



QUALITY MANAGEMENT SYSTEM
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Installation, Operation and Maintenance Manual

COOLING WATER MIXING SKID (CWMS) 35, 80, and 140 GPM

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REVISION HISTORY

Rev. ID	Date	Notes
5	08/04	Added safety precautions to Rev. 4.
6	2/09	Miscellaneous text revisions. Updated kVA & dimensional data.
7	2/10	Changed Programming document number in Procedures section

WARNING notices as used in this manual apply to hazards or unsafe practices, which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in minor personal injury or property damage.

NOTES highlight procedures and contain information which assists the operator in understanding the information contained in this manual.

WARNING

Do not install, maintain, or operate this equipment without reading, understanding and following the proper Sentry Equipment Corp. instructions. Otherwise, injury or damage or both may result.

NOTICE

The information contained in this document is subject to change without notice.

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Normal business hours: 7:00 a.m. to 4:30 p.m. CST (U.S. Central Time), Monday through Friday.

SAFETY PRECAUTIONS

Please read the entire manual before attempting to unpack, set up or operate this product. Pay careful attention to all warnings, cautions and notes. Failure to do so could result in serious personal injury or equipment damage.

Use of Hazard Information

If multiple hazards exist, the signal word corresponding to the greatest hazard shall be used.

Definitions



Indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury.



CAUTION used without the safety alert symbol indicates a potentially hazardous situation, which if not avoided, may result in property damage.

NOTE

Information that requires special emphasis

SHALL

This word understood to be mandatory

SHOULD

This word understood to be advisory

⚠ WARNING

It is solely the responsibility of the user, through its own analysis and testing, to select products suitable for their specific application requirements, ensure they are properly installed, ensure that they are safely applied, ensure they are properly maintained, and limit their use to their intended purpose.

Improper selection, installation, or use can cause personal injury or property damage.

Sentry does not warrant against erosion and corrosion. Sentry makes no claims regarding suitability for specific use, and provides no warranty regarding material compatibility of elastomers in specific services.

⚠ WARNING

Hot Surfaces! This equipment may have very hot surfaces. If an operator contacts a hot surface, injury may occur. Use protective clothing to prevent injury. If other equipment comes in contact with a hot surface, damage to the equipment may occur. Ensure the area around this equipment is kept clear to prevent damage from occurring.

⚠ WARNING

High Pressures! This equipment may contain fluids at very high pressures. Prior to installing, removing or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is de-pressurized, the contents have been drained and the equipment is cool.

GENERAL INFORMATION

The Sentry Cooling Water Mixing Skid (CWMS) is used primarily where cooling water temperature is less than 75°F. The CWMS is designed to provide a continuous flow of cooling water at a specific temperature (generally 77°F) for process cooling applications. A CWMS regulates the temperature of the cooling water by controlling the flow rate of warm return water routed to drain. Cold make up water is added at the same rate to keep the temperature of the cooling water constant. A centrifugal pump delivers the required flow of cooling water to the process.

Each mixing skid is designated by the amount of cooling water flow it can deliver. This manual covers 35, 80, and 140 GPM cooling water mixing skids. Consult Sentry for information on special features and sizes.

SPECIFICATIONS

- Make up water line sized for entire cooling water flow rate
- Check valves at pump discharge on dual-pump skids
- Isolation valves at skid inlet and across pump
- Digital temperature indication
- Loss of flow alarm
- Optional dual pump

Pump Specifications

Centrifugal pump with close coupled 3-phase TEFC motor. Pumps are provided with inlet and outlet isolation valves and unions to facilitate pump maintenance.

Table 1

Model Number	Horsepower	Supply	Full Load (KVA)	Cooling Water (GPM) ⁽¹⁾
CWMS - 35	2.0 HP	480/3ø/60Hz	1.3	35
CWMS - 80	3.0 HP	480/3ø/60Hz	3.6	80
CWMS - 140	5.0 HP	480/3ø/60Hz	5.8	140

(1) Recirculating water flow based on 20 psid external pressure drop

Temperature Control

Temperature control is achieved by bleeding (warm) return water to drain and refilling with (cold) make up water. A PID controlled 2 way ball valve throttles the drain flow.

Accuracy

± 1°F of setpoint. Makeup water must be at least 1°F less than setpoint.

Make Up Water

Minimum 10 psig.

Dimensions

CWMS-35: 54" long x 48" wide x 38" high
 CWMS-80: 54" long x 54" wide x 38" high
 CWMS-140: 60" long x 54" wide x 41" high

Cooling Water

Cooling water must be provided at a minimum of 10 psi. The make up water piping is sized to accommodate the entire cooling water flow rate. If the cooling water temperature is close to or higher than the set point, the unit will maintain within 5°F of the cooling water temperature.

Electrical

480VAC \pm 10%, 3 phase, 60 Hz
NEMA Type 4 enclosure with disconnect

Instrumentation

Discharge temperature indication
Suction pressure indication
Bleed off valve PID controller

Bleed Off valve

Electrically actuated ball valve with a manual override. Accepts a 4-20 mA current from a PID controller.

Customer Connections

	35 GPM	80 GPM	140 GPM
Cooling Water In	1 ½" FPT	2" FPT	2 ½" 150# FLG
Cooling Water Out	1 ½" FPT	2" FPT	2 ½" 150# FLG
Make up Water In	1 ½" FPT	2" FPT	3" 150# FLG
Cooling Water Bleed Off	1 ½" FPT	2" FPT	3" 150# FLG

Options

- Manual controlled dual pumps.
- Dual pumps with automatic switchover.

PRINCIPLE OF OPERATION

Figure 1 is a demonstration of a CWMS in use. The primary components of a CWMS are the cooling water, temperature control, and make up water. A cooling water mixing skid can be ordered with a single pump, dual pumps with manual switchover, or dual pumps with automatic switchover. Standard cooling water flow rates are 35, 80, and 140 GPM. Figure 2, 3, and 4 are process and instrumentation diagrams of the three types of cooling water mixing skids. The component abbreviations in the following sections match symbols in the figures.

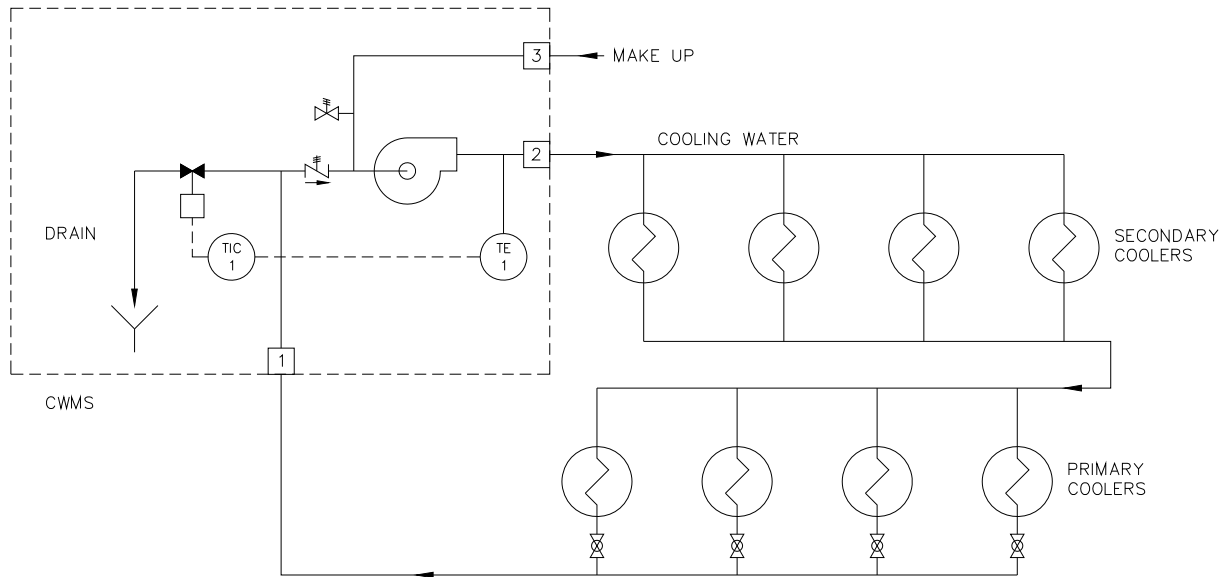


Figure 1: An example of a cooling water mixing skid in service.

Cooling Water

A cooling water mixing skid is designed to provide recirculating cooling water at a constant temperature. The cooling water is pumped to the process where it absorbs heat from the sample. Cooling water enters the inlet side of the CWMS and passes through valve V-3. Valve V-3 a globe valve, can be used for isolation or to throttle the flow rate of the system. Check valve CV-1 protects against make up water flowing through the bleed off system when the pump is not on. The pump has isolation valves V-1 on the suction and discharge for maintenance and removal of the pump. Valves V-1 are ball valves on the 35 and 80 GPM units and butterfly valves on the 140 GPM unit. Flow switch FS-1 will switch the pump off due to any loss of flow condition.

Temperature Control

Bleeding off some of the warm recirculating water controls cooling water temperature. Cold make up water is mixed with the recirculating water as it passes through the pump. The amount of make up water is equal to the amount of warm water discharged. Downstream of the pump a temperature sensor monitors the cooling water temperature. A PID controller (TIC-1) uses the sensed temperature to derive a 4-20 mA output signal. The current signal is sent to a 2 way

electronically actuated ball valve (TCV-1) placed in the bleed off line. The ball valve controls the amount of warm recirculating water sent to drain. In case of power failure the valve is manually adjustable. The control loop keeps the cooling water outlet temperature within 1°F of the setpoint. The PID controller also displays the cooling water outlet temperature. The cooling water temperature will never be less than the make up water temperature.

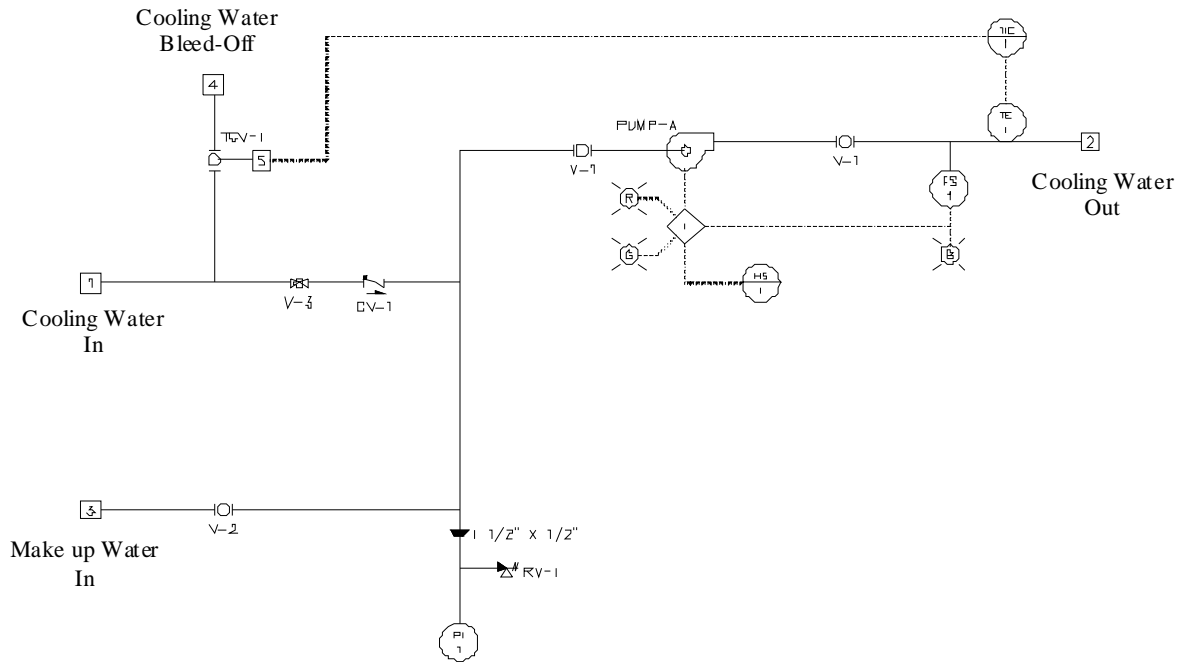


Figure 2: The process and instrumentation diagram for a single pump cooling water mixing skid.

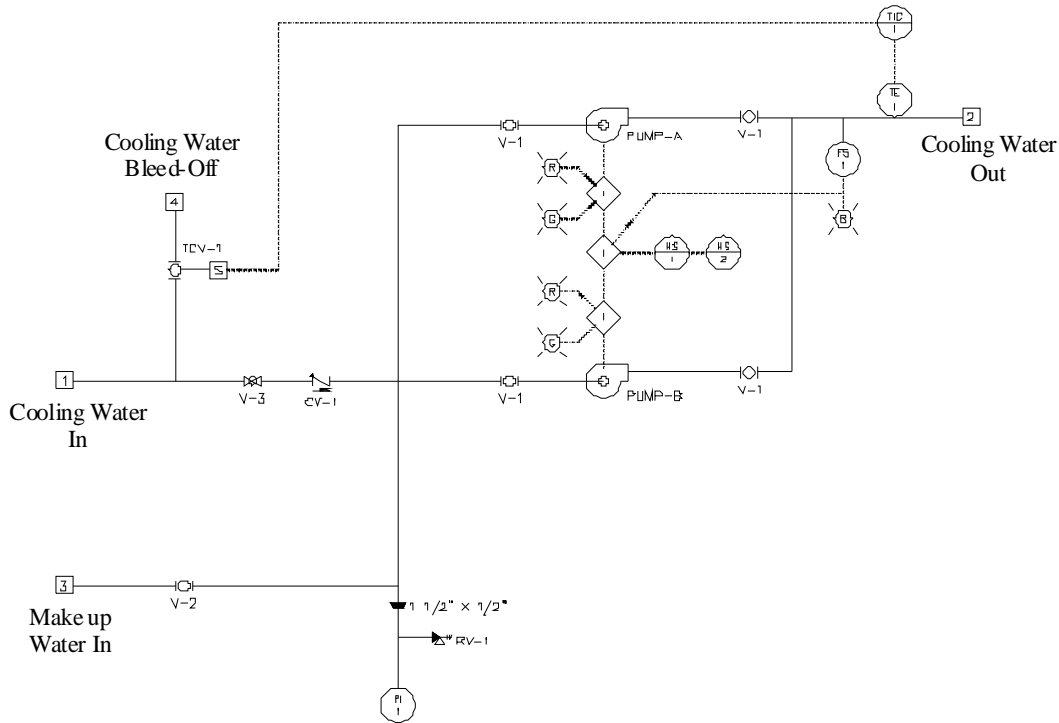


Figure 3: The process and instrumentation diagram for a dual pump cooling water mixing skid with manual switchover.

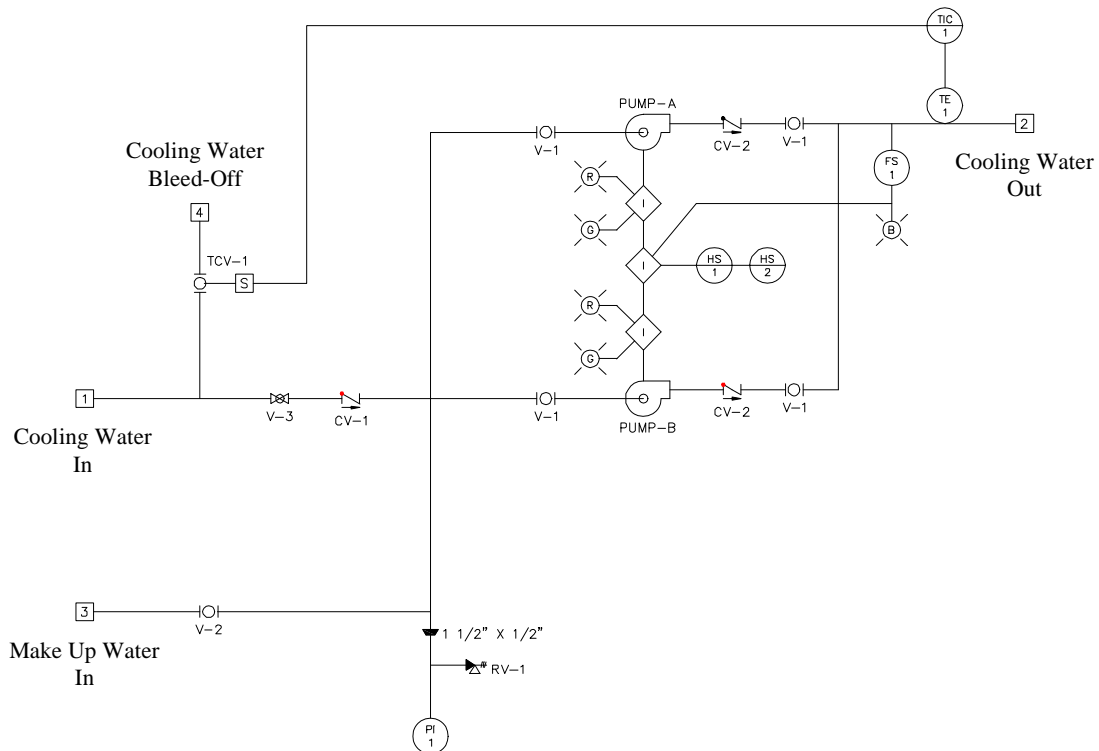


Figure 4: The process and instrumentation diagram for a dual pump cooling water mixing skid with automatic switchover.

Make-up Water

High quality make-up water must be supplied to the CWMS at a minimum of 10 psig. Water with high hardness is not recommended, it will cause scaling of the tubes in the coolers. Use of a corrosion inhibitor is suggested. The make-up water valve (V-2) should be fully open. Pump suction pressure will equal the make up water pressure. If the make up water pressure is above 80 psig a pressure reducing valve should be used. Relief valve, RV-1, will open at 100 psi. Pressure gauge (PI-1) displays the system pressure.

To maximize the efficiency of the CWMS the discharge flow rate should be minimized. Make up water flow and discharge flow are equal. Make up water flow can be calculated from some easily measured parameters. The amount of make up water used can be calculated with equation 1 or equation 2:

$$F_{Makeup} = \frac{Q}{(T_D - T_M) \cdot 500} \quad \text{Eq. (1)}$$

or

$$F_{Makeup} = F_c \cdot \frac{(T_D - T_C)}{(T_D - T_M)} \quad \text{Eq. (2)}$$

where: F_{makeup} = Make up water flow in GPM
 Q = total heat load in BTU/hr
 T_D = discharge water temperature in °F
 T_M = make up water temperature in °F
 T_C = cooling water out temperature in °F
 F_c = cooling water flow in GPM

Equation 1 was used to plot the graph in chart 1. Chart 1 clearly shows that to save make up water drive the temperature difference between the make up water and the discharge as high as possible. The discharge temperature can be raised by throttling V-3. Throttling V-3 will also reduce the total flow in the system. Care must be taken such that none of the coolers are starved of cooling water. Table 1 shows recommended minimum flow rates through Sentry coolers. Cooling water temperature at the outlet of a cooler should never exceed 140°F.

Table 1

Cooler Style	Primary Cooler Flow rate	Secondary Cooler Flow rate
TLF	5 GPM	3 GPM
FLF	8 GPM	5 GPM

Make Up Water Flow vs. Temperature Difference

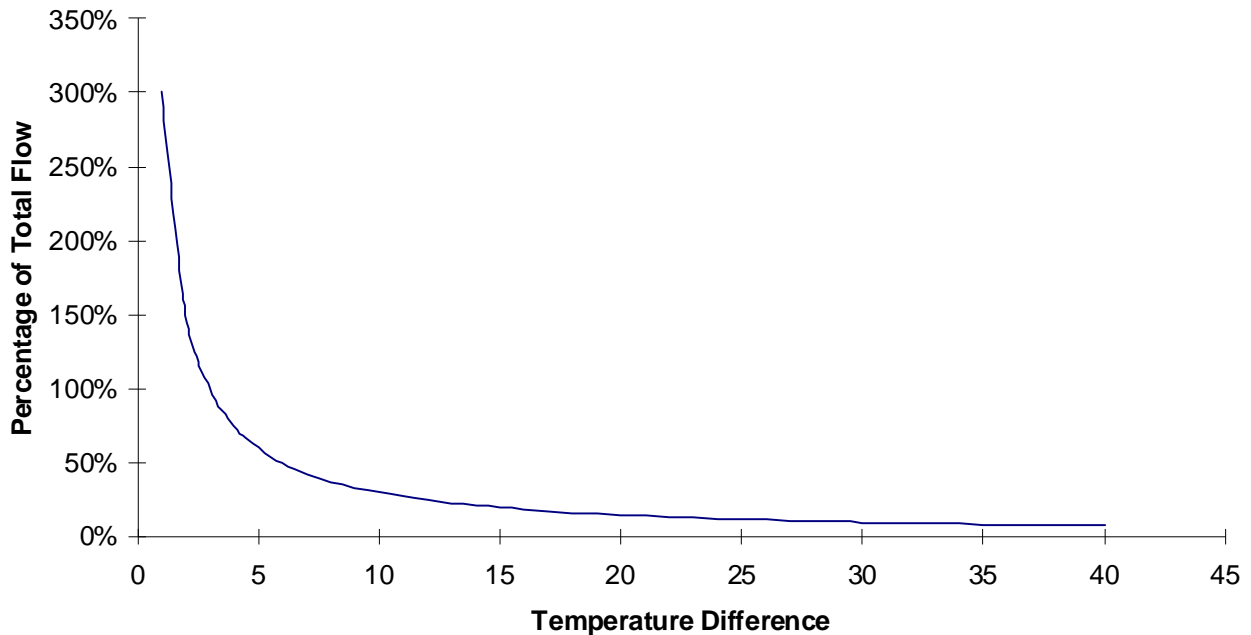


Chart 1: Make up water flow vs. the temperature difference between the discharge water and the make up water.

Often the discharge water is piped into a pressurized system. This way the water can be recovered and cooled in a central cooling loop. Throttling V-3 may be necessary to raise the pressure present at the bleed off outlet. With all the flow directed out the bleed off the pressure drop ranges from 2 psi for the 35 GPM unit up to 10 psi for the 140 GPM unit. The pressurized system will not limit the capacity of the CWMS if sufficient pressure is available at the bleed off outlet.

Dual Pump CWMS

As options to the basic single pump CWMS, Sentry provides the ability to incorporate redundant pumps. Figures 3 and 4 are process and instrumentation diagrams showing optional dual pumps. The dual pump configuration includes isolation valves for easy removal and service of the pumps and check valves to eliminate back flow. The dual pumps can be controlled manually or with automatic switchover. The pumps are controlled manually by a hand switch (HS-1). With automatic switchover, the flow switch (FS-1) senses low flow, shuts off the online pump, and starts the off-line pump. In the case of no flow after pump switchover, the CWMS will shut down.

INSTALLATION

▲WARNING

To ensure the protection provided by this equipment is not impaired, this equipment must not be installed or used in any manner other than that which is specified in this manual.

Receiving, Flushing and Mounting

- Examine the crate for any shipping damage. If in doubt, take photographs of the suspect area(s). Remove the CWMS and examine for any visible damage. Report damages to the freight handler immediately. This is the consignees' responsibility.
- Bolt the unit to the floor using ½" bolts, leave enough space around the unit for maintenance access.
- Refer to general arrangement drawing for process connection location and sizes.

Piping

Connect cooling water piping between the process application and CWMS with minimum pipe sizes in table 2. Provide a vent fitting at the high point of the cooling water piping. It is important to minimize the pressure drop in the external loop (max. 35 psid) as much as possible. Connect a clean water source to the makeup water connection.

Table 2

Filling

- Complete the piping. Open the skid isolation valve (V-3) and the isolation valves around the pump. Vents, make-up water isolation valve, and any valves in the cooling water piping must be opened.
- When water starts to come out of the cooler rack vent, close it. (assuming the

	35 GPM	80 GPM	140 GPM
Cooling water	1½"	2"	3"
Make-up water	1½"	2"	3"

cooler rack vent is higher than the CWMS vent).

Wiring

NOTE

Make all wiring connections in accordance with the National Electrical Code and all local regulations. Use copper conductors only. Do not exceed the equipments electrical rating.

- Check to be sure the available power supply voltage and frequency agrees within 10% of CWMS electrical rating.

CAUTION

Use Copper Conductors Only! Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors may result in equipment damage.

- b. Bring properly sized power leads from the customer supplied fused disconnect to the control box. Cut a cable hole at a convenient location in the control box. Route power leads to terminals L1, L2, L3 in the upper right corner. Dual element time delay fuse sizes recommended for different CWMSs are in Table 3.

Table 3

WARNING

Potential Fire Hazard! Replace fuses only with the same fuse type and ratings.

- c. The cooling water pump must rotate in the proper direction (counterclockwise). If the pump is rotating in the wrong direction (clockwise), a low flow alarm will occur

CWMS Model Number	Fuse Size 480V/60 Hz	Pump Size
CWMS -35	6 Amp	2 HP
CWMS -80	8 Amp	3 HP
CWMS -140	12 Amp	5 HP

because the flow switch was not activated. Ensure the system is properly filled, vented, and initially pressurized above 10 psig.

- d. Connect the ground wire to the lug in upper right corner of control panel.

OPERATION

▲WARNING

Live Electrical Components! It may be necessary to work with live electrical components when installing, testing, servicing, and troubleshooting this product. Have a qualified licensed electrician or other properly trained individual perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components can result in death or serious injury.

Controls and Indicators

- a. The selector switches and lights on the control panel are:
- | | |
|-------------|--------------------|
| Selector | OFF/ AUTO |
| Switch..... | |
| Lights..... | Pump A ON (Red) |
| | Pump A OFF (Green) |
| | Pump B ON (Red) |
| | Pump B OFF (Green) |
| | Power ON (White) |
| | Alarm (Blue) |
- b. Instruments on the CWMS are:
- | | |
|-------------------------------------|--------------------------------------|
| Digital LED display/temp controller | - Cooling water temperature |
| Analog Gauge..... | System Pressure |
| | Temperature Gauge (standard control) |

Start-up

- a. Open all shutoff valves in the cooling water circuit.
- b. Start the pump. Ensure there is not a flow alarm and check for leaks in the piping. Vent air from the high points in the system.

▲WARNING

Drawing-in Hazard! The centrifugal pump has a rotating shaft that may create a drawing-in hazard of loose articles of clothing or maintenance equipment. The expanded metal cage and cover shall remain in place during operation of the equipment. Failure to keep the expanded metal cage and cover in place during operation of the equipment can result in death or serious injury.

- c. The temperature controller is mounted on the enclosure door. Control parameters are set at the factory. The temperature is factory set at 76.6°F (24.4°C). If the temperature setpoint needs to be adjusted, press Setup and use the up and down arrows to change the setpoint. The temperature setpoint cannot be lower than the temperature of the make up water.

Features

- a. A CWMS with close temperature control utilizes a solid state controller to modulate discharge water flow. The controller monitors the cooling water outlet with temperature sensors. A PID control signal modulates the position of the bleed off valve (TCV-1), and regulates the discharge water flow through the heat exchanger.
- b. Flow switch (FS-1) is located in the cooling water outlet piping. If cooling water flow is lost, the flow switch closes turning on a time delay relay. After approximately six seconds, the time delay relay energizes, turning the pump off. After the time delay relay has energized, a local alarm light and customer alarm is activated. The unit then requires a manual restart.
- c. The pumps have isolation valves for easy maintenance and cleaning. A dual pump system can be purchased with either manual or automatic switchover. The automatic switchover option provides automatic pump switching with the loss of flow.

MAINTENANCE

⚠ WARNING

Live Electrical Components! It may be necessary to work with live electrical components when installing, testing, servicing, and troubleshooting this product. Have a qualified licensed electrician or other properly trained individual perform these tasks. Failure to follow all electrical safety precautions when exposed to live electrical components can result in death or serious injury.

⚠ WARNING

Hazardous Voltage! Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure power cannot be inadvertently energized. Failure to disconnect power before servicing can result in death or serious injury.

The CWMS should not require much maintenance. After a year of continuous operation the pump head should be visually checked for bearing wear. Any excessive vibration or noise may require pump replacement.

Troubleshooting Checklist

Condition	Cause	Correction
1. Cannot maintain temperature	a. Excessive cooling water temperature	Verify the temperature of the cooling water is 5°F below set point.
	b. Low cooling water flow	Check the pressure drop in the cooling water circuit.
	c. Low make up water flow	Verify pressure at discharge. Ensure system pressure is 10 psi above.
2. Excessive pump pressure (~70 psig)	a. Restricted water flow	Check for partially closed valves. Be sure all lines are proper size.

System Component Data

Component	Description	Set-Point	Comments
Pump-A	Pump		TEFC motor. Flow rate based on an external 20 psig drop.
FS-1	Flow switch	approx. 10 GPM	Low flow cutout. Factory set
TIC-1	Solid-State temperature controller	Variable	Provides analog PID control signal. Set controller 1°F less than desired sample temperature.
TE-1	Temperature sensor		Monitors recirculating water out. Provides temperature input to controller.
HS-1	Hand switch		OFF/AUTO
PI-1	Pressure gauge		Displays inlet system pressure.
TCV-1	Temperature controlled valve	Variable	Controls flow to discharge. Receives analog control signal from TIC-1.
RV-1	Relief valve	100 psig	
TDR-1	Time delay relay	6 seconds	Eliminates false flow alarm preventing pump cycling.
TDR-2	Time delay relay	6 seconds	Used in a dual pump auto switchover configuration.

WARRANTY

Seller warrants products manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of eighteen months from date of shipment or twelve months from start up (which ever occurs first). If within such period any such products shall be proved to Seller's satisfaction to be defective, such products shall be repaired or replaced at Seller's option. Seller's obligation and Buyer's exclusive remedy hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such product to Seller, ex-works Sentry's factory.

The foregoing warranties are exclusive and in lieu of all other express and implied warranties except in title, including but not limited to implied warranties of merchantability and fitness for purpose. Seller shall not be subject to any other obligations or liabilities whatsoever with respect to products manufactured or furnished by it, or any undertakings, acts or omissions relating thereto.

Warranty Conditions & Limitations

This Warranty shall not apply to any Sentry product which, in the opinion of Sentry Equipment Corp, has been (a) altered or repaired in a manner affecting the efficiency of performance of the unit or (b) incorrectly installed or operated or (c) damaged in shipment or (d) damaged by flood or fire or (e) if the serial number is missing, altered or defaced.

Any materials proposed to be used by Sentry Equipment Corp. ("Seller") are based on published reference literature and/or customer recommendations, and customer assumes sole responsibility for the selection of such materials. Any references are based on third-party studies, and may not correlate directly with the end user's intended usage or process (i.e. chemical composition, concentrations, temperatures, etc.).

EXCEPT FOR THE LIMITED WARRANTIES SET FORTH HEREIN, SELLER HEREBY DISCLAIMS ANY AND ALL WARRANTIES AND REPRESENTATIONS (EXPRESS OR IMPLIED, ORAL OR WRITTEN), INCLUDING ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PURPOSE WHETHER OR NOT SELLER KNOWS, OR HAS REASON TO KNOW, HAS BEEN ADVISED, OR IS OTHERWISE IN FACT AWARE OF ANY SUCH PURPOSE, WHETHER ALLEGED TO ARISE BY LAW, BY REASON OF CUSTOM OR USAGE IN THE TRADE, OR BY COURSE OF DEALING OR PERFORMANCE. Without limiting the generality of the foregoing, Seller makes no warranty regarding ability of products sold hereunder to withstand erosion or corrosion, or regarding material compatibility of elastomers in specific services, and no warranty made hereunder shall apply to products which have been subjected to adverse storage

The owner shall be responsible for maintenance of his equipment. Wear or damage caused by lack of normal maintenance or by misuse of the equipment shall not be considered as defective workmanship and material.

Sentry reserves the right to make product design changes or improvements without notice and without imposing any obligation upon itself to install these changes or improvements on its products previously manufactured.

This warranty is for the sole benefit of the original purchaser and is not transferable unless agreed to in writing by Sentry Equipment Corp.

Receiving Shipments (including loss or damage by transportation)

It is the customer's responsibility to check for missing cartons and sign of damage to cartons. If found, customer should note missing and/or damaged cartons on the delivery receipt and have delivery receipt signed by the representative of the transportation company. If unpacking discloses concealed damage from rough handling, the customer should request a concealed damage inspection from the transportation company.

The Sentry Customer Service Department will aid your organization in any claim proceeding for shortages or damages in shipment, but it is the receiver's responsibility to file claim with the carrier for damage or loss.

Customer Actions For Claims on Products During the Warranty Period

1. Contact the Customer Service Department, Sentry Equipment Corp., Oconomowoc, WI, Telephone: 262-567-7256, to obtain a Return Material Authorization (RMA) number.
2. You will be sent an "RMA" and a "Decontamination Statement" that is required to be filled out and **returned with the equipment**.
3. The following information must appear on the outside of the package:
 - a. RMA number marked on outside of box.
 - b. Decontamination Statement filled out and attached to outside of box.
4. Return defective equipment **FREIGHT PREPAID**. Collect shipments will be refused.
5. The factory will not process warranty claims until the customer has properly accomplished the above items.
6. The Sentry factory may accept the entire claim, a part of the claim or none of the claim if our inspection of returned parts proves the failure was for reasons other than defective material or factory workmanship.

Important Notes:

1. Sentry will not be responsible for damage incurred during the return shipment.
2. All returns subject to inspection and a minimum \$100.00 evaluation fee.
3. This RMA is not authorization for credit. Credits and/or replacements will be issued upon evaluation of returned goods.
4. RMA is valid for thirty (30) days from issue date.

Procedures

Configuration of a Watlow EZ-Zone PM Controller for use in Sentry Cooling Water Skids (CWIS/CWMS) (16-05072A)

Drawings

CWMS-35

Pump/Control	P&ID	General Arrangement	EWD
Single	10-01746A	10-01746D	10-01304N
Dual/Manual	10-01746B	10-01746E	10-01304Q
Dual/Automatic	10-01746C	10-01746F	10-01304S

CWMS-80

Pump/Control	P&ID	General Arrangement	EWD
Single	10-01746A	10-01746G	10-01304N
Dual/Manual	10-01746B	10-01746H	10-01304Q
Dual/Automatic	10-01746C	10-01746J	10-01304S

CWMS-140

Pump/Control	P&ID	General Arrangement	EWD
Single	10-01746A	10-01746K	10-01304N
Dual/Manual	10-01746B	10-01746L	10-01304Q
Dual/Automatic	10-01746C	10-01746M	10-01304S

Drawings