APC

APPLICATION NOTE #158

Pump Selection for InRow Glycol-Cooled Unit System ACRD20X

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Abstract

While pump packages are not directly supported from APC, a minimal design effort is required for the installer to select the necessary components to design and build the pump package for the condenser water / glycol mixture loop. This application note provides the installing contractor with necessary information regarding part selection and design for pump package needed for operation of the water / glycol mixture loop.

Introduction

The ACRD20X Series of InRow® RD cooling products has been equipped with a brazed plate condenser. Condensing of R410A refrigerant occurs in the brazed plate heat exchanger. Customers have an option to select either water or water / glycol mixture as the heat of rejection medium in the brazed plate condenser. Condenser water is typically supplied by a building cooling tower. A fluid-cooler is required for mixture of water / glycol cooled application. The ACRD20X Series of InRow RD cooling products is supported by a variety of fluid cooler selections from APC. (Note that the "X" in the ACRD20X model number represents the ACRD200 and ACRD201 products.) The available fluid cooler selections meet the world wide ambient temperature and power supply considerations.

This application note provides tables, figures, and other necessary information to help the installer select the electrical and electromechanical components required for a single or dual pump package. APC recommends the use of dual pump packages for redundancy. The wiring requirements between the pump package electrical box and the controller in the APC fluid cooler electrical box will also be covered; the controller in the fluid cooler electrical box will control the pump(s) in the pump package. The aspects included shall cover the following:

- Sizing and selection of the pump
- Electrical ladder diagram
- Selecting electrical components
- Interaction between pump package and UNT controller of APC provided dry-cooler for pump operation
- Typical piping diagram of water / glycol mixture loop with dual pump package

THIS DOCUMENT ASSUMES A READER THAT IS SKILLED IN THE FIELD OF HYDRONIC SYSTEMS. Ultimately it is the responsibility of those installing the pump package to assure compatibility, code compliance, and suitability of operation of the system. APC expresses no warranty or responsibility for the suitability and/or installation of associated components.

Furthermore, APC reserves the right to revoke the warranty on any such installation that does not fully comply with the minimal requirements set forth in this document.

Performance Requirements for Pump per One ACRD20X

The maximum glycol percentage in water / glycol mixture shall not exceed 40 percent by volume. The brazed plate condenser in the ACRD20X products is selected for maximum 110°F (43.3 °C) entering water / glycol mixture temperature and 125°F (51.6°C) outlet temperature; the required mixture flow-rate shall be about 10gpm (0.631 l/s). The minimum pipe size recommended between the indoor ACRD20X and the outdoor fluid cooler is 3/4" nominal copper pipe (7/8" od) for one ACRD20X unit. Velocities in pipes should not be above 7.5 ft/s (2.29 m/s) to prevent erosion in the pipes and excessive fluid pressure drop.

A pump shall be selected to overcome the total pressure drop in the water / glycol mixture loop at the required flow-rate and there should be some extra head for safety. Pressure drops for the ACRD20X products and fluid coolers can be seen in **Table 1**. The total pressure drop includes: ACRD20X pressure drop, fluid cooler pressure drop, and the piping pressure drop. If the customer chooses to have a larger fluid cooler for multiple ACRD20X units, APC application engineers shall be consulted for proper fluid cooler selection and necessary information. Piping pressure drop contains pipe frictional pressure drop and pressure drops of elbows, valves, strainers and other components in the loop; a typical piping diagram for dual pump package can be found below.

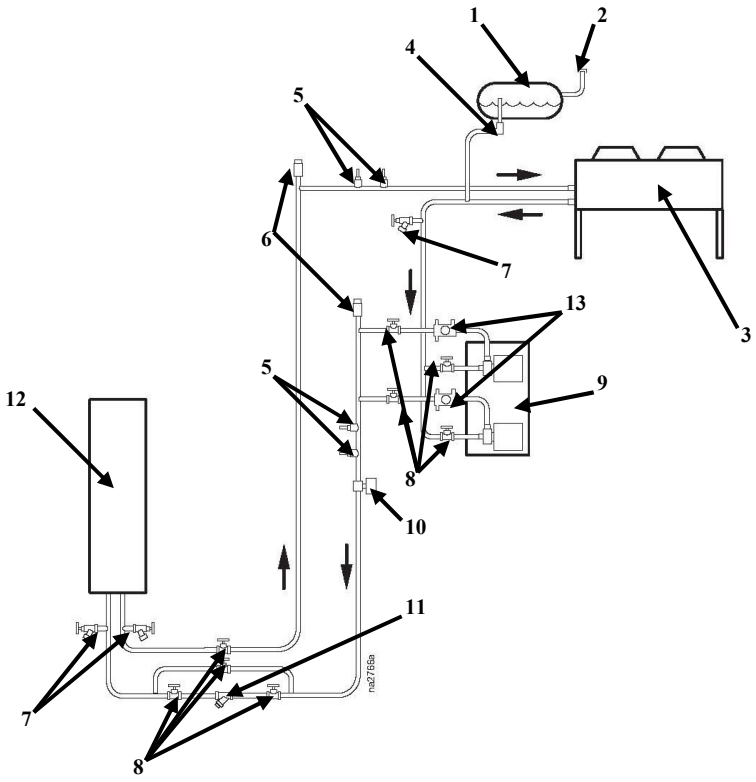
One of the pumps in the dual pump package is redundant and the dual pump package provides continuous operation of the ACRD20X unit in case of a pump failure; details of control and signal wiring will be explained in detail. **Table 2** shows equivalent length values of fittings and valves for various pipe sizes.

***Table 1** – InRow RD unit's and fluid cooler's pressure drop values at 10gpm (0.631 l/s) 40% Ethylene Glycol*

Product Name	APC SKU #	Manufacturer / Model	Pressure Drop Ft-H2O (psi)
InRow RD	ACRD20X	APC / ACRD20X	13.8 (6.0)
Fluid Cooler, NAM, 95F Ambient	ACFC75255	Larkin / PFG-5-8Feeds	14.0 (6.1)
Fluid Cooler, NAM, 105F Ambient	ACFC75210	Larkin / PFG-10-16Feeds	4.0 (1.7)
Fluid Cooler, EMEA, 95F Ambient	ACFC75256	Thermokey / EH1250.ADV 5Feeds	2.3 (1.0)
Fluid Cooler, EMEA, 95F Ambient	ACFC75257	Thermokey / EL1263.ADV 8Feeds	2.3 (1.0)

The piping diagram in **Figure 1** shows all the components needed in typical water/glycol mixture loop; total system pressure drop at a selected flow-rate shall be calculated for selecting the pump. Total system pressure drop and water/glycol mixture flow-rate, which is ~10gpm (0.631 l/s) per one ACRD20X unit, will be used to select the pump.

Figure 1 *– Glycol-cooled module with dual pump package*



1. Expansion tank
2. Tank fill
3. Fluid-cooler
4. Airtrol fitting
5. Temperature and pressure gauges
6. Air vent
7. Hose bibs
8. Gate valves
9. Pump package
10. Flow switch
11. Strainer
12. InRow RD
13. Circuit Setter

Pump manufacturers typically show performance curves for their pumps in a series on one figure; a pump curve of a specific pump model can also be obtained from vendors who have a more detailed figure which is easier to use and includes efficiency curves. The designer should also give special attention to net positive suction head characteristics of the pump selected. Net positive suction head available (NPSHA) shall be higher than net positive suction head required to prevent cavitations.

It is left up to the designers to select the type of pump for the pump package. The pump type selected shall be suitable for the application and the environment where the pump package will be installed.

***Table 2** – Equivalent lengths according to ASHRAE Standard (6ft/s 40% Ethylene Glycol)*

ASHRAE Standard Equivalent Lengths (6 ft/s 40% Ethylene Glycol)									
Sie of Nom. Pipe	Type of fitting or Valve - Equivalent Length of Pipe in Feet							1Ft Pipe Pressure	
In Inches	Std Elbow 90º	Long Turn Elb. 90º	Reduced Coupling	Gate Valve	Globe Valve	Tee Branch*	Tee Line*	psi / 1ft-pipe	H20 WC / 1ft-pipe
3/4	2.1	1.0	0.8	1.4	35.2	4.3	1.8	0.126	0.291
1	2.7	1.4	1.1	1.9	45.9	5.2	2.6	0.090	0.208
1 - 1/4	3.6	1.8	1.4	2.5	61.2	6.3	3.4	0.069	0.160
1 - 1/2	4.2	2.1	1.7	3.0	71.9	7.4	4.2	0.056	0.129
2	5.4	2.7	2.2	3.8	91.8	9.2	5.9	0.039	0.091
2 - 1/2	6.5	3.2	2.6	4.5	110.2	11.2	7.7	0.030	0.070
3	8.0	4.0	3.2	5.6	136.2	12.9	9.6	0.024	0.056

* Screwed Pipe Fitting

Performance Requirements for Pump per Multiple ACRD20Xs and APC InRoom Units

The same rules apply to select a pump when pump package supplies water/glycol mixture to multiple ACRD20X and APC InRoom units. The designer should work with an APC application engineer to select one or multiple dry-coolers for the system. Flow-rate of overall system and maximum pressure drop in the system shall be used for pump selection.

Pump Package Wiring Diagram

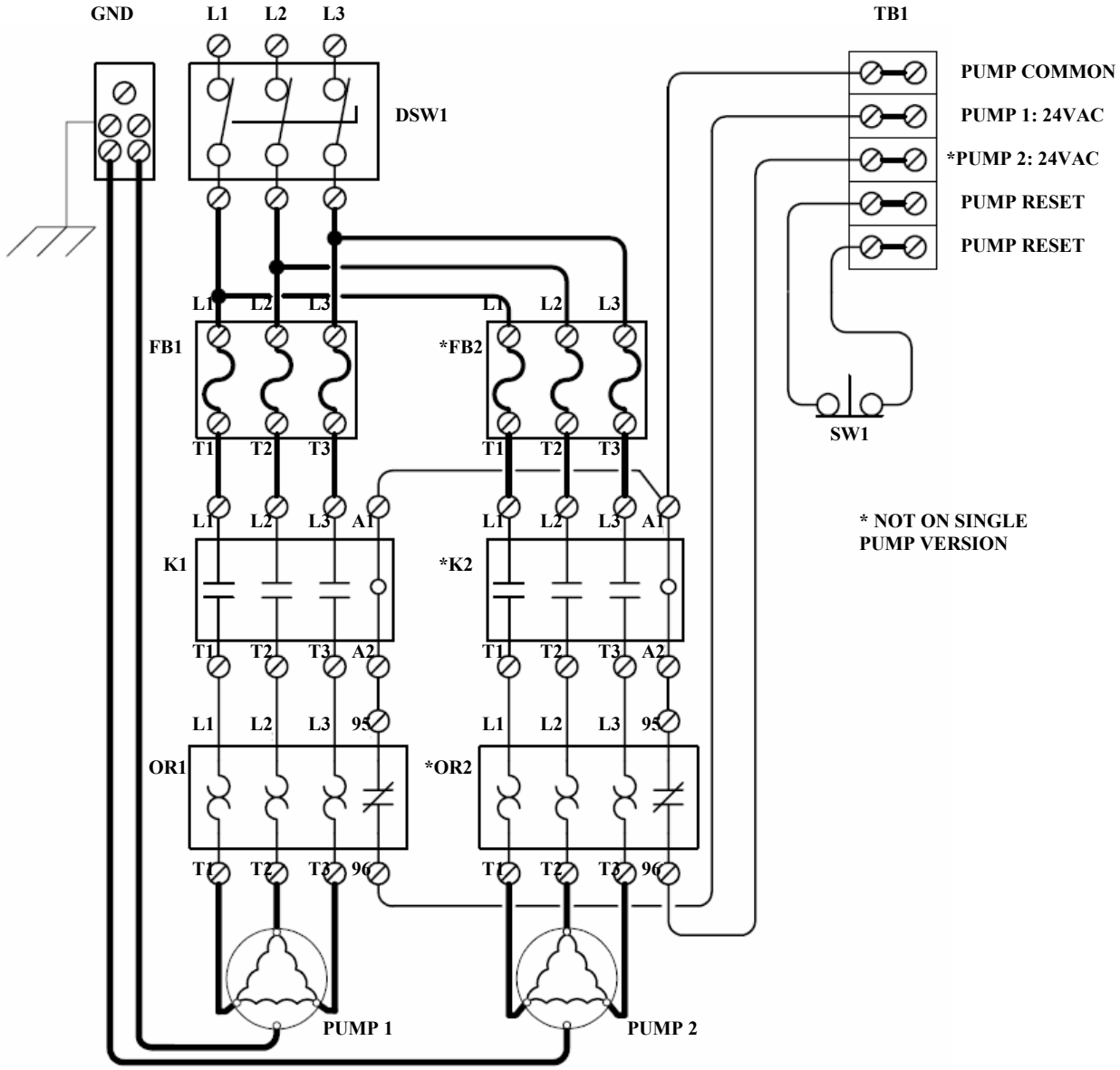
Ladder diagram shown in **Figure 2** was created for pump packages for APC Legacy products and will only work with a dry-cooler provided by APC. The pump package will not have any pump lead lag controller. The signal wiring must be done between all terminals at TB1 in the pump package electric panel and the controller in the dry-cooler. Details of the signal wiring and the operation can be found in **Figure 4** and **5**.

FB Fuse block

K Contactor

OR Overload relay

Figure 2 *– Pump package wiring diagram of APC's legacy pump package*



Electrical Component Selections

Pump package electrical panel and pump housing shall be designed according to local and national codes and the environment where the pump package is going to be installed. The pump used in examples below has an FLA value of 3.2 amps. **The local codes and regulations must be used when selecting all components.**

Contactor: One contactor per pump shall be used in the pump package. Use MCA, which is 125% of FLA or 3.2 * 1.25 = 4amps, for selecting the contactor; contactor rated operational current must be above MCA of the pump. Load side voltage rating of the contactor must be equal or higher than the pump voltage rating; contactor coil voltage shall be 24V. A contactor with 9 amp rated current can be used.

Fuse and Fuse Block: Selection method for fuses or another type of maximum current limitation device may change according to local codes and regulations. Please refer to the NEC and follow the local code at all times. One method is that rated current of a selected fuse shall be higher than 175% of pump's FLA. The fuse selected for our pump with 3.2 amps FLA shall be above 1.75 * 3.2 or 5.6amps. A 6 amp rated fuse is suitable for this application; 3 fuses will be used for 3 phase pumps. LP stands for low peak, and CC is the fuse class; the voltage rating is 600V and below. The time delay avoids unwanted fuse openings from surge currents. A fuse block which holds all three fuses for the pump is needed.

Overload Relay: Overload relay per pump is needed to protect the pump from wrong applications. Overload relay has a lower and upper limit; FLA of the pump shall be in between these limits.

Conductor and cord for the pump: Calculated MCA of a pump can be used for single pump. Calculate the MCA for the dual pump package for cord sizing.

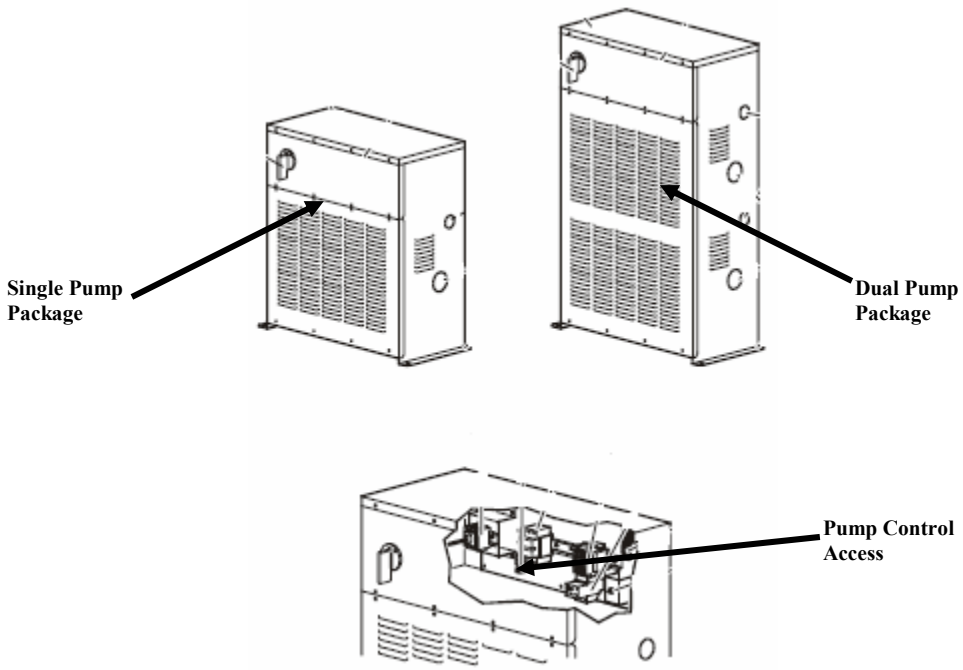
Reset switch: A reset switch is needed in the pump package; when a failed pump is replaced in a dual pump package, pressing the reset switch will enable the controller in the fluid-cooler to clear the pump alarm. Switch "2X901" from Grainger shown below can be used.

Type	Push Switch
Contact Rating @ 125V (Amps)	15
Contact Rating @ 250V (Amps)	10
Contact Form	SPST
Switch Function	On/Momentary Off
Number of Connections	2
Terminals	Screw
Mounting Hole (in.)	1/2" Dia.
Stem Length (in.)	9/16

Housing of the pump package shall have provisions for air ventilation for the pumps; the electric box of the pump package shall be designed to prevent rain entering into the box. Follow local and national codes and regulations for the design. **Figure 3** shows the APC legacy pump packages; front and side panels have louvers to provide adequate ventilation for the pumps that dissipate heat from pump motors.

The designer has the option to have different pump package housing design, and the pump package can be installed indoor or outdoor. The customer can also use a variable speed pump if desired. The location of the pump package should allow service personal to provide service or maintenance to any components in the pump package.

***Figure 3** – APC's legacy pump packages*



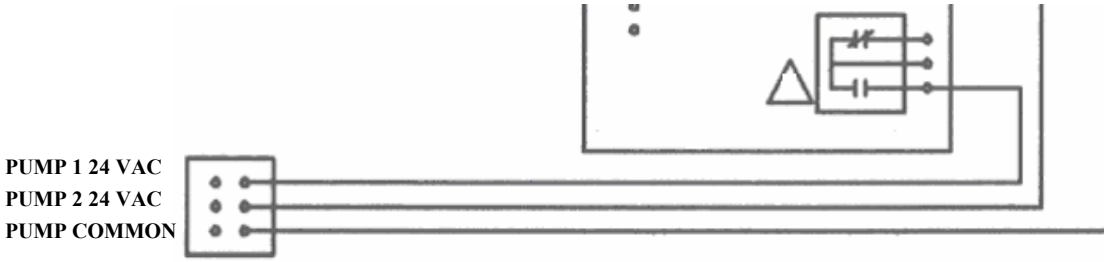
Pump Controls

To prevent buying a pump lead lag controller for the pump package, the customer should purchase an APC provided fluid-cooler which contains UNT controller from Johnson Control. A software application written for APC controls both pumps in the dual pump package and single pump in the single pump package. APC recommends having a dual pump package for continuous operation of ACRD20X unit in case of a pump failure.

There needs to be a total of five signal wires placed between the dual pump package and the APC provided fluid-cooler. **Figure 4** below shows the portion of the fluid-cooler wiring diagram. Three wires will be placed between TB1 in the pump package and TB2 of the fluid-cooler electric box. The controller in the fluid-cooler will only supply 24VAC for pump1 or pump2.

Pump reset switch signal wires should also be installed between TB1 in the pump package and the terminals 1 and 2 of TB4 in the fluid-cooler.

Figure 4 *– Portion of the fluid-cooler's wiring diagram for signal wire installment*

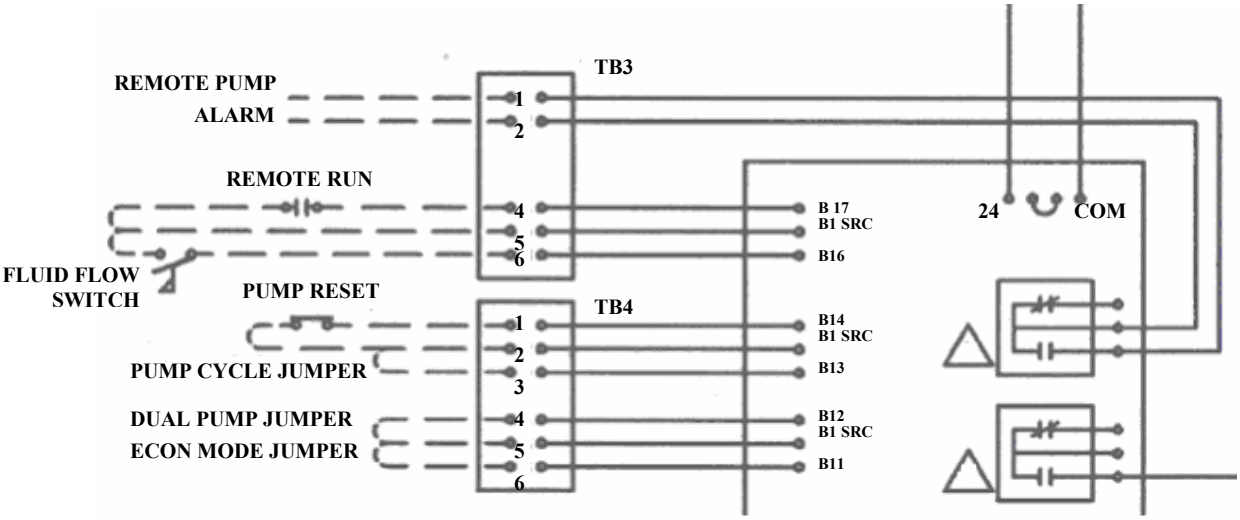


Remote alarm signal wires must be placed between terminal 1 and 2 of TB3 in the fluid-cooler and the ACRD20X unit so that an alarm can be generated if loss of flow is detected by the flow switch. Remote run signal wires shall also be placed between terminal 4 and 5 of TB3 in the fluid-cooler and the ACRD20X unit. More details can be found in the installation manual of ACRD20X units.

Jumper placements are shown in **Figure 5**, there is no economizer coil in the ACRD20X units and "Econ Mode Jumper" should not be placed. Dual pump jumper should be placed for dual pump packages; pump cycle jumper should be installed if the customer wants to switch the lead pump in every 50 hours of operation.

The lead pump will be an operational until it fails unless the pump cycle jumper is placed. In case of a pump failure, the flow switch will open and the other pump in the dual pump package will become the lead pump, thus generating an alarm in the ACRD20X. The failed pump shall be repaired promptly; the alarm condition in the fluid-cooler controller can be cleared by pressing the pump reset switch in the dual pump package for couple of seconds.

Figure 5 *– Portion of the fluid-cooler's wiring diagram for jumper placements*



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Ozan Tutunoglu is a Staff Mechanical Engineer in the Cooling Solutions division at American Power Conversion (APC). He received a Bachelors degree in mechanical engineering from Istanbul Technical University in Istanbul, Turkey and a Masters in mechanical engineering from Johns Hopkins University in Baltimore, MD and is a member of ASHRAE and ASME.