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**HVAC at Yinghua Academy**  
**by Dan Carson, Yinghua Facility Manager**

**Our HVAC Equipment**

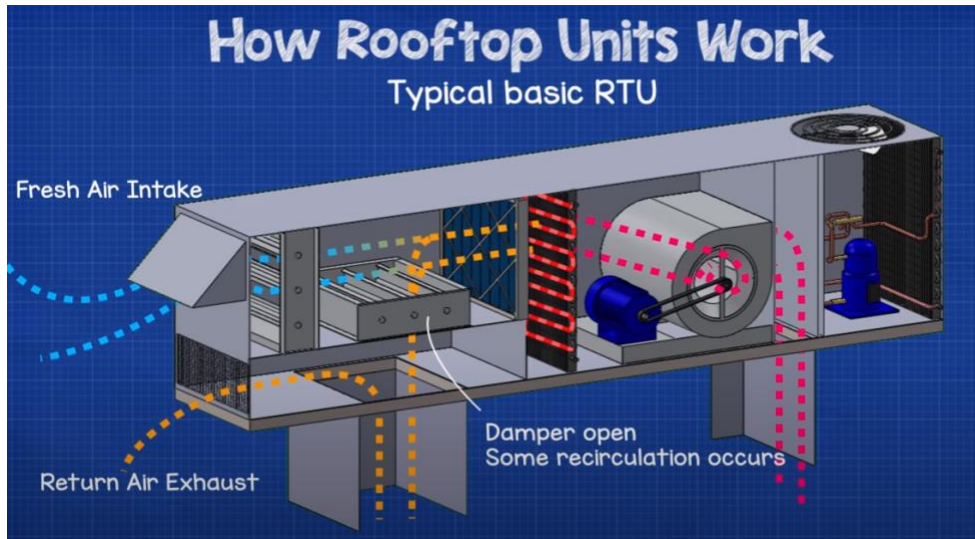
HVAC stands for heating, venting, and air conditioning. Yinghua currently has 15 rooftop units (RTUs) that provide our students and staff with air conditioning (A/C), heat, and fresh air. They were all installed in 2014 when Yinghua expanded its facility. The 15 RTUs supply all of the A/C and the bulk of the heat to Yinghua. We also have a boiler to heat radiators to provide supplementary heat to the older part of the building, but the boiler does not supply air, it simply heats radiators via hot water.

**How Do RTUs Work?**

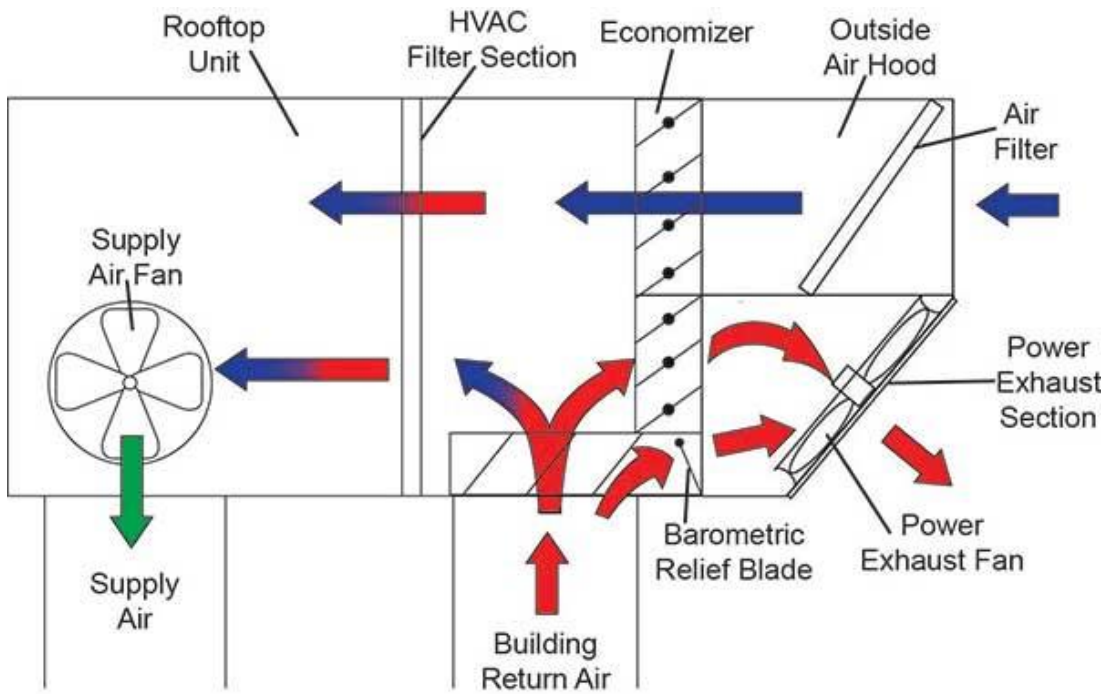
RTUs draw in fresh air and at times mix the air using an economizer to supply heat or A/C depending on the room temperature and set point on the thermostat. Depending on how close the external temperature is to the inside temperature, the recirculation damper will close or open—it works in conjunction with the economizer, which is located just behind the fresh air intake. *See Pictures 1 and 2 on the following page.*

RTUs are designed to be efficient and are meant to keep our CO2 levels low and maintain good air quality. Our RTUs have sensors that test the recirculation air for CO2 (the air we breathe out). If the CO2 is too high, the recirculation dampers will close to allow more fresh air with higher levels of O2 to enter. Economizers improve indoor air quality through increased ventilation. The air passes through filters, which are changed quarterly, then back to the supply vents and into the building to meet the set-point desired at the thermostat.

Picture 1



Picture 2



RTUs also try to balance *air pressure*. We want the building to be slightly air positive—we are taking in more air than the building can hold, and this helps push air out of the building through cracks in windows, door frames, etc. You can tell if a building is air positive or negative if you try to open a door from the outside—if it's slightly positive, it is easy. If negative, you can probably hear a whistling sound as the air is being sucked into the building through the cracks in the door frame, and the door is difficult to pull open. Negative air pressure lowers air quality and efficiency.

*Example:* If the outside temperature is 90F, and the set-point on the thermostat is 73F in a room that is currently 76F, the unit will try to cool the room to 73F by bringing in air chilled at 55F so that the temperature drops 3 degrees from 76F to 73F.

### **Timing Matters—Occupied vs. Unoccupied**

Everything at school, and in most buildings, runs on a schedule, and RTUs are no different. As the day begins at school, the system goes into “Occupied” mode. This means the RTUs will try to satisfy a set-point in between 67F to 73F, depending on the room location (gym vs. classroom, vs. cafeteria), and if the room gets sun or not. RTUs will also bring in as much fresh air as possible because the building will be full of people all breathing in O<sub>2</sub> and out CO<sub>2</sub>.

After everyone leaves at the end of the school day, the building goes into “Unoccupied” mode. The temperature set-points are either lower when cold outside or warmer when it's hot outside—this is meant to save energy. The RTUs still monitor CO<sub>2</sub> levels and will adjust to bring in fresh air if an area has high enough CO<sub>2</sub> levels—like the gym being used after school during sports seasons.

Air quality is best during the day when the building is in occupied mode and is the best when the outside air matches what the building needs because the building uses “free cooling,” which is simply using fresh air to cool the building. The HVAC system is also efficient during the colder season as our body heat helps heat spaces during the day when the building is occupied.

### **Time for a Little Q & A!**

#### **Q: Why can't we adjust the RTUs to just bring in 100% outside air?**

**A:** Air quality will suffer depending on the time of the year. If the temperature outside is too hot, the RTUs would be forced to bring in air that they cannot cool or dehumidify to reach the set-point required in the room.

Let's reexamine the example from above. If the RTU were to only bring in 100% outside air, it would also bring in whatever humidity is in the air, plus the 90F air. The unit might be able to get the room temperature to the desired set-point, but the air might feel cold and clammy if it's too humid, and this is uncomfortable. Remember, people also *add* humidity to the spaces they occupy as they breathe out.

If the air outside is *very* cold, say -10F, and the set-point is at 69F inside the room, the unit might not be able to raise the temperature of the room fast enough if relying only on 100% fresh air. The start of the day might be 65F, but it might take many hours for the RTU to run to meet the 69F set point. An added effect is that if all the RTUs are bringing in 100% outside air, if an external door opens, it might be difficult to shut as the air pressure is too positive.

**Q: Is Yinghua looking at other things, like UVC light, needlepoint bipolar ionization systems, or just opening windows?**

**A:** Yes! We received a quote for UVC lights to be installed in our HVAC units and are awaiting a bid for a needlepoint bipolar ionization system. UVC has been found to be successful in killing a variety of bacteria/viruses although it's debatable how well the fast-moving air in the RTU would be "sanitized" by these lights because UVC lights need *time* to kill organisms, and RTUs move air very quickly through them.

Bipolar ionization systems work by giving all molecules an electronic charge which can kill the bacteria/viruses and also cause them to agglomerate, a fancy word for "clump together," and thus get caught in the air filter or fall to the ground to be cleaned/mopped/vacuumed up.

Opening windows is another option. However, the windows in the older part of the school only bring fresh air into the hallways as most classrooms do not have outside walls. In addition, these windows were not meant to be screened, and for safety reasons they are bolted so that they only open a few inches. Any unscreened open window lets in bugs and pollens or other allergens that might have been caught in the filter in the RTUs. Overall, generally opening windows at Yinghua would not be a viable option.

**Q: When is it good to open windows at school?**

**A:** Open windows are a good source to bring in air or to vent air in situations when a scent or smell might need to be eliminated quickly. The HVAC system does eliminate smells/scents, but it takes longer.

**In summary, Yinghua has a very new HVAC system that is maintained by the facility staff and trained HVAC technicians on a regular basis. The system performs very well and works to benefit the overall air quality of the school.**

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