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April 11, 2020

Town of Chilmark
Attn: Tim Carroll
Chilmark Town Hall
401 Middle Road
PO Box 119
Chilmark, MA 02535-0199

Re: Chilmark Elementary School Mechanical Assessment and Recommendations - Final Report

Dear Mr. Carroll:

This letter and attached report serve to provide information pertaining to the overall energy use of the facility and the condition and operation of the existing mechanical systems as well as our recommendations to improve the overall energy and indoor environment of the school. Please read through this final report in full and let us know if you have any additional questions. Thank you.

Sincerely,

Ross Trethewey, PE, MSME
TE2 Engineering, LLC.

Introduction:

The Chilmark School, formerly the Menemsha School, is an elementary school in the town of Chilmark, Massachusetts on the island of Martha's Vineyard. The school educates students from Kindergarten through grade 5. The school student population is about 60 students who are supported by 10 teachers and staff.

The physical school building was constructed in 1998 and is a wood frame structure. The building is designed in the shape of a "U" with an inner courtyard and a total of 7 "pods". The pods resemble independent buildings all linked together by the common corridors. The satellite view of the school building to the right shows the layout of the school and the "pods". The pod in the center is the School Foyer and administrative offices while the other six are classrooms. There is a partial basement under the lower left pod where the boiler room is located.

Methodology:

The methodology for this study first involved a thorough and exhaustive review of the existing documentation, visits to the site and interviews with staff. The documentation included existing building floor plans as well as building elevations used for heat loss calculations. During the site visits, the mechanical equipment was assessed for condition to determine the remaining life expectancy.

Using the information gathered from the existing documentation and the site visits, a heating and cooling load calculation is done to determine the peak winter and summer energy demand. Finally, taking into consideration the condition of the existing equipment and piping as well as the goals of the project, a recommendation is made for the replacement system as well as feasibility of the alternative approaches.

Summary of Findings:

Overall Impressions

In general, the building has a history of underperforming HVAC systems. The system that exists today is far different than the original design intent. This original design intent was not a bad design but failed largely due to poor installation and workmanship. The subsequent modifications largely blamed the design for the flaws than the installation and addressed symptoms that presented themselves in different ways to different people. The end result is a bandaged system that doesn't perform on an energy basis or on comfort. The building as a whole would benefit from a comprehensive HVAC renovation to address the inadequacies outlined below in the individual components of the system.

Air Handling Units

In total, there are seven (7) existing air handling units located in the attic spaces. These air handling units are all made by McQuay International and consist of hot water heating coils. The main purpose of these units are to provide heating to the building and fresh air (ventilation air). The units appear to be manufactured approximately in 1998, which means the units are beyond their useful life expectancy and should be removed during the next renovation. The design of this system seems to have been inadequate because in 2016, these units were disconnected from the hot water loop and electrical power was removed. In order to provide ventilation to the classrooms, energy recovery ventilators (ERV's)were installed in each classroom to compensate for the loss of the air handling units.

The air from the air handling units was distributed through ductwork between the ceiling and the roof. Ceiling diffusers throughout the spaces were intended to supply the air from the air handling unit evenly through the space. In the rooms with high, cathedral type ceilings, some of the supply diffusers were quite high in the space. Using this type of distribution for warm air can be ineffective due to the natural tendency for that warm air to stay at the peaks. Special "high throw" diffusers can be used to counteract that effect but none of the diffusers in these spaces are that type. In some cases, diffusers that were designed to "throw" the air in only 3 directions instead of 4 were installed incorrectly. Instead of "throwing" the air down, the diffusers were rotated to "throw" the air up; further enhancing the natural tendency for this warm air to stay at ceiling level.

This air distribution design is likely responsible or at least a major reason for the determination that the air handling unit design was inadequate; and ultimately disconnecting the system as a whole.

Heating Water Generation System including Boiler

The boiler room is located in the partial basement area. The hot water generation system consists of a single Buderus GB315 oil fired hot water boiler with a dedicated boiler pump, a pair of system distribution pumps arranged in lead/lag and associated piping, sensors and controls. The Buderus boiler replaced an existing cast iron section boiler that has been functionally disconnected but is still physically in the system. The oil is supplied from two tanks that are 275 gallons each. The system has a chemical treatment system.

Overall, the system could benefit from some upgrades and repairs. While the boiler is new and in good working order, there is evidence throughout the building of excess corrosion as is shown in the photo to the right. The source of the corrosion is unknown but it occurs in several locations throughout the system. This photo was taken at one of the air handling units in the attic.

Hot Water Terminal Units and Finned Tube Radiation

The main heating for the building is provided through baseboard finned tube radiation that is mounted along most of the perimeter of the building. In areas where finned tube radiation could not be installed, cabinet unit heaters were used. There is a hot water supply and return piping loop that travels through the corridor ceiling and taps off into each of the rooms. Each room is set up as an independently controlled zone with a separate thermostat. There are a total of 12 zones in this building.

Overall, the heating system is inadequate; largely because it was never intended as the sole source of heat. The original design intent was for the finned tube radiation and the air handling units to jointly provide the heating and ventilation for the spaces. Once the air handling units were disconnected, the sole source of heat remaining was an undersized finned tube radiation system. In addition to being undersized, the layout of the radiators does not allow for complete heating coverage of all spaces; particularly the classrooms. Entire exterior exposures, where most of the heat is lost, are devoid of any kind of heat in each classroom.

Fortunately, the condition of the finned tube radiation is good. There are some missing end caps and other fittings randomly throughout the building but these can easily be replaced. Each zone also has a water balancing valve to ensure proper flow through each zone and a control valve that is wired to a dedicated thermostat. While each of the 12 zones has a dedicated thermostat, there are only 2 thermostats of the 12 that are the same model. The building is a random collection of thermostats; mostly made by Honeywell. There is no consistent standard within the building; which presents an additional challenge to the staff when trying to control or troubleshoot the spaces.

On the day of the site visit, there were several classrooms that felt too warm. There were doors left open to counteract the overheating. Interviews with the staff revealed that because of the random collection of thermostats, there wasn't anyone with sufficient knowledge of the thermostats to be able to control the rooms properly. It was also revealed during these interviews that during cold days, areas within the classrooms never get warm; which confirms the ineffective layout discussed earlier in this section.

Fresh Air Ventilation System

Originally, the ventilation for the building was provided through the air handling units with separate exhaust fans to maintain the air balance. As a result of various factors, the air handling units were disconnected and the building was left without a source for fresh air (aside from opening windows). The solution provided for the ventilation problem was to install a Renewaire energy recovery ventilator (ERV) in each classroom. These units use a set of fans to bring fresh air from outside and exhaust from inside simultaneously. An internal heat exchanger allows the energy from inside the building to be transferred to the air from the outside, which reduces the demand on the heating system. These units were installed in custom fabricated boxes and mounted either high on the wall in high ceiling areas or on the ceiling in flat ceiling areas. The supply air is distributed to the space with a fabric duct.

While this design meets the ventilation needs of the building, it presents new challenges that previously did not exist. First, the unit includes 2 fans that are now inside each classroom. When operating, these fans make noise.

The custom fabricated box that surrounds the ERV units likely makes that noise worse by reverberating the sound of the fans. The teachers commented that the noise can be very distracting to the learning process; and in some cases, the units were turned off as a result or their motion sensors were covered to prevent the ERV from operating. Secondly, while each unit has an energy recovery heat exchanger, there is no active control of the supply air temperature. The air that is supplied to the space on a cold day will still feel cold. Delivered supply air temperatures from the ERV on a cold day could be in the 50 F range. This further burdens an already undersized finned tube radiation system. Since the cool supply air is delivered from ceiling level, the cool air tends to fall to the space (on top of the students) and creates a cold, drafty feeling.

The energy recovery units themselves are in very good condition because they've been protected in the boxes and they are relatively new. The problem with this installation is not the equipment but the application of the equipment. These types of systems can be very effective in providing fresh air to a building but should be used to pretreat ventilation air for an air handling unit rather than supplying air directly to the space or be provided with post heating capability to increase the delivered supply air temperature to the space at or above room temperature. Due to the age and condition of these units, it may be possible to reuse these units as part of a more appropriate solution. If they are to be reused, they should be located in the attic space where the sound can be properly dampened; and the supply air from these units should be further conditioned by an air handling unit or fan coil.

Air Conditioning Systems

The school currently does not contain any permanently installed air condition equipment in the majority of the spaces within the building. The only space with cooling is the Art Room where a single zone ductless split heat pump system has been installed. The installation of this unit was necessary for heating purposes and not for cooling (although it can provide cooling in the summer). The lack of cooling in the rest of the building is an area of focus for the recommendations later in the report.

HVAC System Upgrade Recommendations:

Considerations and Prerequisites

The most important consideration that TE2 Engineering was tasked with is to find a solution for the uneven heat distribution and the noise generated by the current ventilation system. In addition, the school has expressed a desire to move away from fossil fuel based energy sources. There are several options that can achieve these goals. These options are discussed below:

VRF System

A VRF (variable refrigerant flow) system uses a piping network to transport refrigerant throughout the building. Within each room, the refrigerant piping would connect to an indoor unit that can use the refrigerant to provide either heating or cooling at all times. At the other end of the refrigerant piping are air source heat pumps. These heat pumps capture heat from the outdoor air in heating mode and deliver the heat to the indoor units using the refrigeration cycle (driven with an electric compressor). In cooling mode, the cycle reverses and heat captured from inside the space is rejected to the outdoor air. There are several benefits to this system, the main being that this system is entirely electric and does not use any fossil fuel source. In addition, the indoor units are connected to a common refrigeration piping system which allows the sharing of energy. For example, on a cold but sunny day, a classroom with a southern exposure could benefit from cooling mode operation. The energy captured from this classroom could be used to provide heat in another classroom that has a northern exposure and isn't heated from the sun. Finally, the system allows the different spaces to be broken up into separate zones that can be controlled individually and heating or cooling can occur in different zones at the same time.

There are some negative aspects of this system however. The refrigerant that is used is toxic and this fluid is piped throughout the building. New codes and standards limit how much of this refrigerant can be present in a single system. While the code is designed to protect the health and safety of the building occupants, it can cause the cost of the system to increase significantly as the design could be forced to be broken up into smaller subsystems with lower refrigerant volumes. Finally, as this system is an air source system, the efficiency in heating mode suffers as the outdoor temperature falls. This can cause excessive electricity costs to accumulate during long periods of extreme cold weather.

Air-to-Water Heat Pump

An air-to-water heat pump (known as ATW heat pump) operates similarly to the VRF system described above but uses water as the means to transport energy from inside and outside. All of the toxic refrigerant stays outside of the building. This type of system still uses the outdoor air as a heat source in winter and rejects captured heat from inside during summer. As compared to the VRF system, there are some advantages to an ATW heat pump system. First, as indicated above, all of the toxic refrigerant gas stays outside and away from the building occupants. Secondly, since the system uses water to transport energy from inside and outside, the existing piping distribution system would be reused (if determined to be sufficiently sized). Finally, like the VRF system, an ATW heat pump is entirely electric and also does not use any kind of fossil fuel.

An ATW heat pump and VRF system also share some of the same negative aspects. Like the VRF, the ATW heat pump efficiency is dependent on the outdoor air. When the outdoor temperature falls, so does the efficiency. One drawback that the ATW heat pump has that the VRF does not is the inability to provide heating and cooling at the same time in different spaces. While this can be achieved through a 4-pipe system, the costs to install separate heating and cooling piping becomes prohibitive. Also, since the ATW heat pump uses water and that water is piped outside where the heat pump is located, freezing becomes a concern. In northern climates, ATW heat pumps use a glycol antifreeze solution to protect against freezing. Not only is this more expensive to maintain but lowers the overall efficiency of the system even more. Lastly, ATW heat pumps typically reach maximum supply water temperatures of ~120 F on cold days, so in a retrofit system that was originally designed for temperatures of 180 F+ (like from a boiler), this means the existing heating emitters will be undersized, and will require supplemental heat or additional heating emitters.

Hybrid System

An interesting approach to this building could be a hybrid approach; that is using several different types of systems that compliment each other rather than committing to a single solution. A hybrid system could utilize the existing infrastructure while supplementing with new systems to compensate for the shortcomings. One example of a hybrid system is to use an ATW heat pump to provide heating hot water to the existing baseboard system until the outdoor temperature becomes too cold; at which point the boilers turn on to supplement. While this still uses fossil fuels during the coldest periods of the winter, it would significantly decrease the amount of oil used, and provide redundancy.

Another example could combine an ATW heat pump with a VRF system. Again, the ATW heat pump could replace the boiler system and provide heated hot water for the existing finned tube system. The VRF system could then supplement each space to provide the final comfort and ventilation needed. This would provide an all electric system that benefits from the comfort of hydronic heating and supplements the comfort with the VRF system.

A final option for a hybrid system could be to combine the VRF system with supplemental electric heat for the coldest days of the year. A duct heater could be used on the outlet of the VRF air handling units to provide a "boost" on the coldest days of the year when the system efficiency is very low. While not as comfortable or efficient as a hydronic based system, this option would likely be the most cost effective solution.

Budget Estimates

The options described above lend themselves well to a menu type of cost estimate. Each item can be evaluated individually while also being combined with some of the other options. The costs shown below are the best engineering estimates available with the information gathered through the site visit, interviews with the staff, research into the existing equipment and our own energy calculations performed on the building (available in the appendix). It is recommended that these costs be verified by a qualified contractor prior to allocating funds to perform the work. Market conditions and availability of qualified labor personnel can have a significant effect on pricing as well as the nature of the location on an island. The New England region as a whole is currently experiencing a very tight labor market in the trades which results in higher than expected installation costs and longer than expected project timelines. These factors should also be considered when selecting the type of system to use because some technologies require specialist knowledge while others do not. The issue is further complicated by the recent Corona Virus pandemic. The costs outlined in the table below do not include all costs associated with the upgrade, for example, demolition of existing equipment, insulation of the roof, relocation of ERV's/terminations, any ceiling, sprinkler system or patching/painting work that is required to be done as a part of this HVAC upgrade is not included. The cost for this additional work should be confirmed by a general contractor and respective subcontractors.

Description	**Estimated Cost**
VRF System	$200,000
Air-to-Water Heat Pump for Heating Only	$160,000
Supplemental Electric Heat for VRF System	$20,000
Thermostat upgrades (applicable to all options)	$10,000

The timeline for a project like this can vary greatly with the availability of qualified personnel. Due to the nature of this project being a school, the work must be completed during the summer. This work should not take more than 3 months to complete with an adequately staffed crew.

Conclusions & Recommendations

The first concern for this building is the ventilation system. The current classroom mounted ERV system is unacceptable for the nature of the building. Additionally, the building experiences uneven heating and a lack of cooling. With this in mind, there needs to be some architectural changes to the building to accommodate any of the options described above. The rooms with high cathedral ceilings do not have attic space to mount HVAC equipment. If the ceiling could be made flat in each pod this would allow an "attic space" for mechanical equipment to reside. Since this work needs to be performed to make space for new equipment, it is an ideal time to upgrade the insulation in the attic. Rather than adding additional batt insulation at ceiling level, a better option would be to use closed cell spray foam insulation on the roof joists. This would create a completely insulated and air sealed space within the attic that puts the mechanical equipment inside of the thermal envelope. This is currently not the case for the classrooms with a lowered ceiling, as those attics are vented, and the mechanical equipment experiences very cold and hot conditions. This would provide tremendous benefit to the space and the performance of the equipment. Additionally, acoustic isolation treatment can be added to the ceiling of each classroom to reduce the mechanical noise transmission into the classroom. This, along with finishing the window upgrade project, would help reduce the heating load of the building and save money on the purchase of the new mechanical equipment.

During the ceiling work phase of the project, the fire sprinkler system will require modifications to adapt the sprinkler head locations to the new ceiling. Since the sprinkler piping will no longer be in an unheated attic space, it would be possible to convert the sprinkler system from a dry system to a wet system. The dry system was originally installed to prevent pipes from freezing and bursting. While this is an obvious advantage when there is a freeze condition, eliminating the freeze condition also eliminates the advantage of the dry system. A wet system would respond faster to a fire emergency and it would eliminate the need for the air compressor (which keeps the dry side of the system pressurized).

Once that work is complete, there are two options that make the most sense for this building. The first option makes more sense from a comfort perspective and that is the hybrid system consisting of the VRF system with the ATW heat pump. Hydronic based heating is a more comfortable type of heat because the operating temperature of the system prevents the space from feeling dry, as well as there are no air drafts/convective currents. A new ATW heat pump would be installed somewhere outside (or potential indoors and vented to the exterior); likely near the boiler room; and the piping tied into the existing hot water distribution system. The existing boiler and oil tanks would then be removed. From an operational perspective, the finned tube system would be controlled solely based on 2 factors; occupancy and outdoor temperature. The intention of this system would not be the sole heat source for the building but to address the “base load”, which is the heat loss mainly through the exterior walls. Since this load is dependent on the outdoor temperature, controlling the system as a single zone works quite well. As the outdoor temperature falls, the ATW heat pump will produce warmer water to compensate.

The current finned tube system should operate similar to this method and as experience has revealed, it does not provide enough heat and comfort to the space. To address this concern in addition to a means to incorporate ventilation into the classroom, a new VRF system would need to be installed in the newly constructed attic spaces with outdoor heat pumps located either on the roof or on the ground next to the building. The VRF system would consist of ducted air handling units that supply heated air to the spaces. This same system would also be able to provide air conditioning during the warmer months. To address the ventilation, the existing renewaire ERV units can be moved into the attic spaces and connected to the new air handling units. The control of the VRF system would be based on schedule and space temperature. When the space is unoccupied, the ERV would turn off and the VRF set points would be adjusted to consume less energy. Occupancy sensors could be used in the classrooms in lieu of strictly scheduling to better enhance the energy performance of the new system. By controlling the VRF system from a thermostat and the finned tube radiation based on outdoor temperature, neither system is competing with the other for control of the environment.

The second option is more cost effective but less comfortable. This system is the VRF with supplemental electric heat. With this option, all of the hot water finned tube, piping, boilers and cabinet unit heaters would either be removed or abandoned in place (preferably removed). The VRF system described in the first option would be installed in the new attic spaces. In locations where hot water cabinet /unit heaters were installed, new electric heaters could be used. In addition, new electric resistance duct heaters would be installed in the supply air ductwork for the VRF air handling units,to supplement the space during the coldest days of the year when the VRF heat pumps lose efficiency. The control of this system would strictly be based on occupancy and space temperature. A thermostat in each space would signal the system to provide either heating or cooling. When in heating, if the supply temperature does not achieve the desired set point, the electric duct heaters would turn on to supplement. Again, as in the first option, the ERV would not operate when the space was not occupied.

Lastly, whichever upgrade is selected, the thermostats should all be standardized. Simple to use thermostats are available, and by standardizing throughout the building, all teachers would have proper understanding and control of the HVAC system. In addition, many thermostats are WiFi enabled, which would allow the facilities manager or administrator to see all of the temperatures of the building from a single web enabled dashboard. This would allow temperature adjustments to be made remotely, including schedule adjustments, as well as provide alerts based on low temperature or high temperature limits being exceeded (or other similar conditions). This is far more cost effective than ever before.

In conclusion, both HVAC upgrade options meet the primary goals of addressing the uneven heating and the noise generated from the ERV units with an all electric system. While budget is always a concern, comfort of the occupants within the space should be an important consideration within the decision making process, as well as future operating costs/greenhouse gas emissions. If the proposed systems are evaluated at the present time, efficiencies of VRF heat pumps are approximately 3X that of an oil fired hydronic heating system (Seasonal Heat Pump COP= 2.5-3.0, Boiler COP= 0.85). However the price per gallon of oil, at $2.80/gallon is equivalent to ~$0.07/kWh, which is about one third of the electricity cost on the island ($0.25/kWh). So this puts the operational costs of electrically driven VRF heat pumps “on par” with oil fired hydronic heating systems. Part of this is because the cost of electricity on the island is higher than the state average and much higher than the national average. So it is possible that the VRF and electric resistance heat system would have equal (or potentially higher) operating cost than that of the current oil fired system. This will largely depend on the price of oil/electricity and the extent of the energy currently being wasted through open windows and other inefficiencies/measures to control the indoor comfort. Additionally, the building currently does not have an air conditioning system (except for 1 classroom), so the use of air conditioning during the warmer months will certainly add to the operating costs of the building.

TE2 does not have any insight in terms of predicting future energy costs. If the goal is to ultimately reduce the electrical operating cost of the proposed HVAC solution, gain energy independence, hedge against energy inflation, lower Greenhouse Gas (GHG) emissions and care for the environment than the installation of on-site electrical generation with either solar panels or wind energy should be considered in conjunction with an all electric HVAC system. If the main goal is to reduce operating costs with minimal capital expenditure, in addition to hedging against variable future energy costs, then a dual fuel “hybrid” approach should be considered. This would leave the boiler and oil tanks in place, in the event that oil prices drop in the future, and could run in conjunction with the VRF heat pump system (referred to as covalent and bivalent control strategies).

Ultimately, any of the proposed options would offer a marked improvement of the current HVAC situation at the school, and all should be considered.

Appendix:

- Heating and Cooling Load Calculations
- WiFi Thermostat (Honeywell Vision Pro 8000 WiFi)- reference document for classrooms
- VRF cold climate heat pump (Mitsubishi PVA36-PUZ36 “Hyperheat”)- reference document for classrooms
- Air to Water Heat Pump (Aermec NRK 550)- reference document for example AWHP

Right-Suite® Universal 2019 Load Summary

Entire House

Job: Chilmark Elementary Sc...
Date: March 3, 2020
By: SRM

372 University Avenue, Westwood, MA 02090

Project Information

For: Chilmark Elementary School
8 State Rd., Chilmark, MA 02535

Zone: Entire House

COOLING LOAD

1. DESIGN CONDITIONS at Jul 1800 LDT — Peak load at Jul 1800 LDT

Inside: 75 °F Outside: 87 °F TD: 12 °F

RH: 63 % MoistDiff: 58.6 gr/lb Mult: 1.0 Ins.wb 63 °F

					Sensible	Latent
2.	**SOLAR RADIATION THROUGH GLASS**				75258	-
3.	**TRANSMISSION GAINS**		Sensible		52311	-
	Walls:		15943		-	-
	Glass:		8470		-	-
	Doors:		2527		-	-
	Partitions:		0		-	-
	Floors:		0		-	-
	Ceilings:		25370		-	-
4.	**INTERNAL HEAT GAIN**		Sensible	Latent	58678	17970
	Occupants:		24242	17970	-	-
	Lights:		28715	-	-	-
	Motors:		0	-	-	-
	Appliances:		5721	0	-	-
5.	**INFILTRATION:**	Outside air cfm:		1256	16924	50009
6.	**SUBTOTAL:**	Space load	Sensible	Latent	203171	67979
	Envelope		203171	67979	-	-
	Less external		0	-	-	-
	Redistribution		0	0	-	-
7.	**SUPPLY DUCT**				0	-
8.	**SUBTOTAL:**	Space load + supply duct			203171	-
	Actual cfm:	9433	at supply TD:	20	-	-
9.	**VENTILATION:**	Make-up air cfm:		4064	19159	80877
10.	**RETURN AIR LOAD:**	Lighting + plenum (net)			0	-
11.	**RETURN DUCT**				0	-
12.	**TOTAL LOADS ON EQUIPMENT**				222330	148856

HEATING LOAD

13. DESIGN CONDITIONS Mult: 1.0

Inside: 70 °F Outside: 10 °F TD: 61 °F

14.	**TRANSMISSION LOSSES**				154199
	Walls:		29844		-
	Glass:		44857		-
	Doors:		3356		-
	Partitions:		0		-
	Floors:		52575		-
	Ceilings:		23566		-
15.	**INFILTRATION:**	Outside air cfm:		2098	139464
16.	**SUBTOTAL:**	Space load			293663
	Envelope		293663		-
	Less external		0		-
	Less transfer		0		-
	Redistribution		0		-
17.	**SUPPLY DUCT:**				0
18.	**VENTILATION:**	Make-up air cfm:		4064	94546
19.	**HUMIDIFICATION**				0
	Piping				0
20.	**RETURN DUCT**				0
21.	**TOTAL HEATING LOAD ON EQUIPMENT**				388209

Building Analysis
Entire House

Job: Chilmark Elementary Sc...
Date: March 3, 2020
By: SRM

372 University Avenue, Westwood, MA 02090

Project Information

For: Chilmark Elementary School
8 State Rd., Chilmark, MA 02535

Design Conditions

Location:
Marthas Vineyard, MA, US
Elevation: *33* ft
Latitude: 41°N

Outdoor:

	Heating	Cooling
Dry bulb (°F)	10	87
Daily range (°F)	-	16 (M)
Wet bulb (°F)	-	77
Wind speed (mph)	15.0	7.5

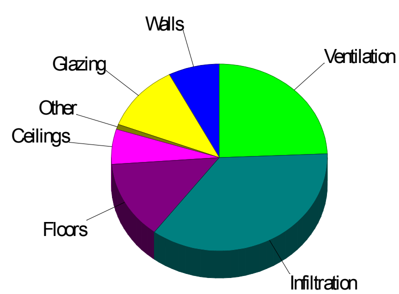
Indoor:

	Heating	Cooling
Indoor temperature (°F)	70	75
Design TD (°F)	61	12
Relative humidity (%)	37	50
Moisture difference (gr/lb)	25.5	58.6

Infiltration:
Method: Simplified
Construction quality: Average

Heating

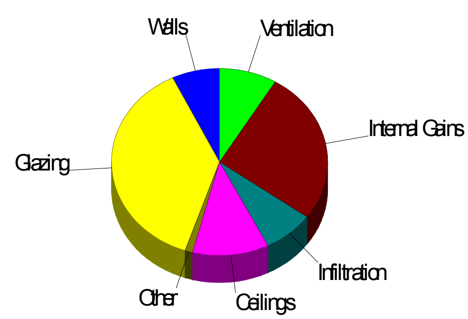
Component	Btuh/ft²	Btuh	% of load
Walls	3.8	29844	7.7
Glazing	19.4	44857	11.6
Doors	16.0	3356	0.9
Ceilings	1.9	23566	6.1
Floors	4.2	52575	13.5
Infiltration	55.2	139464	35.9
Ducts		0	0
Piping		0	0
Humidification		0	0
Ventilation		94546	24.4
Adjustments		0	
Total		**388209**	**100.0**



Cooling

Jul 1800 LDT

Component	Btuh/ft²	Btuh	% of load
Walls	2.1	15943	7.2
Glazing	36.1	83728	37.7
Doors	12.0	2527	1.1
Ceilings	2.0	25370	11.4
Floors	0	0	0
Infiltration	6.7	16924	7.6
Ducts		0	0
Ventilation		19159	8.6
Internal gains		58678	26.4
Blower		0	0
Adjustments		0	
Total		**222330**	**100.0**



Latent Cooling Load = 148856 Btuh
Overall U-value = 0.077 Btuh/ft²-°F

Data entries checked.

Bold/italic values have been manually overridden

Project Information

For: Chilmark Elementary School
8 State Rd., Chilmark, MA 02535

		Htg	Clg			Htg	Clg
Outside db	(°F)	10	87	Inside db	(°F)	70	75
Outside RH	(%)	-	63	Inside RH	(%)	-	50
Outside wb	(°F)	-	77	Inside wb	(°F)	-	63
Daily range	(°F)	-	16	Design TD	(°F)	61	12
Moisture diff.	(gr/lb)	-	59				

Heating Equipment

Make		
Model		
Type	Gas furnace	
Efficiency	80 AFUE	
Heating Input	0	MBtuh
Heating Output	0	MBtuh
Humidifier	9.2	gpd
Leaving Air Temp	70.0	°F
Actual Heating Fan	9433	cfm

Cooling Equipment

Make		
Model		
Type	Split AC	
COP / EER / SEER	0	
Sensible Cooling	0	MBtuh
Latent Cooling	0	MBtuh
Total Cooling	0	MBtuh
Leaving Air Temp	55.0	°F
Actual Cooling Fan	9433	cfm

Equipment Location	Entire House	
System Type	PEAKCV	
Fan Motor Heat Type	PACKAGE	
Fan & Motor Combined Efficiency	0	%
Static Pressure Across Fan	0	in H2O

NAME	Area ft²	Heat Loss	Sensible Gain	Latent Gain	Htg cfm	Clg cfm	Time
001 Storage	754	0	0	0	0	0	Jul 1800 LDT
002 Mechanical	645	0	0	0	0	0	Jul 1800 LDT
109 Airlock/Bell	260	18429	6938	3883	571	353	Jul 1800 LDT
110 Lobby	1521	52767	28528	14685	1570	1262	Jul 1800 LDT
111 Reception	217	3927	1859	1325	108	80	Jul 1800 LDT
112 Girls	134	1483	1026	924	37	44	Jul 1800 LDT
113 Boys	130	1442	1005	906	36	43	Jul 1800 LDT
114 Janitor	27	299	415	406	7	18	Jul 1800 LDT
115 Side Entrance	102	11554	5259	3117	363	246	Jul 1800 LDT
116 Stg.	78	863	706	653	21	30	Jul 1800 LDT
117 Principal	182	3545	1662	1158	99	72	Jul 1800 LDT
118 Conference	197	2185	1388	1231	54	58	Jul 1800 LDT
119 Nurse	122	1349	957	865	33	41	Jul 1800 LDT
120 Staff	76	836	692	641	21	30	Jul 1800 LDT
121 K 1	1332	40121	20696	17849	821	811	Jul 1800 LDT
122 K 1 Restroom	68	747	646	602	18	28	Jul 1800 LDT
123 Art/Music	786	25290	13865	11301	536	576	Jul 1800 LDT
125 Stg	123	2347	1200	869	65	52	Jul 1800 LDT
126 Tech	798	18819	14391	9850	384	592	Jul 1800 LDT

128 Hall W	689	29247	26242	5960	883	1191	Jul 1800 LDT
129 Hall E	670	28977	14633	5868	876	758	Jul 1800 LDT
130 Class-Room	1194	32219	15146	16191	616	562	Jul 1800 LDT
131 Class-Room	1178	33411	18847	16005	659	727	Jul 1800 LDT
132 Special Ed.	204	3600	2308	1263	99	104	Jul 1800 LDT
133 Class Room	1175	31134	20071	15966	587	795	Jul 1800 LDT
134 Class-Room	1183	39475	21681	16061	853	867	Jul 1800 LDT
135 Meeting	207	4139	2170	1278	116	94	Jul 1800 LDT
Entire House	14050	388209	222330	148856	9433	9433	Jul 1800 LDT

372 University Avenue, Westwood, MA 02090

Project Information

For: Chilmark Elementary School
8 State Rd., Chilmark, MA 02535

Design Conditions

	Htg	Clg		Htg	Clg
Outside db (°F)	10	87	Inside db (°F)	70	75
Outside RH (%)	80	63	Inside RH (%)	37	50
Outside wb (°F)	20	77	Inside wb (°F)	55	63
Daily range (°F)	-	16	Design TD (°F)	61	12
Moisture diff. (gr/lb)	25.5	58.6			

Construction descriptions

Construction descriptions	Or	Area ft²	U-value (Btuh/ft²-°F)	UA (Btuh/°F)	Loss (Btuh)	Gain (Btuh)
Walls						
Bg wall, heavy dry or light damp soil, concrete wall, 10" thk, 1/2" gypsum board int fnsh	ne	510	0.09	46.7	0	0
	se	318	0.09	29.0	0	0
	sw	510	0.09	46.7	0	0
	nw	276	0.09	25.2	0	0
	all	1613	0.09	148	0	0
Frm wall, wd ext, 3/8" wood shth, r-11 cav ins, 1/2" gypsum board int fnsh, 2"x6" wood frm, 16" o.c. stud	ne	1659	0.08	133	8038	3512
	se	1579	0.08	126	7648	4465
	sw	1642	0.08	131	7955	5301
	nw	1281	0.08	103	6204	2665
	all	6160	0.08	493	29844	15943
Partitions						
(none)						
Windows			htg / clg	htg / clg		
2 glazing, clr low e, U-0.32, SHGC-0.4, wood frame, French door; 6.67 ft head ht	ne	54	0.32 / 0.32	17.3 / 17.3	1045	1022
	se	54	0.32 / 0.32	17.3 / 17.3	1045	1317
	sw	108	0.32 / 0.32	34.6 / 34.6	2091	5459
	nw	162	0.32 / 0.32	51.8 / 51.8	3136	7459
	all	378	0.32 / 0.32	121 / 121	7318	15257
2 glazing, clr low e, U-0.32, SHGC-0.4, wood frame, operable; 7.5 ft head ht	ne	620	0.32 / 0.32	198 / 198	12003	11996
	se	315	0.32 / 0.32	101 / 101	6098	7685
	sw	541	0.32 / 0.32	173 / 173	10474	27451
	nw	463	0.32 / 0.32	148 / 148	8964	21339
	all	1939	0.32 / 0.32	620 / 620	37539	68471
Doors						
Door, wd sc type	ne	42	0.33	13.9	839	327
	sw	84	0.33	27.7	1678	1536
	nw	42	0.33	13.9	0	0
	nw	42	0.33	13.9	839	664
	all	210	0.33	69.3	3356	2527

Ceilings

Rf/clg ceiling, wood shingles roof mat, frm cons, 1/2" gypsum board int fnsh, 6" thkns, r-44 ceil ins	13k	0.03	390	23566	25370

Floors

Bg floor, heavy dry or light damp soil, 10' depth	1399	0.02	23.9	0	0
Bg floor, heavy dry or light damp soil, on grade depth	736	1.18	869	52575	0

Loads for Multiple Orientations

Entire House

Job: Chilmark Elementary Sc...
Date: March 3, 2020
By: SRM

372 University Avenue, Westwood, MA 02090

Project Information

For: Chilmark Elementary School
8 State Rd., Chilmark, MA 02535

Design Conditions

Location:
Marthas Vineyard, MA, US
Elevation: 33 ft
Latitude: 41°N

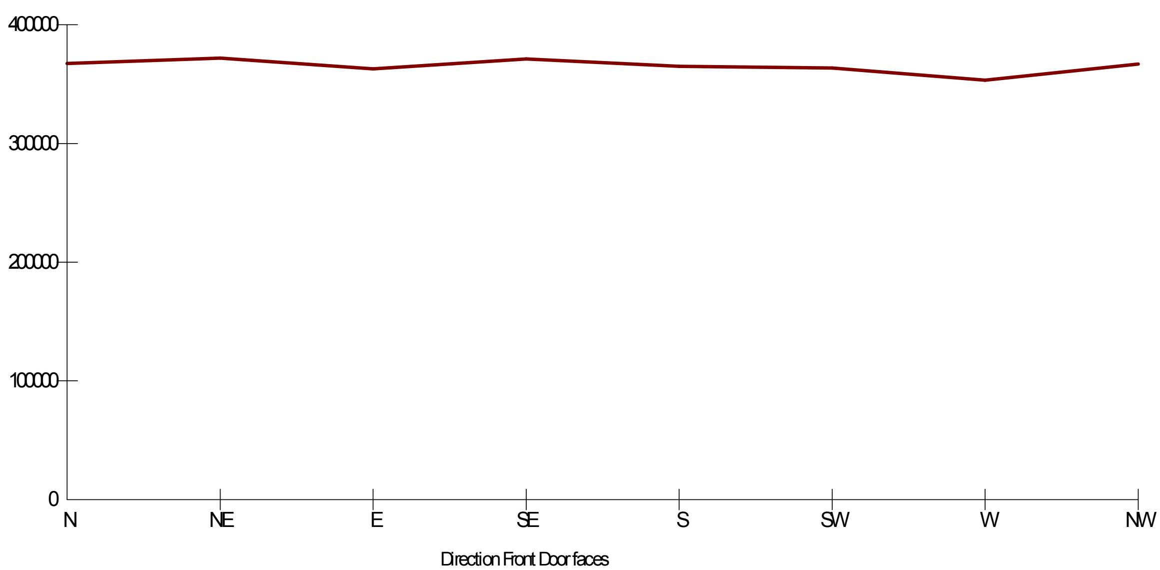
Outdoor:	**Heating**	**Cooling**
Dry bulb (°F)	10	87
Daily range (°F)	-	16 (M)
Wet bulb (°F)	-	77
Wind speed (mph)	15.0	7.5

Indoor:	**Heating**	**Cooling**
Indoor temperature (°F)	70	75
Design TD (°F)	61	12
Relative humidity (%)	37	50
Moisture difference (gr/lb)	25.5	58.6

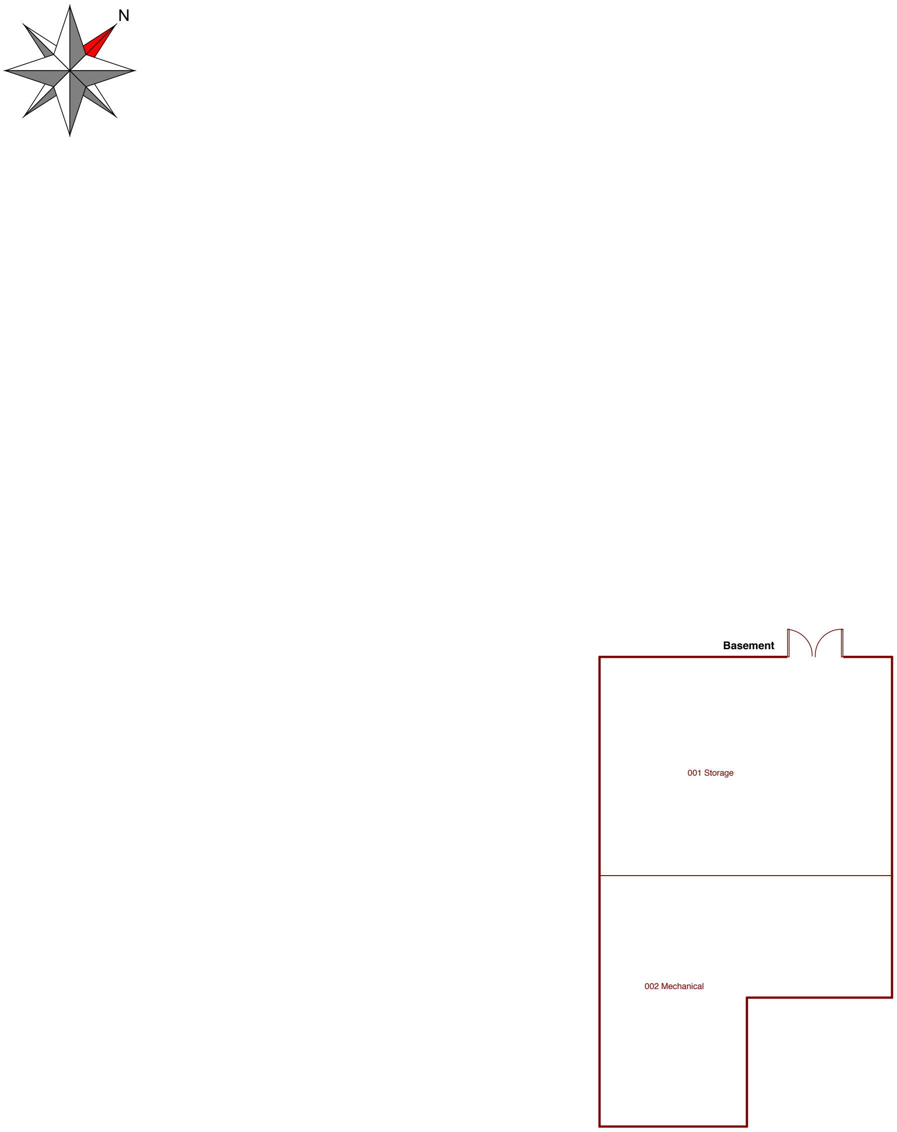
Infiltration:

Front Door	North	Northeast	East	Southeast	South	Southwest	West	Northwest
Sensible Load (Btuh)	218432	223144	214056	222330	216060	214690	204501	218127
Latent Load (Btuh)	148856	148856	148856	148856	148856	148856	148856	148856
Total Load (Btuh)	367288	372001	362912	371187	364917	363546	353358	366984
Heating AVF (cfm)	9696	9660	9055	9433	9497	9388	8906	9510
Cooling AVF (cfm)	9696	9660	9055	9433	9497	9388	8906	9510

Building Orientation Cooling Load



Current Orientation: Front Door faces Southeast
Highest Cooling Load: Front Door faces Northeast



Job #: Chilmark Elementary School
Performed by SRM for:
Chilmark Elementary School
8 State Rd.
Chilmark, MA 02535

372 University Avenue
Westwood, MA 02090

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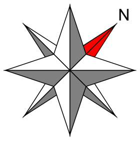
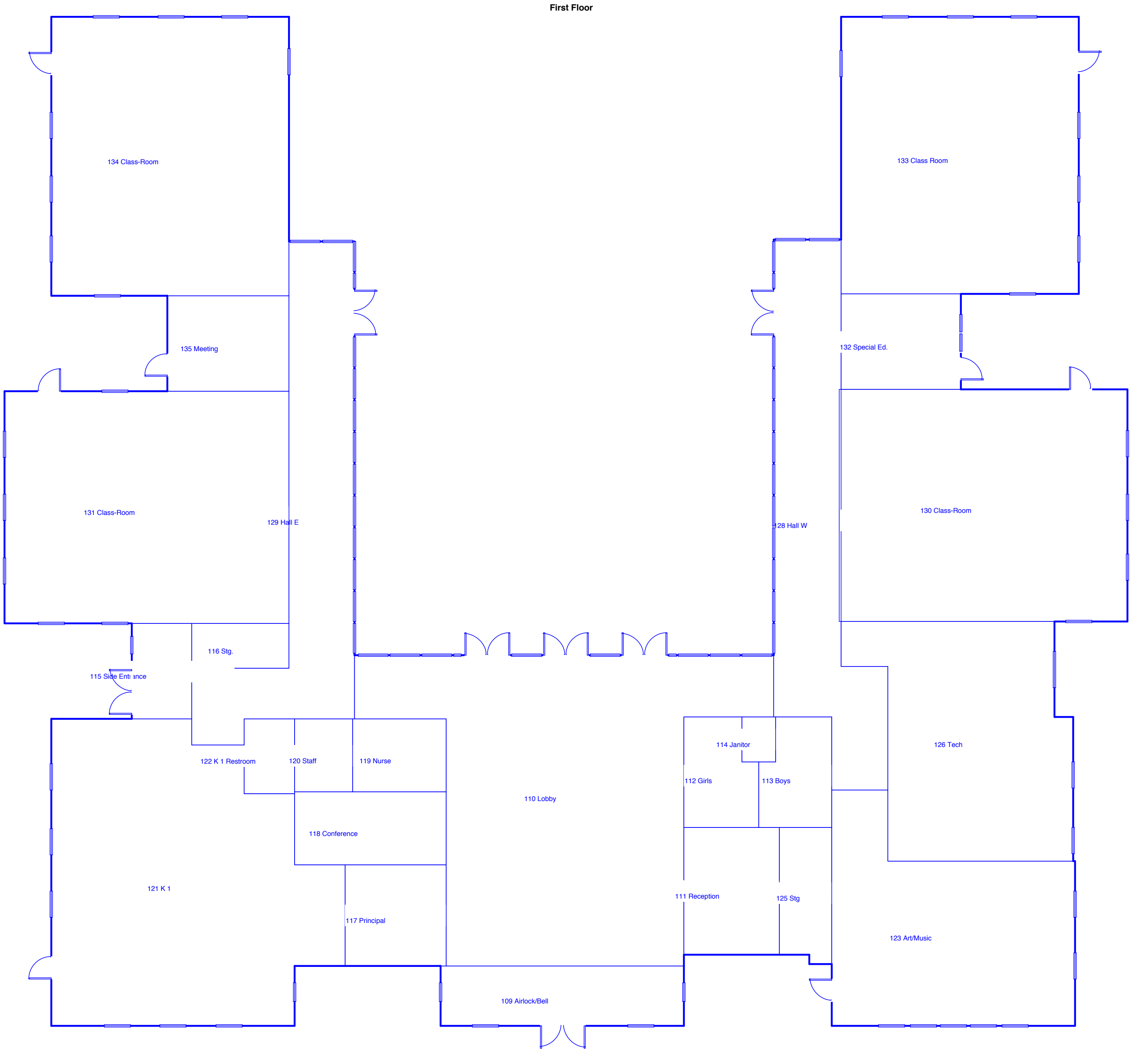




Job #: Chilmark Elementary School **Performed by SRM for:** Chilmark Elementary School 8 State Rd. Chilmark, MA 02535	372 University Avenue Westwood, MA 02090	Scale: 1 : 250 Page 2 Right-Suite® Universal 2019 19.0.18 RSU27561 2020-Apr-08 11:40:40 ...raded Windows+Ceiling_200309.rup

Honeywell

Wi-Fi VisionPRO® 8000

SUBMITTAL SHEET

APPLICATION

Wi-Fi VisionPRO allows remote access through a Smartphone, Tablet or Computer. It controls Up to 3H/2C Heat Pump systems or up to 2H/2C Conventional systems. Thermostat is selectable for Residential or Light Commercial applications. The thermostat have a Universal Relay to control humidification, humidification or ventilation.

- The thermostat is equipped with a touchscreen display with a 2 line message center.
- Provides Remote Access through Smartphone, Tablet or Computer when connected to Wi-Fi and registered to mytotalconnectcomfort.com
- Provides lockout temperatures for auxiliary heat and/or compressor lockout in Heat Pump system using the wired outdoor sensor accessory or using the outdoor information from the cloud if no wired sensor is used, but the thermostat is connected to Wi-Fi and registered.

SPECIFICATIONS

Terminal Designations:
TH8321WF Thermostat: R, RC, C, W-O/B, W2-AUX/E, Y, Y2, G, A-L/A, K, U1 U1, S1 S1

Electrical Ratings (for VisionPRO and Equipment Interface Module):

Terminal	Voltage (50/60 Hz)	Max. Current Rating
W - O/B	18 to 30 VAC	1.00A
Y (cooling)	18 to 30 VAC	1.00A
G (fan)	18 to 30 VAC	0.50A
W2 - Aux/E	18 to 30 VAC	0.60A
Y2 (cooling)	18 to 30 VAC	0.60A
A-L/A (Output)	18 to 30 VAC	1.00A
U1, U1	30 VAC max.	0.50A

Power Consumption of TH8321WF Thermostat:
Backlight on: 2.35 VA

Backlight off: 1.40 VA

Wi-Fi Communication Requirements:
802.11 b/g/n routers

Android or IOS Smartphone, tablet or device

Temperature Setting Range:
Heating: 40 to 90 °F (4.5 to 32 °C)

Cooling: 50 to 99 °F (10 to 37 °C)

Temperature Sensor Accuracy:
± 1.5 °F at 70 °F (0.75 °C at 21.0 °C)

Humidification Setting Range: 10% to 60% RH

Dehumidification Setting Range: 40% to 80% RH

Humidity Display Range: 0% to 99%

Humidity Sensor Accuracy:
± 5% RH from 30% to 50% RH at 75 °F (24 °C)

Cool Indication:
Displays "Cool On" when the thermostat turns the cooling on.

Heat Indication:
Displays "Heat On" when the thermostat turns the heating on.

Auxiliary Heat Indication:
Displays "Aux Heat On" when the thermostat turns the auxiliary heat on.

Interstage Differential:
Comfort: The thermostat keeps the indoor temperature within 1 degree of the setpoint (droop less control). The thermostat turns on stage 2 when the capacity on stage 1 reaches 90%.

When the interstage differential is set to 1.0 or higher, the thermostat stages the equipment based on how far the indoor temperature is from the setpoint.

Clock Accuracy:
If not connected to Wi-Fi: 1 minute per month at 77 °F (25 °C). ± 2 minutes per month over the operating ambient temperature range.

If connected to Wi-Fi and registered to Total Connect Comfort: the current time is synced via the Internet.

Mounting Means:
Thermostat mounts directly on the wall in the living space using mounting screws and anchors provided. Fits a horizontal 2 x 4 in. junction box. Use a cover plate and its mounting bracket to mount the thermostat onto a vertical 2 x 4 in. junction box.

Job Name ____________________

Engineer ____________________

Mechanical Contractor ____________________

Contractor's P.O. No. ____________________

Representative ____________________

Notes ____________________

Model(s)

TH8321WF1001 ☐ **Qty.**________ **Notes**____________________

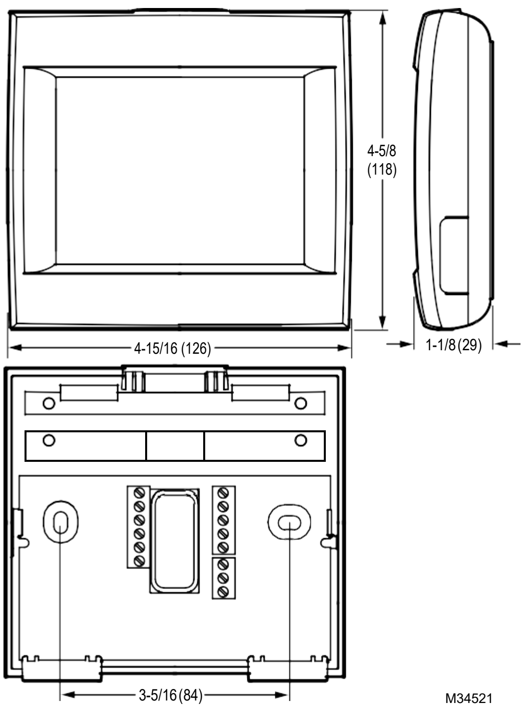
Approval ____________________

Service ____________________

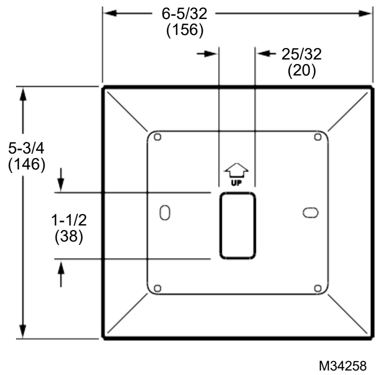
Tag No. ____________________

Product	Part Number	Operating Ambient Temperature	Operating Relative Humidity	Shipping Temperature	Physical Dimensions in in. (mm)	Color(s)
Thermostat	TH8321WF1001	32 to 120 °F (0 to 48.9 °C)	5% to 90% Non-Condensing	-20 to 120 °F (-28.9 to 48.9 °C)	4-15/16 x 4-5/8 x 1-1/8 (126 x 118 x 29)	Arctic White

Dimensions of thermostat in in. (mm).



Dimensions of VisionPRO cover plate in in. (mm).



Automation and Control Solutions
Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

Honeywell

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SUBMITTAL DATA: PVA-A36AA7 & PUZ-HA36NHA5
36,000 BTU/H AIR HANDLER HEAT PUMP SYSTEM

Job Name:	
System Reference:	Date:

Indoor Unit: PVA-A36AA7	Outdoor Unit: PUZ-HA36NHA5
	

INDOOR UNIT FEATURES
- Ducted air handler provides a solution to cool and heat large zones
- Highly efficient totally enclosed ECM motor
- Selectable external static pressure: 0.30, 0.50 and 0.80 in.WG with 3 fan speeds at each static setting
- 1 inch R4.2 fiberglass free insulation reduces condensation and boosts efficiency
- Positive pressure cabinet with air leakage of less than 1.0% at 1.0 in.WG
- Unique blow through design allows simple coil cleaning when the blower is removed
- Multi-position installation: horizontal (left or right), vertical (up or down). For downflow configurations, the CMA-1 is recommended for proper management of condensate to prevent water blow-off in certain conditions
- Optional electric heat kit for additional heat capacity
- Optional humidifier control and ERV control

OUTDOOR UNIT FEATURES
- Variable speed INVERTER-driven compressor
- High heating capacity: flash injection circuit maintains 100% heating capacity at 5°F outdoor temperature
- Wide heating range: heating performance down to -13°F (average of 80% heating capacity)
- High speed heating at start up: Hyper-Heating INVERTER® reduces the time for heating at start up by about half compared to standard models
- Suction accumulator pre-charged with refrigerant volume for piping length up to 100 ft.
- Twinning of two indoor units possible with the 36 kBtu/h model
- High pressure/temperature protection

SPECIFICATIONS: PVA-A36AA7 & PUZ-HA36NHA5

Model Number	Indoor Unit		PVA-A36AA7
	Outdoor Unit		PUZ-HA36NHA5
Cooling[1]	Maximum Capacity	Btu/h	36,000
	Rated Capacity	Btu/h	33,000
	Minimum Capacity	Btu/h	18,000
	Maximum Power Input	W	3,040
	Rated Power Input	W	2,640
	Moisture Removal	Pints/h	7.4
	Sensible Heat Factor		0.74
	Power Factor	%	87.6
Heating at 47°F[2]	Maximum Capacity	Btu/h	40,000
	Rated Capacity	Btu/h	38,000
	Minimum Capacity	Btu/h	18,000
	Maximum Power Input	W	3,360
	Rated Power Input	W	3,040
	Power Factor	%	88.7
Heating at 17°F[3]	Maximum Capacity	Btu/h	38,000
	Rated Capacity	Btu/h	29,000
	Maximum Power Input	W	5,400
	Rated Power Input	W	3,230
Heating at 5°F[4]	Maximum Capacity	Btu/h	38,000
	Maximum Power Input	W	6,100
Efficiency	SEER		17.8
	EER[1]		12.5
	HSPF (IV)		11.0
	COP at 47°F[2]		3.66
	COP at 17°F in Maximum Capacity		2.06
	COP at 5°F in Maximum Capacity		1.82
	ENERGY STAR® Certified (ENERGY STAR products are third-party certified by an EPA-recognized Certification Body)		Yes
Electrical	Voltage, Phase, Frequency		208 / 230V, 1-phase, 60 Hz
	Guaranteed Voltage Range	V AC	198 – 253
	Voltage: Indoor - Outdoor, S1-S2	V AC	208V / 230
	Voltage: Indoor - Outdoor, S2-S3	V DC	24
	Voltage: Indoor - Remote controller	V DC	12
	Recommended Fuse/Breaker Size	A	30
	Recommended Wire Size (Indoor - Outdoor)	AWG	14
Indoor Unit	MCA	A	5.50
	Fan Motor Full Load Amperage	A	4.40
	Fan Motor Output	W	430
	Airflow Rate, Dry	CFM	788-956-1125

Specifications are subject to change without notice.

SPECIFICATIONS: PVA-A36AA7 & PUZ-HA36NHA5

Model Number	Indoor Unit		PVA-A36AA7
	Outdoor Unit		PUZ-HA36NHA5
	Airflow Rate, Wet	CFM	n/a
	External Static Pressure	in.WG	0.30-0.50-0.80
	Sound Pressure Level	dB(A)	30-34-38
	Drain Pipe Size	In. (mm)	3/4 FPT (19.05)
	Condensate Lift Mechanism, Maximum Distance	Ft. (m)	n/a
	Heat Exchanger Type		Plate fin coil
	External Finish Color		Galvanized steel cabinet-Powder coated Slate Gray
	Unit Dimensions // Grille Dimensions	W: In. (mm)	25 (635)
		D: In. (mm)	21-5/8 (548)
		H: In. (mm)	59-1/2 (1511)
	Unit Weight	Lbs. (kg)	172 (78)
Indoor Unit Operating Temperature Range	Cooling Intake Air Temp (Maximum / Minimum)	°F	90 DB, 73 WB / 66 DB, 59 WB
	Heating Intake Air Temp (Maximum / Minimum)	°F	82 DB / 50 DB
Outdoor Unit	MCA	A	28
	MOCP	A	40
	Fan Motor Full Load Amperage	A	0.4+0.4
	Fan Motor Output	W	86+86
	Airflow Rate	CFM	3,530
	Refrigerant Control		Electronic Expansion Valve
	Defrost Method		Reverse Cycle
	Heat Exchanger Type		Cross fin
	Sound Pressure Level, Cooling[1]	dB(A)	52
	Sound Pressure Level, Heating[2]	dB(A)	53
	Compressor Type		INVERTER-Driven Twin Rotary
	Compressor Model		ANB33FJEMT
	Compressor Rated Load Amps	A	18
	Compressor Locked Rotor Amps	A	27.5
	Compressor Oil Type // Charge	oz.	FV50S // 45
	External Finish Color		Ivory Munsell 3Y 7.8/1.1
	Base Pan Heater		n/a
	Unit Dimensions	W: In. (mm)	37-3/8 (950)
		D: In. (mm)	13 + 1-3/16 (330 + 30)
		H: In. (mm)	53-1/8 (1,350)
	Package Dimensions	W: In. (mm)	40-15/16 (1,040)
		D: In. (mm)	17-11/16 (450)
		H: In. (mm)	56-11/16 (1,440)
	Unit Weight	Lbs. (kg)	265 (120)
	Package Weight	Lbs. (kg)	289 (131)

Specifications are subject to change without notice.

SPECIFICATIONS: PVA-A36AA7 & PUZ-HA36NHA5

Model Number	Indoor Unit		PVA-A36AA7
	Outdoor Unit		PUZ-HA36NHA5
Outdoor Unit Operating Temperature Range	Cooling Intake Air Temp (Maximum / Minimum)	°F	115 DB / 0* DB
	Heating Intake Air Temp (Maximum / Minimum)	°F	70 DB, 59 WB / -13 DB, -13 WB
	Thermal Lock-out / Re-start Temperatures**	°F	n/a
Refrigerant	Type		R410A
	Charge	Lbs, oz	12
Piping	Gas Pipe Size O.D. (Flared)	In.(mm)	5/8 (15.88)
	Liquid Pipe Size O.D. (Flared)	In.(mm)	3/8 (9.52)
	Maximum Piping Length	Ft. (m)	245 (75)
	Maximum Height Difference	Ft. (m)	100 (30)
	Maximum Number of Bends		15

Notes

AHRI Rated Conditions (Rated data is determined at a fixed compressor speed)	[1]Cooling (Indoor // Outdoor)	°F	80 DB, 67 WB // 95 DB, 75 WB
	[2]Heating at 47°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 47 DB, 43 WB
	[3]Heating at 17°F (Indoor // Outdoor)	°F	70 DB, 60 WB // 17 DB, 15 WB
Conditions	[4]Heating at 5°F (Indoor // Outdoor)	°F	70 DB, 60 WB // -4 DB, -5 WB

*Wind baffles required to operate below 23°F DB in cooling mode. PUZ with wind baffle: 0°F - 115°F.
**System cuts out in heating mode to avoid thermistor error and automatically restarts at these temperatures.

ACCESSORIES: PVA-A36AA7

Signal Receiver	□ PAR-SA9CA-E
Wireless Remote Controller	□ PAR-FL32MA-E
Wireless Remote Receiver	□ PAR-FA32MA-E
Backlit, Wall-mounted, Wireless Controller	□ MHK1
Portable Central Controller	□ MCCH1
Wired MA Controller	□ PAR-33MAA
Simple MA Controller	□ PAC-YT53CRAU
Touch MA Controller	□ PAR-CT01MAU-SB
Wired Remote Sensor	□ PAC-SE41TS-E
Wireless Temperature and Humidity Sensor	□ PAC-USWHS003-TH-1
Outside Air Sensor for MHK1	□ MOS1
Wireless Interface	□ PAC-USWHS002-WF-1
Thermostat Interface	□ PAC-US444CN-1
kumo station®	□ PAC-WHS01HC-E
USNAP Interface	□ PAC-WHS01UP-E
IT Extender	□ PAC-WHS01IE-E
BACnet® and Modbus Interface	□ PAC-UKPRC001-CN-1
External Fan / Heater Control Relay Adapter	□ CN24RELAY-KIT-CM3
Connector cable for remote display	□ PAC-SA88HA-EP
Connector for CN32 (remote on/off)	□ PAC-SE55RA-E
Remote Operation Adapter (with wire terminals for remote ON/OFF and operation status/ error)[1]	□ PAC-SF40RM-E
Blue Diamond Sensor Extension Cable—15 Ft.	□ C13-103
MegaBlue Advanced Blue Diamond Condensate Pump w/ Reservoir & Sensor	□ X87-835 - 110 to 250V
MaxiBlue Advanced Blue Diamond Mini Condensate Pump w/ Reservoir & Sensor (208/230V) up to 48,000 Btu/h [recommended]	□ X87-721 - 208/230V
MegaBlue Blue Diamond Condensate Pump (110-230V) up to 170,000 Btu/h	□ X87-835
Drain Pan Level Sensor (Control for indoor unit shut off to prevent drain pan overflow)	□ DPLS2
3 Pole Disconnect Switch (30A/600VUL) [fits 2"X4" utility] - Black	□ TAZ-MS303
Separate Power Terminal Block Kit	□ SPTB1
Electric Heat Lockout Control	□ ETC-211000-MIT
Electric Heat Kit for Multi-position AHU	□ EH10-MPA-L(B)
Electric Heat Kit for Multi-position AHU	□ EH15-MPAS- L(B)

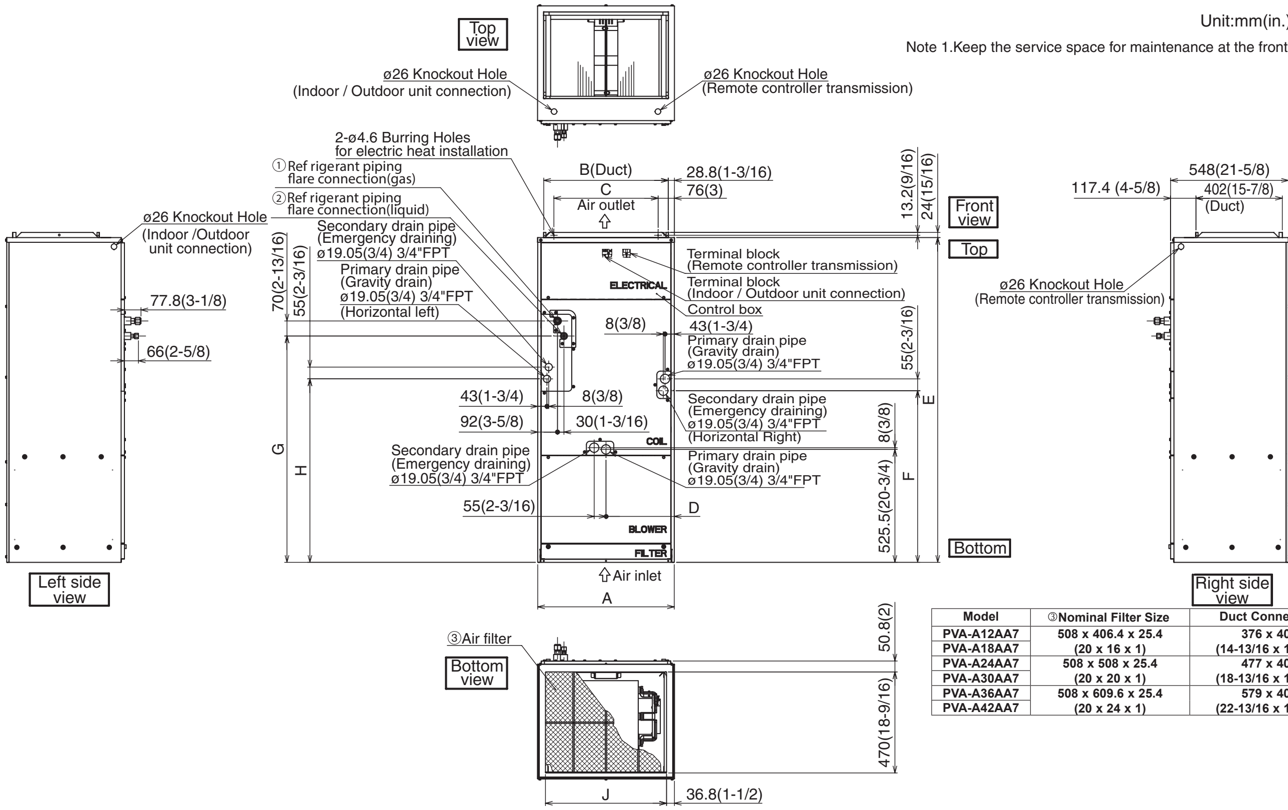
[1] Unable to use with wireless remote controller

ACCESSORIES: PUZ-HA36NHA5

Air Outlet Guide	□ PAC-SG59SG-E
Front Wind Baffle	□ WB-PA5
Drain Socket	□ PAC-SG61DS-E
Centralized Drain Pan	□ PAC-SG63DP-E
M-NET Converter	□ PAC-SF83MA-E
M-NET Converter	□ PAC-SJ95MA-E
Control/Service Tool	□ PAC-SK52ST
Hail Guard	□ HG-A2
Condensing Unit Mounting Pad 24" x 42" x 3"	□ ULTRILITE2
Outdoor Unit Stand—12" High	□ QSMS1202M
Outdoor Unit Stand—18" High	□ QSMS1802M
Outdoor Unit Stand—24"High	□ QSMS2402M
Heavy Duty Wall Mounting Bracket for Outdoor Units—Coated Steel	□ QSWB2000M-1
Heavy Duty Wall Mounting Bracket for Outdoor Units—316 Series Stainless Steel	□ QSWBSS
3/8" x 5/8" x 10' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-10
3/8" x 5/8" x 15' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-15
3/8" x 5/8" x 30' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-30
3/8" x 5/8" x 50' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-50
3/8" x 5/8" x 65' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-65
3/8" x 5/8" x 100' / 1/2" Lineset (Twin-Tube Insulation)	□ MPLS385812T-100

DIMENSIONS: PVA-A36AA7 & PUZ-HA36NHA5

PVA-A36AA7



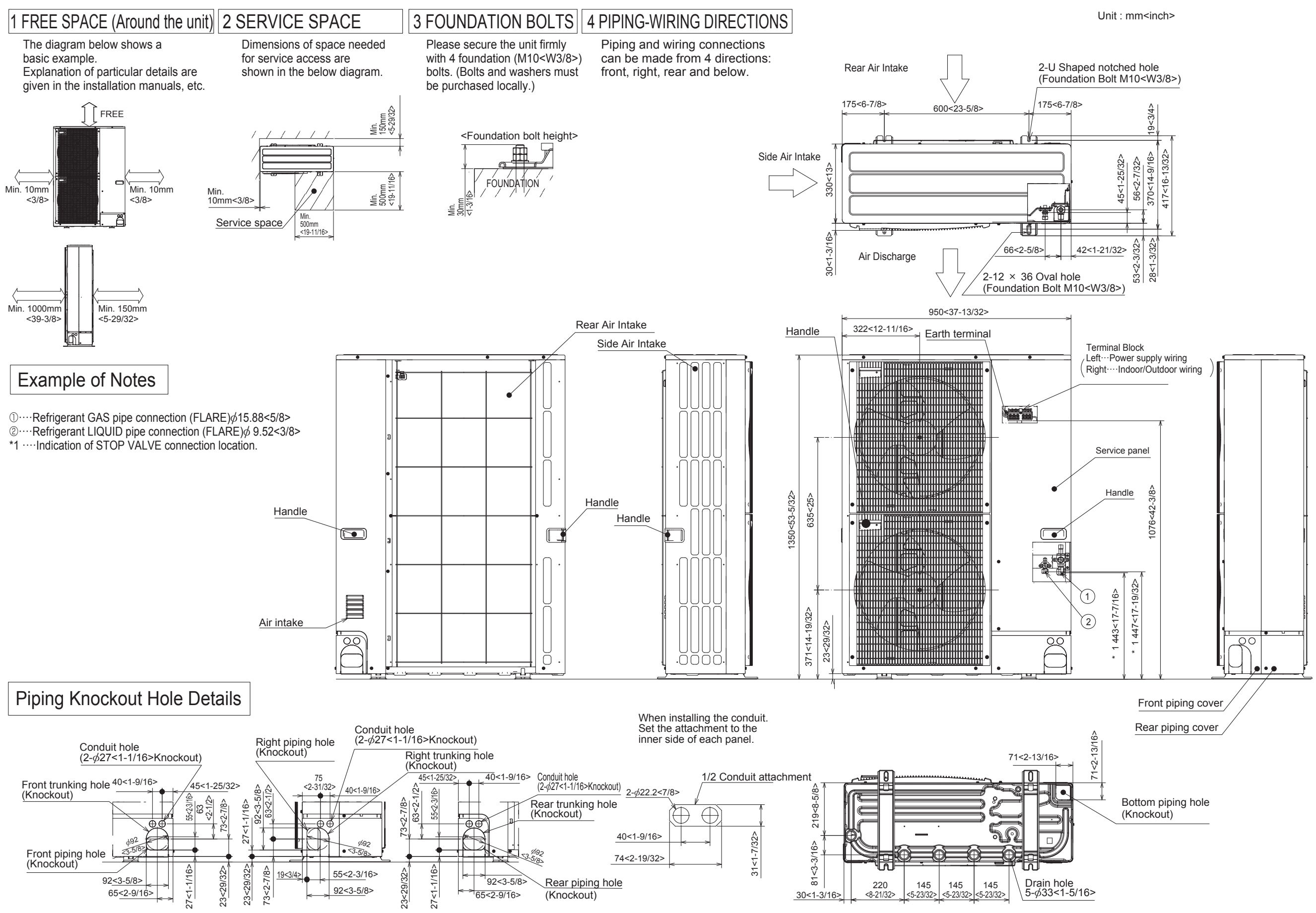
Model	③Nominal Filter Size	Duct Connection
PVA-A12AA7 PVA-A18AA7	508 x 406.4 x 25.4 (20 x 16 x 1)	376 x 402 (14-13/16 x 15-7/8)
PVA-A24AA7 PVA-A30AA7	508 x 508 x 25.4 (20 x 20 x 1)	477 x 402 (18-13/16 x 15-7/8)
PVA-A36AA7 PVA-A42AA7	508 x 609.6 x 25.4 (20 x 24 x 1)	579 x 402 (22-13/16 x 15-7/8)

Unit: mm (in.)

Model	A	B	C	D	E	F	G	H	J	①Gas Pipe	②Liquid Pipe
PVA-A12AA7 PVA-A18AA7	432 (17)	376 (14-13/16)	281 (11-1/8)	224 (8-7/8)	1275 (50-1/4)	680 (26-13/16)	823 (32-7/16)	735.5 (29)	360 (14-3/16)	Φ 12.7 (1/2)	Φ 6.35 (1/4)
PVA-A24AA7 PVA-A30AA7	534 (21)	477 (18-13/16)	382.6 (15-1/8)	266.5 (10-1/2)	1378 (54-1/4)	737 (29-1/16)	953.5 (37-9/16)	792 (31-3/16)	461 (18-3/16)	Φ 15.88 (5/8)	Φ 9.52 (3/8)
PVA-A36AA7 PVA-A42AA7	635 (25)	579 (22-13/16)	484.6 (19-1/8)	317.5 (12-1/2)	1511 (59-1/2)	798.5 (31-7/16)	1053 (41-1/2)	853.5 (33-5/8)	563 (22-3/16)		

DIMENSIONS: PVA-A36AA7 & PUZ-HA36NHA5

PUZ-HA36NHA5



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Toll Free: 800-433-4822 www.mehvac.com

FORM# PVA-A36AA7 / PUZ-HA36NHA5 - 201810

NRK 0150-0700

Reversible air/water heat pump

Cooling capacity 8.8 - 148 ton
Heating capacity 116,866 - 593,235 BTU/W

- **Production of hot water down to 149 °F**
- **Heating operations with external temperatures down to - 4 °F**
- **Optimized for operation in heating mode**
- **High efficiency also at partial loads**
- **Night mode**

DESCRIPTION

Reversible air/water heat pump for air conditioning systems with cold water production for cooling rooms and hot water for heating and/or domestic hot water services, suitable for connection in residential, commercial complexes or industrial applications.
It's optimised for use in heating mode, and can be combined not only with low-temperature emission systems such as floor heating or fan coils, but also conventional radiators.
Equipped with inverter compressors, axial fans, external coil with aluminium fins, plate heat exchanger on the side.
The base the structure and the panels are made of steel treated with polyester paint RAL 9003.

VERSIONS

A High efficiency

FEATURES

Operating field

Working at full load down to - 4 °F outside air temperature in winter, and down to 118.4 °F in summer. Hot water production down to 149 °F.

Version with Integrated hydronic kit

Integrated hydronic kit containing the main hydraulic components; available with various configurations to obtain a solution that allows you to facilitate installation.

Inverter fans

Standard inverter fans for all size.

CONTROL

Microprocessor adjustment, with keyboard and LCD display,for easy access on the unit is a menu available in several languages.
Adjustment includes complete management of the alarms and their log.
The presence of a programmable timer allows functioning time periods and a possible second set-point to be set.
The temperature control takes place with the inte-gral proportional logic, based on the water output temperature.

NIGHT MODE

Iit is possible to set a silenced operation profile. Perfect for night operation since it guarantees greater acoustic comfort in the evenings, and a high efficiency in the time of greater load.

■ *Available for all units with inverter fans.*

ACCESSORIES

AER485P1: RS-485 interface for supervision systems with MODBUS protocol.
AERNET: The device allows the control, the management and the remote monitoring of a Chiller with a PC, smartphone or tablet using Cloud connection. AERNET works as Master while every unit connected is configured as Slave (max. 6 unit); also, with a simple click is possible to save a log file with all the connected unit datas in the personal terminal for post analysis.
CRATE02: Special crate for transport
CRATE03: Special crate for transport
MODU-485BL: RS-485 interface for supervision systems with MODBUS protocol.
MULTICHILLER_EVO: Control, switch-on and switch-off system of the single chillers where multiple units are installed in parallel, always ensuring constant flow rate to the evaporators.
PGD1: Allows you to control the unit at a distance.
GP: Anti-intrusion grid.
VT: Antivibration supports

FACTORY FITTED ACCESSORIES

DRE: Electronic device for peak current reduction.
RIF: Power factor correction. Connected in parallel to the motor allowing about 10% reduction of input current.
RESNRK: Electric heater for the control and electric power board.

ACCESSORIES COMPATIBILITY

Accessories

Model	Ver	0150	0300	0330	0350	0550	0600	0650	0700
AER485P1	A		•	•	•	•	•	•	•
AERNET	A	•	•	•	•	•	•	•	•
CRATE02	A		•	•	•	•			
CRATE03	A						•	•	•
MODU-485BL	A	•							
MULTICHILLER_EVO	A		•	•	•	•	•	•	•
PGD1	A		•	•	•	•	•	•	•

Anti-intrusion grid

Ver	0150	0300	0330	0350	0550	0600	0650	0700
A	-	GP2 x 2 (1)	GP2 x 2 (1)	GP2 x 2 (1)	GP2 x 2 (1)	GP2 x 3 (1)	GP2 x 3 (1)	GP2 x 3 (1)

(1) x _ indicates the quantity to buy.
The accessory cannot be fitted on the configurations indicated with -

Antivibration

Ver	0150	0300	0330	0350	0550	0600	0650	0700
Integrated hydronic kit: 00, 01, 03, P1, P3								
A	VT15	-	-	-	-	-	-	-

The accessory cannot be fitted on the configurations indicated with -

Device for peak current reduction

Ver	0150	0300	0330	0350	0550	0600	0650	0700
A	-	DRENRK03007	DRENRK03307	DRENRK35557	DRENRK35557	DRENRK60657	DRENRK60657	DRENRK07007

The accessory cannot be fitted on the configurations indicated with -
A grey background indicates the accessory must be assembled in the factory

Power factor correction

Ver	0150	0300	0330	0350	0550	0600	0650	0700
A	-	RIFNRK03007	RIFNRK03307	RIFNRK35557	RIFNRK35557	RIFNRK60657	RIFNRK60657	RIFNRK07007

The accessory cannot be fitted on the configurations indicated with -
A grey background indicates the accessory must be assembled in the factory

Electric heater for the control and electric power board

Ver	0150	0300	0330	0350	0550	0600	0650	0700
A	-	RESNRK03007	RESNRK33707	RESNRK33707	RESNRK33707	RESNRK33707	RESNRK33707	RESNRK33707

The accessory cannot be fitted on the configurations indicated with -
A grey background indicates the accessory must be assembled in the factory

CONFIGURATOR

Field	Description
1,2,3	**NRK**
4,5,6,7	**Size** 0150, 0300, 0330, 0350, 0550, 0600, 0650, 0700
8	**Operating field**
°	Standard mechanic thermostatic valve (1)
9	**Model**
H	Heat pump
10	**Heat recovery**
°	Without heat recovery
D	With desuperheater (2)
11	**Version**
A	High efficiency
12	**Coils**
°	Rame - allumunio
R	Copper-copper
S	Copper-Tinned copper
13	**Fans**
J	EC Inverter type
14	**Power supply**
7	460YV 3 ~ 60Hz
15,16	**Integrated hydronic kit (3)**
00	Without hydronic kit
01	Storage tank with low head pump
02	Storage tank with low head pump + stand-by pump
03	Storage tank with high head pump
04	Storage tank with high head pump + stand-by pump
P1	Single pump low head
P2	Pump low head + stand-by pump
P3	Single pump high head
P4	Pump high head + stand-by pump

(1) Water produced down to +39.2 °F
(2) The desuperheater must be isolated in heating mode. In cooling mode, a water temperature no lower than 95°F must always be guaranteed on the heat exchanger inlet.
(3) Option available only for size 0150

PERFORMANCE SPECIFICATIONS

NRK - (A) / 54.1/44.1 °C - 104 °F/113 °F

Size		0150	0300	0330	0350	0550	0600	0650	0700
Cooling performance 54.1 °F / 44.1 °F (1)									
Cooling capacity	ton	8.8	16.1	19.0	21.5	24.0	32.3	36.6	39.7
Input power	kW	9.6	20.2	23.7	27.0	29.9	40.3	49.9	58.1
EER	BTU/W	11.02	9.55	9.61	9.56	9.61	9.63	8.81	8.19
IPLV	BTU/W	14.91	13.51	13.58	13.41	13.38	13.79	12.73	11.23
Water flow rate system side	gpm	21.1	38.5	45.4	51.5	57.4	77.3	87.6	94.9
Pressure drop system side	ft H_2O	17.81	5.69	5.69	5.69	5.69	5.69	5.69	5.69
Heating performance 104 °F / 113 °F (2)									
Heating capacity	BTU/h	116,866	231,872	275,841	304,206	340,426	463,802	539,671	593,235
Input power	kW	10.0	21.0	26.4	29.2	31.9	43.4	51.3	57.2
COP	kW/kW	3.41	3.24	3.06	3.05	3.13	3.13	3.08	3.04
Water flow rate system side	gpm	26.2	52.0	61.9	68.2	76.3	104.0	121.0	133.0
Pressure drop system side	ft H_2O	27.39	10.42	10.59	10.01	10.09	10.31	10.87	11.19

(1) Data: System side water heat exchanger 54.1 °F / 44.1 °F; External air 95 °F
(2) Data: System side water heat exchanger 104 °F / 113 °F; External air 44.6 °F

PARTIALISATIONS EER

Size		0150	0300	0330	0350	0550	0600	0650	0700
Partialisations EER									
100 %	BTU/W	11.02	9.55	9.62	9.55	9.62	9.62	8.80	8.19
75 %	BTU/W	13.38	12.01	12.01	11.94	11.98	12.83	11.81	10.58
50 %	BTU/W	15.80	14.40	14.47	14.26	14.19	14.77	13.65	11.98
25 %	BTU/W	17.20	15.63	16.17	15.66	15.49	13.79	12.76	10.99

ELECTRIC DATA

Size		0150	0300	0330	0350	0550	0600	0650	0700
Electric data									
Peak current (LRA)	A	133.6	165.3	184.0	222.0	222.9	198.6	234.1	278.4
Minimum circuit amperage (MCA)	A	30	59	57	72	71	88	103	123
Maximum overcurrent permitted by the protection device (MOP)	A	47	76	78	97	96	105	124	148

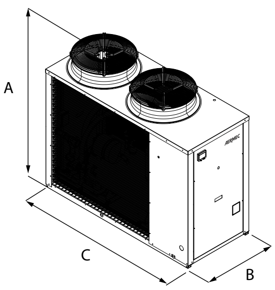
GENERAL TECHNICAL DATA

Size			0150	0300	0330	0350	0550	0600	0650	0700
Compressor										
Type	A	type	Scroll							
Compressor regulation	A	Type	On-Off							
Number	A	no.	1	2	2	2	2	4	4	4
Circuits	A	no.	1	2	2	2	2	2	2	2
Refrigerant	A	type	R410A							
System side heat exchanger										
Type	A	type	Brazed plate							
Number	A	no.	1	1	1	1	1	1	1	1
System side hydraulic connections										
Connections (in/out)	A	Type	Gas - F	Grooved joints	Grooved joints	Grooved joints	Grooved joints	Grooved joints	Grooved joints	Grooved joints
Sizes (in/out)	A	Ø	1"1/4	2" 1/2 US	2" 1/2 US	2" 1/2 US	2" 1/2 US	2" 1/2 US	2" 1/2 US	2" 1/2 US
Inverter fan										
Type	A	type	Axial							
Fan motor	A	type	EC Inverter motors							
Number	A	no.	2	8	2	2	2	3	3	3
Air flow rate	A	cfm	8,064	23,190	22,366	21,954	21,954	33,314	37,904	37,904
Sound data calculated in cooling mode										
Sound power (1)	A	dB(A)	82.9	85.4	85.4	92.3	86.2	88.1	87.8	95.2
Sound pressure level (10 m/33ft) (2)	A	dB(A)	51.3	53.6	53.5	60.4	54.3	56.1	55.7	63.1

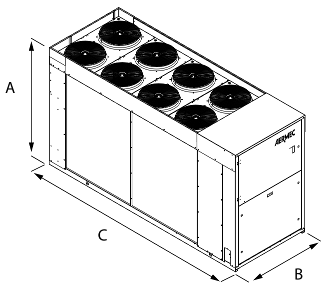
(1) Sound power calculated on the basis of measurements made in accordance with UNI EN ISO 9614-2, as required for Eurovent certification.
(2) Sound pressure (cold functioning) measured in free field, 10m/33ft away from the unit external surface (in compliance with UNI EN ISO 3744).

DIMENSIONS

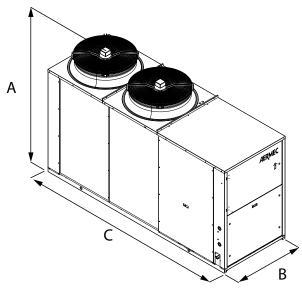
NRK 0150



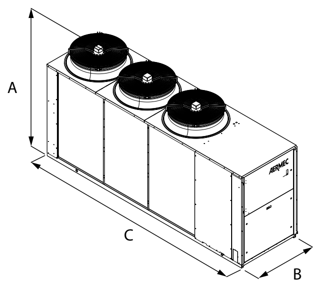
NRK 0300



NRK 0330-0350-0550



NRK 0600-0650-0700



Size		0150	0300	0330	0350	0550	0600	0650	0700
Dimensions and weights for transport									
A	in	62.3	63.3	73.9	73.9	73.9	73.9	73.9	73.9
B	in	72.9	128.1	131.2	131.2	131.2	170.6	170.6	170.6
C	in	34.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3
Dimensions and weights									
Weight empty	lb	820	1,729	1,846	1,938	1,955	2,544	2,544	2,596
Weight functioning	lb	833	1,742	1,862	1,958	1,976	2,572	2,572	2,626

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