



THINKING ABOUT AI IN HVAC & HOME PERFORMANCE:

WHERE COULD THIS TAKE OUR
INDUSTRY?

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March 29, 2023

Energy Circle on the Road

ACCA CONFERENCE

—April 2-5, New Orleans

BETTER BUILDINGS BY DESIGN

—April 5-6, Burlington, VT

NATIONAL HOME PERFORMANCE CONFERENCE

—April 17-20, Seattle



What We'll Discuss

- 1 THE AI & CHATBOT LANDSCAPE TODAY—BIG 3
 - Open AI's chatGPT
 - Microsoft's Bing
 - Google's Bard
- 2 POTENTIAL USES, APPLICATIONS AND INDUSTRY IMPACT
- 3 THE VIRTUAL ASSISTANT CONCEPT: CAN IT HELP SOLVE CHALLENGING BUILDING SCIENCE ISSUES IN THE FIELD?



WELCOME
DAN PERUNKO
BALANCE POINT
HOME
PERFORMANCE,
GRASS VALLEY, CA





DALL-E: "a version of the mind blown emoji in the style of Vincent Van Gogh"



THE CHATBOT LANDSCAPE





November 30, 2022 (GPT3)
March 4, 2023 (GPT4)



February 7, 2023



March 21, 2023

Many More to Come



Hallucinations: What the AI world calls it when a chatbot is flat out wrong.



DALL-E: "an illustration of a hallucination in the shape of a human head"



IMAGINING POTENTIAL USES, APPLICATIONS AND INDUSTRY IMPACT





In list form, what are some of the ways that AI may improve the business operations of HVAC and home performance contractors



AI has the potential to enhance the business operations of HVAC and home performance contractors in various ways, including:



1. **Scheduling and dispatch optimization:** AI can analyze factors like job durations, technician skills, and travel times to optimize scheduling and dispatching, improving overall operational efficiency and customer satisfaction.
2. **Inventory management:** AI can help predict inventory needs based on historical usage, seasonal trends, and other factors, ensuring that contractors have the necessary parts and equipment on hand to minimize delays and reduce excess inventory.
3. **Customer relationship management (CRM):** AI can analyze customer data to identify patterns, preferences, and potential opportunities for upselling, enabling contractors to tailor their services and marketing efforts to better meet customer needs.
4. **Predictive maintenance:** By analyzing system performance data, AI can identify equipment that may be at risk of failure, allowing contractors to proactively schedule maintenance and avoid unexpected breakdowns.
5. **Remote diagnostics and troubleshooting:** AI-powered tools can help technicians remotely diagnose and troubleshoot issues with HVAC systems, potentially reducing the need for on-site visits and saving time and resources.

6. **Training and skills development:** AI can identify skill gaps in technicians and recommend targeted training, helping contractors maintain a highly skilled and knowledgeable workforce.
7. **Energy efficiency analysis:** AI can analyze building performance data to identify opportunities for energy efficiency improvements, enabling contractors to provide tailored solutions to customers.
8. **Marketing and lead generation:** AI can help contractors identify potential customers and target their marketing efforts more effectively, increasing lead generation and conversion rates.
9. **Financial analysis and forecasting:** AI can analyze financial data to identify trends, potential risks, and opportunities for growth, helping contractors make more informed business decisions.
10. **Automated customer service:** AI-powered chatbots and virtual assistants can provide quick and efficient customer service, answering common questions and freeing up staff to focus on more complex issues.

By leveraging AI technology in these areas, HVAC and home performance contractors can improve their business operations, leading to increased efficiency, better customer service, and ultimately, stronger financial performance.



THE VIRTUAL ASSISTANT
CONCEPT: CAN IT SOLVE
CHALLENGING BUILDING
SCIENCE ISSUES IN THE FIELD?





DALL-E: "an illustration of an HVAC technician in a basement using an AI virtual assistant chatbot"





What is the potential for an AI virtual assistant to help HVAC technicians solve difficult problems while diagnosing a heating and cooling system



The potential for an AI virtual assistant to help HVAC technicians solve difficult problems while diagnosing heating and cooling systems is promising. As AI technology continues to improve, it can offer a wide range of benefits to assist technicians in the field. Here are some ways an AI virtual assistant can help:



1. **Access to a vast knowledge base:** AI virtual assistants can be trained on a large amount of data, including HVAC system specifications, troubleshooting guides, and best practices. This can enable them to quickly provide relevant information to technicians based on the specific problem or system they are working on.
2. **Real-time guidance:** Technicians can interact with AI virtual assistants using natural language, either through text or voice, allowing them to ask questions and receive step-by-step guidance in real-time as they diagnose and repair the system.
3. **Pattern recognition and fault detection:** AI virtual assistants can analyze data from HVAC systems, such as sensor readings and historical performance data, to identify patterns and detect potential issues. This can help technicians pinpoint the root cause of a problem more efficiently.

4. **Predictive maintenance:** AI virtual assistants can utilize machine learning algorithms to predict when components are likely to fail, allowing technicians to proactively address potential issues before they cause system failures or other problems.
5. **Remote support and collaboration:** AI virtual assistants can facilitate communication and collaboration between technicians in the field and remote support teams, enabling them to share information and work together more effectively to solve difficult problems.
6. **Continuous learning:** AI virtual assistants can learn from each interaction with technicians, allowing them to continually improve their knowledge and problem-solving abilities over time.

While AI virtual assistants have significant potential to help HVAC technicians diagnose and solve complex problems, it is important to recognize that they are not a replacement for experienced technicians. AI virtual assistants should be viewed as a complementary tool that can enhance the capabilities of technicians, helping them to work more efficiently and effectively.



A FEW TESTS





After a series of sequential blower door tests, in which additional air sealing was done to tighten the building at each stage, CFM50 in test #4 increased. What might explain why a building would test from 375 CFM50 to 450 CFM50 after air sealing measures were implemented?



It's unusual for a building to test from 375 CFM50 to 450 CFM50 after air sealing measures have been implemented, as the goal of air sealing is to reduce the air infiltration rate. There could be several reasons for this unexpected increase:

1. **Testing error:** There's a possibility of a testing error, such as incorrect setup, calibration issues, or inconsistencies in performing the test. Double-check the blower door test equipment, settings, and procedures to ensure accurate and consistent results.
2. **Unintentional openings:** During the air sealing process, new unintentional openings may have been created, or existing openings could have inadvertently been made larger. Re-examine the sealing work and look for any areas that may have been overlooked or damaged during the process.
3. **Changes in building conditions:** Changes in the building's conditions, such as humidity, temperature, or wind, can affect the blower door test results. Ensure the test is performed under similar conditions each time to minimize these variables.

4. **Other building components affected:** During the air sealing process, other building components or systems may have been inadvertently altered or damaged, causing an increase in air infiltration. Inspect the building for any changes or damages that could be contributing to the increased CFM50.
5. **Stack effect:** The stack effect, caused by differences in temperature and pressure between the interior and exterior of the building, can influence blower door test results. If the tests were conducted under significantly different weather conditions or at different times of the day, the stack effect could impact the results.

To address the unexpected increase in CFM50, carefully review the air sealing work, re-examine the testing procedures, and consider the influence of external factors. If necessary, consult a building performance professional to help identify the cause of the increased air infiltration and recommend corrective actions.





based on the following data, what might be wrong with this HVAC system? Suction Line Temp of 67.9F, Superheat of 26.9F, subcooling of 1.2F, return wet bulb of 56.7F, supply temp of 59.2F, estimated airflow of 1744 scfm, TESP of 1.26 in H2O



Based on the provided data, there are a few potential issues with the HVAC system:



1. High Superheat (26.9F): The superheat value seems to be on the higher side, which could indicate a potential issue with the system. High superheat can be caused by a low refrigerant charge, a restricted metering device, or poor airflow across the evaporator coil.
2. Low Subcooling (1.2F): The low subcooling value could indicate that the system is undercharged with refrigerant, which can lead to poor cooling performance and inefficiency. A proper subcooling value should be around 10-15F, depending on the system requirements.
3. Low Supply Temperature (59.2F): The supply air temperature is quite low, which could indicate that the system is not effectively removing heat from the space. This could be due to an undersized system, a refrigerant leak, or a problem with the air handler.
4. High Total External Static Pressure (TESP) (1.26 in H2O): A high TESP value can indicate restricted airflow within the system, possibly due to dirty filters, blocked return or supply ducts, or undersized ductwork. High TESP values can lead to reduced system efficiency and poor overall performance.

To diagnose and resolve these issues, it is recommended that you consult with an HVAC professional who can assess the system and make any necessary repairs or adjustments.





given those performance issues, what would the priority be for correcting the problems?



When addressing the performance issues of the HVAC system, it's important to prioritize the problems based on their potential impact on system efficiency, performance, and lifespan. Here's a suggested order of priority:

1. **Refrigerant charge:** First, address the low subcooling and high superheat, which may be indicative of low refrigerant levels. A professional technician should check for refrigerant leaks and repair them if necessary, then recharge the system with the appropriate amount of refrigerant. This will improve system efficiency, cooling capacity, and overall performance.
2. **Airflow issues:** High Total External Static Pressure (TESP) suggests restricted airflow within the system. Check and replace dirty air filters, inspect and clean the evaporator and condenser coils, and ensure that supply and return ducts are not blocked or undersized. Resolving these issues will help maintain proper airflow, enhancing system performance and energy efficiency.

3. **System sizing:** If the supply temperature is consistently low, it may be worth evaluating whether the HVAC system is appropriately sized for the home. An oversized system may lead to short cycling, which can cause uneven temperature distribution and increased energy consumption. In this case, it's essential to consult an HVAC professional to determine if the system is indeed oversized and if a replacement is necessary.
4. **Thermostat calibration:** Ensure that the thermostat is accurately calibrated to provide proper temperature readings and control the HVAC system effectively. If the thermostat is found to be faulty or inaccurate, consider replacing it with a programmable or smart thermostat for better temperature control and energy savings.
5. **Insulation and building envelope:** Although not directly related to the HVAC system, it's essential to ensure that the home's insulation and building envelope are in good condition. Proper insulation and sealing help maintain comfortable indoor temperatures, reduce the workload on the HVAC system, and improve energy efficiency.

Always consult an HVAC professional when diagnosing and addressing issues with your system to ensure it's done safely and effectively.





Wait a second. The mantra of most experts, like Bryan Orr, is ABC--airflow before charge. And, shouldn't the building envelope be a much higher priority?



You're right. The priority list should be adjusted to follow the best practices recommended by experts in the field. Here is a revised list, taking into consideration the ABC mantra (Airflow Before Charge) and prioritizing the building envelope:



1. **Airflow issues:** High Total External Static Pressure (TESP) suggests restricted airflow within the system. Addressing airflow issues should be the top priority, as proper airflow is essential for efficient system performance. Check and replace dirty air filters, inspect and clean the evaporator and condenser coils, and ensure that supply and return ducts are not blocked or undersized.
2. **Building envelope and insulation:** Ensuring that the home's insulation and building envelope are in good condition is crucial for maintaining comfortable indoor temperatures and reducing the workload on the HVAC system. Evaluate the home's insulation and sealing, and make necessary improvements to enhance energy efficiency and comfort.

3. **Refrigerant charge:** With airflow and building envelope issues addressed, you can now focus on the low subcooling and high superheat, which may indicate low refrigerant levels. A professional technician should check for refrigerant leaks and repair them if necessary, then recharge the system with the appropriate amount of refrigerant. This will improve system efficiency, cooling capacity, and overall performance.
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This system is 3.5 tons/btuh. Based on this data, what would you estimate the actual capacity of the system to be



To estimate the actual capacity of the HVAC system based on the data provided, we can use the formula for calculating cooling capacity:

$$\text{Cooling Capacity (BTU/h)} = \text{Airflow (CFM)} \times \Delta T \times 1.08$$

where ΔT is the difference between the return air temperature and the supply air temperature, and 1.08 is a constant that factors in the specific heat and density of air.

From the provided data:

- Estimated airflow: 1744 SCFM
- Return wet bulb temperature: 56.7°F (assuming this is the return air temperature)
- Supply temperature: 59.2°F

Calculating ΔT :

$$\Delta T = 56.7^\circ\text{F (return air temperature)} - 59.2^\circ\text{F (supply temperature)} = -2.5^\circ\text{F}$$

Note that the negative value for ΔT indicates an unusual situation, as the supply air temperature should typically be lower than the return air temperature for a cooling system. This might be due to incorrect sensor readings, malfunctioning components, or other issues with the system.

Using the formula with the given data:

$$\text{Cooling Capacity (BTU/h)} = 1744 \text{ SCFM} \times (-2.5) \times 1.08 = -4692 \text{ BTU/h}$$

The calculated cooling capacity is negative, which is not physically possible and suggests that there is a problem with the data or system performance. It is essential to consult with an HVAC professional to evaluate and diagnose the issues with the system. They can help determine the actual capacity and make any necessary adjustments or repairs.





5 year old gas furnace has been operating well, but lately it will blow hot air, then cool air, then hot air, then cool air. It's never done this before. What might be wrong?



If a gas furnace is blowing hot and cool air intermittently, there could be a few potential issues that need to be addressed. Here are some possible causes:  

1. **Dirty or clogged air filter:** A dirty air filter can restrict airflow and cause the furnace to overheat. When the furnace overheats, it may shut off the burners and continue to blow air to cool itself down, resulting in cool air coming out of the vents. Check and replace the air filter if it is dirty or clogged.
2. **Thermostat issues:** A malfunctioning or improperly programmed thermostat could cause the furnace to cycle on and off frequently, leading to inconsistent air temperatures. Check the thermostat settings and ensure it is working correctly. If the thermostat is old or faulty, consider replacing it with a programmable or smart thermostat.
3. **Flame sensor or thermocouple problem:** The flame sensor or thermocouple is responsible for detecting whether the burners are lit. If they are dirty or malfunctioning, they might not detect the flame, causing the gas valve to shut off and the furnace to blow cool air. Have a professional clean or replace the flame sensor or thermocouple as needed.

4. **Ductwork issues:** Leaks or disconnections in the ductwork can cause cool air to mix with the warm air being distributed throughout your home. Inspect the ductwork for any visible issues, and consider having a professional evaluate and repair the duct system if necessary.
5. **Gas valve or control board issues:** Malfunctions in the gas valve or control board could lead to intermittent heating problems. These components control the flow of gas to the burners and the overall operation of the furnace. If you suspect an issue with the gas valve or control board, consult a professional technician to diagnose and repair the problem.

It's essential to consult an HVAC professional to diagnose and address the issue with your gas furnace. They can help determine the specific cause of the problem and recommend appropriate repairs or adjustments to ensure your furnace operates safely and efficiently.





my furnace gas valve is not opening. the valve is getting 21 volts to the terminals. is the valve bad?



It is possible that the gas valve is bad if it is not opening despite receiving the proper voltage. However, there may be other factors that could be causing the issue. Here are a few things you can check to help determine the cause of the problem:



1. Check the wiring: Make sure that the wiring connections to the gas valve are secure and not loose or damaged.
2. Check the gas supply: Verify that there is gas flow to the furnace and that the gas supply valve is open.
3. Check the limit switch: The limit switch may be preventing the gas valve from opening. Check to see if the limit switch is tripped or faulty.
4. Check the ignitor: If the ignitor is faulty, it may not be signaling the gas valve to open. Check to see if the ignitor is working properly.

If after checking these factors, you still suspect that the gas valve is the problem, you may need to replace it. However, it is recommended to consult with a licensed technician to diagnose and fix the issue to ensure safety and proper repair.



QUESTIONS?

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