



PATTERSON-KELLEY

P-K MACH 'n' Roll™ with NURO® CONDENSING COMFORT HEATING BOILER WITH INDIRECT DOMESTIC & POOL WATER HEATING SYSTEM



MnR300-MnR399-MnR500
MnR750-MnR1050 for Indirect
Domestic Water Heating
&
MnRP300-MnRP399-MnRP500
MnRP750-MnRP1050 for
Indirect Pool Water Heating

Part # 1004905989

Model Number: _____

Serial Number: _____

Start-Up Date: _____

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**NOTE:
THIS MANUAL IS A SUPPLEMENT TO THE
APPLICABLE BOILER INSTALLATION &
OWNER'S MANUAL**

**PRIOR TO INSTALLATION,
REFER TO THE
MACH® CM300-C1050 NURO
INSTALLATION AND OPERATION MANUAL**

MnR300 & MnRP300 → CM300

MnR399 & MnRP399 → CM399

MnR500 & MnRP500 → CM500

MnR750 & MnRP750 → C750

MnR1050 & MnRP1050 → C1050



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1 Introduction

WARNING

If the information in this manual is not followed, fire or explosion may result causing property damage, personal injury, or loss of life.

This manual describes the installation and operation of the P-K MACH 'n' Roll™ condensing indirect domestic hot water and pool heating systems for use with P-K MACH® CM300, CM399, CM500, C750 & C1050 boilers:

CM300-CM399-CM500 and C750-C1050:

- Natural Gas, 120V (single phase), 60 Hertz
- Propane Gas, 120V (single phase), 60 Hertz

It is important to note that the P-K MACH 'n' Roll™ system is an add-on package to the standard P-K MACH® appliance. Please refer to the latest edition of the P-K MACH® CM300 through C1050 NURO installation and operation manual for detailed appliance operation requirements before installing the P-K MACH 'n' Roll™ condensing indirect domestic hot water or pool heating systems.

Individual differences between each P-K MACH 'n' Roll™ model will be called out and defined in separate sections and the titles of these sections will include the appliance model number. If model numbers are not listed in the section title, that section is common to all models.

If you have any questions on the information contained within, or do not fully and completely understand the content, please contact Patterson-Kelley Technical Service at **570.476.7261** or toll free at **877.728.5351**.

Do not store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

Ne pas entreposer ni utiliser d'essence ou ni d'autres vapeurs ou liquides inflammables à proximité de cet appareil ou de tout autre appareil.

WHAT TO DO IF YOU SMELL GAS:

- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- Ne pas tenter d'allumer d'appareils.
- Ne touches à aucun interrupteur. Ne pas vous servir des téléphones dans le bâtiment où vous vous trouvez.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur de gaz,appelez le

WARNING

It is essential to read, understand, and follow the recommendations of this manual before installing, operating or servicing this equipment. Failure to do so could result in personal injury or death.

WARNING

Installation and service must be performed by a qualified and knowledgeable individual who has been certified on the P-K MACH® Appliance. The features which permit this boiler to achieve high-efficiency performance can be misused which could result in personal injury or death.



The P-K MACH 'n' Roll™ systems and P-K MACH® appliance are only a part of a complete heating system. This add-on package may be fully operational and yet because of poor circulation, control, or other operating characteristics, not deliver hot water to the desired location. Additional equipment such as storage tank(s), storage tank temperature sensor, pumps, flow switches, balancing valves, and check valves will be required for satisfactory operation of any system. Patterson-Kelley cannot be responsible for the design or operation of such systems and a qualified engineer or contractor must be consulted.



2 Safety

2.1 General

The P-K MACH 'n' Roll™ MnR & MnRP models with sizes 300/399/500/750/1050 **must** be:

- Installed, operated and serviced in accordance with instructions contained in this manual and other supplemental manuals.
- Installed by qualified personnel in accordance with designs prepared by qualified facility engineers including: structural, mechanical, electrical and all other applicable disciplines.
- Operated and serviced in accordance with a comprehensive safety program determined and established **by the customer**. Do not attempt to operate or service until such a program has been established.
- Operated and serviced by experienced, qualified and properly trained personnel in accordance with all applicable codes, laws and regulations.

NOTICE! Each safety device must be maintained and checked per the recommended schedule. Refer to [Section 3.7](#) of this manual.

Upon receiving the P-K MACH® appliance and P-K MACH 'n' Roll™ system, inspect for signs of shipping damage. Some damage may be hidden. Unpack the appliance, open the front and side doors and inspect the equipment. Verify that the total number of pieces shown on the packing slip agrees with those actually received.



DANGER The P-K MACH 'n' Roll™ water heater is a dynamic system that is designed to heat water in a storage tank or pool to a wide range of temperatures. The P-K MACH 'n' Roll™ system is capable of heating water to scalding temperatures. Refer to your local codes for guidelines on compliance for domestic hot water or pool water systems. A thermostatic mixing valve may be required to prevent scalding.



WARNING
Installation and service must be performed by a qualified installer, service agency, or gas supplier. Failure to install the equipment in accordance with this manual could result in an unsafe operating condition.

NOTICE!

Controls and other equipment that are damaged or fail due to weather exposure are not covered by warranty.



WARNING
The appliance is heavy and requires additional technicians to support and move the unit(s) during installation. Use extreme caution to avoid dropping the appliance or cause any bodily injury while lifting or handling. When positioning this appliance, maintain positive control of it at all times. Do not attempt to move the appliance on surfaces that are not level. Failure to heed this warning could result in personal injury or death.

NOTICE!

The P-K MACH 'n' Roll™ may be installed on a combustible floor; however, the appliance must never be installed on carpeting.



WARNING
Bumping hazard from overhead ducts! Install all components with adequate vertical clearances. Insufficient clearance can restrict the service access, increasing the possibility of injury.



2.2 Training

Proper training is the best protection against accidents. Factory training sessions are available to qualified individuals who are sponsored by the local Patterson-Kelley representative.



It is **essential** to read, understand, and follow the recommendations of this manual before installing, operating, or servicing this equipment. Failure to do so could result in fire or explosion and serious injury, death, and/or property damage.

Operating and service personnel must be thoroughly familiar with the basic construction of the P-K MACH® CM300/CM399/CM500 or C750/C1050 appliances, the use and locations of the controls, the operation of the appliances, adjustment of their various mechanisms, and all applicable safety precautions. If any of the provisions of this manual are not fully and completely understood, contact Patterson-Kelley Technical Service at 570.476.7261 or toll free at 877.728.5351.

2.3 Safety Features

It is the responsibility of the customer to maintain the safety features, including but not limited to: guards, safety labels, safety controls, interlocks, lockout devices and temperature/pressure safety relief valves.

2.4 Safety Labels

The following words are used in this manual to denote the degree of seriousness of the individual hazards.



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

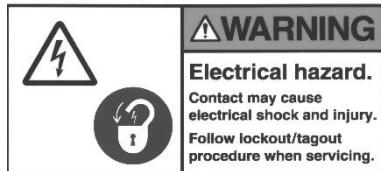
NOTICE/NOTE - NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol is not used with this signal word.



2.5 Safety Precautions

Provide a suitable location for the P-K MACH 'n' Roll™ system, away from normal personnel traffic, with adequate working space, adequate clearances, proper ventilation and lighting, with a structure sufficiently strong and rigid to support the weight of the boiler, P-K MACH 'n' Roll™ system, all piping, and accessories.

2.5.1 Electrical Hazards



- Shock hazard! Properly lockout/tag out the electrical service and all other energy sources before working on or near the boiler.
- Shock hazard! Do not spray water directly on this boiler or on any electrical components.
- Electrical hazard! Do not alter wiring connections.

2.5.2 Burn, Fire, and Explosion Hazards



General Warning

- Burn, fire, and explosion hazards! Installation must be in strict conformance to all applicable codes and standards including NFPA 54, ANSI Z223.1 and CAN/CSA B.149.
- Burn hazard! Possible hot surfaces. Pipes and internal components could be hot. Do not touch piping or internal components during operation or immediately after shutdown of the appliance.
- Burn hazard! Hot fluids. Use caution when servicing or draining appliance.



Hot Surface



DANGER The P-K MACH 'n' Roll™ water heater is a dynamic system that is designed to heat water in a storage tank or pool to a wide range of temperatures. The P-K MACH 'n' Roll™ system is capable of heating water to scalding temperatures. Refer to your local codes for guidelines on compliance for domestic hot water or pool water systems. A thermostatic mixing valve may be required to prevent scalding.

2.5.3 Crush Hazards



General Warning

- Lifting hazards! Use properly rated lifting equipment to lift and position the boiler. The load is unbalanced. Test balance before lifting 3 ft. above the floor. Do not allow personnel beneath the lifted load. Refer to approximate weights in the table.

Model	Shipping Weight in Pounds
MnR300/MnRP300	1390 lbs
MnR399/MnRP399	1417 lbs
MnR500/MnRP500	1417 lbs
MnR750/MnRP750	1340 lbs
MnR1050/MnRP1050	1440 lbs



2.5.4 Chemical Hazards



General Warning

- Chemical hazards from cleaning products. Use caution when cleaning the system. The use of professional assistance is recommended. Use safe procedures for the disposal of all cleaning solutions.

2.5.5 Pressure Hazards



General Warning

- Pressure hazard! Hot fluids. Install isolation valves on appliance water inlet and outlet. Make sure isolation valves are closed before servicing.
- Pressure hazard! Hot fluids. Annually test safety relief valve for proper operation. Do not operate with faulty relief valve(s).

2.5.6 Slip, Fall Hazards



General Warning

- Tripping hazard! Do not install piping on floor surfaces. Maintain clear path around the P-K MACH 'n' Roll™ system.
- Slip and fall hazard! Use drip pan to catch water while draining. Maintain dry floor surfaces.
- Fall hazard! Do not stand on the P-K MACH 'n' Roll™ system or the P-K MACH® appliance.

WARNING

If the information in these instructions are not followed exactly, a fire or explosion may result causing property damage, personal injury, or death.

AVERTISSEMENT

Assurez-vous de bien suivre les instructions données dans cette notice pour réduire au minimum le risqué d'incendie ou d'explosion ou pour éviter tout dommage materiel, toute blessure ou la mort.

Should overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance.

En cas de surchauffe ou si l'admission de gaz ne peut être coupée, ne pas couper ni débrancher l'alimentation électrique de la pompe. Fermer plutôt le robinet d'admission de gaz à l'extérieur de l'appareil.



3 Installation

⚠ WARNING

Installation and service must be performed by a qualified installer, service agency, or gas supplier.

3.1 Receiving and Storage

3.1.1 Initial Inspection

Upon receiving the P-K MACH 'n' Roll™ system, inspect it for signs of shipping damage. Since some damage may be hidden, unpack the product, open the front, and side doors to inspect. Verify that the total number of pieces shown on the packing slip agrees with those actually received.

NOTICE! Note any damage, suspected potential damage, or shortage of materials on the freight bill and immediately notify the carrier. File all claims for shortage or damage with the carrier. Claims for hidden damages must be filed with your carrier within 7 days.

3.1.2 Storage Prior to Installation

If the P-K MACH 'n' Roll™ system is not installed immediately, it must be stored in a location adequately protected from the weather, preferably indoors. If this is not possible, then it should remain in the shipping container and be covered by a tarpaulin or other waterproof covering.

NOTICE! Controls and other equipment that are damaged or fail due to weather exposure are not covered by warranty.

3.2 Compliance with Codes

The brazed plate heat exchanger is constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 for 219 psig maximum operating pressure. However, certain components in the domestic piping have a maximum pressure rating of 150 psig. Therefore, the domestic side pressure must never exceed 150 psig.

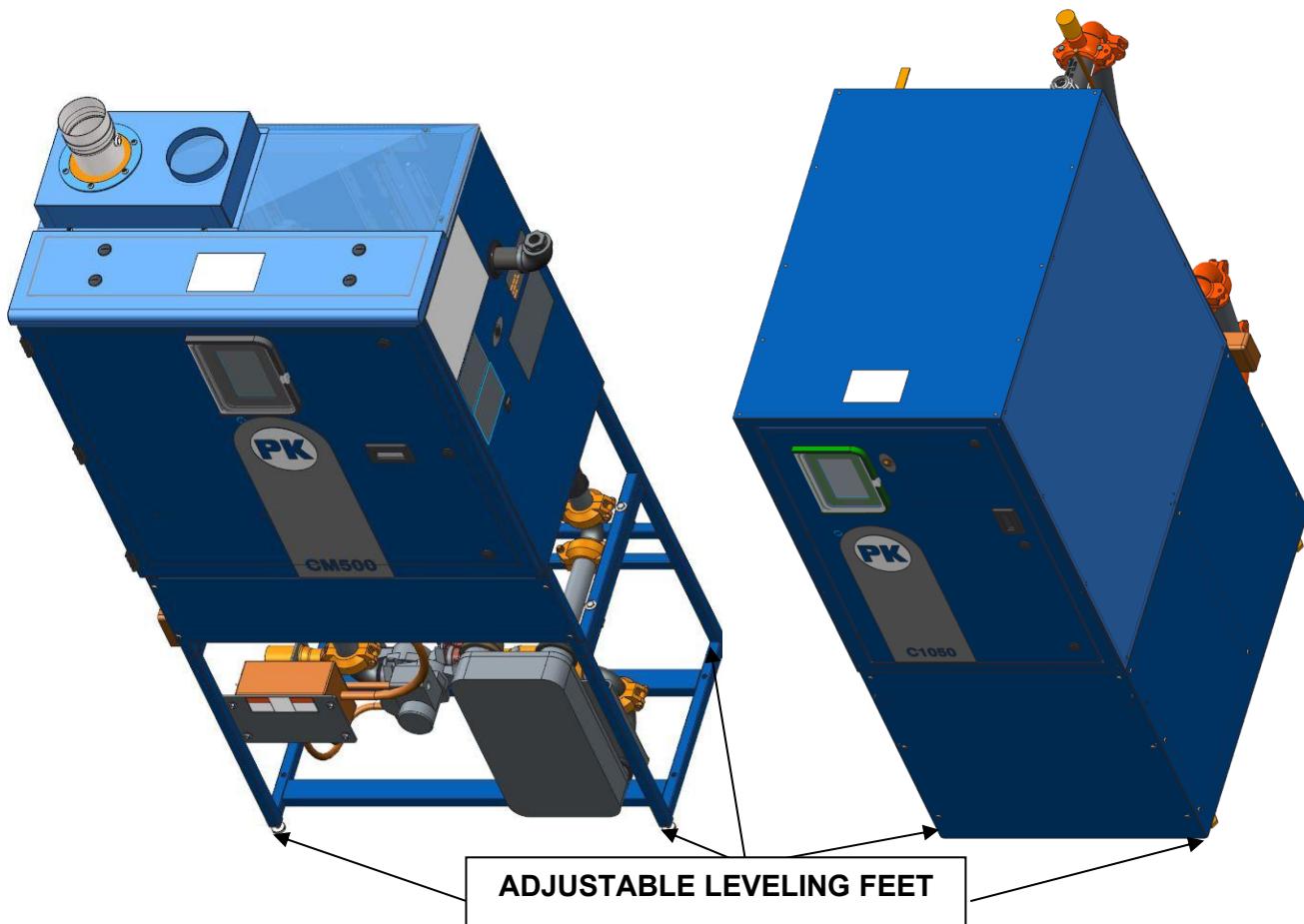
Patterson-Kelley recommends a pressure-only relief valve constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII with a maximum 150 psig set pressure. Most MACH 'n' Roll installations will be piped to a storage tank which will feature a T&P relief valve (excluding pool heater versions). Ensure that any pressure relieving devices installed in the domestic hot water system prevent the pressure from exceeding 150 psig.

Please refer to the P-K MACH® CM300 through C1050 NURO installation and operation manuals for code compliance related to the P-K MACH® appliance.

3.3 Setup

3.3.1 Foundation and Placement

Provide a firm, level foundation, preferably of concrete. The P-K MACH 'n' Roll™ system and P-K MACH® appliance must be level to function properly. To assist in leveling the equipment, the four (4) adjustable leveling feet (1/2" – 13 NC) must be installed and adjusted accordingly. The adjustable feet also provide adequate floor clearance and prevent distortion/twisting of the cabinet enclosure.

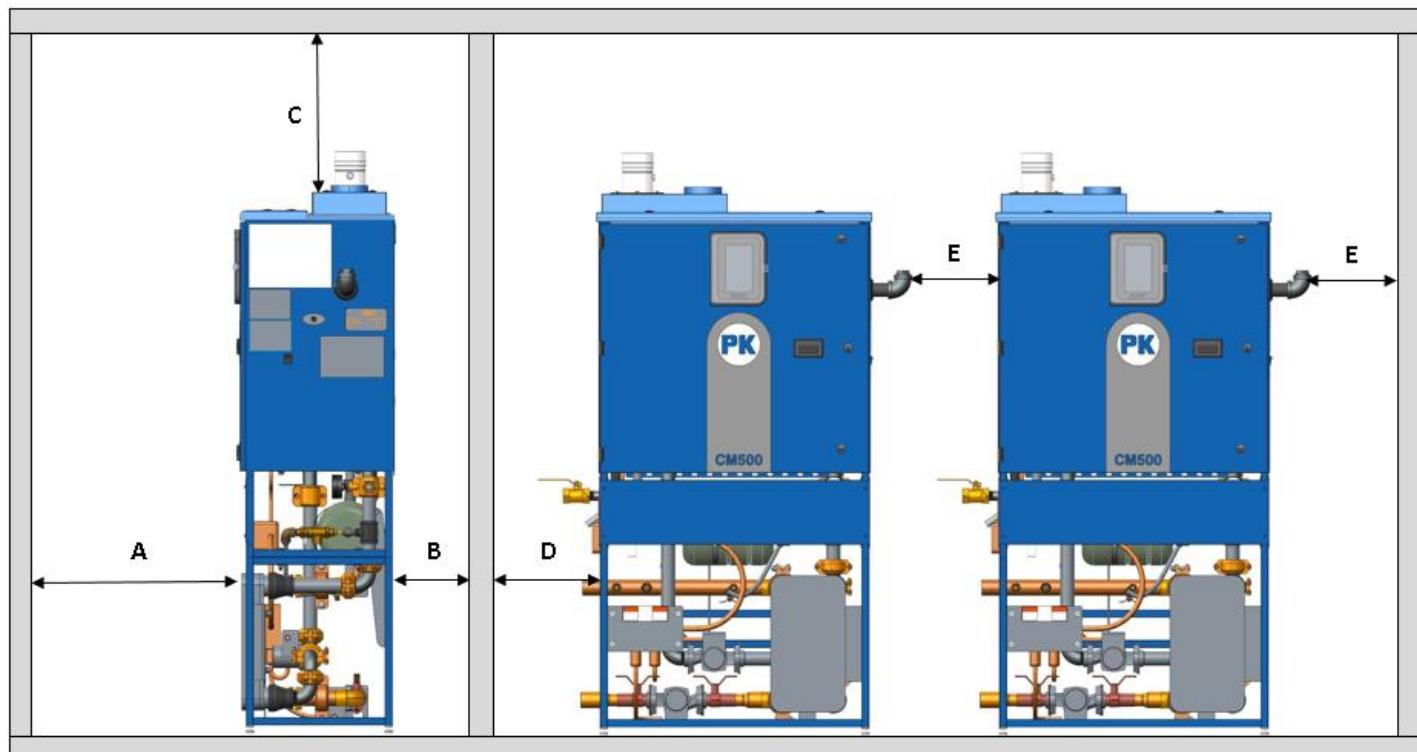


NOTICE! The P-K MACH 'n' Roll™ system may be installed on a combustible floor; however, it must **never** be installed on carpeting.

3.3.2 Clearances (MnR & MnRP sizes 300,399, & 500)

Since the P-K MACH 'n' Roll™ is designed to sit underneath the applicable P-K MACH® appliance, it generally requires the same clearances as the appliance itself. Some additional clearance considerations may be required for the domestic hot water piping. The P-K MACH 'n' Roll™ system is designed to be serviced from the front, so ensure there are no obstructions present in front of the unit.

If the MACH 'n' Roll™ is to be installed near combustible surfaces, there must be six (6") inches minimum clearance. Failure to provide adequate service clearances, even with non-combustible surfaces, may present problems during routine maintenance of the appliance. The appliance must be installed in a space large in comparison to the appliance as described in the National Fuel Gas Code, NFPA 54/ANSI Z223.1, Latest Edition.



Type of Surface	Dimensions (inches)				
	A	B	C†	D	E**
CSA Minimum Clearances to Combustibles	0	0	0	0	0
Clearance to Non-Combustible Surfaces	0	0	0	0	0
Required Minimum Service Clearances	36	0	24	0	12
Recommended Service Clearances	36	0	24	24	24**

† "C" dimension includes clearance to remove the burner. Do not put pipes, ducts, etc. in area above the appliance.

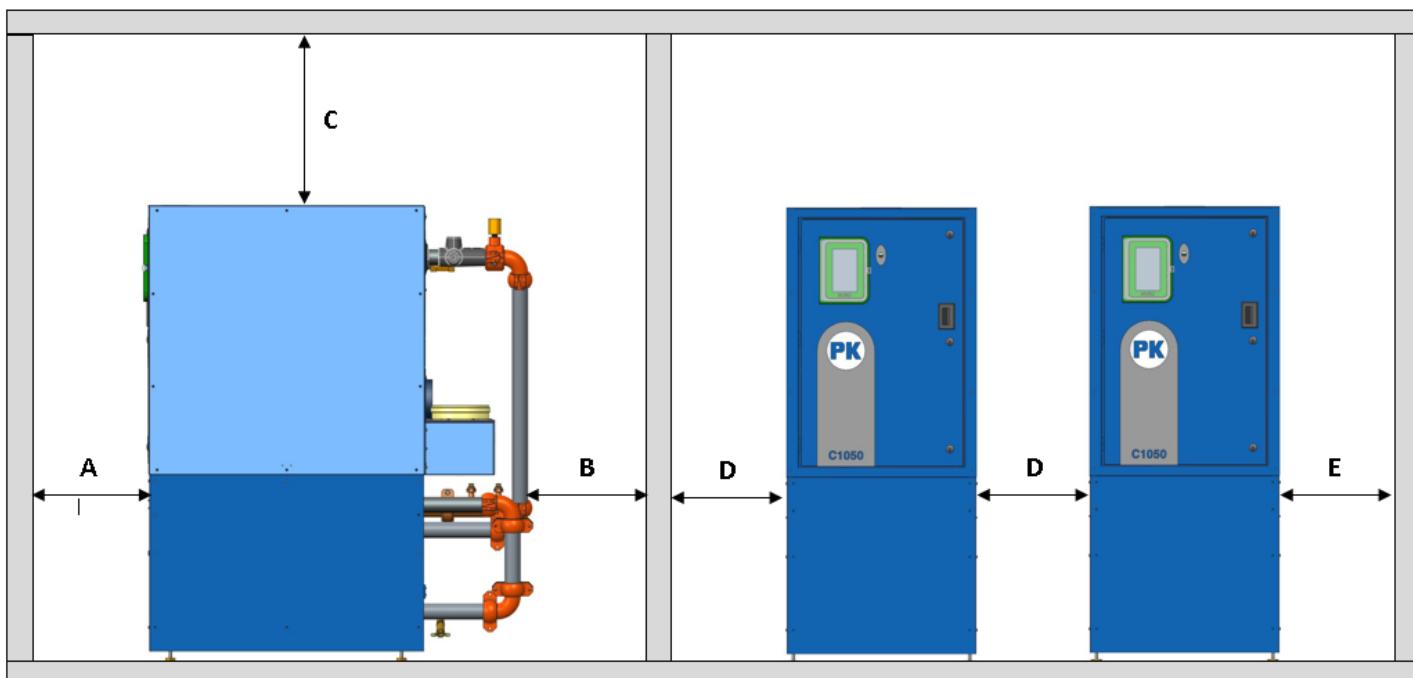
*CSA minimum. Actual clearance depends upon venting requirements.

** Right-Side service access ("E" Dimension") is needed to view the boiler's runout/safety labels, as well as viewing the combustion flame.

3.3.3 Clearances (MnR & MnRP sizes 750 & 1050)

Since the P-K MACH 'n' Roll™ is designed to sit underneath the applicable P-K MACH® appliance, it generally requires the same clearances as the appliance itself. Some additional clearance considerations may be required for the domestic hot water piping. The P-K MACH 'n' Roll™ system is designed to be serviced from the front, so ensure there are no obstructions present in front of the unit.

If the appliance is to be installed near combustible surfaces, there must be twenty-four (24") inches minimum clearance. Failure to provide adequate service clearances, even with non-combustible surfaces, may present problems during routine maintenance of the appliance. The appliance must be installed in a space large in comparison to the appliance as described in the National Fuel Gas Code, NFPA 54/ANSI Z223.1, Latest Edition.



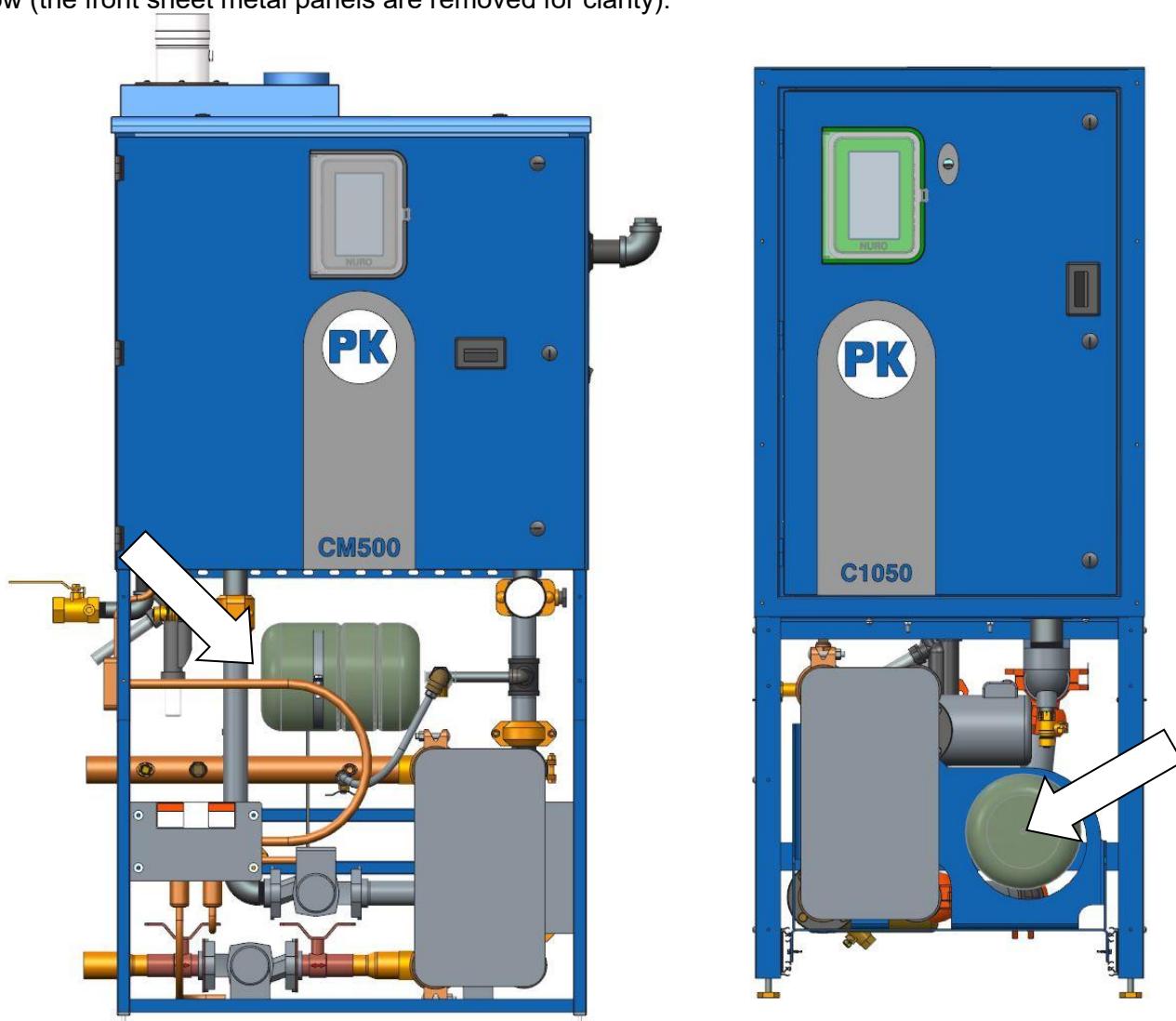
Type of Surface	Dimensions (inches)				
	A	B	C	D**	E
CSA Minimum Clearances to Combustibles	36	24*	24	24	24
Clearance to Non-Combustible Surfaces	0	0	0	0	0
Required Minimum Service Clearances	30	24	24	6	6
Recommended Service Clearances	36	24*	24	24**	24

* CSA minimum. Actual clearance depends upon venting requirements.

** Left-Side Service access ("D" Dimension) is helpful for routine maintenance access. Patterson-Kelley recommends equal clearance between **each appliance** when there is insufficient access at the rear to allow for service and adjustment

3.3.4 Expansion Tank & Fill System

Before making any mechanical connections to the P-K MACH 'n' Roll™ system or to the P-K MACH® appliance, it is imperative that the expansion tank / fill system be checked for a suitable fill pressure. The expansion tank ships with a 12 psig precharge, but it is possible that air pressure may reduce during shipment. Locate the Schrader valve on the expansion tank as shown by the white arrow in the images below (the front sheet metal panels are removed for clarity).



Use a pressure gauge to verify the air pressure is at least 12 psig. If the pressure is insufficient, use an air pump with built-in pressure gauge to charge the air pressure to a **minimum of 12 psig** before making ANY mechanical connections. The maximum air pressure need not exceed 20 psig.

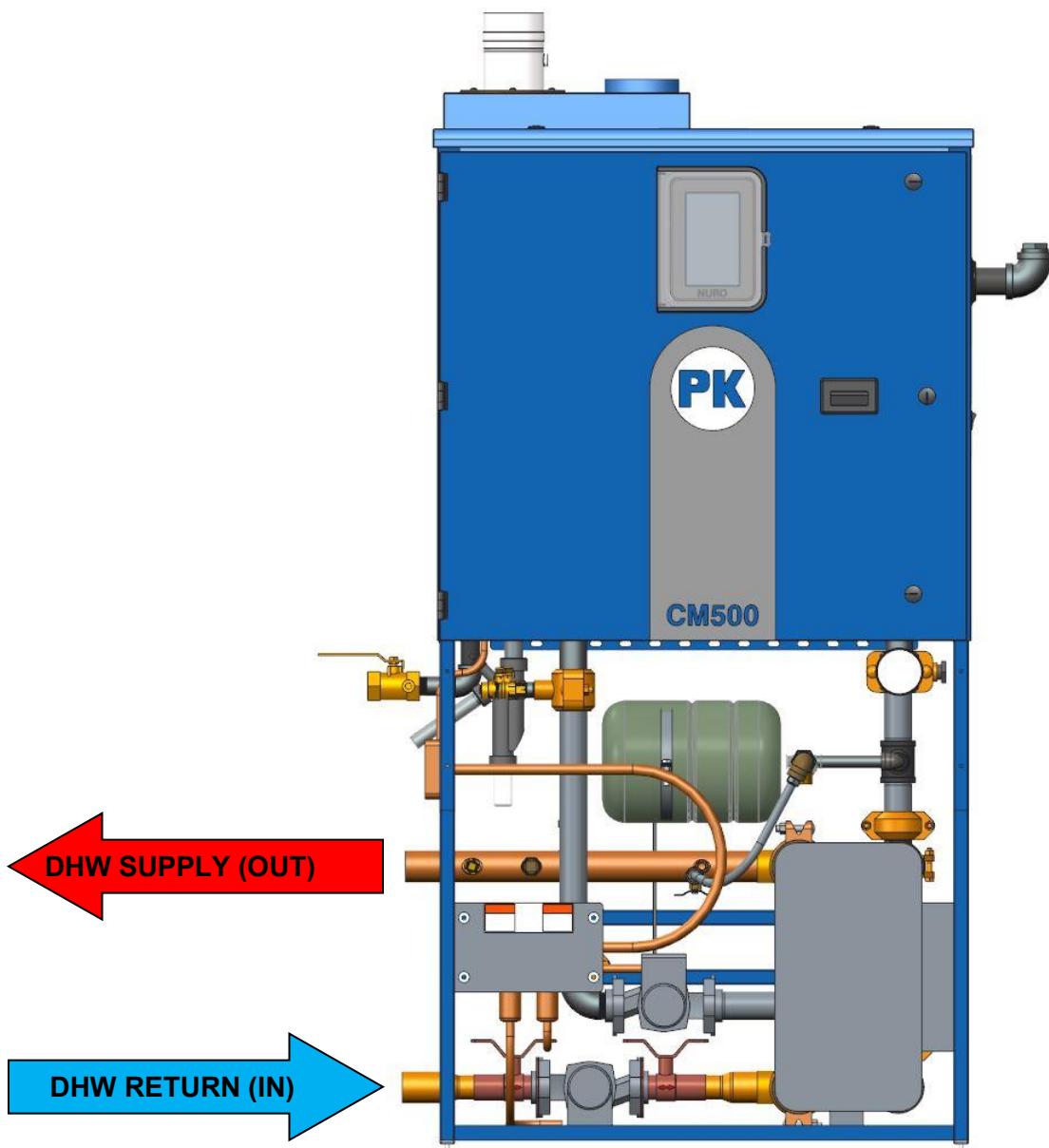
The expansion tank assembly features an integral fill valve which floods the appliance loop with water to the same air pressure that exists on the bladder. As the appliance operates, you may notice that the appliance loop pressure exceeds the initial fill pressure which is completely normal and is due to thermal expansion of the appliance water.

3.4 Connecting to the Domestic Hot Water System (MnR Indirect Domestic Water Heating Models)

The P-K MACH 'n' Roll™ is designed to occupy the space underneath the applicable P-K MACH® appliance. The steel piping is connected to & from the P-K MACH® appliance at the factory, but the 2" copper piping must be connected to the domestic hot water system.

3.4.1 Domestic Hot Water Piping Connections (MnR300-MnR399-MnR500)

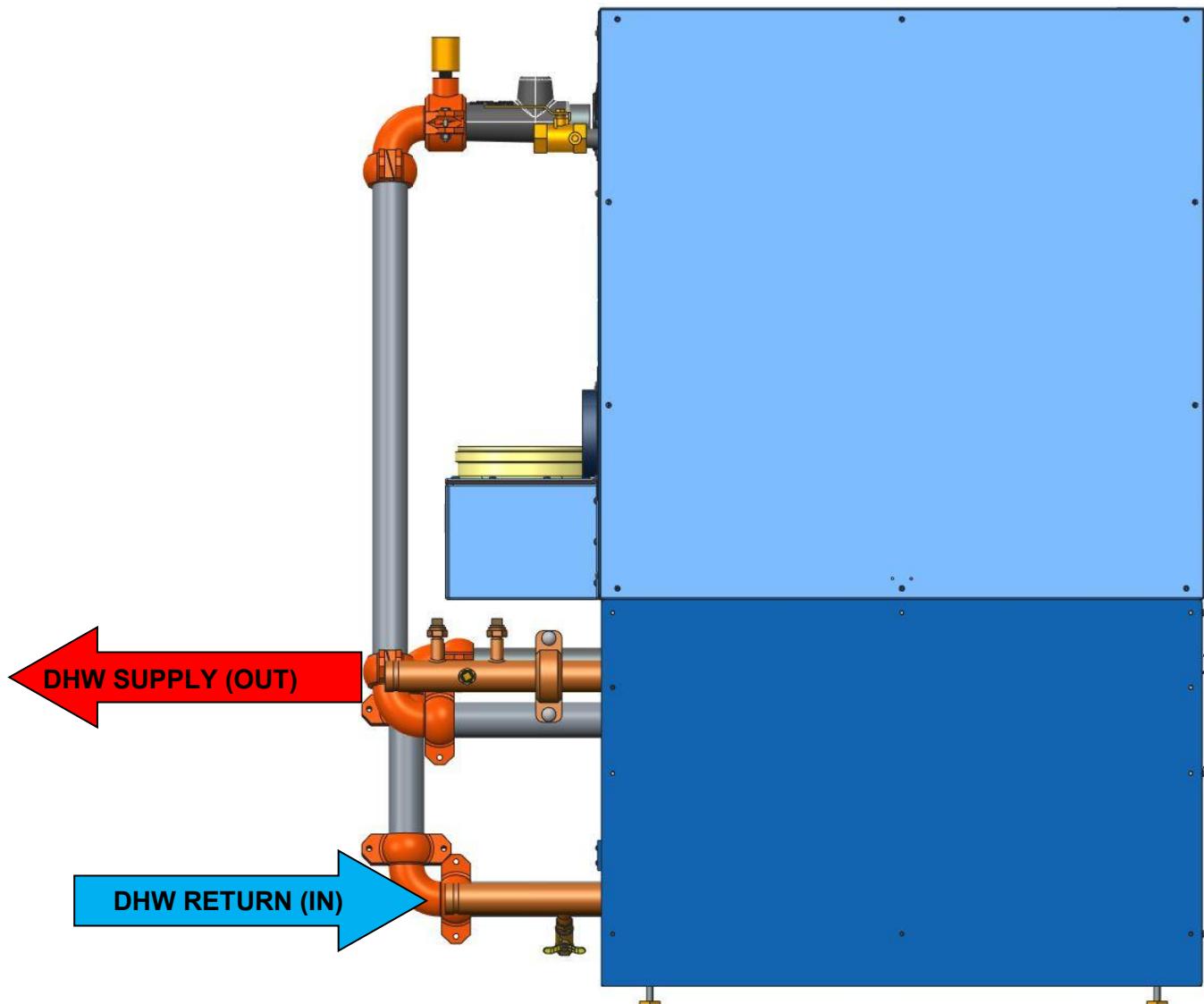
On the MnR300-MnR399-MnR500, the domestic hot water piping connections (2" type L copper) are located on the left hand side of the unit as shown below:



NOTICE! There are a variety of ways to connect to the domestic water piping on the MACH 'n' Roll™, but any sweat/soldered connections **must** use lead-free solder. Also, any brass or bronze pipe fittings, isolation valves, unions, check valves, etc. must also be lead-free.

3.4.2 Domestic Hot Water Piping Connections (MnR750-MnR1050)

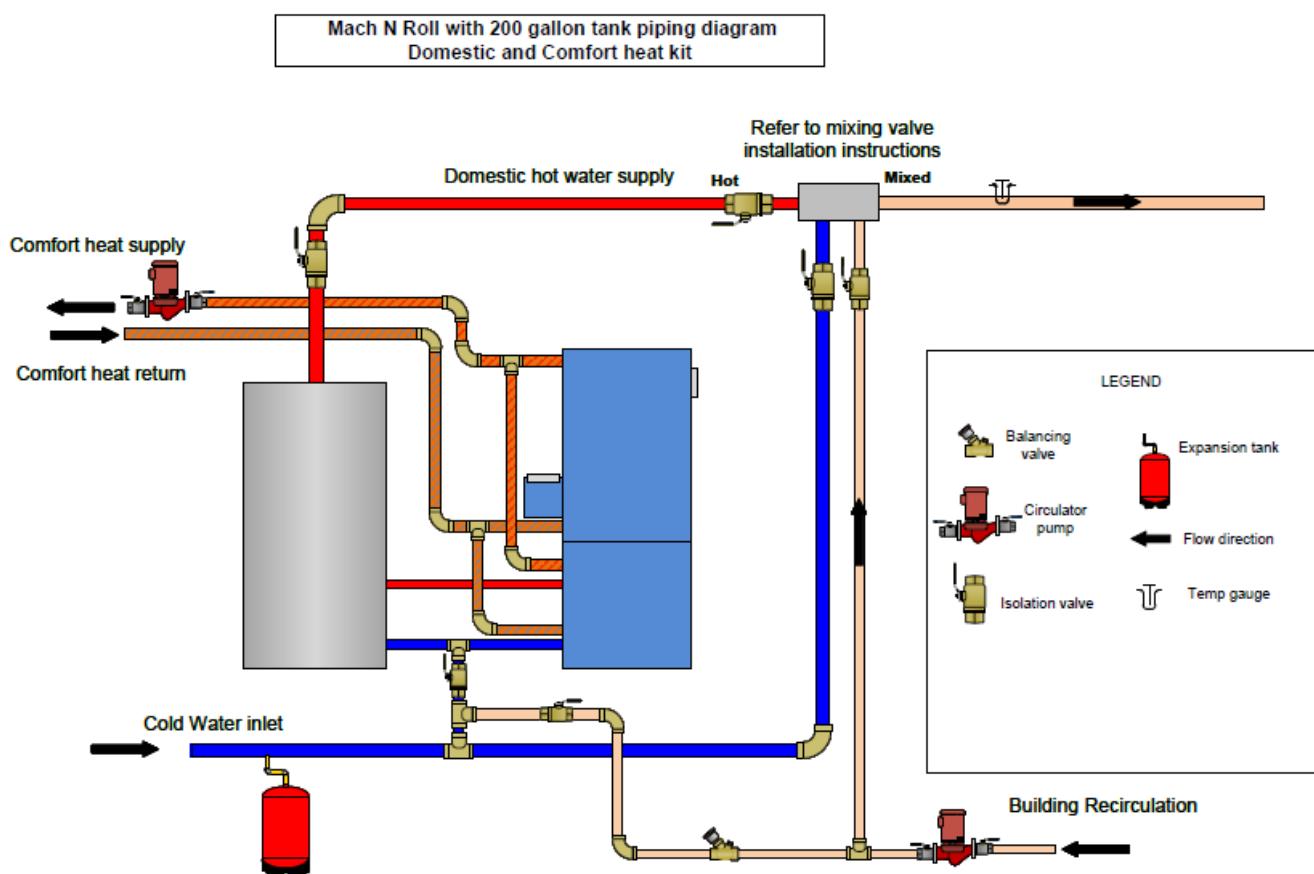
On the MnR750 & MnR1050, the domestic hot water piping connections (2" type L copper) are located at the left rear side of the unit as shown below:



NOTICE! There are a variety of ways to connect to the domestic water piping on the MACH 'n' Roll™, but any sweat/soldered connections **must** use lead-free solder. Also, any brass or bronze pipe fittings, isolation valves, unions, check valves, etc. must also be lead-free.

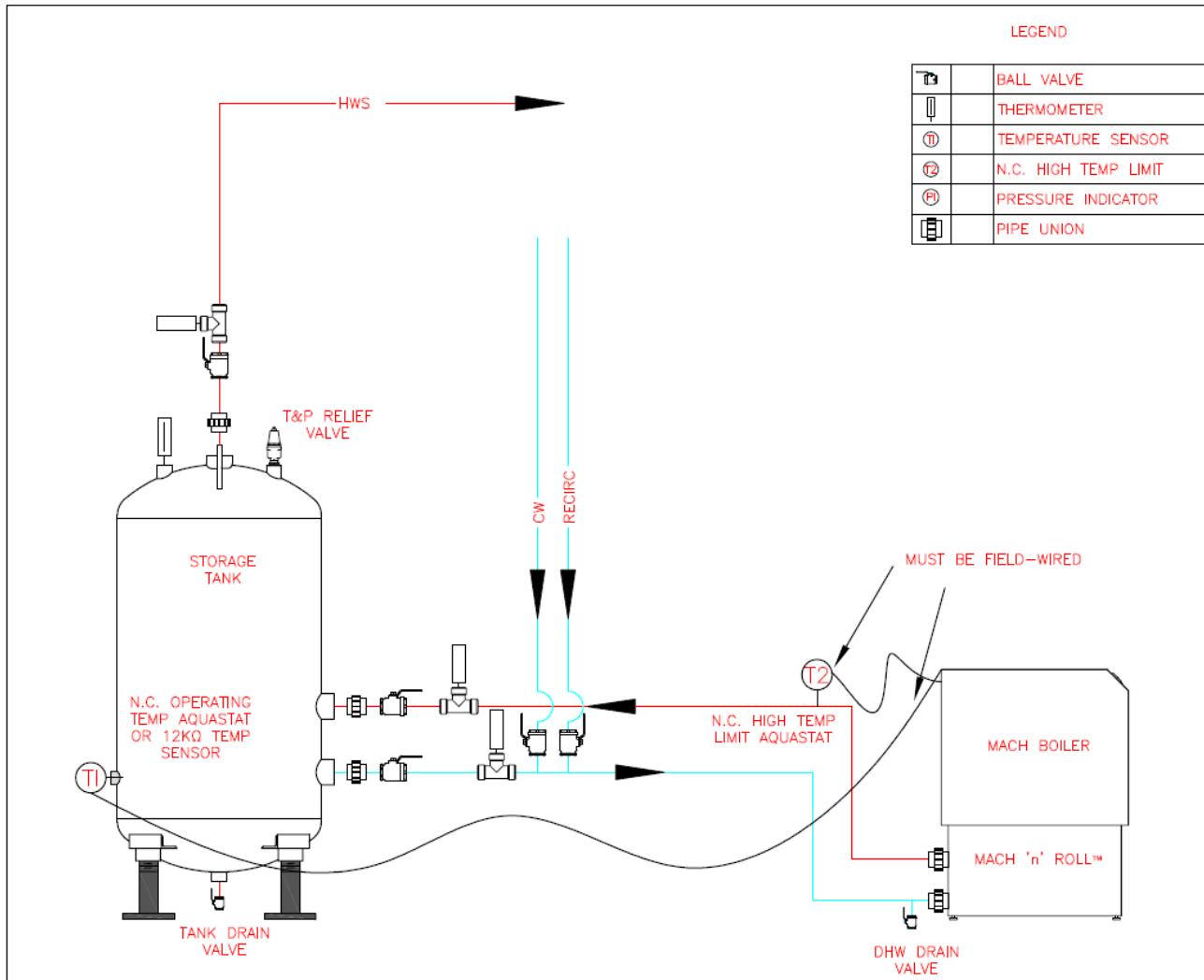
3.4.3 Example Comfort Heating Application with DHW

The image below shows a sample piping arrangement for a typical Domestic Hot Water Heating System with a P-K Mach'n'Roll unit and with Comfort Heating kit installed (Kit Numbers – BP00000577 for the 300-500, and BP00000572 for the 750-1050).



3.4.4 Example Domestic Hot Water System Installation (Single Unit)

It is important to note that the MACH 'n' Roll™ is designed to operate in conjunction with a domestic water storage tank. From the initial call for heat, it takes approximately two minutes until the P-K MACH® appliance operates at maximum power, so the storage tank needs to be sized appropriately for the application. The image below shows a sample piping arrangement for a typical domestic hot water system.

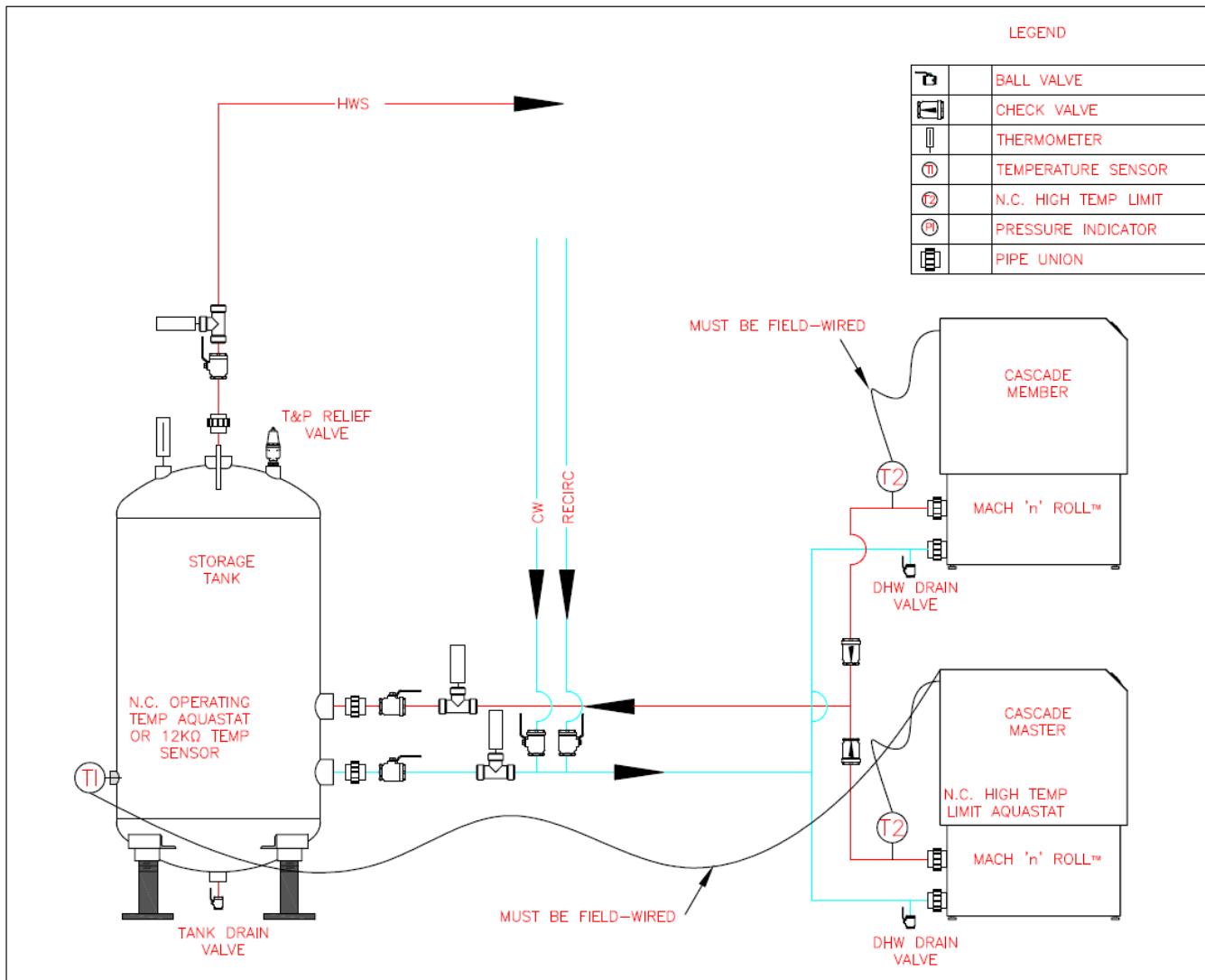


The P-K MACH n' Roll™ system features a thermowell in the domestic hot water supply connection which can be used for a normally closed high temperature limit aquastat. Alternatively, this high temperature limit aquastat can be installed in the domestic water storage tank. The normally closed and common terminals on the aquastat should be wired to the appliance's START INTERLOCK #1 terminals (TB2-7 & TB2-8). If the domestic water temperature exceeds the high temperature limit aquastat, the MACH 'n' Roll™ will go into a blocking error to prevent a high temperature condition. The system will remain in blocking for 5 minutes after which the NURO control will lockout.

The P-K MACH 'n' Roll™ system requires either a normally-closed operating temperature aquastat or a 12kΩ thermistor-type temperature sensor installed in the lower 1/3rd of the domestic water storage tank, wired to the appliance's DHW STAT/SENSOR terminals (TB1-7 & TB1-8). Ensure the insertion depth is sufficient to achieve an accurate tank temperature reading. If using a thermowell, thermal paste is recommended.

3.4.5 Example Domestic Hot Water System Installation (Multiple Units)

The image below shows a sample piping arrangement for a typical domestic hot water system with two P-K MACH 'n' Roll™ units.



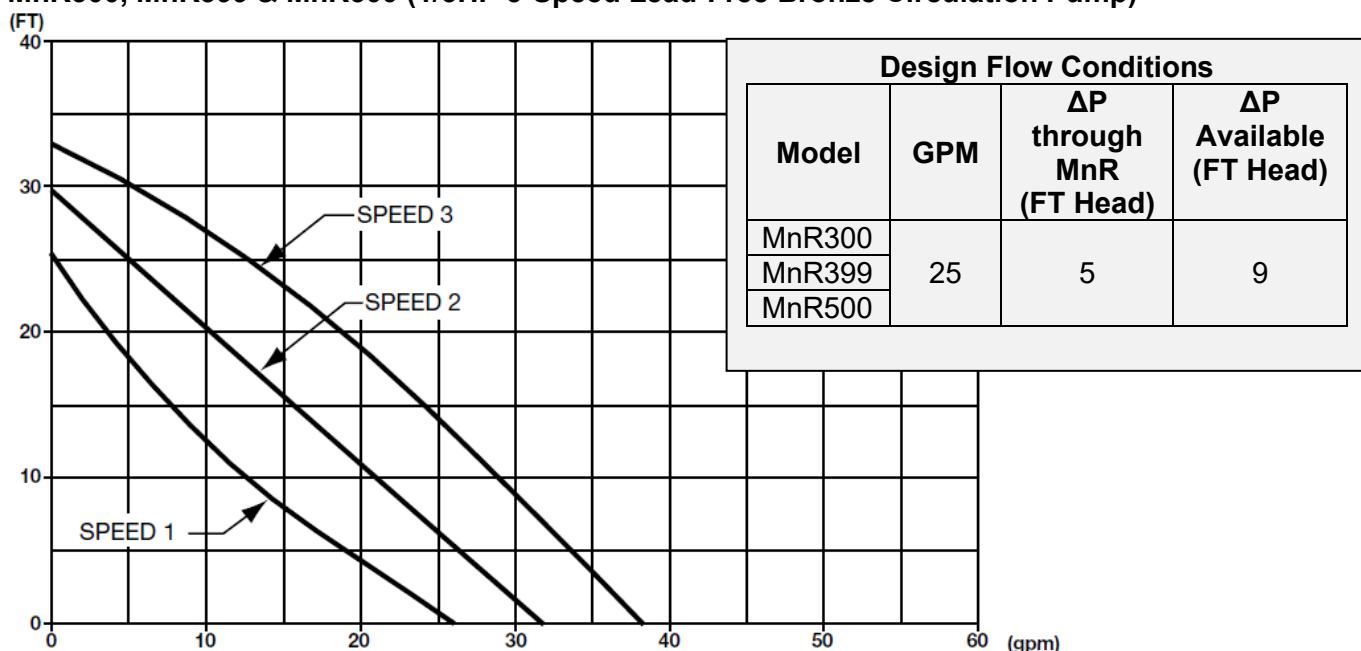
NOTE: Ensure a check valve is installed on the DHW supply piping of each MACH 'n' Roll™ in the system. This will ensure the hot water is directed to the storage tank, and isn't allowed to backflow through offline MACH 'n' Roll™ units.



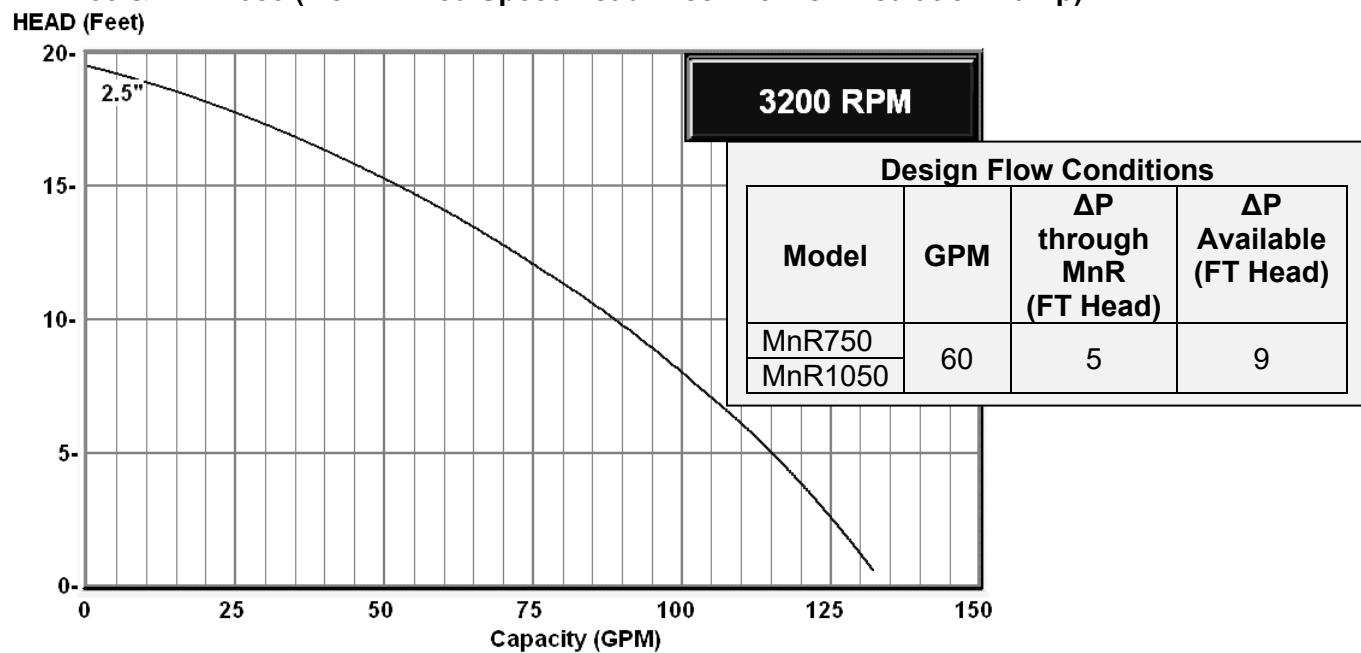
3.4.6 Domestic Hot Water Piping Considerations

It is recommended to install the P-K MACH 'n' Roll™ system as close as possible to the domestic water storage tank in order to minimize the overall length of piping. The P-K MACH 'n' Roll™ system features a fractional horsepower domestic water circulation pump which may have difficulty providing the design flow rate if the piping is too long, or if there is excessive pressure drop through elbows, tees, valves, etc. The pump performance curves and flow requirements are listed below for reference:

MnR300, MnR399 & MnR500 (1/3HP 3-Speed Lead-Free Bronze Circulation Pump)



MnR750 & MnR1050 (2/5HP Fixed Speed Lead-Free Bronze Circulation Pump)





3.4.7 Flushing the Domestic Water

The P-K MACH 'n' Roll™ system features an expansion tank/fill valve assembly that provides water to the P-K MACH® appliance and its piping. A dual-check valve ensures that the water in the appliance loop cannot re-enter the domestic loop. It is imperative that the water quality guidelines required for a P-K MACH® appliance be strictly followed. The P-K MACH® appliance heat exchanger is made of an aluminum alloy. All heat exchangers require proper water conditions to remain efficient and function properly. For information log on to our website: www.pattersonkelley.com for Multi-Metal Systems Water Quality Standards information as this applies to the warranty of the appliance's heat engine.

NOTICE! Glycol or other treatment chemicals added to the system must be certified by the chemical manufacturer for use in multi-metal systems that include cast aluminum appliances.

NOTICE! Under no circumstances should petroleum based cleaning or sealing compounds be used in the appliance system.

NOTICE! Under no circumstances should the hydronic system be flushed while the appliance is attached to the system since the debris or corrosion products could accumulate in the appliance and plug the appliance heat exchanger.

NOTICE! Performance data for recovery capacity of the P-K MACH 'n' Roll™ system (see [Section 7](#)) was performed with pure water with no additives. Chemical additives will impact the performance of the P-K MACH 'n' Roll™ system.

NOTICE! If the piping system attached to this unit will be chemically cleaned, the appliance must be disconnected from the system and a bypass installed so that the chemical cleaning solution does not circulate through the appliance. Following chemical cleaning, the system should be thoroughly rinsed to remove cleaning agents prior to reconnecting the appliance to the system.

Before the initial fill, ensure that any and all sediment or particulates have been removed from the domestic water. Ensure that any isolation valves between the domestic water storage tank and the P-K MACH 'n' Roll™ system are closed. If available, use a drain valve on the domestic water storage tank to purge sediment and particulates.

3.4.8 Filling the System

Before filling the system, ensure all the mechanical connections are complete. Also, refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to ensure the appliance's pressure relief valve is installed correctly.

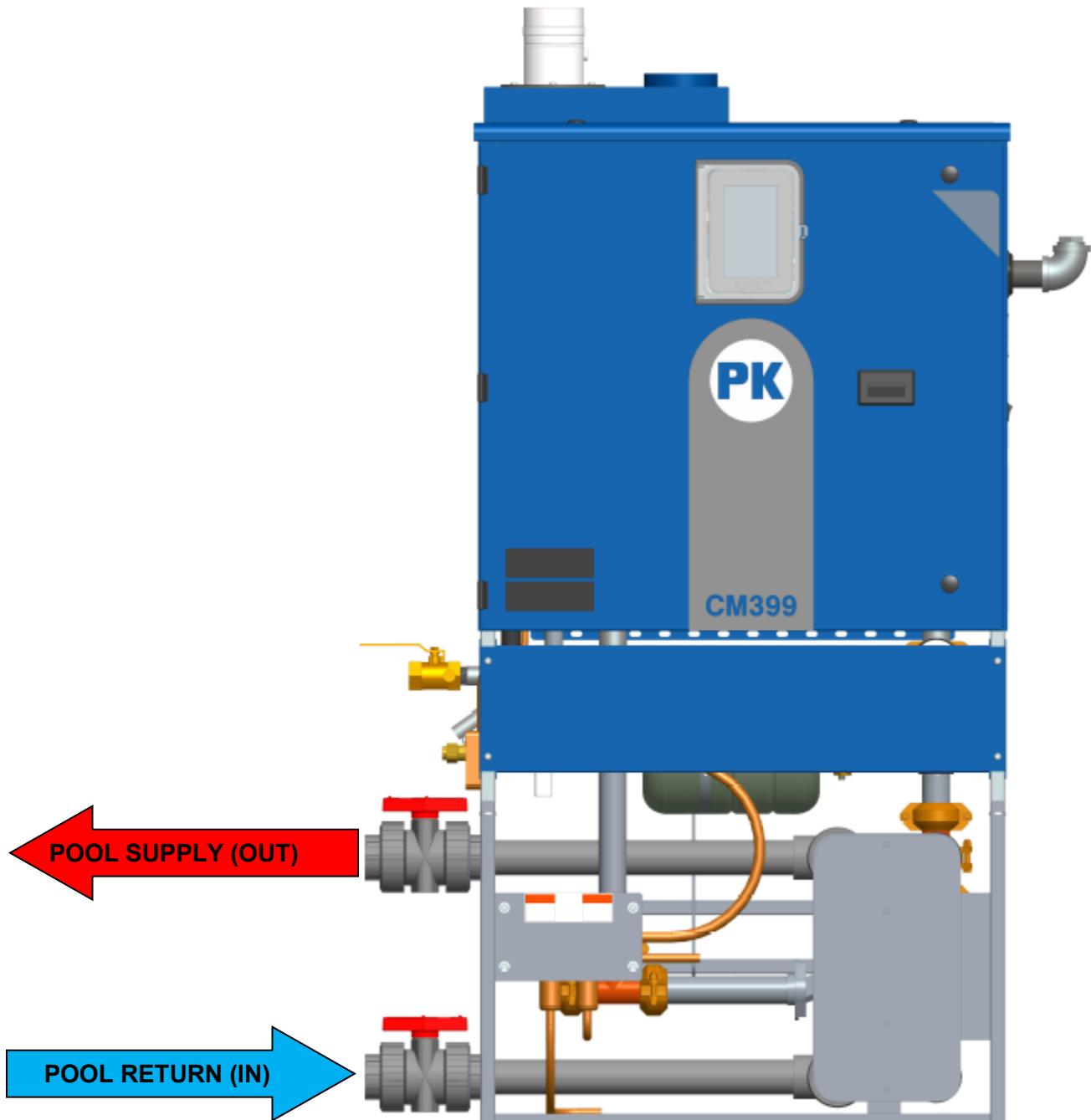
- **STEP 1** – Remove either the front or left panel from the P-K MACH 'n' Roll™ system to provide better access to the expansion tank/fill valve assembly isolation valve.
- **STEP 2** – If available, close the manual isolation valves in the domestic piping between the domestic water storage tank and the P-K MACH 'n' Roll™ system.
- **STEP 3** – Close the manual isolation valve ahead of the expansion tank/fill valve assembly. Refer to [Section 3.3.4](#) to ensure the expansion tank is charged to at least 12 psig and not more than 20 psig.
- **STEP 4** – Close the drain valves on the appliance and domestic piping.
- **STEP 5** – Open the cap on the automatic air vent in the appliance piping.



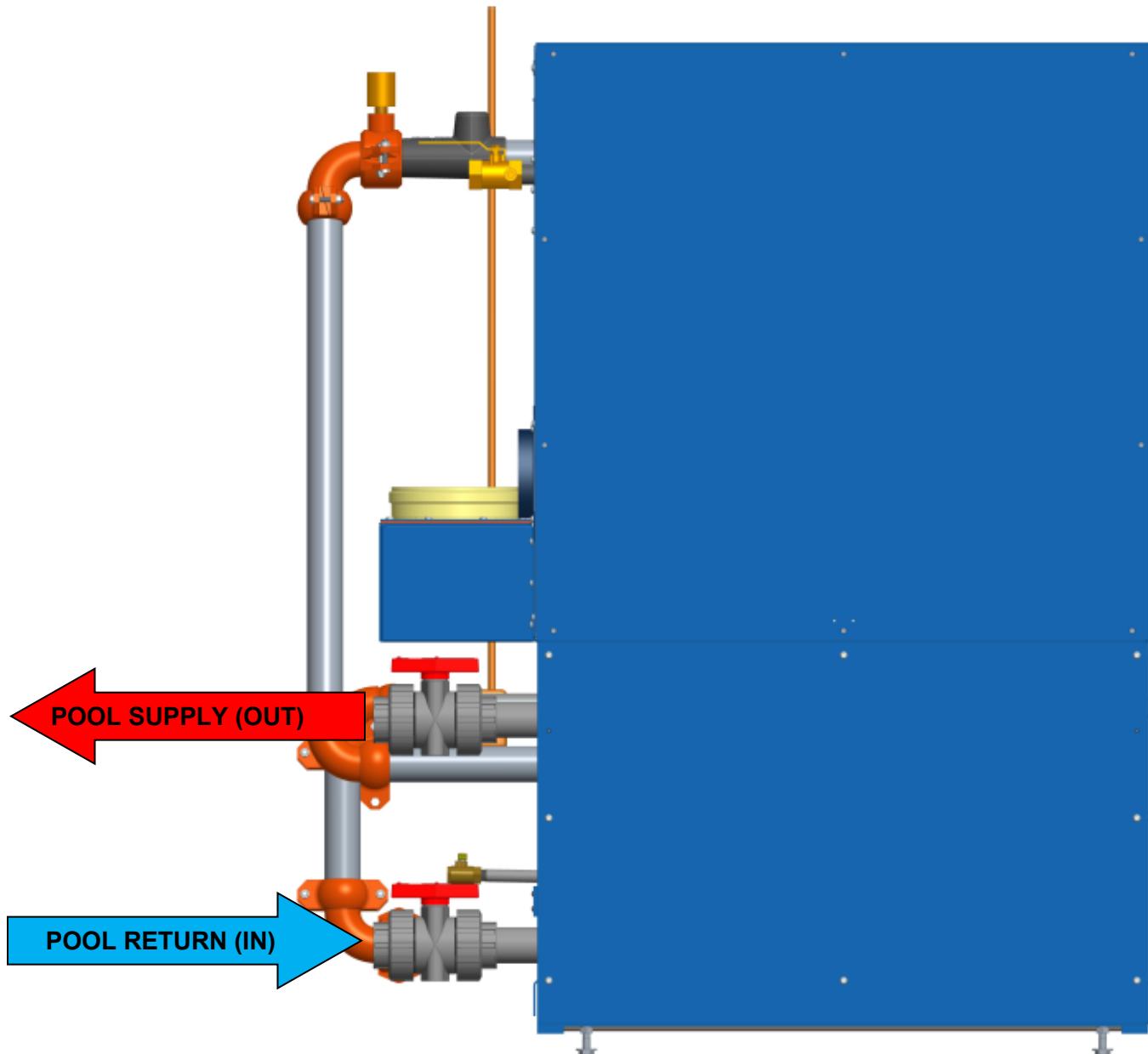
- **STEP 6** – Open the stem of the appliance's safety relief valve.
- **STEP 7** – If available, open the manual isolation valves in the domestic piping. This will fill the domestic side of the heat exchanger with water.
- **STEP 8** – Open the manual isolation valve ahead of the expansion tank/fill valve assembly. This will fill the appliance side of the heat exchanger with water.
- **STEP 9** – When water escapes from the boiler's safety valve discharge, close the stem of the safety relief valve.
- **STEP 10** – Ensure the water pressure is at least 12 psig in the appliance piping. If the water pressure is less than 12 psig, drain the water in the appliance piping and refer to [**Section 3.3.4**](#) to charge the expansion tank. When the expansion tank is charged properly, repeat Steps 1 through 9.
- **STEP 11** – Check for any leaks in the appliance piping, especially at the Victaulic couplings as these may have loosened during shipment. Tighten or reseat the connections if necessary.
- **STEP 12** – Check for any leaks in the domestic piping, especially at the Victaulic couplings and pump flanges which may have loosened during shipment. Tighten or reseat the connections if necessary.

3.5 Connecting to the Pool Water System (MnRP Indirect Pool Heating Models)

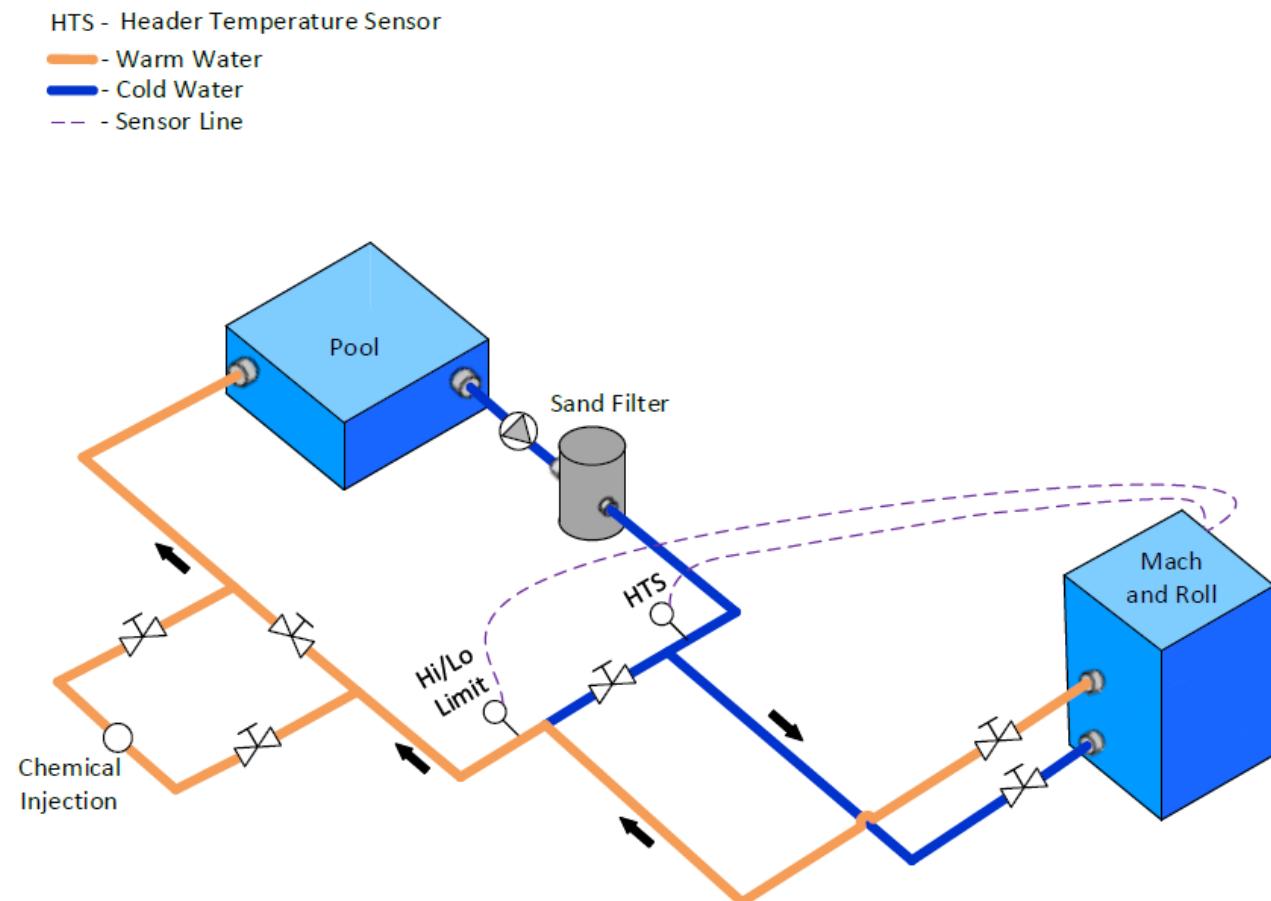
3.5.1 Pool Hot Water Piping Connections (MnRP300, 399, & 500)



3.5.2 Pool Hot Water Piping Connections (MnRP750 &1050)



3.5.3 Example Pool Heating System (Single Unit)



3.5.4 Example Pool Heating System (Multiple Units with Duration)

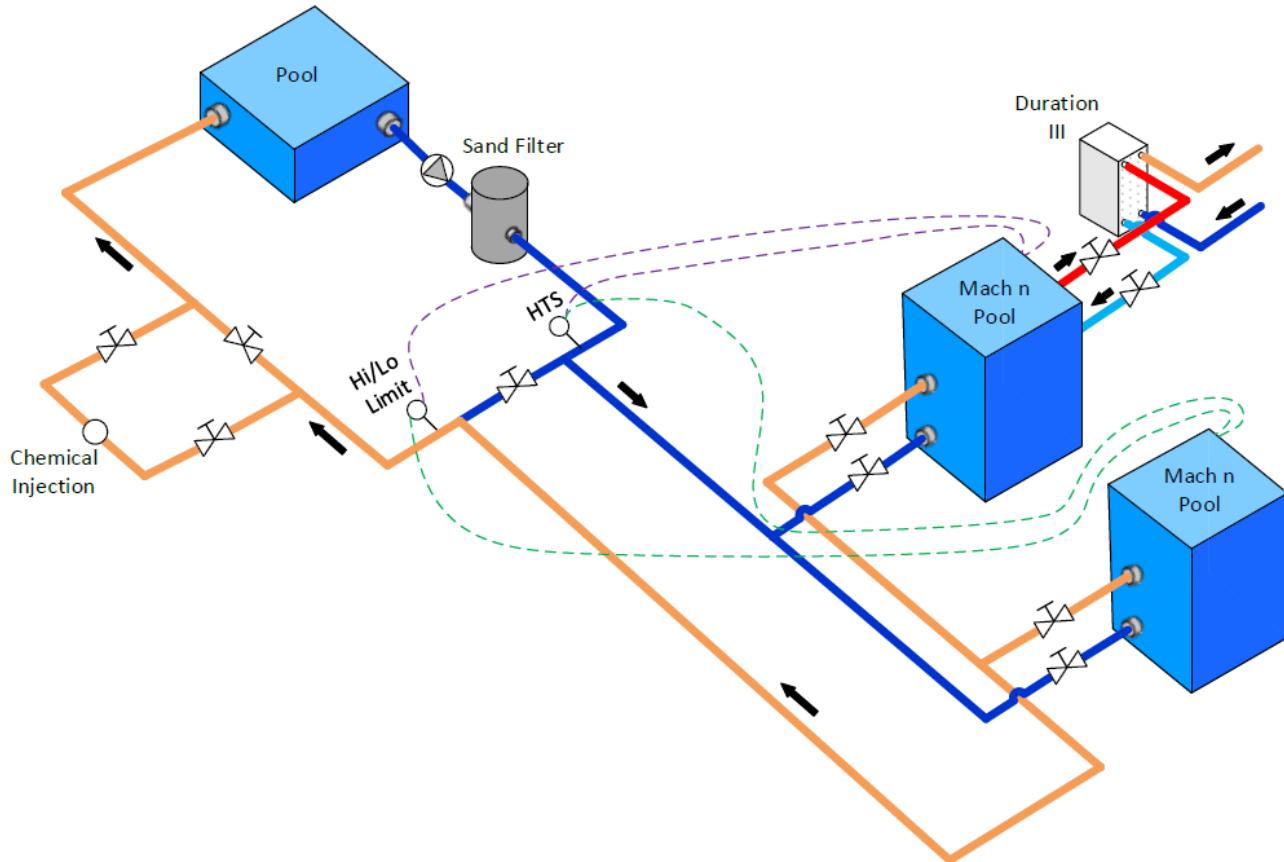
HTS - Header Temperature Sensor

— Warm Water

— Cold Water

— Sensor Line Boiler 1

— Sensor Line Boiler 2





3.5.5 Pool Water Piping Considerations

It is recommended the installer take into consideration the distance that the unit will be placed away from the pool. Since the intention of the pool package is to have the heat exchanger operate through the pool circulation pump loop, no additional MACH circulation pump is installed. In its place, a control valve intended to divert a percentage of the flow away from the main pool loop shall be installed. This valve can be either 2-way or 3-way design depending on the configuration of the system. The further the unit is placed away from the pool; more heat will be lost through piping and to the surrounding atmosphere. In addition to heat loss, the frictional losses in the pipe and connections will require the system pump to have adequate head capability and still maintain proper flow.

The MnRP unit should be piped downstream from the system pump and filtration system, but upstream from the chlorinator or other types of chemical treatments for the pool system.

3.5.6 Flushing Pool Water

The P-K MACH 'n' Roll™ system features an fill valve assembly that provides water to the P-K MACH® appliance and its piping. It is imperative that the water quality guidelines required for a P-K MACH® appliance be strictly followed. The P-K MACH® appliance heat exchanger is made of an aluminum alloy. All heat exchangers require proper water conditions to remain efficient and function properly. For information log on to our website: www.pattersonkelley.com for Multi-Metal Systems Water Quality Standards information as this applies to the warranty of the appliance's heat engine.

NOTICE! Glycol or other treatment chemicals added to the system must be certified by the chemical manufacturer for use in multi-metal systems that include cast aluminum appliances.

NOTICE! Under no circumstances should petroleum based cleaning or sealing compounds be used in the appliance system.

NOTICE! Under no circumstances should the hydronic system be flushed while the appliance is attached to the system since the debris or corrosion products could accumulate in the appliance and plug the appliance heat exchanger.

NOTICE! Performance data for recovery capacity of the P-K MACH 'n' Roll™ Pool system (see [Section 7](#)) was performed with pure water with no additives. Chemical additives will impact the performance of the P-K MACH 'n' Roll™ system.

NOTICE! If the piping system attached to this unit will be chemically cleaned, the appliance must be disconnected from the system and a bypass installed so that the chemical cleaning solution does not circulate through the appliance. Following chemical cleaning, the system should be thoroughly rinsed to remove cleaning agents prior to reconnecting the appliance to the system.

Before the initial fill, ensure that any and all sediment or particulates have been removed from the pool water. Ensure that any isolation valves between the pool water and the P-K MACH 'n' Roll™ system are closed.



3.5.7 Filling Pool Water Side of System

Before filling the system, ensure all the mechanical connections are complete. Also, refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to ensure the appliance's pressure relief valve is installed correctly.

- STEP 1** – Remove either the front or left panel from the P-K MACH 'n' Roll™ system to provide better access to the fill valve assembly isolation valve. (750 & 1050 models)
- STEP 2** – Close both manual isolation valves included on the pool piping.
- STEP 3** – Close the manual isolation valve ahead of the fill valve assembly.
- STEP 4** – Close any drain valves on the appliance and pool piping.
- STEP 5** – Open the cap on the automatic air vent in the appliance piping.
- STEP 6** – Open the stem of the appliance's safety relief valve.
- STEP 7** – Open the manual isolation valves in the pool piping. This will fill the pool side of the heat exchanger with water.
- STEP 8** – Open the manual isolation valve ahead of the expansion tank/fill valve assembly. This will fill the appliance side of the heat exchanger with water.
- STEP 9** – When water escapes from the appliance's safety valve discharge, close the stem of the safety relief valve.
- STEP 10** – Check for any leaks in the appliance piping, especially at the Victaulic couplings as these may have loosened during shipment. Tighten or reseat the connections if necessary.
- STEP 11** – Check for any leaks in the pool piping, especially at the union ball valves and fittings near the heat exchanger which may have loosened during shipment. Tighten or reseat the connections if necessary.

3.6 Electrical Connection

Only after all the mechanical connections have been completed and verified should any electrical connection be made. The P-K MACH 'n' Roll™ system can be configured to operate in several applications, so the electrical connections may need to be modified depending on the application. Please refer to [Section 6.1](#) for a wiring diagram of the P-K MACH 'n' Roll™ system.

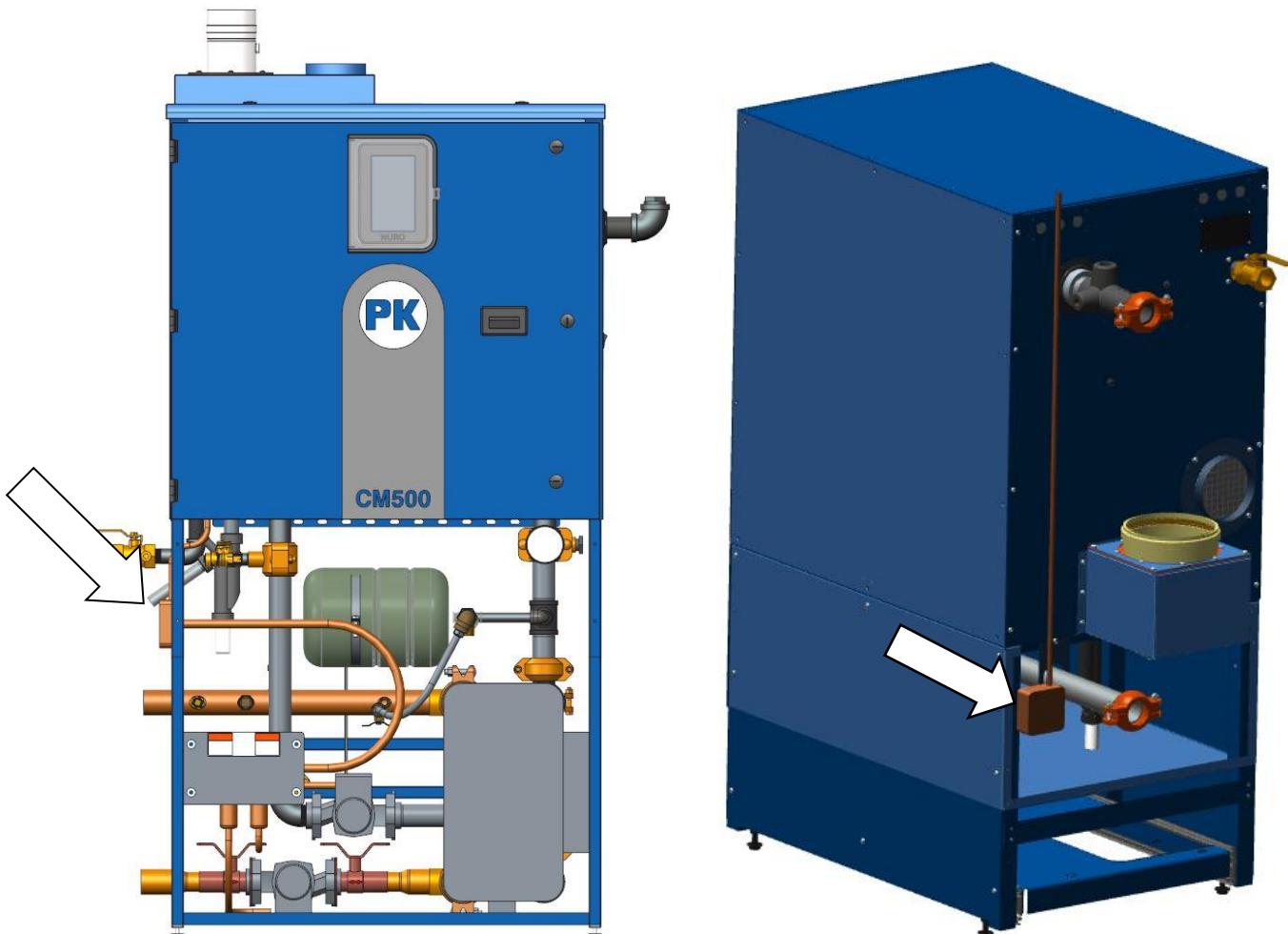


CAUTION Be sure to check the nameplate on the equipment before connecting electrical supply.

NOTICE! A dedicated earth ground (green wire) is required to avoid nuisance shutdowns. Do not ground through the conduit.

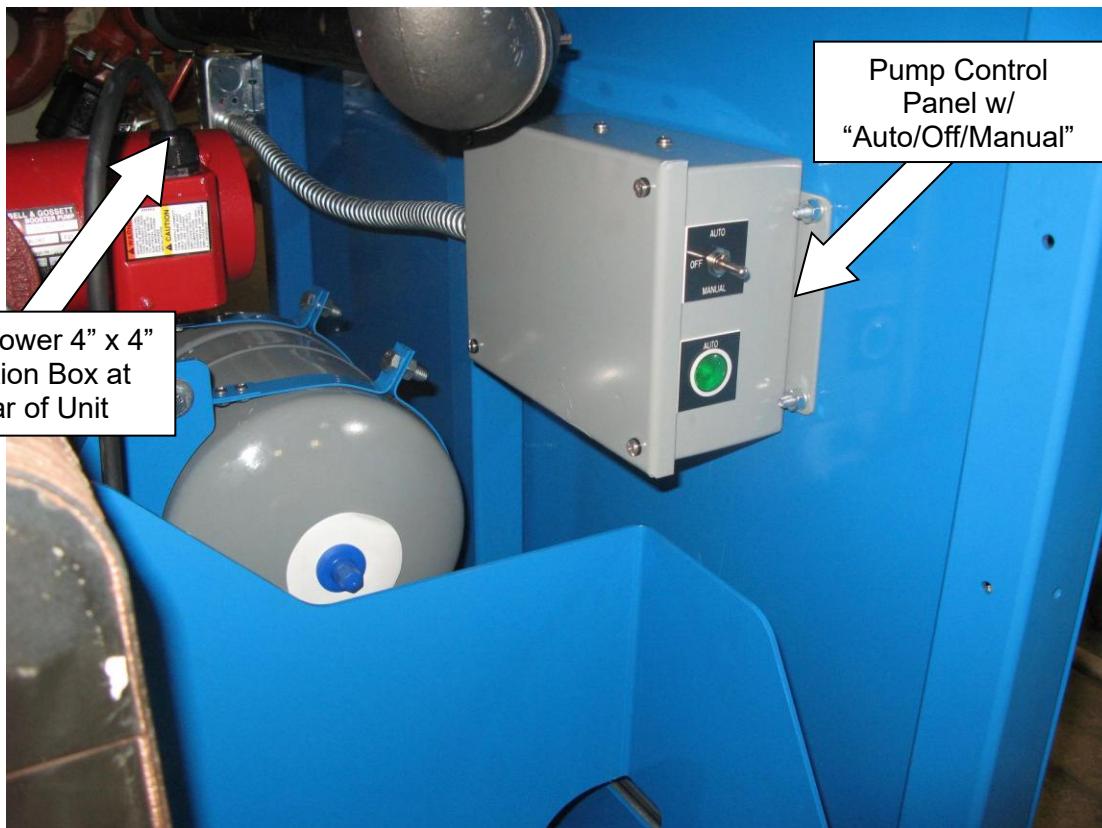


The P-K MACH 'n' Roll™ system requires 20 Amp, 120 VAC, single phase, 60 hertz electrical service. For added convenience, a 4"x4" electrical junction box is provided with "pigtails" for the hot, neutral, and ground leads. **THE ELECTRICAL SERVICE MUST BE ROUTED TO THIS 4" x 4" JUNCTION BOX** because it supplies power to both the P-K MACH® appliance and the P-K MACH 'n' Roll™ system. The images below show the location of the electrical junction box on the MnR300-MnR399-MnR500 and MnR750-MnR1050:



3.6.1 Control Panel for the Circulating Pumps

Remove the lower front sheet metal panel of the MnR750-MnR1050 to reveal the pump control panel. On the MnR300-MnR399-MnR1050, the pump control panel is located on the left hand side of the lower frame. The pump control panel features a green light which will illuminate when the pumps are running in "Auto" mode.



NOTE: Image Representative of MnR750-MnR1050

When operating in DHW mode, the P-K MACH 'n' Roll™ system uses the RELAY C (terminals TB2-18 and TB2-19) from the P-K MACH® appliance's high voltage terminal block. When the P-K MACH® appliance receives a domestic hot water call for heat, RELAY C provides contact closure and continuity for a pilot-duty 120VAC signal. Refer to [Section 6.1](#) for more information.

The pilot-duty 120VAC pump signal activates to the 120VAC coil on the pump relay, which provides continuity on the contactor side of the relay, allowing both the appliance and DHW circulating pumps to run. The pump control panel also features an "Auto/Off/Manual" switch:

- In the "Off" position, the circulating pumps are disabled.
- In the "Manual" position, the circulating pumps will run continuously.
- In the "Auto" position, the circulating pumps will respond to the pump signal from the P-K MACH® appliance's NURO controls. "Auto" is the recommended setting during normal operation.

NOTE: MACH 'n' Roll Pool System model is supplied with a single pump. This pump is for the Appliance Water loop.

NOTICE! The "Off" position on the pump relay switch is intended for use only when the P-K MACH 'n' Roll™ system is out of service for maintenance. **NEVER** change this switch to the "Off" position while the P-K MACH 'n' Roll™ system is in operation.



3.6.2 High Voltage (TB2) Terminal Block

⚠ WARNING

For P-K MACH® appliances, the high voltage (TB2) terminal block has inputs for line voltage (120VAC) connections, all other connections are for pilot duty output use only.

- **RELAY C (TB2-18 & TB2-19):** Common and Normally-Open terminals for Relay C. Upon a DHW call for heat, Relay C provides continuity for a 120VAC pilot-duty pump signal.
- **START INTERLOCK #1 (TB2-7 & TB2-8):** Install a high temperature limit aquastat in the domestic supply piping or in a domestic water storage tank. Wire the normally closed contacts to the P-K MACH® appliance's START INTERLOCK #1 terminals (TB2-7 & TB2-8). When the domestic water temperature is below the setpoint on the high temperature limit aquastat, the normally closed terminals will provide continuity on the external interlock circuit, allowing the appliance to run. If the domestic water temperature exceeds the setpoint on the high temperature limit aquastat, the external interlock circuit will be opened, which will immediately disable the appliance and the domestic circulation pump (except on the Pool Package) while the appliance circulation pump continues to run to dissipate heat from the appliance. This circuit while open, will prevent the appliance from running. If open for 5 minutes, this will lock out the NURO control, requiring a manual reset.

NOTICE! The START INTERLOCK #1 circuit is energized by the appliance with a 120VAC potential, so the high temperature limit aquastat must be rated for minimum 120VAC.

⚠ DANGER

The high temperature limit aquastat **MUST NOT** be installed across the P-K MACH® appliance's "ENABLE/DISABLE" terminals. It **MUST** be installed across the P-K MACH® appliance's "START INTERLOCK #1" terminals.

3.6.3 Low Voltage (TB1) Terminal Block

- **DHW STAT/SENSOR (TB1-9 & TB1-10)** – Terminals TB1-9 & TB1-10 are connected to the DHW temperature sensor or thermostat. This circuit is energized by the appliance with a 5V potential. If a temperature sensor is used (preferred method), it must be 12kΩ thermistor type. Alternatively, a normally-closed, break on rise aquastat can be used to enable and disable the MACH 'n' Roll™ system.

3.7 Drain Valve and Piping

A drain valve is factory installed in the boiler piping. Prior to draining the appliance, electrical power and gas supply **MUST** be turned off to the appliance, and the appliance must be isolated from the system at the supply and return connections.

NOTICE! This drain valve is factory installed for draining of the appliance water only, not the entire system. Draining of the system through the appliance will result in depositing sediment from the system in the appliance which will result in poor heat transfer characteristics of the appliance and early failure.



3.8 Pre-Start Check List

Before attempting to start the P-K MACH 'n' Roll™ system and P-K MACH® appliance, ensure the following items have been completed.

1. Refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to verify the gas piping is installed correctly.
2. Refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to verify the flue venting is installed correctly.
3. Refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to verify the combustion air ducting is installed correctly (if applicable).
4. Refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to verify the proper installation of condensate piping and neutralization equipment.
5. Refer to [Sections 3.1](#) through [Sections 3.6](#) of this manual to verify the domestic hot water piping, electrical service, temperature sensors/aquastats, drain piping, etc. are installed correctly.
6. Refer to the P-K MACH® CM300 through C1050 NURO installation and operation manual to ensure the appliance's pre-start check list has been followed.
7. Inspect the P-K MACH 'n' Roll™ system for leaks in either the appliance side or domestic hot water/pool water side piping. Correct any and all leaks promptly.
8. Inspect the relief valve discharge piping and ensure this is routed to a nearby floor drain or safe point of discharge.
9. Ensure there is sufficient clearance around the unit, especially the front and left surfaces.

3.9 Safety Checks

The following checks of safety systems must be made before putting the P-K MACH 'n' Roll™ system into normal operation.



WARNING Never attempt to operate a P-K MACH 'n' Roll™ system that has failed to pass all the safety checks described below.



WARNING After checking controls by manual adjustment, make sure they are always reset to their proper settings.

3.9.1 Test of Circulation Pumps

It is imperative to verify the correct operation of both the appliance circulation pump and the domestic hot water circulation pump. Refer to [Section 3.4.6](#) to properly fill the domestic water and appliance water piping. Once the MACH 'n' Roll™ system is filled with water, move the pump control switch to the "On" position and verify that both the appliance circulation pump and domestic circulation pump operate properly. Listen for abnormal noises which might indicate cavitation, deadheading or general poor performance.

Note: For pool versions follow the above procedure taking into consideration that the domestic circulation pump is not present. Ensure the pool circulation pump is operating at time of test.



3.9.2 Test of High Temperature Limit Aquastat

Ensure that a normally-closed high temperature limit aquastat is installed either in the domestic hot water, pool water supply piping or the domestic water storage tank. The normally-closed terminals **MUST** be wired to the appliance's START INTERLOCK #1 terminals (TB2-7 & TB2-8). Refer to [Section 3.5.2](#) for more information on the installation.

NOTICE! Isolate the domestic hot water storage tank from the rest of the system before testing the high temperature limit aquastat.

When the appliance is powered on, adjust the dial on the high temperature limit aquastat to the lowest possible setting. Allow the P-K MACH® appliance to start its normal firing sequence. Once the domestic water temperature exceeds this value, the high temperature limit aquastat should open the appliance's START INTLEROCK #1 circuit. When this happens, the appliance is immediately disabled and the circulation pumps continue to run to dissipate heat from the appliance.

If this does not work, check the wiring on the high temperature limit aquastat and ensure there is no jumper or other wiring attached to the P-K MACH® appliance's START INTERLOCK #1 circuit. If necessary, replace the high temperature limit aquastat.

3.9.3 Test of Domestic Water Temperature Sensor

If using a 12kΩ thermistor-type temperature sensor installed in the domestic water storage tank, ensure the sensor is wired to the P-K MACH® appliance's DHW STAT/SENSOR terminals (TB1-9 & TB1-10). From the NURO® home screen, press <INFO> and scroll down to "**DHW temp**" which should show a read-only domestic water temperature value. If this temperature value is inaccurate, check the wiring and installation of the temperature sensor. Also, ensure the temperature sensor is of sufficient length to accurately measure the tank temperature. If necessary, replace the domestic water temperature sensor.

3.9.4 Test of Operating Aquastat

If using an aquastat (break on rise) installed in the domestic water storage tank, ensure the normally-closed terminals are wired to the appliance's DHW STAT/SENSOR terminals (TB1-9 & TB1-10). Adjust the aquastat until it provides a domestic call for heat to the P-K MACH® appliance. If this does not happen, check the wiring and installation of the aquastat. Also, ensure the aquastat's temperature probe is of sufficient length to accurately measure the tank temperature. If necessary, replace the operating aquastat.



The NURO® control features a 7" color touchscreen display. The "Home Screen" (above) displays the general operating conditions of the MACH 'n' Roll™. To access additional temperature values and information, press <INFO> in the bottom left corner of the "Home Screen" which accesses the "Information" screen (right).

The "Information" screen allows the user to scroll through dozens of real-time read-only values related to the operation of the MACH 'n' Roll™ unit, including outlet temperature, inlet temperature, exhaust temperature, firing rate, alarms, etc.

Press <HOME> in the lower right corner at any time to return to the "Home Screen".

NOTE

For more information on any parameter, please refer to the NURO Boiler Controller: Advanced User's Guide, Part Number is 1004905979

4 NURO CONTROL SYSTEM SETUP

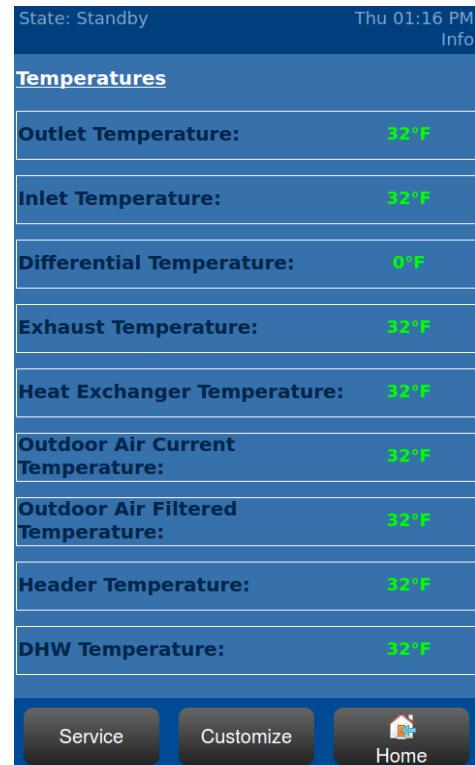
4.1 NURO Control System Overview

The P-K MACH® appliance is equipped with the NURO® control which consists of 2 main components; the combustion and temperature controllers. The NURO® is an intelligent control system with advanced features including a 7" color touchscreen display, MODBUS® communication capabilities, and more. Firing rate and setpoint can be controlled via an external 4-20ma analog control signal or MODBUS®. Errors are date and time stamped with extensive description explanations. The system records burner run time at various operating points.

This manual is intended to provide very basic setup steps for typical MACH 'n' Roll™ installations. For more advanced setup and parameter information, please refer to the latest edition of the NURO Advanced User's Guide.

CAUTION

The user should become completely familiar with the operation of the appliance and controls before attempting to make any adjustments.





4.2 Domestic Hot Water Setup Wizard

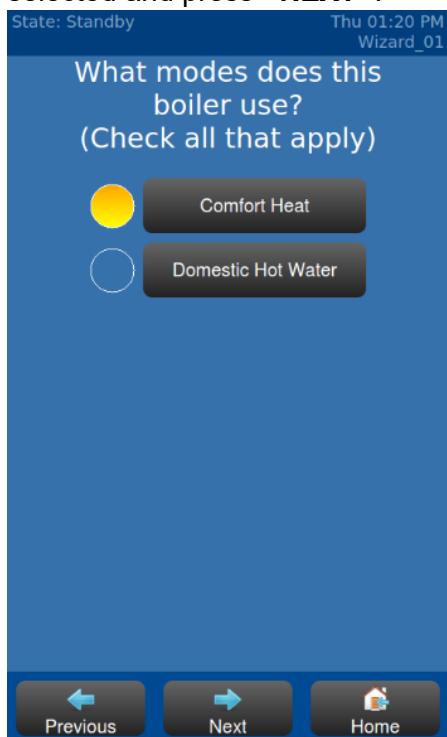
From the Home Screen, press **<SETTINGS>** in the lower right corner to load the “**Main Menu**” screen shown to the right.

Touch **<Setup Wizard>** to launch the “**Setup Wizard**” screen shown at the far right. If prompted for a Service Level 1 passcode, enter “4321” and press **<ACCEPT PASSWORD>** to proceed.

The first step of the Setup Wizard asks if the MACH ‘n’ Roll™ unit is operating as “**Standalone Boiler**” or “**Boiler in Cascade System**”.

Select **<Standalone Boiler>** and press **<NEXT>** to proceed.

Next, the Setup Wizard asks which modes the MACH ‘n’ Roll™ unit is using: “**Comfort Heat**” or “**Domestic Hot Water**”. Make sure that only **<Domestic Hot Water>** is selected and press **<NEXT>**.



The next step of the Setup Wizard explains the Relay Instructions. The NURO® control system features four configurable relay outputs labeled RELAY A through RELAY D. The factory-default settings are recommended for most installations, but customization is possible. For more information on the configurable relay outputs, please refer to the NURO Boiler Controller: Advanced User’s Guide, Part Number is 1004905979. Press **<NEXT>** to proceed.

NOTE

The relay assignments **must** agree with the wiring to/from the boiler. For example, if Relay A is user-configured to enable/disable the Boiler Pump, the control wires to operate the boiler pump must be properly wired to the Relay A terminals in the High Voltage (TB2) terminal block. Press the “Next” button to continue.

Make sure that RELAY C is assigned to “**DHW Boiler Side Pump**”. If not, press **<RELAY C>**, then select **<DHW Boiler Side Pump>** and press **<NEXT>** to continue.

NOTE: If using an aquastat installed in the domestic water storage tank, proceed to [Section 4.2.1](#). If using a temperature sensor installed in the domestic water storage tank, proceed to [Section 4.2.2](#).

For Pool Heater models, program the NURO as Domestic Hot Water being the pool water values.



4.2.1 Domestic Hot Water Control (Aquastat in Storage Tank)

The next screen of the Setup Wizard allows the user to choose how the MACH 'n' Roll™ system is controlled for Domestic Hot Water (DHW) operation. If the installation features a normally-closed (break on rise) aquastat installed in the domestic water storage tank and wired to the P-K MACH® appliance's DHW STAT/SENSOR terminals (TB1-9 & TB1-10), select **<Aquastat in Storage Tank>** and press **<NEXT>** to proceed.

The next screen of the setup wizard allows the user to adjust three settings:

- **DHW Appliance Setpoint Temperature**

- This is the supply temperature setpoint for the P-K MACH® appliance during a domestic call for heat from the aquastat in the storage tank.
- **NOTE:** The "DHW Boiler Setpoint Temperature" must exceed the desired domestic hot water temperature. For the most efficient and reliable operation, it is recommended to find the lowest possible appliance setpoint which satisfies the domestic hot water load requirements.
- **NOTE:** The "DHW Boiler Setpoint Temperature" will typically need to exceed the setpoint on the storage tank aquastat by at least 10°F-20°F. Some fine-tuning of this value will be required in order to satisfy the domestic hot water load requirements.

- **DHW Appliance Max Setpoint Temperature**

- The NURO control system provides the ability to increment the "DHW Boiler Setpoint Temperature" in order to maintain the desired domestic hot water temperature. For example, in periods of high demand, the NURO control may require the P-K MACH® appliance to operate to a higher supply temperature setpoint.
- **NOTE:** The "DHW Boiler Max Setpoint Temperature" must exceed the desired domestic hot water temperature. For the most efficient and reliable operation, it is recommended to find the lowest possible appliance setpoint which satisfies the domestic hot water load requirements.
- **NOTE:** Setting "DHW Boiler Max Setpoint Temperature" equal to "DHW Boiler Setpoint Temperature" means the P-K MACH® appliance will always operate to the same setpoint during DHW operation.

- **Max DHW Appliance Temperature**

- This is the maximum allowable supply temperature for the P-K MACH® appliance during domestic hot water operation. If the P-K MACH® appliance's supply temperature reaches this value, the appliance will be forced to return to "Standby".
- **NOTE:** The "Max DHW Boiler Temperature" must exceed the desired domestic hot water temperature. For the most efficient and reliable operation, it is recommended to find the lowest possible appliance setpoint which satisfies the domestic hot water load requirements.

These setpoint temperatures can be adjusted in one of 3 methods:

1. Use the **<UP>** or **<DOWN>** arrows to adjust the setpoint in increments of 1°F.
2. Move the slider bar left or right to perform quick adjustments to the setpoint.
3. Press the numeric temperature value to access a numeric 0-9 keypad. Once the keypad is displayed, the user can enter the desired setpoint value.

After the "DHW Boiler Setpoint Temperature", "DHW Boiler Max Setpoint Temperature" and "Max DHW Boiler Temperature" values have been programmed, press **<NEXT>** to continue.

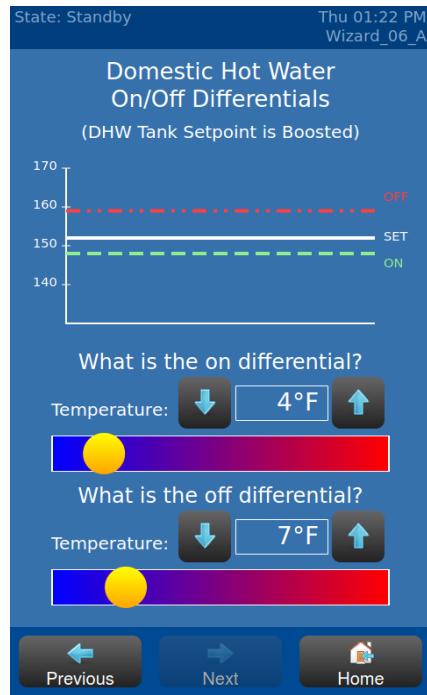


The final screen of the Setup Wizard asks the user to adjust the “on differential” and the “off differential” as shown to the right. A visual representation of the appliance’s “DHW Boiler Setpoint Temperature” is shown by the horizontal white line. The “on differential” is the lower temperature deadband which will enable the P-K MACH® appliance for operation and is represented by the dashed green line. The “off differential” is the upper temperature deadband which will disable the P-K MACH® appliance and is represented by the dashed red line.

In the example to the right, the “DHW Boiler Setpoint Temperature” is 153°F, the “on differential” is 4°F, and the “off differential” is 7°F. In this scenario, upon a domestic call for heat from the aquastat, the P-K MACH® appliance will be enabled when its supply temperature drops below $153^{\circ}\text{F} - 4^{\circ}\text{F} = 149^{\circ}\text{F}$. The P-K MACH® appliance will continue to operate until either the domestic call for heat is removed by the aquastat, or its supply temperature exceeds $153^{\circ}\text{F} + 7^{\circ}\text{F} = 160^{\circ}\text{F}$.

Once the “on differential” and “off differential” are programmed, press <NEXT> to proceed. The NURO will present a confirmation screen with a 30 second countdown timer. Press <HOME> to return to the home screen, or simply wait for the timer to expire. The MACH ‘n’ Roll™ system is now programmed to respond to the aquastat installed in the domestic water storage tank.

For Pool Heater models, program the NURO as Domestic Hot Water being the pool water values.



4.2.2 Domestic Hot Water Control (Temperature Sensor in Storage Tank) – Preferred

The preferred method for controlling the MACH ‘n’ Roll™ is to use a 12kΩ thermistor-type temperature sensor installed in the domestic water storage tank, ensure the sensor is wired to the P-K MACH® appliance’s DHW STAT/SENSOR terminals (TB1-9 & TB1-10). This temperature sensor should be installed in the lower 1/3 portion of the storage tank and be of sufficient length to obtain an accurate temperature reading.

On the Setup Wizard, select <Temperature Sensor in Storage Tank> and press <NEXT> to proceed. The NURO control allows the user to change the behavior of the temperature sensor to two different settings: “Sensor as an Aquastat” or “Sensor for Remote Modulation”.

- **Sensor as an Aquastat**
 - The 12kΩ temperature sensor will remotely monitor the domestic water tank temperature and enable/disable the P-K MACH® appliance according to the temperature setpoint and differentials.
 - The P-K MACH® appliance will PID modulate to its own supply (outlet) temperature but will not PID modulate to the tank temperature conditions.
 - **NOTE:** If “Sensor as an Aquastat” is selected, press proceed to [Section 4.2.2.1](#)
- **Sensor for Remote Modulation**
 - The 12kΩ temperature sensor will remotely monitor the domestic water tank temperature and enable/disable the P-K MACH® appliance according to the temperature setpoint and differentials.
 - The P-K MACH® appliance will PID modulate to the tank temperature conditions.
 - **NOTE:** If “Sensor for Remote Modulation” is selected, proceed to [Section 4.2.2.2](#)

Press <NEXT> to proceed to the next Setup Wizard screen, and refer to either [Section 4.2.2.1](#) or [4.2.2.2](#).

For Pool Heater models, program the NURO as Domestic Hot Water being the pool water values.



4.2.2.1 Sensor as an Aquastat

If "Sensor as an Aquastat" is selected, the next screen allows the user to adjust four settings:

- **DHW Tank Setpoint Temperature**
 - This is the desired domestic hot water setpoint temperature to maintain in the storage tank.
- **DHW Tank Setpoint Boost**
 - The NURO will control the P-K MACH® appliance to a "DHW Boiler Temperature Setpoint". Initially, this setpoint will exceed the "DHW Tank Setpoint Temperature" by the "DHW Tank Setpoint Boost".
 - For example, if the "DHW Tank Setpoint Temperature" is 140°F, and the "DHW Tank Setpoint Boost" is 10°F, the NURO will initially control the P-K MACH® appliance to a "DHW Boiler Temperature Setpoint" of $140^{\circ}\text{F} + 10^{\circ}\text{F} = 150^{\circ}\text{F}$.
- **DHW Appliance Max Setpoint Temperature**
 - The NURO control system provides the ability to increment the "DHW Boiler Temperature Setpoint" in order to maintain the desired domestic hot water temperature. For example, in periods of high demand, the NURO control may require the P-K MACH® appliance to operate to a higher supply temperature setpoint.
 - **NOTE:** The "DHW Boiler Max Setpoint Temperature" must exceed the desired domestic hot water temperature. For the most efficient and reliable operation, it is recommended to find the lowest possible appliance setpoint which satisfies the domestic hot water load requirements.
 - **NOTE:** Setting "DHW Boiler Max Setpoint Temperature" equal to "DHW Boiler Setpoint Temperature" means the P-K MACH® appliance will always operate to the same setpoint during DHW operation.
- **Max DHW Appliance Temperature**
 - This is the maximum allowable supply temperature for the P-K MACH® appliance during domestic hot water operation. If the P-K MACH® appliance's supply temperature reaches this value, the appliance will be forced to return to "Standby".
 - **NOTE:** The "Max DHW Boiler Temperature" must exceed the desired domestic hot water temperature. For the most efficient and reliable operation, it is recommended to find the lowest possible appliance setpoint which satisfies the domestic hot water load requirements.

These setpoint temperatures can be adjusted in one of 3 methods:

1. Use the <UP> or <DOWN> arrows to adjust the setpoint in increments of 1°F.
2. Move the slider bar left or right to perform quick adjustments to the setpoint.
3. Press the numeric temperature value to access a numeric 0-9 keypad. Once the keypad is displayed, the user can enter the desired setpoint value.

After the "DHW Tank Setpoint Temperature", "DHW Tank Setpoint Boost", "DHW Boiler Setpoint Temperature" and "Max DHW Boiler Temperature" values have been programmed, press <NEXT> to continue. Proceed to [Section 4.2.3](#).



4.2.2.2 Sensor for Remote Modulation

If “Sensor for Remote Modulation” is selected, the next screen allows the user to adjust two settings:

- **DHW Tank Setpoint Temperature**
 - This is the desired domestic hot water setpoint temperature to maintain in the storage tank.
- **Max DHW Appliance Temperature**
 - This is the maximum allowable supply temperature for the P-K MACH® appliance during domestic hot water operation. If the P-K MACH® appliance’s supply temperature reaches this value, the appliance will be forced to return to “Standby”.
 - **NOTE:** The “Max DHW Boiler Temperature” must exceed the desired domestic hot water temperature. For the most efficient and reliable operation, it is recommended to find the lowest possible appliance setpoint which satisfies the domestic hot water load requirements.

These setpoint temperatures can be adjusted in one of 3 methods:

1. Use the <UP> or <DOWN> arrows to adjust the setpoint in increments of 1°F.
2. Move the slider bar left or right to perform quick adjustments to the setpoint.
3. Press the numeric temperature value to access a numeric 0-9 keypad. Once the keypad is displayed, the user can enter the desired setpoint value.

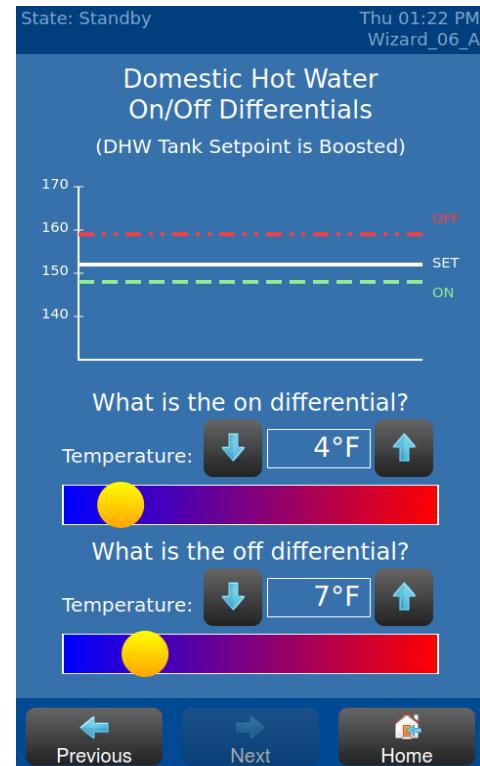
After the “DHW Tank Setpoint Temperature” and “Max DHW Boiler Temperature” values have been programmed, press <NEXT> to continue. Proceed to [Section 4.2.3](#).

4.2.3 On/Off Differentials

The final screen of the Setup Wizard asks the user to adjust the “on differential” and the “off differential” as shown to the right. A visual representation of the appliance’s “DHW Tank Setpoint Temperature” is shown by the horizontal white line. The “on differential” is the lower temperature deadband which will enable the P-K MACH® appliance for operation and is represented by the dashed green line. The “off differential” is the upper temperature deadband which will disable the P-K MACH® appliance and is represented by the dashed red line.

In the example to the right, the “DHW Tank Setpoint Temperature” is 153°F, the “on differential” is 4°F, and the “off differential” is 7°F. In this scenario, the P-K MACH® appliance will be enabled when the tank temperature drops below $153°F - 4°F = 149°F$. The P-K MACH® appliance will continue to operate until the tank temperature exceeds $153°F + 7°F = 160°F$.

Once the “on differential” and “off differential” are programmed, press <NEXT> to proceed. The NURO will present a confirmation screen with a 30 second countdown timer. Press <HOME> to return to the home screen, or simply wait for the timer to expire. The MACH ‘n’ Roll™ system is now programmed to respond to the aquastat installed in the domestic water storage tank.





5 Maintenance

5.1 Maintenance and Inspection Schedule

This schedule applies when the MACH 'n' Roll™ is in use. Verify proper operation after servicing.

⚠ WARNING

Proper lockout/ tag out procedure must be employed when servicing this unit.

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

⚠ WARNING

Determine the cause of any lockout or errors before resetting the appliance. If able to determine cause of lockout, then appropriate corrective action should be taken. If unable to determine cause of the problem, call a qualified service technician.

⚠ WARNING

Verify proper operation after operation servicing.

5.1.1 Daily

- Observe operating temperature and general conditions.
- Check the pressure/temperature gauge on the appliance's supply manifold to ensure there is a sufficient water pressure.
- Listen to the performance of the P-K MACH 'n' Roll™ system and P-K MACH appliance.
 - A "sloshing" noise indicates that air is present in the system, most likely inside the MACH appliance. Ensure the vent cap on the automatic air vent is open.
 - If the pumps are making excessive noise, ensure they are not deadheaded or cavitating. Refer to [Section 5.3](#) for troubleshooting information.

5.1.2 Weekly

- Check for leaks in the appliance piping and the domestic piping. Correct immediately if discovered.
- Scroll through the appliance's "Information" screen and record the supply temperature, return temperature, firing rate, and domestic water temperature.

5.1.3 Monthly

- Check the pump relay and ensure the pumps stop running when switched to "Off". Also ensure the pumps run continuously when switched to "Manual". Finally, turn the switch back to "Auto" and ensure the pumps respond to the NURO® control.
- Check all relief valves by slightly opening the stem. Once you see a small amount of water exit the discharge, close the relief valve's stem. Once the stem is closed, ensure there is no additional water that exits the relief valve.
- Scroll through the appliance's "Information" screen and record the supply temperature, return temperature, firing rate, burner run high hours, and domestic water temperature.
- If applicable, verify the domestic temperature sensor reading is accurate in the "Information" screen.
- Ensure the high temperature limit aquastat is functioning properly.



- If applicable, verify the operating aquastat is functioning properly.

5.1.4 Annually

- The brazed plate heat exchanger can scale up with calcium and other minerals present in the domestic water. This will inhibit heat transfer and it may be necessary to clean or replace the brazed plate heat exchanger. Cleaning the brazed plate heat exchanger may be needed to ensure continued performance.
- Remove and inspect the circulating pumps for signs of deterioration. Repair or replace if needed.
- Clean and inspect the P-K MACH 'n' Roll™ system for any signs of cracks, leaks, or loose connections. Repair or replace if needed.

5.2 Accessing the Components (MnR & MnRP, 750 & 1050)

The P-K MACH 'n' Roll™ 750/1050 designs allow the user to pull out the components for easier access and service.

1. Lockout/tag out gas supply to the appliance.
2. Lockout/tag out electrical service to the appliance and P-K MACH 'n' Roll™ system.
3. If available, close the isolation valves in the domestic piping between the storage tank and the P-K MACH 'n' Roll™ system.
4. Open the drain valves on the appliance piping and the domestic piping. Allow the water content to drain completely.
5. Open the Victaulic couplings on the appliance piping at the rear of the P-K MACH 'n' Roll™ system.
6. Open the 2" copper Victaulic coupling on the domestic piping at the rear of the P-K MACH 'n' Roll™ system.
7. Remove the 2" pump flange on the domestic piping at the rear of the P-K MACH 'n' Roll™ system.
8. Remove the front panel of the P-K MACH 'n' Roll™ system.
9. Pull the components out the front surface by grabbing either the brazed plate heat exchanger or the supporting tray. The components should pull out smoothly to allow for easier access and inspection.



CAUTION Use caution when moving the lower tray in and out. Avoid placing hands or fingers near moving parts or pinch points.

NOTE: THE ABOVE LISTED MAINTENANCE ITEMS ARE FOR THE MACH-N-ROLL PORTION OF THIS UNIT. SEE THE P-K MACH® APPLIANCE O&M MANUAL FOR IMPORTANT MAINTENANCE ITEMS REQUIRED FOR THE P-K MACH® APPLIANCE.



5.3 Troubleshooting

Circulation Pump Deadhead

Deadheading occurs when the circulation pump is unable to deliver any flow. Ensure that any isolation valves installed in the system are OPEN. It may be necessary to slightly restrict isolation valves on the pump discharge to achieve the desired flow rate, but they should never be completely closed unless the unit is turned off and being serviced.

Circulation Pump Cavitation

Cavitation occurs when the water pressure at the suction side of the pump is below the pump's required suction head pressure. Ensure that any isolation valves on the suction side of both circulation pumps are OPEN. Also, ensure that there is a sufficient static fill pressure of the system. Refer to [Sections 3.3.4 & 3.4.8](#) for more information on the expansion tank/fill valve assembly. If there are any strainers on the domestic circulation line, these may be clogged and should be thoroughly cleaned to restore flow.

NURO Error 10203: “Delta T Limit has been reached”

The P-K MACH® appliance requires sufficient water flow at all times in order to operate safely. A “Delta T Limit has been reached” error indicates the appliance’s supply temperature has departed too far from the appliance’s return temperature. This is usually due to insufficient water flow on the appliance loop. Ensure that all of the isolation valves are open and that the circulating pumps aren’t deadheading or cavitating.

NURO Error 10204: “Maximum Outlet Temperature Reached”

The P-K MACH® appliance requires sufficient water flow at all times in order to operate safely. A “Maximum Outlet Temperature Reached” error indicates the appliance’s supply temperature is above the maximum allowable value. This is usually due to insufficient water flow on the appliance loop. Ensure that all of the isolation valves are open and that the circulating pumps aren’t deadheading or cavitating.

NURO Errors 10014 or 10015: “Start Interlock Open”

In the event the high temperature limit aquastat trips, the appliance’s START INTERLOCK #1 circuit will open. Ensure that all of the isolation valves are open and that the circulating pumps aren’t deadheading or cavitating. Once the source of the high water temperature has been identified, reset the high temperature limit.

NURO Error 10010: “Low Water Limit”

The appliance loop must be completely full of water at all times in order to operate. The P-K MACH® appliance features a low water cutoff probe that will put the appliance into alarm if water is not detected inside the appliance’s heat engine. Check the water pressure on the appliance piping to ensure there is a sufficient water pressure. Also, ensure the automatic air vents are able to purge any air that has accumulated within the appliance. Refer to [Sections 3.3.4 & 3.4.8](#) for instructions on filling the P-K MACH appliance.

Poor Heat Transfer

Poor heat transfer can be caused by insufficient flow, insufficient appliance water temperature, or scaling of the heat exchanger. First, ensure that both the appliance side and domestic side circulation pumps are moving water at the desired rate. Next, increase the appliance’s setpoint in small increments to ensure there is sufficient temperature to produce the desired domestic water temperature. If these two steps are unable to restore heat transfer, it may be necessary to clean or replace the brazed plate heat exchanger.



6 Parts/Technical Support

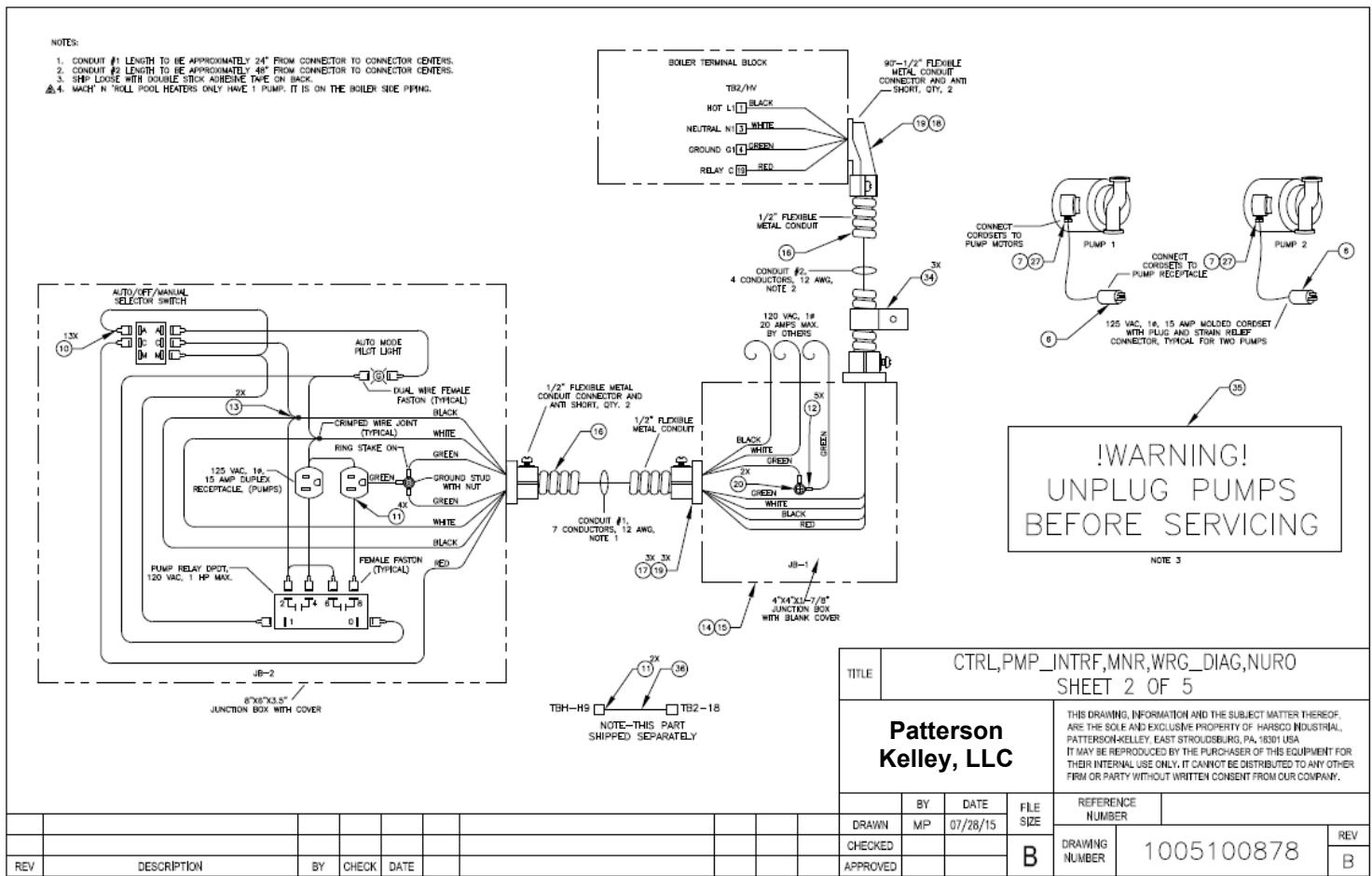
Spare parts and replacement parts can be ordered from Patterson-Kelley by calling toll free (877) 728-5351. The fax number is (570) 476-7247. Refer to the parts list shown on the assembly drawing provided in this manual. Technical information is also available at the above number and at the -Kelley website www.pattersonkelley.com.

⚠ WARNING

Use of Non-Factory Authorized replacement parts are not recommended for this equipment. All control components are engineered for safety and are designed to work in unison with each of the other components. Use of non-factory authorized replacement parts jeopardizes the functionality of the safety features as well as the performance of the appliance.

When ordering replacement parts please have the **model number** and **serial number** of your product. Typical schematic drawings are shown on the following pages. Drawings specific to your particular product can also be supplied by your local Patterson-Kelley representative.

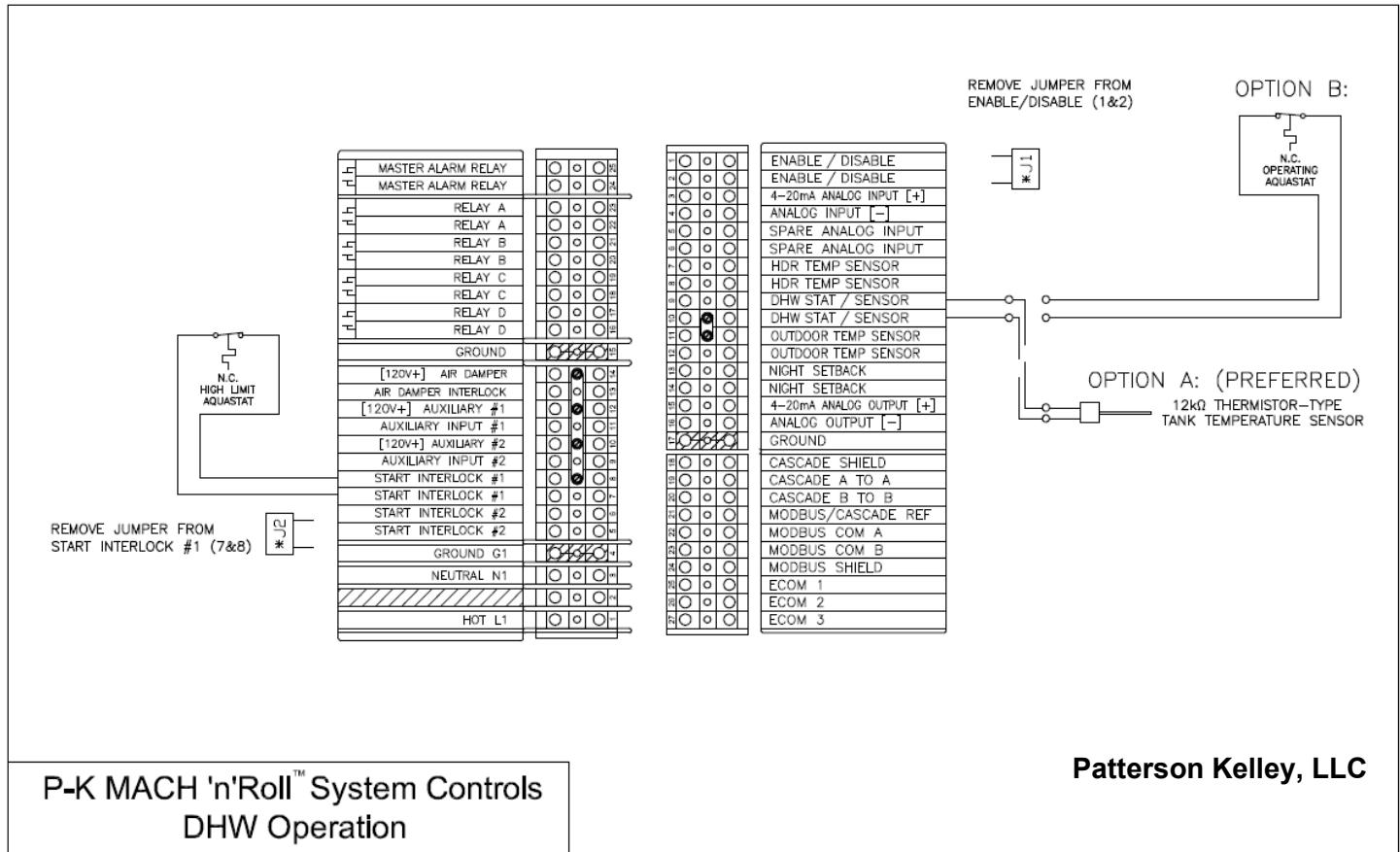
6.1 Wiring Diagram – Boiler Power & Pump Control





NOTE: The power distribution on the P-K MACH 'n' Roll™ system provides power to the circulation pumps as well as to the P-K MACH® appliance. This allows the user to bring a single code-compliant disconnect to the 4"x4" junction box and power the entire system. Connect a single grounded, code-compliant disconnect to JB-1 (Junction Box 1) to the three wire pig-tails (hot, neutral and ground).

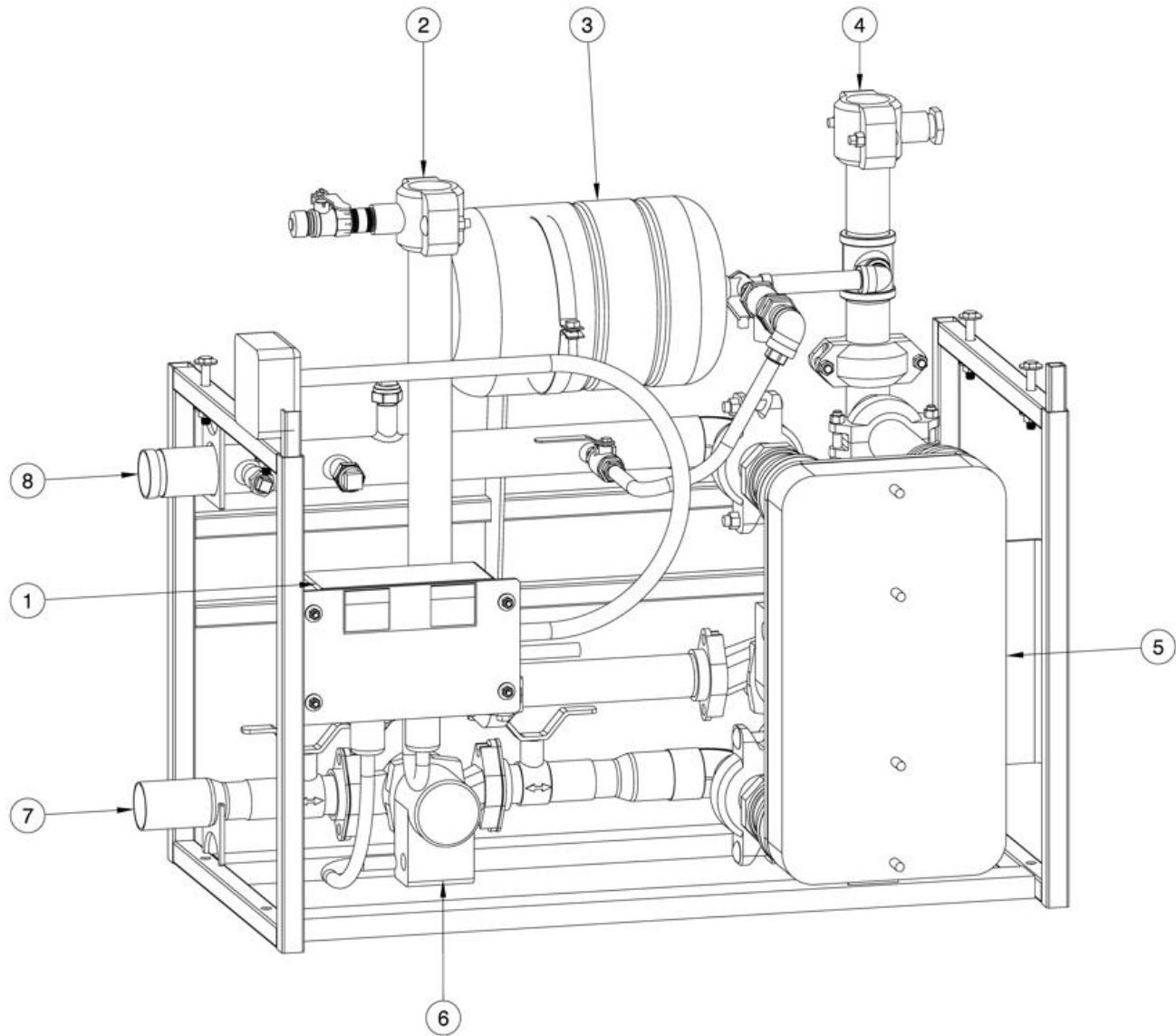
6.2 Wiring Diagram – Controls for DHW Operation



In standard DHW operation, the P-K MACH 'n' Roll™ system is capable of operating to either a normally-closed aquastat, or a 12kΩ thermistor-type temperature sensor (preferred). This aquastat or temperature sensor should be installed in the lower 1/3rd of a domestic water storage tank of suitable size for the application. It is important that the sensing element is of sufficient length to accurately measure the storage tank temperature. Wire either the aquastat's normally-closed terminals or the 2 sensor wires to the boiler's DHW STAT/SENSOR terminals (TB1-9 & TB1-10).

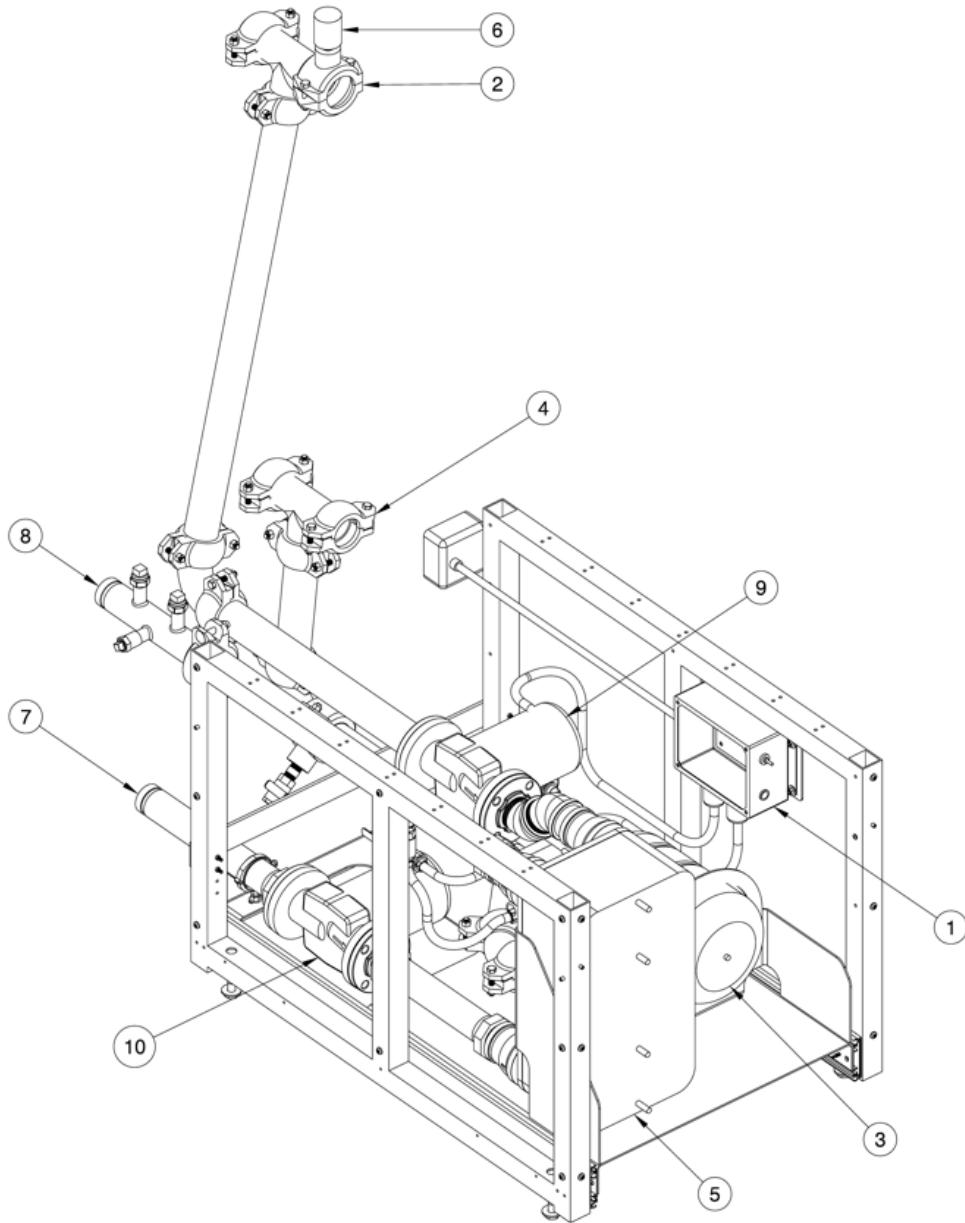
A normally-closed high temperature limit aquastat **MUST** be installed either in the domestic hot water supply pipe exiting the P-K MACH n' Roll™ system, or in the storage tank or domestic hot water pipe which supplies the building. Wire the normally-closed terminals of the high temperature limit aquastat to the appliance's START INTERLOCK #1 terminals (TB2-7 & TB2-8).

6.3 MnR300, 399, & 500 Components



Mark	Description	Part Number
1	Pump Control Panel	1005100878
2	1-1/2" Victaulic Appliance Return	2650000101
3	Expansion Tank	8685600100
4	1-1/2" Victaulic Appliance Supply	2650000101
5	30 Plate Brazed Heat Exchanger Single Wall Double Wall	2600000674 2600000543
6	Circulating Pump	1004907895
7	2" Grooved Copper Hot Water Return	N/A
8	2" Grooved Copper Hot Water Supply	N/A

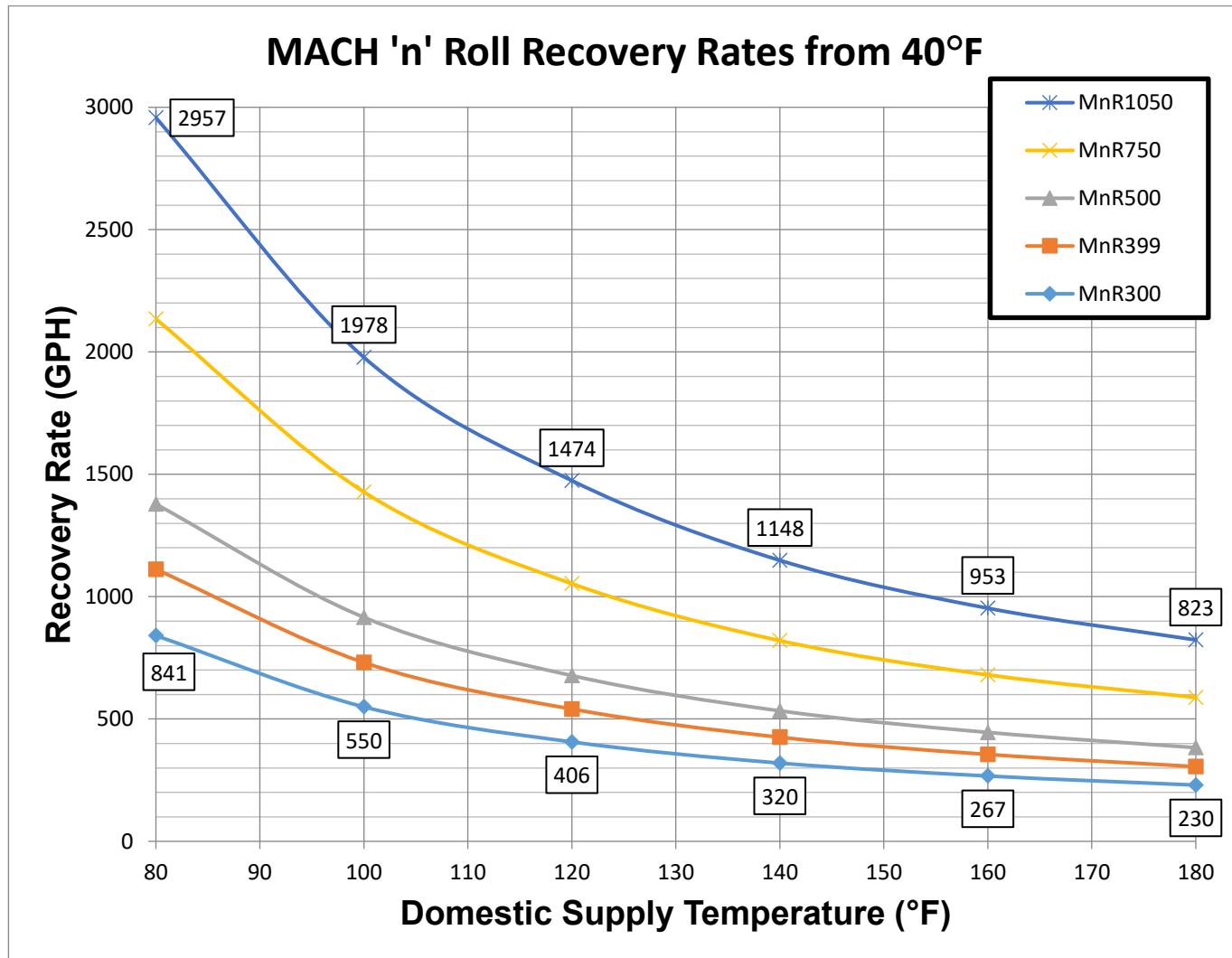
6.4 MnR750 & 1050 Components – Appliance Side



Mark	Description	Part Number
1	Pump Control Panel	1005100878
2	2" Victaulic Tee Appliance Supply	N/A
3	Expansion Tank	8685600100
4	2" Victaulic Tee Appliance Return	N/A
5	Brazed Heat Exchanger 50 Plate 80 Plate	2600000675 2600000548
6	1/2" NPT Automatic Air Vent	1004907147
7	2" Grooved Copper Hot Water Return	N/A
8	2" Grooved Copper Hot Water Supply	N/A
9	Appliance Circulation Pump	1004908437
10	DHW Circulation Pump	1004908074

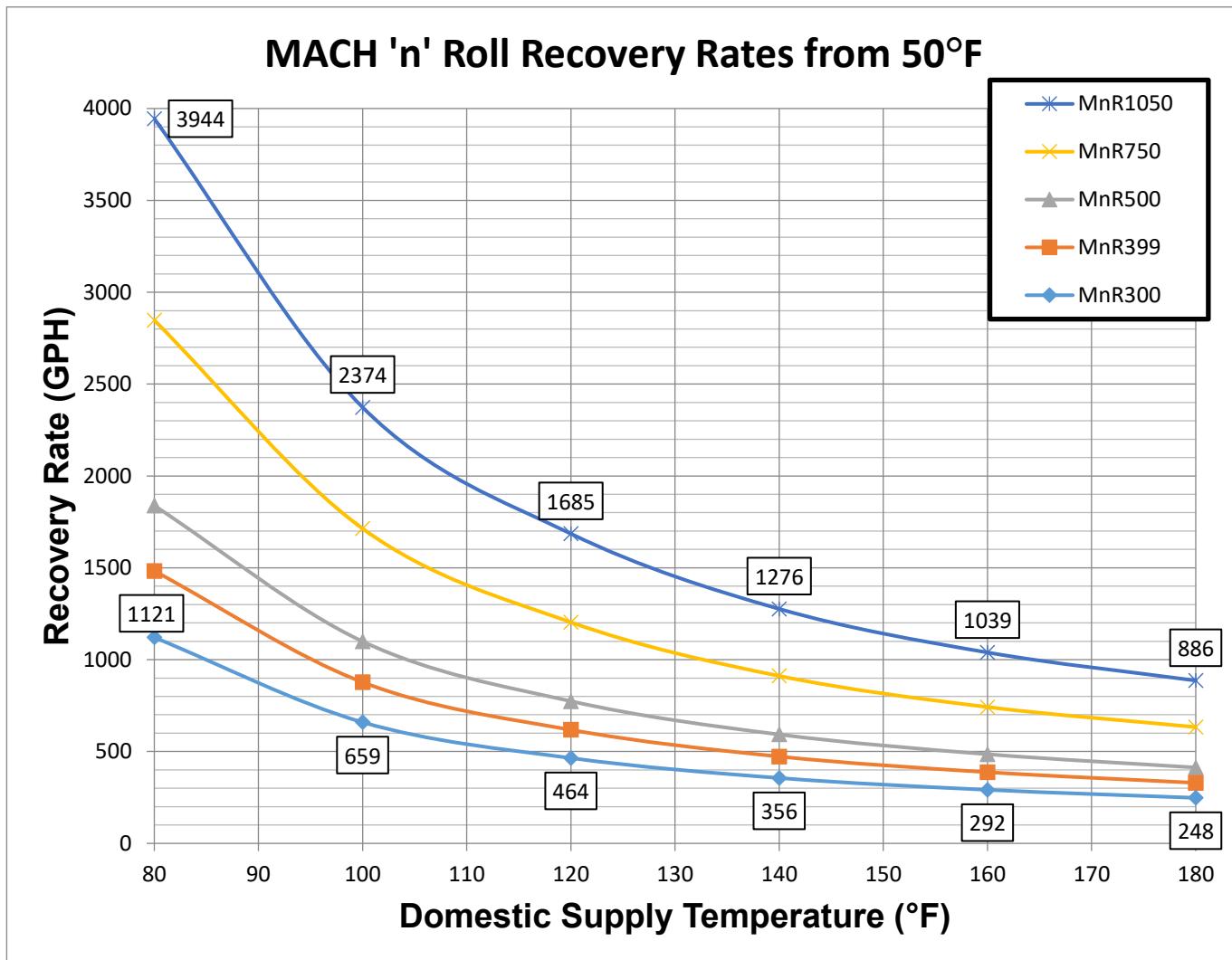
7 RECOVERY PERFORMANCE DATA

7.1 P-K MACH 'n' Roll™ Recovery Performance Data at 40°F



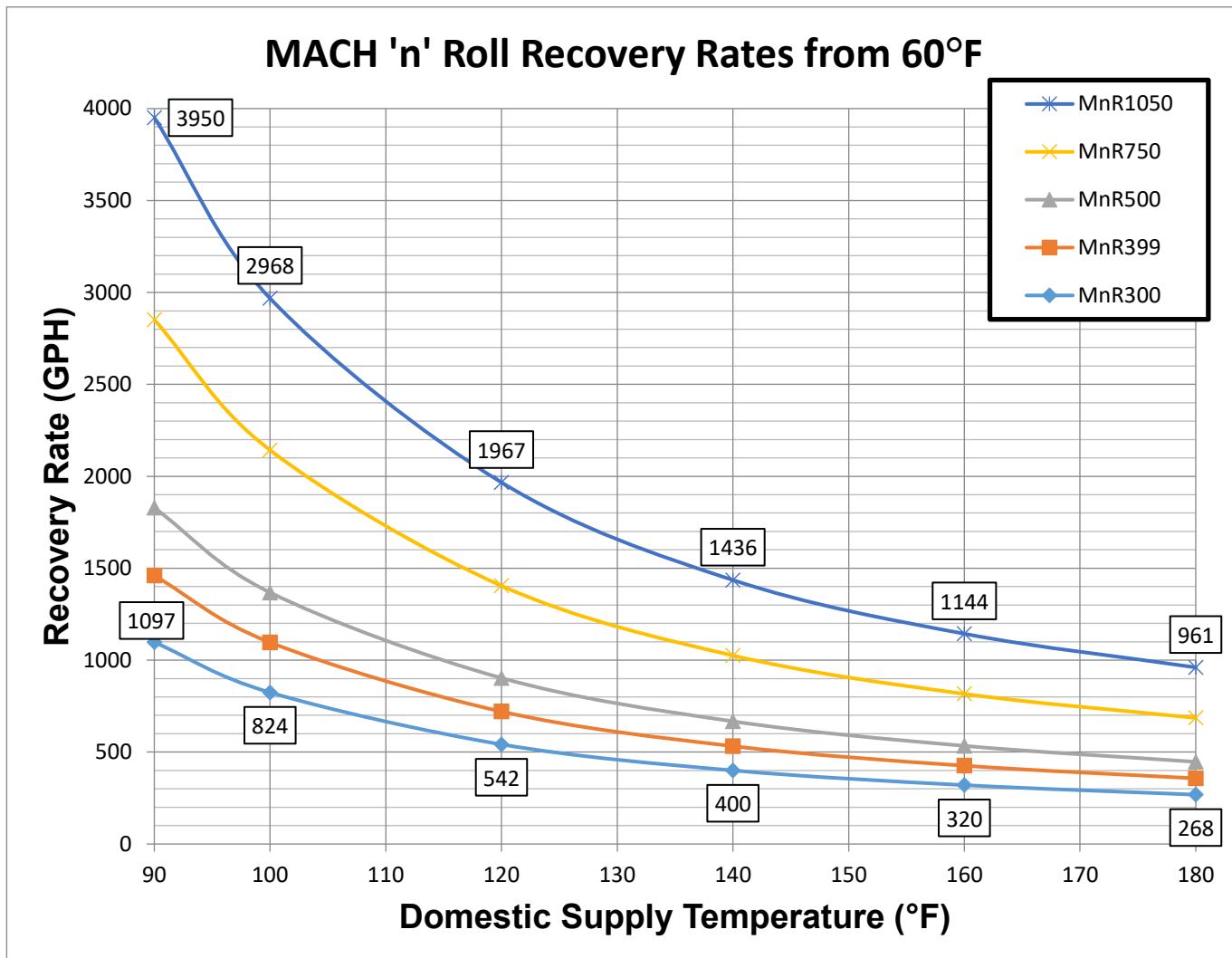
Choose the curve based on the size of appliance (MnR300, MnR399, MnR500, MnR750, and MnR1050). Move along the x-axis to the desired domestic hot water supply temperature. Move vertically until the intersection with the applicable curve. From this intersection, move horizontally to the left to determine the recovery rate from the y-axis. Several sample recovery rate data points are included for reference.

7.2 P-K MACH 'n' Roll™ Recovery Performance Data at 50°F



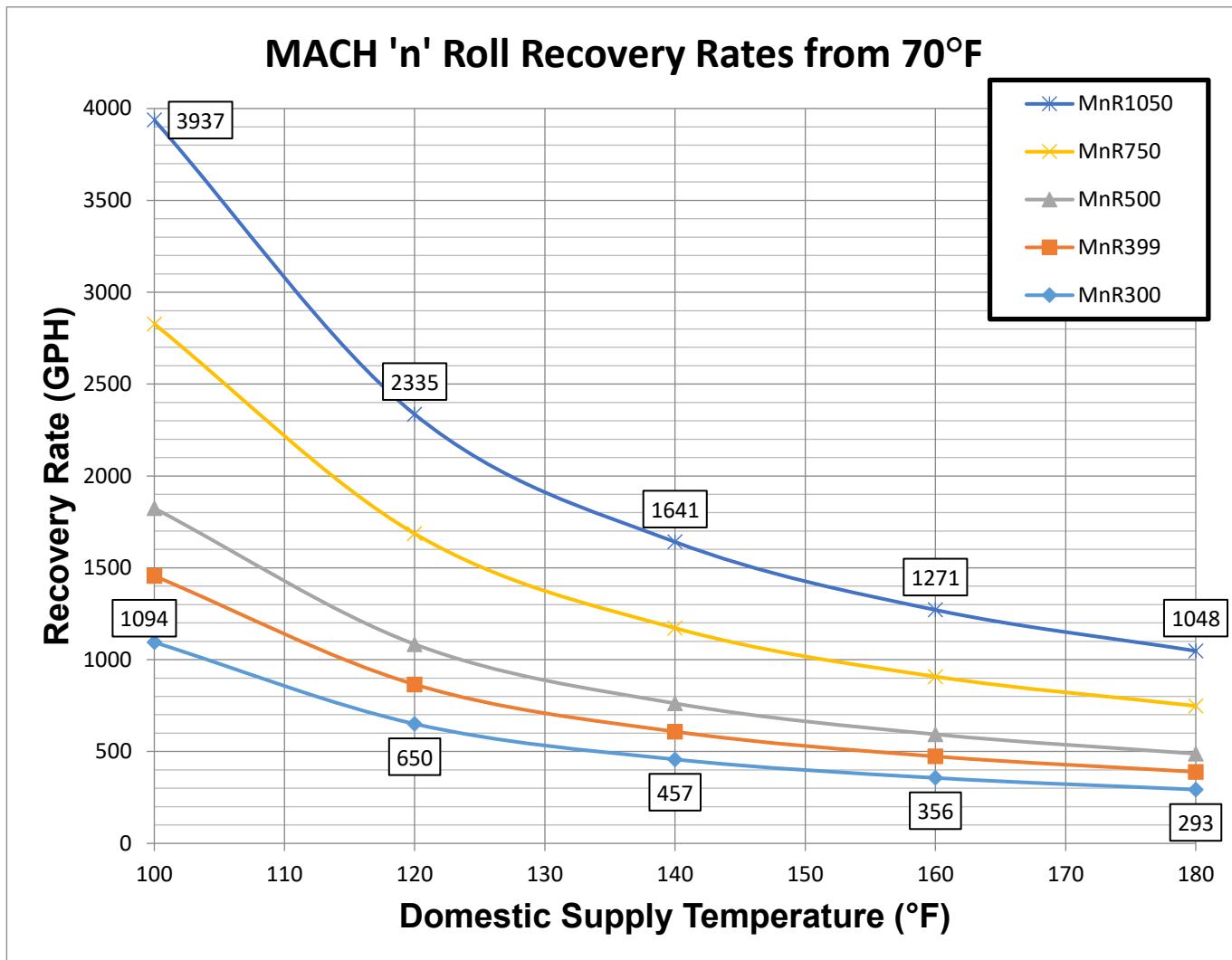
Choose the curve based on the size of appliance (MnR300, MnR399, MnR500, MnR750, and MnR1050). Move along the x-axis to the desired domestic hot water supply temperature. Move vertically until the intersection with the applicable curve. From this intersection, move horizontally to the left to determine the recovery rate from the y-axis. Several sample recovery rate data points are included for reference.

7.3 P-K MACH 'n' Roll™ Recovery Performance Data at 60°F



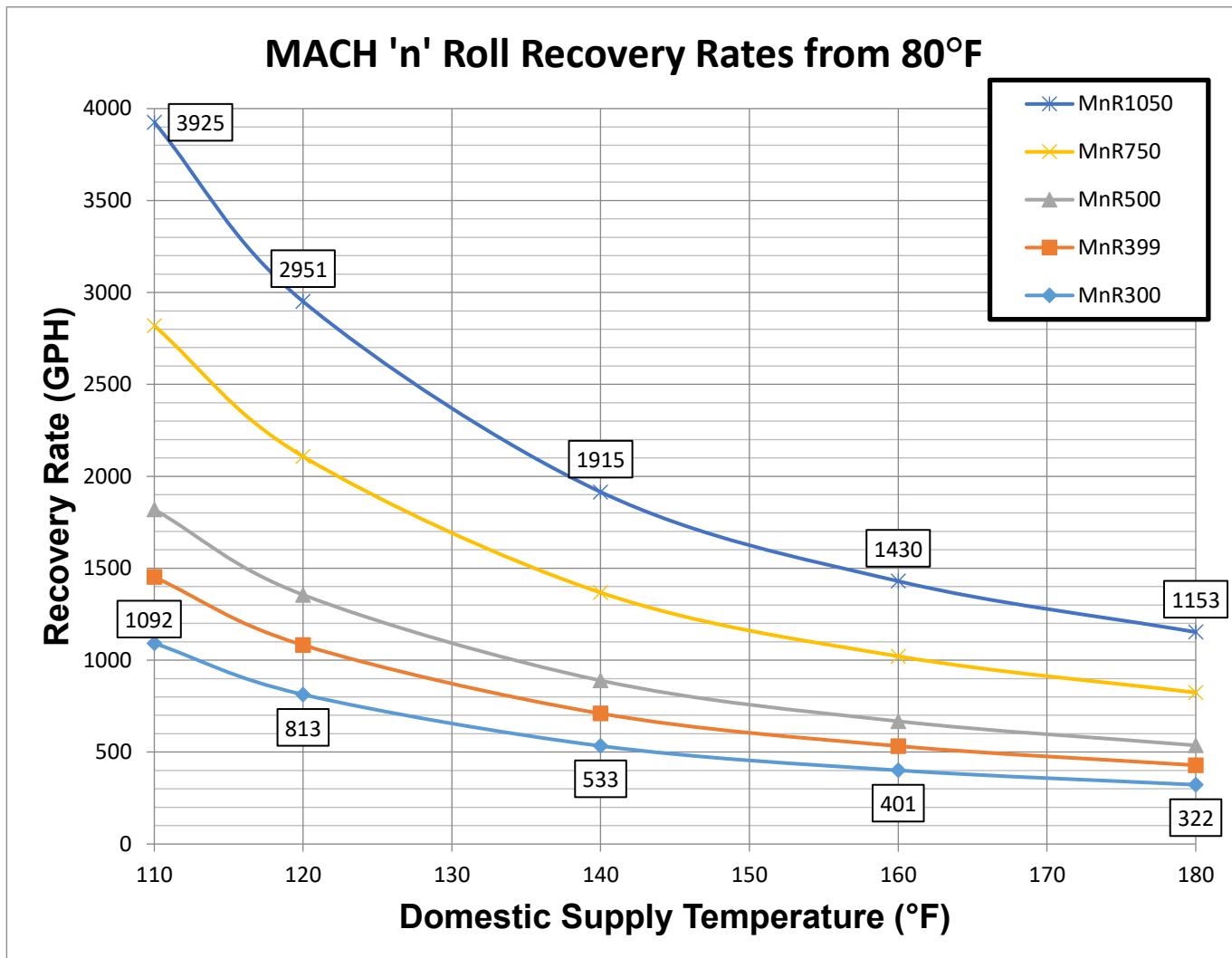
Choose the curve based on the size of appliance (MnR300, MnR399, MnR500, MnR750, and MnR1050). Move along the x-axis to the desired domestic hot water supply temperature. Move vertically until the intersection with the applicable curve. From this intersection, move horizontally to the left to determine the recovery rate from the y-axis. Several sample recovery rate data points are included for reference.

7.4 P-K MACH 'n' Roll™ Recovery Performance Data at 70°F



Choose the curve based on the size of appliance (MnR300, MnR399, MnR500, MnR750, and MnR1050). Move along the x-axis to the desired domestic hot water supply temperature. Move vertically until the intersection with the applicable curve. From this intersection, move horizontally to the left to determine the recovery rate from the y-axis. Several sample recovery rate data points are included for reference.

7.5 P-K MACH 'n' Roll™ Recovery Performance Data at 80°F



Choose the curve based on the size of appliance (MnR300, MnR399, MnR500, MnR750, and MnR1050). Move along the x-axis to the desired domestic hot water supply temperature. Move vertically until the intersection with the applicable curve. From this intersection, move horizontally to the left to determine the recovery rate from the y-axis. Several sample recovery rate data points are included for reference.



7.6 P-K MACH 'n' Roll™ Pool Performance Data

Pool Size with Respect to Equipment Size						
20°F Rise				25°F Rise		
Correction Factor	10	5	3.4	2.5	12.5	6.3
Heat Time (Hours)	24	48	72	96	24	48
Pool Size (thousands of gallons)						
MACH'n' Pool Size (kBTU)	1050	105	210	309	420	84
	750	75	150	221	300	60
	500	50	100	147	200	40
	399	40	80	117	160	32
	300	30	60	88	120	24
30°F Rise				40°F Rise		
Correction Factor	15	7.5	5.1	3.75	20	10
Heat Time (Hours)	24	48	72	96	24	48
Pool Size (thousands of gallons)						
MACH'n' Pool Size (kBTU)	1050	70	140	206	280	53
	750	50	100	147	200	38
	500	33	67	98	133	25
	399	27	53	78	106	20
	300	20	40	59	80	15
50°F Rise				60°F Rise		
Correction Factor	25	12.5	8.5	6.25	30	15
Heat Time (Hours)	24	48	72	96	24	48
Pool Size (thousands of gallons)						
MACH'n' Pool Size (kBTU)	1050	42	84	124	168	35
	750	30	60	88	120	25
	500	20	40	59	80	17
	399	16	32	47	64	13
	300	12	24	35	48	10



8 P-K MACH® (MACH & ROLL) SPECIFIC LIMITED WARRANTY

Subject to the terms and conditions herein and the Terms and Conditions of Sale (as defined herein), Patterson-Kelley ("Seller") warrants to the purchaser of the product ("Buyer") that the heat exchanger and burner are free of defects in material and workmanship, when operated in accordance with the conditions stated herein, for a period of five (5) years and a ten (10) year warranty against failure due to thermal shock commencing on the date of shipment or, if a start-up report is furnished to Seller, on the start-up date shown on the report furnished to Seller (the "Warranty Period"), provided that startup is completed within six (6) months of shipment and the start-up report is furnished to Seller within thirty (30) days of startup (this "Specific Limited Warranty"). The Exclusions and limitations of liability set forth in the Terms and Conditions of Sale (as defined herein) apply to this Specific Limited Warranty. Capitalized terms used but not defined herein have the meanings ascribed to them under Seller's terms and conditions of sale for the product, which can be found at

<http://pattersonkelley.com/warranty.php> (the "Terms and Conditions of Sale"). This Specific Limited Warranty is transferrable to the owner that utilizes the product(s) purchased hereunder for its intended use at the original installation site (the "Original Owner"). This Specific Limited Warranty is non-transferable to anyone who subsequently receives or purchases products from the Original Owner. If the Original Owner did not purchase the product directly from Seller, the Original Owner should contact the reseller from whom it purchased the product for a copy of the Terms and Conditions of Sale attached to the Order Acknowledgement received by the original purchaser of the product from Seller.

I. REMEDY

Seller's obligations under this Specific Limited Warranty is limited to repairing or, if in Seller's judgment it seems more appropriate, to furnishing without charge (installation not included), FCA Seller's factory (Incoterms 2010), a similar part to replace any part which after examination shall, to Seller's own satisfaction be determined to have been defective at the time it was shipped. In the event that a replacement is provided by Seller, the defective item will become the property of Seller. Transportation to Seller's facility or other designated facility for repairs of any products or party alleged defective shall, in all events, be at Buyer's sole risk and cost. This warranty applies only if the original installer and Seller (Attention: Patterson-Kelley, 155 Burson Street, East Stroudsburg, PA 18301) receive, within the Warranty Period, an immediate written notice, providing a detailed description of all claimed defects, upon discovery of such defects together with proof of purchase (invoice or Order Acknowledgment) and a copy of the start-up report for the affected product. Seller may seek reimbursement of any costs incurred by Seller where the product is found to be in good working order, or when it has been determined that this Specific Limited Warranty does not apply as per the exclusions set forth below. The remedies available to Buyer set forth herein are exclusive remedies, and all other remedies, statutory or otherwise, including but not limited to the right of redhibition, are waived by Buyer. Buyer acknowledges that the exclusion of remedies is neither unreasonable nor unconscionable. Buyer shall indemnify and hold Seller harmless against, any claim due to any injury or death to any person or damage to any property resulting in whole or in part from any modification or alteration Buyer makes to any product sold hereunder.

II. EXCLUSIONS

To the full extent permitted by law, Seller shall have no liability for and the Warranties do not cover:

- (A) any product which has been altered or repaired by other than Seller's personnel;
- (B) deterioration or failure of any product due to
 - (i) abrasion, corrosion, erosion or fouling,
 - (ii) misuse,
 - (iii) modification not authorized by Seller in writing or
 - (iv) improper installation, lack of or improper maintenance or operation;
- (C) equipment not furnished by Seller by the owner, either mounted or unmounted, or when contracted for by a party or parties other than Seller to be installed or handled;
- (D) the suitability of any product for any particular application;
- (E) the design or operation of owner's plant or equipment or of any facility or system of which any product may be made a part;
- (F) any damage to the product due to abrasion, erosion, corrosion, deterioration, abnormal temperatures or the influence of foreign matter or energy;
- (G) the performance of any product under conditions varying materially from those under which such product is usually tested under industry standards at the time of shipment;
- (H) leakage or other malfunction caused by:
 - (i) defective installations in general and specifically, any installation which is made
 - (a) in violation of applicable state or local plumbing, housing or building codes or
 - (b) contrary to the written instructions furnished with the product,
 - (ii) adverse local conditions in general and, specifically, sediment or lime precipitation in the tubes, headers and/or shells or corrosive elements in the water, heating medium or atmosphere, or



- (iii) misuse in general and, specifically, operation and maintenance contrary to the written instructions furnished with the unit, disconnection, alteration or addition of components or apparatus, not approved by Seller, operation with heating media, fuels or settings other than those set forth on the rating plate or accidental or exterior damage;
- (I) production of noise, odors, discoloration or rusty water;
- (J) damage to surrounding area or property caused by leakage or malfunction;
- (K) costs associated with the replacement and/or repair of the unit including: any freight, shipping or delivery charges, any removal, installation or reinstallation charges, any material and/or permits required for installation, reinstallation or repair, charges to return the boiler and/or components;
- (L) INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, SUCH AS LOSS OF THE USE OF PRODUCTS, FACILITIES OR PRODUCTION, INCONVENIENCE, LOSS OF TIME OR LABOR EXPENSE INVOLVED IN REPAIRING OR REPLACING THE ALLEGED DEFECTIVE PRODUCT;
- (M) any claim due to any injury or death to any person or damage to any property resulting in whole or in part from any modification or alteration Buyer makes to any product sold hereunder; and
- (N) Design defects where Seller has complied with Buyer's design specifications.

III. PROOF OF PURCHASE

Proof of purchase (invoice or Order Acknowledgement) and a copy of the start-up report for the affected product must be provided to Seller when requesting service under this Specific Limited Warranty.

IV. ORDER OF PRECEDENCE

The Standard Limited Warranty set forth in the Terms and Conditions of Sale, (b) this Specific Limited Warranty and (c) any applicable Extended Limited Warranty exclusively govern and control Seller's and Buyer's respective rights and obligations regarding the warranty of the product. In case of any inconsistency, conflict, or ambiguity between the Standard Limited Warranty, this Specific Limited Warranty and any applicable Extended Limited Warranty (collectively, the "Warranty Documents"), the documents shall govern in the following order: (w) any applicable Extended Limited Warranty; (x) this Specific Limited Warranty; (y) the Standard Limited Warranty and (z) other provisions in the Terms and Conditions of Sale. Information identified in one Warranty Document and not identified in another shall not be considered a conflict or inconsistency. No sales representative, agent, or employee of Seller or any reseller in the chain of sale of the product is authorized to make any modification, extension, or addition to this Specific Limited Warranty, unless agreed to in writing by Seller.