Falling Film Chiller

INSTALLATION AND OPERATION MANUAL

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MUELLER

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Section 1.0 – Introduction

1.1 GENERAL INFORMATION

Paul Mueller Company falling film chillers are designed to quickly and efficiently cool water or a liquid solution of water and glycol for many different processes. Mueller® falling film chillers use gravity to flow the medium over the refrigerated vertical evaporators for instant cooling. The medium is then either recirculated back into the distribution pan above the Mueller Temp-Plate® evaporators to be cooled again or flowed out of the reservoir into the process piping.

This manual provides the basic information necessary to install, startup, and operate a Mueller falling film chiller. Please contact Paul Mueller Company for additional technical assistance.

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1.2 MODEL 3 X 5 FALLING FILM CHILLER STANDARD FEATURES

- Constructed of Type 304 or 316L stainless steel.
- Designed for use with R-22, R-404A, R-507, R-134a, R-448A, or R-717.
- Electronic makeup water solenoid assembly (optional).
- Hinged and gasketed cabinet top doors (optional).
- Clamp-type ferrule and male pipe-thread adapter for the inlet (included).
- Falling film chiller expansion valves for each refrigeration plate are available.
- Refrigeration capacity and refrigerant type must be specified at the time of order.

A. Required Water Flow Rates

1. High-flow distribution pan:
   Minimum flow rate: 14.7 gpm per plate
   Maximum flow rate: 29.0 gpm per plate

2. Low-flow distribution pan:
   Minimum flow rate: 9.1 gpm per plate
   Maximum flow rate: 14.3 gpm per plate

3. Extra-low-flow distribution pan:
   Minimum flow rate: 5.8 gpm per plate
   Maximum flow rate: 8.95 gpm per plate

1.2 MODEL 3 X 5 FALLING FILM CHILLER STANDARD FEATURES (CONTINUED)

B. Nominal Operating Capacity of Insulated Tank*

- 2–8 plates: 173 U.S. gallons
- 2–8 plates, oversized reservoir: 365 U.S. gallons

**Tankless cabinets are also available.*

C. Circulation Water Connection Size

- 2–8 plates: Inlet: Single, extra-low-flow pan, 2″ MPT Outlet**: 4″ MPT
  Inlet: Single, low-flow pan, 2″ MPT Outlet**: 4″ MPT
  Inlet: Single, high-flow pan, 3″ MPT Outlet**: 4″ MPT

**Optional 6″, 8″, and 10″ RFSO pipe flanges are also available.*

TABLE 1: MODEL 3 X 5 FALLING FILM CHILLER DIMENSIONS

3 x 5 Tankless	Length (in)	Width (in)	Height (in)	Height with Top Door (in)	Weight (lb)	Weight with Top Door (in)
2–8 plate cabinet	70	40.75	46.75	49.25	436	420
Refrigerant plate					64	
Glycol plate					48	
Pan					49	
3 x 5 Tankless	**Length (in)**	**Width (in)**	**Height (in)**	**Height with Top Door (in)**	**Weight (lb)**	**Weight with Top Door (in)**
2–4 plate cabinet	68	24.75	46.75	49.25	354	348
Refrigerant plate					64	
Glycol plate					48	
Pan					33	
3 x 5 with Tank	**Length (in)**	**Width (in)**	**Height (in)**	**Height with Top Door (in)**	**Weight (lb)**	**Weight with Top Door (in)**
2–8 plate cabinet	68.5	39.13	77.13	79.63	770	754
Refrigerant plate					64	
Glycol plate					48	
Pan					49	
3 x 5 Oversized	**Length (in)**	**Width (in)**	**Height (in)**	**Height with Top Door (in)**	**Weight (lb)**	**Weight with Top Door (in)**
2–8 plate cabinet	68.5	39.13	97.13	99.63	837	821
Refrigerant plate					64	
Glycol plate					48	
Pan					49	

1.3 MODEL 4 X 8 FALLING FILM CHILLER STANDARD FEATURES

- Constructed of Type 304 or 316L stainless steel.
- Designed for use with R-22, R-404A, R-507, R-134a, R-448A, or R-717.
- Electronic makeup water solenoid assembly (optional).
- Hinged and gasketed cabinet top doors (optional).
- Clamp-type ferrule and male pipe-thread adapter for the inlet (included).
- Falling film chiller expansion valves for each refrigeration plate are available.
- Refrigeration capacity and refrigerant type must be specified at the time of order.

A. Required Water Flow Rates

1. High-flow distribution pan:
   Minimum flow rate: 31.0 gpm per plate
   Maximum flow rate: 50.2 gpm per plate

2. Low-flow distribution pan:
   Minimum flow rate: 17.9 gpm per plate
   Maximum flow rate: 28.7 gpm per plate

3. Extra-low-flow distribution pan:
   Minimum flow rate: 8.3 gpm per plate
   Maximum flow rate: 15.5 gpm per plate

B. Nominal Operating Capacity of Insulated Tank*

- 2–8 plates: 293 U.S. gallons
- 9–16 plates: 525 U.S. gallons
- 17–24 plates: 750 U.S. gallons
- 25–32 plates: 1,113 U.S. gallons

**Tankless cabinets with 2–8, 9–16, and 17–24 plates are also available.*

C. Circulation Water Connection Size

• 2–8 plates:	Inlet:	Single, extra-low-flow pan, 2″ MPT	Outlet**:	4″ MPT
• 2–8 plates:	Inlet:	Single, extra-low-flow pan, 4″ MPT	Outlet**:	4″ MPT
	Inlet:	Single, low-flow pan, 4″ MPT	Outlet**:	4″ MPT
	Inlet:	Single, high-flow pan, 6″ MPT	Outlet**:	4″ MPT
• 9–16 plates:	Inlet:	Dual, extra-low-flow pan, 4″ MPT	Outlet**:	6″ RFSO pipe flange
	Inlet:	Dual, low-flow pan, 4″ MPT	Outlet**:	6″ RFSO pipe flange
	Inlet:	Dual, high-flow pan, 6″ MPT	Outlet**:	6″ RFSO pipe flange

1.3 MODEL 4 X 8 FALLING FILM CHILLER STANDARD FEATURES (CONTINUED)

C. Circulation Water Connection Size (Continued)

- 17–24 plates: Inlet: Triple, extra-low-flow pan, 4″ MPT — Outlet**: 8″ RFSO pipe flange
  Inlet: Triple, low-flow pan, 4″ MPT — Outlet**: 8″ RFSO pipe flange
  Inlet: Triple, high-flow pan, 6″ MPT — Outlet**: 8″ RFSO pipe flange

- 25–32 plates: Inlet: Quad, extra-low-flow pan, 4″ MPT — Outlet**: 10″ RFSO pipe flange
  Inlet: Quad, low-flow pan, 4″ MPT — Outlet**: 10″ RFSO pipe flange
  Inlet: Quad, high-flow pan, 6″ MPT — Outlet**: 10″ RFSO pipe flange

***Optional 6", 8", and 10" RFSO pipe flanges are also available.*

TABLE 2: MODEL 4 X 8 FALLING FILM CHILLER DIMENSIONS

4 x 8 with Tank	Length (in)	Width (in)	Height (in)	Height with Top Door (in)	Weight (lb)	Weight with Top Door (in)
2–8 plate cabinet	104.38	39.13	90.63	92.88	1,169	1,164
9–16 plate cabinet	104.38	72.38	90.63	92.88	1,621	1,604
17–24 plate cabinet	104.38	105.63	90.63	92.88	2,060	2,035
25–32 plate cabinet	104.38	138.88	90.63	92.88	3,700	3,642
Refrigerant plate					130	
Glycol plate					100	
Pan					100	
4 x 8 Tankless	**Length (in)**	**Width (in)**	**Height (in)**	**Height with Top Door (in)**	**Weight (lb)**	**Weight with Top Door (in)**
2–8 plate cabinet	108.75	41.75	61.44	63.59	787	782
9–16 plate cabinet	108.75	75.88	61.44	63.59	1,041	1,024
17–24 plate cabinet	108.75	109.13	61.44	63.59	1,444	1,419
Refrigerant plate					130	
Glycol plate					100	
Pan					100	

1.4 PLATE DESIGN

Paul Mueller Company manufactures plates for the falling film chiller in two different styles. Figure 1 shows the plate used for direct expansion or recirculated refrigeration systems. Figure 2 shows the plate used for flooded refrigeration systems. Note the number of baffles in both designs. The direct expansion or recirculated refrigeration plate has three baffles and the flooded refrigeration plate only has one.

FIGURE 1: PLATE DESIGN FOR DIRECT EXPANSION OR RECIRCULATED REFRIGERATION SYSTEMS

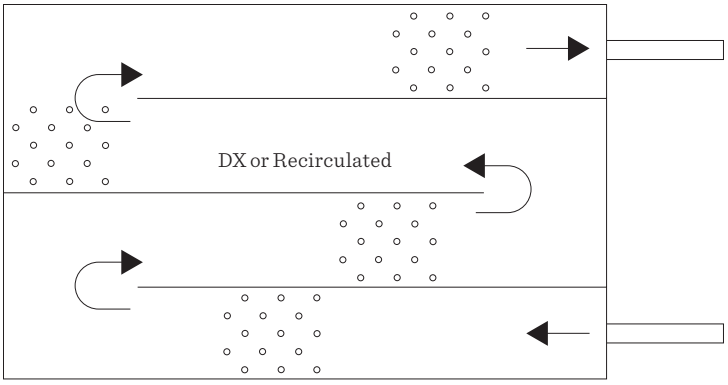
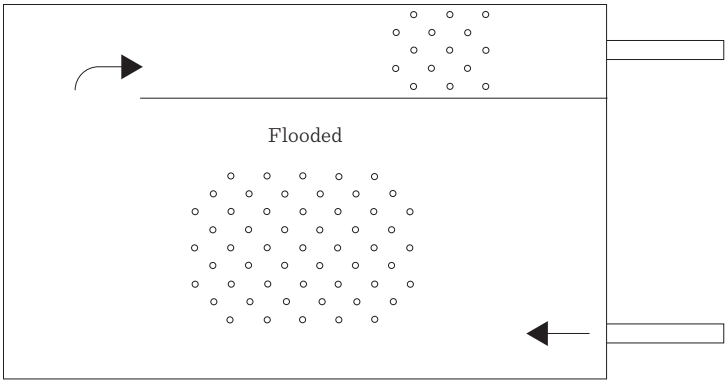
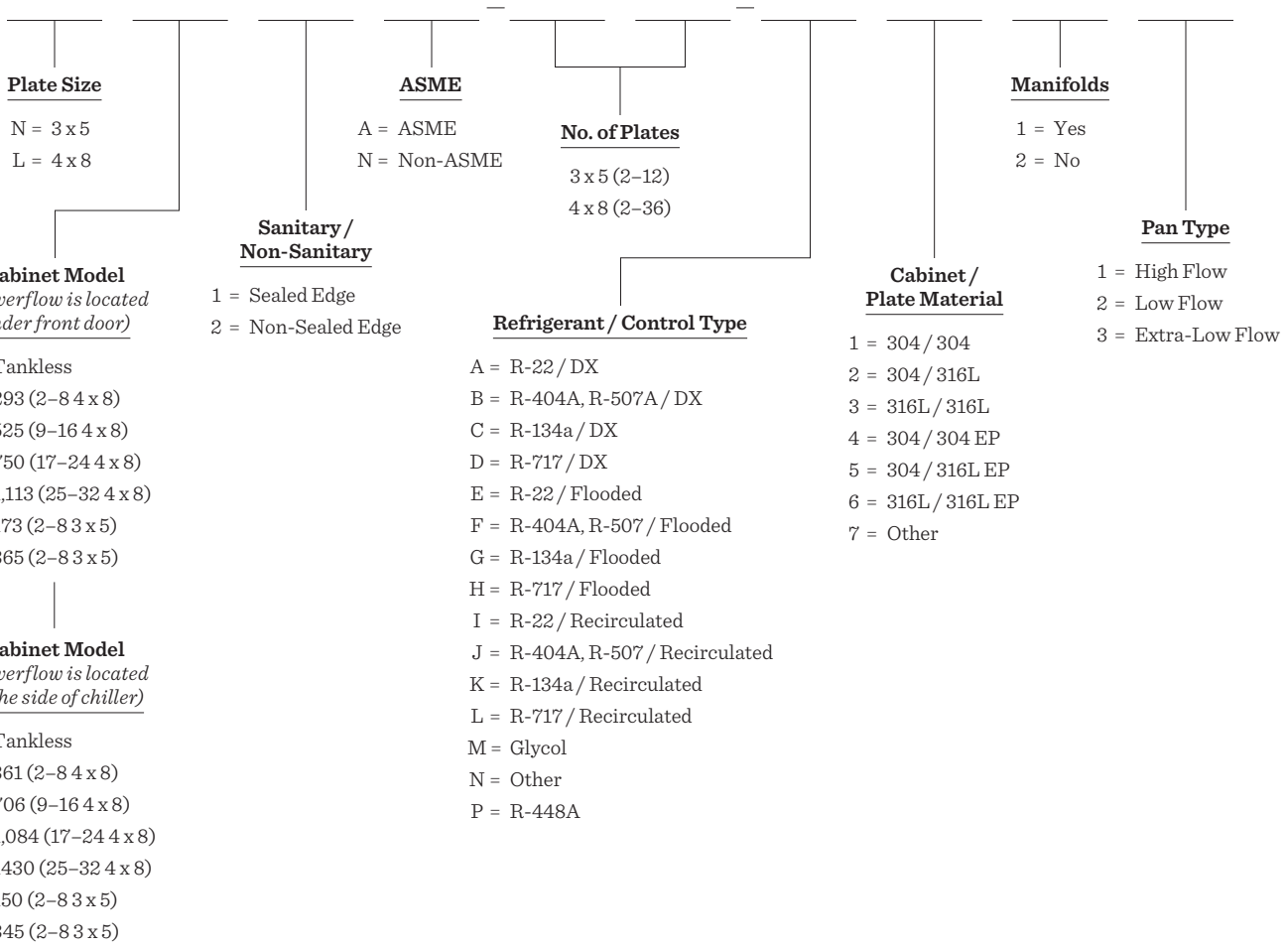


FIGURE 2: PLATE DESIGN FOR FLOODED REFRIGERATION SYSTEMS



1.5 MODEL NUMBER BREAKDOWN



Section 2.0 – Installation

2.1 INSPECTION

Paul Mueller Company **requires** thoroughly inspecting the equipment before it is unloaded from the freight truck. Carefully examine the equipment for concealed damage. Note any damage on the bill of lading, and take photos of the damage, crating, and how the unit is positioned on the truck. In the unlikely event of damage during shipment, it may be considerably difficult to receive compensation for damage not found prior to unloading.

IMPORTANT: It is imperative to note any damage on the bill of lading and have the driver sign it.

Open all packages and check against the bill of lading for shortages of parts. This allows you to order them prior to equipment installation.

2.2 LOCATION AND LEVELING THE CHILLER

A. Location

Locate the falling film chiller as close as practical to the process and to the condensing units. A drain should be close by for draining the chiller.

Consider ease of disassembly for cleaning and the possible future addition of more vertical evaporator plates when selecting a location for the falling film chiller. To take full advantage of the chiller's easy-clean feature, a 3-foot clearance on each side of the chiller and a clearance equal to the length of the evaporator plate should remain at the end opposite the refrigeration connections.

B. Leveling

The falling film chiller is equipped with adjustable legs for leveling. The chiller must be level for proper operation of the distribution pan and to maintain an even film flow over the vertical evaporator plates. Leveling also allows for complete drainage of the holding tank.

It is recommended to use a carpenter's level placed on the top edge of the distribution pan in both directions or on the top edge of the water storage tank will place the chiller at the proper pitch.

2.3 OBTAINING PARTS

The parts quantity, size, and type will vary with each installation.

A. Refrigeration

- Liquid line tubing.
- Suction line tubing.
- Reducers.
- Elbows (if elbows are used, Paul Mueller Company recommends a long radius type).
- Refrigerant (i.e., R-22, R-404A, R-448A, R-507, etc.).
- Hangers and brackets to support refrigerant lines or water lines.
- Support stands (if compressors are to be stacked or wall-mounted).
- Insulation: Due to evaporator temperatures, condensation is likely. Insulation will be required to cover the refrigerant lines.
- Liquid line solenoid valve (if necessary).

2.3 OBTAINING PARTS (CONTINUED)

B. Water Lines

- Chilled water line (see Table 3 for the recommended chilled water line size).
- Adapter, tri-clamp to pipe thread.
- Fittings (e.g., Elbows, tees, unions, valves, and adapters).
- Circulating pump, if not provided.
- Flow switch. Please call Paul Mueller Company for sizing assistance.
- Overflow line, 2.0″ PVC.
- Propylene glycol will be required if the cooling water is to be operated below 34°F (1.1°C).
- Drain valve(s) for draining the reservoir during maintenance.

TABLE 3: RECOMMENDED CHILLED WATER LINE SIZE

Recommended Suction Line Size			Recommended Discharge Line Size		
Line Size (in)	Maximum Flow (gpm)	Velocity (ft/sec)	Line Size (in)	Maximum Flow (gpm)	Velocity (ft/sec)
3	70	3.04	1.5	60	10.5
4	120	3.02	2	100	10.1
6	260	2.89	3	220	10.1
8	450	2.89	4	400	10.5
10	700	2.85	6	850	10.0

IMPORTANT: The maximum velocity recommended on the suction line to the circulator pump is 2 to 3 feet per second (FPS). The maximum velocity recommended on the discharge line and through the plate heat exchanger (if used) is 7 to 10 FPS (feet per second).

2.4 LOCATING CONDENSING UNITS

Air Flow *(for air-cooled condensing units only)*: There are several factors to consider when locating the refrigeration units; the most important is air flow. Whether located inside or outside, it is essential that the condenser has a supply of unrestricted fresh air. When units are located inside, it is very important that the louvers be at least the same dimension as the condensing unit face.

- An exhaust fan or opening large enough to prevent any increase in static pressure must be provided.
- The units must be located so that routine maintenance can be accomplished (e.g., cleaning the condensers and replacing the compressors).
- Avoid areas with machines that would create dust or oil.

2.5 CONNECTING THE REFRIGERANT LINES

- Do not use tubular fittings that are smaller in diameter than the connections on the condensing unit or a flow restriction will result. Use practical refrigeration practices for refrigerant line sizes.
- Use long radius fittings and do not bend tubing in a manner that will cause it to flatten.
- Always clean and deburr all fitting and tubing ends before soldering and purge with nitrogen.
- After soldering is complete, pressurize the tubing and leak test before evacuating and insulating the lines.

IMPORTANT: United States Environmental Protection Agency (EPA) regulations require that any technician performing refrigerant installation or service on a high-pressure appliance be certified as a Type II or Universal Technician in accordance with Section 608 of the Clean Air Act. Clean Air act regulations may change or differ, depending on locality. It is the responsibility of the technician performing the refrigerant service and/or installation to abide by all regulatory requirements and procedures for the locality, state, and country.

2.6 LIQUID LINE SOLENOID VALVE

The Mueller condensing unit is designed to start and stop based on water temperature. It is not designed as a pump-down system. For proper operation of the falling film chiller it is necessary to install a liquid line solenoid valve to prevent refrigerant migration during down time. The solenoid should be wired to close upon compressor shut down and open when the compressor restarts. Contact points are provided on the condensing unit to connect a customer-supplied solenoid valve. See the general wiring schematic in Figure 5 for solenoid wiring information.

2.7 WATER LINE CONNECTIONS

- The water connections on the falling film chiller will be male pipe thread or tri-clamp fittings with an adapter to male pipe thread.
- A short length of flexible hose must be used between the pump and chiller outlet to prevent damage to the outlet due to vibration.
- Mueller recommends mounting the pump reasonably close to the falling film chiller with a gate-type valve on both the inlet and outlet of the pump, so it can be isolated for servicing.
- A flow switch can be installed in the pump discharge line. It should be wired to shut the refrigeration units off and activate an alarm if the cooling solution flow should stop unexpectedly to prevent a freezeup.
- If the chilled water is to be routed to more than one piece of equipment, a balancing valve must be used to regulate the flow of water to each piece of equipment. It may be more effective to use a second pump for the additional equipment.
- It is recommended to insulate the chilled water lines to prevent condensation from dripping at lower operating temperatures.
- It is recommended to install a drain valve in the reservoir outlet piping so the chiller may be drained for cleaning or maintenance purposes.

2.7 WATER LINE CONNECTIONS (CONTINUED)

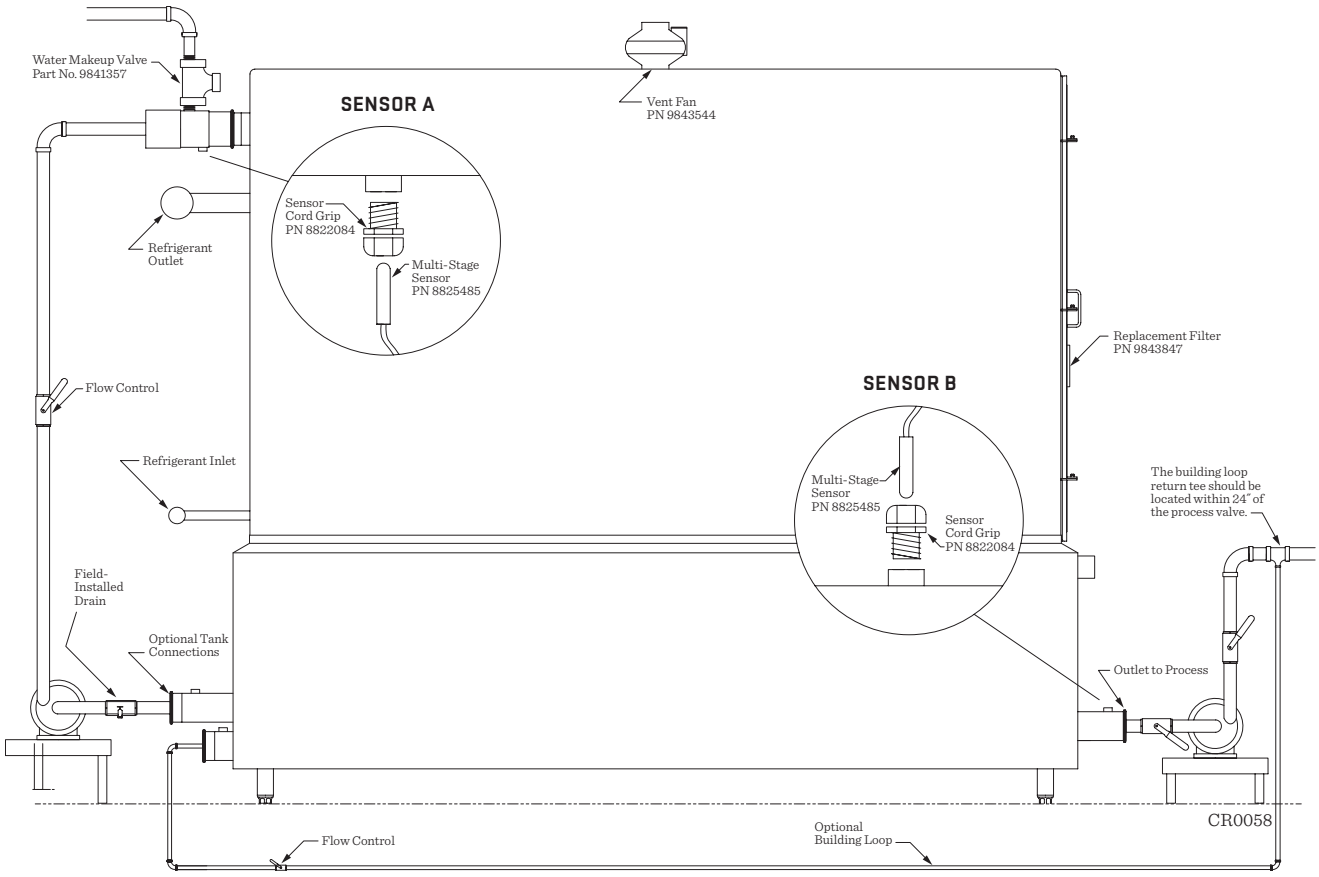
- If PVC plastic pipe is used with solutions containing propylene glycol, the manufacturers of PVC or CPVC pipe recommend Schedule-80 purple primer and Schedule-80 gray adhesive be used. The following procedure should be used to assemble PVC or CPVC:

  a. Scour primer into the surface with a hard bristle brush. It should be alternately applied to the surface of the pipe once and to the fitting socket twice.

  b. Solvent cement should be applied with a hard bristle brush while the primer is wet. It should be alternately applied to the surface of the pipe twice and to the fitting socket once.

IMPORTANT: Galvanized pipe should not be used for applications with propylene glycol, as propylene glycol can strip the zinc coating from galvanized pipe.

FIGURE 3: COMPONENT LOCATIONS



2.8 MAKEUP WATER VALVE

An optional water makeup valve is available. Some installations require a makeup water valve to replenish the water used in the process. See Part No. 8826498, "Falling Film Chiller Water Level Control Instructions" for more information.

2.9 CONNECTING THE OVERFLOW LINE

This line should be installed with PVC pipe and must have a continuous pitch to the drain, as any trapping may prevent drainage of this line. See Figure 3 for component locations.

2.10 MUELLER MULTI-STAGE CHILLER COOLING AND PUMP CONTROL

If the Mueller multi-stage chiller cooling and pump control was purchased, please reference the multi-stage chiller control manual for installation and setup procedures.

A crucial step in the installation of the multi-stage chiller control is the location of the temperature sensors. A rise in water temperature inside the chiller's distribution pan will turn on Stage 1 and the condensing unit. The most efficient way to accomplish this is to sense the temperature entering the pan. Sensor A should be installed in the .5" FPT port between the water makeup valve and the chiller distribution pan connection. See Figure 3, "Component Locations." Sensor B should be located in the .5" FPT port on the process pump connection under the chiller door. Sensor B is only used for referencing the temperature inside the chiller reservoir.

2.11 OPTIONAL CHILLER CABINET VENTING

Chillers using chlorinated water must be constantly vented to prevent chlorine rusting. Venting is handled by an optional chiller cabinet vent fan located on the top of the chiller (see Figure 3 for location and part number). This fan requires a separate, field-installed 120/60/1 power supply with a fused disconnect for service.

The chiller cabinet brings in fresh air through the door on the front of the chiller cabinet through a replaceable mesh filter (see Figure 3 for location and part number).

2.12 GLYCOL SOLUTION

If the system is to be operated at or below 34°F (1.1°C), the water must be protected with an approved propylene glycol to prevent freezing. To prevent fowling of the liquid solution, deionized water must be used. Refer to the glycol manufacturer's ratios to obtain the proper freeze point.

2.13 SETTING CHILLER WATER FLOWS

Setting the water flows after the temperature and pump controls are installed is important for several reasons. When the recirculation and makeup water flows meet in the chiller's distribution pan, it creates the blended temperature that was specified when the chiller was sized. If the blend temperature is not correct, the chiller will not perform properly.

When the chiller calls for makeup water, the sensor sees the rise in temperature as the water enters the pan. The refrigeration unit then turns on, cooling the water down to the designed temperature in one pass across the evaporator plates.

The correct water flow rates across the plates are achieved by setting the water depth in the distribution pan. The two flows can be regulated by flow control setters or a manual valve that can be set to maintain the set position.

2.13 SETTING CHILLER WATER FLOWS (CONTINUED)

In order to set the correct distribution pan water depth, follow these instructions:

1. First, gather the following sizing information for the chiller:

   - Size (3 x 5 or 4 x 8) and number of evaporator plates.
   - Style of distribution pan (high flow, low flow, or extra low flow).
   - Recirculation water flow required.
   - Total water depth required in the distribution pan.

2. Allow the bottom reservoir to fill up to near the top level probe. Once it is close to that point, shut off the makeup water with the isolation valve. The only water going into the distribution pan should be from the recirculation circuit.

3. Using the sizing information in step 1, divide the required recirculation flow by the number of plates in the chiller to calculate the water flow rate (gpm) per plate. Then, refer to the appropriate line in Table 4 for the chiller size and selected distribution pan to determine the proper water depth.

   Example: Falling film chiller, extra low-flow distribution pan; (4) 3 x 5 plates, 27 gpm recirculation flow. 27 gpm ÷ 4 plates = 6.75 gpm per plate. Referring to Table 4, this shows 2″ of water depth.

4. Using the water depth determined from step 3, adjust the recirculation water flow to obtain this water depth. The water level will require a few minutes to stabilize with each adjustment.

5. Reopen the makeup water supply and begin draining water from the reservoir so the makeup water solenoid will open. Continue draining water to adjust the makeup water flow.

6. Using the sizing information gathered for this chiller, obtain the total water depth required in the distribution pan. Adjust the makeup water valve to obtain this final level including the recirculation water depth calculated from above. The water level will require a few minutes to stabilize with each adjustment.

Contact Paul Mueller Company's Service Department at 1-800-756-5991 or DFETechService@paulmueller.com for assistance with obtaining sizing data for the chiller.

TABLE 4: DISTRIBUTION PAN WATER FLOW RATES

Distribution Pan Distribution	Plate Size	Water Flow Rate (GPM) Per Plate vs. Height of Water in Pan															
		1″	1.25″	1.5″	1.75″	2″	2.25″	2.5″	2.75″	3″	3.25″	3.5″	3.75″	4″	4.25″	4.5″	4.75″
High Flow	3′ x 5′	14.7	17.8	19.8	21.1	22.3	23.5	24.6	25.5	26.3	27.4	28.2	29				
Low Flow	3′ x 5′		9.1	9.9	10.7	11.3	11.9	12.5	12.9	13.5	13.9	14.3					
Extra Low Flow	3′ x 5′			5.8	6.4	6.75	7.2	7.45	7.8	8.15	8.4	8.65	8.95				
High Flow	4′ x 8′				31	33.3	35.8	37.6	39.3	40.5	42.4	43.5	44.8	46.5	47.8	48.8	50.2
Low Flow	4′ x 8′				17.9	19.3	20.5	21.8	22.6	23.6	24.5	25.3	26.3	27.2	27.8	28.7	
Extra Low Flow	4′ x 8′			8.3	9.2	10	10.6	11.3	11.9	12.5	13	13.4	13.9	14.3	14.6	15.2	15.5

2.14 CLEANING THE SYSTEM

The entire water circulation system must be cleaned prior to startup. See Section 4.3 for startup system cleaning.

2.15 TEST RUNNING

After the refrigeration and water piping is completed, the flows are set, all the electrical connections are made, both water temperature sensors are installed, and the system has been cleaned, it is time to test run the system.

Start the circulating pump. After determining the chilled water system is operating properly, start the refrigeration system(s) and check the setpoints of the refrigeration units, as described in Section 3.

Section 3.0 – Condensing Unit Setup/Startup Procedures

3.1 REFRIGERANT CHARGING

IMPORTANT: EPA regulations require any technician performing refrigerant installation or service on a high-pressure appliance be certified as a Type II or Universal Technician in accordance with Section 608 of the Clean Air Act.

The initial charge for the condensing unit is specified in Table 5. The charges indicated represent the volume of refrigerant the condensing unit requires. This refrigerant volume does not account for refrigerant piping or evaporator volume.

Extra refrigerant will be necessary in the winter for the head pressure control valve to function as designed. The extra refrigerant must be sufficient enough in the receiver to flood the condenser and still maintain a "liquid seal" at the receiver outlet. To assure the proper refrigerant charge for winter conditions and to avoid nuisance high pressure trips in summer conditions, the extra refrigerant to flood the condenser should be weighed into the system when the system is operating with its summer charge. Make sure that all fans are on when adding the extra winter charge. Match the extra charge shown in Table 5 to the typical winter ambient temperature for the region the condensing unit is installed in.

Once the total refrigerant charge has been determined follow these steps to charge the condensing unit properly:

1. Triple evacuate the entire refrigeration system to 500 microns. Break the first and second evacuation with dry nitrogen. Make sure to leave all hoses connected through this process.

2. Following the third evacuation to 500 microns, keep the charging hoses connected to the low and high sides of the system and connect the yellow hose to a cylinder of new or reclaimed ARI 700-88 specifications refrigerant.

3. Weigh and record the gross weight of the refrigerant cylinder.

4. Purge any air from the manifold gauge hose, as specified by EPA Section 608, de-minimus release.

5. With the chiller circulation pump running, break the refrigeration system's vacuum with liquid refrigerant, charging into the liquid receiver on the high side of the system.

6. When the system pressure equalizes with the pressure of the refrigerant drum, energize the compressor.

7. While monitoring the gross weight of the refrigerant cylinder, weigh in the remaining charge in the liquid state into the suction side of the system up-stream of the suction accumulator.

8. The final charge will be dependent on two factors; the volume of the evaporator plates and the equivalent length of refrigeration piping. The sight glass must be clear with no bubbles for proper final operating charge.

TABLE 5: CONDENSING UNIT REFRIGERANT CHARGE*

Condensing Unit (HP)	Summer Charge (lb)	Extra Charge (lb) vs. Ambient Temperature						
		40°F	-20°F	0°F	20°F	40°F	60°F	Max Extra (lb)
8 and 10	10.9	15.0	14.6	13.9	12.8	11.1	3.8	17.6
15	21.2	21.7	21.2	20.2	18.7	16.1	11.0	25.5
20 and 25	39.8	21.7	21.2	20.2	18.7	16.1	11.0	25.5
30	44.8	32.2	31.4	29.9	27.6	23.8	16.3	37.8
35	52.2	32.2	31.4	29.9	27.6	23.8	16.3	37.8
40	60.5	47.9	46.7	44.5	41.1	35.5	24.2	56.3
50**	63.6	44.2	43.1	41.0	38.0	32.7	22.4	63.6
60**	84.1	64.3	62.8	59.8	55.3	47.7	32.6	84.0
70**	104.4	64.4	62.8	59.8	55.3	47.7	32.6	75.6
80**	121.0	95.8	93.4	89.0	82.2	71.0	48.4	112.6

**All table values are based on R-507, R-404A, and R-448A. To calculate for R-22 or R-134a, multiply the total by 1.12.*
***50–80 horsepower (HP) units are dual circuit. The listed charge is the sum of both units.*

3.2 PRESSURE SWITCH ADJUSTMENTS

The high- and low-pressure switches will need to be adjusted prior to startup of the condensing unit. Verify each pressure switch is set according to Table 6, below. It is important to verify the correct cut-in and cut-out of each pressure switch by using a manifold gauge. **DO NOT rely on the pressure switch pressure ranges alone to verify proper settings.**

TABLE 6: PRESSURE SWITCH SETTINGS

Refrigerant	High-Pressure Switch		Low-Pressure Switch	
	Cut-In	Cut-Out	Cut-In	Cut-Out
R-22	175	350	40	20
R-507	220	400	55	35
R-404A	220	400	55	35
R-448A	225	400	42	35

3.3 HEAD PRESSURE CONTROL VALVE ADJUSTMENT

The head pressure control valve is required to maintain stable head pressure when the outdoor ambient temperature falls. This condensing unit has an adjustable control, which is factory set at 180 psig for 8 HP condensing units and 200 psig for condensing units 10 HP and up.

IMPORTANT: This valve should *not* be adjusted unless it has been replaced.

If adjustment is required, the setting is increased by turning the adjusting stem clockwise and decreased by turning it counterclockwise. A 15 to 20 psi change in head pressure results from one complete turn of the adjusting stem. This adjustment should be made during low-ambient conditions.

3.4 PLATE SUPERHEAT ADJUSTMENT

IMPORTANT: Ensure the evaporator plates are receiving the proper water flows prior to making any superheat adjustments. See Section 2.12 for setting the correct water flows.

De-energize the hot gas solenoid valve and the liquid injection solenoid valve so these valves do not interfere with the plate superheat adjustment. Deactivation of these valves can be done by turning off the "PDS" toggle switch in the condensing unit electrical cabinet.

The evaporator plate superheat should be adjusted with a product temperature higher than what the final design product temperature requires to allow the condensing unit to operate while the adjustments are made. The superheat should be adjusted at the expansion valves located on the liquid line of the evaporator plate. Begin adjusting the superheat with a product temperature of 50°F. Take a pressure measurement at the suction Schrader valve located on the suction header. Measure the temperature at the expansion valve suction bulb location. Set the superheat at 12°F to 13°F, which is slightly high due to the 50°F product temperature. As the product temperature pulls down to the setpoint, the superheat should settle to around 8°F to 10°F. Make the necessary adjustments while the temperature continues to drop to ensure the correct superheat is achieved.

3.5 HOT GAS ADJUSTMENT

The hot gas valve's purpose is to maintain a 27°F evaporator saturation temperature to prevent water from freezing to the plates which could result in unwarranted equipment damage.

First, adjust the unload pressure switch (UPS) to operate the hot gas valve and liquid injection valve at the correct pressures. The UPS needs to cut-in at a 25°F saturated suction temperature and cut-out at a 30°F saturated suction temperature. See Table 7 for UPS pressure settings.

Next, unwire the liquid injection valve solenoid and energize the hot gas solenoid. As the product temperature approaches 36°F, measure the suction pressure at the compressor. Adjust the hot gas valve to maintain a 27°F evaporator. See Table 7 for hot gas valve pressure settings.

IMPORTANT: Observe the compressor superheat while making hot gas adjustments. The superheat of the compressor will increase while hot gassing, as there is no liquid injection at that time. To prevent the compressor from overheating, do not allow the compressor's superheat to get above 40°F. Also, the compressor's discharge temperature should not be allowed to exceed 200°F. The compressor superheat adjustment is discussed in Section 3.6.

TABLE 7: HOT GAS BYPASS SETTINGS

Refrigerant	Unload Pressure Switch (UPS) Settings		Hot Gas Valve Setting
	Cut-In Pressure Setting (psig)	Cut-Out Pressure Setting (psig)	Pressure Setting (psig)
R-22	48	55	51
R-507	65	73	68
R-448A	50	57	53
R-404A	62	69	65

3.6 LIQUID INJECTION ADJUSTMENT

Rewire and energize the liquid injection solenoid valve. At the compressor, check the superheat on the suction line. Open or close the liquid injection expansion valve to adjust the superheat at the compressor to maintain 20°F to 25°F. This should result in a compressor discharge temperature below 200°F.

3.7 AMBIENT FAN CYCLING CONTROL ADJUSTMENT

With all fans running, the condensing temperature will range from 15 to 20 degrees above the outdoor ambient temperature. If the resulting head pressure is too low for proper system operation, it can be raised by cycling fans off and on in response to changes in the outdoor ambient temperature. Fan cycling thermostats should be adjusted according to the number of condenser fans as shown in Table 8.

TABLE 8: AMBIENT FAN CONTROL SETTINGS

No. of Condenser Fans	Ambient Fan Control Setting (°F)			Minimum Outdoor Ambient
	Fan No. 1[1]	Fan No. 2 or 4[2]	Fan No. 3	
1	N/A	N/A	N/A	75
2 or 4	N/A	75	N/A	62
3	N/A	67	75	52

[1]Fan No. 1 is closest to the header end.
[2]Four fan units are duplex design and fans are cycled in pairs.

FIGURE 4: CONDENSING UNIT SCHEMATIC

IMPORTANT: The condensing unit schematics are for operational reference only. Please contact Paul Mueller Company's Refrigeration Products division for unit specific schematics.

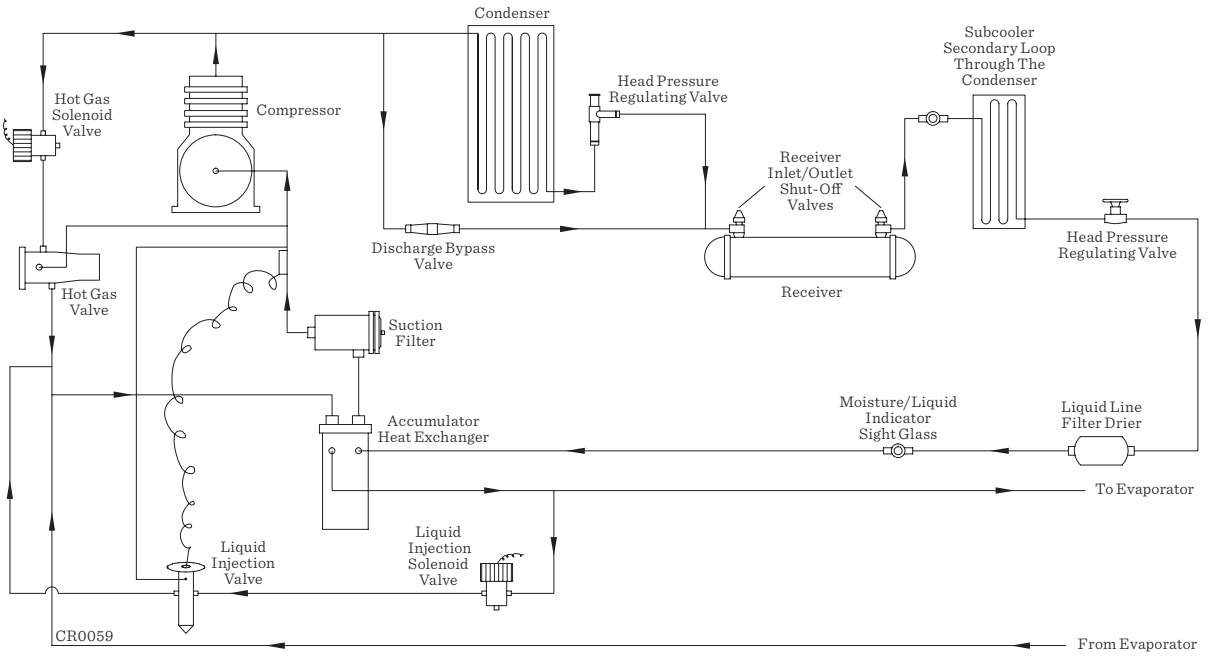
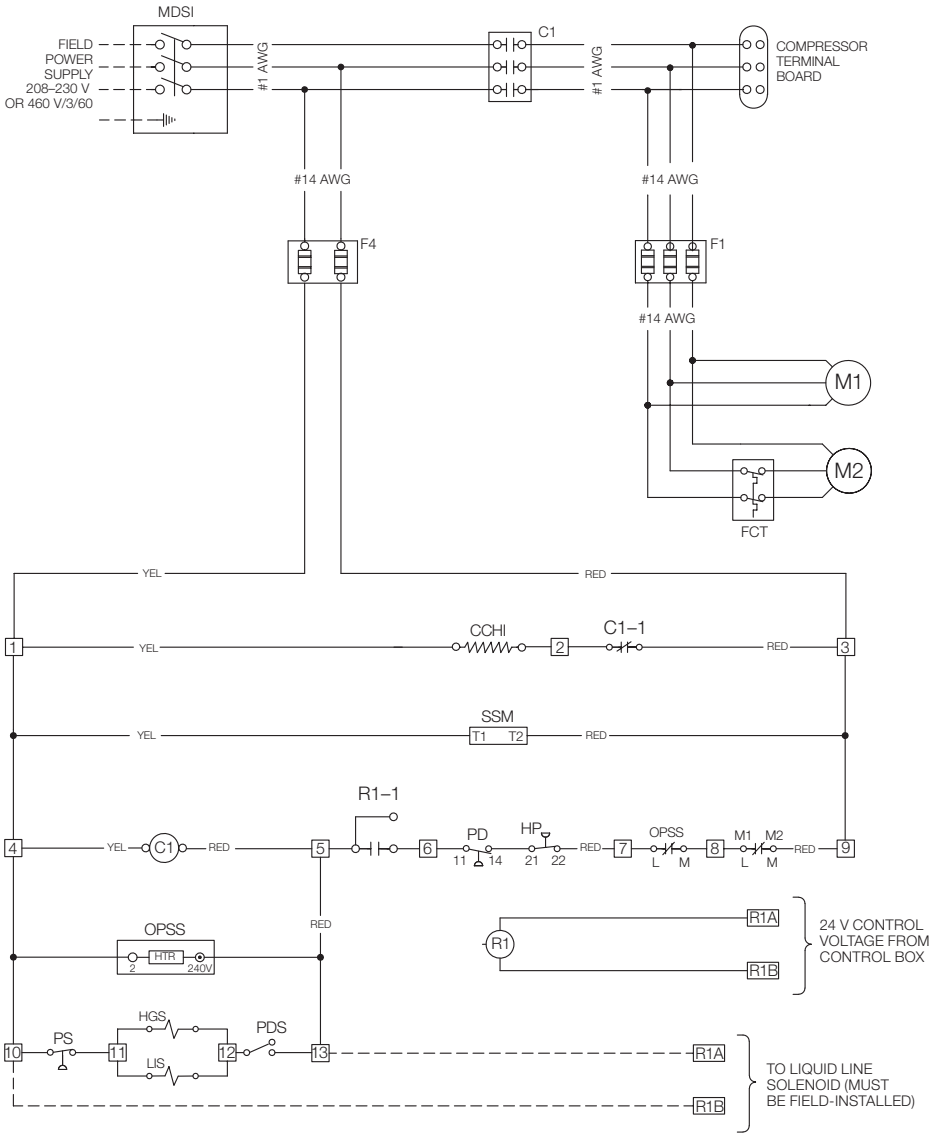


FIGURE 5: GENERAL WIRING SCHEMATIC

LEGEND

C1:	Compressor Contactor
C1–1:	Auxiliary Contact on C1
CCH1:	Crankcase Heater
F1:	Condenser Fan Motor Fuse
F4:	Control Circuit Fuse (Primary)
FCT:	Fan Cycling Thermostat
HGPS:	Hot Gas Pressure Switch
HGS:	Hot Gas Solenoid
HP:	High-Pressure Contacts (Dual Pressure Control)
LIS:	Liquid Injection Solenoid
M1–M2:	Condenser Fan Motors
MDS1:	Main Disconnect Switch
OPSS:	Oil Pressure Safety Switch
PD:	Pump-Down Contact (Dual Pressure Control)
PDS:	Pump-Down Switch
PS:	Pressure Switch
R1:	Control Relay
TF1:	Control Transformer
☐	Identifies Terminal Blocks
———	Factory Wired
— — — —	Field Wired

CR0060



NOTE- The above schematic is for reference only. Please contact Paul Muller Company for condensing unit-specific wiring diagrams.

Section 4.0 – Cleaning the System

4.1 GENERAL INFORMATION

Mueller falling film chillers must be cleaned prior to commissioning to remove any dirt or debris that may have accumulated during shipping and handling and periodically as maintenance.

4.2 CHEMICAL AND CLEANING CAUTIONS

- **Wear protective clothing and eye protection when handling caustic chemicals!**
- **Always observe the chemical manufacturer's precautions, warnings, and usage recommendations!**
- **Store all chemicals in a location protected from freezing, unauthorized access, and direct sunlight.**
- **Request a copy of the Safety Data Sheet (SDS) for each cleaning chemical in use. Keep these readily available and be familiar with the first aid instructions and emergency contacts in case of a chemical accident or spill.**
- **Keep all chemicals out of reach of children.**
- **Only use cleaning solutions and materials specifically recommended for stainless steel approved for food handling equipment.**
- **Never use more chemical than called for by the chemical manufacturer's instructions. Excessive use of cleaning chemicals can corrode and cause permanent damage to stainless steel.**
- **Do not sanitize your chiller with solutions containing in excess of 200 parts per million (ppm) of chlorine. This can cause permanent damage and corrosion to the stainless steel.**
- **Never mix any chlorine containing compounds with acid. This can result in damage to the stainless steel and can generate a hazardous gas dangerous to your health.**
- **Never wash the chiller with water temperatures exceeding 160°F.**
- **Never allow tools, clamps, or other wet objects to lie on the surface of the chiller.**
- **Keep all surfaces of the chiller clean.**
- **Never use abrasive materials on the stainless steel.**
- **Never put cleaning chemicals in an empty chiller. Always mix cleaning chemicals with water first for proper chemical dilution.**

4.3 CLEANING THE SYSTEM: STARTUP

IMPORTANT: The system should be cleaned before the reservoir is filled. This will retard the growth of algae, which could result in fouling of the distribution pan.

Before filling the reservoir with water, perform the following cleaning procedures:

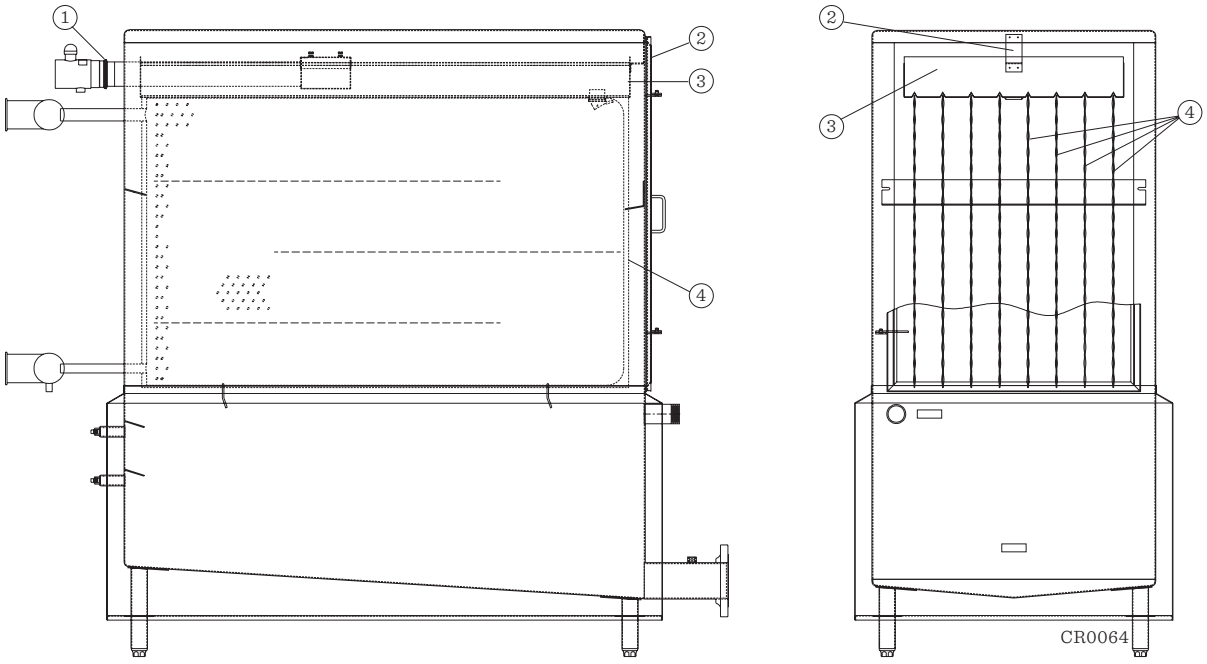
1. Remove all dirt, paper, and any other debris that accumulated during shipment and installation.
2. Fill the reservoir with 30 to 50 gallons of water, and operate the circulating pump with the refrigeration compressor turned off.
3. Check all liquid solution piping and components for leaks. Confirm the system has no leaks, and then drain the reservoir and proceed with the outlined cleaning procedure.
4. Fill the reservoir with approximately 50 gallons of 160°F water and 8 pounds of high-quality trisodium phosphate. (Mix the trisodium phosphate with water before pouring into the reservoir.)
5. Operate the circulating pump for 30 minutes with the refrigeration unit(s) off. During this time, brush the inside of the reservoir with a nylon bristle brush to clean the areas not submerged.
6. Drain the wash solution, and then fill with 30 to 50 gallons of lukewarm rinse water.
7. Operate the circulating pump for 10 minutes while manually brushing the reservoir walls not submerged.
8. Drain the rinse water and fill the reservoir to within 8″ of the top with water.

IMPORTANT: Do not use standard softened water, as there is an increased possibility of chloride corrosion to the stainless steel evaporator or remote, secondary plate heat exchanger.

4.4 CLEANING THE SYSTEM: PERIODIC INSPECTIONS AND CLEANING PROCEDURES

IMPORTANT: The system should be inspected and cleaned periodically to prevent the growth of algae and bacteria, which could result in fouling of the distribution pan. Due to the various applications of Mueller falling film chillers and the environment where the units operate, inspection and cleaning intervals vary. It is the responsibility of the end user/operator to determine the proper frequency of periodic inspections and cleanings.

FIGURE 6: CHILLER COMPONENTS



1. Tri-Clover Clamp
2. Support Bracket
3. Distribution Pan
4. Evaporator Plates

4.5 GENERAL INSPECTION PROCEDURES

Refer to Figure 6 for chiller component locations.

1. Inspect the ventilation filter and vent fan (if equipped) for cleanliness and proper operation. Clean or replace as needed.

2. While in operation, observe the water flow from the distribution pan (item 3) over the evaporator plates (item 4). If any holes in the pan are obstructed, clean the distribution pan and then the chiller, following the instructions in Section 4.6 and 4.7.

3. Inspect the interior of the chiller cabinet for cleanliness. If soil, algae, rust, or hard water stains are visible, follow the appropriate cleaning procedures in Section 4.6 and 4.7.

4.6 GENERAL DISTRIBUTION PAN CLEANING PROCEDURES

Refer to Figure 6 for chiller component locations.

1. Turn off the refrigeration, circulation pumps, and water level control.

2. Drain the reservoir. This may be accomplished by disconnecting the piping at the reservoir outlet or opening the drain valve in the field installed piping, if so equipped.

4.6 GENERAL DISTRIBUTION PAN CLEANING PROCEDURES (CONTINUED)

3. Remove the tri-clover clamp (item 1) at the water inlet connection on the distribution pan.

4. Remove the support bracket (item 2) inside the door which secures the chiller pan to the cabinet.

5. Remove the chiller pan (item 3) through the door of the chiller cabinet.

6. Prepare a solution of 160°F water and stainless steel safe detergent according to the manufacturer's directions.

7. Brush all surfaces of the distribution pan with a nylon bristled brush to loosen and remove any soil present.

8. Rinse the distribution pan with cool water.

9. Reinstall the pan and proceed with Section 4.7, "General Chiller Cleaning Procedures," beginning at step 3.

4.7 GENERAL CHILLER CLEANING PROCEDURES

Refer to Figure 6 for chiller component locations.

1. Turn off the refrigeration, circulation pumps, and water level control.

2. Drain the reservoir. This may be accomplished by disconnecting the piping at the reservoir outlet or opening the drain valve in the field installed piping, if so equipped.

3. Rinse the distribution pan (item 3), evaporator plates (item 4) and interior surfaces of the chiller with warm water (100°F to 120°F) to remove any loose soils and debris, if necessary.

4. Close the drain valve and fill the reservoir with approximately 50 gallons of 160°F water, then add the appropriate amount of stainless steel-safe detergent according to the manufacturer's directions.

5. Operate the circulation pump and brush the inside of the reservoir, distribution pan, and evaporator plates with a nylon bristle brush.

6. Drain the detergent solution and rinse all surfaces with clear warm (100°F to 120°F) water to remove all loose soils and remaining detergent.

7. If required, prepare a sanitizing solution by filling the reservoir with 30 to 50 gallons of water and mix according to the manufacturer's instructions.

CAUTION: Do not sanitize the chiller with solutions containing in excess of 200 parts per million (ppm) of chlorine. This can cause permanent damage and corrosion to the stainless steel. DO NOT mix chlorine sanitizers with water in excess of 100°F!

8. Operate the circulation pump and brush the inside of the reservoir and chiller with a nylon bristle brush to sanitize the areas that are not submerged.

9. Allow the sanitizing solution to drain fully from the chiller.

4.7 GENERAL CHILLER CLEANING PROCEDURES (CONTINUED)

10. Close the drain valve or reconnect the piping to the chiller reservoir outlet.

11. Turn on the water level control and refill the chiller reservoir. Flush the process lines to drain to ensure any remaining chemical is removed from the system.

12. Turn on the refrigeration and circulation pumps.

4.8 CLEANING THE SYSTEM: RUST AND HARD WATER STAIN REMOVAL

IMPORTANT: Clean, non-chlorinated water should be supplied to the chiller system. If the incoming water supply contains chlorine, it can cause rust of the non-wetted areas of the chiller system. Charcoal filters should be installed to remove the chlorine, and the ventilation filter and fan (if equipped) should be checked periodically to ensure cleanliness and proper operation.

4.9 RUST AND HARD WATER STAIN REMOVAL PROCEDURES

Refer to Figure 6 for chiller component locations.

1. Turn off the refrigeration, circulation pumps and water level control.

2. Clean the chiller following steps 1 through 6 of Section 4.7, "General Chiller Cleaning Procedures."

3. If the distribution pan (item 3) is fouled with hard water deposits or rust, remove it following steps 3 through 5 of Section 4.6, "Distribution Pan Cleaning Procedures." Otherwise, proceed to step 4.

4. Prepare a solution of Quick Brite Citrus (Part No. 8828543, one gallon) and room temperature water in a garden sprayer, mixed at a 1:1 ratio.

CAUTION: Do not heat the product or mix with hot water. Do not allow the product to dry on the surface.

5. Assemble a Doodle Bug mop head (Part No. 2800042) equipped with a white mop pad (Part No. 2800048, box of 5). Soak the pad in the prepared solution.

CAUTION: Do not use harsh abrasives, wire brushes, etc. to remove rust or hard water stains.

6. Wet the area to be cleaned with the prepared solution, then scrub with the grain of the stainless steel using the Doodle Bug mop. Continue applying the solution and scrubbing with the grain until the rust or hard water stains have been removed. A nylon bristled brush may be used to clean the distribution pan, if necessary.

7. After a few minutes, rinse the area with cold water. Continue applying the solution, scrubbing the area, and rinsing with cold water until the rust or hard water deposits have been removed.

8. Once the area has been cleaned, apply the 1:1 diluted solution to the cleaned areas and allow it to set for a few minutes, keeping the areas wet with the mixture, and then rinse with cold water. This will begin the passivation process.

9. Reinstall the distribution pan if it was removed.

4.9 RUST AND HARD WATER STAIN REMOVAL PROCEDURES (CONTINUED)

10. If required, prepare a sanitizing solution by filling the reservoir with 30-50 gallons of water and mix according to the manufacturer's instructions.

CAUTION: Do not sanitize the chiller with solutions containing in excess of 200 parts per million (ppm) of chlorine. This can cause permanent damage and corrosion to the stainless steel. DO NOT mix chlorine sanitizers with water in excess of 100°F!

11. Operate the circulation pump and brush the inside of the reservoir and chiller with a nylon bristle brush to sanitize the areas that are not submerged.

12. Allow the sanitizing solution to drain fully from the chiller.

13. Close the drain valve or reconnect the piping to the chiller reservoir outlet.

14. Turn on the water level control and refill the chiller reservoir. Flush the process lines to drain to ensure any remaining chemical is removed from the system.

15. Turn on the refrigeration and circulation pumps.

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