensure proper installation and operation of the HVAC system. Please refer to the LEED EA Prerequisite 1 or EA Credit 3 for a more detailed explanation of what is involved in building commissioning.



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