# INSTALLATION AND MAINTENANCE MANUAL

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# AIR COOLED FLUID COOLER

## MODELS

FSS/FSL 101A TO 603A

FDS/FDL 401B TO 1203B

## GENERAL

Closed circuit fluid coolers are practical heat rejection devices for use with relatively small capacity packaged refrigeration systems used for process cooling as well as specialized applications such as computer rooms. During most of the year, it will deliver cooled fluid temperatures approaching those obtained by a cooling tower. The fluid cooler circulates the fluid inside a finned tube coil specifically designed and circuited for the fluid to be cooled.

One of the problems the fluid cooler has in common with conventional cooling towers and evaporative cooled systems is operation in freezing climates. This is overcome by the use of anti-freeze. The most common anti-freeze is a 20% to 50% solution of ethylene or propylene glycol in water. The reduction in heat transfer capability caused by use of the anti-freeze is partially compensated for by the use of higher coolant flow rates. Even though additional energy is required to pump the coolant, it results in lowering the compressor head pressure. Operating with this reduced pressure has a greater effect on energy costs than does the higher water flow rate. Also, as there is no drift loss or evaporation in a closed coolant circuit. Anti-freeze must be replaced only in the event of a leak.

As with any equipment, proper installation and maintenance will improve performance and life expectancy.

## INSPECTION

Check all items against the bill of lading to make sure all crates and cartons have been received. If there is any damage, report it immediately to the carrier and file a claim. Make sure the voltage on the unit nameplate agrees with the power supply available.

## RIGGING AND HANDLING

FVAC 5 thru 19 model condensers are shipped on their sides, and all other FRAC / FVAC models are shipped flat. All units come shipped on a skid with a wooden skeleton frame to prevent damage in transit. Leave all framing attached until the unit is as close as possible to its final installed location.

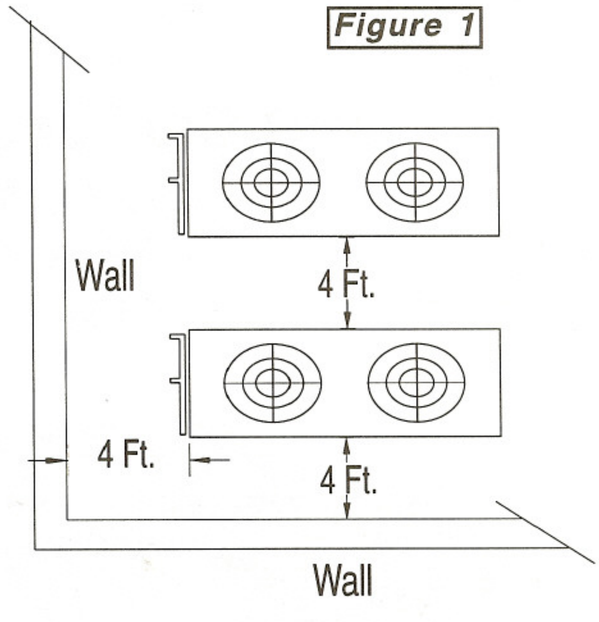
All units have built in lifting lugs. Use spreader bar(s) when necessary, failure to do so will damage the air cooled condenser. Never use the coil headers or return bends for moving or lifting the condenser.

## UNIT LOCATION

Do not locate any unit so as to be bordered by tall obstructions on three or more sides. See ***Figure 1*** for minimum clearance from obstructions and between units. Short circuiting of the air flow or the intake of warmer air from another unit will seriously degrade the performance of the fluid cooler. Noise consideration should be considered when locating an fluid cooler. Proximity to windows, walls, and surrounding structures can cause objections by the occupants. An acoustical expert should be consulted when noise is of a particular concern.

Structural supports and roof platforms should be sufficiently strong to support the fluid cooler operating weight. Consult with a professional structural engineer to determine safe platform loading.

***Figure 1***




## INSTALLATION

1. Design structural supports to carry the weight of the fluid cooler plus the fluid weight in the coil. If this is a roof installation provide suitable flashing of the roof. For ground level mounting, a concrete pad is recommended. Mounting holes permit the unit to be bolted down to withstand wind pressures.

2. The mounting legs of the fluid cooler are shipped in a recessed position. Raise the unit to lower the legs down and reinstall all fastener.

3. Level mounting is necessary to assure proper fluid distribution through the coil as well as a flooded suction for the pump.

4. Water piping must comply with local codes. Correct pipe sizing will help reduce pumping power and operating costs.

5. If in doubt, consult Russell for the fluid cooler fluid pressure drop at the specific conditions on your job.

6. Provide sufficient valves and unions to permit easy access to parts subject to wear and possible repair or replacement.

7. After fluid piping is completed, all joints should be leak tested.

8. Where city water make-up is required, follow local plumbing codes and make certain that disconnecting provisions are provided.

9. If the fluid cooler is supplied without starters, select starters and wire in accordance with nameplate data on the fan and pump motors. The installation must conform to local codes.

## PIPE INSTALLATION

The piping system should provide maximum leak prevention. Weld or sweat joints should be used where possible. If threaded pipe joints are used tightly drawn teflon tape should be sufficient. A possibility that the glycol solution or other heat transfer fluids will leak while water will not, should be considered during installation.

A glycol system should not use a pressure reducing valve. This is because a slight leak would lead to dilution of the glycol mixture. Any refill should be controlled so as to maintain the proper glycol-to-water ratio.

**Table 1** shows pressure drops for various pipe sizes at flow rates commonly used with a typical fluid cooler. These pipe sizes are standard connections actual size may vary according to available pump head. This can be determined by subtracting from the total available pump head at design flow, the condenser pressure drop and the fluid cooler pressure drop. Allow some safety factor for last minute pipe fittings added to the system and for eventual fouling of the system.

(a) Glycol piping requires no insulation except when fluid temperature will be below ambient dewpoint temperatures. Fluid coolers normally produce about 70°F or higher fluid temperatures.

(b) Vents are required at all high points in piping to bleed air when filling the system. If fluid coolers are at high points, vent valves should be installed at each fluid cooler.

(c) It is recommended that gate valves be installed on both sides of the pump to prevent loss of fluid in the event the pump should require repair or replacement.

## TABLE 1

Pressure Loss (Water) for a Typical Fluid Cooler

| Flow GPM | Pipe Size Steel | Type L O.D. Copper | Schedule 40 Steel Head Ft/100 Ft | Copper Tube Head Ft/100 Ft Equiv. Lgths. |
|---|---|---|---|---|
| 15 | 1" | 1-1/8" | 27.8 | 15.0 |
| 20 | 1" | 1-1/8" | 50.8 | 23.1 |
| 24 | - | 1-1/8" | - | 32.3 |
| 24 | 1-1/4" | 1-3/8" | 25.8 | 12.7 |
| 30 | 1-1/4" | 1-3/8" | 40.6 | 18.5 |
| 32 | 1-1/4" | 1-3/8" | 42.5 | 20.8 |
| 40 | - | 1-3/8" | - | 30.0 |
| 40 | 1-1/2" | 1-5/8" | 27.8 | 12.9 |
| 45 | 1-1/2" | 1-5/8" | 37.0 | 16.4 |
| 60 | - | 1-5/8" | - | 27.7 |
| 60 | 2" | 2-1/8" | 14.9 | 7.6 |
| 80 | 2" | 2-1/8" | 27.8 | 12.0 |

## TABLE 2

Pressure Drop Correction Factors:
50% Glycol Solution vs Water

| Fluid Temperature °F | Pressure Drop Correction @ Equal Flow | Total Pressure Drop Correction; 50% Glycol Flow (INcreased per Table 1) |
|---|---|---|
| 40 | 1.45 | 2.14 |
| 100 | 1.1 | 1.49 |
| 140 | 1.0 | 1.32 |
| 180 | 0.94 | 1.23 |
| 220 | 0.9 | 1.18 |

## FLUID CIRCULATING PUMP

Although Russell does not supply the circulation pump, this section is general reference to pumps. Please consult with the pump manufacturer for proper selection and installation.

Mechanical seal type pumps ***must*** be used for glycol systems. Gland type pumps will cause glycol waste, and if used with a pressure reducing valve will lead to dilution of the glycol mixture and eventual freeze-up.

Pump is selected for piping friction loss plus pressure drop through the fluid cooler coil, plus pressure drop through the heat source. **No allowance for vertical lift is made** since in a closed system a counterhead acts on the pump suction.

With glycol solution the pump performance curve will drift to the right from its design point because differences in circuit design: control valve application; pressure drop calculations; etc. The pump should be selected high on the curve so as to provide for the "drift". The pump curve should be "flat" so that the pump will compensate for the inability to exactly predict the final operating system flow condition and to provide sufficient flow for satisfactory heat transfer and maximum protection against freezing at the far end of the circuit. The pump motor should have sufficient power for operation over the entire pump curve, to prevent motor overload at reduced voltages.

Paralleled pumps can also be used for good power economy and continuous and automatic standby operations. Properly applied parallel pumps will guard against systems breakdown caused by a simple pump failure. Certain older systems have non-operating stand-by pumps of equal capacity to the operating unit. We recommend paralleled pumps in continuous operation because they provide practically the same type of stand-by, in addition to being completely automatic.

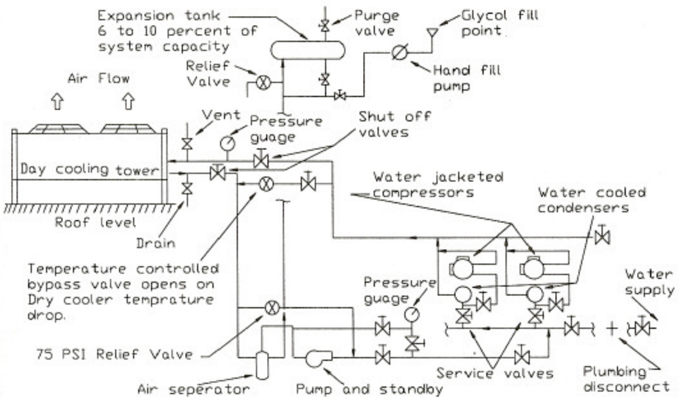



Figure 2

## START - UP

1. Check for correct fluid cooler fan rotation. This can be done by quickly jogging the fan contactor. Be sure that the fans run freely. The same check is recom-mended for pumps.
2. **Fill Procedure:** After being certain that the system is pressure-tight and leak-free, fill fluid through the charging valve located in the line between the expan-sion tank and air separator (***See Figure 2***). Continue fill procedure until gauge installed at the system high point reads approximately 4 PSIG. This will assure a completely filled system. Open manual air vent installed at system high point maintaining gauge pressure. Repeat this procedure until all air is released from piping. Close the manual air vent tight ly and open the expansion tank level indicating valve until fluid appears at the valve opening. Fill valve is open and pressure on system is maintained at the high point while this operation is taking place. Once fluid is sighted coming from the level indicating valve - close quickly. This indicates that sufficient fluid has entered the tank and system. Simultaneously the fill valve should be closed and the fluid source disconnected from the valve. If the gauge pressure at the system high point should be substantially above 4 PSIG, merely open the charging valve slightly until pressure drops back. Now the fluid circulating pump is started. Observe discharge gauge pressure until proper flow is being delivered, but adjusting the valve until the gauge shows the pressure necessary to make pump deliver the required GPM according to the pump performance curve.

## GLYCOL FREEZE PROTECTION DESIGN

The most common coolant is a 20% to 50% solution of ethylene or propylene glycol anti-freeze in water.

Closed circuit glycol systems are used in areas where the outside air temperature may go below freez-ing. Effects of glycol on system design are mainly the following:

1. Heat transfer
   (a) Finned coils - glycol solution to air as compared with water to air coils.
   (b) Heat exchangers - water to glycol and refrigerant to glycol as compared with water to water and refrigerant to water heat exchangers.

2. Effect on heat transfer of a glycol-water solution compared with water (greater GPM requirements). **See Table 5.**

3. Greater pressure drop of glycol solutions compared with water.

4. Pump curve effect of glycol solution compared with water.

5. Corrosive effect of glycol solution compared with water.

6. Special installation requirements for glycol solutions compared with water.

## GLYCOL SLUDGE PREVENTION

Glycol systems may be subject to sludge forma-tion in coils, due to one or more of the following causes:

1. Reaction of the corrosion inhibitor with **galvanized piping** (Zinc).

2. Reaction of the glycol with chromate type water additives.

3. Reaction of the glycol with pipe dope, cutting oils, solder flux, and other system dirt.

Glycol manufacturers offer a specially inhibited glycol (formulated for snow melting systems) which does not react with Zinc. This glycol is also suitable for heat transfer systems. Glycol manufacturers also provide inhibitor check services on a regular basis.

Consequently, good glycol system design requires the following precautions:

1. No galvanized piping is to be used.

2. System piping must be thoroughly cleaned and flushed with a heated tri-sodium phosphate solution before filling with the water/glycol solution.

3. Do not use a chromate inhibitor treatment.

4. The glycol manufacturer should provide inhibitor check service and supply additional inhibitor as required.

## GLYCOL CHARGE

The amount of ethylene glycol required depends upon the following:

(a) The holding volume of the system which includes the holding capacity of the fluid cooler, the holding capacity of the inter-connecting piping (**Table 3**) and the holding capacity of the condenser. (**Table 8**).

(b) Percentage of glycol required by volume to provide protection at the design minimum outside temperature (**Table 4**).

### TABLE 3

Holding Capacity of Piping

| Steel Nominal Pipe Size | O.D. Copper | Holding Capacity per 100 Feet |
|---|---|---|
| 1" | 1-1/8" | 4.5 Gallons |
| 1-1/2" | 1-5/8" | 7.8 Gallons |
| 1-1/2" | 1-5/8" | 10.6 Gallons |
| 2" | 2-1/8" | 17.4 Gallons |

### TABLE 4

Percentage of Ethylene Glycol to be Added by Volume

| Percent (%) | 20% | 30% | 40% | 45% | 50% |
|---|---|---|---|---|---|
| Minimum Outside Design Temp. °F | +15 | +3 | -14 | -23 | -38 |

## CLOSED SYSTEM

In such a system the fluid being cooled does not come in contact with the atmosphere at any time. ***Figure 2*** shows a closed and sealed compression tank at the pump suction. The water-glycol system should be designed with a compression tank to prevent oxygen contamination and consequent corrosion, which is, perhaps, the most effective protective measure that can be used. In a closed system, the water soon becomes neutral because its initial corrosive oxygen charge is used up after a short period of time. The same will apply to the water-glycol system; therefore, it is important to design the system as a closed system to prevent oxygen contamination.

**Advantages:** Little or no make-up water is used so that no oxygen and other corrosive agents are added, and no scaling takes place so that system life is expanded. A more compact installation results due to elimination of open tanks.

With pressure-tight, leak-proof system, lower fluid volume issued lowering fill cost, especially in glycol systems or with other high-cost fluids.

Since fluid expands and contracts as temperatures change, provisions for this expansion must be made. An expansion (compression) tank is therefore required allowing the expansion of the heated fluid against the air pocket or in the compression tank. Expansion (compression) tanks are not furnished by Russell; contact your local wholesaler. To size the compression tank the following information must be known:

1. Total system volume in gallons (**See Tables 3,5 & 6** for fluid cooler and piping volume).
2. Vertical distance or head pressure in feet from compression tank to highest point in system.

### TABLE 5

Flow Requirement for Equal Heat Transfer
50% Glycol Solution vs Water

| Average Fluid °F | Flow Rate for 50% Glycol Solution (Water = 1.0) |
|---|---|
| 40 | 1.22 |
| 100 | 1.16 |
| 140 | 1.15 |
| 180 | 1.14 |
| 220 | 1.14 |

Sizing of the compression tank for the glycol system is not nearly as important as for water systems because of the high boiling point of a 50% glycol mixture. The glycol mixture does, however, have an expansion rate on the order of 1.2 times that of pure water. Therefore, the glycol system compression tank should have a volume at least 1.2 times that required for water.

**Table 6** shows multiplying factors when using a 50% glycol solution and other variable factors. Be certain to read the qualifications for tank selection.

It is recommended that a closed system with a compression tank be equipped with an air separator. Air separators are not supplied by Russell; contact your local plumbing wholesaler. The function of the air separator is to remove air absorbed by the water in the system and return it to the compression tank. Without the use of a separator eventual water logging of the compression tank may result, causing the relief valve to open due to excess water pressure, necessitating system refill.

Refer to the air separator sizing chart (**Table 7**) and install per schematic diagram ***Figure 2***. Tank selection is based on a maximum vertical distance of 18 feet between the highest point in the system and the compression tank. For each 2 foot vertical distance over 18 feet, add 5% to compression tank size.

## TABLE 6

Compression Tanks

| System Capacity in Gallons | Std. Tank Size or Volume in Gallons | Tank Size for 50% Ethylene Glycol by Volume |
|---|---|---|
| 0 to 50 | 3 | 4 |
| 50 to 100 | 6 | 8 |
| 100 to 300 | 15 | 24 |
| 300 to 600 | 30 | 40 |
| 600 to 1000 | 60 | 80 |
| 1000 to 2000 | 120 | 160 |
| 2000 to 3000 | 160 | 200 |
| 3000 to 4000 | 240 | 300 |
| 4000 to 5000 | 300 | 400 |
| 5000 to 6000 | 340 | 475 |
| 6000 to 8000 | 475 | 600 |
| 8000 to 10000 | 600 | 750 |

## TABLE 7

Suggested Air Separator Tank Size and Construction

| For Flow Rates Up To | Tank Diameter | Length | Air Vent Size | Min. in & out Connection | Drain Size |
|---|---|---|---|---|---|
| 20 GPM | 4" | 12" | 3/4" | 1-1/4" | 3/4" |
| 50 GPM | 6" | 18" | 3/4" | 2" | 3/4" |
| 80 GPM | 8" | 24" | 1" | 2-1/2" | 1" |
| 150 GPM | 10" | 30" | 1-1/4" | 3" | 1-1/4" |
| 200 GPM | 12" | 36" | 1-1/2" | 4" | 1-1/2" |
| 350 GPM | 16" | 48" | 2" | 6" | 2" |

## START - UP

Prior to start-up check the following items:

1. Check fans for freedom of movement.

2. Check and tighten all fan blade set screws, motor mounts, and mounting leg fasteners.

3. Check that the nameplate voltage matches the power supply voltage.

4. Upon start-up check the rotation of all fans to insure that air is being discharged up out of the fan discharges. If discharge is wrong, correct by reversing 2 of the motor leads in the junction box.

## MAINTENANCE

Maintenance of the fluid cooler is extremely important for extended life and peak performance. The following is a recommended maintenance schedule. Site conditions will dictate the frequency of maintenance plan. The equipment warranty does not cover corrosion, misuse, or misapplication of the condenser.

1. Shut all power off the fluid cooler and refrigeration system at the closest disconnect switch and use a lock to prevent others from turning power back on to the unit.

2. Remove fan guards.

3. Remove all large debris (leaves, paper, cardboard, plastic film, etc.) from the top as well beneath the unit. Keep the area clean around the cooler by removing loose debris around the fluid cooler.

4. Inspect the unit for damaged fins caused by the debris. Comb out any bent fins with fin comb. Inspect the unit for signs of corrosion. Note the area and amount of corrosion in your maintenance reports.

5. Should the heat transfer surface require cleaning use the following procedure. Use a cleaning solution that is compatible with the finned material and any protective coating that may have been applied to the heat transfer surface. Follow the cleaning instructions exactly as described by the manufacturer of the cleaning agent. It is extremely important that a proper rinse be applied to the core once the cleaning process is completed. Use a hose with a spray wand and rinse from the top of the unit only. Do not rinse from the underside as this will not properly flush the cleaning agent from the core. Any residue of cleaner left for any extended period will begin to corrode the heat transfer surface. It is recommended to use a detergent type cleaner like Cal-Clean as a cleaning solution.

6. Inspect all fan and motor fasteners for tightness before installing the fan guards.

7. Turn power back on to the system.

Special consideration should be taken for units that are installed up to 30 miles from a sea coast or body of salt water. These units should be inspected at least once every 3 months for corrosion and salt accumulation. The heat transfer surface should be rinsed thoroughly every 3 to 6 months. Once a year the heat transfer surface should be cleaned with an approved cleaning solution.