FALLING FILM CHILLER
INSTALLATION MANUAL

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MUELLER®

THE MILK COOLING SYSTEMS SPECIALISTS™

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SECTION 1.0 - INTRODUCTION

1.1 Model NS-R Standard Features

- Electronic control assembly with two temperature probes and two probe fittings for staging multiple refrigeration units and control of circulator pump.

- Constructed of Type 304 stainless steel.

- Designed for use with R-22, R-134A, R409A, MP39, R-502, or R-507. Each refrigeration plate will handle 44,000 BTUh of refrigeration.

- Nominal operating capacity of insulated tank:
  2 - 8 plates: 190 U.S. gallons
  7 - 12 plates: 300 U.S. gallons

- 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*
7 - 12 plates:	Inlet: dual extra low-flow pan 2" MPT	Outlet: 4" MPT*
	Inlet: dual low-flow pan 2" MPT	Outlet: 4" MPT*
	Inlet: dual high-flow pan 3" MPT	Outlet: 4" MPT*

  Note: *6" , 8", and 10" RFSO pipe flange available as an option.

- Make-up water float assembly is optional.

- Clamp-type ferrule and male pipe-thread adapter included for inlet.

- Falling film chiller expansion valves for each refrigeration plate are included.

- Refrigeration capacity and refrigerant type must be specified at time of ordering.

1.2 Model NS-R Required Water Flow Rates

a. Using high-flow distribution pan: Minimum flow rate: 14.7 gpm per plate
Maximum flow rate: 29.0 gpm per plate

b. Using low-flow distribution pan: Minimum flow rate: 9.1 gpm per plate
Maximum flow rate: 14.3 gpm per plate

c. Using extra-low-flow distribution pan: Minimum flow rate: 5.8 gpm per plate
Maximum flow rate: 8.95 gpm per plate

1.3 Model NS-R Dimensions

Model	Length	Width	Height	Shipping Weight
NS2-R to NS8-R	68 1/2"	39 1/4"	77 7/8"	1,075 lbs.
NS7-R to NS12-R	68 1/2"	60 1/2"	76"	1,570 lbs.

1.4 Model LNS-R Standard Features

- Electronic control assembly with two temperature probes and two probe fittings for staging multiple refrigeration units and control of circulator pump.

- Constructed of Type 304 stainless steel.

- Designed for use with R-22, R-134A, R409A, MP39, R-502, or R-507. Each refrigeration plate will handle 84,000 BTUh of refrigeration.

- Nominal operating capacity of insulated tank:
  2 - 8 plate 325 U.S. gallons
  9 - 16 plate 650 U.S. gallons

- Circulation water connection size:

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 plate	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*

  Note: *6" , 8", and 10" RFSO pipe flange available as an option.

- Make-up water float assembly is optional.

- Clamp-type ferrule and male pipe-thread adapter included for inlet.
- FFC expansion valves for each refrigeration plate are included.

- Refrigeration capacity and refrigerant type must be specified at time of ordering.

1.5 Model LNS-R Required Water Flow Rates

a. Using high-flow distribution pan: Minimum flow rate: 31.0 gpm per plate
Maximum flow rate: 50.2 gpm per plate

b. Using low-flow distribution pan: Minimum flow rate: 17.9 gpm per plate
Maximum flow rate: 28.7 gpm per plate

c. Using extra-low-flow distribution pan: Minimum flow rate: 8.3 gpm per plate
Maximum flow rate: 15.5 gpm per plate

1.6 Model LNS-R Dimensions

Model	Length	Width	Height	Shipping Weight
LNS2-R to LNS8-R	104 3/8"	39 1/8"	91"	1,575 lbs.
LNS9-R to LNS16-R	104 3/8"	72 3/8"	91"	2,010 lbs.

2.1 Inspection

It is important to inspect the chiller and parts for any damage when it is received. Note the damage on the bill of lading and file a claim immediately if needed. It is very difficult to obtain claims if the damage is not noted on the bill of lading with the driver's signature.

Open all packages and check against the bill of lading for shortages of parts. This allows you to order them immediately, before actual installation time.

2.2 Locating and Leveling the Chiller

The chiller should be located in a position as close as practical to the milk room and to the refrigeration units. A drain should be close by for draining the chiller.

When selecting a location for the Mueller Falling Film Chiller, disassembly for cleaning and the possible future addition of more vertical evaporator plates should be considered. To take full advantage of the "easy-clean" feature of the chiller, a 3' clearance should be left on each side of the chiller and a clearance equal to the length of the evaporator plate should be left at the end (opposite refrigeration connections).

The falling film chiller is equipped with four 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 provides for complete drainage of the holding tank.

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

Before going to the installation site, it will save time if you make a list of parts you need that are not furnished with the chiller. The following is a list you may wish to use as a guide. The quantity, size, and type will vary with each installation.

a. Refrigeration:
   - Liquid line tubing
   - Suction line tubing
   - Reducers
   - Elbows (if elbows are used, we recommend the long, radius type)
   - Refrigerant (R-22, 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 the evaporator temperatures, the lines will sweat excessively, so it will be necessary to cover refrigerant lines.)

2.3 Obtaining Parts (Continued)

b. Water Lines:
- Chilled water line: See Table 3 for recommended chilled water line size.
- Adapter: Tri-clamp to pipe thread. The 2" is Part No. 9840758; the 3" is Part No. 9840759.
- Fittings (elbows, tees, unions, valves, adapters, etc.)
- Circulating pump.
- Flow switch (please call for sizing).
- Overflow line: 3/4" PVC.
- Propylene glycol will be required if the cooling water is to be operated below 35°F. The addition of propylene glycol to obtain a 15°F freeze point is recommended.
- Deionized or distilled water should be used to fill the reservoir to prevent the minerals in the water from forming a slime on the walls of the reservoir and in the distribution pan.

2.4 Locating Refrigeration Units

Air flow *(for air-cooled condensing units only)*: There are several factors to consider when locating the refrigeration units, and the most important is air flow. Whether located inside or outside, it is absolutely necessary that the condenser have a supply of unrestricted fresh air. If the units are outside, a north-side or east-side location is much preferred with the unit air flow in the same direction as the prevailing winds. When units are located inside, it is very important that the louvers be at least the same dimension as the condensing unit face.

The bottom of the condenser must not be below the open area of the louver. 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 (cleaning the condensers, replacing the compressors, etc.).

Avoid areas with vacuum pump exhaust, feed dust, or other machines that would create dust or oil.

2.5 Connecting the Refrigerant Lines

We recommend you use a support to help arrange the lines in a neat and orderly manner. If one or two units are connected to the chiller at a time, you can make more efficient use of your vacuum pump and time.

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 — EPA Statement on Hydrochloro-fluorocarbon (HCFC): A substance that is released into the environment, HCFC contributes to a serious public health and environmental problem by depleting the ozone layer. Ozone layer depletion increases the risk of skin cancer and other diseases in humans and is harmful to plant and animal life. This equipment shall be serviced and disposed of only in accordance with EPA Section 608 Regulations and the Ozone Depleting Substances Regulation (Clean Environment Act.) N.B.

2.6 Refrigeration Capacity Sizing

Compatible with R-134A, R-409A, MP39, R-22, R-502, or R-507 refrigerants.

Each refrigeration plate is circuited to insure maximum refrigeration efficiency. Each NS-R model refrigeration plate will handle 44,000 BTUh of refrigeration and the LNS-R model will handle 84,000 BTUh. If conventional units are used, an expansion valve must be provided for each refrigeration plate. (Refer to Service Bulletin No. 1291.)

2.7 Water Line Connections

The water connections on the falling-film chiller will be male pipe thread or tri-clamp fitting 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.

We recommend you mount the pump reasonably close to the 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 should 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 for some reason.

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 will probably be necessary to insulate the chilled water lines or they will drip condensate at lower operating temperatures.

The piping between the Mueller falling film chiller and the Mueller Accu-Therm® plate heat exchanger should be Schedule-40 or -80 PVC, stainless steel, or copper pipe. Make any reducer connections at the Accu-Therm and install a union and shut-off valve in each line for service. (See Table 3 for recommended chilled water line sizing.)

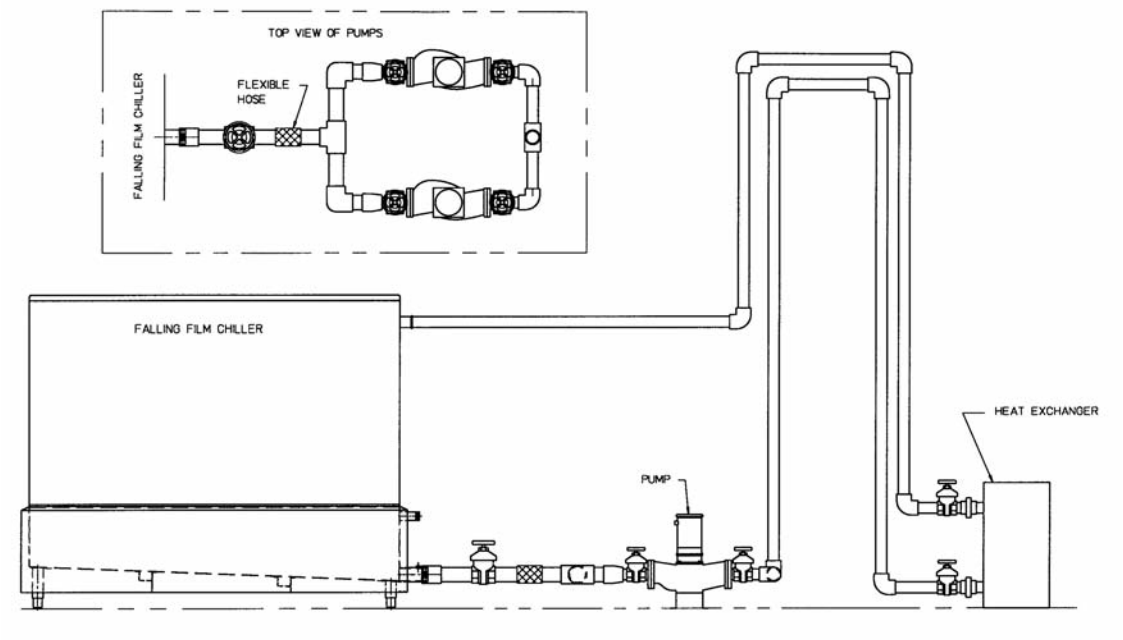
If PVC plastic pipe is used with solutions containing propylene glycol, the manufacturers' of PVC or CPVC pipe recommend that Schedule-80 purple primer and Schedule-80 gray adhesive be used. The following procedure should be used to assemble PVC or CPVC:

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 1 - Water Line Connections



2.8 Make-Up Water Valve

An optional water make-up valve is available but is not normally required.

There may be an increase in volume due to condensation if the unit is operated without the splash covers in place or if the unit is operated with chilled water at very low temperatures.

2.9 Chilled Water Holding Reservoir

The chilled water holding reservoir must be filled 8" from the top during operation of the chilled water circulating pump.

2.10 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.

2.11 Distribution Pan Water Flow Rates

For best efficiency, all of the returned water must flow over the refrigeration plates, and level in pan must be maintained at 3/4 full.

Table 1 - Distribution Pan Water Flow Rates

Model	Plate Size	Pan Type	Per Plate		Per Pan		Pan Connection Size
			Minimum Flow	Maximum Flow	Minimum Flow	Maximum Flow	
NS-R	3 x 5	Extra Low Flow	5.8	8.95	34.8	53.7	2"
	3 x 5	Low Flow	9.1	14.3	54.6	85.8	2"
	3 x 5	High Flow	14.7	29.0	88.2	174.0	3"
LNS-R	4 x 8	Extra Low Flow	8.3	15.5	66.4	124.0	4"
	4 x 8	Low Flow	17.9	28.7	143.2	229.6	4"
	4 x 8	High Flow	31.0	50.2	248.0	401.6	6"

Table 2 - Chilled Water Circulation Pump Capacities

Part No.	HP	Voltage	Inlet/Outlet Connections	Flow Range	Head Range	Replacement Seal Kit Part No.
8823401	1.5 hp	208-230/460/60/3	3", 4-bolt flange #125 Class	60-300 gpm	10-22 feet	8823404
8823400	1.5 hp	115/208-230/60/1	3", 4 bolt flange #125 Class	60-300 gpm	10-22 feet	8823404
8823403	2.0 hp	208-230/460/60/3	3", 4 bolt flange #125 Class	60-320 gpm	15-28 feet	8823404
8823402	2.0 hp	115/208-230/60/1	3", 4 bolt flange #125 Class	60-320 gpm	15-28 feet	8823404
8823271	3.0 hp	208-230/460/60/3	3", 4 bolt flange #125 Class	60-340 gpm	20-38 feet	8823404
8823272	5.0 hp	208-230/460/60/3	3", 4 bolt flange #125 Class	60-350 gpm	20-46 feet	8823405
8823273	5.0 hp	208-230/460/60/3	3", 4 bolt flange #125 Class	60-340 gpm	44-58 feet	8823405
8823121	7.5 hp	208-230/460/60/3	3", 4 bolt flange #125 Class	60-380 gpm	56-71 feet	8823405
8823324	3.0 hp	208-230/460/60/3 3,450 rpm	3", 4 bolt flange #125 Class	12-240 gpm	30-68 feet	8823406
8823784	3.0 hp	115/208-230/60/1 3,450 rpm	3", 4 bolt flange #125 Class	12-240 gpm	30-68 feet	8823406

Table 3 - Recommended Chilled Water Line Size

Recommended Suction Line Size			Recommended Discharge Line Size		
Line Size	Maximum Flow (gpm)	Velocity (ft/sec)	Line Size	Maximum Flow (gpm)	Velocity (ft/sec)
3"	70	3.04	1½"	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

Technical Notes:

1. Maximum velocity recommended on the suction line to the circulator pump is 2-3 FPS.
2. Maximum velocity recommended on the discharge line and through the PHE is 7-10 FPS.

2.12 Liquid Solution for Instant Cooling

If the system is to be used for instant cooling and operated at a liquid solution temperature at or below 34°F, the liquid solution must be protected with an approved propylene glycol to prevent failure of the evaporator by freezing. The propylene glycol liquid solution must be concentrated to obtain a minimum of 17°F freeze point.

Paul Mueller Company recommends Dowfrost™ propylene glycol, manufactured by Dow Chemical Company. Table 1 provides freeze points of Dowfrost solutions at specific concentration percentages. Please contact the Mueller Service Department for assistance in locating a local Dow Chemical dealer.

Table 4 - Typical Freezing Points of Aqueous Solution of Dowfrost

Volume % Dowfrost	Freezing Point °F
0.0	32.0
5.0	29.1
10.0	26.1
15.1	22.9
20.3	19.2
21.3	18.3
22.4	17.6
23.4	16.6
24.5	15.6
25.5	14.7
26.5	13.7
27.6	12.6
28.6	11.5
29.7	10.4
30.7	9.2

IMPORTANT: A refractometer designed for testing the freeze point of propylene glycol solutions should be used to determine the actual freeze point of the solution. Please contact the Mueller Service Department for assistance in locating a supplier of propylene glycol refractometers.

2.13 Installing the Sensors

A connection is provided on the water inlet connection to the distribution pan and on the water outlet connection from the reservoir. Utilize a 0.5" NPT cord grip to secure the sensor in the water stream.

2.14 Function of the Electronic Temperature Control

The temperature of the chilled liquid solution is monitored by two remote sensors that send a signal to the electronic temperature control which displays the temperature and controls the refrigeration system. The control is connected to the liquid solution flow switch and protects the evaporator(s) in case of a pump failure or flow stoppage by shutting off the compressor(s).

The control can be reprogrammed to a new set point and differentials by operation of the control buttons. See Multi-Stage Chiller Control Manual for wiring and programming.

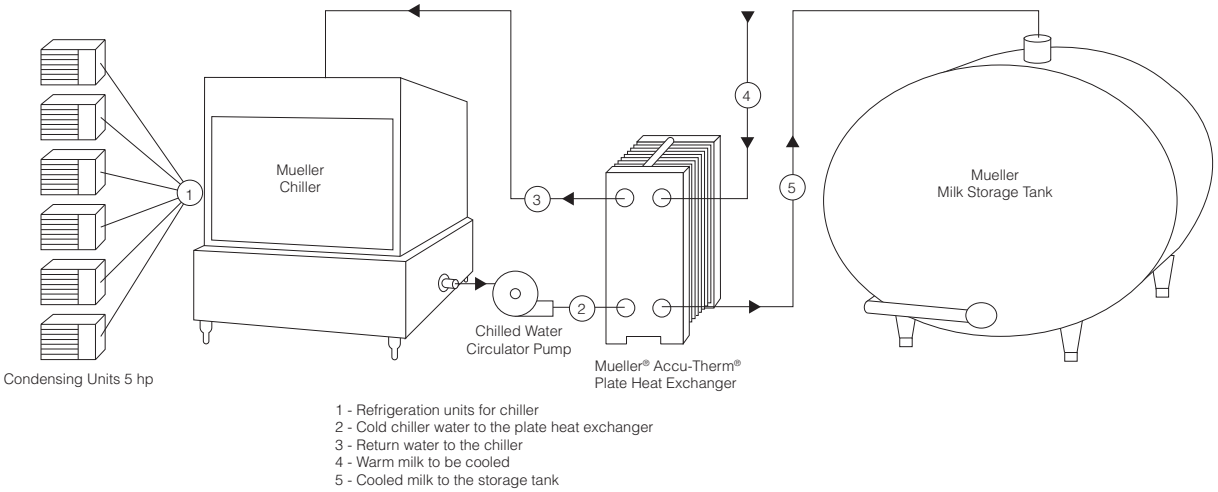
2.15 Electrical Wiring

1. We recommend you connect all the wiring before applying power to the system; however, to prevent damage to the compressors, the power should be connected to T1 and T2 of the condensing unit contactor at least four hours before starting the compressor. This is to energize the crankcase heaters in order to force any refrigerant out of the compressor oil which has migrated to the crankcase.

2. Connect the circulating pump and flow switch as shown in the multi-stage chiller control manual, Part No. 8825582.

3. If a compressor unloader is used, the stage controlling the unloader solenoid will need to be programmed to the heat mode.

2.16 Basic Cooling System Layout



2.17 Cleaning the System

It is very important that the system 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, you should follow the cleaning procedures as follows:

1. Remove all dirt, paper, and any other debris that accumulated during shipment and installation.

2. Fill the reservoir with 30-50 gallons of water and operate the circulating pump with the refrigeration compressor turned off. Check all liquid solution piping and components for leaks.
3. After confirming that the system has no leaks, 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 trisodium phosphate with water before pouring into reservoir.)

5. Operate the circulating pump for 30 minutes with the refrigeration unit(s) off. During this time, brush the inside of the reservoir to clean the areas that are not submerged.

6. Drain the wash solution and fill with 30-50 gallons of lukewarm rinse water.

7. Operate the circulating pump for 10 minutes while manually rinsing the reservoir walls that are not submerged.

8. Drain the rinse water and fill the reservoir to within 8" of the top with deionized or distilled water. Do not use softened water from a standard water softener as there is an increased possibility of chloride corrosion to the stainless steel evaporator or remote, secondary plate heat exchanger.

9. Never use chlorine as a bacteria inhibitor as it will cause premature failure of the plates within the remote, secondary plate heat exchanger. The water quality must meet the following standards:

    - Chlorides 25 ppm maximum
    - Sulfates 25 ppm maximum
    - Calcium 50 ppm maximum
    - Magnesium 50 ppm maximum
    - Total Hardness 100 ppm maximum

2.17 Cleaning the System (Continued)

10. If the system is to be used for instant cooling and operated at liquid solution temperatures below 34°F, the liquid solution must be protected with an approved propylene glycol with a minimum freeze point of 15°F. (See Section 2.12.)

11. Methyl paraben, a food-grade bacteria inhibitor, may be added to the initial chilled water solution to assist with the control of bacteria and algae formation. The proper dosage is 3.33 grams of methyl paraben per gallon of chilled water solution. 333-gram containers, sufficient to treat 100 gallons of solution, may be purchased from Paul Mueller Company by ordering Part No. 9841027.

    Note: Tungsten carbide pump seals are recommended when methyl paraben is used.

2.18 Test Running

1. After the refrigeration and water piping has been completed, all the electrical connections have been made, and the system has been cleaned, it is time to test run the system.

2. Start the circulating pump. When it is determined that the chilled-water system is operating properly, start the refrigeration system(s) and check the set points of the refrigeration units.

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