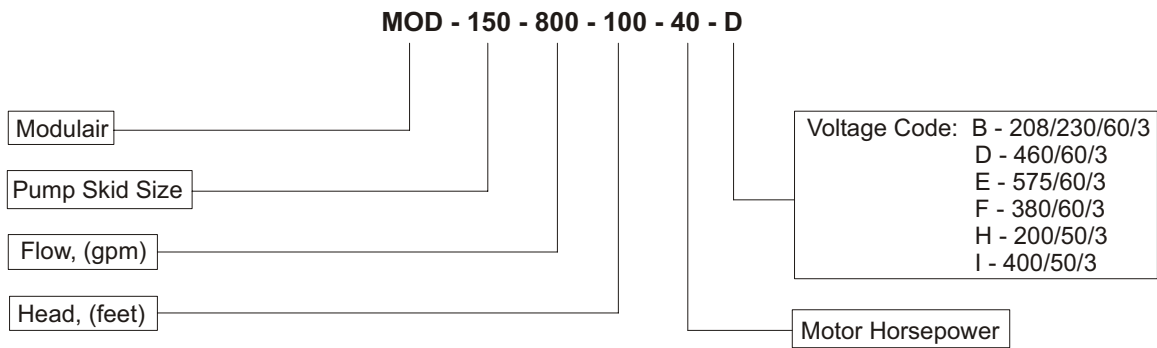


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1. MODEL NOMENCLATURE



2. GENERAL DESCRIPTION

Colmac Modulair Pump Skids are designed for closed loop cooling of water, ethylene glycol / water and propylene glycol / water solutions with air cooled fluid coolers for many power generation cooling applications such as gas turbines, diesel engines and fuel cells. The pump skids are available in a series of pre-engineered standard modules with a range of flows from 200 gpm to 2300 gpm with the following standard features:

- Two 100% full rated pumps and motors rated for continuous outdoor duty.
- Bladder type expansion tank prevents air contact with the glycol water.
- Design pressure 150 psig with 150# ANSI RF flanges except bladder tank is 125 psig.
- Heavy-duty TEFC motors high efficiency 1.15 SF with Class F insulation.
- Motors and switches are factory wired to a weatherproof NEMA 4 electrical enclosure to provide single point field wiring.
- Pressure switches to signal pump changeover and low liquid level alarm.
- Structural steel base with provision for lifting.

The pumps are heavy-duty ANSI standard end-suction centrifugal design flanged pumps.

- Open impeller with external adjustment and balanced to ISO standards.
- Ductile iron casing.
- Extra heavy-duty shaft and oil lubricated bearings minimum life (L_{10}) of two years.
- Industry Standard Mechanical Shaft Seal.
- Flexible type spacer shaft coupling.
- Fully enclosed OSHA compliant coupling guard.

3. RECEIVING

Inspect the equipment on receipt for shortages or damage. If a shortage or damage is found note the discrepancies on the delivery receipt. If a shortage or damage is found after unloading contact the carrier for a concealed damage inspection.

Colmac pump skids are provided with four holes in the steel base for lifting with slings and an overhead crane. Forklift trucks may be used providing the forks extend to the far side of the steel base.

4. INSTALLATION

MECHANICAL: Move the skid into position to line up with the manifold inlet flange before the mechanical anchors are installed. The fluid air cooler, pump skid and interconnecting manifold must be aligned and leveled. Install steel shims to adjust the height if necessary and add shims to fill any gaps under the support feet to avoid distorting the steel base. The cooler inlet manifold flanges are bolted to the fluid air cooler(s) first and final alignment is made at the manifold connection to the pump skid. In some cases the manifold connection flange and adjoining pipe are shipped loose for final fit up and welding in the field. Install a 1/8 inch shim between the flanges when welding to allow for the gasket thickness.

After the flange gaskets and bolts are installed tighten snug but do not torque. Next install the mechanical anchors at all the support legs and tighten down and then tighten the flange bolts. Do not force flanges to come together. If flanges are not parallel they may need to be removed and rewelded. Contact Colmac for instructions.

When the bladder tank is shipped separately install it after the skid is in position. Fit the connecting pipe and bolt the tank securely to the skid base. The residual pressure in the tank is 12 psig. Check the tank air pressure with a tire pressure gauge and add more air if required.

ELECTRICAL: Each Colmac Modulair Pump Skid is factory wired for single-point connection in the field to a weatherproof terminal box on the skid. Standard construction does not include contactors and fused disconnects which may be ordered as an option or supplied by others. All field wiring must comply with the National Electrical Code and all other state and local regulations. This includes providing proper and safe motor protection, fusing, disconnects and other basic equipment.

Check that the supply voltage matches the motor rated voltage. After the motors are connected rotate the pumps by hand to make certain they are not jammed. Then jog the pumps to check that rotation is correct as shown by the arrow on the pump casing. Change two of the electrical connections to reverse the rotation if necessary. The pump motor heaters should be connected and energized as soon as possible to keep the motors dry during commissioning. See the I.O. & M. instructions from the pump manufacturer for detailed instructions for checking the pump alignment and impeller end clearance.

DO NOT OPERATE THE PUMPS UNTIL THE ALIGNMENT HAS BEEN CHECKED AND THE SYSTEM IS FILLED. IMPROPER ALIGNMENT CAN LEAD TO PREMATURE FAILURE OF THE PUMPS.

5. FILLING

The pump skid schematic shown in Figure 1 illustrates the pipe connections and locations of valves. The pump skid is filled at the same time as the fluid air cooler and manifold using the 1 ¼ inch valve on the inlet header to the pumps. Open the vents during filling located on the pump outlet elbows, the outlet header and at the top of the bladder tank piping (for bladder tanks with a top connection). Clean water is suitable for flushing and testing in warm weather but when the temperature is below freezing a glycol /water solution is required. The external piping must be flushed before connecting to the fluid cooler and pump skid. When all the air is vented, shut off the valve to the expansion tank, pressurize the system and check all the flange joints for leaks. Retighten flange bolts where necessary.

Drain the flushing fluid and replace with clean demineralized water and glycol solution of the specified ratio repeating the filling and venting procedure. When the air is all vented open the

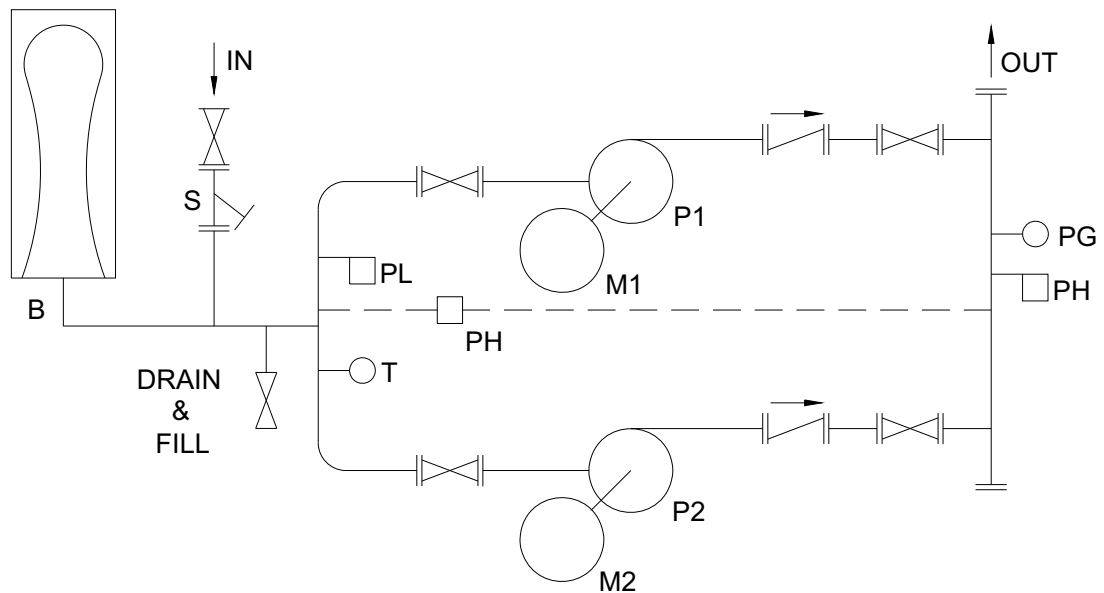
valve to the expansion tank and continue to pump more fluid into the system to bring it to the pressure that corresponds with the fluid temperature as shown in the table below.

System Pressure psig	17	24	32	38	43
Fluid Temperature °F	-30	+20	70	100	140

The expansion tank capacity determines the system operating pressure change. The pressure chart above is based on an expansion tank capacity equal to 5% of the total system volume using 50/50 glycol water. If the tank capacity is greater than 5% of the system volume the pressure change will be smaller.

As the system is filled the extra fluid will enter the expansion tank bladder compressing the tank air and causing the tank pressure to rise. In operation the pressure will increase as the fluid becomes warmer and fall as the fluid temperature falls. A loss of coolant will cause the pressure to fall eventually triggering the low-pressure alarm switch. This switch should be set about 5 psig below the minimum expected operating pressure.

PIPING SCHEMATIC



- T DIAL THERMOMETER
- PL LOW PRESSURE SWITCH
- PH HIGH PRESSURE SWITCH
- PG HIGH PRESSURE GAGE
- P1 PUMP 1
- P2 PUMP 2
- M1 MOTOR 1
- M2 MOTOR 2
- S FLANGED Y STRAINER
- B BLADDER TYPE EXPANSION TANK

Figure 1.

6. STORAGE

The pump skid may be stored outdoors but the pump motor heaters must be energized at all times. If the pump skid is to be stored or not operated for an extended period the pump motor heaters must be energized with a temporary power supply. The pump should be rotated at regular intervals to re-oil the bearings.

7. OPERATION

Successful operation of Colmac Modulair pump skid requires proper maintenance and operating conditions that do not exceed the design temperatures and flows. After all the venting is complete and the system is at operating pressure shut off the pump outlet valve and start the pump. Gradually open the valve for a few minutes then stop the pump and vent the system again. Repeat this start up procedure for the second pump. Next operate one of the pumps for two hours then remove and clean the strainer. To remove the strainer, close the valve at the strainer inlet, both pump inlet valves and the valve to the expansion tank. Open the drain valve to release the pressure and then remove the strainer cover. Clean the basket and replace it. Operate the system for another two hours and repeat the cleaning procedure. Continue to repeat the flush cycle for longer intervals until the basket remains clean then remove it and store for future use.

Check the pump performance by reading the pressure difference between the high and low pressure gauges and comparing the pump head to the pump curve. The motor current can also be used to check the actual B.H.P. compared to the pump performance curve. To set the pump pressure changeover switch, throttle the pump flow with the outlet valve until the pressure difference is about 70% of normal pressure then adjust the switch setting to trip at that point.

8. MAINTENANCE

Glycol/Water Mixture: The glycol/water solution must be maintained at the specified mix ratio to protect the fluid from freezing in cold weather. Maintain the concentration of corrosion inhibitors as supplied with the original fill. Glycol/water solutions can become corrosive after a few years if not maintained which can lead to corrosion of the system components and fouling of the inside of the cooler tubes.

Pumps: The pump bearings are oil lubricated and the oil level must be maintained. The oil level should be checked every 6 months or when there is any evidence of leaking oil. Details on pump maintenance are contained in the O.I. & M. manual provided by the pump manufacturer.

Expansion Tank: If the airside of the expansion tank loses air pressure recharge and test for leaks. Release the air pressure before attempting any repairs to the tank. If the rubber bladder develops a leak it can be replaced through the flanged opening. Refer to the instructions available from the bladder tank manufacturer.

Paint: Examine the steel painted components each year such as the skid base, expansion tank and piping. Repair any rusted areas by sanding to bare metal and repainting.

These instructions are intended for general use. If any difficulties are encountered please contact Colmac Coil Manufacturing Inc. for specific instructions.

Always provide the pump skid serial number or drawing when requesting information or parts.



LIMITED WARRANTY

Manufacturing Inc.

WARRANTY

Colmac warrants that the product manufactured by it will be of the kind and quality described in its specifications, and will be free of defects in workmanship and material. Should any failure to conform to this warranty appear within a period of one year from the date of original installation or eighteen months from date of shipment to the purchaser, whichever comes first, Colmac shall, upon prompt written notification thereof correct such non-conformity at its option, by repair or replacement F.O.B. factory, of the defective part or parts.

In no event shall Colmac be responsible for providing working access to the defect, the removal, disassembly, replacement or reinstallation of any product, materials or structures to the extent necessary to permit Colmac to perform its warranty obligations, or transportation costs to and from the Colmac factory. The conditions of any tests shall be mutually agreed upon and Colmac shall be notified of and may be present at all tests that may be made.

GENERAL WARRANTY

To validate a claim, Colmac reserves the right to require that defective parts be returned to the factory, transportation charges prepaid.

Filters, fan belts, refrigerants, and oil are not included. This warranty does not apply to products or parts damaged by accidents, abuse, improper installation, lack of proper maintenance, unauthorized alterations, misapplications, improper applications, fire, flood, or acts of God. Furnishing of parts as described above shall constitute fulfillment of all Colmac obligations with respect to the warranty and replacement parts will be warranted only for the unexpired portion of the original warranty.

Products supplied by Colmac, but manufactured by others, are warranted only to the extent of the manufacturer's warranty.

THE WARRANTIES SET FORTH IN THIS PROVISION ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER STATUTORY, EXPRESS OR IMPLIED (INCLUDING ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE AND ALL WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE), EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT.

The remedies provided above are the purchaser's sole remedies for any failure of Colmac to comply with its obligations. Correction of any non-conformity in the manner and for the period of time provided above shall constitute complete fulfillment of all the liabilities of Colmac whether the claims of the purchaser are based in contract, in tort (including negligence) or otherwise with respect to or arising out of the product furnished hereunder.

LIMITATION OF LIABILITY

Colmac, its contractors and suppliers shall not be liable in contract, in tort (including negligence and strict liability) or otherwise for damage or loss of other property or equipment, loss of profits or revenue, loss of use of equipment or power system, cost of capital, cost of purchased or replaced power or temporary equipment (including additional expenses incurred in using existing facilities), claims of customers of the purchaser or for any special, indirect, incidental, or consequential damages whatsoever.

The remedies of the purchaser set forth herein are exclusive and the liability of Colmac with respect to any contract, or anything done in connection therewith such as the performance of breach thereof, or from the manufacture, sale, delivery, resale, or use of any equipment covered by or furnished under the contract, whether in contract, in tort (including negligence and strict liability) or otherwise, shall not exceed the price of the equipment or part on which such liability is based.

See Selling Policy 1000 For Additional Terms and Conditions of Sale.

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