FLUKE®

When infrared surveys pay off
for HVAC and Facilities Applications

Application Note

Testing Functions
Case Study

Measuring tools: Fluke 561 IR Thermometer, 80PK-8 Pipe Clamp Probe, 87V DMM

Operator: Bill Dove, CM, HVAC trainer and installation specialist

Inspections: Ambient air, diffuser, window, and wall-surface temperature; blower component temperatures; subcooling; electrical inspection

There's a gentle breeze and the temperature's hit 80 °F for the first time this year. I think, "How am I gonna make it through another summer doing this?" I wonder the same thing every year.

I'm on my way to visit Musky Lake Lumber, a home-grown third generation building supply who's called in with cooling problems in their display area. I drive through run-off from leftover mounds of snow and pass overturned boats on the lakeshore, waiting for the lake ice to melt.

Customer profile

Musky Lake Lumber's new facilities are steel construction, just completed, and commissioned this past fall. The drive-through lumber warehouses are heated by a combination of unit heaters with air rotation and radiant heat above the entrances. The building that houses the offices, showrooms, and hardware has a "home-style" front with siding and double hung windows. Two 20-ton gas-electrics sitting on the ground at the side of the building handle the summer and winter air conditioning. One is a CAV (constant air volume) single zone packaged unit, the other is a VAV (variable air volume) packaged unit that is zoned for the office areas, sales area, and the display area where the complaint has originated.

I've worked with this design engineer on other projects. He doesn't skimp and specs good, respected equipment. All Musky Lake's jobs call for independent NEBB (National Environmental Balancing Bureau) certified technicians for the final Test-Adjust-Balance procedures. I did the equipment start-ups, commissioned the DDC (direct digital controls) controls, and was "on hand" while the TAB (test-adjust-balance) technicians did their thing, so I know I'm headed toward a jobsite I can respect.

Tools

I also learned early in my career that having the best tools and test equipment makes my job easier, quicker, provides accurate diagnostic capabilities and enhances my reputation which, in turn, enhances my paycheck. I've also learned that my paycheck can't afford all of the latest test equipment that I would like to have, so I make my choices carefully.

Tools and test equipment must be right for the job, accurate, reliable, durable and, when possible, set me apart from the pack by giving me a competitive edge. I've seen electronics blossom into an incredible array of choices and capabilities unimagined when I started in this trade. And now, I see young mechanics using digital equipment when analog is still the best. Why buy a digital manometer when the water or gauge oil in a U-tube or inclined manometer is always accurate and never needs calibrating?

I prefer to spend my money on electronics that can't be duplicated in the analog world. Quality *and* accurate true-rms meters are not a luxury in today's world; they are a necessity. Power quality meters will get you to the root of problems and pay for themselves. Event recorders can reveal mysteries that drive sane men mad. Multi-point digital temperature meters with a variety of thermocouple probes are essential in HVACR work.

Enter infrared devices—IR thermometers and imagers —to fill an analog void and now we save time and money for contractor and customer alike, as well as being able to perform diagnostics that were previously impossible without shutting down the system.

Scenario

And here we are. As I step out of my truck, I marvel at how hot and bright it can be with so much evidence of winter still lingering. I enter the outer doors and see the antique sleigh displayed with a sign that says, "Do not touch". I notice all the fingerprints, continue across the entry vestibule, open the door, and head to the display area where I'm greeted by Wanda who says, "It's hot over here".

Wanda's sitting at her desk. She runs parts and supplies in the morning, then works at her desk in the afternoons. Her desk is under a window. I tell her, "All-righty then. I'll get you fixed up."

Indoor survey

I have my Fluke 561 combination IR Contact Thermometer with me since I value its capacity for quick initial assessments when I first get to a job. I plug the thermocouple probe into the Fluke 561 for a room temperature reading while I scan the diffusers for IR temperatures. I can tell by the 55 °F temperature on the diffusers that the system is calling for cooling.

I think the display area would be better served if it were not all on the same zone. One part of the display area is about 30 ft x 50 ft with high ceilings. Two rows of exposed spiral duct suspended about 18 ft off the floor each have 5 pairs of short branches that feed round diffusers.

The 55 °F IR temperature reading on each of the suspended diffusers tells me we are calling for cooling. The 72 °F thermocouple temperature reading tells me everyone is still in winter mentality here. The zone sensors are still at the minimum setting—that's pretty low.

I focus my attention on the other part of the display area zone. This area is where Wanda's and Joe's desks are. Joe doesn't talk much, so I don't know if he's been hot too. Although this display area office is open to the display area, it has an 8 ft dropped ceiling with two diffusers and is about 15 ft by 20 ft with the long side and one short side on outside walls. I train my Fluke 561 on each of the diffusers. They also are both at 55 °F.

Measuring diffuser temperature.

Since the diffusers are in a dropped ceiling, I continue to use my IR thermometer to scan the ceiling surface area outward from the diffusers. The ceiling tiles are 55 °F at the diffusers, increasing to only 58 °F seven feet away. The windows in front of Wanda's and Joe's desks are facing in a southwest direction and the sun is shining on the desk surfaces. I know that the windows have "high-E" glass, and I am surprised when I aim my IR thermometer at the desk surfaces that they are emitting 90 °F of radiated heat. My IR thermometer shows that the southwestern wall surface temperature is 76 °F.

First solution

Well, I think I see what's going on here and I haven't even needed to get out the big guns. In the office area of the display area, the ceiling diffusers are exhibiting a prime example of surface effect. The air is clinging to the ceiling, reducing throw and drop velocity. I can change the diffusers to adjustable vane "throw" diffusers. This will get the air away from the ceiling where it can mix and throw to the outside walls. Wanda should be happy with the results. We may never know how Joe feels about it, though.

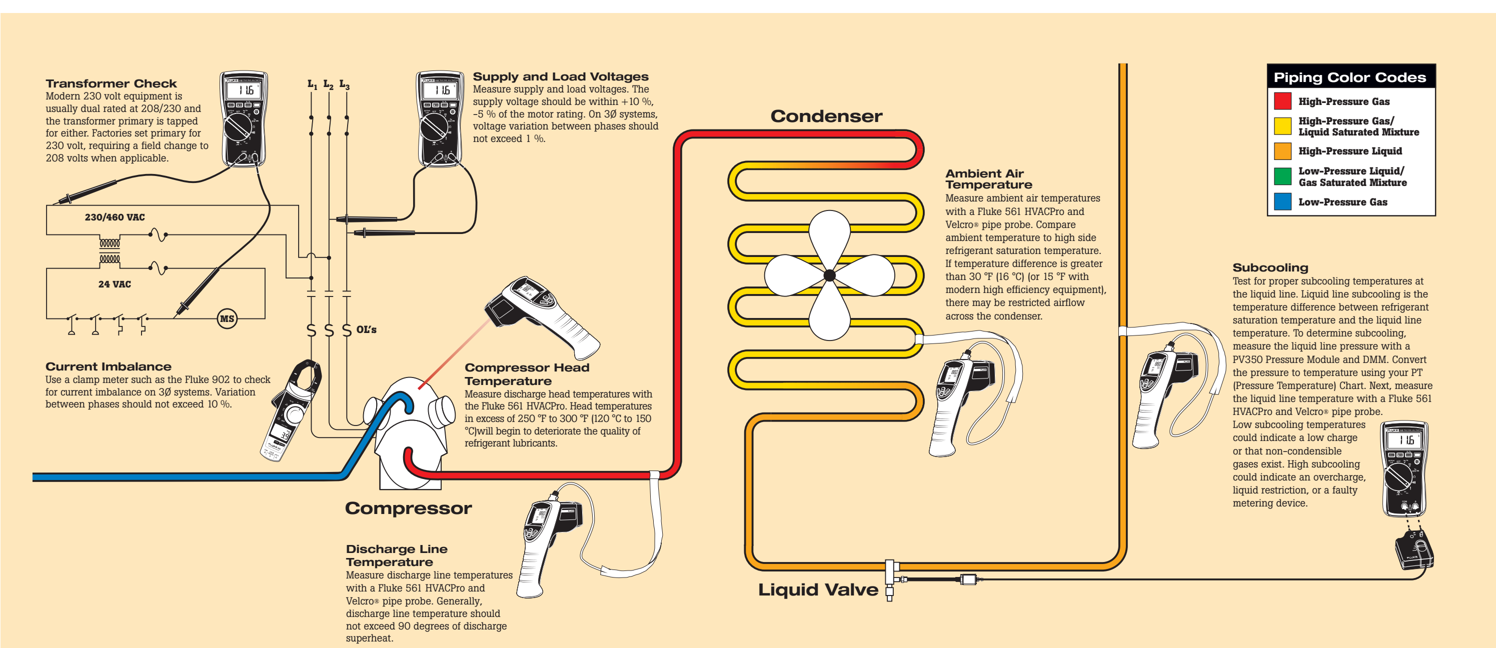
Systems check

As long as I'm here, I decide to give the systems a quick once-over. I drive my truck to the other side of the building and park next to the packaged equipment. I look at the filters, find them recently changed, and proceed to open the blower access door and train my Fluke 561 IR thermometer on the sheaves and belts. I read good even temperatures, with no elevated temperatures on the circumference of the sheaves to indicate slipping belts. Next, I train the IR thermometer on the row split evaporator U-bends and see, at 40 °F, two of the four compressors are operating.

I close the blower access door and walk around to the control panel access door. These units have four stages of heat provided by two burner sections each with high and low fire, four stages of cooling provided by four independent compressor circuits, all controlled by a discharge air sensor. The zoned system has a VFD (variable frequency drive) drive controlled by a static pressure sensor in the supply and has row split evaporators. The single zone CAV unit has face split evaporators and hot gas condenser reheat coils for humidity control.

I fire up my computer and connect to the network. I see zone temperatures are all close to setpoint. Discharge duct static is at 0.4 °F WC (water column) and control output to the VFD is 5 V dc calling for an RPM that is 50 % between minimum and maximum. Discharge air temperature is at 50 °F which tells me if a call for cooling continues, one of the compressors should be dropping out soon.

I set the software to enter "air balance" mode. This will open all zone dampers and energize the blower. Then I command all cooling stages on. The equipment manufacturer has provided an alternate means of checking subcooling by comparing liquid line temperature to outdoor ambient air temperature.



Measuring compressor line temperature with the Velcro K-type thermocouple for the Fluke 561 IR Thermometer.

I attach the Fluke 561 Velcro thermocouple to the circuit 1 liquid line and compare the IR temperature to the contact temperature. By setting the emissivity to "Low", my IR temperature matches the contact temperature. This will make for quick verification of proper charge. The difference between liquid line and ambient temperatures should be 9 °F for circuit 1, 12 °F for circuit 2, 11 °F for circuit 3, and 10 °F for circuit 4, all +/- 1 °F.

I let the thermocouple probe hang in the air so I can read the air temperature as I measure liquid line temperature. I hold my Fluke 561 IR thermometer 6 inches from the liquid lines, each in turn, and measure liquid line temperatures that are all within specs. It's good, with no refrigerant loss over the winter, a good tight system as expected.

I break out one of my Fluke 80PK-8 pipe clamp probes, connect it to my Fluke 561 and read the suction line temperatures of each circuit. They are all between 60 °F and 65 °F, no need to break out the gauges with readings like these. I'm starting to think jobs just don't get any better than this. I do an IR temperature scan of the compressors from the sumps to the top where the scroll heads discharge hot gas into the discharge line. Nothing out of the ordinary here, either.

Electrical

Now I turn my attention to the electrical side. With my Fluke 561, I start an IR temperature scan of contactors and relays. I scan the relay casings for consistent temperatures. I scan each pole of the blower contactor and each of the four compressor contactors. What's this? Pole 2 on compressor 3 contactor has an elevated temperature. It's about 30 °F warmer than the other poles.

With my Fluke 87V DMM, I measure relatively equal voltage (close to 475 volts) across L1-L2, L1-L3, L2-L3. I snap my clamp meter around each pole in turn and they are all very close to 7.5 amps. I open the disconnect for a closer "hands-on" look at the contactor connections.

Second solution

It seems part of the wire insulation has been captured underneath the lug on the T2 pole, creating a poor connection on the bare conductor. I back the wire out of the lug a little so only bare wire is captured. How did I miss this on the startup? I restart the unit, wait and take pole temperatures again. Temperatures are consistent between poles and a future service call has been prevented.

As I close up the unit, I'm feeling pretty good about what I've accomplished here today. Now I'm off to pick up a couple throw diffusers so I can make Wanda feel good too.

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