CE2 Engineers, Inc.

MEMORANDUM

TO: Susan Randlett, P.E., Village Safe Water Engineer

FROM: Paul C. Weisner, P.E., CE2 Engineers, Inc. PCW

SUBJECT: Scope of Review of Wood Heating System design

DATE: January 18, 2009

This memorandum describes the scope for review of the proposed wood heat improvements at the Tanana WTP (Water Treatment Plant) and Washeteria.

This project grew out of a need for lowering the cost of heating the Water Treatment Plant and Washeteria. Presently, the wood-fired hydronic heating system (GARN tank-type heaters) is connected to the existing WTP through four heat exchangers and is underutilized.

CE2 has proposed to upgrade the existing system with some minimal changes. This project was not envisioned as a full blown design. The main changes involve:

- Fitting new circulating pumps in the GARN system to meet the hydraulic needs of the hydronic loop.
- Installing a heat exchanger upstream of the existing oil boilers
- Replacing the existing domestic water storage tank and single-walled heat exchanger with a new storage tank with self-contained double-walled heat exchanger coil.

The new heating system would have components located as shown in the as-built drawings of the Tanana Water Treatment Plant and Laundry Facility, sheet A-2, as attached. Existing mechanical piping can be found on sheets M-1 and M-3 (attached).

A view of the existing wood-fired heating system piping is shown in attached figures 1 and 2.

Attachments: Montgomery-Watson record drawings A-2, M-1, and M-3.
Photos: Fig 1 through Fig 4
Tanana Wood Heat Assessment and Figures
Tanana Wood Heat Design Technical Memorandum
Mechanical and Electrical Drawings
Proposed Main Equipment Cut Sheets

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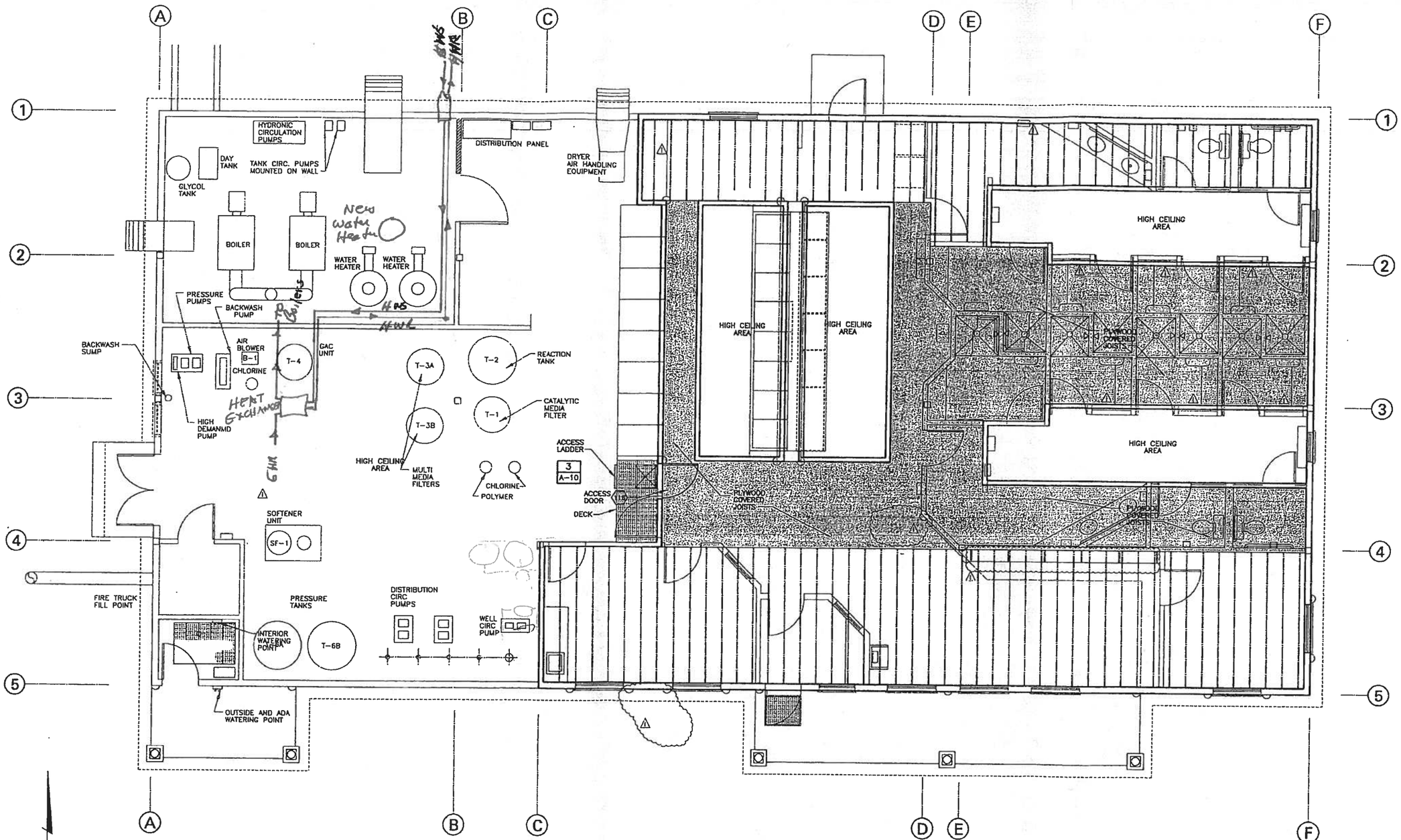

ATTIC FLOOR PLAN
SCALE: 1/4"=1'-0"

RECORD DRAWING CERTIFICATE
THESE DRAWINGS REFLECT RECORDED INFORMATION OBTAINED DURING CONSTRUCTION. INFORMATION PROVIDED HEREIN IS ACCURATE TO THE BEST OF MY KNOWLEDGE.
2/10/03
DATE
NAME

VILLAGE SAFE WATER

MONTGOMERY WATSON
Anchorage, Alaska
IN ASSOCIATION WITH
ECI, INC.
kamin associates, inc.
ARCHITECTS & PLANNERS

TOO'GHA INC. - TANANA, ALASKA
WATER TREATMENT PLANT / LAUNDRY FACILITY

ATTIC FLOOR PLAN

REVISION	BY	DATE
ISSUED FOR CONSTR.		12/99
⚠ RECORD DRAWING	MT	1/03

Project No. 1189078.010101
Date DEC. 30, 1999
Designed ALS/LAG
Drawn LAG
Approved

Sheet No. A-2
SHEET OF

JOB No. 1189078.00101 TIME: 10-FEB-2003 11:27 FILE: \\Uancis-files-v\server\Cad\Pro\Tananna\laundry\sabit\a02.dgn

PIPING MATERIALS

WATER PIPING EXPOSED IN WTP AREA AND ATTIC SPACE: TYPE 'L' COPPER W/SWEAT JOINTS MADE WITH LEAD FREE SOLDER. INSULATE 2" O.D. AND SMALLER WITH 1" INSULATION & 2 1/2" O.D. AND LARGER WITH 1 1/2" INSULATION.

WATER PIPING CONCEALED IN WALLS: CROSS LINKED POLYETHYLENE (PEX) TUBING W/POLYSULFONE (PLS) PLASTIC INSERT FITTINGS AND BRASS THREAD ADAPTER FITTINGS.

HEATING GLYCOL PIPING: TYPE 'L' COPPER W/SWEAT JOINTS MADE WITH LEAD FREE SOLDER.

DRAIN AND VENT PIPING ABOVE FLOOR: ABS PLASTIC DWV PIPE W/SOLVENT WELD DRAINAGE PATTERN FITTINGS. BELOW FLOOR SERVICE WEIGHT CAST IRON WITH HUBLESS FITTINGS AND COUPLINGS.

NOTES

1. ROUTE PIPING APPROXIMATELY WHERE SHOWN. MAKE OFFSETS WHERE NECESSARY TO AVOID STRUCTURE AND OTHER EQUIPMENT.
2. PROVIDE SLEEVE AND FIRE CAULK ALL PIPE PENETRATIONS THRU BOILER ROOM WALLS.
3. INSULATE VENT PIPING TO 3' BELOW ROOF PENETRATIONS WITH 1" THICK 3 LB. DENSITY FIBERGLASS W/ VAPOR BARRIER JACKET.

PIPING LEGEND

CW	COLD WATER
GR	GLYCOL RETURN
GS	GLYCOL SUPPLY
HW	HOT WATER (140T)
HWC	HOT WATER RECIRCULATION
THW	TEMPERED HOT WATER (115T)

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DATE 8/02

VILLAGE SAFE WATER

TOOLGHANG TANANA ALASKA
WATER TREATMENT PLANT/ LAUNDRY FACILITY
PLUMBING AND HEATING PIPING PLAN

MONTGOMERY WATSON
EDC, INC.

NO	REVISION	BY	DATE
1	ISSUED FOR CONSTR	KCH	11/20/01
2	ISSUED FOR BID WITH ADDENDUM #1	KCH	09/27/01
3	ADDENDUM #2	JJH	10/9/01
4	ADDENDUM #3	JJH	10/16/01
5	ADDENDUM #4	JJH	10/23/01
6	ADDENDUM #5	JJH	10/30/01
7	ADDENDUM #6	JJH	11/6/01
8	ADDENDUM #7	JJH	11/13/01

Designed KCH
Drawn JJH
Checked KCH
Approved

SHEET M1 OF

PLUMBING & HEATING PIPING PLAN
1/4"=1'-0"

NOTES:

1. AIR-AIR HEAT EXCHANGER ELEMENT - PLATE TYPE - SEE DWG M7.
2. CEILING DIFFUSERS - TITUS TMS - NECK SIZE & AIR VOLUME AS SHOWN.
3. SUPPLY REGISTER - TITUS 300RS - SIZE & AIR VOLUME AS SHOWN.
4. EXHAUST GRILLE - TITUS 350FL - ALUMINUM - SIZE & AIR VOLUME AS SHOWN.
5. INSULATE DUCTWORK BETWEEN EXHAUST FANS AND BUILDING WALL WITH 2" THICK 3 LB DENSITY FIBERGLASS W/ FOIL FACED JACKET. SEAL JOINTS W/FOIL TAPE.

NOTES: (CONT)

6. INSULATE DUCTS BETWEEN HV-1 AND HEAT EXCHANGERS AND BETWEEN HEAT EXCHANGERS AND EF-1 WITH 2" THICK 3 LB DENSITY FIBERGLASS W/FOIL FACED JACKET. SEAL JOINTS W/FOIL TAPE.

36x36 SNOW HOOD INLET

SEE 8/M5 SIM

SEE 3/M5

32x32 EXHAUST HOOD

30x30 COMBUSTION AIR INLET

SEE 8/M5

EF-1

SEE NOTE 3

24ø

21ø

20ø

14ø

22ø

18ø

12x6 290 CFM

10ø

16x12 510 CFM

12x12

8x8 EXHAUST HOOD WITH BACKDRAFT DAMPER

41x42 MOTORIZED DAMPER

60x42 SCREENED INTAKE OPENING CENTERED IN ENTRY SOFFIT

SEE 5/M6

INSULATE INLET DUCTS W/ 4" FG

SEE NOTE 1

HV-1

24x24

24ø

SEE NOTE 3

16ø

150 CFM 12x4

12ø

SEE NOTE 4 (TYP OF 2)

SEE NOTE 5 TYPICAL

BALANCING DAMPER TYPICAL

HV-2

16x42 MOTORIZED DAMPER

TRANSITION 16x42 TO 24x12

10ø

5ø

10ø

SEE NOTE 2 (TYPICAL)

5ø

100 CFM

290 CFM

100 CFM

EF-2

VENTILATION SYSTEMS PLAN

SCALE: 1/4" = 1'-0"

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DATE 9/02

VILLAGE SAFE WATER

TOOGHA, INC. — TANANA, ALASKA
WATER TREATMENT PLANT / LAUNDRY FACILITY

VENTILATION SYSTEMS FLOOR PLAN

MONTGOMERY WATSON
EDC, INC.

REVISION	BY	DATE
50% SUBMITTAL	KH	12/5/02
90% SUBMITTAL	KH	08/02
FINAL SUBMITTAL	KH	09/02
RECORD DRAWING	KH	09/02

Project No. 1-0
Drawn KH
Designed KH
Checked KH
Approved KH
Date 9/02

Sheet No. M 3

SHEET ___ OF ___

Fig 1 Distribution Manifold from Wood Heat Loop to Loads, in boiler Room,

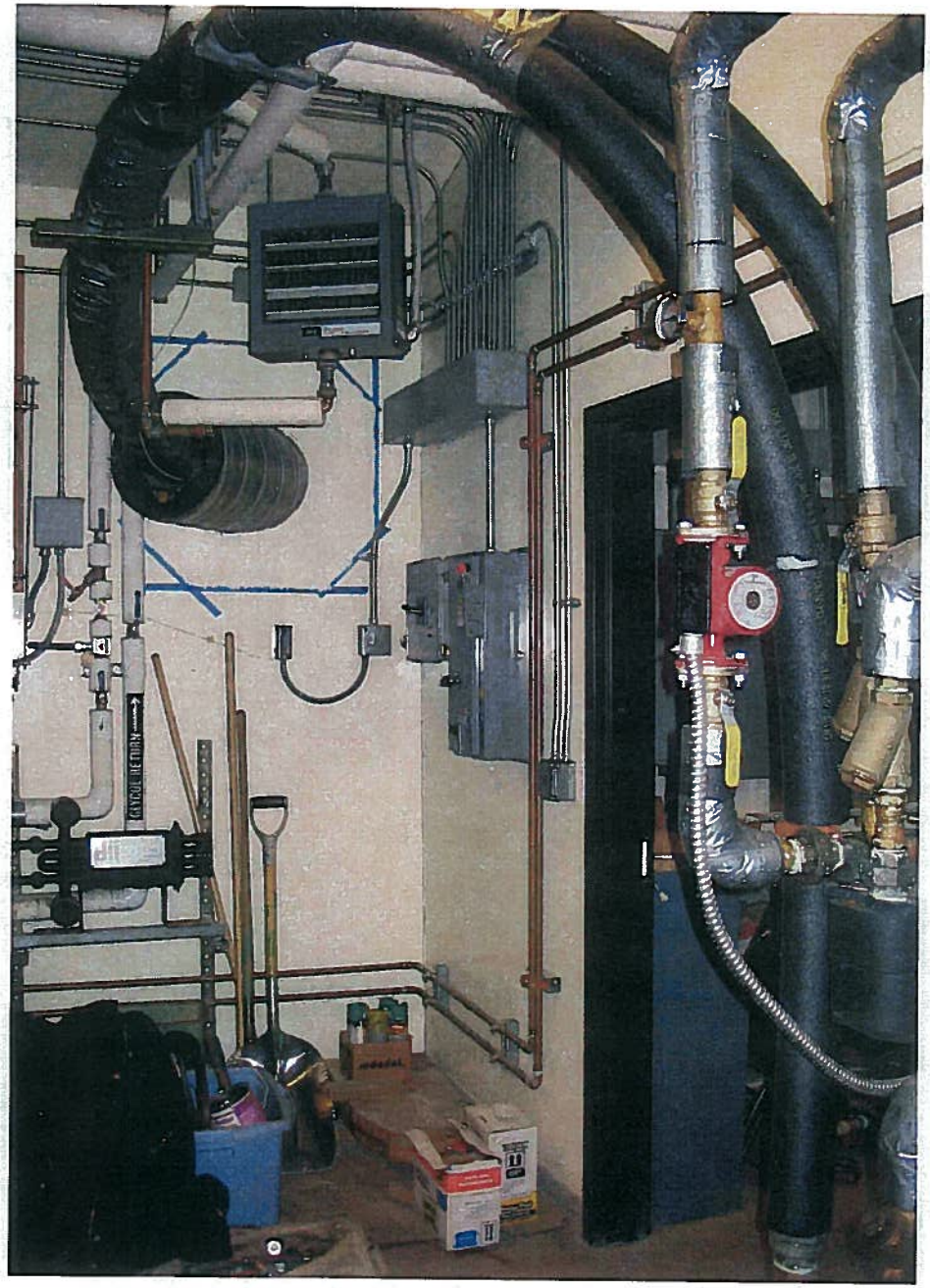


Fig 2 Pex Pipe from Wood Heat System entering Boiler Room in WTP

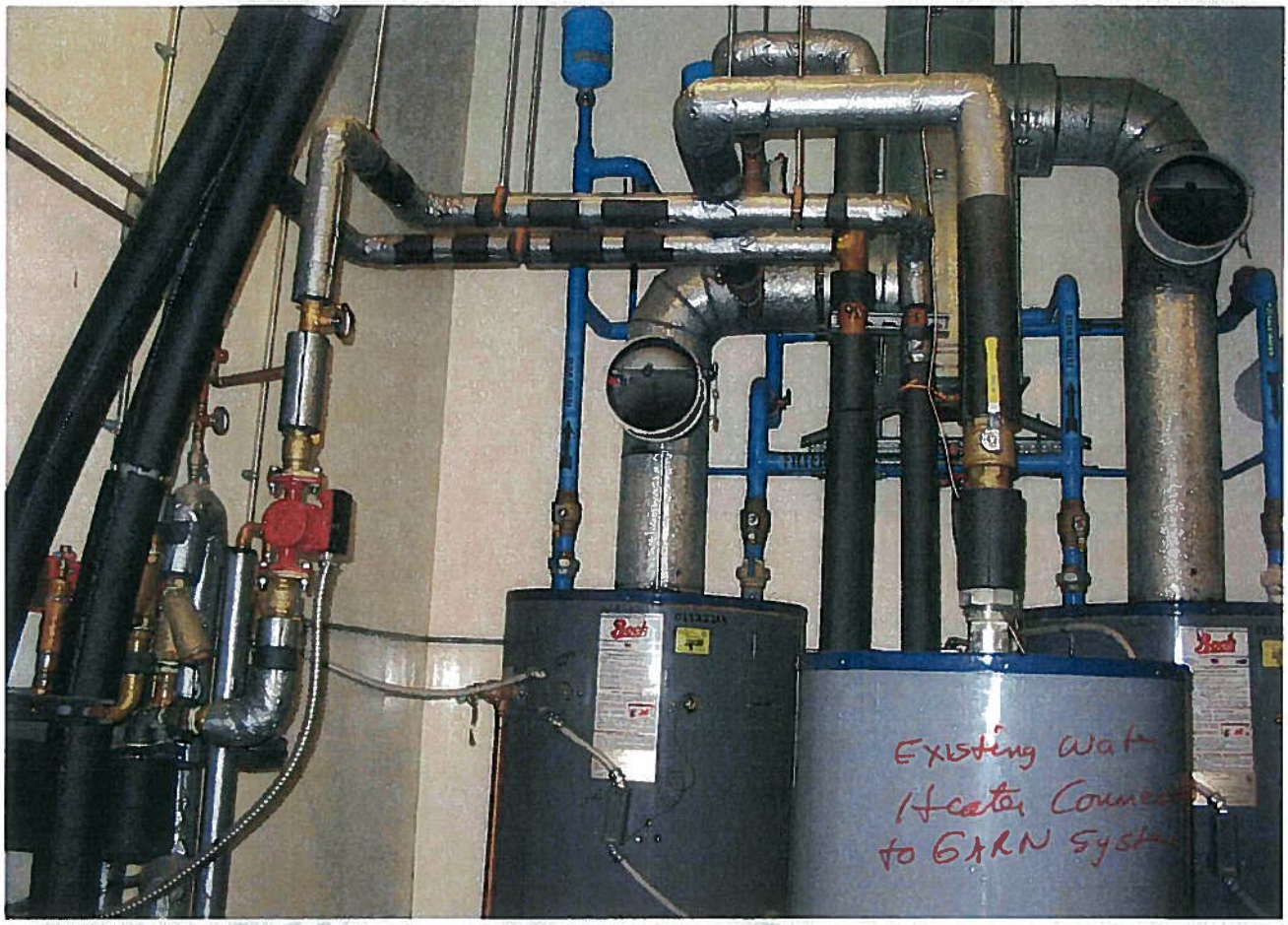


FIG 3

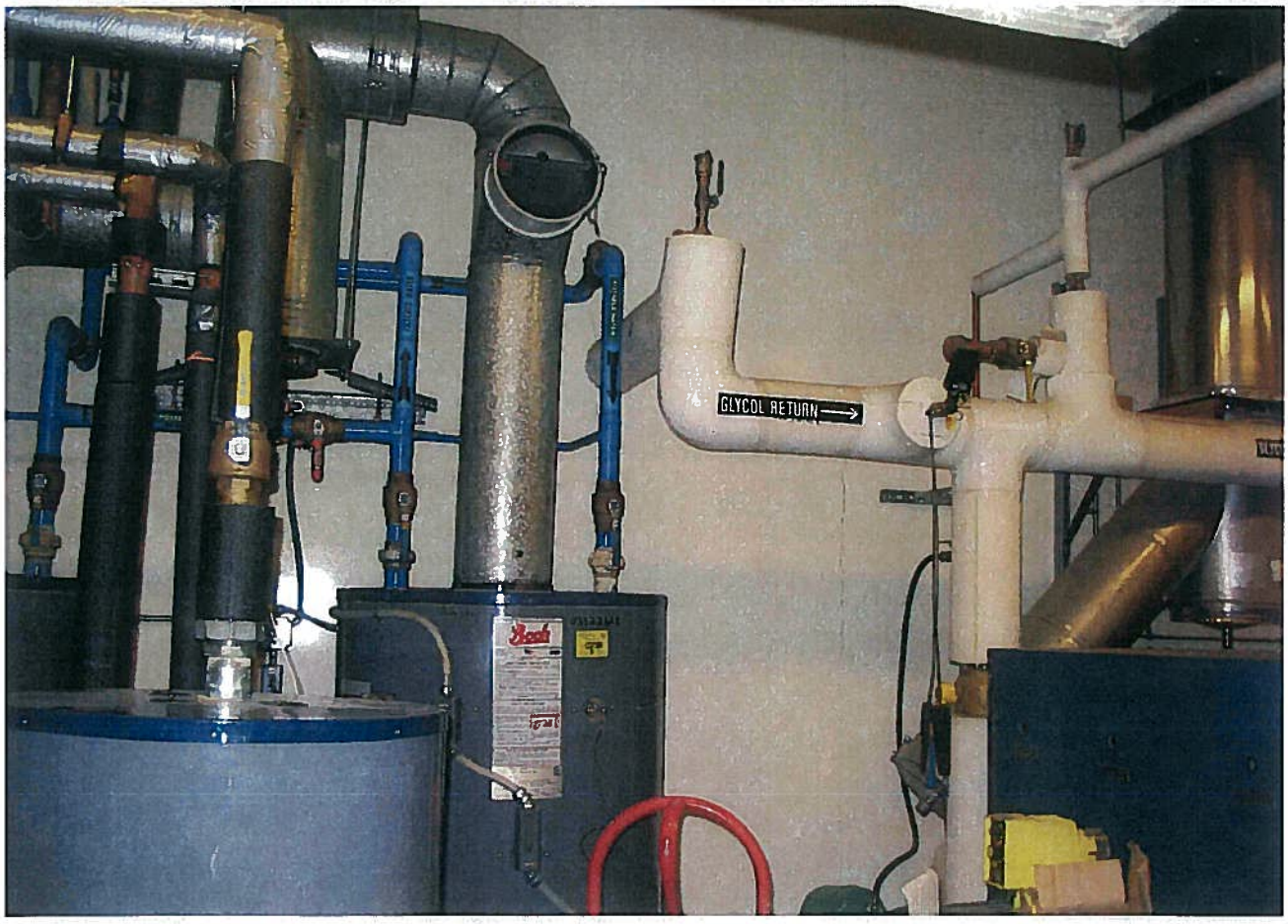


FIG 4

CE2 Engineers, Inc.

MEMORANDUM

TO: Susan Randlett, P.E., Village Safe Water Engineer
Charlie Wright, Water and Sewer Utility Operator
Mike Andon, President, Too'gha, Inc.
Al "Bear" Ketzler, Jr., City Manager, City of Tanana
Pat McAree, Area RMW

FROM: Paul C. Weisner, P.E., CE2 Engineers, Inc. PCW

SUBJECT: Assessment of existing wood heat system and recommendations for better utilization of wood heat

DATE: September 22, 2009

This memorandum is an assessment of the existing wood fired hydronic heating system adjacent to the Tanana Water Treatment Plant and Washeteria, and a proposal of how to better utilize the existing wood fired heating system to save the maximum amount of heating oil at the plant.

Brian Aklin and I travelled to Tanana on Friday, September 18, 2009 to assess the operation of the wood heat system (set up by a grant obtained by the City), and to examine problems in the sewage collection system.

ASSESSMENT

1. Two GARN Model 2000 wood fired hydronic heating units were installed in the garage building adjacent to the north side of the water treatment plant/Washeteria building. Insulated 2-in PEX hot water supply and return lines were run from the two GARN heaters to the water treatment plant boiler room through a 6-in x 12-in arctic pipe insulated duct connecting the buildings approximately 8-ft above the ground. The hot water supply and return PEX piping were routed over the door into the boiler room into a pair of 2-1/2-in copper tubing manifolds that supply hydronic heating to heating units for the Washeteria:
   - Two unit heaters in the area behind the dryers
   - One cabinet unit heater for heating the space in the Washeteria
   - Heat exchanger for heating domestic water for the Washeteria.
   - Heat exchanger for adding heat to the water storage tank.

2. Installing the wood-fired hydronic heater was a good idea, and it has helped to lower fuel oil consumption. The intent of the project was to start gradually and to add additional loads to displace fuel oil. However, there is a way to achieve that goal in one step, which is to put heat directly into the glycol heat return piping of the existing facility heating system.

3. When the PEX lines were routed from the Garage to the Water Treatment Plant boiler room, they formed a high point upstream of the pump manifold to the wood heat supplied unit heaters and heat exchangers. When hot water in the order of 180°F to 200°F is circulated, there is a very strong possibility of water at the high point releasing vapor under lower pressure, causing a gas-lock at the high point, causing the pumps to stop pumping. The existing wet-rotor circulating pumps, under low pressure conditions, are subject to failure from dry running conditions in their rotor cavities.

4. Wood-fired hydronic heaters, like the GARN system, operate on atmospheric pressure, so the pressure in the piping is low, in the order of 2.5 psi. Normal operating systems in pressurized hot water systems operate at 12 psi. This is not a major problem in design, but the low pressure must be accounted for in design of these low pressure systems, especially for pumps.

5. It was also related that water loss in the system due to evaporation requires make-up water once a month or so. Normal water loss needs to be made up only once a year. Adding extra water will also require the addition of more corrosion inhibitor, which presently is not done. Water loss through evaporation should be addressed.

6. The operator also mentioned that water heat was brought up to only 176°F. To fully utilize the GARN heating units, the units should be fired up to 200°F and refired at 150°F to 160°F for maximum thermal storage and utilization.

Figure 1 (attached) shows schematically how the existing wood-fired heating system works in the plant. Note the high point in the line supplying the pump manifold. Problems in this existing system are discussed in the Assessment section above.

RECOMMENDATIONS

Figure 2 (attached) shows an upgraded system that will better utilize the two GARN heaters and should eliminate 75% to 85% of the fuel oil demand, when operated per procedures recommended by GARN. Given the existing 2-in PEX piping, the maximum flow rate through the piping should be 4 ft/sec or 40 gallons per minute (gpm). Based upon a 20°F drop in temperature across the heating system, the heating system should be able to deliver:

H	=	500 x GPM x ΔT	=	500 x 40 x 20
H	=	400,000 BTU/hr	or equivalent to 4 gallons fuel oil per hour	

1. **Connect the wood heating system to the existing hydronic heating system in the Water Treatment Plant/Washeteria.** To fully utilize wood derived heat anywhere in the building heating system, connect the wood heat hydronic system to the glycol heat return side of the building hydronics with a heat exchanger, as shown in Figure 2. In this way, heat goes into the system upstream of the two oil-fired boilers, which will prevent them from running. All heat will go to those zones calling for it, through the existing building heating system.

2. **Eliminate the two added-on hydronic unit heaters in the area behind the bank of clothes dryers.** They serve no useful purpose if the wood heat goes to the building hydronic system, where heat can be brought where it is needed by the existing system.

3. **Keep the cabinet unit heater in the Washeteria space for now.** Monitor operations after the wood heat is fully utilized per Recommendation 1. There is no reason for that heater if all wood heat is directed to the building hydronic system.

4. **Add a circulation pump and backup in the garage to replace the existing wet rotor pump.** This pump will be the main circulator for moving heating water from the GARN heaters to the water treatment plant. This pump should be sized and specified for low pressure (net positive suction head) operation. The existing pump, bypass check valve, and 3-way tempering valve is not needed.

5. **In the water treatment room, add a rack, which will contain a 400,000 btu/hr heat exchanger and a circulation pump for transferring heat to the existing building hydronic system.** Placing the system here will make installation and operations and maintenance easier.

6. **Install motorized valve and plate and frame heat exchanger for domestic water heating.** The present system is single-walled, which is not legal. Heating water in the GARN system is not potable, so a double walled heat exchanger is required.

7. **Take care of the problem of water loss in the GARN units due to evaporation.** Water loss and replacement with untreated water can cause corrosion and deposit problems in the GARN units. Check access manhole gasketing, replace if necessary, test for corrosion inhibitor levels and add inhibitor if required.

8. **Train operators in the proper operation and firing of the GARN units.** This will allow the GARN units to store and supply the maximum amount of heat to the facility.

ESTIMATED FUEL AND COST SAVINGS

According to Bear Ketzler, the system presently uses 15 cords of wood annually, costing $250/cord and displacing 5,000 gallons of fuel oil, which is the equivalent of $1.33/gallon. Labor costs are sunk, as the operators are paid for a day's work, no matter what they do.

Fuel oil bought last year was 7,000 gallons. At $4.00/ gallon, this translates to $28,000 per year for fuel oil. Thus the total cost for heating was $3750 for wood and $28,000 for oil, totaling $31,750 annual cost.

With normal operating procedures, a GARN heating system can displace 85% of the fuel oil heating demand per year. For the equivalent of 12,000 gallons per year, wood heat should handle the equivalent of 12,000*0.85 or 10,200 gallons, and oil should only use 1,800 gallons.

Annual heating cost would be:

Wood:	10,200 equivalent gallons @$1.33/gallon =	$13,566
Oil:	1,800 gallons @$4.00/gallon =	$7,200
Total heating cost with 85% wood heat		**$20,766**
Present heating costs:		$31,750
Annual savings		**$10,984**

Simple payback, considering conservative cost estimate below:

$$\frac{\$61{,}820 \text{ construction cost}}{\$10{,}984 \text{ per year savings}} = 5.6 \text{ years}$$

This is a very worthwhile project, considering the relatively short payback period.

PRELIMINARY COST ESTIME FOR THE UPGRADES
To properly upgrade the wood heating system to that envisioned would roughly cost:

1.	Materials:	Heat Exchangers	$4,500
2.	Materials:	Pumps	3,500
3.	Materials:	Piping, Valves, fittings, insulation	6,000
4.	Materials:	Electrical	1,500
5.	Labor:	Plumbing superintendent, 2 weeks	12,000
6.	Labor:	Local labor, 2 laborers, 2 weeks	7,200
7.	Labor:	Electrician, 5 days	5,000
8.	Freight		4,000
9.	Support:	Food, lodging, travel	2,500
10.	Construction Management		3,000
11.	Engineering, inspection		7,000
	Subtotal		**$56,200**
	Contingency, 10%		**5,620**

FIGURE 1

Tanana Wood Heat System – Existing Process Schematic

1. Two GARN 2000 gal cordwood fired hydronic heating units provide the heat.
2. Existing wet rotor circulation pump has a cord and plug for additional circulation, if necessary. Adjacent 3-way temperature regulating valve limits output temperature of heating water.
3. Existing 6-in HDPE x 12-in aluminum outer jacket arctic pipe serves as an insulated connecting duct for 2-in PEX heat supply and return piping between the garage containing the GARN heaters and the water treatment plant boiler room.
4. A circulating pump, isolation valves, and heat exchanger form a heat loop of the heating supply and return header to heat domestic hot water.
5. A cabinet unit heater in the Washeteria is connected to a heat loop.
6. A unit heater, located in the area behind the clothes dryers, is connected to the wood heat hot water loop supply and return header.
7. A unit heater, located in the area behind the clothes dryers, is connected to the wood heat hot water loop supply and return header.
8. A check valve is installed across the wood heat hot water loop supply and return headers to provide minimum loop circulation in the case of a no load condition.

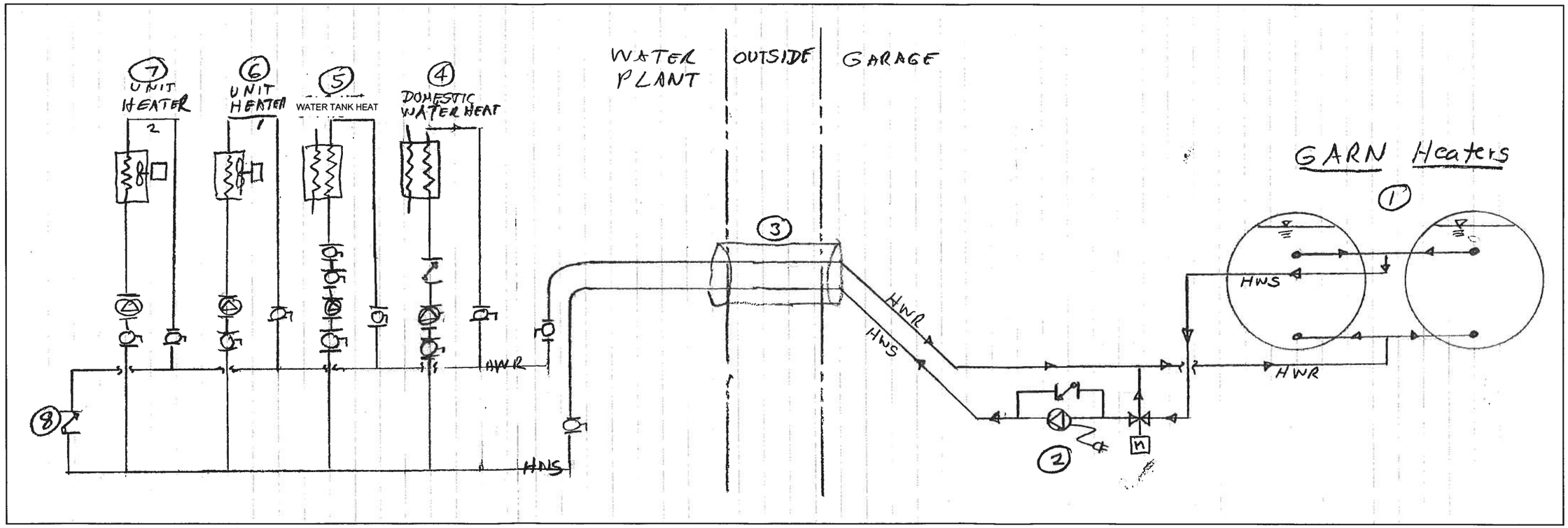


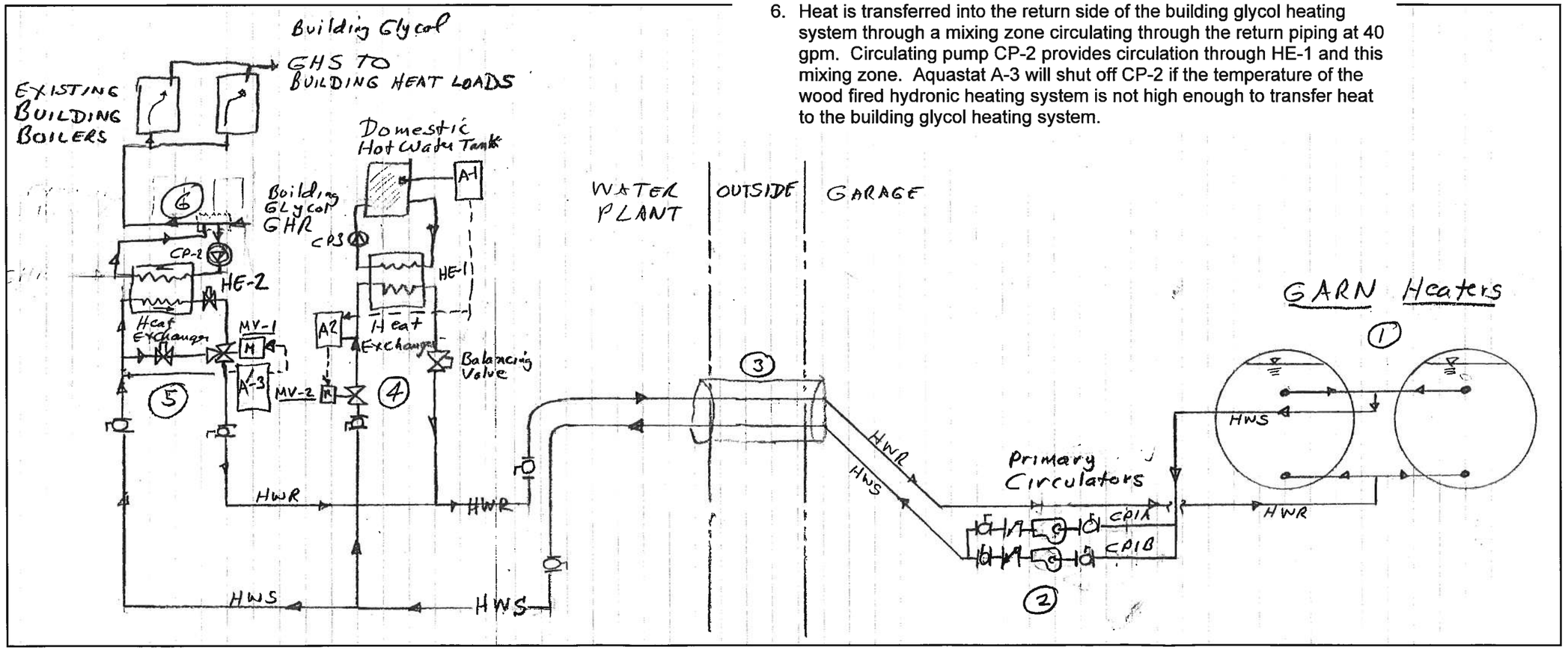
FIGURE 2

Tanana Wood Heat System – Proposed Process Schematic

This is a conceptual process schematic diagram for upgrading the hot water circulation system for the two GARN heaters in order to better utilize their capacity, and to displace 75% to 85% of the fuel oil presently used in the facility.

The basic principle of this upgrade is to deliver the heat generated by the wood fuel to the existing glycol heating system in the water treatment plant and Washeteria, and let existing heating system components deliver the heat where it is needed.

1. Two GARN 2000 gal cordwood fired hydronic heating units provide the heat.
2. A new close coupled pump and backup pump constantly circulate hot water from the GARN heaters to the two heat exchangers in the water treatment plant. The old pump, check valve, and mixing valve would be removed, as they serve no useful purpose. Primary pump placement here is the best location, as the pump suction is always flooded, with no high points upstream. Flow rate will be 40 gpm.
3. The existing 6-in HDPE x 12-in aluminum outer jacket arctic pipe serves as an insulated connecting duct for 2-in PEX heat supply and return piping between the garage containing the GARN heaters and the water treatment plant boiler room.
4. Domestic hot water is heated by double-walled plate and frame heat exchanger HE-1. Motorized valve MV-2 is operated by aquastat A-1 in the domestic hot water tank to produce domestic hot water, and aquastat A-2 in the hot water supply piping to prevent operation of MV-2 if the temperature of the wood heating system water is not hot enough. Circulating pump CP-3 circulates domestic hot water through heat exchanger HE-1 for heating.
5. Building heat is supplied from the wood heat system through heat exchanger HE-2. Motorized mixing valve MV-1 normally allows heating water to go straight through HE-2. If aquastat A-3 senses low temperature in wood heat supply water, then MV-1 bypasses water around HE-2, preventing back feed of heat from the building to the wood fired hydronic heating system.
6. Heat is transferred into the return side of the building glycol heating system through a mixing zone circulating through the return piping at 40 gpm. Circulating pump CP-2 provides circulation through HE-1 and this mixing zone. Aquastat A-3 will shut off CP-2 if the temperature of the wood fired hydronic heating system is not high enough to transfer heat to the building glycol heating system.



CE2 Engineers, Inc.

MEMORANDUM

TO: Susan Randlett, P.E., Village Safe Water Engineer
Pat McAree, Area RMW

FROM: Paul C. Weisner, P.E., CE2 Engineers, Inc. PCW

SUBJECT: Technical Memorandum for design of improvements for the wood heat system at the Tanana Water Treatment Plant and Washeteria

DATE: January 8, 2010

This memorandum discusses the design aspects of the proposed improvements to the existing cordwood-fired hydronic heating system and water treatment plant/Washeteria hydronic heating system.

BACKGROUND

The existing cordwood-fired hydronic heating system consisted of two each GARN 2000 heating units plumbed in parallel. A single circulating pump circulated heating water to several unit heaters, water tank heat exchanger, and a heat exchanger used to heat domestic water for the Washeteria.

This arrangement helped to reduce fuel oil consumption for the plant, but did not fully utilize the potential of the GARN heaters to displace the maximum amount of fuel oil for the facility, which could amount to 75% to 85%. The existing heat loads on the GARNs did not address the main heat loads of the facility, which were distribution water loop heating, clothes dryers, and other building loads.

An assessment of the system was made in September 2009 (attached), and recommendations in presented for modifying the system to better utilize the cordwood-fired heaters.

P.O. Box 232946 • Anchorage, AK 99523-2946 • (907) 349-1010 • Fax: (907) 349-1015

PROPOSED SYSTEM UPGRADE

The system upgrade would include the following:

1. Install appropriately sized circulating pumps in the boiler shelter building to circulate hot water from the GARNs to the heat loads. This would also include pump motor starters and overloads.
2. Connect the GARN hydronic system to only two heat loads in the Washeteria/Water Treatment Plant:
   A. Provide domestic water heater through its own heat exchanger.
   B. Provide a heat exchanger on the return side of the building hydronic system that will feed all of the building heat loads through this existing system.
   C. Add control circuits to each heating system to prevent over-temperature and potential back feeding of oil-fired building heat to the wood heat system.

DESCRIPTION OF OPERATION

Refer to Drawing MS-1 from Capstone Engineering.

1. The two GARN wood-fired hydronic heaters are hand-fired by the operator, and the existing oil-fired units are controlled by the building system.
2. Circulating pump PMP-1 or PMP-2 continuously circulates 42-50 gpm of water with inhibitor through the GARN-side of the heating system.
3. A new domestic water heater HWM-1 supplies domestic hot water to the Washeteria. It has a self-contained double-walled heat exchanger, per State of Alaska requirements. Temperature control TC-1 is the operating aquastat that controls the temperature of the domestic water. Temperature control TC-2 is wired in series with TC-1, and provides protection against back feeding of heat from HWM-1 in the event that there is inadequate heat from the GARN heating system. Control valve CV-2 is a two-way hydronic valve that allows heating fluid from the GARN heat system to heat domestic water.
4. Another branch of the GARN hydronic loop provides heat to heat exchanger HX-1, which transfers heat to the glycol heat transfer fluid returning to building boilers from heat loads in the Washeteria and Water Treatment Plant. HX-1 keeps the two systems separated. Three-way control valve CV-1, on the GARN side of the system, bypasses water around HX-1 to maintain building hydronic system temperature. In the event that there is not a high enough temperature for heat transfer from the GARN side to the building side of HX-1, water is bypassed around HX-1 to prevent back feeding of heat to the GARN system.

DESCRIPTION OF ELECTRICAL IMPROVEMENTS

Refer to electrical drawing E1 by EIC Engineers, Inc. for power one-line diagram of improvements.

1. Control transformer CT-1, which provides 50 VA of 24 volts AC for control devices is powered by a separate 15A, 120VAC circuit from the Water Plant mechanical room branch panel.
2. Pumps PMP-1 and PMP-2 are powered by a single 20 A 120 volt AC circuit in the boiler shelter building panel. Only one pump is allowed to run at a time through a 3-position switch (PMP-1---OFF---PMP-2) that is hand selected by the operator. The switch feeds power to each pump's combination motor starter/overload enclosure and disconnect.

EQUIPMENT CUT SHEETS

Major equipment cut sheets are attached:

1. PMP-1, 2: Another pump was selected that was 18% more efficient than the one shown on the drawings. Both curves are shown.
2. Heat exchanger HX-1. This unit transfers the heat from the GARN system to the building system.
3. Domestic Water Heater HWM-1. This unit contains a double walled heat exchanger inside. It is cheaper to purchase a new water heater than to purchase a separate double-walled heat exchanger and convert the existing water storage tank.
4. Heat exchanger controller HXCP-1. This protects the building heating system from back feeding heat to the GARN hydronic loop.
5. Control Valve CV-1. This valve and operator prevent back feeding of heat to the GARN system from building heat.
6. Control Valve CV-2. This solenoid valve prevents back feeding of heat to the GARN system from the domestic hot water tank.
7. Temperature Controller TC-2. Low limit aquastat for HWM-1

Attachments: Wood Heat System Assessment document
Mechanical Drawing sheet MS-1
Electrical Drawing sheet E1
Equipment cut sheets

EQUIPMENT LIST

HX-1 HEAT EXCHANGER (LOCATED IN MECH ROOM)

HEAT EXCHANGE CAPACITY: 700 MBH:
INPUT SIDE FROM WOOD HEATING: 42 GPM: WATER EWT-190 F LWT-156 F 2 FT PD MAX
OUTPUT SIDE TO WASHETERIA SYSTEM 65 GPM EST: 50 / 50 ETHYLEN GLYCOL/WATER
EWT-155F LWT-180 F 1 FT PD MAX
MFG: GEA NUD8B4U4B OR EQUAL

HWM-1 HOT WATER MAKER: (LOCATED IN MECH ROOM)

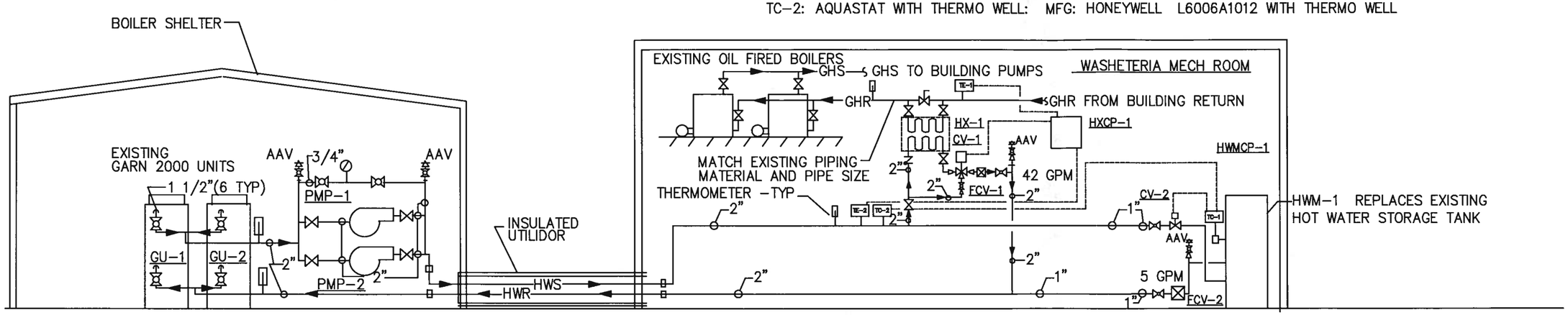
HOT WATER MAKER WITH CONTROLS, DOUBLE WALL HEAT EXCHANGER, 45 GALLON TANK, 60 GPH DEMAND
MFG: SUPER STOR ULTRA SSU-45-DW WITH TC-1 MFG RECOMMENDED CONTROLLER

PMP-1, PMP-2 CIRCULATOR PUMPS:

PUMPING HOT WATER, 47 GPM @ 22 FT TDH. INLINE OR FRAME MOUNTED PUMPS
GOULD SSH/9SH 1 X 2-6 5 11/16 IMPELLOR 1750 RPM 1/2 HP / 115 V / 1 PHN OR EQUAL

SYSTEM CONTROLS

HXCP-1 HEAT EXCHANGE CONTROLLER
ELECTRONIC CONTROLLER WITH 2 SENSOR INPUTS, 1 ANALOG OUTPUT
MFG: HONEYWELL T775M2006 OR EQUAL
TE-1, TE-2, TEMPERATURE SENSORS: HOT WATER TYPE WITH WELL
MFG: HONEYWELL C7031D2003 WITH 5001774-001 IMMERSION WELL OR EQUAL
CV-1 CONTROL VALVE AND OPERATOR: 3 WAY 42 GPM @ 4' PD CV=24.3
SELECTION: HONEYWELL V5013N 1 1/2 INCH VALVE FEMALE SCREW FITTINGS
WITH HONEYWELL ML7984 ACTUATOR 24 VAC POWER 0-10 VDC OR 4-20 MA SIGNAL
CT-1 CONTROL TRANSFORMER: 115 V PRIMARTY/ 24 VAC SECONDARY TRANSFORMER 50 VA
MFG: HONEYWELL AT87A1106 OR EQUAL
CV-2 CONTROL VALVE: 2 WAY HYDRONIC 24 VAC OPERATOR 3/4 INCH SWEAT CONNECTOR:
MFG: ASCO RED HAT 8210 SERIES RATED 200 F OR EQUAL
FCV-1 FLOW CONTROL VALVE 42 GPM 2' PD MFG: TACO ACUF-200-AT 2" SCREW OR EQUAL
FCV-2 FLOW CONTROL VALVE 5 GPM 2' PD MFG: TACO ACUF-075-AT 3/4" SCREW OR EQUAL
TC-1: TEMPERATURE CONTROLLER FOR HWM-1: PER HWM-1 SPECIFICATION
TC-2: AQUASTAT WITH THERMO WELL: MFG: HONEYWELL L6006A1012 WITH THERMO WELL



SYSTEM MODIFICATION MATERIAL

GU-1, GU-2, EXISTING: WOOD BOILERS: MFG: GARN MODEL WHS 2000
CONNECTING PIPING(IN UTILADOR) 2 INCH CROSS LINKED PEX .
PIPING IN BOILER AREA AND MECH ROOM: SCHEDULE 40 A53 STEEL PIPE OR TYPE L COPPER WITH WROUGHT FITTINGS.:
MATCH EXISTING PIPING IN EXISTING BOILER HYDRONIC SYSTEM IN MECH ROOM AT HX-1
VALVES: USE FULL PORT BALL VALVES.

TANANA WASHETERIA SUPPLIMENTARY WOOD HEAT DIAGRAM

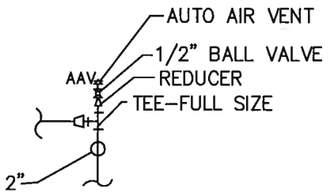
SEQUENCE OF OPERATION

WOOD BOILERS ARE HAND FIRED BY OWNER. EXISTING OIL FIRED BOILERS ARE SYSTEM CONTROLLED

PMP-1 OR PMP-2 OPERATES CONTINUOUSLY

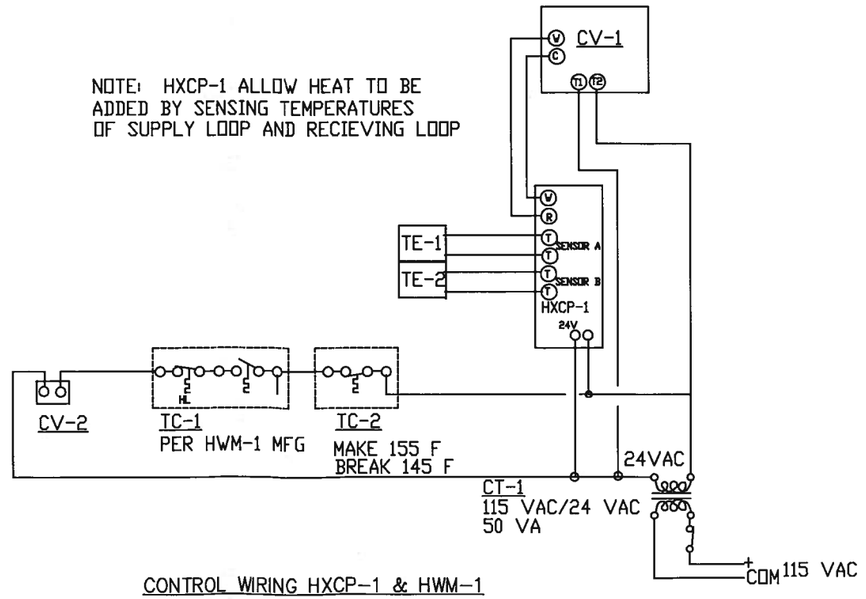
HWM-1, HWMCP-1, CV-2 HOT WATER HEATING: TEMPERATURE SENSORS T-3, T-4 SENSE TANK TEMP AND HEATING FLUID HOT WATER SUPPLY TEMP AND ADD HEAT AS REQUIRED TO MAINTAIN TANK TEMP IF HOT WATER SUPPLY TEMP IS ABOVE HWM-1 TANK TEMP. HWMCP-1 CYCLES CV-2 AS NEEDED.

HX-1, HXCP-1, CV-1 ADD HEAT TO EXISTING HYDRONIC SYSTEM: TEMPERATURE SENSORS T-1, T-2 SENSE GHR TEMP AND HEATING FLUID HOT WATER SUPPLY TEMP AND ADD HEAT AS REQUIRED TO MAINTAIN SYSTEM TEMP OF EXISTING GLYCOL HEATING SYSTEM IF WATER SUPPLY IS ABOVE GHR RETURN TEMP. HXCP-1 MODULATES CV-1 AS NEEDED



AUTO AIR VENT INSTALLATION

NO SCALE



CONTROL WIRING HXCP-1 & HWM-1

CAPSTONE ENGINEERING LLC
MECHANICAL ENGINEERS
12110 BUSINESS BLVD STE 6 PMB 169
EAGLE RIVER, ALASKA 99577
TELEPHONE & FAX 541-884-8625

STATE OF ALASKA 49TH REGISTERED MECHANICAL ENGINEER PROFESSIONAL ENGINEER

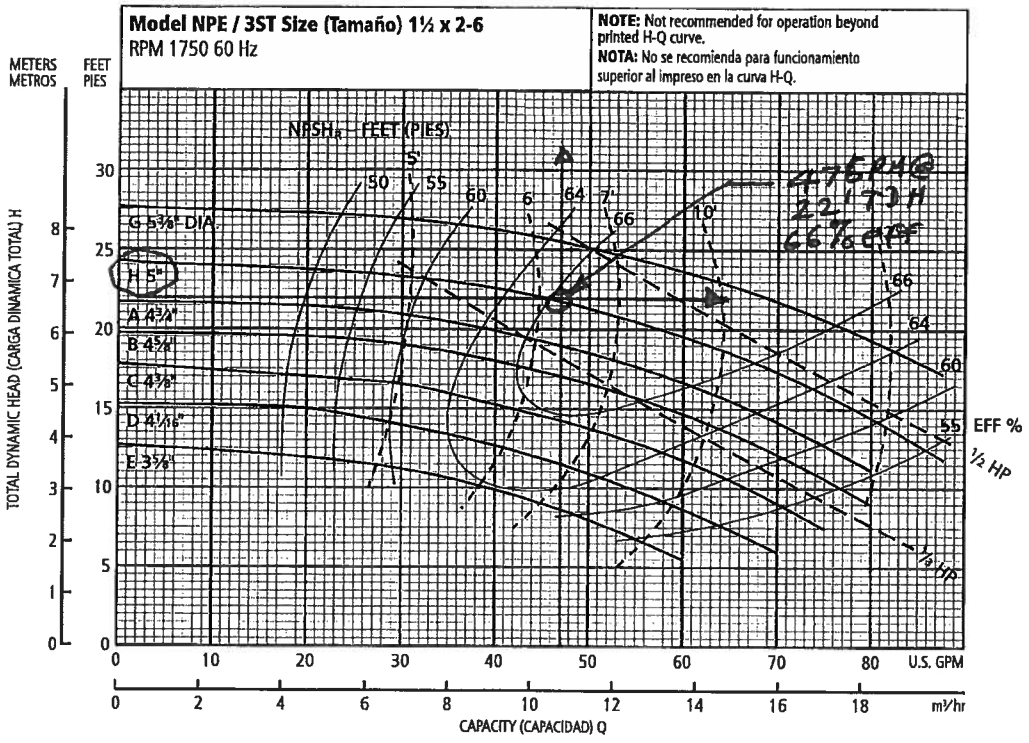
TANANA WASHETERIA WOOD HEAT R.E.PIPING
TANANA WASHETERIA
TANANA, ALASKA

DATE: DEC 8, 2009
DRAWN: F.H. BELZ
CHKD:
SCALE: AS NOTED
REVISED:
JOB NO. C371

SHEET NO. MS-1 | 1 OF 1

Performance Curves – 60 Hz, 1750 RPM
Curvas de Funcionamiento – 60 Hz, 1750 RPM

Ciro Pump PMP-1, 2

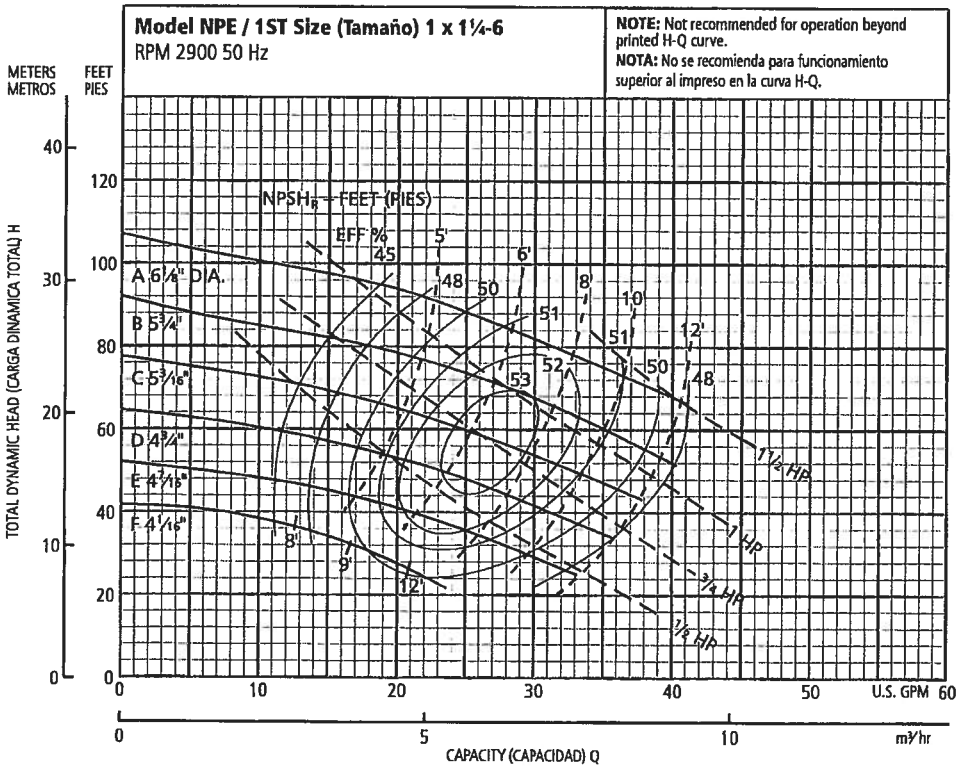


Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
G	5⅜"
H	5
A	4¾
B	4⅝
C	4⅜
D	4¹⁄₁₆
E	3⅝

NOTE: Although not recommended, the pump may pass a 11/32" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 11/32".*

Performance Curves – 50 Hz, 2900 RPM
Curvas de Funcionamiento – 50 Hz, 2900 RPM



Optional Impeller, *Impulsor Opcional*	
Ordering Code, *Código de Pedido*	**Dia.**
A	6¹⁄₈"
B	5¾
C	5³⁄₁₆
D	4¾
E	4⁷⁄₁₆
F	4¹⁄₁₆

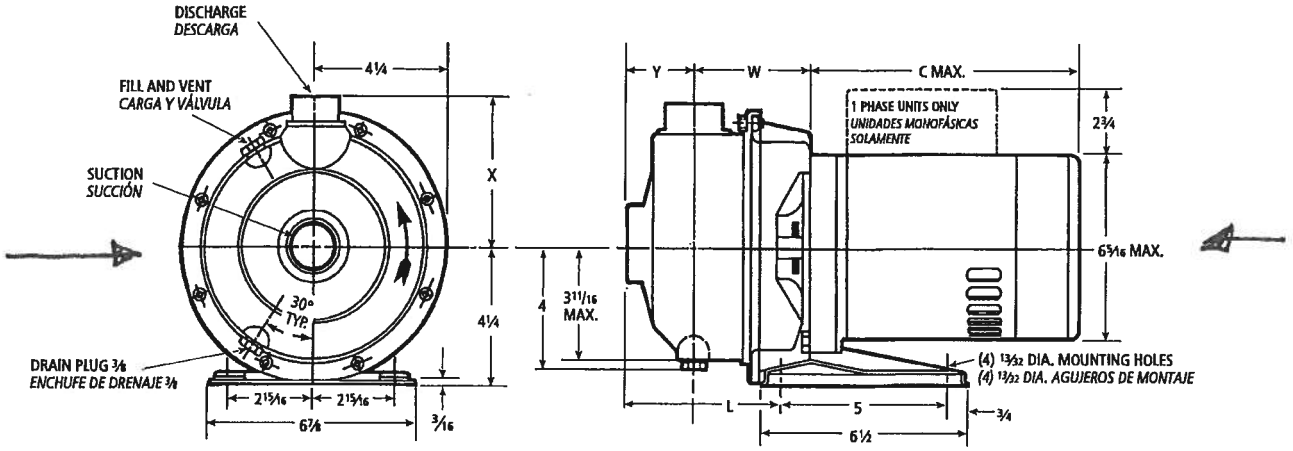
NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

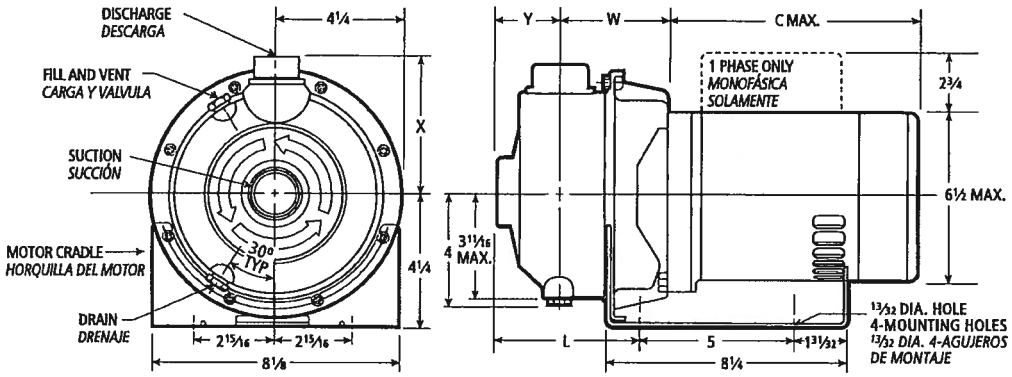
RMP 1, 2

NPE Close Coupled – Dimensions, Weights and Specifications
NPE Acople Cerrado – Dimensiones, Pesos y Especificaciones

Clockwise Rotation Viewed from Drive End
Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor



ODP and TEFC ½, ¾ and 1 HP (standard), *ODP y TEFC ½, ¾ y 1 HP (estándar)*



ODP and TEFC 1½, 2 and 3 HP (standard), *ODP y TEFC 1½, 2 y 3 HP (estándar)*

Specifications
Especificaciones

Capacities to:
85 GPM (322L/min) at 1750 RPM
170 GPM (643L/min) at 3500 RPM

Heads to:
39 feet (12 m) at 1750 RPM
150 feet (46 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to:
250° F (121° C)

Direction of rotation:
Clockwise when viewed from motor end.

Motor specifications:
NEMA 56J frame, 1750 RPM, ½ HP. 3500 RPM ½ through 5 HP. Open drip-proof, totally enclosed fan-cooled or explosion proof enclosures. Stainless steel shaft with ball bearings.

Single phase: Voltage 115/230 ODP and TEFC. (3 and 5 HP model – 230 V only) Built-in overload with auto-reset provided.

Three phase: Voltage 208-230/460 ODP, TEFC and EX PROOF.

NOTE: For three phase motors, overload protection must be provided in starter unit. Starter and heaters must be ordered separately.

Capacidades:
85 GPM (322L/min) a 1750 RPM
170 GPM (643L/min) a 3500 RPM

Cargas:
39 pies (12 m) a 1750 RPM
150 pies (46 m) a 3500 RPM

Presión de trabajo:
125 PSIG (9 baras)

Temperatura máxima:
250° F (121° C)

Dirección de rotación:
En dirección de las agujas del reloj visto desde el extremo final del motor.

Motores:
Armazón 56J NEMA, 1750 RPM ½ HP. 3500 RPM ½ a 5 HP. Cubiertas abiertas resguardadas, totalmente encerradas enfriadas por ventilador o a prueba de explosiones. Eje de acero inoxidable con balineras de bolas.

Monofásicos: *Voltaje 115/230 ODP y TEFC. (modelo 3 y 5 HP – 230 voltios solamente) Se proporciona protección térmica contra sobrecarga construida con reseteo automático.*

Trifásicos: *Voltaje 208-230/460 ODP, TEFC y EX PROOF.*

NOTA: *Para motores trifásicos se debe de proporcionar la protección térmica contra sobrecarga en la unidad de arranque. El arrancador y los calentadores se deben pedir por separado.*

PMP 1,2, G#L#3ST2C4H65

A Full Range of Product Features
Una Gama Total de Características del Producto

Superior Materials of Construction: Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

High Efficiency Impeller: Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustment.

Casing and Adapter Features: Stainless steel construction with NPT threaded, centerline connections, easily accessible vent, prime and drain connections with stainless steel plugs. Optional seal face vent/flush available.

Mechanical Seal: Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts. Optional high temperature and chemical duty seals available.

Motors: NEMA standard open drip-proof, totally enclosed fan cooled or explosion proof enclosures. Rugged ball bearing design for continuous duty under all operating conditions.

Materiales Superiores de Construcción: *Componentes completos para manejo de líquidos en acero inoxidable AISI 316L y consola para el montaje para resistencia a la corrosión, apariencia de calidad, y fuerza y ductilidad mejoradas.*

Impulsor de Eficiencia Superior: *El impulsor encerrado con un diseño único de anillo del sello flotante, mantiene sin ajustes, la eficiencia máxima sobre la vida de la bomba.*

Características de la Carcasa y del Adaptador: *Construcción en acero inoxidable con NPT roscado, conexiones centrales, válvulas de fácil acceso, conexiones de cebado y drenaje con enchufes de acero inoxidable. Cara del sello válvula/chorro opcional disponible.*

Sello Mecánico: *Estándar John Crane Tipo 21 con carbón en contraste con caras de silicón-carbide, elastómeros de Viton, y partes metálicas de acero inoxidable 316. Sellos de alta temperatura y productos químicos están disponibles.*

Motores: *Estándar NEMA a prueba de goteo, ventilador totalmente encerrado o recintos a prueba de explosión. Diseño robusto de balineras de bolas para trabajo continuo en todas las condiciones de funcionamiento.*

The various versions of the NPE are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown at left.

Las diferentes versiones de la NPE se identifican con un número de código del producto en la etiqueta de la bomba. Este número es también el número del catálogo para la bomba. El significado de cada dígito en el número de código del producto se muestra a la izquierda.

NPE Product Line Numbering System
Línea de Producto NPE Sistema de Numeración

Example Product Code,
Ejemplo Código del Producto

1 ST 2 C 1 A 4 F

Seal Vent/Flush Option,
Opción de Sello Válvula/ChorroSeal Ven

Mechanical Seal and O-ring
4 = Pre-engineered standard
For optional mechanical seal modify catalog order no. with seal code listed below.

Sello Mecánico y Anillo 'O'
4 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálogo con el código del sello anotado abajo.

John Crane Type 21 Mechanical Seal (⅝" seal),
Sello Mecánico John Crane Tipo 21 (sello de ⅝")

Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
2	Carbon	Silicon Carbide	EPR	316 SS	10K18
4			Viton		10K55
5	Silicon Carbide		EPR		10K81
6			Viton		10K62

250°F Max

Impeller Option . . . No Adder Required
For optional impeller diameters modify catalog order no. with impeller code listed. Select optional impeller diameter from pump performance curve.

Código del Impulsor Opcional
Para impulsores con diámetros opcionales modificar el número de orden del catálogo con el código del impulsor anotado. Escoger el impul con diámetro opcional de la curva de funcionamiento de la bomba.

Impeller Code, *Código del Impulsor*	Pump Size, *Tamaño de la Bomba*		
	1 x 1¼ – 6	1¼ x 1½ – 6	1½ x 2 – 6
	Diameter	Diameter	Diameter
K	–	6⅛	–
G	–	5 15/16	5⅛
H	–	5½	5
A	6⅛	5¼	4¾
B	5¾	5 1/16	4⅝
C	5 3/16	4⅞	4⅜
D	4¾	4⅝	4 1/16
E	4 7/16	4¼	3⅝
F	4 1/16	3⅞	–

Driver, *Conductor*
1 = 1 PH, ODP 7 = 3 PH, XP
2 = 3 PH, ODP 8 = 575 V, XP
3 = 575 V, ODP 9 = 3 PH, TEFC Premium Eff.
4 = 1 PH, TEFC
5 = 3 PH, TEFC 0 = 1 PH, XP
6 = 575 V, TEFC

HP Rating, *HP Potencia*
C = ½ HP E = 1 HP G = 2 HP J = 5 HP
D = ¾ HP F = 1½ HP H = 3 HP

Driver: Hertz/Pole/RPM,
Conductor: Hercios/Polo/RPM
1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

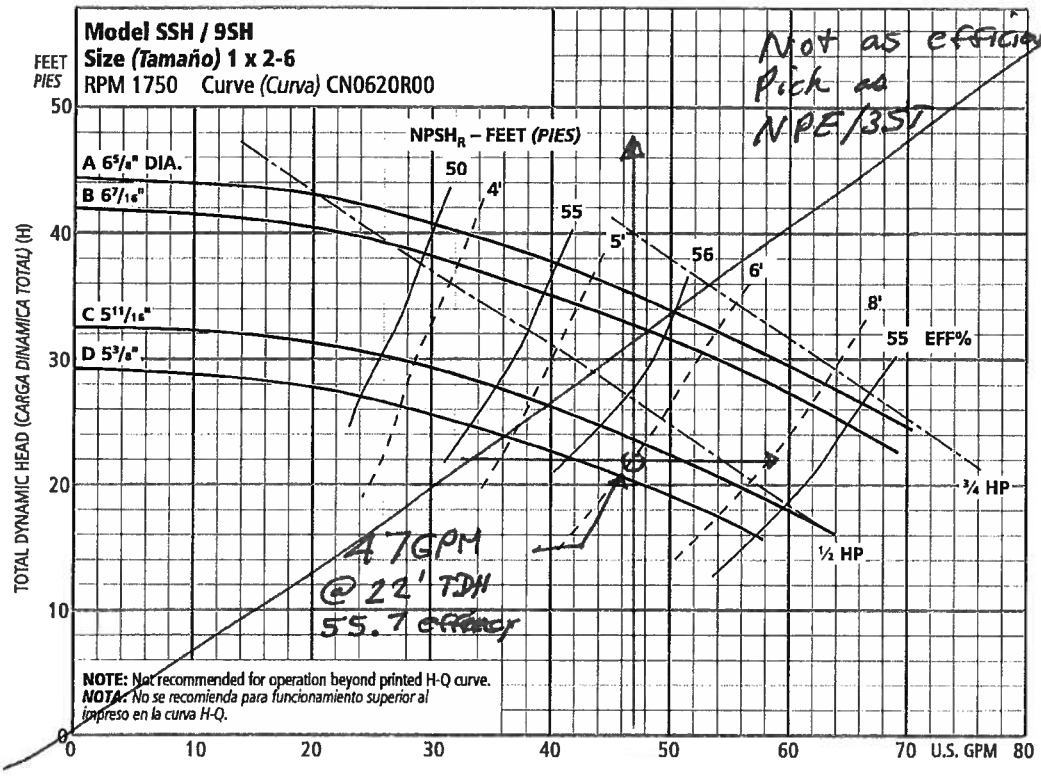
For frame mounted version, substitute the letters "FRM" in these positions.
Para la versión con el armazón montado, sustituya las letras "FRM" en estas posiciones.

Material
ST = Stainless steel, *Acero inoxidable*

Pump Size, *Tamaño de la Bomba*
1 = 1 x 1¼ – 6 2 = 1¼ x 1½ – 6 3 = 1½ x 2 – 6

Performance Curves – 60 Hz, 1750 RPM
Curvas de Funcionamiento – 60 Hz, 1750 RPM

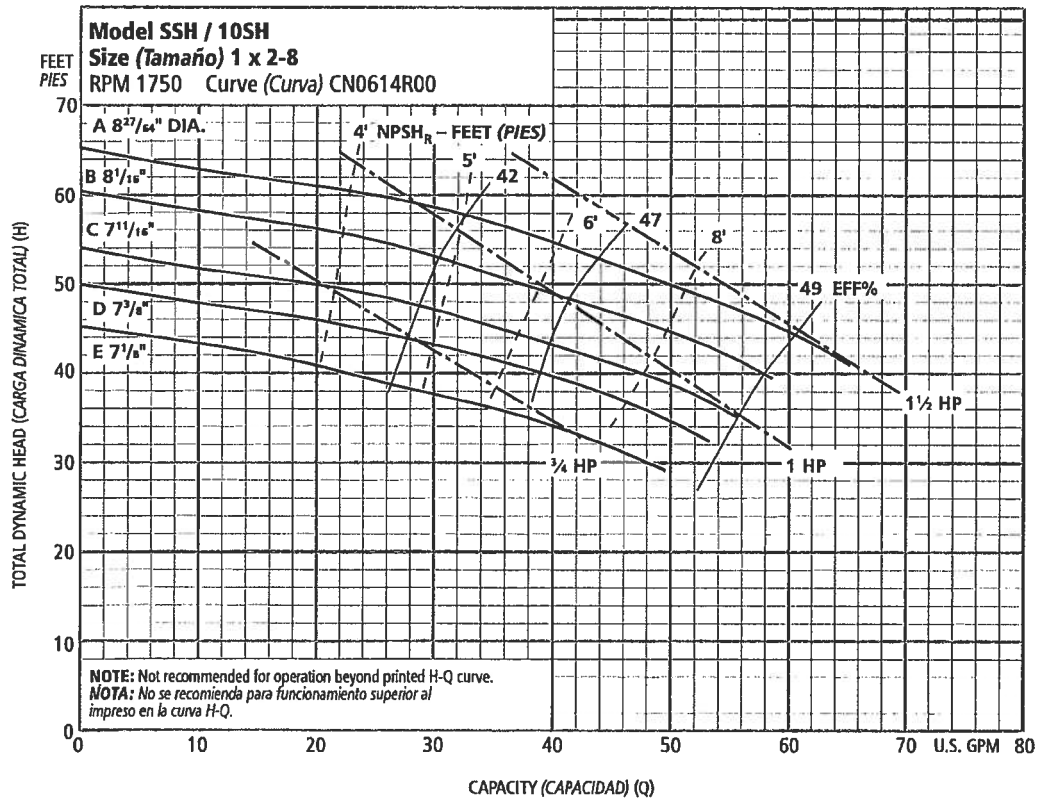
Original PMP-1, 2



Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	**Dia., *Diá.***	**Standard HP Rating, *Estándar HP Potencia***
A	6⅝"	¾
B	6⅞	¾
C	5¹¹⁄₁₆	½
D	5⅜	½

NOTE: Pump will pass a sphere to ⅛" diameter.

NOTA: La bomba pasará una esfera a ⅛" diámetro.



Optional Impeller, *Impulsor Opcional*		
Impeller Code, *Código del Impulsor*	**Dia., *Diá.***	**Standard HP Rating, *Estándar HP Potencia***
A	8²⁷⁄₆₄"	1½
B	8¹⁄₁₆	1½
C	7¹¹⁄₁₆	1
D	7⅜	¾
E	7⅛	¾

NOTE: Pump will pass a sphere to ⅛" diameter.

NOTA: La bomba pasará una esfera a ⅛" diámetro.

Heat Exchanger HX-1

GEA PHE Systems North America, Inc.
100 GEA Drive
York, PA 17406 USA
Ph: (717) 268-6200
FAX: (717) 268-6163
Website: www.geaphena.com

Liquid to liquid

Project.....Tanana Wood Heat
Customer.....Paul Weisner
User name.....Paul Weisner

Selection ID.....NUD9C6Y7G
Print date.....1/8/2010

Comment

Heat Exchanger HX-1

Model: FP15x34H-90-FB (3" FLG)

Load (Btu/h).....696,749
Log mean temp. diff. (°F).....4.4
Overall HTC (Btu/h·ft²·°F).....511
Oversurface percent.....0.8
Model size.....15x34H-FB

Nominal surface (ft²).....311.7
Dimensions.....15.2W x 34.3H x 9.3D
Plate construction.....Single wall
Net weight (lb).....339.0

Design Conditions	Side A - Liquid	Side B - Liquid
Fluid type	**Water**	**Propylene glycol**
Fluid conc.		40
Fluid mass flow rate (lb/min)	341.0	543.3
Entering fluid temp. (°F)	190.0	155.0
Leaving fluid temp. (°F)	156.0	178.1
Fluid flow rate (GPM)	42.0	65.0
Fluid fouling factor (h·ft²·°F/Btu)	0.00010	0.00010
Model Parameters		
Number of channels	44	45
Velocity (ft/s)	0.28	0.42
Pressure drop (psi)	0.5	1.1
Heat transfer coef. (Btu/h·ft²·°F)	1,370	972
Internal volume (ft³)	1.221	1.248

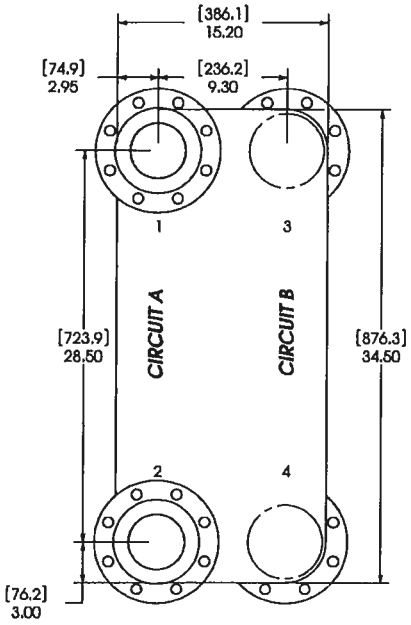
GEA PHE Systems North America, Inc.
100 GEA Drive
York, PA 17406 USA
Ph: (717) 268-6200
FAX: (717) 268-6163
Website: www.geaphena.com

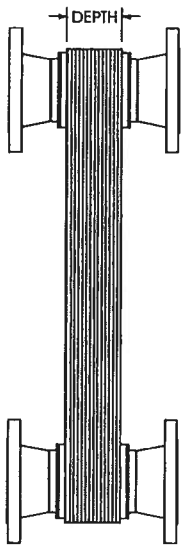
Ratings at Varying Conditions

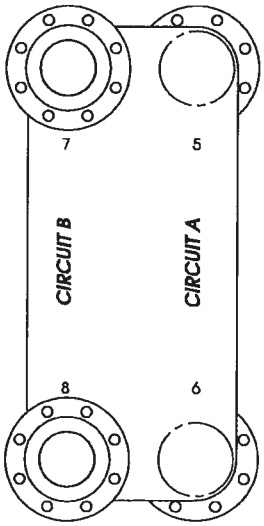
Percent difference	**-15%**	**-7½%**	**0%**	**7½%**	**15%**
Pressure drop (psi) (Side A)	0.5	0.5	0.5	0.5	0.5
Pressure drop (psi) (Side B)	0.8	1.0	1.1	1.3	1.5
Load (Btu/h)	696,749	696,749	696,749	696,749	696,749
Fluid flow rate (GPM) (Side A)	42.0	42.0	42.0	42.0	42.0
Fluid mass flow rate (lb/min) (Side A)	341.0	341.0	341.0	341.0	341.0
Fluid flow rate (GPM) (Side B)	**55.3**	**60.1**	**65.0**	**69.9**	**74.8**
Fluid mass flow rate (lb/min) (Side B)	461.4	502.3	543.3	584.2	625.2
Entering fluid temp. (°F) (Side A)	190.0	190.0	190.0	190.0	190.0
Entering fluid temp. (°F) (Side B)	155.0	155.0	155.0	155.0	155.0
Leaving fluid temp. (°F) (Side A)	156.0	156.0	156.0	156.0	156.0
Leaving fluid temp. (°F) (Side B)	182.1	179.9	178.1	176.4	175.0
Oversurface percent	-27.9	-12.5	0.8	12.6	23.3

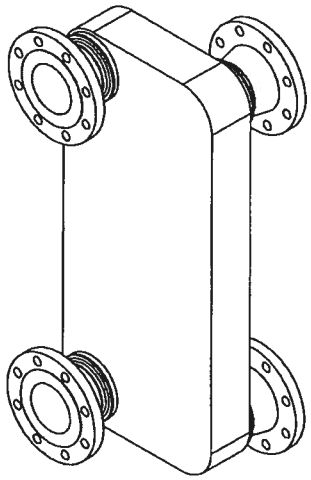
Disclaimer

DIMENSIONS ARE FOR REFERENCE ONLY.
DIMENSIONS ARE IN INCHES(MM).









INSTALLATION NOTES:

1. UNIT MUST BE INSTALLED IN VERTICAL POSITION. (ON REFRIGERATION APPLICATIONS ONLY).
2. FIELD INSTALLATION BY OTHERS.
3. PIPE IN COUNTERFLOW DIRECTION.
4. WATER CHILLER AND FLUID APPLICATIONS: WATER STRAINER (20-40 MESH) SHOULD BE INSTALLED SWEAT CONNECTION: USE 45% SILVER SOLDER

PRESSURE, TEMPERATURE AND CODES:

MAXIMUM ALLOWABLE WORKING PRESSURE: 300 PSIG (21 BAR)
MAXIMUM ALLOWABLE WORKING TEMPERATURE: 350°F (177°C)
APPROVALS: U.L. LISTED, US & CANADA, CRN
OPTIONAL: ASME SECT. VIII (U STAMPED)
EUROPE, PED 97/23/EC (CE)
PLATE MATERIAL: 316L STAINLESS STEEL
CONNECTOR MATERIAL: 304 STAINLESS STEEL
BRAZE ALLOY: COPPER

DEPTH: 0.9(23.0) + (0.093(2.35) X np)
np = NUMBER OF PLATES

CUSTOMER:			PROJECT:				SELECTION:	GEA PHE SYSTEMS NORTH AMERICA INC. PROPRIETARY INFORMATION	**SUBMITTAL DRAWING**
Paul Welsner			Tanana Wood Heat				NUD9C6Y7G	ALL RIGHTS RESERVED. THIS DRAWING MAY NOT BE COPIED, AND NO INFORMATION OR DATA CONTAINED WITHIN THE DRAWING MAY BE DISCLOSED, WITHOUT THE EXPRESS, WRITTEN RELEASE BY GEA PHE SYSTEMS NORTH AMERICA INC.	FP15X34 SERIES
MODEL NOMENCLATURE	1 OUTLET	2 INLET	3	4			WEIGHT		User: Paul Welsner Date: 1/8/2010
FP15x34H-90-FB (3" FLG)	3" FLG	3" FLG					339.0 lb (153.8 kg)		GEA
	5	6	7 INLET	8 OUTLET			DEPTH		
			3" FLG	3" FLG			9.29 [236.0]		

HeatTransfer
Advanced Heating and Hot Water Systems
120 Braley Road • P.O. Box 429 • East Freetown MA 02717 • 508 763 8071 • Fax 508 763 3769

Submit by Email | Print Form

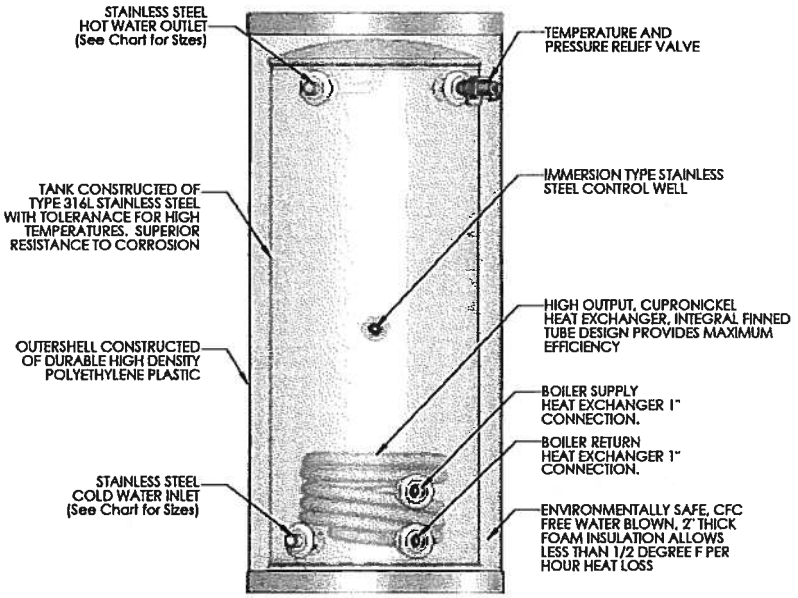
Water Heater HWM-1

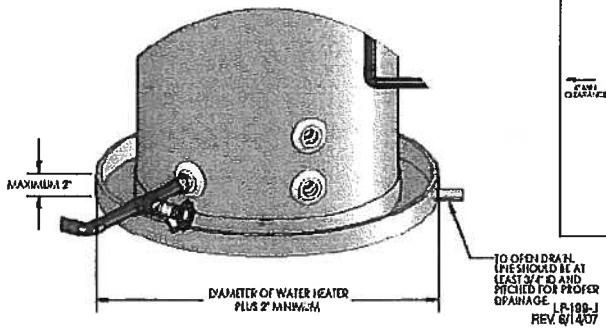
SUPERstor ULTRA

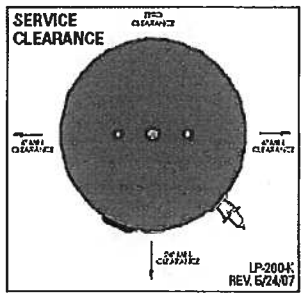
JOB NAME: Tanana Wood Heat Upgrade
LOCATION: Tanana Water Treatment Plant Mechanical Room
ARCHITECH/ENGINEER: Paul Weisner, P.E., CE2 Engineers
WHOLESALER:
MECH. CONTRACTOR:
MODEL NUMBER: SSU-45-DW (double walled heat exchanger)

Standard Features

- **Underwriters laboratory Listed File # E113265 per U.L. 174 and Canadian Standard C22.2 No. 110-M90**
- **Environmentally safe , CFC-Free Water Blown Foam Insulation 2" thick, allows less than ½ F degree per hour heat loss.**
- **Rated as ASME equivalent in Massachusetts**
- **High output Cupronickel Heat Exchanger**
- **NSF Listed Component**
- **Constructed of type 316L Stainless Steel**
- **Stainless steel Dip Tube Delivers 5 to 7% more hot water**
- **Limited Lifetime Protection Plan**







ULTRA RESIDENTIAL SERIES

MODEL	DIMENSIONS		CAPACITY	HEAT EXCH. SURFACE	RECOMM. FLOW RATE	PRESSURE DROP (FEET)	180° BOILER WATER FIRST HOUR RATINGS*		200° BOILER WATER FIRST HOUR RATINGS*	
	HT.	DIA.					140°F	115°F	140°F	115°F
SSU-20	27"	19 ¼"	20	15 SQ. FT.	8	6.0	121 gal	168 gal	136 gal	185 gal
SSU-30	39 ½"	19 ¼"	30	15 SQ. FT.	8	6.0	154 gal	212 gal	172 gal	234 gal
SSU-30LB	28 ½"	23 ¼"	30	15 SQ. FT.	8	6.0	169 gal	234 gal	189 gal	257 gal
SSU-45	52 ½"	19 ¼"	45	20 SQ. FT.	10	7.9	212 gal	292 gal	237 gal	322 gal
SSU-60	52 ½"	23 ¼"	60	20 SQ. FT.	10	7.9	266 gal	370 gal	298 gal	405 gal
SSU-80	72"	23 ¼"	80	34 SQ. FT.	12	9.1	330 gal	440 gal	370 gal	503 gal
SSU-119	73 ½"	27"	119	34 SQ. FT.	14	11.3	423 gal	564 gal	474 gal	645 gal

***DOE TEST METHOD BASED ON 90°F. TEMPERATURE RISE, 50°/140° W/ BOILER WATER AT 180°F**

TANK SIZE	FLOOR TO BOILER SUPPLY	FLOOR TO BOILER RETURN	FLOOR TO DOMESTIC OUT	DOMESTIC CONNECTIONS	TEST PRESSURE	WORKING PRESSURE	SHIPPING WEIGHT	180 BOILER BTU/SIZE	200 BOILER BTU/SIZE
SSU-20	9"	4 ½"	22"	¾ NPT MALE	300 PSI	150 PSI	60 LBS.	84,000	87,000
SSU-30	9"	4 ½"	34"	¾ NPT MALE	300 PSI	150 PSI	72 LBS.	102,000	117,000
SSU-30LB	9"	4 ½"	22"	¾ NPT MALE	300 PSI	150 PSI	79 LBS.	114,000	131,000
SSU-45	9"	4 ½"	46"	¾ NPT MALE	300 PSI	150 PSI	88 LBS.	141,000	161,000
SSU-60	9"	4 ½"	46"	1" NPT MALE	300 PSI	150 PSI	110 LBS.	174,000	198,000
SSU-80	29"	6"	64.75"	1 ½" NPT MALE	300 PSI	150 PSI	141 LBS.	212,000	241,000
SSU-119	30 ¼"	7 ¼"	66"	1 ½" NPT MALE	300 PSI	150 PSI	210 LBS.	269,000	301,000

NOTE: TANK RECOVERY FROM COLD START WILL BE BETWEEN 10-13 MINUTES WHEN SIZED WITH CORRECT FLOW RATE, BOILER SIZE, AND PRESSURE DROP RATINGS FROM LIST IN ABOVE CHART.

ULTRA COMMERCIAL SERIES

MODEL	DIMENSIONS		CAPACITY	HEAT EXCH. SURFACE	RECOMM. FLOW RATE	PRESSURE DROP (FEET)	180° BOILER WATER FIRST HOUR RATINGS*		200° BOILER WATER FIRST HOUR RATINGS*	
	HT.	DIA.					140°F	115°F	140°F	115°F
SSU-45C	42	23 ¼"	45	40 SQ. FT.	20	6.8	314 gal	414 gal	351 gal	477 gal
SSU-60C	52 ½"	23 ¼"	60	40 SQ. FT.	22	9.2	354 gal	467 gal	396 gal	539 gal
SSU-80C	72"	23 ¼"	80	68 SQ. FT.	24	10.0	490 gal	647 gal	548 gal	745 gal
SSU-119C	74"	27"	119	68 SQ. FT.	28	12.7	637 gal	841 gal	713 gal	970 gal

***DOE TEST METHOD BASED ON 90°F. TEMPERATURE RISE, 50°/140° W/ BOILER WATER AT 180°F**

TANK SIZE	FLOOR TO BOILER SUPPLY	FLOOR TO BOILER RETURN	FLOOR TO DOMESTIC OUT	DOMESTIC CONNECTIONS	TEST PRESSURE	WORKING PRESSURE	SHIPPING WEIGHT	180° BOILER WATER FIRST HOUR RATINGS* BTU/SIZE	200° BOILER WATER FIRST HOUR RATINGS* BTU/SIZE
SSU-45C	9"	4 ½"	35"	1 ¾" NPT MALE	300 PSI	150 PSI	99 LBS.	215,000	246,000
SSU-60C	9"	4 ½"	46"	1" NPT MALE	300 PSI	150 PSI	115 LBS.	245,000	270,000
SSU-80C	29"	6"	64.75"	1 ½" NPT MALE	300 PSI	150 PSI	141 LBS.	331,000	374,000
SSU-119C	30 ¼"	7 ¼"	66"	1 ½" NPT MALE	300 PSI	150 PSI	210 LBS.	425,000	490,000

NOTE: TANK RECOVERY FROM COLD START WILL BE BETWEEN 10-13 MINUTES WHEN SIZED WITH CORRECT FLOW RATE, BOILER SIZE, AND PRESSURE DROP RATINGS FROM LIST IN ABOVE CHART.

CONTINUOUS FLOW PERFORMANCE CALCULATION

FIRST HOUR RATING – (.75 x TANK CAPACITY) = CONTINUOUS FLOW

EXAMPLE: SSU-45C = 314 – (.75 x 45) = 280.25
(FHR) (CONTINUOUS FLOW)

Honeywell

T775 Series 2000 Electronic Stand-Alone Controllers

Heat Exchanger Temperature Control
HXCP-1

SPECIFICATION DATA

DESCRIPTION

The T775 electronic stand-alone controllers are the next generation of commercial and agricultural controls capable of remote sensing of temperature and providing switched and/or proportional outputs to various types of loads.

IMPORTANT

The T775 is an operating control, not a limit or safety control. If used in applications requiring safety or limit controls, a separate safety or limit control device is required.

FEATURES

- **Easy-To-Use Graphical Interface** Operating the new T775 is easy and the intuitive programming will save you time on every job. Each model includes a keypad lockout.
- **NEMA 4X Enclosure Option** Certain models are offered with NEMA 4X enclosures to protect them from water and corrosion for installations like washdown areas, animal confinement areas, swimming pools and other similar locations.
- **Internal Time Clock Scheduler** The Setback and Disable Output options, controlled by the built-in scheduler or digital input, will help save energy during unoccupied times and give you more control of the equipment without needing to purchase an additional time clock. Run times can be displayed for the first 4 relay outputs.
- **Up To Two Independent Modulating Outputs** Each output can be individually configured for 0-10 Vdc, 2-10 Vdc, 4-20 mA or Series 90.
- **Modulating High Or Low Limit Control** To protect your equipment from freezing or overheating, models offering this feature give you the ability to adjust your control temperature at Sensor A to protect equipment at Sensor B. The control adjusts its modulating output to prevent exceeding the user-entered High or Low limit for Sensor B.
- **Optional Configurable Integral And Derivative Times** Standard on every device, this feature delivers pinpoint (PI or PID) control on modulating outputs set up by default to behave just like the previous T775 Series 1000, but now you can adjust reaction times and behavior, giving you more control. Anti-integral wind-up is standard.
- **Reset Models With Simplified Setup** Reset programming is easy. Simply enter the high and low control temperatures and the corresponding high and low outdoor temperatures. As your outside temperature gets colder, the setpoint temperature automatically adjusts to save energy.
- **Configurable Minimum Off Time** If needed, setting a minimum off time can protect equipment and reduce the need for a separate time delay device.
- **Sensor Calibration** Calibrate input sensors up to +/-10° F (+/-6° C) for temperature and up to +/-10% of range for other sensors (e.g. pressure, humidity) to compensate for resistance drops in longer sensor wire runs.
- **Special Models** Five T775 models are available for special applications:
  - **Universal Models (T775U2006 and T775U2016)** to control pressure, humidity, or any medium with an analog input
  - **Special Boiler Model (T775P)** for boiler control
  - **Special Staged Sequencing Model (T775L)** for sequence staging of relays with one or two setpoints
  - **Special Expansion Model (T775S)** for staging up to 12 relays with two setpoints

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E4436

63-1318-03

SPECIFICATIONS

Power: 24, 120, or 240 Vac; 50/60 Hz
A separate earth ground is required for any power source.

Power Consumption:
- 8 VA maximum at 60 Hz
- 10 VA maximum at 50 Hz

Operating & Storage Temperature Ambient Rating:
- -40°F to 125°F (-40°C to 52°C) @ 50 Hz
- -40°F to 140°F (-40°C to 60°C) @ 60 Hz

Relative Humidity: 5% to 95% non-condensing

Dimensions: refer to Fig. 1 on page 4.
All T775 controllers are field-mountable in any orientation to either a panel or wall.

Digital Input (DI): 18 Vdc and 3.5 mA (for choosing external contact)

Digital Output (DO) Alarm (T775P only):
- Alternating Current (AC):
  - — 30 Vac RMS; 1.5 A steady 3 A inrush P.F. 0.45 NC
  - — 20 Vac RMS; 100 mA minimum load on NO and NC contacts
- Direct Current (DC): 1 mA at 100 mV DC minimum load

NOTE: In applications requiring a gold contact signal relay, an external signal relay or additional load resistor may be needed for the digital output.

Relay Contact Output Ratings (N.O. and N.C.):
- 1/2 hp; 9.8 AFL, 58.8 ALR @ 120 Vac
- 1/2 hp; 4.9 AFL, 29.4 ALR @ 240 Vac
- 125 VA pilot duty @ 120/240 Vac
- 10A @ 24 Vac (resistive)

Modulating Outputs:
- 0-10 Vdc; drive a minimum of 2,000 Ohms
- 2-10 Vdc; drive a minimum of 2,000 Ohms
- 4-20 mA; drive a maximum of 600 Ohms
- Electronic Series 90; requires 340 Ohm resistor (included) across terminals R and W
- Floating

Sensed Temperature Limits (displayed):
- Minimum -60°F (-51°C)
- Maximum 270°F (132°C)

High Setpoint Limit: An irreversible high limit setpoint can be configured to meet local code requirements.

Sensed Temperature Accuracy:
- T775: 1°F/C @ ambient room temperature of 77°F (25°C)
- 50021579-001 and T775-SENS-WR: ±0.42°F from -22°F to 248°F (+/-.24°C from -30°C to 120°C)

Setpoint Range: -40°F to 248°F (-40°C to 120°C)

Time Clock: Two settable time periods per day are standard on all models.

Volatile Memory: The date and time settings are retained for 24 hours after a power outage. After a power loss of more than 24 hours, the date and time settings may need to be reentered. All other settings are stored permanently.

Approvals: UL 60730-1 for US and Canada, CuL, CE, C-tick

COMPATIBLE COMPONENTS

Temperature Sensors[a]

The controller accepts 1,097 Ohms PTC at 77°F (25°C):
- 50021579-001 – Standard sensor (included with all models except NEMA 4X models)
- T775-SENS-STRAP – Strap on sensor with wiring box
- T775-SENS-WR – Water resistant with 5 foot leads (included with NEMA 4X models)
- T775-SENS-WT – Watertight with 6 foot lead
- T775-SENS-OAT – Outdoor air temperature sensor
- C7031D2003 – 5 inch immersion sensor with wiring box (use immersion well; P/N 50001774-001)
- C7031J2009 – 12 foot duct averaging sensor with wiring box
- C7046D1008 – 8 inch duct probe with mounting flange
- C7100D1001 – 12 inch fast response, duct averaging sensor with flange
- C7130B1009 – Room mount sensor

Humidity Sensors (T775U only)

The controller accepts 0-10 Vdc or 4-20 mA input with a range of 0-100%

H7625, H7635, and H7655 models (available in 2, 3, and 5% RH accuracy) can be used.

Differential Pressure Sensors (T775U only)

P7640A and PWT pressure transducer models with selectable pressure ranges can be used.

The controller accepts pressure sensors with a signal output of 0-10 Vdc or 4-20 mA for any output range within the following ranges (the minimum and maximum for the sensor output range can be adjusted within the following limits):
- -500 to 500 PSI
- -30.0 to 30.0 inches w.c.
- -3,000 to 3,000 Pa
- -3,000 to 3,000 kPa

Universal Sensors (T775U only)

The controller accepts 0-5 Vdc, 0-10 Vdc or 4-20 mA input for temperature, pressure, humidity, etc. They may be programmed in units of °F, °C, %, Pa, kPa, PSI, Inches W.C., PPM, or None (no units). CO_2 sensors (C7232 and C7632) are also compatible.

Actuators

For more information on compatible actuators or other Honeywell products, such as dampers and valves, go to www.customer.honeywell.com. From the home page select **Product Selection Tool** under **Products**.
- Spring return models: ML6425, ML7425, MS4105, MS4110, MS4120, MS7505, MS7510, MS7520, MS8105, MS8110, MS8120
- Non-spring return models: ML6161, ML6174, ML7161, ML7174, MN6105, MN6110, MN7505, MN7510

Accessories

- 107324A – Bulb Holder, duct insertion
- 107408 – Heat Conductive Compound, 4 ounce
- 50001774-001 – Immersion Well, stainless steel 304, 1/2 in. threading

[a] See form 62-0265 – *Temperature Sensors for the T775 Series 2000 Stand-alone Controller*

Table 1. T775 Controller Configurations.

Controller Model [a]	Description	Replaces	Output Reset	SPDT Relay Outputs	Analog (Mod) Outputs[b]	DO[c]	Floating Outputs[d]	Sensor Inputs	Nbr of Sensors Included	Staged Loop Control	Addable T775S	Enclosure
T775 A/B/M/R Controller Configurations												
T775A2009	Standard	T775A1001	No	1	None	N/A	None	1	1	N/A	N/A	NEMA 1
T775B2016	Standard	N/A	No	2	None	N/A	1	2	1	N/A	N/A	NEMA 4X
T775B2024	Standard	T775C1009 T775D1008	No	4	None	N/A	2	2	1	N/A	N/A	NEMA 4X
T775B2032	Standard	T775A1019 T775B1000	No	2	None	N/A	1	2	1	N/A	N/A	NEMA 1
T775B2040	Standard	T775A1027 T775A1035 T775B1018 T775B1026 T775B1042	No	4	None	N/A	2	2	1	N/A	N/A	NEMA 1
T775M2006	Modulating	N/A	No	None	2	N/A	None	2	1	N/A	N/A	NEMA 1
T775M2014	Modulating	T775G1005 T775G1013 T775G1021 T775G1039	No	4	2	N/A	None	2[e]	1	N/A	N/A	NEMA 4X
T775M2022	Modulating	N/A	No	2	2	N/A	None	2[e]	1	N/A	N/A	NEMA 4X
T775M2030	Modulating	T775E1114 T775F1022 T775F1055 T775F1089	No	4	2	N/A	None	2[e]	1	N/A	N/A	NEMA 1
T775M2048	Modulating	T775E1015 T775E1023 T775E1056 T775E1064 T775E1098	No	2	2	N/A	None	2[e]	1	N/A	N/A	NEMA 1
T775R2001	Reset Option	N/A	Yes	4	None	N/A	2	2	2	N/A	N/A	NEMA 1
T775R2019	Reset Option	N/A	Yes	4	2	N/A	None	2	2	N/A	N/A	NEMA 1
T775R2027	Reset Option	T775J1043 T775J1050 T775J1068	Yes	2	2	N/A	None	2	2	N/A	N/A	NEMA 1
T775R2035	Reset Option	T775J1001 T775J1076	Yes	2	None	N/A	1	2	2	N/A	N/A	NEMA 1
T775R2043	Reset Option	T775J1019 T775J1027 T775J1035	Yes	None	2	N/A	None	2[e]	2	N/A	N/A	NEMA 1
T775 L/P/U/S Special Application Controller Configurations												
T775L2007[f]	Stage Sequencer with Reset	N/A	Yes	4[g]	None	N/A	None	2	1	Yes	Yes	NEMA 1
T775P2003	Boiler Model with Reset[h]	N/A	Yes	4	None	1	None	3	3	Yes	Yes	NEMA 1
T775U2006	Universal Humidity, Pressure, Temperature, etc.	H775A1006 H775A1022 H775A1048 H775A1063 H775B1005 H775C1004 H775D1003 H775E1002	Yes	2	2	N/A	None	2[i]	None	N/A	N/A	NEMA 1
T775U2016		N/A	Yes	2	2	N/A	None	2[i]	None	N/A	N/A	NEMA 1
T775S2008	4-Relay Expansion Module[k]	N/A	N/A	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NEMA 1

a All models include a digital input for use with the disable or setback option.

b The modulating (analog) outputs are 4-20 mA, 0-10 Vdc, 2-10 Vdc, or Series 90 selectable.

c Digital Output alarm (low voltage) available only on the T775P model. The Digital Output alarm can be configured based on minimum, maximum, or differential temperature.

d Each floating output eliminates two SPDT relays.

e For the models noted above, Sensor B can support a high/low modulating limit for temperature control at Sensor A.

f The T775L model can be used to stage multiple relays from two independent heat or cool setpoints. The number of stages for each setpoint can be freely chosen, limited by the number of relays available (up to 12 using two T775S expansion modules). For example, programming could be (3 heat - 4 cool), (5 heat - 1 cool), etc. In addition to the two staged loops, an additional two relays can be available for independent on-off control.

g For the T775L model, the maximum number of non-sequenced relays is two (2) with each having its own setpoint and its own throttling range. These relays are available if they are not being used by the staged relay loops.

h The T775P model provides an optional Pump Output using the last SPDT relay output (4th, 8th, or 12th depending on configuration). Stages can be configured for either standard, first-on first-off, or equal run time.

i For the T775U2006 sensor inputs, Sensor A can be 0-5 Vdc, 0-10 Vdc, 4-20 mA, or a standard temperature input. Sensor B is a standard temperature sensor input only. Sensor B is used only for reset on the T775U2006.

j The T775U2016 can control Sensor A (universal) and Sensor B (temperature) independently, like other standard T775 controllers.

k Up to two T775S expansion modules can be used with the T775L and T775P models to provide a total of 8 or 12 stages.

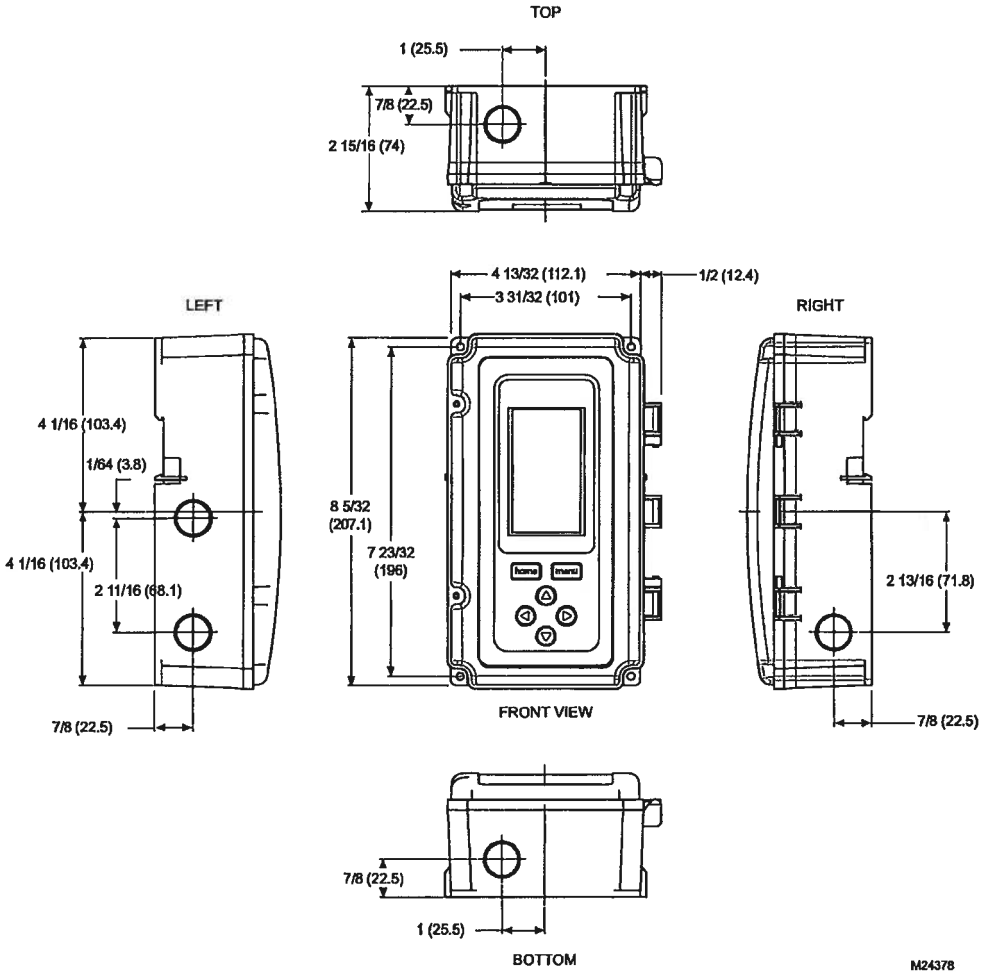

Fig. 1. T775 Dimensions in inches (mm).

Automation and Control Solutions

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Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
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Honeywell

63-1318—03 M.S. Rev. 02-09

Control Valve CV-1

Honeywell

V5013N
Three-Way Threaded Globe Valve

The V5013N is a three-way threaded globe valve for control of hot water, cold water, and glycol solutions (up to 50 percent concentration) in heating or cooling HVAC applications. The valve is used for mixing service to direct flow from one of two inlets to a common outlet in two-position or modulating control systems.

SPECIFICATION DATA

FEATURES

- **Red brass body with NPT-threaded connections.**
- **Stainless steel stem and brass plug.**
- **Low seat leakage rate (≤0.05 percent of C_v).**
- **50:1 rangeability per VDI/VDE 2173.**
- **Spring-loaded, self-adjusting packing.**
- **Constant total flow throughout full stem travel.**
- **Accurate positioning to ensure state of the art temperature control.**
- **Sizes range from 1/2 in. to 2 in.**
- **Suitable for pneumatic or electric/electronic actuation.**
- **Repack and rebuild kits available for field servicing.**

SPECIFICATIONS

Models:
- V5013N Valve: Three-way mixing valve for water and glycol. NPT-threaded pipe connections. Constant total flow. Push down valve stem to close bottom (B) port.

Valve Sizes and Flow Capacities:

Size (in.)	Capacity (C_v)
1/2	2.9
	4.7
3/4	7.3
1	11.7
1-1/4	18.7
1-1/2	29.3
2	46.8

Pipe Connections:
- Female NPT-threaded connections.

Seat:
- 1/2 in.: Replaceable stainless steel upper, replaceable brass lower.
- 3/4 in. to 2 in.: Integral brass upper, replaceable brass lower.

ANSI Body Class:
- 150 psi.

Stem:
- Stainless steel.

Plug:
- Brass.

Stroke:
- 3/4 in. (20 mm).

Approximate Leakage Rate:
- 0.05 percent C_v.

Body Material:
- Red brass.

Packing:
- Spring-loaded, carbon fiber reinforced PTFE V-rings.

Pressure-Temperature Body Ratings:
- Water:
  - 36°F to 248°F, 217 psi (15 bar).
  - 248°F to 337°F, 185 psi (12.8 bar).
  - Maximum water differential pressure: 230 psid (15.8 bar).

Valve Flow Characteristics:
- Equal percentage port A-AB, linear port B-AB. Movement of the valve stem at any point of the flow range does not significantly change the total flow rate at the AB outlet port (constant total flow).

Close-Off Pressure Ratings:
- Refer to the product data, 63-2549.

Maximum Pressure Differential for Quiet Water Service:
- 20 psi differential.

Rangeability:
- 50:1 per VDI/VDE 2173.

Motor and Linkage Selection:

Electric	Pneumatic
ML6421/ML6425	MP953C (5 and 8 in.)
ML7421/ML7425	MP953E (5 and 8 in.)
ML7984/ML6984	—
Modutrol IV with Q5001	—
Damper DCA with Q5020	—

ACCESSORIES

Stem Button:
❑ 0901116

Repack Kits:
❑ 0901786 for 1/4 in. stems (1/2 in. through 1-1/4 in. valves).
❑ 0901787 for 3/8 in. stems (1-1/2 in. through 2 in. valves).

Rebuild Kits:
❑ Refer to V5013N Three-Way Threaded Globe Valve Product Data, form 63-2549.

TYPICAL SPECIFICATIONS

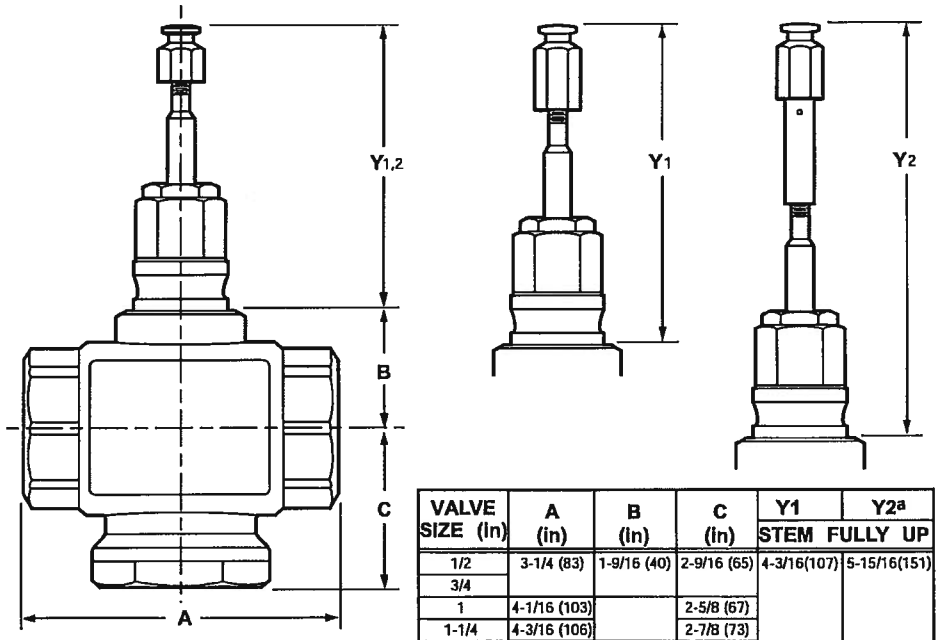
Automatic control valves shall have NPT threaded type fitting, 1/2 in. through 2 in. sizes, and shall be ANSI-rated to withstand the pressures and temperatures encountered.

Valves shall have metal-to-metal seats, stainless-steel stems, and replaceable spring-loaded reinforced carbon filled teflon packing.

Valves shall have a leakage rate of 0.05% C_v or less. Valves shall have a 50:1 rangeability or better.

All three way water valves shall be provided with throttling plugs such that the total flow through the valve remains constant regardless of the valves position.

Dimensions:



VALVE SIZE (in)	A (in)	B (in)	C (in)	Y1 STEM FULLY UP	Y2[a] STEM FULLY UP
1/2	3-1/4 (83)	1-9/16 (40)	2-9/16 (65)	4-3/16(107)	5-15/16(151)
3/4					
1	4-1/16 (103)		2-5/8 (67)		
1-1/4	4-3/16 (106)		2-7/8 (73)		
1-1/2	4-3/4 (120)	1-13/16 (46)	3-1/16 (77)		
2	5-1/4 (134)		3-5/16 (84)		

[a] Y_2 WITH STEM EXTENSION FOR MP953C,E (8 IN. ONLY)

M17379A

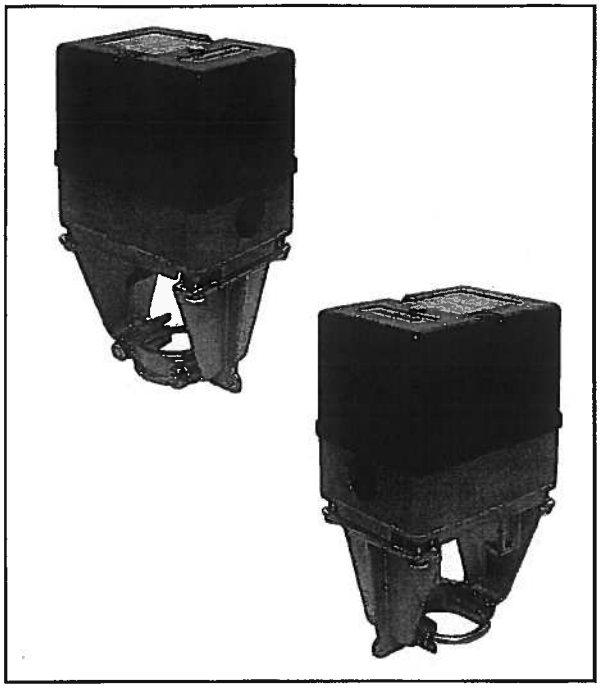
Honeywell

Honeywell

operator for control valve CV-1

ML6984, ML7984 Series 4000 Direct Coupled Valve Actuators

PRODUCT DATA



FEATURES

- **Self-contained, motorized globe valve linkage.**
- **Microprocessor-based digital position sensing and motor control for accurate positioning.**
- **Compact size for easy installation in confined spaces.**
- **NEMA 3R rain-proof cover for outdoor installation.**
- **Self-calibrating for valve stroke from 1/2 in. (13 mm) to 1 in. (25 mm).**
- **DIP switch input configuration selection.**
- **LED (light-emitting diode) status indication.**
- **Configurable to 3-wire mode for floating models.**
- **710 N 160 lbf (712 N) valve closing force.**
- **Usable with common transformer power supply for multiple actuators and controllers.**
- **24 Vac or 28 Vdc power supply.**
- **Field-addable position feedback/auxiliary switch module available for 5-wire models.**

APPLICATION

The ML6984 and ML7984 are self-contained, self-adjusting, motorized valve actuators that mount directly onto V5011 two-way and V5013 three-way globe valves, providing linear stem operation between 1/2 in. (13 mm) and 1 in. (25 mm).

ML6984 is for use with low voltage SPDT Series 20, Series 60 (on-off), or SP3T Series 60 (floating) electro-mechanical and electronic controllers.

ML7984 is for use with Series 70 0-10 Vdc, 2-10 Vdc, 4-20 mA; electronic Series 90 "SuperMod"; and 135 ohm modulating controllers.

Contents

95C-10939—6

SPECIFICATIONS

IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, an individual unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions and some minor differences in performance can be expected if those conditions are changed.

Operating Environment:
Operating Ambient Temperature: 32° to 130° F (0° to 54° C) measured at the actuator.

Shipping Temperature: -40° to 150° F (-40° to +65° C).

Relative Humidity: 15% to 95% up to 104° F (40° C), non-condensing atmosphere NEMA-3R/IP54 cover for outdoor installation.

Acoustic Noise:
55 dBA maximum Sound Pressure Level at 39 in. (991.0 mm) distance.

Electrical Ratings:
Power supply/consumption:
24 V (+10%, -15%), 50/60 Hz or 28 Vdc +/- 10%, 6 VA (Running), 12 VA (Valve seating).

Specifications/CE Declaration:
ML6984 and ML7984 actuators conform to the essential requirements of the Low Voltage Directive 73/23/EEC based on the standards EN 60730-1:2000 and EN 60730-2-14:1995+A1:2001

Inputs:
ML6984 - 25 mA 24 Vac (5-wire mode only)
- 500 mA (valve seating 3-wire mode)
- Minimum Signal Input Duration: 100 ms

ML7984* - 2 -10 Vdc (1 mA); 4-20 mAdc

*May be used with 0-10 Vdc input but valve will be closed at 2 Vdc.

Input Impedance for the ML7984:
Voltage Source — 20 KW ohm
Current Source — 237 ohm

Shipping Weight:
Approx. 2.2 lbs (1 kg).

Accessories/Parts:
272629A - Mounting adapter for V5045 valves.

272630D - Electronic position feedback low voltage auxiliary switch.

272822 - Resistor kit for multiple actuator Series 90 application and for ML7984 to replace the old ML784 (4-20 mA).

272775 - Replacement motor brush kit.

40003793-005 - Mounting hardware bag assembly.

Mechanical Ratings:
Stroke — Between 1/2 in. (13 mm) and 1 in. (25 mm), self-adjusting.
Bonnet — 1 3/8 in. (35 mm) for V5011/13 valves up to 3 in. (76 mm)(DN80).
Stem Coupling — 1/4-28 UNF thread.
Stroke Timing — Nominal 63 seconds for 3/4 in. (19 mm) stroke.
— Proportional to stroke length at 24 Vac.
Closing Force — 710 N (160 lbf) minimum at 24 Vac.
— Force varies 22 N/V (5 lbf/volt).

Performance Specifications:
Life Expectancy — (at rated load and power conditions) 50,000 full stroke cycles plus 1,000,000 repositions of 10% stem travel or 10 years, whichever occurs first.

Hysteresis — 5%

Table 1. Close-off Pressure Ratings for ML6984/7984 Series with Honeywell Globe Valves, psid.

Type	Valve Family	1/2 in.	3/4 in.	1 in.	1-1/4 in.	1-1/2 in.	2 in.	2-1/2 in.	3 in.
Flange	V5011A	--	--	--	--	--	--	33 (228)	19 (131)
	V3350/51; V3450/51	--	--	--	--	--	--	25 (172)	17 (117)
	V5013B, C; V3360/61; V3460/61	--	--	--	--	--	--	25 (172)	17 (117)
NPT	V5011F, G*	150 (1034)	150 (1034)	150 (1034)	150 (1034)	91 (627)	58 (400)	33 (228)	19 (131)
	V5011H, J	150 (1034)	150 (1034)	150 (1034)	150 (1034)	--	--	--	--
	V5011N*, V5013N	230 (1586)	230 (1586)	193 (1331)	123 (848)	79 (545)	44 (303)	--	--
	V5011N2xxx Steam	100 (689)	100 (689)	100 (689)	100 (689)	79 (545)	44 (303)	--	--
	V5011G Steam	100 (689)	100 (689)	100 (689)	100 (689)	91 (627)	58 (400)	33 (228)	19 (131)
	V5013F	150 (1034)	150 (1034)	150 (1034)	149 (1027)	91 (627)	58 (400)	--	--

*** Do not exceed 100 psid with valves used in steam applications.**

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Toronto, Ontario, M1V 4Z9.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, United Kingdom, U.S.A.

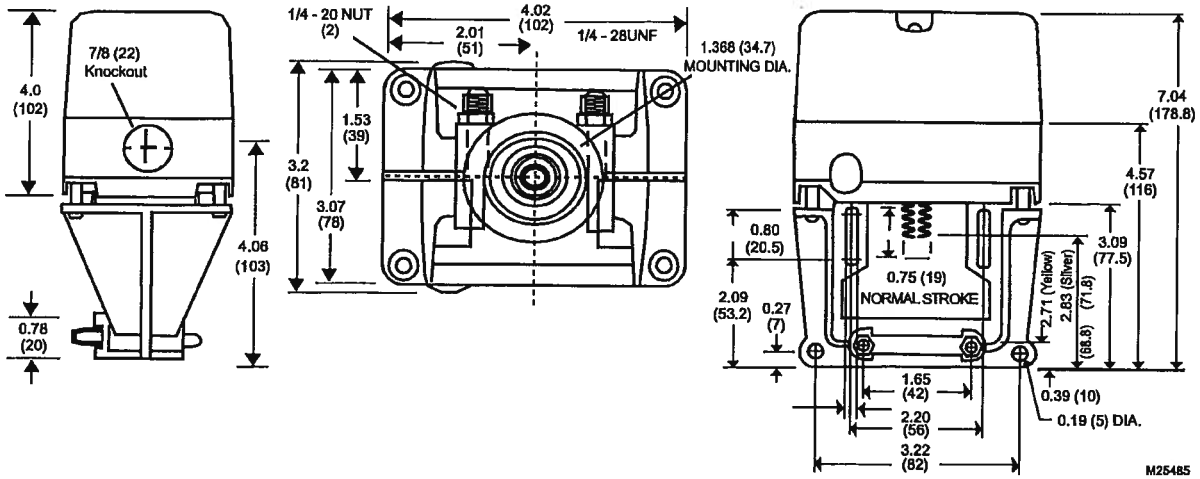


Fig. 1. ML6984 Valve Actuator Dimensions, in. (mm).

INSTALLATION

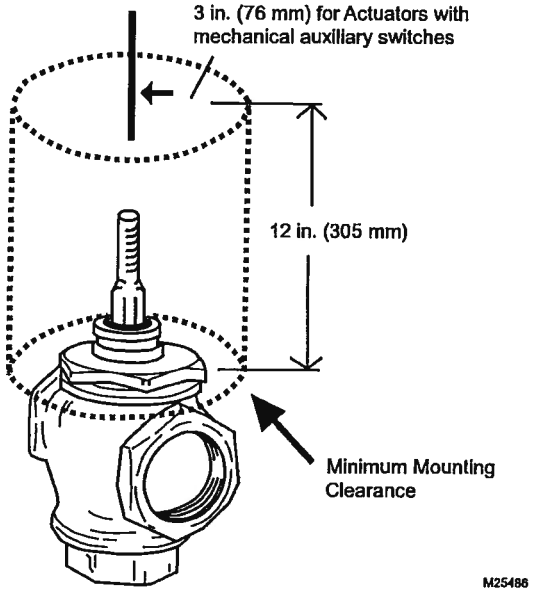


Fig. 2. Minimum Mounting Clearance.

⚠ CAUTION

Short and rapid cycling/repositioning may result in possible switch device lock-up or reduced service life.

When Installing This Product...

1. Read these instructions carefully. Failures to follow them could damage the product or cause a hazardous condition.
2. Check ratings given in instructions and on the product to ensure the product is suitable for your application.
3. The installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.
5. DO NOT electrically operate the actuator before assembly to the valve because damage not apparent to the installer may occur.

IMPORTANT

Before installing the valve, raise and lower the valve stem to make sure that the valve stem operates freely. Impaired stem operation can indicate that the stem was bent by rough handling. This condition can require repair or replacement of the valve.

Protect the stem from damage due to bending or scratching. Damage to the stem packing may result.

Proper Use:

Valves are to be installed by skilled personnel and in strict accordance with installation instructions and local regulations. Honeywell assumes no responsibility for damages or injuries resulting from non-compliance with installation instructions or standard good practice when mounting, operating, or maintaining the valves, even if not explicitly mentioned in the installation instructions. Observe all safety practices when working with steam systems.

Mounting:

1. Ensure that valve body is installed correctly, arrow pointing in the direction of flow.
2. Actuator can be mounted in any position; however, it is preferable that it is mounted above the horizontal plane of the pipe. This minimizes the risk of damage to the actuator in the event of condensation or valve gland leak. When controlling steam, rotate the valve body with the actuator beside the valve to avoid exceeding ambient temperature limits of the actuator. For the same reason, do not mount ML Actuators to steam valves in enclosed cabinets. For on-off control of steam in small pipe sizes, Honeywell recommends V8043J zone valves.

NOTE: NEMA 3R rainproof rating only applies to actuators mounted vertically. Cover has been treated with UV stabilizers for outdoor applications. Weather-proof conduit fittings approved for outdoor and wet locations must be used to maintain NEMA 3R rating.

3. Remove stem button (Fig. 3) from valve stem.
4. (Optional) Snap red position indicator (metal clip) over valve stem and position for best visibility (Fig. 3). Indicator will self-align to the marking on yoke after complete operating cycle. It is recommended that this is done after actuator installation.

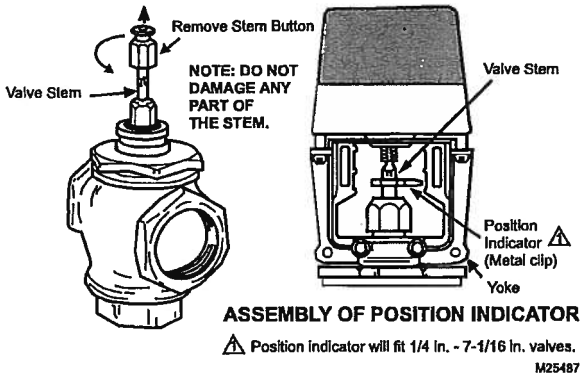


Fig. 3. Preparation for Valve Assembly.

Assembly of MLx984 Actuator to the Valve:

1. The drive shaft of the MLx984 Actuator has a 1/4-28 UNF threaded hole to link with the valve stem. Slide the yoke over the valve bonnet (Fig. 4).
2. Thread the MLx984 Actuator drive shaft onto the valve stem all the way, until it is completely attached (with no threads showing), by turning the valve actuator in a clockwise direction, as viewed from above. Depending on the valve body, use a pin or wrench to keep valve stem from turning. Note that the valve actuator is shipped with drive shaft in the mid-position.
3. Care should be exercised when using tools on the valve stem during tightening (Fig. 4). DO NOT damage the threads or other parts of the stem.
4. Orient the conduit hole to the most desirable direction, then tighten the LOCKNUTS on the U-bolt.
5. Remove the plastic cover from the MLx984 by loosening the two captive screws located on the top. Drop the Allen (Hex) type of set screw (included in the plastic bag) into the top of the shaft, hex side up.
6. **Tighten the set screw to lock valve stem in place** (Fig. 6), using a 1/8 in. Allen wrench (included).

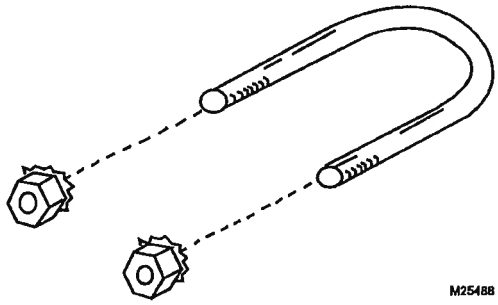


Fig. 4. U-bolt Assembly.

NOTE: Use U-bolt supplied with actuator. Do not replace with stainless steel U-bolt on chilled water valves. Condensation may cause corrosion of yoke with SS U-bolt.

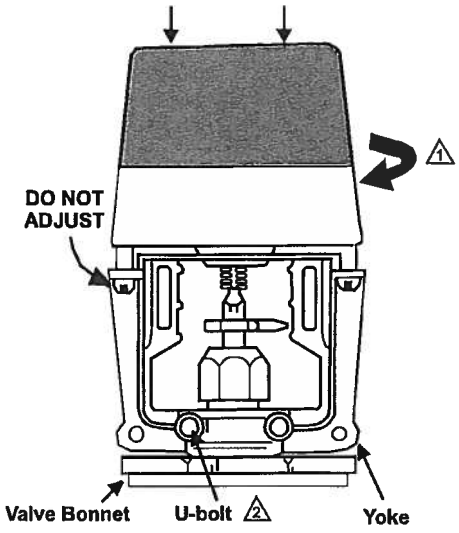


Fig. 5. Assembly of MLx984A to Valve.

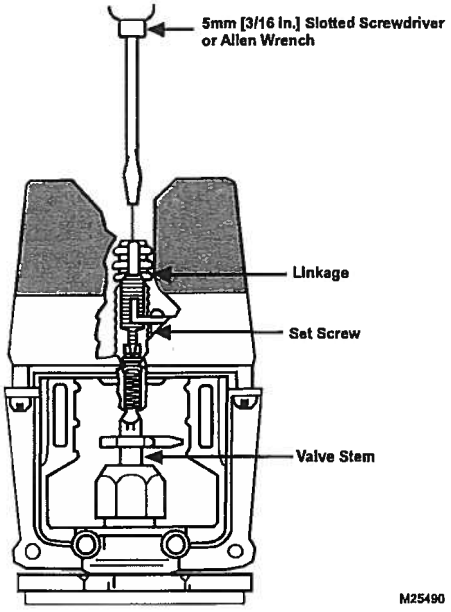


Fig. 6. Locking MLx984A Drive Shaft to Valve Stem.

⚠ CAUTION

For proper valve operation, valve stem must be threaded into the actuator all the way (with no threads showing) and locked in place with the set screw provided.

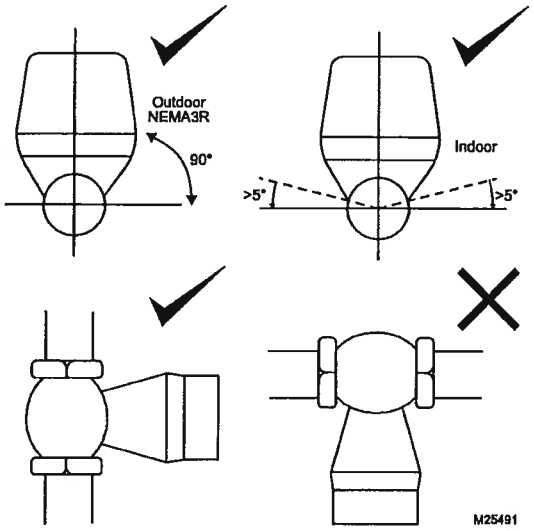


Fig. 7. Mounting Positions.

WIRING SCHEMATICS

MLx984 actuators are designed to operate from a Safety Extra Low Voltage, Class II power source. A 7/8 in. (22 mm) wiring hole is provided for attaching flexible conduit where required by local codes. When installing outdoors, weatherproof conduit fittings approved for outdoor and wet locations must be used.

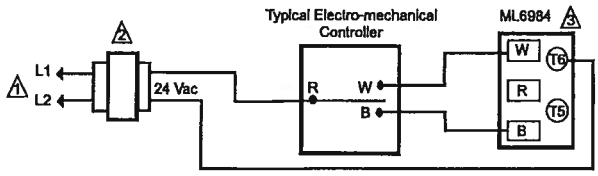
⚠ CAUTION

Electrical Shock or Equipment Damage Hazard.
Can Shock Individuals or Short Equipment Circuitry.
Disconnect power supply to the actuator to prevent electrical shock and equipment damage, or remove and cap the air line to the actuator.

NOTE: In all cases when wiring multiple actuators, the power supply to all actuators must be connected in a "star" fashion to reduce excessive voltage drop. DO NOT "daisy chain" i.e. connect power to one actuator then branch to another.

Operation:

The recommended valve actuator power source is a Safety Extra-Low Voltage (SELV) Class II, 24 V transformer or regulated 28 Vdc across terminals T5 and T6. Internal circuitry provides dc power for the electronic sensing and drive motor circuits.

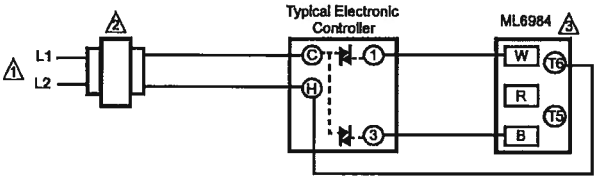


⚠1 POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.

⚠2 ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER, PROVIDED THAT THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.

⚠3 CONTROLLER CAN BE LOW VOLTAGE SPDT SERIES 20 "ON-OFF" OR SP3T SERIES 60 "FLOATING" (TRI-STATE) TYPE. TERMINALS R AND T5 ARE CONNECTED INSIDE THE ML6984. M25492

Fig. 8. 3-Wire Control of ML6984 with Series 60 Controller.



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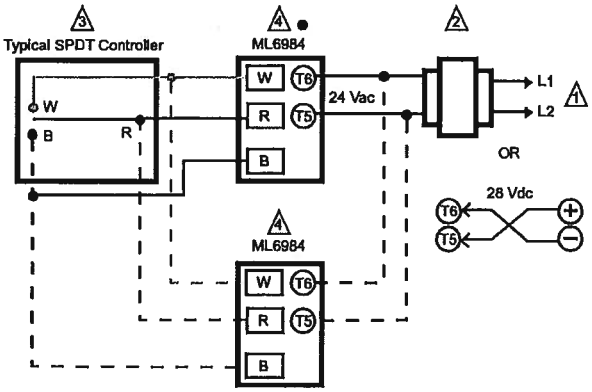
⚠3 CONTROLLER CAN BE LOW VOLTAGE SPDT SERIES 20 "ON-OFF" OR SP3T SERIES 60 "FLOATING" (TRI-STATE) TYPE. TERMINALS R AND T5 ARE CONNECTED INSIDE THE ML6984. M25493

Fig. 9. 3-Wire Control of ML6984 with Electronic Controller.



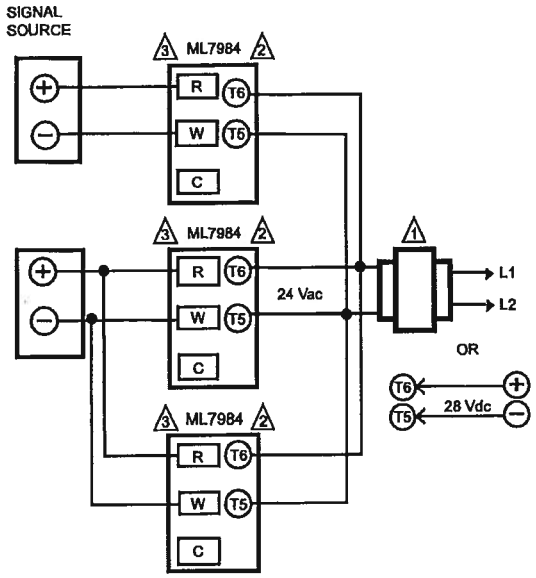
⚠1 POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.

⚠2 ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER, PROVIDED THAT THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.

⚠3 CONTROLLER CAN BE LOW VOLTAGE SPDT SERIES 20 "ON-OFF" OR SP3T SERIES 60 "FLOATING" (TRI-STATE) TYPE. TERMINALS R AND T5 ARE CONNECTED INSIDE THE ML6984.

⚠4 MULTIPLE ACTUATORS CONTROLLED BY A COMMON CONTROLLER IN PARALLEL MUST BE WIRED SO THAT THEY ALL TRAVEL IN THE SAME DIRECTION. REVERSE ACTING ACTUATORS WILL NOT OPERATE RELIABLY IN COMBINATION WITH DIRECT ACTING UNITS DUE TO GEARBOX TOLERANCES. USE ML7984 MODULATING ACTUATORS, OR DEDICATED CONTROLLERS, OR SEPARATE CONTROLLER OUTPUTS FOR EACH GROUP INSTEAD. M25494

Fig. 10. 5-Wire Control of ML6984.

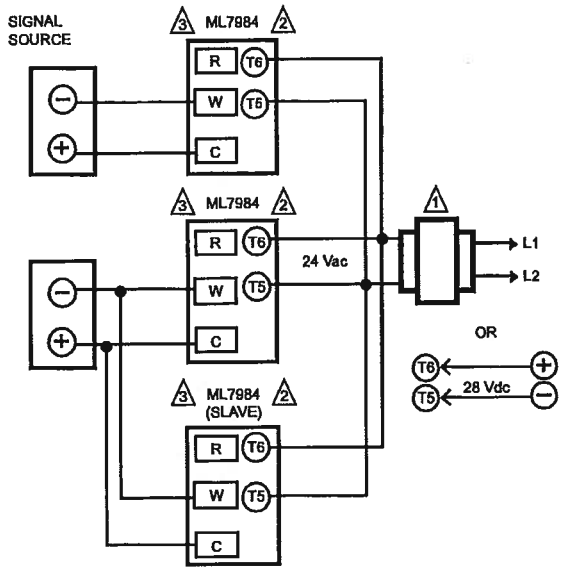


FUNCTION	DIP SWITCH CONFIGURATION
1000 2-10 Vdc Direct Acting	On (1) Off (0) 1 2 3 4
1010 10-2 Vdc Reverse Acting	On (1) Off (0) 1 2 3 4

1. POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.
2. ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER PROVIDING THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.
3. IN ML7984, "T5" AND "W" TERMINALS ARE CONNECTED INTERNALLY. DEVICE IS COMPATIBLE WITH 3 CONDUCTOR WIRING.
4. USE CONFIGURATION DIP SWITCHES TO SELECT DEVICE FUNCTIONS: DIRECT ACTING FUNCTION (ACTUATOR STEM MOVES DOWNWARDS WITH SIGNAL INCREASES TO 10V/20MA) OR REVERSE ACTING FUNCTION (ACTUATOR STEM MOVES UPWARDS WITH SIGNAL INCREASES TO 10V/20MA).
5. ALWAYS TURN POWER OFF BEFORE SETTING ANY DIP SWITCHES.

M25495

Fig. 11. ML7984 Wiring with 10 Vdc Analog Control Signal.

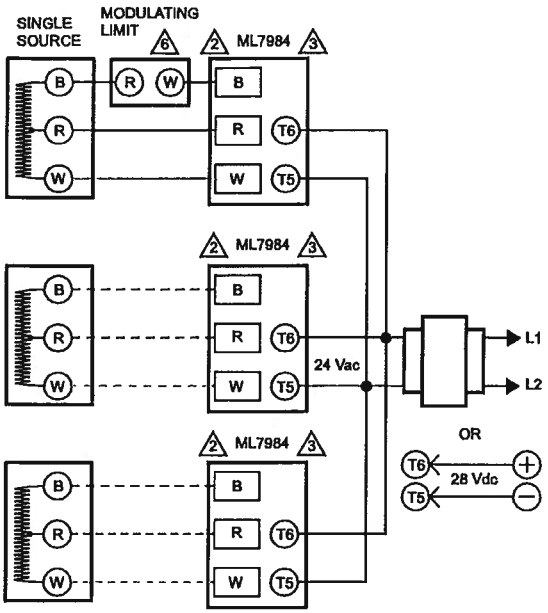


FUNCTION	DIP SWITCH CONFIGURATION
X000 4-20 mA Direct Acting	Master actuator → ← Slave actuator On (1) Off (0) 1 1 2 3 4
X010 20-4 mA Reverse Acting	Master actuator → ← Slave actuator On (1) Off (0) 1 1 2 3 4

1. POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.
2. ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER PROVIDING THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.
3. IN ML7984, "T5" AND "W" TERMINALS ARE CONNECTED INTERNALLY. DEVICE IS COMPATIBLE WITH 3 CONDUCTOR WIRING.
4. USE CONFIGURATION DIP SWITCHES TO SELECT DEVICE FUNCTIONS: DIRECT ACTING FUNCTION (ACTUATOR STEM MOVES DOWNWARDS WITH SIGNAL INCREASES TO 10V/20MA) OR REVERSE ACTING FUNCTION (ACTUATOR STEM MOVES UPWARDS WITH SIGNAL INCREASES TO 10V/20MA).
5. ALWAYS TURN POWER OFF BEFORE SETTING ANY DIP SWITCHES.

M25496

Fig. 12. ML7984 Wiring with 20mA Analog Control Signal.

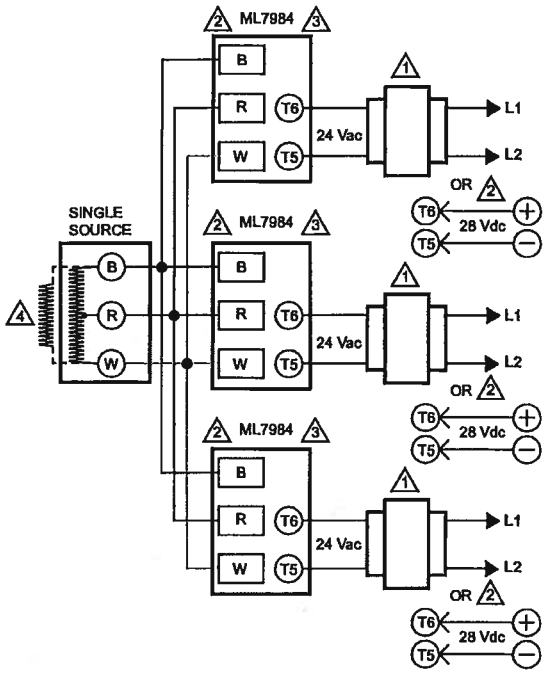


FUNCTION	DIP SWITCH CONFIGURATION	
1001 Mechanical Series 90 Direct Acting	1 2 3 4 — On (1) Off (0)	4
1011 Mechanical Series 90 Reverse Acting	1 2 3 4 — On (1) Off (0)	5

1. POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.
2. ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER PROVIDING THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.
3. DO NOT MIX M984/6 OR MODUTROL MOTORS WITH THE ML7984 IN THE SAME CIRCUITRY.
4. USE CONFIGURATION DIP SWITCHES TO SELECT DEVICE FUNCTIONS: DIRECT ACTING FUNCTION (ACTUATOR STEM MOVES UPWARDS WITH SIGNAL INCREASE) OR REVERSE ACTING FUNCTION (ACTUATOR STEM MOVES DOWNWARDS WITH SIGNAL INCREASE).
5. TURN POWER OFF BEFORE SETTING ANY DIP SWITCHES. FOR COMMON TRANSFORMER AND COMMON CONTROLLER APPLICATION, PLEASE CONSULT THE FACTORY.
6. MAXIMUM RESISTANCE PER CONTROL CIRCUIT OF 280 OHM.

M25497

Fig. 13. ML7984 Wiring with Common Transformer, Individual Controllers.

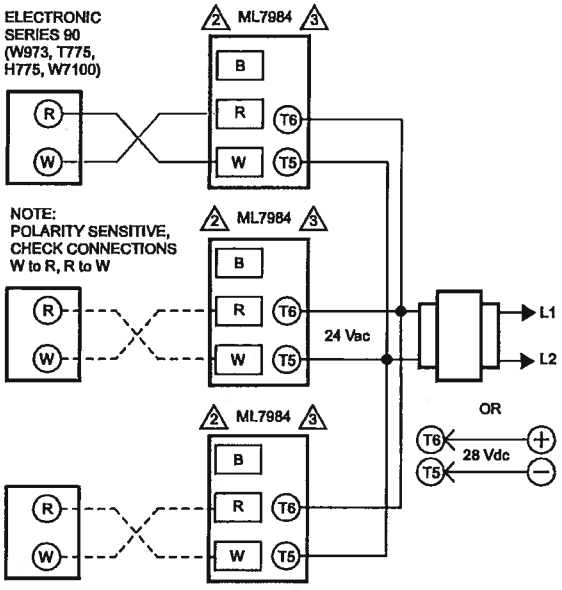


RESISTOR SELECTION CHART 4		
NO. OF ACTUATORS	RESISTOR VALUE	
1	RESISTOR NOT REQ'D.	ALL RESISTORS 1/4 WATT 1% METAL FILM
2	133 OHM	
3	68.1 OHM	
4	45.3 OHM	

1. POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.
2. ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER PROVIDING THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.
3. DO NOT MIX M984/6 OR MODUTROL MOTORS WITH THE ML7984 IN THE SAME CIRCUITRY.
4. USE RESISTOR KIT PART NUMBER 272822.

M25498

Fig. 14. ML7984 with Individual Transformers, Common Controller.

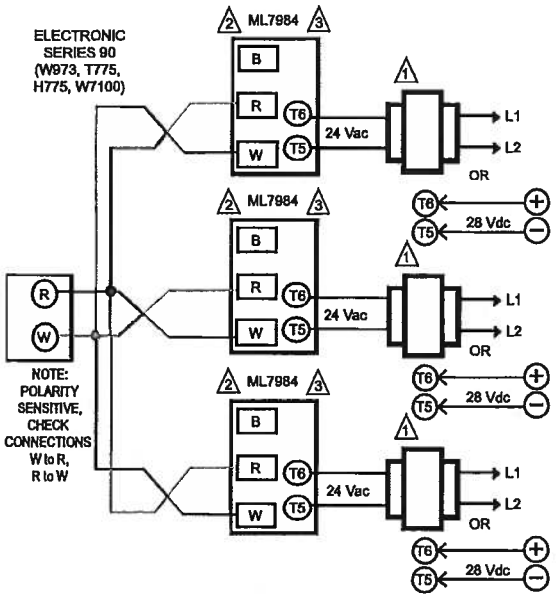


FUNCTION	DIP SWITCH CONFIGURATION	
1101 Electronic Series 90 Direct Acting	1 2 3 4	On (1) Off (0) 4
1111 Electronic Series 90 Reverse Acting	1 2 3 4	On (1) Off (0) 5

1. POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.
2. ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER PROVIDING THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.
3. DO NOT MIX M984/6 OR MODUTROL MOTORS WITH THE ML7984 IN THE SAME CIRCUITRY.
4. USE CONFIGURATION DIP SWITCHES TO SELECT DEVICE FUNCTIONS: DIRECT ACTING FUNCTION (ACTUATOR STEM MOVES UPWARDS WITH SIGNAL INCREASES TO 10V/20MA) OR REVERSE ACTING FUNCTION (ACTUATOR STEM MOVES DOWNWARDS WITH SIGNAL INCREASES TO 10V/20MA).
5. TURN POWER OFF BEFORE SETTING ANY DIP SWITCHES.

M25499

Fig. 15. ML7984 with Common Transformer, Individual Controllers.



FUNCTION	DIP SWITCH CONFIGURATION	
1101 Electronic Series 90 Direct Acting	1 2 3 4	On (1) Off (0) 4
1111 Electronic Series 90 Reverse Acting	1 2 3 4	On (1) Off (0) 5

1. POWER SUPPLY PROVIDES OVERLOAD PROTECTION AND DISCONNECT MEANS.
2. ALLOW UP TO 0.5 AMPS FOR EACH DEVICE. ACTUATORS AND CONTROLLER CAN SHARE SAME TRANSFORMER PROVIDING THE VA RATING OF THE TRANSFORMER IS NOT EXCEEDED AND PROPER PHASING IS OBSERVED. DO NOT MIX A.C. AND D.C. POWER SOURCES.
3. DO NOT MIX M984/6 OR MODUTROL MOTORS WITH THE ML7984 IN THE SAME CIRCUITRY.
4. USE CONFIGURATION DIP SWITCHES TO SELECT DEVICE FUNCTIONS: DIRECT ACTING FUNCTION (ACTUATOR STEM MOVES UPWARDS WITH SIGNAL INCREASES TO 10V/20MA) OR REVERSE ACTING FUNCTION (ACTUATOR STEM MOVES DOWNWARDS WITH SIGNAL INCREASES TO 10V/20MA).
5. TURN POWER OFF BEFORE SETTING ANY DIP SWITCHES.

M25500

Fig. 16. ML7984 with Individual Transformers, Common Controller.

OPERATION

Each time actuator terminals T5 and T6 are (re)powered, the microprocessor will cycle the valve through a full stroke to calibrate its position. Any stroke between 1/2 in. (13 mm) and 1 in. (25 mm) will be divided into 30 equal steps. Run time is proportional to stroke length and power supply voltage. The actuator will also slow down as the valve closes off the seat. The LED lights when terminals T5 and T6 are powered, and flashes when the actuator is in motion. T5 is connected to Terminal R in ML6984 and to Terminal W in ML7984.

NOTE: Initial callibration does not apply to ML6984 installed for 3-wire control or installed for 5-wire control without the 272630D position feedback/ auxiliary switch module. Span and start positions will need to be set during controller set-up. See ML6984 Operation 3-wire, below. ML7984 always conducts a self-calibration sequence when (re)powering up.

ML7984 Operation:

The microprocessor responds to the signal across the input terminals based on the configuration DIP switch settings.

When correctly connected to the actuator, a control signal between signal input terminals is converted to a digital run time and compared to pulse counts from the first gear in the gear train. When these counters are equal, the drive motor and drive shaft are stationary.

As long as the value of the controlled medium remains at the controller setpoint, the control loop circuit is in balance, and the actuator does not run. When the controller set point or controlled temperature changes, the controller output voltage is changed, causing the counters to differ. As the actuator moves in the direction to correct the difference, the counters increment or decrement, and stop the actuator when the input and gear counts agree.

At the end of the valve stroke, the actuator develops the necessary force for positive valve close-off. The motor stops automatically when the motor draws a predetermined current which corresponds to a force level. The digital counters are reset and calibrated at each end of stroke.

Modulating actuators will automatically travel to the position corresponding to analog input signal following the self-calibration cycle.

⚠ CAUTION

Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.

All wiring must comply with applicable local electrical codes, ordinances, and regulations.

Make certain that the voltage and frequency of the power supply correspond to the rating of the device.

DO NOT electrically operate the MLx984 actuator before assembly to the valve because damage not apparent to the installer may occur.

DO NOT connect 24 Vac between any ML7984 signal input terminals. DEVICE FAILURE WILL RESULT.

NOTE:

1. The ML7984 must be field configured with the DIP switches which are located beside the terminal block. See wiring diagrams for details. Turn power off before setting any DIP switches.
2. There is a 1.5 second delay in actuator response to every signal change. This occurs to screen out electrical noise.
3. For proper operation, voltage on the T5 and T6 must not be less than 22 Vac or 24 Vdc during running or force generating stages. Increase transformer VA rating or use a model with better regulation if voltage drops below 22 Vac when the valve is closing off.

ML6984 Floating Operation, 5-Wire:

The motor is controlled by a microprocessor. Connecting B to R for 1/10 second or longer tells the microprocessor to cause the actuator to drive upwards. Connecting W to R will cause the actuator to drive downwards. For "floating" control, the actuator will remain in the last position when there is no connection to R.

At the end of the valve stroke, the actuator will develop the necessary force for positive valve close-off. As forces are developed, the current to the motor increases. The microprocessor stops the actuator automatically when motor current and force reaches the factory-calibrated level.

NOTE: There must be at least 1.5 second delay between successive floating input signals. The actuator will ignore floating signals during calibration cycle and does not remember any pulses sent during this period. The controller may need to run through its own calibration cycle before use.

ML6984 Operation, 3-Wire:

ML6984 may be installed like a conventional (non-electronic) floating actuator. The interface electronics are powered at the same time as the motor. Pulses must be at least 100 ms long with a delay of at least 1500 ms between pulses. When ML6984 is not powered between terminals T6 and T5/R, self-calibration will not occur. The controller must drive the valve through a cycle manually to calibrate stroke to the controller.

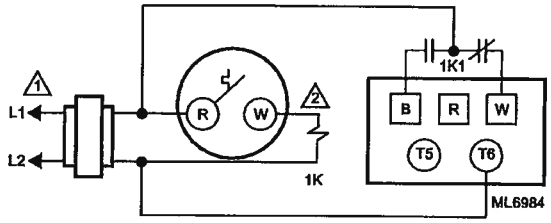
NOTE: The 272630D position feedback/auxiliary switch module cannot be used with ML6984 3-wire installation. The 272630D requires continuous power.

ML6984 XL10 Controller Compatibility:

XL10 controllers are designed to work with constant-speed actuators. ML6984 actuators use direct current motors which vary their speed as the valve seats or if power supply voltage is not consistent. ML6984 actuators in 5-wire mode offer 30 discrete positions only. To minimize potential valve position drift, XL10 controllers should use the 3-wire installation and be programmed for a daily valve exercise cycle.

ML6984 On-Off Operation:

For on-off operation, ML6984 requires a 24 Vac SPDT contact. An interface relay such as RA889 is required to power the anticipator heater of an electromechanical thermostat such as T87F (See Fig. 17).



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

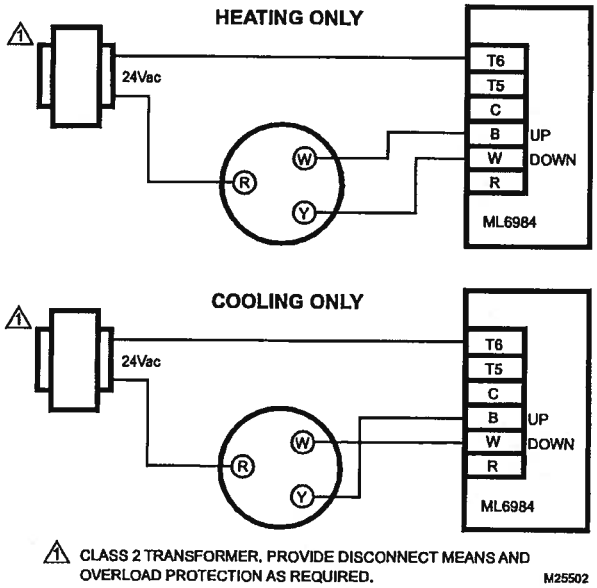
2 SET HEATING ANTICIPATOR TO MATCH CURRENT DRAW OF RELAY 1K. DO NOT ROUTE RELAY CONTACTS THROUGH THERMOSTAT.

M25501

Fig. 17. ML6984 with Honeywell T87F Round™ Thermostat.

If connecting the ML6984 directly to a T87F with a Series 20 sub-base, clip out the cooling anticipation resistor on the sub-base between terminals R and Y. This is needed for electrical compatibility with ML6984 but may result in wider room temperature swings due to the loss of anticipation.

REPLACEMENT NOTES

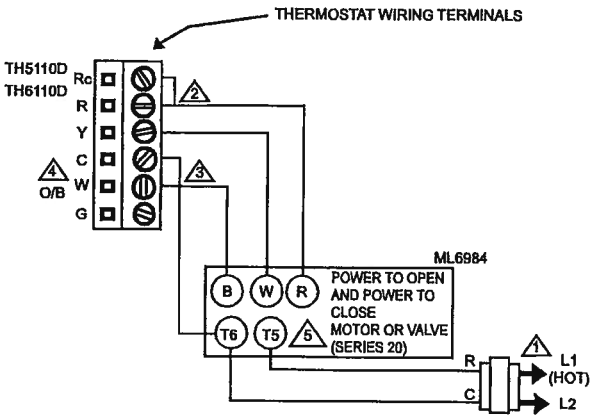


1 CLASS 2 TRANSFORMER. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

M25502

Fig. 18. ML6984 with Honeywell T87K Round™ Thermostat.

See Fig. 19, if connecting TH5110D or TH6110D FocusPRO™ thermostats to ML6984. Configure the thermostats for Series 20 operation.



1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

2 FACTORY INSTALLED JUMPER.

3 OPTIONAL 24 VAC COMMON CONNECTION.

4 CONFIIGURE SYSTEM TYPE TO HEAT ONLY IN THE INSTALLER SETUP.

5 TERMINALS R AND T5 ARE INTERNALLY CONNECTED.

M25503

Fig. 19. ML6984 with FocusPro™ Electronic Thermostat.

To Replace ML784 or ML984:

1. The old ML784 or ML984 actuators cannot be used with new ML7984 valve actuators in the same circuitry, unless the old models are each powered by their own transformer to prevent cross-talking.
2. The ML7984 is a direct replacement for all old ML784 and ML984, except:
   a. When replacing the old reverse acting models, the signal input wires to the new devices no longer need to be reversed. Just follow the terminal polarity designations and DIP switch settings.
   b. When replacing the old actuator which has an Electronic Series 90 "Supermod" controller - e.g.: T775, W973, H775, W7100 - the old interface resistor must be removed. The ML7984 Series 4000 will work directly with the controller without the external 240 ohm resistor.
   c. When replacing the old ML784 (mA model) in multiple-actuator installations, resistor(s) will be needed. Use Resistor Kit (part no. 272822) and set DIP switches accordingly. See Figures 17 and 18.

To Replace ML684A:

1. The new ML6984 is a direct replacement for the old ML684A in single actuator or parallel multiple actuators hook-up. The old and new actuators can be mixed in the same electrical circuit. For multiple actuators controlled by a common controller in parallel, these actuators must be wired so that they all travel in the same direction.
2. When replacing the ML684A1009 (80 lbf) with this new ML6984 on the V5045 valve, the installed valve adaptor (part no. 272629A) on the valve stem and actuator assembly is still needed.

NOTE: The 272630D position feedback/auxiliary switch module cannot be used with ML6984 3-wire installation. The 272630D requires continuous power.

To Replace ML6874:

1. The ML6984 is a direct replacement for the old ML6874 in single actuator hook-up.
2. For parallel, multiple ML6874 actuators applications, an isolation relay must be used. The isolation relay contacts should be placed in the new ML6984 actuator signal input "W" and "B" circuit.

To Replace Line Voltage Auxiliary Switches:

These accessories are no longer available. Replace the old actuator with new model and 272630D position feedback/ auxiliary switch module.

Operate an external relay, such as R8845U, using the adjustable SPDT pilot duty output on the 272630D.

If a second, independent output switch is needed, wire the 2-10 Vdc position feedback signal to an Approved, adjustable, voltage-controlled relay.

CHECKOUT

ML7984:

1. Make sure the valve stem is completely screwed into the actuator drive shaft with no threads showing before applying power.
2. Make sure the valve stem is locked in place with the set screw.
3. Make sure the Configuration DIP switches are set correctly.
4. With 24 Vac or 28 Vdc power source connected to T5 and T6, actuator operation can be verified by connecting appropriate control signal (Series 70/90) from controller to the signal input terminals (Figures 8 thru 16). For direct acting: A modulating action can be obtained by increasing the control signal. The actuator will travel from stem down to stem up. On signal failure (disconnected/no signal), actuator defaults to closed position. For reverse acting: Decreasing controller signal will drive actuator from full stem down to full stem up. On signal failure (disconnect/no signal), actuator defaults to open position.
5. Operate the system (valve, actuator, and controller) for several cycles to ensure proper installation.
6. When checkout is complete, return the controller to the desired setting.

NOTE:
1. Device will ignore any input changes until it has completed its repositioning relative to the initial signal input.
2. 272630D position feedback/auxiliary switch module is inactive during self-calibration.

ML6984: 5-Wire Installation:

1. Make sure the valve stem is completely screwed into the actuator drive shaft with no threads showing before applying power.
2. Make sure the valve stem is locked in place with the set screw.
3. Connect 24 Vac or 28 Vdc power to T5 and T6.
4. Jumper R and B. The valve stem should move up.
5. Jumper R and W. The valve stem should move down.
6. For Floating operation, open R connection Valve stem should remain in position.
7. Re-connect all control wiring.
8. Operate the system (valve, actuator, and controller) for several cycles to ensure proper installation.
9. When checkout is complete, return the controller to the desired setting.

ML6984: 3-Wire Installation:

1. Make sure the valve stem is completely screwed into the actuator drive shaft with no threads showing before applying power.
2. Make sure the valve stem is locked in place with the set screw.
3. Connect 24 Vac to T6.
4. Manually override the controller to signal the actuator to open/close for a few cycles to ensure proper installation.
5. When checkout is complete, return the controller to the desired setting.

TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSES	ACTIONS
Valve seat leaks or will not close properly	Wrong actuator used and/or system head pressure too high	1) Check valve close-off rating 2) Check voltage at actuator terminals
	Actuator not properly installed	Ensure valve stem is fully threaded into brass drive shaft and locked in place with the set screw
	Incorrect DIP switch settings	Check against Product Instruction Sheet
Noisy motor	Bearing failed due to overheat	1) Check for excessive temperature and replace complete actuator 2) Use high temperature kit (43196000-001)
	Brushes worn out	Check for excessive cycling and replace actuator or brushes (part no. 272775)

SYMPTOM	POSSIBLE CAUSES	ACTIONS
Motor overheats/smoke/component burn-out	Current sensing circuit failed or electronic components failed	Replace actuator. Make sure: 1) Correct actuator used 2) Properly installed 3) Do not operate actuator before mounting on valve supply 4) Proper voltage supply
ML will not respond	LED (on):	
	Incorrect DIP switch settings	Check against Product Instruction Sheet
	No control signal present	Check controller
	Incorrect wiring connections	Check against Product Instruction Sheet
	Internal time delay	Allow at least 1/2 - 1 second for the ML to respond
	LED (off):	
	No or low power supply	Check voltage on T5 and T6 terminals
	Error mode (gearbox damage)	1) Check power supply 2) Check calibration cycle 3) Valve stroke length less than 1/2 in. or greater than 1 1/4 in. 4) Reset device by a momentar disconnect of power at T5 and T6
Vdc/mA signal drops when connected to ML	ML7984 in mA mode with voltage input	Change DIP switch setting
	Signal degradation due to incompatible load impedance	Output and ML input impedance specifications
Actuator yoke corrodes	Galvanic reaction from dissimilar metals if SS U-bolt used with aluminum yoke	Replace U-bolt with galvanized U-bolt and nuts
Floating Actuator position "drifts" when used with building automation system	Mismatch between actuator resolution (30 steps) and BAS controller	1) Read actual valve position using 272630D feedback module 2) Rewire actuator for 3-wire control 3) Program daily valve reset

TYPICAL SPECIFICATIONS

Valve Actuators shall mount directly to the bonnet of the valve, and shall be self-contained and self adjusting.

Direct coupled valve actuators shall be 24° Vac or 28° Vdc power, available with floating or modulating control signal inputs. Actuator shall be usable with common power supply for multiple actuators and controllers.

Position feedback voltage/pilot duty auxiliary switch kit, mounting adaptor, high temperature kits, and resistor kits for multiple actuator application shall be optional accessories for direct coupled valve actuators.

Direct coupled valve actuators shall have a minimum performance rating of 50,000 full stroke cycles plus 1,000,000 repositions documented in the product literature.

Direct coupled valve actuators shall be manufactured by the same company as manufactures the valves.

Automation and Control Solutions

Honeywell International Inc.
1985 Douglas Drive North
Golden Valley, MN 55422

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95C-10939—6 J.I. Rev. 04-08

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ASCO®

RedHat®

Control Valve CV-2

Normally Closed or Normally Open

Hot Water and Steam Valves

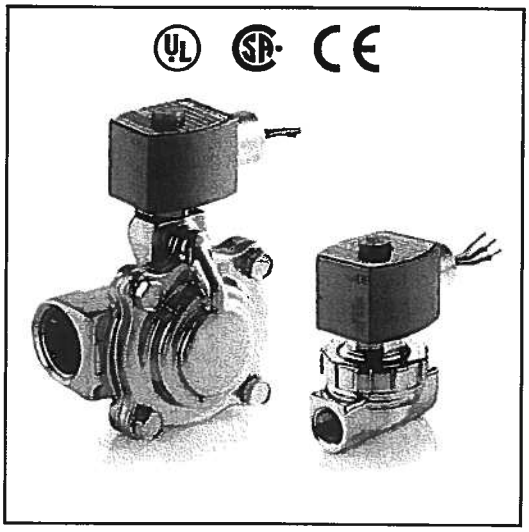
Brass or Stainless Steel Bodies

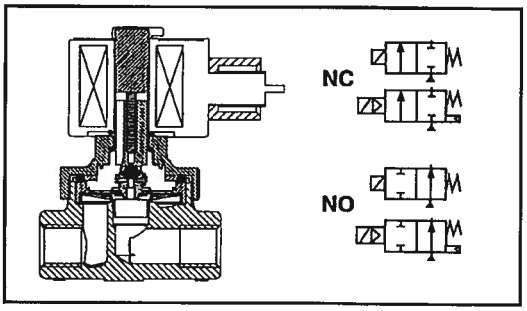
1/8" to 2 1/2" NPT

2/2 SERIES Hot Water/ Steam

Features

- Hot water service to 150 psi @ 210°F; Steam sevice to 125 psi @ 353°F
- Specify these valves for the high-temperature applications found in laundries, molding, steam atomization, sterilizers, autoclaves, and many others
  - Series 8263: direct acting miniature valves
  - Series 8267: direct acting straight-through, self-cleaning design
  - Series 8210/8220: pilot operated diaphragm valves
  - Series 8220: pilot operated diaphragm and piston valves; floating PTFE diaphragms or stainless steel pistons with EPDM or PTFE discs
  - Series 8221: slow-closing, anti-water hammer design
  - Series 8222: pilot operated diaphragm and piston valves. Y-body floating piston design





Construction

Valve Parts in Contact with Fluids		
Common Parts		
Body	Brass	Stainless Steel
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver
8210HW Series		
Seals, Discs, and Diaphragms	EPDM	
8263 Series		
Seals	EPDM or PTFE	
Disc	EPDM or PTFE	
8220/8221 Series		
Piston/Diaphragm	Stainless Steel/PTFE	
Discs	EPDM or PTFE	
Seals	EPDM, PTFE or TFE/P	
8222 Series		
Seals, Discs, and Diaphragms	TFE/P, EPDM and/or PTFE	
Piston	Brass or PTFE	
8267 Series		
Seals	FKM, PTFE	
Disc	Stainless Steel	
Seat	Glass-Filled PTFE	

Electrical

Standard Coil and Class of Insulation	Const. Ref.	Watt Rating and Power Consumption				Spare Coil Part Number			
			AC			General Purpose		Explosionproof	
		DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	1,2,36,38,39, 40,41,42	-	6.1	16	30	238210	-	238214	-
F	4, 8, 33, 50	-	6.1	16	40	238210	-	238214	-
H	4	-	6.1	16	40	238410	-	238414	-
F	32-35	11.6	-	-	-	-	238710	-	238714
F	5,7,10,14,15, 28,30,32,34, 51,52,53	-	10.1	25	70	238610	-	238614	-
F	16,17,18	-	10.1	25	50	238610	-	238614	-
H	3,31	-	10.1	25	50	238810	-	238814	-
H	9,12,14,51, 52,53	-	10.1	25	70	238810	-	238814	-
H	51-52	15.6	-	-	-	-	238910	-	238914
F	21-27,43-49	-	16.1	35	95	272610	-	272614	-
H	21-27	-	16.1	35	95	272810	-	272814	-
H	19-20	-	16.1	35	180	272810	-	272814	-
H	3,31	-	17.1	40	70	238810	-	238814	-
H	6,11,29	-	17.1	40	93	238810	-	238814	-
H	13	-	28.2	55	220	224195	-	224195	-

Solenoid Enclosures

Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; Red-Hat - Type 1.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; RedHat - Explosionproof and Raintight, Types 3, 7, and 9. (To order, add prefix "EF" to catalog number.)

See Optional Features Section for other available options.

SPECIAL SERVICE VALVES

Nominal Ambient Temp. Ranges

RedHat II AC: 32°F to 125°F (0°C to 52°C)

For 8210 Hot Water Series

RedHat II DC: 32°F to 104°F (0°C to 40°C)

For 8220 Steam/Hot Water Series

RedHat II DC: 32°F to 125°F (0°C to 52°C)

Refer to Engineering Section for details.

Approvals

Most are UL listed, CSA certified, and meet applicable CE directives. *Contact ASCO for details.*

Important: Explosionproof Catalog Numbers EF8210HW, EF8220, EF8221HW, and EF8263 (except G300-306) are not UL listed. They are suitable for Types 4 & 7 (A-D), and 9 (E, F, & G for Class F; E for class H coils) only, and have a temperature range code of T3B (Class F) or T3A (Class H).

Specifications (English units)

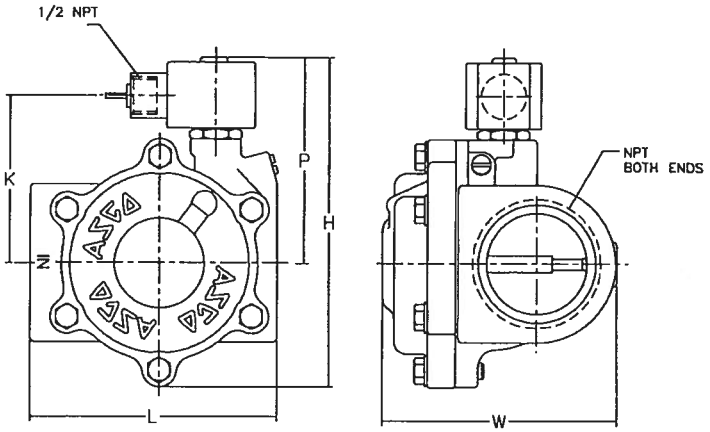
Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Hot Water Min. ③	Max. AC	Max. DC	Max. Fluid Temp. °F Hot Water AC	DC	Brass Body Catalog Number	Const. Ref.	AC Watt Rating/ Class of Coil Insulation AC	DC
HOT WATER SERVICE ONLY - NORMALLY CLOSED (Closed when de-energized), EPDM Diaphragm											
3/8	5/8	3	0 ②	100	40	210	150	8210G093HW	32	10.1/F	11.6/F
3/8	5/8	3	5	125	100	210	150	8210G001HW	33	6.1/F	11.6/F
1/2	5/8	4	0 ②	100	40	210	150	8210G094HW	32	10.1/F	11.6/F
1/2	5/8	4	5	125	100	210	150	8210G002HW	33	6.1/F	11.6/F
3/4	3/4	5	0 ②	100	40	210	150	8210G095HW	34	10.1/F	11.6/F
3/4	3/4	5	5	125	100	210	150	8210G009HW	35	6.1/F	11.6/F
HOT WATER SERVICE ONLY - SLOW CLOSING - NORMALLY CLOSED (Closed when de-energized), EPDM Disc											
3/8	9/16	3	5 ①	150	-	210	-	8221G001HW	36	6.1/F	-
1/2	9/16	3.5	5 ①	150	-	210	-	8221G003HW	36	6.1/F	-
3/4	3/4	5.5	5 ①	150	-	210	-	8221G005HW	36	6.1/F	-
1	1	11.5	5 ①	150	-	210	-	8221G007HW	38	6.1/F	-
1 1/4	1 1/8	13	5 ①	150	-	210	-	8221G009HW	39	6.1/F	-
1 1/2	1 1/4	24	5 ①	150	-	210	-	8221G011HW	40	6.1/F	-
2	1 3/4	36	5 ①	150	-	210	-	8221G013HW	41	6.1/F	-
2 1/2	1 3/4	38	5 ①	150	-	210	-	8221G015HW	42	6.1/F	-
HOT WATER SERVICE ONLY - SLOW CLOSING - NORMALLY OPEN (Open when de-energized), EPDM Disc											
3/8	9/16	3	5 ①	150	-	210	-	8221G021HW	43	16.1/F	-
1/2	9/16	3.5	5 ①	150	-	210	-	8221G023HW	43	16.1/F	-
3/4	3/4	5.5	5 ①	150	-	210	-	8221G025HW	44	16.1/F	-
1	1	11.5	5 ①	150	-	210	-	8221G027HW	45	16.1/F	-
1 1/4	1 1/8	13	5 ①	150	-	210	-	8221G029HW	46	16.1/F	-
1 1/2	1 1/4	24	5 ①	150	-	210	-	8221G031HW	47	16.1/F	-
2	1 3/4	36	5 ①	150	-	210	-	8221G033HW	48	16.1/F	-
2 1/2	1 3/4	38	5 ①	150	-	210	-	8221G035HW	49	16.1/F	-

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi) Min. ③	Max. AC Steam	Max. AC Hot Water	Max. DC Steam	Max. DC Hot Water	Max. Fluid Temp. °F AC Steam	AC Hot Water	DC Steam	DC Hot Water	Brass Body Catalog Number	Const. Ref.	Stainless Steel Body Catalog Number	Const. Ref.	Watt Rating/Class of Coil Insulation AC	DC
STEAM/HOT WATER SERVICE - DIRECT ACTING - NORMALLY CLOSED (Closed when de-energized), Stainless Steel Seat, EPDM ④ or PTFE Disc																	
1/8	1/8	.34	0	50	-	-	-	298	-	-	-	8263G052 ④	1	-	-	6.1/F	-
1/8	1/8	.34	0	90	-	-	-	331	-	-	-	8263G058	1	-	-	6.1/F	-
1/4	1/8	.34	0	50	-	-	-	298	-	-	-	8263G053 ④	2	-	-	6.1/F	-
1/4	1/8	.34	0	90	-	-	-	331	-	-	-	8263G059	2	-	-	6.1/F	-
1/4	5/32	.52	0	110	110	-	-	344	210	-	-	8263G300	3	-	-	10.1/H	-
1/4	7/32	.72	0	70	-	-	-	316	-	-	-	8263G301	3	-	-	10.1/H	-
1/4	9/32	.85	0	60	-	-	-	307	-	-	-	8263G303	3	-	-	17.1/H	-
3/8	1/8	.36	0	125	125	-	-	353	210	-	-	8263G304	3	8263G318	31	10.1/H	-
3/8	5/32	.52	0	110	110	-	-	344	210	-	-	8263G305	3	8263G319	31	10.1/H	-
3/8	7/32	.72	0	70	-	-	-	316	-	-	-	8263G306	3	8263G320	31	10.1/H	-
3/8	9/32	.85	0	60	-	-	-	307	-	-	-	8263G308	3	8263G321	31	17.1/H	-
STEAM/HOT WATER SERVICE - PILOT OPERATED - NORMALLY CLOSED (Closed when de-energized)																	
1/4	3/8	1.2	1	80	-	-	-	324	-	-	-	8222G068	4	-	-	6.1/F	-
1/4	3/8	1.2	1	125	-	-	-	353	-	-	-	8222G070	4	-	-	6.1/H	-
3/8	3/8	2.5	1	80	-	-	-	324	-	-	-	8222G064	4	-	-	6.1/F	-
3/8	3/8	2.5	1	125	-	-	-	353	-	-	-	8222G074	4	-	-	6.1/H	-
3/8	1/2	4.4	5	50	150	-	-	300	210	-	-	8220G401	50	-	-	6.1/F	-
3/8	1/2	4.4	0	50	150	50	100	300	210	300	210	8220G402	51	-	-	10.1/F	15.6/H
3/8	1/2	4.4	5	125	150	-	-	353	210	-	-	8220G403*	51	-	-	10.1/H	-
3/8	5/8	3.0	5	50	150	-	-	300	210	-	-	8222G001	5	-	-	10.1/F	-
1/2	3/8	2.5	1	80	-	-	-	324	-	-	-	8222G066	4	-	-	6.1/F	-
1/2	3/8	2.5	1	125	-	-	-	353	-	-	-	8222G076	4	-	-	6.1/H	-
1/2	1/2	3.6	2	125	-	-	-	353	-	-	-	8222G047	9	-	-	10.1/H	-
1/2	5/8	4.0	0	50	-	-	-	300	-	-	-	8222G094	7	8222G060	28	10.1/F	-
1/2	5/8	4.0	0	125	-	-	-	353	-	-	-	8222G002	6	-	-	17.1/H	-
1/2	1/2	4.7	5	50	150	-	-	300	210	-	-	8220G404	50	-	-	6.1/F	-
1/2	1/2	4.7	0	50	150	50	100	300	210	300	210	8220G405	51	-	-	10.1/F	15.6/H
1/2	1/2	4.7	5	125	150	-	-	353	210	-	-	8220G406*	51	-	-	10.1/H	-

Dimensions inches (mm)

Const. Ref.		H	K	L	P	W
21	ins.	5.11	3.13	2.71	4.35	3.58
	mm	130	80	69	111	91
22	ins.	5.30	3.29	2.78	4.51	3.58
	mm	135	84	71	115	91
28	ins.	4.17	2.47	2.81	3.44	2.28
	mm	106	63	71	87	58
30	ins.	5.82	3.22	3.75	4.19	4.44
	mm	148	82	95	106	113
31	ins.	3.25	1.70	2.00	2.67	1.95
	mm	83	43	51	68	50
36	ins.	4.32	2.69	2.71	3.56	3.45
	mm	110	68	69	90	88
43	ins.	5.12	3.14	2.71	4.35	3.65
	mm	130	80	69	111	93
44	ins.	5.30	3.30	2.78	4.51	3.65
	mm	135	84	71	115	93

Const. Ref. 17, 18, 26, 27, 38-42



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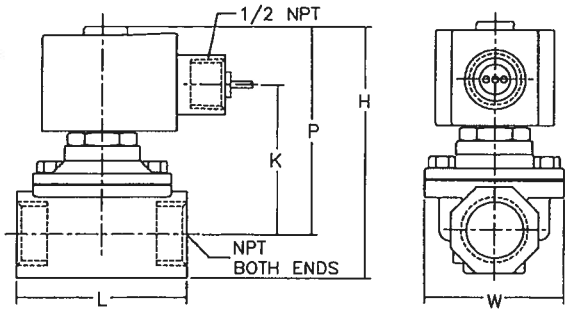

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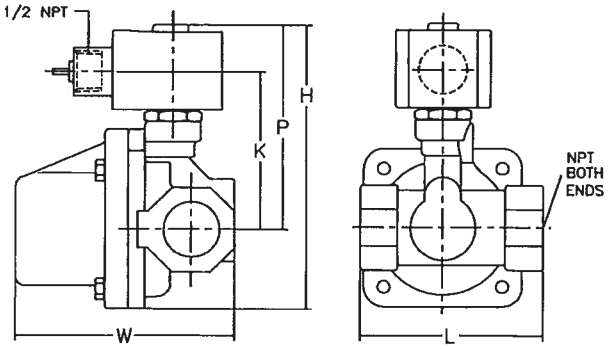

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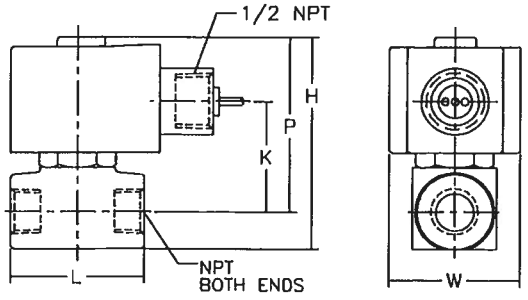
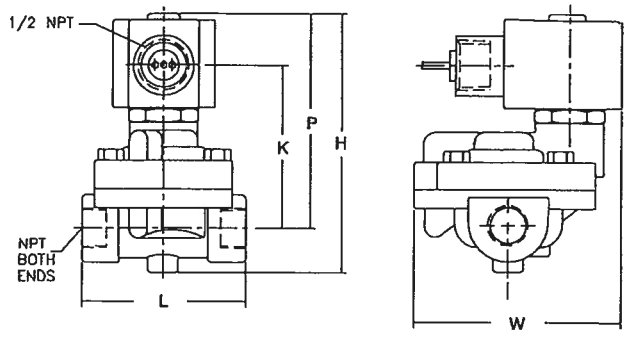


Const. Ref. 21, 22, 36, 43, 44

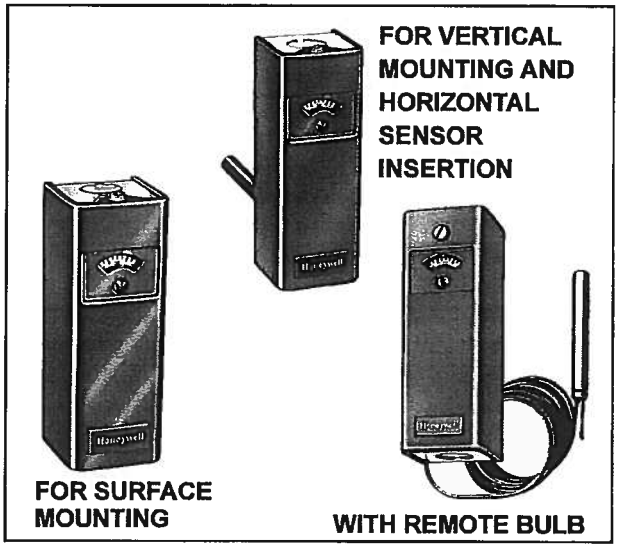


Honeywell

L4006,7,8; L6006,7,8 Aquastat® Controllers

TC-2
Temp Controller (Low Limit)
for HWM-1

PRODUCT DATA



GENERAL

Aquastat® Controllers are immersion type devices for limiting or regulating the temperature of liquids in boilers, storage tanks, and other applications where temperature control is required.

FEATURES

- **L4006, 7, and 8 provide Spst switching for high or low limit or circulator control.**
- **L4006G includes two Spst switches that provide high limit and circulator control.**
- **L4006,7; L6006,7 models are available for insertion in: vertical or horizontal immersion well, vertical or horizontal direct immersion, and surface mounting.**
- **L4008, L6008 include remote bulb for mounting controller at a location away from the sensing element.**
- **Totally enclosed Micro Switch™ snap-acting switches operate on temperature rise to set point.**
- **Models calibrated for high limit use are also suitable for low limit control if a separate high limit controller is used.**
- **Visible control point scale and external adjustment screw, permit easy setting.**
- **Remote bulb models may be used to sense air temperature in ducts and in outside air sensing applications.**

Contents

60-2104—10

SPECIFICATIONS

IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, this unit may not exactly match the listed specifications. Also, this product is tested and calibrated under closely controlled conditions, and some minor differences in performance can be expected if those conditions are changed.

SUPER TRADELINE®/TRADELINE MODELS

SUPER TRADELINE controls offer features not available on TRADELINE or standard models, and are designed to replace a wide range of Honeywell and competitive controls.

TRADELINE models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. Specifications of SUPER TRADELINE and TRADELINE controls are the same as those of standard models except as noted below.

SUPER TRADELINE Model: L6006A Aquastat Controller.

SUPER TRADELINE Features:
SUPER TRADELINE package with cross reference label and special instructions.
Factory-set stop at 240° F (116° C).
Vertical or horizontal mount.
Tube of heat-conductive compound.
Insulation: 1-1/2 in. to 3 in. (38 mm to 76 mm).

TRADELINE Models: L4006A,B,E; L4008E; L6006C; L6008A Aquastat Controllers.

TRADELINE Features Available:
TRADELINE package with cross reference label and special instructions.
Some TRADELINE models include immersion well.
Factory-set stops at 180° F, 240° F, or 250° F (82° C, 116° C, or 121° C).
Vertical or horizontal mount.
Tube of heat-conductive compound.
Insulation depths of 1-1/2 in. or 3 in. (38 or 76 mm).

NOTE: The following specifications are standard. Variances, available as options, are listed in Tables 1 and 2.

Electrical Ratings (A):
Models with 2° F (1° C) fixed differential:

	120 Vac	240 Vac
Full Load	2.6	1.3
Locked Rotor	15.6	7.8

Models with 5° F (3° C) fixed differential or 5° F to 30° F (3° C to 17° C) adjustable differential:

	110/120 Vac	200/240 Vac	277 Vac[a]
Full Load	8.0	5.1	4.2
Locked Rotor	48.0	30.6	25.2
Millivoltage	0.25 at 0.25 to 12 Vdc		

[a] L6008G only.

Switching:
L4006, L4007, L4008: Spst.
L6006, L6007, L6008: Spdt (breaks R-B and makes R-W on temperature rise at setpoint).

Pressure Rating:
Capillary Bulb (Direct Immersion): 200 psi (1379 kPa).
Immersion Well: 255 psi (1758 kPa).

Sensing Bulb Material: Copper.

Sensing Bulb Fill: Liquid—toluene or silicone oil.

Sensing Bulb Dimensions: 2-7/8 in. (73 mm) long, 3/8 in. (10 mm) diameter.

Wiring: Screw terminals.

Maximum Ambient Temperature: 150° F (66° C).

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or distributor, refer to the TRADELINE® Catalog or price sheets for complete ordering number.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Automation and Control Products Sales Office (check white pages of your phone directory).
2. Honeywell Customer Care
   1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9.
International Sales and Service Offices in all principal cities of the world. Manufacturing in Australia, Canada, Finland, France, Germany, Japan, Mexico, Netherlands, Spain, Taiwan, United Kingdom, U.S.A.

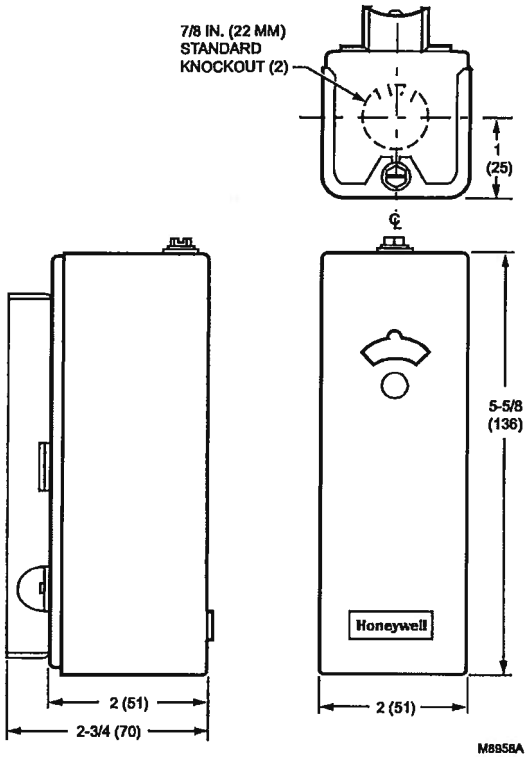


Fig. 3. Approximate installation dimensions in inches (mm) for surface mount models.

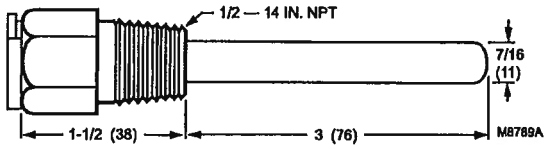


Fig. 4. Approximate immersion well dimensions in inches (mm) for all models except L4006C and L6006B.

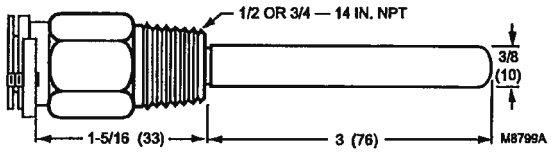


Fig. 5. Approximate boiler fitting and bulb dimensions in inches (mm) for L4006C and L6006B.

Table 2. L6006, L6007, L6008 Controller (SPDT Switching) Specifications.

Model	Application	Range °F (°C)	Midscale Differential °F (°C)	Insertion[a]	Available Options
L6006A 1012	Circulator and low limit or high limit	100° F to 240° F (38° C to 116° C) or 100° F to 290° F (38° C to 143° C)	5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable	Horizontal	— SUPER TRADELINE model available. — Modified dial with stop. — NPT brass spud 1/2 in. or 3/4 in. (13 mm to 19 mm) — 3-3/8 in. (86 mm) insertion. — Without well. — Adapter for horizontal or vertical mount. — Insulation depth 1-1/2 in. or 3 in. (38 mm or 76 mm).
L6006B	Circulator and low limit or high limit	100° F to 240° F (38° C to 116° C)	5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable, or 30° F (17° C) fixed.	Horizontal	— Direct immersion. — Insulation depth 1-1/2 in. (38 mm). — 3/4 in. (19 mm) brass compression fitting.
L6006C	Circulator, low limit, and high limit	65° F to 200° F (18° C to 93° C)	5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable	Horizontal or vertical surface mounted	— TRADELINE model available. — Strap-on, surface mount.
L6007A	Circulator and low limit or high limit	40° F to 180° F (4° C to 82° C)	Fixed	Horizontal or vertical	— Insulation depth 1-1/2 in. or 3 in. (38 mm or 76 mm).
L6008A	Circulator and low limit cooling	100° F to 240° F (38° C to 116° C) or -30° F to +70° F (-35° C to +21° C)	5° F (3° C) fixed or 5° F to 30° F (3° C to 17° C) adjustable	Remote bulb	— TRADELINE models available. — Modified dial with stop. — Capillary 5-1/2 ft (1.7 m).
L6008G	Two-stage Aquastat Controller to cycle two-stage gas valve.	130° F to 230° F (54° C to 110° C) or 60° F to 160° F (16° C to 71° C)	3-1/2° F (2° C) fixed	Remote bulb	— Capillary 6 ft (1.8 m). — Adjustable interstage differential; 5° F to 10° F (2° C to 6° C).
L6008H (maximum temperature of element 405° F (207° C))	Low fire Aquastat Controller	150° F to 200° F (66° C to 93° C)	15° F (8° C) fixed	Remote bulb	— Capillary 33 in. (0.8 m).

[a] Some models include copper well or fitting; specify when ordering. Also specify boiler tapping size 1/2 or 3/4 in. NPT and insulation depth.