

# Residential Air Quality and Humidity Control System



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[\*Presentation Link\*](#)

# ***Residential Air Quality and Humidity Control System***

## ***(RAQHCS)***

Many heating systems across New York City are equipped with ‘heat balancing’ valves; these valves are mechanically operated and need manual adjustment. These valves malfunction frequently due to their unreliability and building management failing to properly maintain them, as well as inconsistently recording resident heat complaints. What these systems neglect is air quality, such as humidity. In fact, there are no regulations by the NYC Department of Buildings (D.O.B.) requiring landlords to address such issues. Presenting our device to the D.O.B. would be a great push in improving living conditions without the extensive process of introducing new legislation.

Low humidity may not be a large issue during the summer, when the air is naturally denser, and there is no need to keep the windows shut, but during the winter a lack of humidity leads to many issues. Low humidity can very harmfully affect the human body by “drying out mucous membranes”(Biology Insights, 2025). This makes the respiratory system, specifically the nasal passages, “less effective at trapping airborne particles like bacteria and viruses” (Biology Insights, 2025). Alongside internal effects, low humidity can have outward effects like causing “conditions like eczema or psoriasis [to] worsen, causing discomfort and pain.”(Biology Insights, 2025). These risks are especially prominent in older buildings that have not been renovated and are primarily occupied by the elderly or families with children. During the winter, the air can get

so dry inside of apartments that it can lead to nose bleeds and sinus headaches. This is why we propose our device, the Residential Air Quality and Humidity Control System(RAQHCS).

The purpose of our device is to control the humidity levels in pre-war residential buildings. In the current climate crisis, it has become increasingly difficult to properly ventilate and stabilize indoor spaces due to rapid, unpredictable weather changes. The RAQHCS would provide a solution for regulating air quality and humidity to ensure comfortable living.

These devices would be placed throughout the building's reported problem areas, ideally connected to in-unit radiators, and would be equipped with humidifiers. Our device would be effective to implement due to its cost efficiency and convenience to install and maintain. Our device would, in theory, bring down reported respiratory issues and overall tenant complaints in New York City. It can be turned on when needed and turned off when necessary, but aside from manual operation it will also be sensor triggered and will activate when the humidity falls below a specific percentage. The goal is to avoid the air feeling like a weight on the chest of New York City residents while also avoiding the air feeling like sandpaper. Despite the possibility of our device malfunctioning as any device has the same possibility, it would still be worth the installation as it is a one-time investment and does not pose any direct risks to residents should it not work as intended.

## **Device mechanisms**

The RAQHCS operates through a steam integration mechanism that connects directly to a radiator's existing air vent port, allowing the device to



draw controlled amounts of steam into its internal system. The device functions by recycling the steam used in the radiators of housing units and releasing said steam in increments, which requires a coordinated set of mechanical components to regulate flow.

Inside the unit, stainless steel piping maintains a pitched pathway from the radiator to the device, ensuring proper steam movement, while an integrated air vent assembly withstands high temperatures and prevents pressure buildup. The device also contains a cool water reservoir, which the steam contacts after entering the system, enabling it to cool and condense before being redistributed. Temperature sensors, hygrometers, and a central control board form the regulatory core of the mechanism, continuously measuring indoor conditions and adjusting internal valves to maintain stable humidity levels. Together, these components create a closed mechanical loop that manages steam intake, cooling contact, and controlled release without altering the building's existing heating infrastructure.

### **How RAQHCS works:**

The way our device is meant to work is by recycling the steam used in the radiators of housing units and releasing said steam in increments. Like standard humidifiers, our device will be able to be controlled manually from the physical settings present on the outward casing. However our humidifier will be equipped with sensors that allow for automated activation based on the reported temperature and humidity of the room.



According to the National Library of Medicine, humidities “between 21% and 30% is considered an attention state; between 12% and 20% an alert; and below 12% an emergency”(National

Library of Medicine, 2021). For this reason when the temperature reaches a specific humidity, for example 30% as it is considered a low point, the humidifier will automatically trigger and begin to release a set amount of cooled steam. Our device would either be beside the radiator or in front of the radiator, as the water container would be at risk of being melted if set atop the radiator.

It would be similar to the process of reverse osmosis, the movement of up, then down, then back up. Though in this case, it would be just the steam moving and coming in contact with the water before being released again. Think of it like fog resting atop a lake, not quite touching, but the gas carries the chill from the water back up into the air.

## **Materials:**

Humidifiers are rather straightforward and simple devices, only requiring a handful of materials to build. Our humidifier is a two part object that will include the actual humidifier, as well as the sensor that connects the humidifier with in-unit radiators or heating systems.

The materials needed to make this possible are:

- Silica gel
- Temperature sensor
- Hygrometer
- Stainless steel piping
- Pipe coverings
- Heat resistant water containers



This all adds up to \$200+, at the very most, for one in-unit sized system. It does take more than one person to build the humidifier systems and our labor does go into the creation of

the systems. Installation, however, isn't serviced by us. Rather, installation is a matter to be handled by professional installers and/or the landlord of any residential building. Installation, based on the area you're in, varies in pricing and labor efforts. The price of our unit itself depends on how many are ordered at once. This will not be a sum paid by the tenants directly, but rather bought by landlords or building managers, and installed per tenant request or necessity.

## **How the device would be installed**

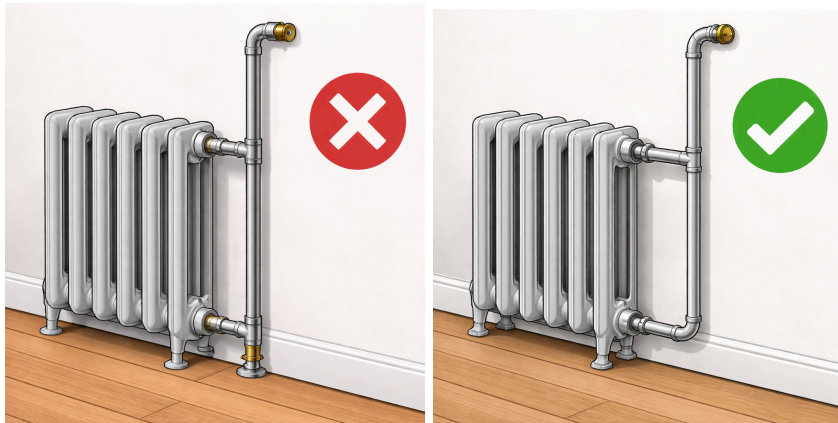
RAQHCS should, and would be installed by a trained professional and compliant to all area building codes. We recommend the device be installed in open public areas as well as individual apartments to maximise efficiency and diminish the possibility of still/dry air. Humidity levels should be measured in all areas and locations with levels under 30% (otherwise follow building code ), and areas that do not have access to windows or some form of ventilation to circulate air. Our device should be installed at the nearest heating unit, so it can properly recycle the steam. All devices should be secured either in front of or beside in unit radiators as to avoid melting risks or fire hazards. The devices should also be set on the ground, ideally on a hard surface rather than carpeting. This is to avoid damage to carpeting, and avoid the possibility of the humidifier being knocked over from a platform and rendered broken.

## **Installation Instructions**

Tools needed: Screw driver, pliers, pipe wrench, Drill, and Teflon tape.

Step 1: After finding the appropriate place of installation, make sure you install a unit at 60” above the floor, and you have the closest heating element within 5 feet. Mount the main unit control board on the wall.

Step 2: Turn off the valve feeding the heating element and unscrew the air vent after a couple of minutes. Install our provided hose adapter at the heating element's former air vent location. Cut the metal pipe to size and maintain the pitch from the heating element to RAQSHCS.



Step 3: Apply teflon tape on all connections and tighten.

Step 4: Remove the protective plastic cover on the RAQHCS integrated air vent.

Step 5: Prefill the water tank with water through a plastic nozzle.



Step 6: Open the heating element valve and test all connections for leaks. Then turn on the device by pressing the button.

Step 7: The device will come up with a loading screen when it is taking measurements and adjusting to your indoor atmosphere. (This step may take a few minutes)

## **Conclusion (Goals)**

The RAQHCS device is meant to be a simple and stable solution to an underlying issue in many New York City homes. While our device can not completely eliminate the possibility of low humidity in residential spaces, it can fight against the low humidity of these spaces and lower the risk and health threats that come with them. Our goal with the RAQHCS is to provide an engineering innovation that is in favor of residents and tenants. Low cost, low labor efforts, little to no compromise or rearranging of homes or building infrastructure.

It is an initiative to present solutions that are reliable and accessible, and more importantly a solution that will still be comfortable for residents. One that will not make them skeptical, or one that will call for construction of their homes and potentially even more living inconveniences. We hope that all users of our device are satisfied with the results of the product and see results in their living comfortability when the colder seasons roll around. The RAQHCS will always have the good of the city people at heart.



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