

WATER TREATMENT PREVENTATIVE MAINTENANCE PROGRAM

Presented at

Alberta Public Works, Supply & Services
Property Management

Water Treatment Co-ordinators' Meeting Number 22
Edmonton, Alberta
October 18th 1995

by

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October 16th 1995

HOT WATER HEATING SYSTEM

Operation and Maintenance

These systems are susceptible to scale formation, caused by the precipitation of hardness salts which originate from the fresh water make-up, and corrosion caused by dissolved oxygen, which originates from the fresh water make-up and air ingress.

Therefore, once the system is filled with water, every effort should be made to minimize the entrance of additional hardness salts and dissolved oxygen into the system by the following operational type methods:

- (a) Limit the amount of make-up water as follows:
 - (i) install water meter(s) in the water make-up line(s);
 - (ii) locate and repair system leaks immediately;
 - (iii) adjust pump packing seals so that there is minimum leakage;
 - (iv) ensure that pumps with mechanical seals have zero leakage;
 - (v) do not drain and fill these systems seasonally---if maintenance or inspection is required, only those portions of the system that are affected should be drained;
 - (vi) ensure that the safety valves have zero leakage;
 - (vii) minimize the amount of water lost from the system during water sampling, low-water fuel cut-off controller blow down, safety valve testing & filter cartridge replacement activities;

- (b) Ensure that there is positive pressure at the top of the system at all times by maintaining a minimum static system pressure according to the following equation by the addition of air to the expansion tank:

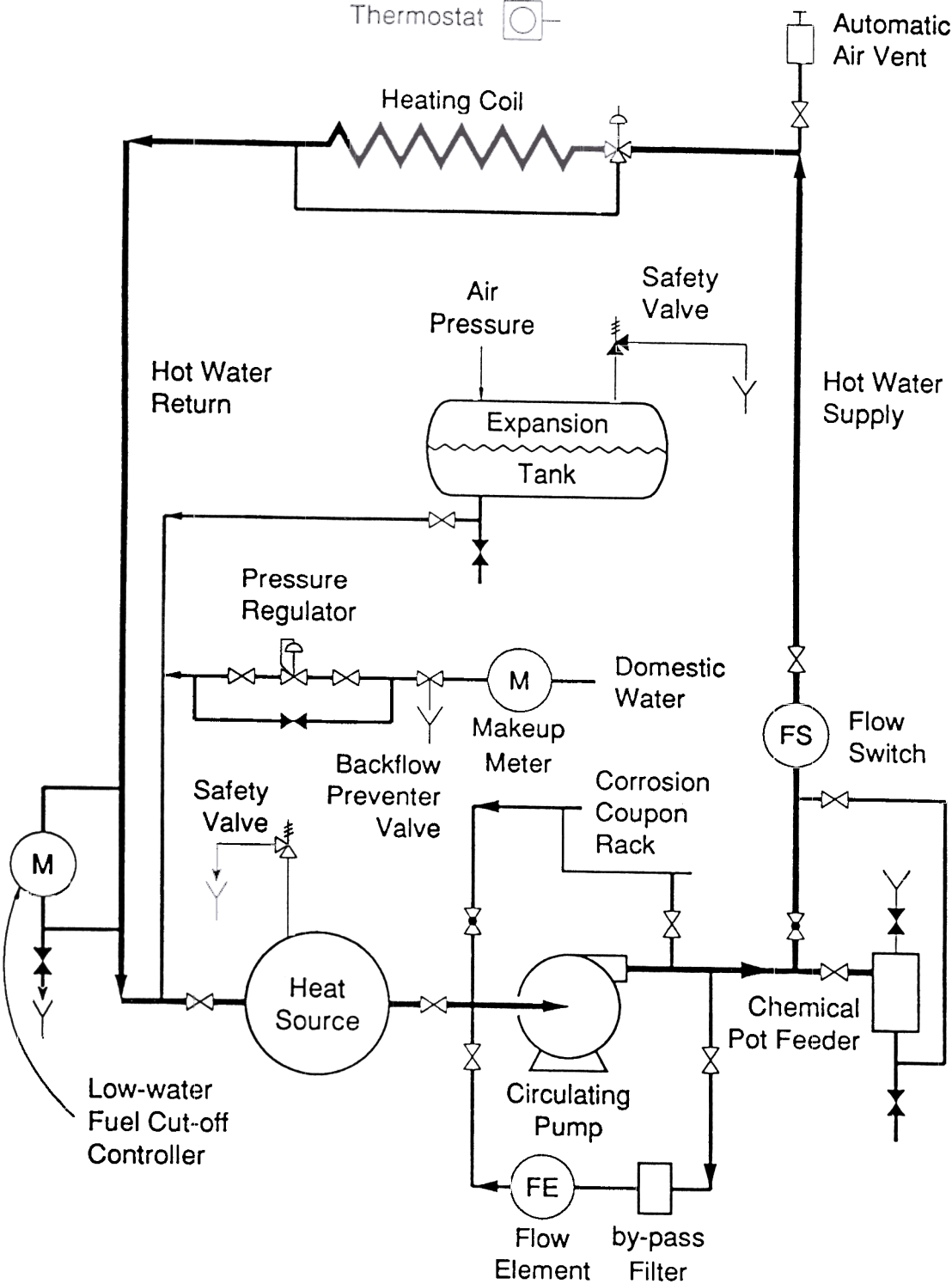
$$P = (H/2.31) + 5$$

where P: system pressure at the circulating pumps with the pumps shut off, psig;
 H: elevation of the system piping above the circulating pumps, feet

Operation and Maintenance (continued)

- (c) Ensure that there is a water level in the expansion tank at all times;
- (d) Replace faulty automatic vents as required;
- (e) Confirm the operation of the make-up water meter by noting the changes in its reading before & after such activities as water sampling, low-water fuel cut-off controller blow down, safety valve testing & filter cartridge replacement.

Schematic Diagram of a Typical Closed Hot Water Heating System



STEAM BOILER SYSTEM

Operation and Maintenance

Due to the elevated temperatures and the concentration effect in these systems, they require closer attention to power plant basic operating and maintenance procedures than the closed water systems in order to protect them against contaminants such as dissolved oxygen, dissolved carbon dioxide, and hardness salts.

The specific operating and maintenance procedures are indicated in ASME (American Society of Mechanical Engineers) Boiler & Pressure Vessel Code, Section VI, "Recommended Rules for the Care and Operation of Heating Boilers". However, the more general procedures are as follows:

- (a) Limit the amount of make-up water as follows:
 - (i) install water meter(s) in the water make-up line(s);
 - (ii) locate and repair system leaks immediately;
 - (iii) repair faulty steam traps immediately;
 - (iv) collect all condensate in the condensate return tank;
- (b) Blow down the water gauge glass at least once per week (prove the low level flame cut-off at the same time);
- (c) Prove the operation of the bottom blowdown valve by opening and closing it once per week;
- (d) Drain the boiler for inspection as required by the Boilers and Pressure Vessel Act;
- (e) For seasonal shutdown, drain the boiler down while it is still hot, remove the man-way covers, and store it empty;
- (f) For short term shutdown, flood the boiler to the steam stop valve with treated water such that the sulphite & hydroxide alkalinity concentrations are 200 ppm as SO_3 & CaCO_3 respectively.

WATER TREATMENT LOG SHEET

BUILDING NAME & LOCATION: _____ BUILDING FILE NO.: _____

WATER SYSTEM: Steam Boiler

Date	199__		
Boiler TDS (1500-3000 ppm)	note 1		
Boiler pH (10.5-11.5)	note 1		
Boiler Sulphite (30-60 ppm SO ₃)	note 1		
Boiler M Alkalinity (700 ppm CaCO ₃ max)	note 1		
Boiler OH Alkalinity (150-300 ppm CaCO ₃)	note 1		
Boiler Phosphate (40-80 ppm PO ₄)	note 1		
Condensate pH (8.5-9.5)	note 1		
Feedwater Hardness (2 ppm CaCO ₃ max)	note 1		
Phosphate Addition	note 3		
Caustic Addition	note 3		
Sulphite Addition	note 3		
Amine Addition	note 3		
Meter Reading	note 2		
Blow Down Water Gauge Glass (prove low level flame cut-off)	note 2		
Prove Operation of Bottom Blow Down	note 2		

Notes: **1:** once per day for multiple boilers, three times per week for single boilers; **2:** once per week; **3:** as required

CHILLED WATER SYSTEM

Operation and Maintenance

These systems are susceptible to corrosion caused by dissolved oxygen and bacteria.

Once the system is filled with water, every effort should be made to minimize the entrance of additional dissolved oxygen into the system by the following operational type methods:

- (a) Limit the amount of make-up water as follows:
 - (i) install water meter(s) in the water make-up line(s);
 - (ii) locate and repair system leaks immediately;
 - (iii) adjust pump seals with packing so that there is minimum leakage;
 - (iv) ensure that pumps with mechanical seals have zero leakage;
 - (v) do not drain and fill these systems seasonally---if maintenance or inspection is required, only those portions of the system that are affected should be drained;
 - (vi) ensure that the safety valves have zero leakage;
 - (vii) minimize the amount of water lost from the system during water sampling, safety valve testing & filter cartridge replacement activities;

- (b) Ensure that there is positive pressure at the top of the system at all times by maintaining a minimum static system pressure according to the following equation by the addition of air to the expansion tank:

$$P = (H/2.31) + 5$$

where P: system pressure at the circulating pumps with the pumps shut off, psig;
 H: elevation of the system piping above the circulating pumps, feet

- (c) Ensure that there is a water level in the expansion tank at all times;

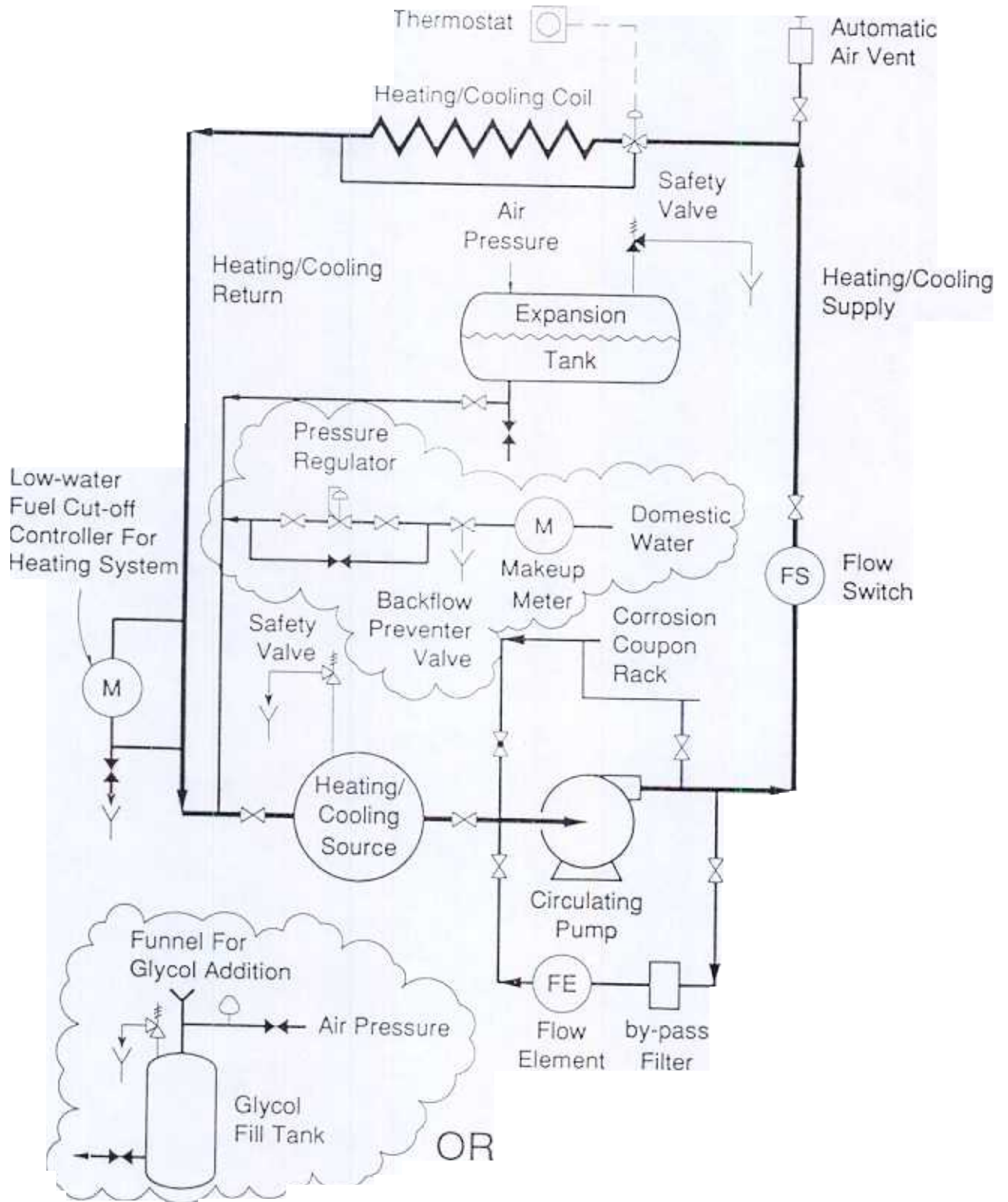
Operation and Maintenance (continued)

- (d) Replace faulty automatic vents as required;
- (e) Confirm the operation of the make-up water meter by noting the changes in its reading before & after such activities as water sampling, safety valve testing & filter cartridge replacement.

Bacteria contamination of the system is minimized by the following operational type methods:

- (a) Drain the expansion tank at the beginning & end of the cooling season;
- (b) At the end of the cooling season, drain the cooling coils, and fill or flush them with glycol;
- (c) At the beginning of the cooling season, drain the glycol from the cooling coils to a container, and thoroughly flush out the cooling coils with water.

Schematic Diagram of a Typical Glycol System



CONDENSER WATER SYSTEM

Operation and Maintenance

The fresh make-up water to these systems contain hardness salts, dissolved oxygen, and dissolved solids. If these contaminants as well as microbiological contaminants and air-borne debris are not controlled, corrosion, scaling, and fouling will occur within these systems.

Corrosion, scaling, and fouling may be partially controlled by the following operational and maintenance activities:

- (a) Adjust the continuous bleed-off valve such that scaling and corrosion are prevented---ideally an automatic blowdown system should be used for this adjustment;
- (b) Log the make-up water meter reading at least once per week;
- (c) Provide screens on the slats of the cooling tower if airborne debris are gaining access to the cooling tower;
- (d) Inspect the cooling tower at least once per week to detect scaling, corrosion, or slime growths;
- (e) Inspect the chiller condenser coils or chilled water cooling coils when maintenance is being carried out on these units.

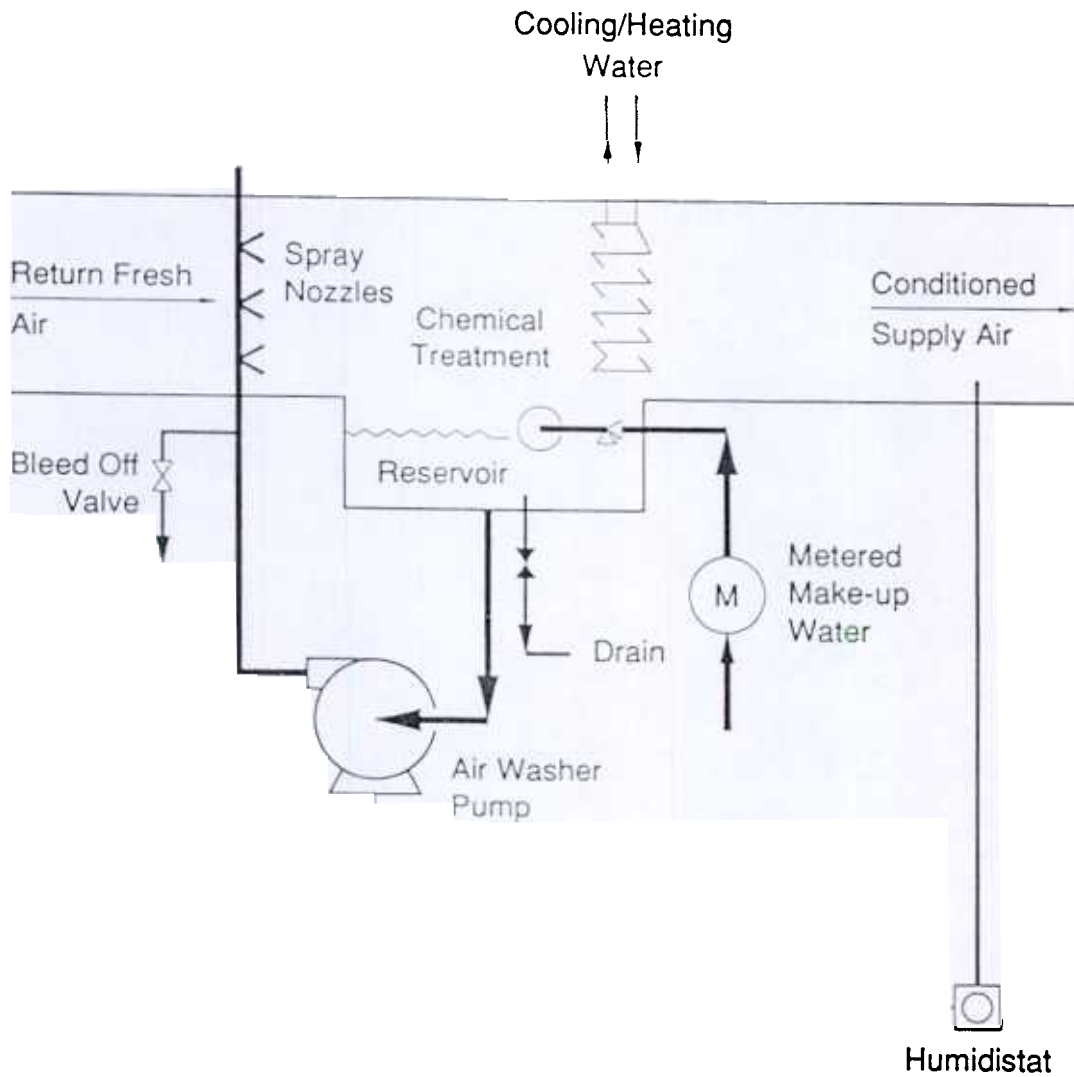
AIR WASHER HUMIDIFIER SYSTEM

Operation and Maintenance

The fresh make-up water to these systems contain hardness salts, dissolved oxygen, and dissolved solids. If these contaminants as well as microbiological contaminants and air-borne debris are not controlled, corrosion, scaling, and fouling will occur within these systems.

Corrosion, scaling, and fouling may be partially controlled by the following operational and maintenance activities:

- (a) Adjust the continuous bleed-off valve such that scaling and corrosion are prevented;
- (b) Log the make-up water meter reading at least once per week;
- (c) Inspect the nozzles, reservoir & baffle surfaces at least once per week to detect scaling, corrosion, or slime growths;
- (d) Clean the nozzles and ductwork as required.



GLYCOL SYSTEM

Operation and Maintenance

Industrial grade glycol is composed of either ethylene or propylene glycol, a corrosion inhibitor, and water. Note that automotive grade glycol should **not** be used in commercial or industrial glycol systems because their corrosion inhibitors have a limited useful life and they contain silicates which can foul or plug the system.

If there is a concern that the glycol may be orally consumed, an industrial grade **propylene** based glycol should be used because of its low oral toxicity, otherwise an industrial grade **ethylene** based glycol is the preferred choice.

Since dissolved oxygen in the system will decompose the ethylene/propylene glycol into organic acids, particularly at elevated temperatures, thus causing corrosion & fouling, both types of glycol contain corrosion inhibitors. The corrosion inhibitor in propylene based glycol consists of food grade dipotassium hydrogen phosphate in order to maintain the low oral toxicity of this product, whereas the corrosion inhibitor in the ethylene based glycol consists of a proprietary mixture of numerous corrosion inhibitors.

The water which is used in both types of glycol systems must be of the highest possible quality (ie., softened, demineralized, deionized, boiler condensate), otherwise the hardness and corrosive salts in most domestic water supplies will deplete the inhibitor concentration in the glycol.

Once the system is filled with the glycol-water solution, every effort must be made to minimize the entrance of additional hardness salts and dissolved oxygen into the system by the operational type methods indicated overleaf.

Operation and Maintenance (continued)

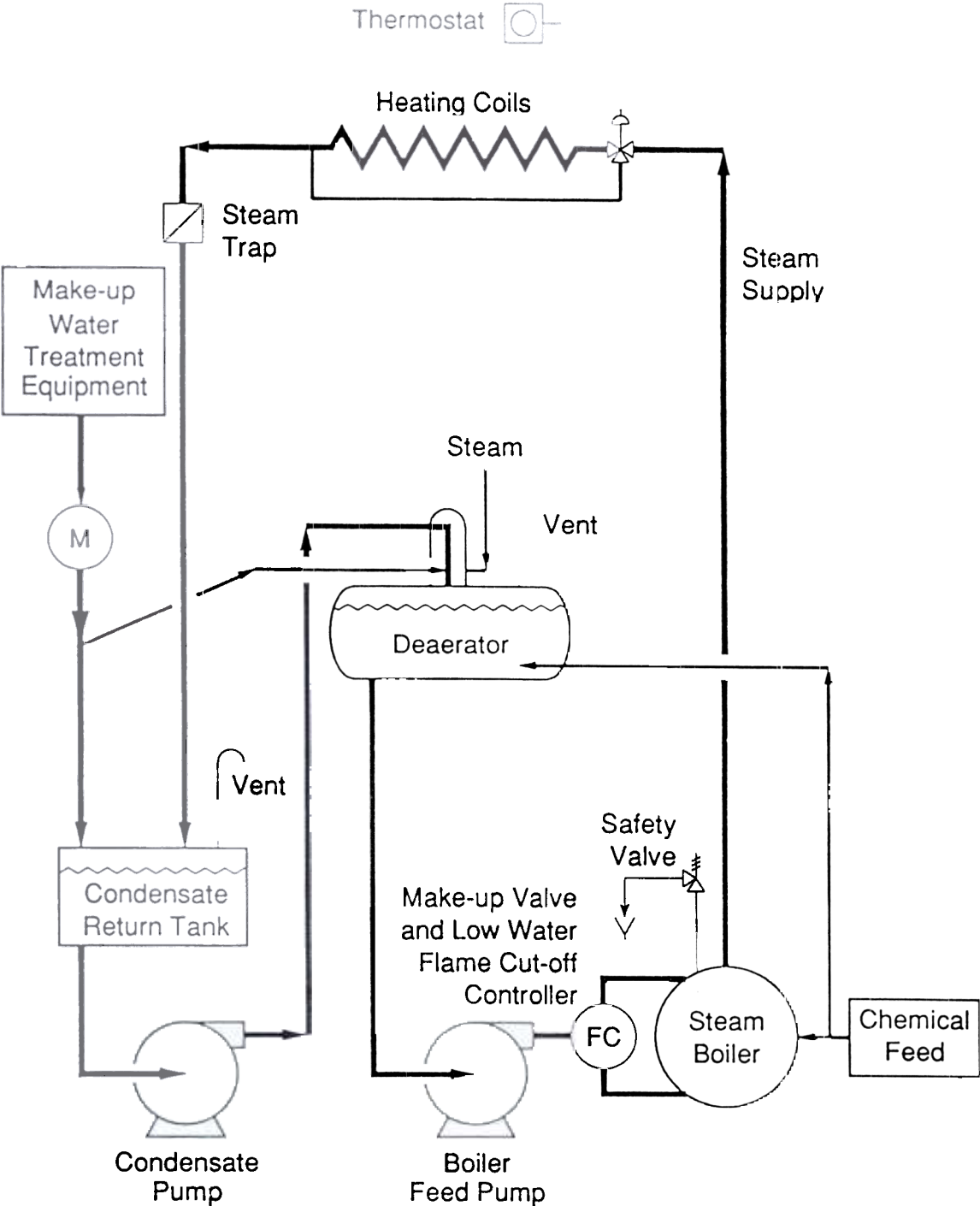
- (a) Limit the amount of make-up water as follows:
 - (i) install water meter(s) in the water make-up line(s);
 - (ii) locate & repair system leaks immediately;
 - (iii) adjust pump seals with packing so that there is minimum leakage;
 - (iv) ensure that pumps with mechanical seals have zero leakage;
 - (v) ensure that safety valves have zero leakage;
 - (vi) minimize the amount of glycol-water solution lost from the system during water sampling, low-water fuel cut-off controller blowdown, safety valve testing & filter cartridge replacement activities;
- (b) Ensure that there is a positive pressure at the top of the system at all times by maintaining a minimum static system pressure according to the following equation by the addition of air to the expansion tank:

$$P = (H/2.31) + 5$$

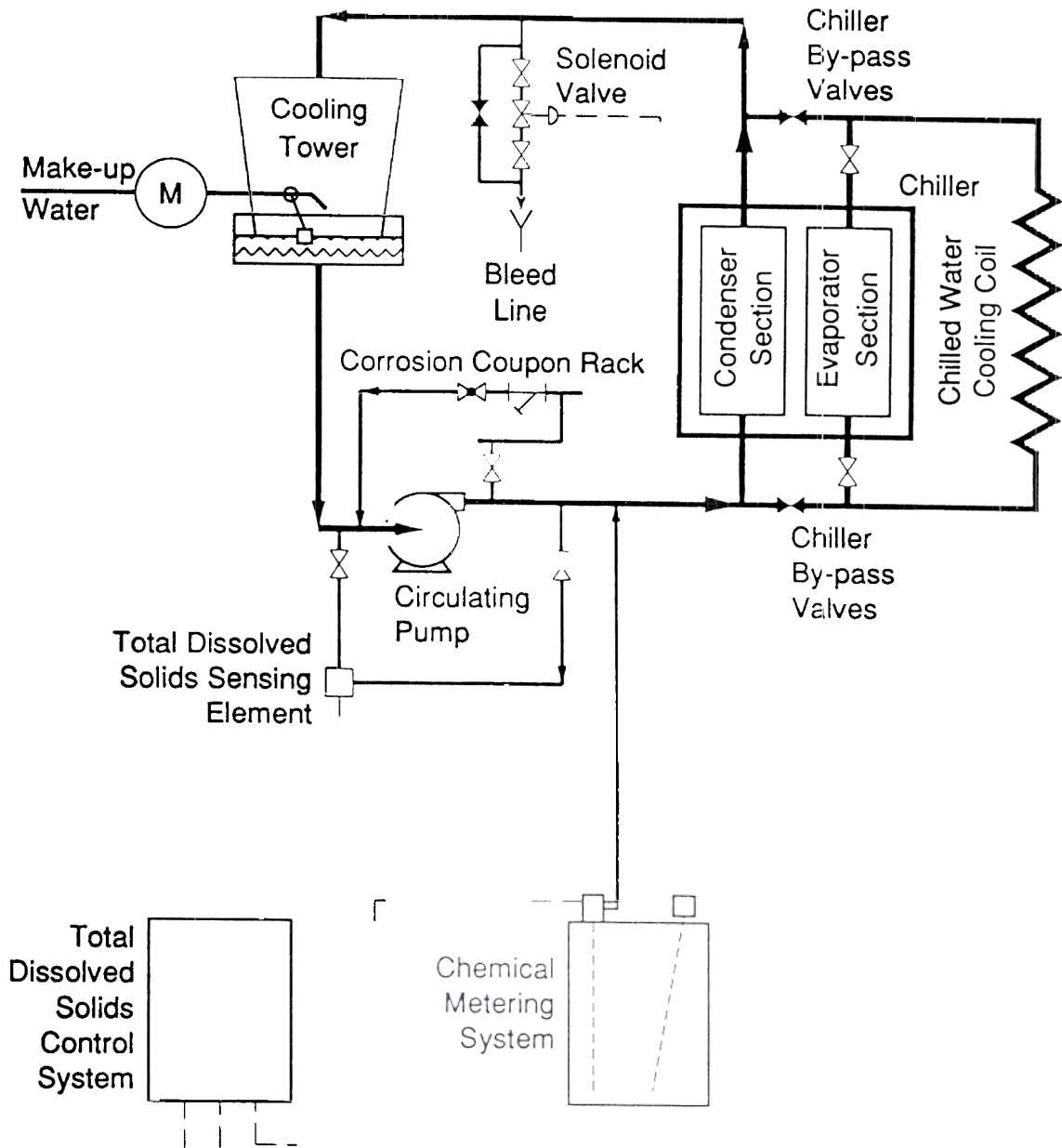
where P: pressure at the circulating pumps with the pumps shut off, psig;
 H: elevation of the system piping above the circulating pumps, feet

- (c) Ensure that there is a glycol-water solution level in the expansion tank at all times;
- (d) Replace faulty automatic vents as required;
- (e) Confirm the operation of the make-up water meter by noting the changes in its reading before & after such activities as glycol sampling, low-water fuel cut-off controller blowdown, safety valve testing & filter cartridge replacement activities;
- (f) In order to prevent excessive decomposition of the glycol into organic acids, the operating bulk temperature of the glycol-water solution must be limited to 120 °C (250 °F).

Schematic Diagram of a Typical Steam Boiler System



Schematic Diagram of a Typical Open Cooling Water System



Note:

Corrosion coupon rack must be located below water line in Cooling Tower Basin so that it is flooded at all times.