Honeywell

TrueSTEAM™ Humidification Reference Guide

WHAT'S INSIDE

Sizing Best Practices
TrueSTEAM Humidification System

Guidelines are presented for determining how to choose the best TrueSTEAM™ for your application, taking into consideration best practices recommended by industry experts, and other factors that influence indoor humidity loads.

Setting the Baseline

The Air-Conditioning, Heating and Refrigeration Institute (AHRI) set guidelines for determining humidification capacity requirements. The recommendation is based on the square footage and type of home construction, and assuming typical conditions. It is important to realize many homes will have humidification requirements that differ from the guidelines depending on how the circumstances differ from standard conditions. Factors that can influence the humidification capacity requirements include:

> Geographic region
> Ventilation type
> Number of people living in the home
> Ceiling height
> Window type
> Insulation type
> Equipment type

AHRI has also established a standard method of determining capacity ratings, which provides a means for comparing products, including those from different manufacturers. Capacity is determined by the output of the device as if it operated 24 hours per day. Honeywell TrueSTEAM capacity ratings are determined by testing in accordance with the AHRI guidelines.

Sizing for the Job

Selecting the appropriate humidifier for the job is critical.

Chart 1: TrueSTEAM capacity ratings to maximum home size achievable.

Square Feet of Space	500	1000	1500	2000	2500	3000
AHRI* Recommended Output Delivery (GPD)	0.1	2.2	4.4	6.5	8.6	11.7
TrueSTEAM HM512 - 12 Gallons						
TrueSTEAM HM509 - 9 Gallons						
TrueSTEAM HM506 - 6.5 Gallons						

**AHRI Guideline F-2007 for maintaining 35% RH in a tight, four-person residence with 8-ft. ceilings. Outdoor conditions = 20°F and 70% RH.*

This chart assumes fixed values in ceiling height, outdoor conditions, structure insulation, window type, number of occupants and ventilation type. As these values change from home to home, so does the humidity load requirement, and potentially the humidifier model that is best for the home. To better understand what TrueSTEAM size to choose, let's review humidity load requirements.

What is meant by a humidity load requirement?

The humidity load requirement is the daily amount of vapor needed to maintain 35% RH in specific home sizes and is often listed in minimum gallons per day (GPD) needed.

Chart 2: Humidity requirements in GPD based on home size and construction type (from AHRI Guideline F). Loads assume people living within home.

	Square feet of space					
Structure tightness	**500**	**1000**	**1500**	**2000**	**2500**	**3000**
	Humidity needed (GPD per AHRI)					
Tight	**0.1**	**2.2**	**4.4**	**6.5**	**8.6**	**10.7**
Average	**1.3**	**4.5**	**7.8**	**11.1**	**14.3**	**17.6**
Loose	**2.6**	**7.2**	**11.8**	**16.4**	**21**	**25.6**

How is structure type defined?

AHRI defines structure type as follows:

'Tight' construction = Well insulated with vapor retarders, tight storm doors, windows with weather stripping, dampered fireplace and using 1/2 air change per hour of air infiltration.

'Average' construction = Insulated with vapor retarders, loose storm doors and windows, dampered fireplace with 1 air change per hour of air infiltration.

'Loose' construction = Generally built before 1930 with little or no insulation, no storm doors, no insulated windows, no weather stripping, no vapor retarders, undampered fireplace, and with 1-1/2 air changes per hour of air infiltration.

Taking humidity load requirements into consideration, contractors can better pinpoint the ideal TrueSTEAM model based on the run time to meet 35% RH in the home. This is important since run times affect the homeowner operating cost, the system fan noise and actual indoor humidity achievable.

Chart 3: TrueSTEAM average run times to meet 35% RH.

Home size	**Humidity needed****	**TrueSTEAM**		
		HM506 (6.5 GPD)	**HM509 (9 GPD)**	**HM512 (12 GPD)**
Square feet	**GPD per AHRI**	**Average hours per day**		
500	**0.1**	**0.2**	**0.15**	**0.12**
1000	**2.3**	**8.5**	**6.1**	**6.0**
1500	**4.4**	**16.2**	**11.7**	**8.8**
2000	**6.5**	**24.0**	**17.3**	**13.0**
2500	**8.6**	**24***	**22.9**	**17.2**
3000	**10.7**	**24***	**24***	**21.4**

** Red indicates model is undersized for the home size, and cannot achieve 35% RH under these conditions.*
*** Based on people living in a home with tight construction and 8-foot ceilings.*

Using run time averages per TrueSTEAM model and house size, you can determine the humidifier that is best suited for meeting 35% RH in the home. For example, you can see that for smaller homes, there is little difference in the run times required between units. Thus, choosing a smaller size TrueSTEAM which draws fewer amps to achieve 35%RH in about the same time as the larger model is more economical. As the home gets larger, the run time increases for the smaller size TrueSTEAM, which then makes it logical to upsize to the larger model. Taking into consideration the hourly run time and amp draw per model, Chart 4 shows the total daily operating costs, based on national averages (source: Department of Energy web site, Nov 2008).

Chart 4: National average daily operating costs to achieve 35% RH in a tight-fit home with 8-foot ceilings and people living in it.

Home size (sq. ft.)	Humidity needed (GPD per AHRI)	TrueSTEAM		
		HM506	HM509	HM512
500	0.1	$0.76	$0.99	$1.15
1000	2.3	$1.04	$1.00	$1.16
1500	4.4	$2.08	$1.96	$1.71
2000	6.5	$3.08	$2.89	$2.53
2500	8.6	$3.08*	$3.82	$3.35
3000	10.7	$3.08*	$3.82*	$4.55

**Red indicates 35%RH cannot be achieved under these conditions*

Additional Considerations

There are additional considerations beyond square footage to appropriately size TrueSTEAM to the home. The following is a list of general questions that relate to these variables.

What if my ceilings are higher than 8 feet?

The sizing listed above is based on square footage with a ceiling height of 8 feet. If the ceiling is higher than 8 feet, the total cubic feet should be taken into consideration for proper sizing of the device. For example, if the ceiling is 10 feet instead of 8, there is 25% more air volume to consider.

Converting square footage to cubic requires multiplying the square footage by the ceiling height (i.e., 2000 square foot space with 10 foot ceilings is 20000 cubic feet). Converting AHRI's standard to cubic feet, Chart 5 shows the daily load requirements in cubic feet. In general, the higher the ceilings, the smaller the square footage space each TrueSTEAM model will cover since it must humidify the additional air volume.

Chart 5: AHRI humidity load requirements* in cubic feet.

	Cubic feet of space					
Construction Type	4000	8000	12000	16000	20000	24000
	Humidity needed (GPD per AHRI)					
Tight	0.1	2.2	4.4	6.5	8.6	10.7
Average	1.3	4.5	7.8	11.1	14.3	17.6
Loose	2.6	7.2	11.8	16.4	21	25.6

**Based on people living in the home.*

Chart 6: Sizing recommendations based on cubic feet and insulation type.

Cubic feet of space		4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000	15000	16000	17000	18000	19000	20000	21000	22000	23000	24000
Tight	HM506	$0.76								$2.08												
	HM509									$1.96				$2.89								
	HM512													$2.53								
Average	HM506	$0.76				$2.13																
	HM509					$2.00			$3.47													
	HM512								$3.03													
Loose	HM506																					
	HM509	$1.16				$3.20																
	HM512					$ 2.80																

**Listed values are average daily operating costs to achieve 35% RH, per AHRI guidelines.*

How does fresh air ventilation affect indoor humidity?

Outdoor conditions during the humidification season are drier than indoor conditions.

1. Ventilation occurs naturally via the 'breathing' that occurs within the home. This infiltration/exfiltration has become more restrictive as new home construction has followed tighter building practices for improved energy efficiency.

2. Ventilation also occurs mechanically, through intake and exhaust ventilation devices, such as heat and energy recovery cores, fireplace flues or open windows. Ventilation can have a negative affect on the humidity level achievable and the overall run time of the humidifier. Understanding natural and mechanical ventilation rates is important when choosing the best humidifier size for the home and in setting expectations with the homeowner upon installation.

How does warmer air affect humidity?

Relative humidity is the ratio between the amount of moisture in the air and the amount of moisture the air is capable of holding at a given temperature. A higher air temperature with a fixed amount of vaporized water will have a lower Relative Humidity than that same amount of vaporized water in a lower air temperature because warm air can hold more moisture than cold air.

This basic science is important in understanding how to size the humidifier, especially when considering intake ventilation in the form of natural building 'breathing' or mechanical ventilation. Warmer air entering the space can actually decrease the %RH ratio. It may be the same amount of vaporized water, but because air temperature increased, the %RH decreased. It is better to err on the side of over sizing the humidifier when dealing with higher indoor air temperatures.

What is the issue with undersizing the humidifier to the space?

Undersizing the humidifier will not only reduce the potential to meet the homeowner's desired humidity set point, it may also lead to extensive system fan run time or higher operating costs as it tries to deliver to the control's setting. While oversizing the humidifier may lead to higher amp draw, the system run time will be less, which in some situations may be less expensive at the bottom line. Refer to Chart 3 and 4 above for average run times and operating costs.

Summary

The first priority for most homeowners with centrally ducted humidification is comfort, followed closely by operating cost and run time. The best solution for your customer is a humidification system that will achieve their desired humidity setting, while minimizing the run time and operating costs. As part of the selling process, it may be necessary to educate the homeowner on what ideal humidity is, and what is realistic for the humidifier they are willing to purchase. Also take into consideration external variables within the home which may negatively impact the humidification capacities possible. The purpose of this paper is to provide guidance on evaluating homes and choosing the best TrueSTEAM model for the home.

Additional information can be found online at www.forwardthinking.honeywell.com/truesteam

Operating Costs

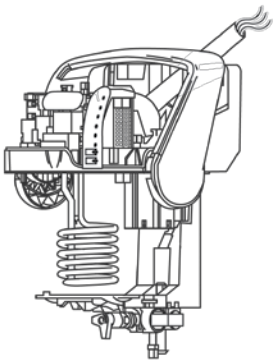
TrueSTEAM Humidification System

Regardless of the brand or type of humidifier you offer homeowners, there are operating costs incurred to achieve desired comfort. It is a common misconception that evaporative pad humidifiers provide the lowest total cost solution. Let's take a closer look at the operating costs for evaporative and steam humidifiers to illustrate how they are more comparable than you might think.

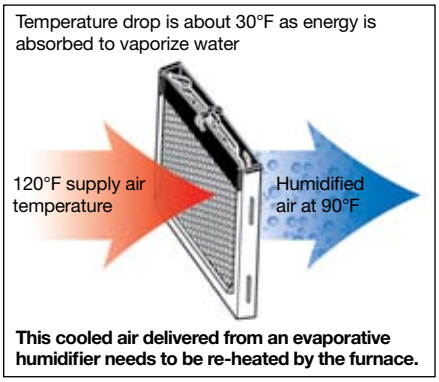
How can this be true?

You can **boil** it down to one universal law that applies to all humidifiers…
Energy must come from somewhere to convert water into vapor.

- In steam devices, an internal heating element adds this energy directly to the water (via boiling).



- In evaporative pad devices, energy is absorbed from the air and must be restored later by the heating system.



This cooled air delivered from an evaporative humidifier needs to be re-heated by the furnace.

Whether it is from an electric heating element or from the furnace, it's essentially the same amount of energy. In order to compare total operating costs of TrueSTEAM and an evaporative humidifier, there are four factors to consider:

1. The energy cost to convert water to vapor and to operate the system fan
2. Water consumption
3. Sewer drain when metered
4. Cost to heat water when connected to water heater as supply

Let's look at an example and contrast the operating cost of an evaporative bypass humidifier with the Honeywell TrueSTEAM. We will use national average costs as listed by the U.S. Department of Energy (DOE) and Consumer Energy websites, November 2008.

National Averages according to U.S. DOE and Consumer Energy, Nov 2008
Natural gas cost = $20.19 per 1000 ft^3 (D.O.E.)
Electricity cost = $0.11 per kW/hr (D.O.E.)
Water consumption = $0.003 per gallon (Consumer)
Sewer drainage = $0.003 per gallon (Consumer)

According to AHRI guidelines (Appendix A), a 2000 ft^2, two-person home with tight insulation requires 6.5 gallons of humidity per day to satisfy home comfort. Both a large bypass humidifier and a TrueSTEAM HM509 can achieve this requirement, but they do so in different ways, and with different associated costs.

Let's first review how the large bypass evaporative humidifier operates to reach and maintain setpoint.

How large bypass humidifiers achieve the output requirement

A large bypass humidifier with a 17-GPD output rating will be able to deliver 4.25 gallons of humidity to the air during the six hours of furnace run time.

With 4.25 gallons delivered against the daily requirement of 6.5, the large bypass humidifier must convert an additional 2.25 gallons using the system fan without the benefit of heated air from the furnace. With fan-only operation, an evaporative humidifier's output is typically only 50% (0.35 gallons per hour) of what it is with the furnace running (0.71 gph). At 0.35 gph, it will take an additional 6.4 hours of fan-only operation to make up the 2.25 gallon deficit.

As illustrated above, the air that passes through the pad will be cooled, and the furnace will use about 54,000 BTUs each day to reheat the air. During the 12.4 hours of run time, the large bypass will consume 43.2 gallons of water, putting only 6.5 gallons into the home and 36.7 gallons go down the drain. That's 1296 gallons of hot water used per month, with only 195 of those gallons going into the air as humidity. When using heated water to supply the humidifier as recommended by some manufacturers, the energy used to heat all that wasted water goes down the drain.

Using the national average utility rates, Chart 1 provides the daily operating costs for a large bypass humidifier to achieve 35% RH in a 2000 ft^2 tight home are provided. Notice the cost is significantly higher if using an electric furnace versus a gas furnace.

Chart 1: Large Bypass operating costs with furnace running 6 hours to convert water to vapor (cost calculation details in Appendix B)

Natural gas heating and water heating	
	cost/day
Blower electrical	$0.55
Water	$0.26
Natural gas for humidifier	$1.13
Natural gas for hot water	$0.66
TOTAL	**$2.60**

Electric heating and water heating	
	cost/day
Blower electrical	$0.55
Water	$0.26
Electric for humidifier	$1.82
Electric for hot water	$1.07
TOTAL	**$3.70**

When running a large bypass evaporative humidifier without the furnace (100% fan-only), more time is required (18.4 hours) to deliver the 6.5 gallons of humidity. During that time, 64.2 gallons of water are consumed of which only 6.5 gallons per day go into the air as humidity. That equals 1926 gallons per month of heated water that the homeowner is paying for, with only 195 gallons going into the air as humidity.

Chart 2: Large Bypass operating costs when humidifying without heating cycles using HVAC fan only. (for details see Appendix B)

Natural gas heating and water heating	
	cost/day
Blower electrical	$0.82
Water	$0.39
Electric for humidifier	$1.13
Electric for hot water	$0.98
TOTAL	**$3.32**

Electric heating and water heating	
	cost/day
Blower electrical	$0.82
Water	$0.39
Electric for humidifier	$1.82
Electric for hot water	$1.59
TOTAL	**$4.62**

Next, we will review how TrueSTEAM HM509 achieves the output requirement in this example.

How TrueSTEAM HM509 achieves output requirements.

TrueSTEAM HM509 runs at maximum efficiency regardless of air temperature. Because it has a heating element to turn water to vapor, TrueSTEAM does not waste furnace BTUs to deliver the 6.5 gallons of humidity the 2000 ft^2 home requires.

The TrueSTEAM heating element uses 1100 watts and the system fan will run 17 hours to deliver the 6.5 gallons of humidity. A total of 6.5 gallons of water will be used, with all of it going into the air as humidity – that is up to 90% less water than what the large bypass uses. And because it is cold water that is going into the humidifier, the homeowner doesn't incur the extra cost of externally heating the water. NOTE: TrueSTEAM output is rated with inlet water temperature of 60°F.

Using the national averages listed, Chart 3 shows the daily operating costs for a TrueSTEAM HM509 to achieve 35%RH in a 2000 ft^2 home.

Chart 3: TrueSTEAM operating costs to achieve output requirement in this example. (for details see Appendix B)

Total TrueSTEAM® operating costs	
	cost/day
Blower electrical	$0.78
Water	$0.05
Heater electrical	$2.06
TOTAL	**$2.89**

	Total daily operating cost	Cost of evaporative bypass vs. TrueSTEAM
TrueSTEAM HM509	$2.89	–
Bypass model with gas water heater and 6 hours of heating per day	$2.60	Bypass $0.29 less
Bypass model with gas water heater and no heating requirements	$3.31	Bypass $0.42 more
Bypass model with electric water heater and 6 hours of heating per day	$3.70	Bypass $0.81 more
Bypass model with electric water heater and no heating requirements	$4.62	Bypass $1.73 more

For your convenience Chart 5 provides the average daily operating costs to achieve 35% RH for the various evaporative and steam humidifiers in different home sizes.

Chart 5: Operating cost comparison to achieve 35% RH per AHRI guidelines for tight-fitting homes.

Home size (sq ft)	Humidity needed (GPD per AHRI)	Small Bypass		Large Bypass		Fan-Power		TrueSTEAM		
		Gas Furnace and water heater	Electric Furnace and water heater	Gas Furnace and water heater	Electric Furnace and water heater	Gas Furnace and water heater	Electric Furnace and water heater	HM506	HM509	HM512
1000	2.3	$1.10	$1.53	$1.10	$1.53	$1.10	$1.53	$1.04	$1.00	$1.16
1500	4.4	$2.14	$3.00	$1.53	$2.21	$1.48	$2.15	$2.08	$1.96	$1.71
2000	6.5	$3.51	$4.87	$2.60	$3.70	$2.08	$3.55	$3.08	$2.89	$2.53
2500	8.6	$3.51*	$4.87*	$3.67	$5.20	$3.51	$4.99	$3.08*	$3.82	$3.35
3000	10.7	$3.51*	$4.87*	$5.09*	$7.14*	$5.43*	$7.61*	$3.08*	$3.82*	$4.55

* red entries indicate that the humidity requirement cannot be achieved under these conditions

Assumptions:
- Desired humidity level is 35% RH with humidity requirement based on AHRI Guidelines
- Costs are calculated using national average utility rates and typical water and sewer rates.
- 6 hours of furnace run time per day

A key takeaway from the cost comparisons is that even the smallest size TrueSTEAM (HM506) can match the humidity output of the largest size bypass models for spaces up to 2000 ft^2. Moving up to the larger TrueSTEAM models (HM509 and HM512) will meet the load requirement more quickly, costing even less. And because 18-gpd fan-powered evaporative humidifiers have only 1 gallon per day additional output compared to large bypass models, the smallest TrueSTEAM (HM506) compares favorably with those models as well, and with similar total operating costs.

It is also important to recognize that evaporative bypass humidifiers introduce additional system losses that we haven't quantified in this discussion. The bypass duct steals heated air that is intended to be delivered to the living space and sends it back to the return duct, resulting in less efficient equipment operation.

Keep in mind that this just one example using fixed variables on cost and home type. Additional factors will affect how the humidifier performs in specific homes, including geographic region, insulation and window type, equipment type and number of people living in the home. Honeywell offers a software simulator that allows you to input variable utility costs for your city to see how TrueSTEAM and evaporative humidifiers compare. Contact your Honeywell sales representative for more information.

Summary

As illustrated, the total operating costs for both humidifiers are closer than you might expect when considering all associated operating costs. When choosing the humidifier that is right for your business model, it is important to consider the humidity output as it relates to actual home requirements, not the maximum ‘gallon per day’ (gpd) rating that manufacturers list on the box. Remember that the capacity of evaporative humidifiers is determined by assuming that the furnace is heating 24 hours per day. It's output will be substantially less when it operates without heat - even if heated water is used. TrueSTEAM output is not dependent on the furnace heat time.

With Honeywell, you get TrueSTEAM with the highest output and efficiency of any residential humidifier – along with a full portfolio of evaporative bypass and fan-powered humidifiers that are comparable to competitive models on the market in regard to output and operating cost. Honeywell is your one-source for all residential humidifiers, with industry leading controls for your HVAC system and IAQ equipment.

Appendix A - Humidity requirements in GPD based on AHRI Guideline F

	500	1000	1500	2000	2500	3000
Average	1.3	6.6	10.8	15	19.3	23.4
Loose	2.6	10.7	17.1	23.5	29.8	36.1
Tight	0.1	2.3	4.4	6.5	8.6	10.7

**Based on people living in the home.*

Appendix B – Evaporative bypass cost calculations

Energy required to convert water to vapor (BTU/day) = GPD required * latent heat of vaporization * water weight (pounds per gallon)

Humidity required is 6.5 GPD as defined by AHRI for the example above
Latent heat of vaporization is 1000 BTU per lb of water
One gallon of water weighs 8.3 lbs

Energy to convert 6.5 gallons of water to vapor = 6.5 * 1000 * 8.3 = 53,950 BTU

Energy content of natural gas = 1031 BTU per ft3 natural gas

53950 / 1031 = 52.33 ft^3/day of natural gas

Cost of natural gas = 52.33 ft^3 * ($20.19/1000 ft^3) = $1.06 per day
Cost of electricity to convert water to vapor = [(53950 BTU/day) / (3414 BTU/kW hr)] * ($0.11/kW hr) = $1.74

Water cost = Total used * (cost of water + cost of sewer)
(43.2 GPD)(.003 + .003) = $.026 per day

Cost to heat water with natural gas (heating 60°F to 120°F) = (43.2 GPD)(8.3 lbs/gallon)(1 BTU/lb-F)(120-60°F)($20.19/1000 ft^3) / (1031 BTU/ft^3) = $0.42 per day

Additional information can be found online at www.forwardthinking.honeywell.com/truesteam

Humidifier Selection

TrueSTEAM Humidification System

With the multiple humidifier styles and sizes available to distributors and contractors, it can be difficult to discern which model provides the best solution for the homeowner. A common method of rating the humidification capacity is to state the output in terms of gallons per day (GPD). However, that rating can be misleading since evaporative pad and steam-based products can perform differently depending on the operating conditions.

Evaporative Pad

GPD rating is based on the amount of moisture the humidifier can deliver if it is running continuously over a 24 hour period 120°F air passing through the wetted pad. This rating does not account for periods when the furnace is off, and cooler plenum temperatures and duct air flow may impact performance.

Steam-Based

GPD rating is based on the amount of water evaporated by heating the water. These units are typically installed so that they turn on the HVAC fan when there is a need for humidity so they are not dependant on furnace run time. Steam is delivered to the air duct regardless of plenum temperatures.

It is important to understand the difference between these two as it directly affects which product is best for each home. For example, a evaporative pad humidifier rated for 18 GPD that is installed in a home where the furnace and fan only run 8 hours (33%) of any given day may actually be delivering only 5.8 GPD of humidity. If that furnace air temperature is less than 120°F, that delivery rate will be even less – perhaps closer to 4 GPD.

One of the distinct advantages of using steam-based humidifier designs is that there are no dependencies on air temperature or furnace operation in order to deliver its rated GPD. For example, the TrueSTEAM HM506, which is rated at 6.5 GPD will deliver 6.5 GPD regardless of furnace operation or air temperature. This makes steam based designs ideal for moderate climates where the furnace doesn't run as often, as well as for homes that have high-efficiency or multi-stage (heat pump) equipment that run less frequently and at lower air temperatures.

There are situations, however, where evaporative pad humidifiers can meet and in some cases exceed the delivery rates of smaller steam-based units. This becomes relevant with gas/oil conventional furnaces that have plenum air temperatures over 120°F and in colder climates where the furnace may run 50-75% of the time. As established earlier, the TrueSTEAM HM506 will deliver 6.5 GPD regardless of furnace run time. The HE225 evaporative pad humidifier has a 12 GPD rating, which if applied to a conventional (gas/oil) furnace in a colder climate where the furnace and fan run for 12 hours (50%) can deliver up to 6 GPD – comparable to the TrueSTEAM HM506.

The following table provides reference based on furnace temperature, runtime, as well as whether the system fan is running intermittently or continuous. These factors play a critical role in the GPD output of each humidifier style and model.

Furnace Run time per day	Furnace Temp	Additional Fan Cirrculation (70°F)	HE225 Bypass	HE265 Bypass	HE365 Fan	HM506 TrueSTEAM	HM509 TrueSTEAM	HM512 TrueSTEAM
				Evaporative Pad			Steam-based	
5 hrs (20%)	120°F	100%	6.7	9.5	10.1	6.5	9.0	12.0
	110°F	100%	6.5	9.1	9.7	6.5	9.0	12.0
	100°F	100%	6.2	8.8	9.3	6.5	9.0	12.0
	90°F	100%	5.9	8.4	8.9	6.5	9.0	12.0
	120°F	33%	3.8	5.4	5.7	6.5	9.0	12.0
	110°F	33%	3.6	5.0	5.3	6.5	9.0	12.0
	100°F	33%	3.3	4.7	4.9	6.5	9.0	12.0
	90°F	33%	3.0	4.3	4.6	6.5	9.0	12.0
	120°F	Intermittent	2.4	3.4	3.6	6.5	9.0	12.0
	110°F	Intermittent	2.1	3.0	3.2	6.5	9.0	12.0
	100°F	Intermittent	1.9	2.7	2.8	6.5	9.0	12.0
	90°F	Intermittent	1.6	2.3	2.4	6.5	9.0	12.0
8 hrs (33%)	120°F	100%	7.6	10.8	11.4	6.5	9.0	12.0
	110°F	100%	7.2	10.1	10.7	6.5	9.0	12.0
	100°F	100%	6.7	9.5	10.1	6.5	9.0	12.0
	90°F	100%	6.3	8.9	9.4	6.5	9.0	12.0
	120°F	33%	5.2	7.3	7.8	6.5	9.0	12.0
	110°F	33%	4.7	6.7	7.1	6.5	9.0	12.0
	100°F	33%	4.3	6.1	6.5	6.5	9.0	12.0
	90°F	33%	3.9	5.5	5.8	6.5	9.0	12.0
	120°F	Intermittent	4.0	5.7	6.0	6.5	9.0	12.0
	110°F	Intermittent	3.6	5.0	5.3	6.5	9.0	12.0
	100°F	Intermittent	3.1	4.4	4.7	6.5	9.0	12.0
	90°F	Intermittent	2.7	3.8	4.0	6.5	9.0	12.0
12 hrs (50%)	120°F	100%	8.7	12.3	13.1	6.5	9.0	12.0
	110°F	100%	8.0	11.4	12.1	6.5	9.0	12.0
	100°F	100%	7.4	10.5	11.1	6.5	9.0	12.0
	90°F	100%	6.7	9.5	10.1	6.5	9.0	12.0
	120°F	33%	6.9	9.8	10.3	6.5	9.0	12.0
	110°F	33%	6.2	8.8	9.3	6.5	9.0	12.0
	100°F	33%	5.6	7.9	8.4	6.5	9.0	12.0
	90°F	33%	4.9	7.0	7.4	6.5	9.0	12.0
	120°F	Intermittent	6.0	8.5	9.0	6.5	9.0	12.0
	110°F	Intermittent	5.3	7.6	8.0	6.5	9.0	12.0
	100°F	Intermittent	4.7	6.6	7.0	6.5	9.0	12.0
	90°F	Intermittent	4.0	5.7	6.0	6.5	9.0	12.0

In addition to the GPD differences highlighted above, other criteria specific to the home must be taken into account to select the best humidifier option for the home. The Air-Conditioning and Refrigeration Institute (ARI) Guideline for Selection, Installation and Servicing of Residential Humidifiers lists the following factors to consider when determining humidity capacity requirements:

- Indoor and outdoor temperature and humidity conditions
- Conditioned space volume
- Tightness of structure, insulation, storm windows and doors.
- Quantity of outside air entering the conditioned space
- Mechanical and natural ventilation
- Fireplace dampers (ARI ratings are based on these being closed)
- Internal load requirements
- This includes bathing, laundry habits, cooking, number of occupants. 2 gallons per day is factored off the GPD figures below to account for internal sources of humidity (based on a family of four)

Taking these considerations into account, ARI recommends the following humidity capacity ratings (GPD) for the size and type of building construction:

Humidity Requirements, GPD*						
Type	**Size of building, sq. ft [m²]**					
	500 [46.45]	**1000 [92.90]**	**1500 [139.35]**	**2000 [185.80]**	**2500 [232.25]**	**3000 [278.80]**
Tight	.01	2.2	4.4	6.5	8.6	10.7
Average	1.3	4.5	7.8	11.1	14.3	17.6
Loose	2.6	7.2	11.8	16.4	21.0	25.6
*Based on 8-ft ceiling height, indoor conditions of 70°F and 35%RH, outdoor conditions of 20°F and 70%RH.						

Summary

Many factors must be considered when choosing the right humidifier for the particular application. This technical brief is meant to serve as a guide for not only choosing the right humidifier style and size for the home's equipment and runtime, but also to convey the importance of understanding the nuances in output ratings as they relate to the particular home. Applying these recommendations to the home's you install whole-house humidification into will lend not only to the optimized comfort of the home's occupants, but also help them to conserve energy and save money. All of which serve to increase your bottom line through reduced callbacks, and repeat business.

Works Cited

1. 2007 Guideline for Selection, Installation, and Servicing of Residential Humidifiers. ARI Guideline-F, 2007.

Additional information can be found online at www.forwardthinking.honeywell.com/truesteam

Commonly Asked Wiring Questions

TrueSTEAM Humidification System

I. Power Monitoring
II. Air Proving-system Fan Activation
III. Optional Add-on Air Proving

I. Power Monitoring

What is it?

Contractors must configure TrueSTEAM to run only when the HVAC system has power present. By monitoring power, at R and C TrueSTEAM will not produce humidity without air moving in the duct. When no power is present, there is no airflow.

How does it works?

Power monitoring is done with one of two methods.

Method 1

TrueSTEAM Power Monitoring

- Wire TrueSTEAM R and C to HVAC system R and C
- On the TrueSTEAM circuit board, there are six DIP switches. The 4th DIP from the left (DIP-4) is used to enable TrueSTEAM power monitoring.
  - > Setting DIP-4 down enables TrueSTEAM to monitor power at R and C before allowing humidity into the ductwork.
  - > Setting DIP-4 up disables TrueSTEAM power monitoring through its R and C terminals. Monitoring in this situation is done through (an alternative source) such as a thermostat with humidifier control that is powered via the HVAC system transformer. NOTE: TrueSTEAM still requires a humidity control.

Method 2

Power monitoring from thermostat

- The thermostat must be able to operate the system fan and a humidifier, and be powered from the HVAC system transformer.
- In the control's software set-up, select the option that allows humidification only when the system's fan or heat is active. In VisionPRO IAQ, this is setup function 0374, and the contractor can select option 0 or 2 to monitor power for humidity operation.
- On the TrueSTEAM circuit board, set DIP-4 to up to disable power monitoring by the humidifier, since it is being monitored by the thermostat.

When should I use one over the other?

- TrueSTEAM power monitoring is ideal when using a humidity control separate from the thermostat, such as TrueIAQ or a mechanical humidistat (H8908). It is important to note that 'humidity on demand' is still possible with power monitoring enforced. If using a humidistat that has the capability to activate the system fan when humidity is needed. See the next section on 'System Fan Monitoring and Activation' for more details.

- Power monitoring from a thermostat with built-in humidification control is ideal for simplifying the wiring between the humidifier and HVAC system. If the thermostat receives R and C power from the HVAC system, and controls humidity, you only need to connect two wires between the TrueSTEAM and the system board. For VisionPRO IAQ, connect the two HUM terminals on TrueSTEAM to the HUM terminals on the Equipment Interface Module.

What happens if done wrong?

• The most common mistake in Power Monitoring is incorrect positioning of the DIP-4 switch. If you leave DIP-4 in its default position (down), TrueSTEAM will look for power at its R and C terminals. If this R/C wire connection is not present, and DIP-4 is down, then TrueSTEAM's fault notification 'Call Service' light will activate and humidity output will not start.

• If DIP-4 is up, TrueSTEAM will not look for power at the R and C terminal, even if it is wired up. It is critical for the contractor to understand that if DIP-4 is up, TrueSTEAM itself is ignoring Power and Airflow Monitoring. Therefore, an alternative source must be installed. Such as a thermostat that receives R and C power from the system transformer, and controls humidification.

How do I troubleshoot the Power Monitoring?

• Unplug the TrueSTEAM line cord, and remove the TrueSTEAM cover.

• Check to see if DIP-4 is UP or DOWN. If DOWN, ensure the TrueSTEAM R and C terminal are wired to the HVAC system R and C terminals. This is needed to ensure a fault mode doesn't occur.

• If DIP-4 is UP, make sure the humidifier control (thermostat) is powered by the system transformer to ensure the humidifier isn't running without the system having power.

II. Air Proving - System Fan Activation

What is it?

A centrally ducted humidifier like TrueSTEAM requires air movement via the HVAC system fan to push humidity into the living space. The system fan is controlled through its G-terminal. TrueSTEAM can be wired to monitor when the system G terminal is energized – indicating there is air flow in the duct. If airflow is not present and humidity is demanded by the control, TrueSTEAM can be configured to energize the HVAC system G when humidity is needed.

How does it work?

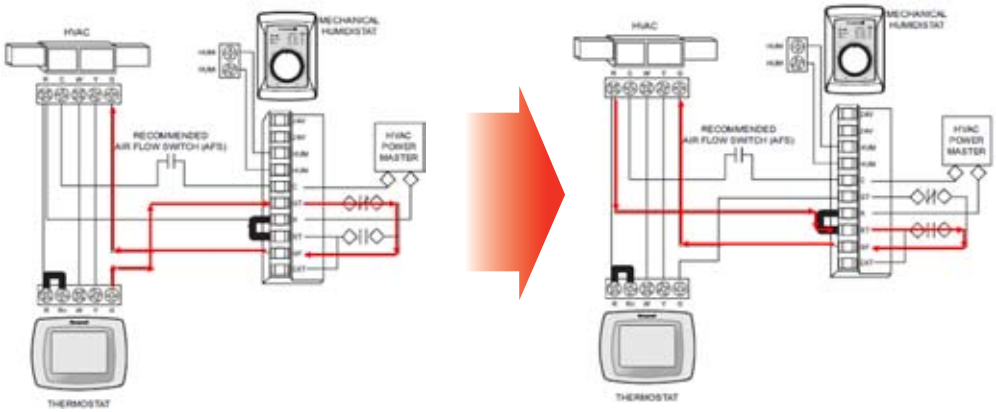
Fan activation can be done in two ways – through the TrueSTEAM or through a thermostat that has built-in humidifier control, such as VisionPRO IAQ or Prestige

TrueSTEAM Fan Enforcement

• Break the G connection between the thermostat G and the HVAC system G
  — Thermostat G goes to TrueSTEAM Gt terminal.
  — HVAC system G goes to TrueSTEAM Gf terminal.

Thermostat fan signals: From the thermostat will travel through Gt to Gf to the HVAC system G. Humidity is allowed if that signal is present from the thermostat.

If the thermostat G signal is not present: The TrueSTEAM will send power through Gf to HVAC system G to ensure there is airflow for humidity production, when humidity is needed.



• TrueSTEAM sends this signal when water temperature in the tank is at 170°F (just before boil). This ensures room temperature air isn't circulated through the home prior to steam production thus avoiding cold drafts in the home.

• Wire TrueSTEAM R to HVAC system R.

• If DIP-4 is up, TrueSTEAM does not validate R and C system power before initiating a humidity call. If DIP-4 is down, TrueSTEAM will verify R and C system power before allowing humidity call to initiate. Humidity will not be allowed if HVAC system power is not available.

Fan activation from the thermostat

• To do this, the thermostat must have the ability to operate the system fan and a humidifier.

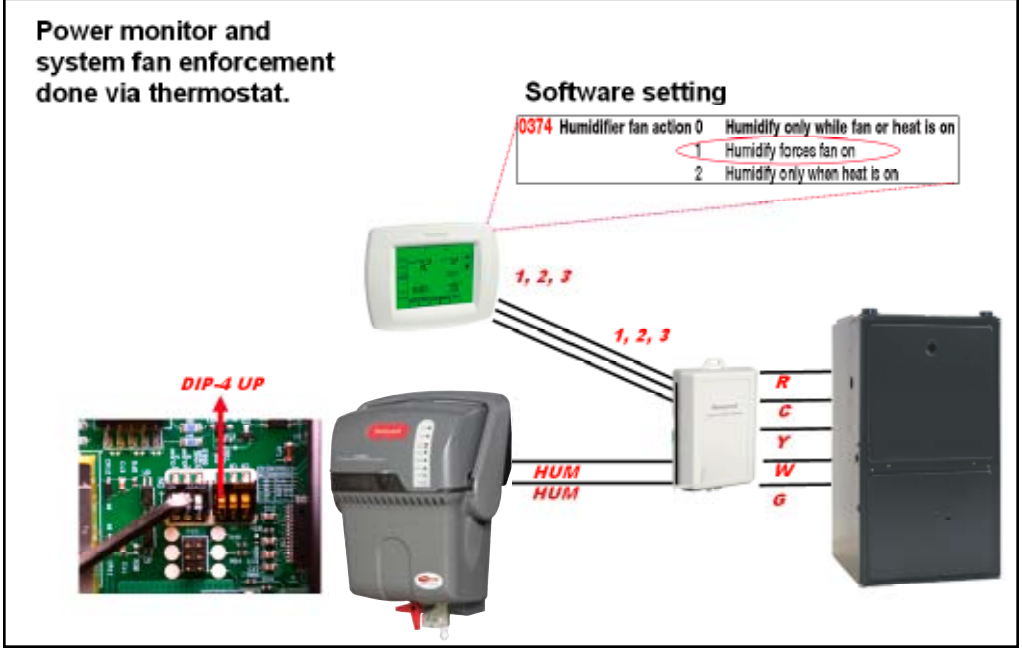
— This can be integrated in one thermostat for system and humidifier operation or separate controls for the HVAC system and humidifier. *Each have their own recommended set-up, illustrated below.*

• In the thermostat installer setup, there are options to wait for the thermostat to turn on the system fan before allowing humidification or to force the system fan on when there is a demand for humidity.

— In VisionPRO IAQ, this is setup function 0374

- Option 1 forces the fan on. This energizes system G when the HUM terminals energize from a humidity demand
- Option 0 or 2 waits for the system to energize G before allowing HUM terminals to energize
- Because the thermostat is enforcing the fan, you do not need to power monitor or activate fan from TrueSTEAM – the control does it for you.
- On TrueSTEAM, set DIP-4 up. Wire only HUM-HUM terminals of TrueSTEAM to HUM-HUM terminals of the Equipment Interface Module of VisionPRO IAQ.

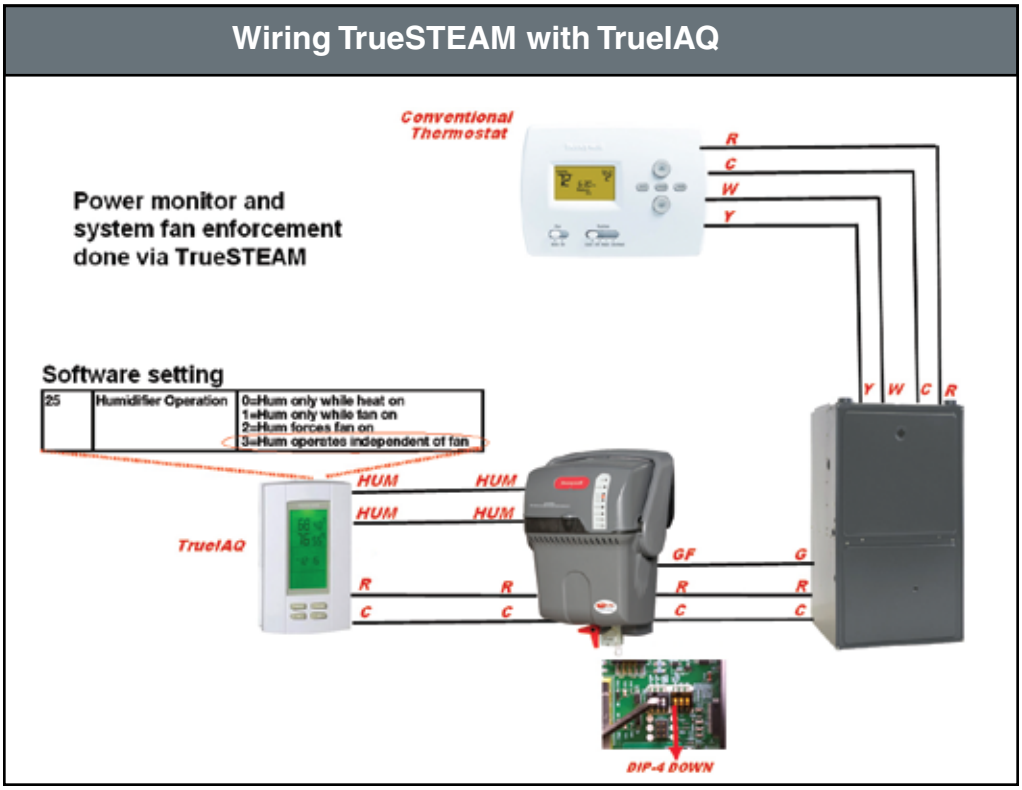
Wiring TrueSTEAM with VisionPRO IAQ



— In TrueIAQ, this is setup function 25

- Because the humidifier control is separate from the HVAC system control (thermostat) in this situation, it is necessary to power monitor and enforce the system fan from TrueSTEAM.
    - On TrueSTEAM, set DIP-4 down.
    - Disconnect thermostat G from HVAC system G
    - Wire TrueSTEAM
        - R and C to HVAC system R and C.
        - Gf to HVAC system G
        - Gt to Thermostat G
        - HUM-HUM to TrueIAQ HUM-HUM
        - 24V-24V to TrueIAQ R and C
    - Wire TrueIAQ
        - R and C to HVAC system R and C.
        - HUM-HUM to TrueSTEAM HUM-HUM

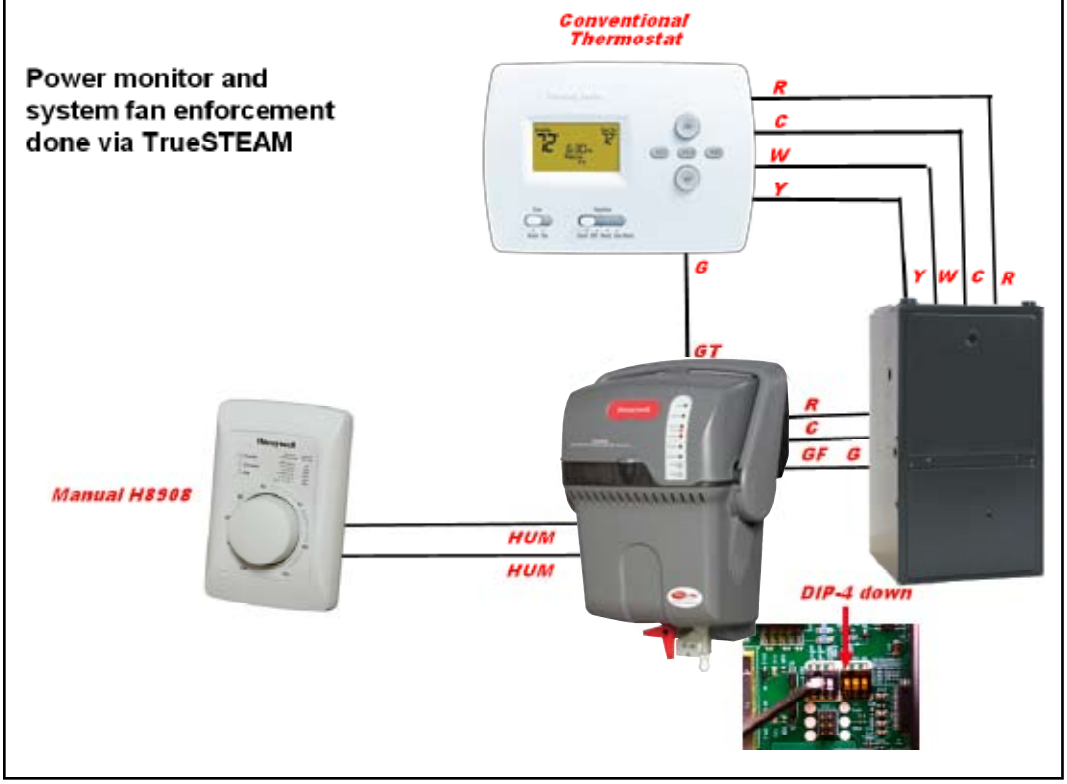
Wiring TrueSTEAM with TrueIAQ



— In a manual humidistat, such as H8908

- Because the humidifier control is separate from the HVAC system control (thermostat) in this situation, it is necessary to power monitor and ensure system fan operation from TrueSTEAM.
    - On TrueSTEAM, set DIP-4 down.
    - Disconnect thermostat G from HVAC system G
    - Wire TrueSTEAM
        - R and C to HVAC system R and C.
        - Gf to HVAC system G
        - Gt to Thermostat G
        - HUM-HUM to H8908 HUM-HUM

Wiring TrueSTEAM with H8908ASPST



— In a Prestige HD wireless, this is setup function .374

- Select option 'Humidifier forces fan on'
- Wire Prestige HD R, C, Y, W, G to system R, C, Y, W, G
- Wire TrueSTEAM A-B-C-D to wireless adaptor A-B-C-D
- Press 'Connect' on the adaptor with Prestige HD set to add a wireless device

Wireless TrueSTEAM with Prestige HD

What are my options and when would I use one over the other?

Two levels of safeguarding are provided when TrueSTEAM is configured to monitor airflow since mechanical air movement is required to change the system's switch state and HVAC power is transferred to TrueSTEAM to indicate this state or transition to TrueSTEAM.

If the thermostat is powered from the HVAC system and power is interrupted, then the thermostat can't turn on TrueSTEAM or the system fan. This is a safeguard to prevent humidifying without airflow applicable only to thermostats that control the fan and humidifier.

With humidistats that are separate from the thermostat, it will be required to configure TrueSTEAM to control the system fan.

- Slight differences exist between the options, which will determine if fan control is desired through TrueSTEAM or the thermostat
  - — TrueSTEAM fan control enforcement utilizes a temperature sensor in the water tank which does not force the fan on until just before humidity is produced. For homeowners that are sensitive to air draftiness in the home, this provides optimal humidity output while minimizing fan operation.

  - — Using the thermostat for fan enforcement during humidity calls is ideal for minimizing the amount of wiring between the TrueSTEAM and the HVAC system. By setting the thermostat to energize system G with each HUM demand call, you need only two wires from the TrueSTEAM to the control (HUM terminals on TrueSTEAM to HUM terminals on equipment interface module or control). In addition DIP-4 on TrueSTEAM is in the UP position.

What happens if done wrong?

- It is critical that contractors configure TrueSTEAM to operate in conjunction with the system fan, either through the humidifier wiring or through a thermostat with humidifier control.
  - — If neither the TrueSTEAM Gf-Gt enforcement or thermostat fan with HUM demand enforcement are enrolled, there is risk of TrueSTEAM producing humidity without air movement in the duct.

  > Example: If the HUM-HUM terminal is wired to a HUM-HUM terminal on a basic manual humidistat that is separate from the thermostat, and you do not wire the G terminals through TrueSTEAM, then TrueSTEAM will humidify without turning the system fan on.

- Keep in mind that TrueSTEAM can monitor power with DIP-4 DOWN, but if G is missing in either scenario, TrueSTEAM will produce humidity without knowledge of fan control.

How do I troubleshoot?

- The most common complaint you will hear from homeowner if G enforcement isn't engaged is 'I'm not getting humidity.'

  — If you get this complaint, unplug TrueSTEAM line cord and remove cover. Ensure G is wired properly as described above.

  Ensure TrueSTEAM can enforce the system fan with these steps:
  — Turn the desired humidity to off, or a level lower than the actual indoor humidity present.
  — Turn off system Heat or Cool calls.
  — Set the thermostat fan to 'Auto', and validate the fan is off before proceeding.
  — Turn the desired humidity to on, or a level higher than the actual indoor humidity present.
  — Validate that the TrueSTEAM starts the fan. If using the Gt-Gf wire connections, note that the fan start will be up to 20-minutes after the initial humidity call, as it waits for water to near boil. Wait for it to engage the fan.

III. Optional Add-On Air Proving

What is it?

Air proving can be defined two ways – proving the fan has power to move air, or proving physical air movement in the duct. Proving the fan has power has been integrated into TrueSTEAM's Fan Enforcement feature. This integrated air proving through fan G-terminal enforcement makes wiring easy, while safeguarding the home by positively confirming the fan has power to move air before allowing TrueSTEAM to humidify. Follow the Fan Enforcement steps applicable to the home during the installation, as illustrated in the previous section of this guide. In nearly all applications, enforcing the fan G-terminal (G wiring and power monitoring) will provide the necessary safeguards against humidity production without airflow.

An optional add-on accessory is available, at extra cost, for proving physical air movement in the duct. This optional accessory is above and beyond fan G-terminal enforcement. By adding this air proving switch and setting DIPs accordingly, TrueSTEAM will verify fan operation – first via G-terminal enforcement, then by looking for air movement via the switch making contact. Think of the system fan G-energization as the primary safeguard feature, and the air proving device as a supplementary option.

How it works

- Air proving via integrated fan G-enforcement
  - — See previous section

- Air proving via an additional air proving option
  - — Wiring an air proving device requires breaking a wiring contact between TrueSTEAM and the HVAC system.
    - Break TrueSTEAM C and HVAC system C contact with the air proving device.
    - On TrueSTEAM, flip DIP-5 UP. This configures TrueSTEAM to monitor physical air movement prior to steam production.
- Once wired in this way with DIP 5 up, TrueSTEAM will check for air movement in the duct when the tank's water temperature reaches 170°F, just prior to humidity production.
  - — This check is switch-based and depends on what air proving device is employed (i.e., pressure switches check for a desired +/- pressure in the duct to prove air, while a sail switch waits for the 'sail' to flip over from air movement). Each actuation will complete the C contact between TrueSTEAM and the HVAC system C, allowing for TrueSTEAM to prove air movement in the duct.
  - — If airflow is not present, TrueSTEAM will shut down prior to humidity production.

What are my options and when would I use one over the other?

In nearly all applications, enforcing the fan G-terminal provides the necessary safeguards against humidity production without airflow. Either TrueSTEAM or the thermostat will force the fan on prior to humidity entering the duct.

Some contractors may want to include the optional air proving in homes where the occupants are gone for extended periods of time, such as vacation homes. This ensures the home is safeguarded against excessively dry conditions, while simultaneously ensuring humidity production is shutdown if the system fan is physically not moving air. An example would be where the system G has been energized, but the fan belt is broken so air is not moving.

The optional air proving device is not critical in homes where there are daily occupants. If the fan has power but air is physically not moving the occupant will notice temperature discomfort and take action (service call) well before TrueSTEAM could affect the ductwork.

What happens if done wrong?

Aside from wiring, the most common error would be misconfiguration of the DIP switches to enable TrueSTEAM to check physical air movement.

— If DIP 4 is up, it does not matter what position DIP 5 is in - TrueSTEAM will not check its R and C terminals for power. And because the air proving device is wired into the C terminal of TrueSTEAM and the HVAC system, it will not be checking it for air proving verification. Operation will continue as if the air proving device is not installed. As long as the system fan G-enforcement is properly wired, TrueSTEAM or its control will still enforce fan energization upon humidity demands.

— If DIP-4 and DIP-5 are down, TrueSTEAM is not enabled to check for air proving through its R and C terminals. Humidifier operation will continue as if the air proving device was not installed. Again, as long as system fan G-enforcement is properly wired, TrueSTEAM or its control will still enforce fan energization upon humidity demands. Think of the system fan G-energization as the primary safeguard feature, and the air proving device as a supplementary option.

How do I troubleshoot?

Verify DIP-4 is down and DIP-5 is up on TrueSTEAM when using the air proving device. It must be power monitoring R and C since the air proving device is on the C terminal. Having DIP 4 down provides power monitoring and DIP-5 enables the TrueSTEAM to check for airflow once the water in the tank reaches 170°F and TrueSTEAM energizes the fan. TrueSTEAM will wait until water is 170°F before activating the fan, to avoid air draftiness in the home.

Summary

Illustrated in this paper are the most common questions contractors have asked regarding wiring the TrueSTEAM humidifier. What is given as a response are most common for overcoming these questions. It is the contractor's choice on what options make most sense for their business and customer. Standardizing on specific control schemes and wiring will help to overcome these hurdles as the installing technicians become familiar with the installation of the TrueSTEAM humidifier, allowing for more installs per day.

NOTES

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