

Demystifying HVAC:

Post-Construction HVAC Inspections (Buyer Beware)

by Ron Prager

Why do I need post construction inspections?

During an extremely cold winter, the facility manager of a big-box retail chain store finds that he has lost three compressors on rooftop units on a two year old store in a Chicago suburb. The contractor servicing the store informs the facilities manager that he believes the inordinate number of compressor failures is due to the fact that the units are not equipped with low ambient controls or outside air economizers. The facilities manager consults the mechanical design plans for the location and determines that while low ambient controls and outside air economizers were accessories specified by the consulting engineer, somehow they were never provided by the installing contractor. The cost to retrofit eight rooftop units with the specified accessories is \$18,000.00, and the cost to replace the three compressors is an additional \$10,000.00.

During this same winter, a four foot high, eight foot long, dry cooler water coil bursts in a store in Manhattan. The store is six years old, and the primary cause of the issue is a damper linkage that failed, but subsequent review of the mechanical design plans shows that the consulting engineer specified that the system be filled with a 50% solution of propylene glycol. The installing contractor hooked the system up to a domestic water line in lieu of charging the system with glycol. For want of \$1000.00 in glycol, \$25,000.00 in repair costs were incurred and \$50,000.00 in merchandise and equipment were destroyed.

A big-box retail store is heated and cooled by eight, forty ton, packaged rooftop units. The store is currently four years old and the owner has spent \$20,000.00 in mechanical consulting fees attempting to find a cure for the fact that the front vestibule of the store becomes a wind tunnel at certain times and four of the eight entry doors blow wide open. After deciding to live with the issue, the owners of the store are served with a summons and complaint by a lady who patronized the store until the day she walked through the door and her skirt blew up over her head. The amount the suit was settled for was undisclosed, but it cost \$165,000.00 to retrofit the HVAC units with power exhaust fan accessories, modulating exhaust dampers, and static pressure controllers. These items were specified on the original mechanical design, but the project manager and the HVAC contractor "Value engineered," them out of the job. Part of the immense expense was due to the fact that when the units were manufactured, these items were available as factory installed accessories. After installation, these items had to be assembled from replacement parts.

Each of the scenarios described above actually occurred. While these were errors and omissions by contractors that had grave consequences for the retailers involved, little if any restitution was made by the installers. This was mostly due to the amount of time that had passed between the completion of the projects and the identification of the issues.

There is a definite need for a party with mechanical expertise, armed with a set of mechanical plans to perform a thorough inspection of the completed HVAC systems in a retail store to make certain that they have been installed as specified by the manufacturer and the consulting engineer, and that they operate properly.

The examples above are major in nature and thank goodness they are not the norm. However, almost every post construction inspection I have seen, turned up something that was omitted or performed incorrectly. Sometimes it is something as simple as a flexible duct that was never connected to a diffuser, or the fact that the engineer specified shielded control cable and unshielded cable was used. While these items are simple in nature they can cause issues for years before the cause is identified.

What makes this inspection different from others?

Facility managers and construction managers often fail to require post construction inspections because they believe that any issues will be discovered by the general contractor, by the test and balance contractor, or by a factory supervised start-up. Unfortunately, while each of these inspections has their function, they do not replace the post construction inspection.

The general contractor's superintendent and project manager are responsible for building a project according to plans and specifications provided, completing the project on time, and making a profit for their company. Normally they have very little in the way of expertise with respect to mechanical systems. In addition, it is not in their best interests to point out something that was neglected during construction and may cause the project to require more time to complete. Most of these construction professionals are very good at what they do. It's just that verifying that the mechanical contractor conforms to the plans and specifications is not something they do.

Test and balance reports are required on almost every retail store construction project. Sometimes they are accurate and sometimes they are fabricated. This has a lot to do with the individual test and balance contractor and who is paying for his work. There is a much better chance that this report will be accurate if the retailer is paying the test and balance contractor directly. The main purpose of the test and balance report is to determine the quantities of air being delivered to each outlet and adjust the systems so that these readings are within ten percent of the values specified on the mechanical plans. The test and balance contractor may note that the outdoor air damper accessory is missing, but he certainly won't check the condensate piping or look for a low ambient control.

HVAC manufacturers have instituted programs for retailers where they authorize a technician to visit a site at the owners request and supervise the commissioning or start-up of the units. The technician is issued a specific checklist of unit functions and settings to make as well as current, voltage, temperature and pressure readings to take. While this represents part of a post construction inspection, it's certainly not going to tell the retailer that the installer neglected to pin the acoustic liner in the ductwork.

What should be included?

The following list is the minimum information that should be include in a post construction inspection report:

- Site information such as store #, address, ambient temperature, Date of inspection.
- Who performed the inspection? (Company and technician)
- Type of controls including manufacturer, model number. Location of thermostats and sensors should match the locations on the design drawings.
- Is shielded cable required ? Was it installed.
- Confirm that thermostats are marked with unit number and area served.
- Confirm that correct thermostat and sensor corresponds to each unit.
- Programming of controls. I.e. setpoints, setbacks, setups, and times.
- Prove exhaust fan operation at each grille and confirm timers for exhaust fans are programmed correctly.
- Check air outlet and return quantities and location against the design drawings.
- Check each outlet with an infrared thermometer to confirm the outlet is connected.
- Confirm that ductwork is lined and insulated as specified on the mechanical plans.
- Check overall quality of duct fabrication and connections.
- Confirm that duct layout is the same as the layout on the design drawings.
- If store is occupied or being stocked, note any issues observed by management.
- Equipment information, such as make, model, serial #, belt size, filter sizes, voltage.
- Nameplate amperage and measured amperage for each motor and compressor.
- Verification of operation in heating, cooling, economizer, and fan modes.
- Verification that all accessories such as power exhaust, economizer, low ambient control, smoke detectors, disconnect switches, convenience receptacles are installed and operational.
- Verify unit is numbered and number on roof matches number on drawings.
- Note any physical damage to unit.
- Check installation of gas piping including service type and protection of piping.
- Check condensate piping to make certain it meets manufacturer's and engineer's requirements with respect to P traps and disposal of condensate.
- Check unit for proper positioning on roof curb, level, and proper seal.
- Check to make certain that vibration isolation and seismic restraint requirements have been met.
- Check cleanliness of air filter and coils. If units were run during construction, has construction dust been removed?
- Check alignment of sheaves and check drive belt tension.
- Check return, mixed air, and discharge air temperatures.
- Check suction line and liquid line temperatures.
- If necessary, check refrigerant pressures.
- Verify proper air to fuel ration on gas fired heating units.
- Confirm that the correct primary tap on the control transformer has been connected.

- Check for debris on roof around unit, including extra screws.

\There will be other checklist items that are required for different types of systems, but the list above should be sufficient for the majority of the units used on retail stores. When they are performed properly, post construction inspections will identify ninety five percent of the HVAC defects in newly constructed stores, assuming, that the consulting engineer has done his job well. We must remember that much of the post construction inspection relies on comparing what has been built to what has been designed. If the design is poor, the resulting defect is not the responsibility of the installing contractor. Most important is the fact that any issues identified can be dealt with during the warranty period, while the retailer has recourse to the general contractor, HVAC subcontractor, engineer, manufacturer, or landlord.