Demystifying HVAC

HVAC Issues in New Stores

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Have you ever wondered why there seem to be so many HVAC issues in new stores? After all, the equipment is brand new, so there can't be any maintenance-based issues. A certified test and balance contractor has just issued a report stating that the systems are delivering the exact quantity of heating, ventilation, and air conditioning specified by the Mechanical Engineer on the design drawings. It stands to reason that new stores should be the least of your HVAC worries.

Yet, we seem to have more HVAC issues per store within the first year warranty period than we have during any other year of a store's lease. Unfortunately, it's been our experience that service contractors, troubleshooting issues which have plagued a store for years, find that the problems are due to defects in the initial mechanical design and construction. Sometimes, these defects are responsible for premature component failure.

Let's examine some of the most common new store issues and their causes.

Issue #1: There was a water leak from the ceiling, under the air conditioning unit, whenever it rained. The roofer was out to examine the situation on several occasions, and has determined that the roof is not leaking. The mechanical contractor who installed the system visited the store three times. He caulked all of the access panels on the rooftop unit and has stated that he could not find the source of the water leak. He said that it must be a roof leak.

Cause: The electrical contractor who ran the power wiring to the rooftop units found it difficult to route the cable through the knockouts provided by the manufacturer for this purpose. He decided to drill a hole through the base pan of the outdoor section of the unit in lieu of using the knockout in the indoor section.

As a matter of fact, by routing the cable through the base pan, it was far easier for him to land the conductors on the terminal block in the outdoor section. This electrician may have even caulked the cable entry with some silicon caulking. The electrician made his job easier and created the leak. This leak may even be intermittent in nature as portions of the outdoor section of the unit are protected from direct entry of rain. However, depending on the direction the rain is coming from, and with vibration over time, sooner or later these field made penetrations leak.

Electrical power and control wiring connections as well as gas piping to rooftop equipment should only be made through openings provided by the equipment manufacturer for this purpose.

Issue #2: There were many service calls placed for a particular unit which stoppped cooling leaving a blank display on the thermostat. Each time a call was placed, the installing contractor responded and reset the unit, or replaced a blown control fuse. This problem occurred six times during the one-year warranty period. Each time the contractor reset the unit and left. Now the warranty period is gone and so is the installing contractor.

Cause: Typically, we find the cause of this malfunction to be insufficient control voltage at the unit. Rooftop air conditioners use 24 volts of AC power to operate the controls within the unit. If this voltage drops below 20 volts, the problem described above can result as well as many other problems. The 24 volts AC is developed by a transformer which steps down the incoming power of 230 volts or 460 volts. This 24-volt control power will therefore vary lightly with the incoming power furnished by the utility company.

A 5% drop in line voltage from the utility will cause a 5% drop in the 24-volt control voltage. If no other significant voltage drops exist, a typical air conditioner can operate with line voltage fluctuations of up to 10%. Additional voltage drop can be caused by a number of installation based problems.

If the installing contractor runs thermostat wiring of lighter gage than that recommended by the equipment manufacturer, or the length of run is too large voltage drops occur. If he selects wrong primary voltage tap on the control transformer, or if the run to the smoke detector is too long or of too light a gage, the result, is the same.

Issue #3: On three separate occasions during the first year warranty period, the store manager has called complaining that one of the rooftop units has stopped blowing air. Each time, the installing mechanical contractor has responded to the call and replaced the blower drive belt. At this rate, the store is going to require at least three service calls each year just to replace drive belts.

Cause: If the motor sheave and the blower sheave are not properly aligned, premature drive belt failure will result. If the belt tension is not adjusted properly, or the drive speed is adjusted higher than the equipment manufacturer's maximum recommended speed, the result will be the same. The lack of one minor adjustment can cause many repairs and much downtime over the life of an air conditioning system.

Issue #4: The manager of a big box retail store requested HVAC service six times during the first year warranty period. Her complaint was that the only way that she could get the store cool was to close the door of her office. When the office door was closed the store was actually cold. When the door was left open, the store was hot. After responding to each of the six calls, the installing contractor told the GC that the problem was the manager, not the equipment.

Cause: This chain typically used digital programmable thermostats with remote space temperature sensors. These thermostats are mounted together on the wall of the manager's office. They can be configured to use internal temperature sensors or remote sensors by throwing a switch on the back of the thermostat. The installing contractor never configured the thermostats for use with remote sensors. All eight thermostats were responding to the temperature in the manager's office. When the door was closed the computers and photocopy machine caused the office to warm up,and the thermostats brought on cooling in the store. When the door was left open, the office cooled off and the thermostats shut down the cooling.

Issue #5: The front doors on a 50, 000 square foot store always hung open. When outdoor temperatures were moderate, the doors stayed almost fully open. The Storefront contractor responded several times during the warranty period. He made adjustments, and finally, obviously frustrated, he said that he couldn't set the doors below the maximum ADA required opening pressure and still have them swing fully closed.

Cause: The culprit, once again was the HVAC system. The Mechanical Engineer on this project specified that the eight, 40-ton rooftop units at this store be equipped with power exhaust accessories. As ventilation air is brought into a store, some means of exhausting an equal quantity of air must be provided. If the exhaust path is restricted in any fashion it may be easier for exhaust air to leave the store by pushing the doors open than to leave via the mechanical equipment.

During mild weather, this situation is exacerbated as outdoor air economizers are being utilized to provide cooling. The installing contractor "Value Engineered" the power exhaust accessories out of this job and substituted barometric relief dampers. During normal equipment operation, approximately 13 000 cubic feet of air was required to be exhausted each minute for ventilation purposes. With all economizers operating, this number grew to 130 000 cubic feet per minute. With no exhaust fans to help discharge the air from the store, the easiest path was out through the front doors.

As the power exhaust accessories were not available as an after-market product, exhaust assemblies had to be built from replacement parts. This "least expensive" resolution of the issue ended up costing the retailer $160 000.00 to implement.

Issue #6: A manager of a new store complained several times during the first year that she could not adjust the temperature on one of the thermostats, and that the unit controlled by that thermostat did not operate properly. The problem seems to occur on an intermittent basis. The installing contractor responded on several occasions and then refused to give further response. He stated that the problem is due to the manager's inability to program the thermostat.

Cause: Manufacturers of certain HVAC controls have found that in certain situations, shielded cable must be run between the controls, or thermostats and the remote space temperature sensors. Unshielded cable can allow the wiring to act as an antenna that

picks up unwanted signals. If these signals are strong enough, the temperature control reads them, locks itself in its' current mode, or responds in one of several undesirable ways. Using wiring that contains a foil jacket around the conductors prevents the wiring from picking up stray signals that can be produced by something as simple as fluorescent fixture ballast, or a large transformer.

Issue #7: A manager of a new store found that the children's department was always warmer than the balance of the store during the cooling season, and cooler than the balance of the store in winter. The installing contractor dispatched a technician who told the manager that the problem is due to a design defect because the equipment was working properly and the "Test & Balance Report" showed proper air delivery.

Cause: A short time after the first year warranty period expired, a service contractor attempted to trouble shoot the problem and found that a section of trunk duct feeding six ceiling diffusers had never been tied into the main supply duct. There was a transition piece missing, and the air was blowing free into the ceiling plenum. The transition piece must have been fabricated incorrectly, and the ceiling was installed before a correctly sized transition found its way to the Jobsite. In a similar situation, it was found that new 7.5-ton rooftop units were never completely installed. One unit was never connected to power, and another unit was never connected to its supply trunk. On one project, the installing contractor assembled the roof curb in such a fashion that air was being forced into the space between the corrugated deck and the roof insulation instead of being delivered into the supply duct. In another situation with the same complaint, it was found that the equipment was set on the curbs incorrectly. Approximately half of the return opening in the bottom of each unit was outside the perimeter of the roof curb. These units were effectively attempting to heat and cool 100% outdoor air.

Issue #8: Multiple tenants in a new mall had numerous air conditioning failures due to refrigerant leaks. The installing contractor has responded to each call, supposedly repaired the leak, and recharged the unit in question.

Cause: The refrigerant piping to the split systems at this mall were installed using soft solder (95 / 5) rather than 15% silver brazing rods. The soft soldered joints will continue to be an ongoing source of downtime and expense. The fact that the refrigerant piping runs through other tenant's premises will only increase the cost and complication of dealing with this issue. Unfortunately, the Landlord was responsible for furnishing and installing the equipment and the tenants are responsible for maintaining it.

Issue #9: There were consistent complaints for more than a year of some areas of a big box retail store being too hot and other areas being too cold. This situation did not vary with the change of seasons.

Cause: After a thorough inspection, and some troubleshooting, we discovered that RTU (A) was responding to the thermostat located in area (B). Likewise, RTU (B) was responding to the thermostat in area (A). One unit was continuously cooling and the

other unit was continuously heating. Aside from the discomfort suffered, the energy costs were enormous.

Issue #10: Over a two-year period, a 30 000 square foot store in southern Florida, experienced serious condensation problems. Between June and September, there was continuous dripping from the ductwork in many areas of the store. The outside surface of all of the acoustically lined ductwork was sweating, as were the base pans of the rooftop units. The General Contractor was replacing ceiling tiles 70 at a time. The mechanical subcontractor, who was located in another state claimed that the internal liner he substituted for the external duct insulation had the same R value and that he bore no responsibility because he complied with the mechanical specifications.

Cause: During a site visit, it was found that the dewpoint within the attic space of the store was 74°F and condensation was visible on most of the ductwork. This dewpoint was the same as the outdoor dewpoint. Normally, one would expect that the dewpoint in the attic space would reach an equilibrium point somewhere between the dewpoint inside the conditioned space and the dewpoint outdoors.

It was found that the Mechanical Engineer had specified a large roof mounted exhaust fan. This fan drew air directly from the store. The purpose of the fan was to discharge a quantity of air equal to the quantity of outdoor air which was being brought in by the rooftop units to satisfy ventilation requirements. When the store opened, there were some initial complaints of insufficient cooling capacity. To help lower the cooling load, the installing contractor closed all of the outdoor air dampers on the rooftop units fully. Therefore, the exhaust fan created negative pressure within the space. The building was not a very tight structure, and therefore the negative pressure caused infiltration of outdoor air into the attic space. When the exhaust fan was shut off, the ductwork and the base pans stopped dripping within two hours.

Issue #11: A 50, 000 square foot retail store experienced 12 compressor failures during a one-year period. There was no fault of the part of the electrical utility serving the store.

Cause: There were manufacturing defects in both the compressors and the compressor contactors in these units. It is believed that the combination of these two issues caused the high number of compressor failures. The equipment manufacturer paid for all repairs and is still confirming the cause.

The examples above are just a sample of the new store issues we've seen. Why do they occur? Are all HVAC installers incompetent?

The issues arise because like everyone, installers, engineers, manufacturers, and service technicians make mistakes. If the installing contractor has a good start-up team, a thorough test and balance contractor, and a good service department, most issues are discovered early and repaired, or prevented entirely. Unfortunately, the trends today are

such that the installing contractors are typically sheet metal contractors with little knowledge of the inner workings of the equipment. In addition, today, the trend is for someone other than the installing contractor to purchases the HVAC equipment. We have seen many situations where accessories such as economizers, barometric relief dampers, and power exhaust assemblies are not installed, are installed incorrectly, or are left laying on the roof in their original cartons. Contractually, the installer is responsible for start-up of the equipment and first year warranty service, but psychologically he has no responsibility for this equipment's proper operation because he didn't furnish it and he didn't make a profit on it.

The installing HVAC contractors normally hire "independent" test & balance contractors (T&B) as part of their work scope. There are many fine certified T&B contractors in the industry. However, the bottom line is that the contractor who delivers a clean report stands a better chance of being hired on future projects than the T&B contractor who delivers a report that causes the installer to perform additional work.

Another situation that increases the frequency of new store HVAC issues is the fact that HVAC units are sold by the manufacturer with a one-year parts-only warranty. Labor for installation of accessories, start-up and first year warranty service is a line item on the installing contractors cost sheet. Unfortunately for the tenant, if the contractor expends less than the amount estimated for this work, the savings is considered buy-out and becomes profit after the warranty period has expired. Another issue is the fact many HVAC systems are being installed for the Landlord or the developer, rather than directly for the tenant. The installing contractor does not feel any loyalty towards the tenant, nor does he foresee any future business coming from the tenant, so solving tenant issues is not a priority.

Manufacturers have been under a great deal of pressure to lower equipment cost and raise operating efficiencies. Some cost saving changes have resulted in eliminating controls and devices that protect the other components within the system. In addition, there have been major manufacturing defects announced in the past few years which required re-working equipment according to factory bulletins. These defects have included multiple compressor failures, control board and contactor failures, blower bearing support failures, etc.

So, now that I've thoroughly depressed you, how do we prevent your new stores from becoming an even larger HVAC headache than your existing stores?

- Perform a thorough HVAC post construction inspection on every new store using a checklist to insure that the same standards are being used for all new stores. These inspections should be performed by an engineer or a contractor you know has the ability and experience to troubleshoot complex problems.

- If you have a good HVAC service company handling your stores, and you have the latitude, it's a wise idea to have your service contractor handle first year maintenance and first year equipment labor warranty as well. It's amazing, how much substandard work can be hidden for a one-year period.

- If you are working under a national account agreement, request that the manufacturer you're working with copy you on all factory service bulletins.

- Never assume that the person reporting a problem is imagining the issue. We've found that in almost every case, if an issue is reported, the issue exists. The problem is in the technician's ability to identify the issue and cause.

- If you must use the installing contractor for first year warrantee service, put teeth in your mechanical specifications, or your lease exhibit which require service to be available round the clock, with a reasonable response time. We've seen contractors in Ohio performing warranty service in Wisconsin with their own technicians. The store waited three weeks for service call response. We also attempt to get some verbiage in the documents regarding the contractor's ongoing responsibility for work that is performed within the warranty period and then fails again within 90days of the expiration of the warranty period.

- Require copies of the original equipment invoices between the purchaser of the equipment and the manufacturer. This allows you to track what accessories and options were ordered with the equipment including extended compressor and heat exchanger warrantees. This also gives you a way to prove date of purchase if warranty exchange of replacement parts is required. It also allows you to determine if the specified models are being furnished.

- Take test and balance work out of the scope of work provided by the installing contractor. Hire the test and balance contractor directly. Wouldn't you prefer to be the master that the T&B contractor answers to? Also, review all test and balance reports making certain that DX equipment is moving between 350 and 450 CFM per ton. Insufficient airflow leads to cracked heat exchangers and broken compressor valves.

- Train your construction project managers as to what physical defects they should look for when making site visits during construction. It's a lot easier to have the electrician re-route his conduit supplying power to a unit while he's still on the job. The work will be easier for him to correct, and you have more leverage than after the work is complete.

- Specify that shielded cable be run to all remote temperature sensors. The cost increase for shielded cable over non-shielded is negligible.

- Provide store manager with a consumer type instruction book for the temperature controls and a diagram of the area served by each unit. It's far easier for a manager to describe a problem when they have some knowledge of the system.