



# **Water Treatment Program**

## **Training Manual**

**First Edition, April 2006**

The Operating Personnel involved in the Water Treatment Program come from various trade backgrounds and they may not have received any formal training in Water Treatment.

In order to maximize their operational skills so that they fully understand the value and significance of the Alberta Infrastructure and Transportation, Property Management, Water Treatment Program Manual, it has become necessary to re-introduce this 'Water Treatment Program Training Manual'.

It is the intent of this manual to provide training in basic water systems, water testing, chemical addition, documentation and safety as per the Water Treatment Program Manual. This manual includes treatment guidelines and testing procedures for generic chemicals only and will not include any information on proprietary treatment. A section on systems and classifications is included showing their recommended operating guidelines.

An Advanced Sulphite Treatment (AST) incorporating sulphite as the oxygen scavenger and corrosion inhibitor, a buffer system to maintain the specified pH limits, and a specific corrosion inhibitor for the protection of yellow metals, is approved in general by Alberta Infrastructure and Transportation. The requirement of a particular system for an advanced sulphite treatment must be investigated and evaluated on a case-by-case basis. AST-programs are proprietary in nature and require approval and authorization by Alberta Infrastructure and Transportation.

**Any changes to chemical treatment or chemical suppliers must have prior approval from Alberta Infrastructure's Representative, which is the Facility Manager, Water Treatment Coordinator or Water Treatment Consultant.**

## **ACKNOWLEDGEMENTS**

We wish to thank the Water Treatment Consulting Committee members and Io Consulting for their valuable input and review in the preparation of this Training Manual.

SECTION A	INTRODUCTION TABLE OF CONTENTS INFORMATION COURSE AGENDA	
SECTION B	SYSTEMS CLASSIFICATIONS, CARE AND OPERATIONS	<u>Page</u>
	1.0 Closed Hot Water Heating System	1
	2.0 Steam Boiler System	6
	3.0 Closed Chilled Water Cooling System	11
	4.0 Open Cooling Water System	16
	5.0 Air Washer Humidifier System	20
	6.0 Glycol System	24
	7.0 Contact Steam Cooking System	30
	8.0 Potable Water Systems	32
SECTION C	WATER TESTING PROCEDURES	<u>Page</u>
	1.0 General	1
	2.0 Determination of Total Dissolved Solids (TDS)	4
	3.0 Determination of P, M, and OH Alkalinity	6
	4.0 Determination of Hydroxide Alkalinity	7
	5.0 Determination of Sulphite	8
	6.0 Determination of Total Hardness, High	9
	7.0 Determination of Phosphate, Ortho	10
	8.0 Determination of pH	11
	9.0 Determination of Bacteria (Dip Slide Test)	12
	10.0 Determination of Chlorine, Total and Free	13
SECTION D	TESTING FREQUENCY	<u>Page</u>
	1.0 Field Testing Schedules	1
	2.0 Monitoring Sampling Schedule	2
SECTION E	SAFETY	
SECTION F	ENVIRONMENTAL GUIDELINES	
SECTION G	DEFINITIONS / EXPLANATIONS	
SECTION H	SAMPLE RECORD WORKSHEETS	

Internet Address: ([www.infras.gov.ab.ca/Content/doctype306/production/water.htm](http://www.infras.gov.ab.ca/Content/doctype306/production/water.htm))

# Property & Supply Management Water Treatment Program

Last Updated: April 2006

## OVERVIEW

The purpose of the **Water Treatment Program** is to prevent deterioration of the water systems in Alberta Government buildings and plants that are managed by Alberta Infrastructure and Transportation, Property Management. In order to ensure that the operating personnel were sufficiently trained to implement the Water Treatment Program at the physical plant level, the Water Treatment Training Program was initiated and the corresponding Water Treatment Program Training Manual was issued in 1987.

- **Revision 1** of the Water Treatment Program Manual was issued in January 1995 in order to accommodate the administrative, personnel and technical changes that occurred since the 1984 edition. Also, in order to save the cost of maintaining two separate documents, it was decided in October 1994 to do away with the publication of a separate Water Treatment Training Program Manual, since the essential elements of the Training Manual are already covered in the Water Treatment Program Manual.
- **Revision 2** of the Water Treatment Program Manual was issued in January 1997 in order to include Section I - Environmental Guideline.
- **Revision 3** of the Water Treatment Program Manual dated January 2000 was issued in order to accommodate technical changes that have occurred since the 1997 edition.
- **Revision 4** of The Water Treatment Program Manual dated May 2005 was issued to reflect technical changes and to include the addition of Potable Water Systems.
- **Revision 5** of the Water Treatment Program Manual was issued in January 2006.

## Water Treatment Program Manual

### Water Treatment Program Manual

- Section A: Water Treatment Program Outline
- Section B: Definitions of Terms Related to Water and Water Treatment
- Section C: Water Systems
- Section D: Chemicals
- Section E: Ion Exchange Resin
- Section F: Supplies and Miscellaneous Program
- Section G: Water Tests
- Section H: Safety
- Section I: Environmental Guideline
- Entire Manual in PDF Format

## USING ADOBE ACROBAT READER TO VIEW THESE DOCUMENTS

All reports are formatted for viewing and printing using Adobe Acrobat reader. If you do not have this reader, select [ADOBE ACROBAT READER](#) to download this program. It is free!



<http://www.adobe.com/prodindex/acrobat/readstep.html>

**COURSE AGENDA**

09:00 – 09:15 - Introductions

09:15 – 09:30 - Brief Overview of Course

09:30 – 10:30 - System Classifications

10:30 – 10:50 - Break

10:50 – 12:00 - Complete System Classifications, Testing Frequencies, Safety

12:00 – 12:20 - Break

12:20 – 13:15 - Environmental Guidelines, Definitions, Sample Sheets & Water  
Testing Procedures

13:15 – 13:30 - Summarize Course Material, Answer Group Questions, Course  
Evaluation

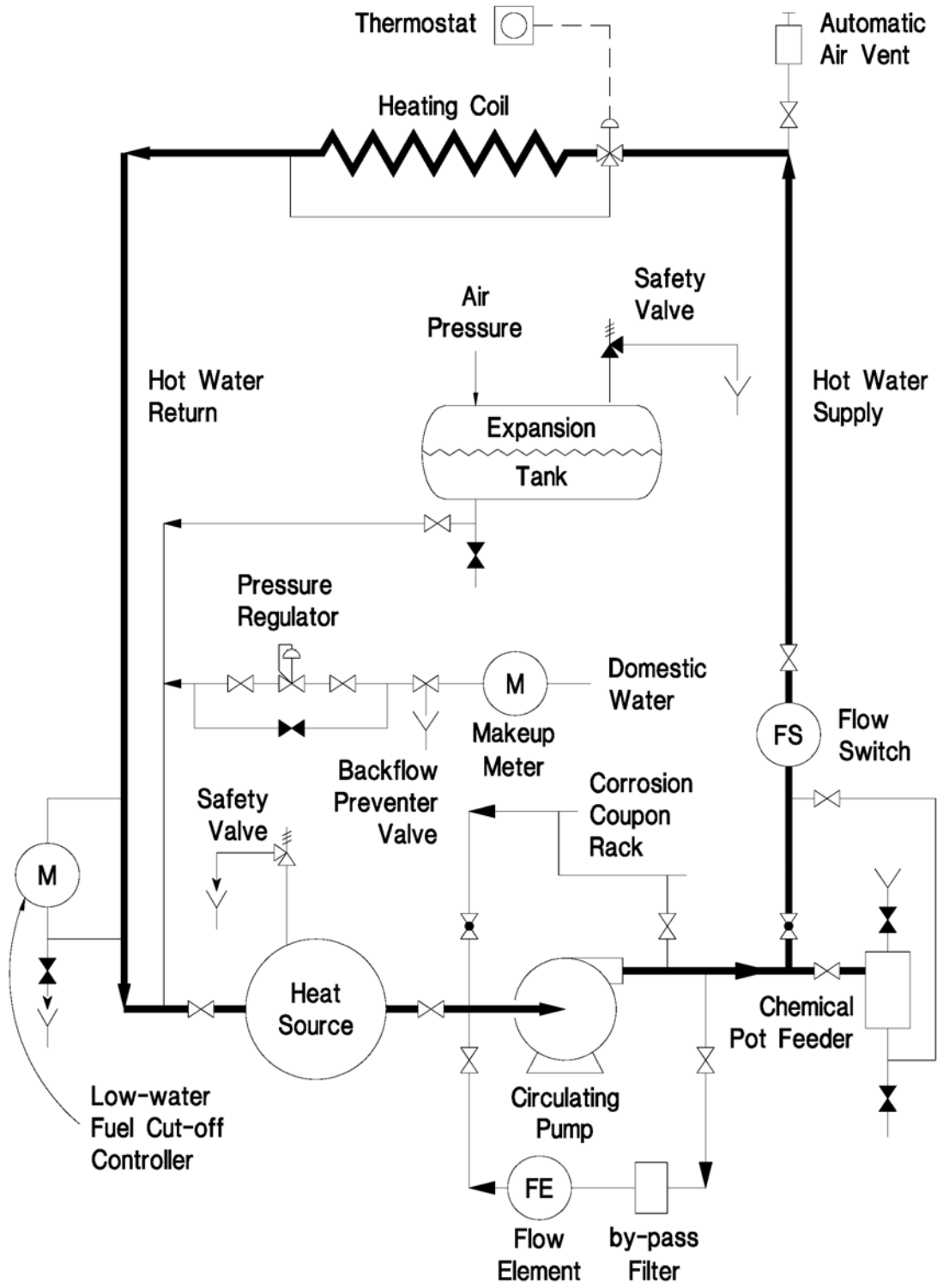
13:30 – 14:30 - Conduct Applicable Tests, General Discussions & Questions

**1.0 Closed Hot Water Heating System****1.1 Description**

A closed hot water system, a typical schematic drawing of which is included, is a heating system where hot water is circulated to finned elements or fan coil units throughout the building, or through heating coils in an HVAC system to provide space heating.

The principal components of a hot water heating system include a heat source (i.e. converters, fired heaters, or fired boilers), automatic air vents, circulating pumps, expansion tank (atmospheric or pressurized), safety valves, heat exchangers, flow switch, low-water fuel cut-off controller, chemical pot feeder, by-pass filter with flow element, corrosion coupon rack, water make-up meter, backflow prevention device, and pressure regulator.

1.2 Typical Schematic Drawing



### 1.3 Operations 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/or air ingress.

Therefore, once the system is filled 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:

1. Limit the amount of make-up water as follows:
  - a. Install water meter(s) in the water make-up line(s)
  - b. Locate and repair system leaks immediately
  - c. Adjust pump's packing seals so that there is minimum leakage
  - d. Ensure that pumps with mechanical seals have zero leakage
  - e. 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
  - f. Ensure that the safety valves have zero leakage
  - g. Minimize the amount of water lost from the system during water sampling, low water fuel cut-off controller blow down, safety valve testing and filter cartridge replacement activities
2. 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:  
  
Imperial Formula:  $P = (H/2.31) + 5$   
  
Metric Formula:  $P = [(9.81 \times H) + 34.5]$   
  
Where P: system pressure at the circulating pumps with the pumps shutoff, psig (kPa)  
  
Where H: elevation of the system piping above the circulating pumps, feet (meters)
3. Ensure that there is a water level in the expansion tank at all times.
4. Replace faulty automatic vents as required.
5. Confirm the operation of the make-up water meter by noting the changes in its reading before and after such activities as water sampling, low-water fuel cut-off controller blow down, safety valve testing and filter cartridge replacement.



## 1.4 Water Treatment

When a new system is filled with un-softened domestic water and heated for the first time, the hardness salts are precipitated in the boiler and system piping, and the dissolved oxygen is consumed by uniform corrosion, thus leaving only inert nitrogen in the system. In this perfect closed state, the water in the system will not cause further corrosion or scale formation.

However, since the system cannot be a perfectly closed one in reality, sodium sulphite is added as an oxygen scavenger such that a residual sulphite concentration of 50 - 100 ppm  $\text{SO}_3$  (80 - 160 ppm  $\text{Na}_2\text{SO}_3$ ) is maintained, and sodium hydroxide (caustic) is added as required to elevate the pH level within its control range of 8.5 - 9.5 (Note: corrosion of copper material is excessive at pH levels greater than 9.5; corrosion of iron material is excessive at levels less than 8.5)

In addition to being an oxygen scavenger, the sodium sulphite will react with iron and copper in the system to form black magnetite and copper oxide, respectively. These two materials will offer moderate corrosion protection for the system, but if air is constantly entering the system, they will be sacrificed, thus causing the TDS concentration to increase and the water in the system to become corrosive.

Chemical treatment **cannot** correct the problems associated with continuous hardness and air ingress into the system. Chemical treatment can only provide a certain amount of temporary insurance against the effects of these contaminants should they temporarily gain entrance to the system. Therefore, under normal operation, if the operation and maintenance activities referred to previously are diligently carried out, only very small amounts of chemicals, or maybe none at all, are required in order to maintain their residual concentrations after the initial charge has been added.

Based on a generally acceptable maximum make-up water rate of 0.1% of the system capacity per day, the "rule of thumb" maximum acceptable sodium sulphite addition rate in grams/month is equivalent to 2% of the system capacity in imperial gallons. That is, if the system capacity is 1,000 imperial gallons, the maximum acceptable sodium sulphite addition rate would be 20 grams/month. If the sulphite consumption is greater than this amount, excessive air is entering the system via, either through make-up water or air ingress.

If excessive amounts of caustic or sodium sulphite have been added to the system, its pH level will rise above 9.5 and the TDS concentration will gradually increase, possibly surpassing its limit of 2000 ppm (or 2500  $\mu\text{S}/\text{cm}$ ). Therefore, in order to prevent corrosion of the copper materials, due to the high pH level, and corrosion of iron material, due to the high TDS concentration, the system must be partially drained, fresh make-up water must be added, and sodium sulphite must be added such that its concentration is maintained at 50 - 100 ppm  $\text{SO}_3$  (80 - 160 ppm  $\text{Na}_2\text{SO}_3$ ). Also, the source of air ingress into the system must be located and the appropriate corrective actions must be taken.

## 1.5 Control Tests

In order to minimize scaling and/or corrosion of these systems, the following control tests must be performed, and all water test results must be documented on a dedicated record sheet (see typical record sheet in Section G).

1. Document the make-up water meter reading at least once per month.  
It must be negligible.
2. Determine and document the sulphite concentration of the water in the system at least once per month.  
It must be 50 - 100 ppm SO<sub>3</sub> (80 - 160 ppm Na<sub>2</sub> SO<sub>3</sub>). Do NOT blow down if it is high.
3. Determine and document the pH level of the water in the system at least once per month.  
It must be 8.5 - 9.5 pH.  
Add caustic if it is low; blow down if it is high.
4. Determine and document the TDS (or conductivity) level of the water in the system at least once per month.  
It must be less than 2000 ppm or less than 2500 µS/cm; blow down if it is high.
5. Determine and document the visual appearance of the water in the system at least once per month.  
It must be clear and colorless.
6. Replace the by-pass filter cartridge when the flow indicator shows a reduced flow and document this activity.
7. If present, replace the iron and copper corrosion coupons with fresh coupons once every six months and determine the respective corrosion rates.  
  
The iron corrosion rate must be less than 0.5 mpy (i.e. mils per year), and the copper corrosion rate must be less the 0.2 mpy.
8. File all documentation pertaining to system activities and test results for future reference.

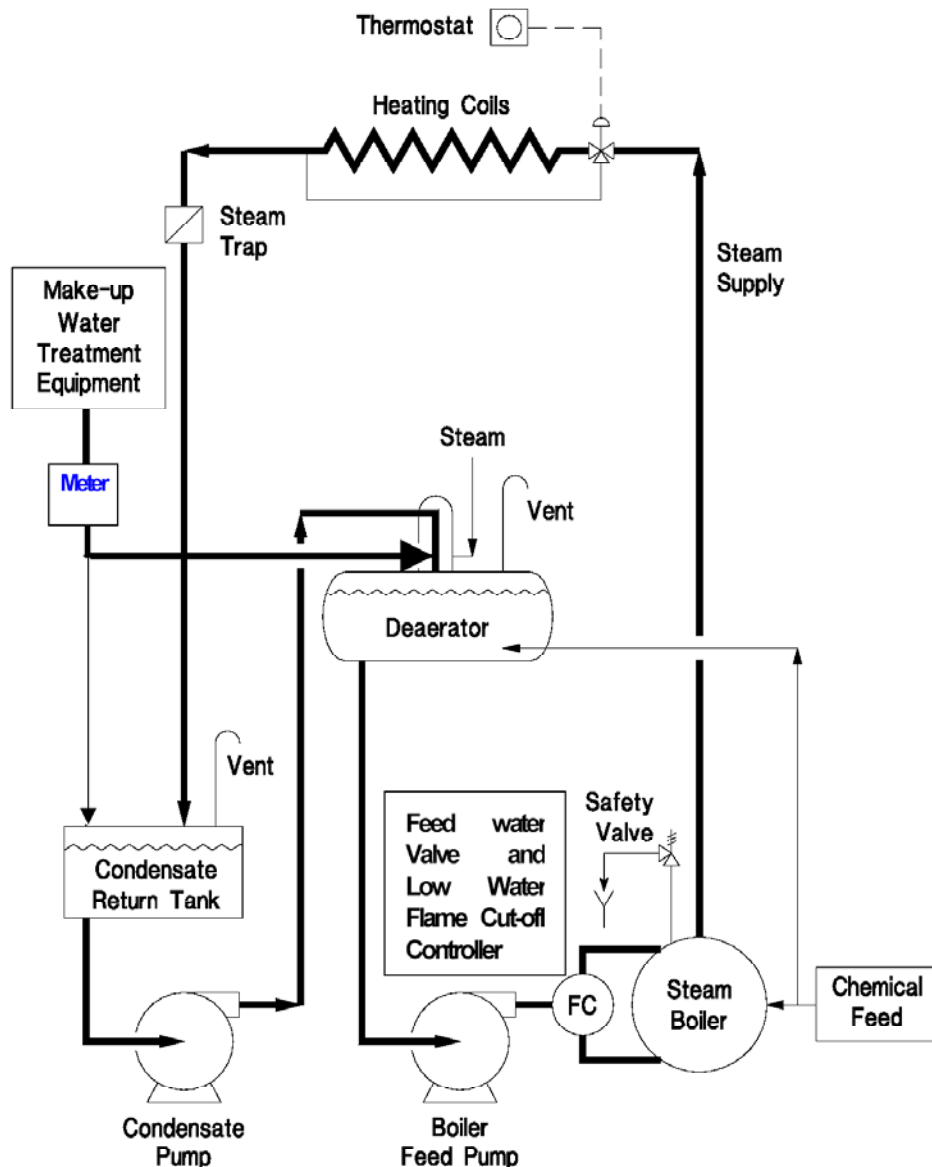
## 2.0 Steam Boiler System

### 2.1 Description

A steam boiler system, a typical schematic diagram of which is included, is a system, which provides steam for space heating, humidification, indirect contact cooking, and/or sterilizing.

The principal components of a steam boiler system include a steam boiler, condensate return tank, condensate pump, deaerator, feedwater pump, steam traps, low water flame cur-off controller, chemical feeder, and make-up water treatment equipment. However, depending on the size of the system and the end use of the steam, other components may include a converter or heating coils, unit heater, steam sparger (steam mist), jacketed steam cooker, and/or steam sterilizer.

### 2.2 Typical Schematic Drawing



### 2.3 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 and Pressure Vessel Code, Section VI, "Recommended Rules for the Care and Operation of Heating Boilers" and Section VII, "Recommended Rules for Care and Operation of Power Boilers".

However, the more general procedures are as follows:

1. Limit the amount of make-up water as follows:
  - a. Install the water meter(s) in the water make-up line(s)
  - b. Locate and repair system leaks immediately
  - c. Repair faulty steam traps immediately
  - d. Collect all condensate in the condensate return tank
2. Blow down the water gauge glass at least once per week. Prove the low water flame cut-off controller at the same time.
3. Prove the operation of the bottom blow down valve by opening and closing it once per week.
4. Drain the boiler for inspection as required by the Alberta Boilers Safety Association.
5. For seasonal shutdown, drain the boiler while it is warm and store it empty.
6. For short-term shutdown, flood the boiler up to the steam stop valve with treated water such that the minimum sulphite and hydroxide alkalinity concentrations are 200 ppm  $\text{SO}_3$  (300 ppm  $\text{Na}_2\text{SO}_3$ ) and 200 ppm  $\text{CaCO}_3$  respectively.

Note:

ABSA uses and follows the ASME Codes. They are used extensively especially in the calculations and procedures. Regarding Section VI & VII, they are mainly guidelines in plant operations.

ABSA is the governing authority and in Canada they follow the Safety Codes Act and Regulations, including the Engineer's Regulations, etc. They also follow the CSA Codes, mainly the B51 & B52, although other sections that are pertinent are also valid.

## 2.4 Water Treatment

The following recommendations are made with respect to the water treatment for these systems.

1. The make-up water treatment to these systems depends on the size of the system and the end use of the steam, that is:
  - a. The make-up should preferably be softened for steam boiler systems with negligible make-up
  - b. The make-up must be softened for steam boiler systems with measurable make-up
  - c. The make-up must be softened and dealkalized for steam boiler systems when the total alkalinity concentration in the make-up is high (i.e. systems where the boiler is blown down to control alkalinity rather than TDS)
2. Sodium sulphite must be added at a point after mechanical deaeration such that a residual sulphite concentration of 30 - 60 ppm (50 - 100 ppm  $\text{Na}_2\text{SO}_3$ ) is maintained in the boiler water. It is not critical if the sulphite concentration is greater than 60 ppm  $\text{SO}_3$  (100  $\text{Na}_2\text{SO}_3$ ), but it must be greater than 30 ppm  $\text{SO}_3$  (50 ppm  $\text{Na}_2\text{SO}_3$ ).
3. If the pH of the boiler water is less than 10.5, caustic/phosphate must be added to the boiler. If the pH of the boiler water is greater than 11.5, the blowdown rate must be increased and the caustic/phosphate/amine addition must be decreased. The boiler water pH level must be 10.5 - 11.5 pH.
4. If the boiler water total alkalinity concentration is greater than 700 ppm  $\text{CaCO}_3$ , then the blowdown rate must be increased and the caustic or tri-sodium phosphate addition must be decreased. The boiler water total alkalinity concentration must be less than 700 ppm  $\text{CaCO}_3$ .
5. If the boiler water hydroxide alkalinity concentration is less than 150 ppm  $\text{CaCO}_3$ , caustic or tri-sodium phosphate must be added to the boiler water. Alternately, if the boiler water hydroxide alkalinity concentration is greater than 300 ppm  $\text{CaCO}_3$ , the blowdown rate must be increased and the caustic or tri-sodium phosphate addition must be decreased. The boiler water hydroxide alkalinity must be 150 - 300 ppm  $\text{CaCO}_3$ .
6. Phosphate, either hexameta or tri-sodium types, must be added such that a residual phosphate concentration of 40 - 80 ppm  $\text{PO}_4$  is maintained in the boiler water.

### NOTES:

- a. If the phosphate is added upstream of the boiler feed pumps, hexameta phosphate must be used since tri-sodium phosphate would precipitate hardness salts, thus increasing the wear on pump seals. Hexameta phosphate on the other hand keeps hardness in solution until it reaches the boiler, at which point the alkalinity and increased temperature there converts it to tri-sodium phosphate.
- b. If the phosphate is added directly to the boiler water, either hexameta or tri-sodium phosphate may be used.
- c. If the phosphate is being consumed more rapidly than tri-sodium phosphate is being added (i.e. hardness in-leakage into the system), hexameta phosphate should be used at least temporarily because it has a higher phosphate concentration and thus a higher capacity for hardness than tri-sodium phosphate.
- d. When hexameta phosphate is used, its conversion to tri-sodium phosphate in the boiler effectively reduces the OH alkalinity concentration and the pH level of the boiler water.

## 2.4 Water Treatment (continued)

7. If the pH level of the condensate return is less than 8.5, a neutralizing amine such as morpholine must be added to the feedwater after the make-up location. If the pH level of the condensate return is greater than 9.5, the amine addition must be decreased. The condensate return pH level must be 8.5 - 9.5.

### NOTES:

- a. If a portion of the steam is used to control the humidity level within the building, the condensate return pH level must be 8.0 - 8.5. In addition, the amine concentration in the building air handling system must be in compliance with the amine exposure limits indicated in the Alberta Occupational Health and Safety Act Chemical Hazards Regulation.
  - b. If there is no condensate return, amine must not be added.
  - c. If problems with the condensate return system persist, the amine consumption is excessive or the pH cannot be maintained, contact the Water Treatment Consultant to investigate.
8. In conjunction with the above controls and regulation of boiler blowdown, the boiler water neutralized total dissolved solids must be controlled within the limits of 1500 - 3000 ppm (or 2000 - 4000  $\mu\text{S}/\text{cm}$ ).

## 2.5 Control Tests

In order to minimize scaling and/or corrosion of these systems, the following control tests must be performed, and all water test results must be documented on a dedicated record sheet (see typical record sheet in Section G).

1. Log the quantity of water softened/dealkalized between regenerations.
2. Log the make-up water meter reading at least once per month.
3. At least once per day on large systems, and three (3) times per week on small systems, perform the following tests on boiler water samples and log the following test results (must be within ranges shown).

Neutralized total dissolved solids	1500 - 3000 ppm (2000 - 4000 $\mu$ S/cm)
Phosphate	40 - 80 ppm PO <sub>4</sub>
Hydroxide Alkalinity	150 - 300 ppm CaCO <sub>3</sub>
Total Alkalinity	< 700 ppm CaCO <sub>3</sub>
Sulphite	30 - 60 ppm SO <sub>3</sub> (50 ppm Na <sub>2</sub> SO <sub>3</sub> )
pH	10.5 - 11.5

4. At least once per day on large systems and three (3) times per week on small systems, determine and log the pH level of the condensate return. It must be 8.5 - 9.5 pH for systems that are NOT used for humidity control and 8.0 - 8.5 pH for systems that are used for humidity control.
5. At least once per day on large systems and three (3) times per week on small systems, determine and log the TDS concentration of the condensate return.  
It must be less than 40 ppm (50  $\mu$ S/cm).
6. At least once per day on large systems and three (3) times per week on small systems, determine and log the total hardness concentration of the condensate return and softener effluent.  
They both must be less than 2 ppm CaCO<sub>3</sub>.
7. While performing the above tests, note the general appearance of the water samples. The boiler water samples may be colorless or amber and contain either no sediment or a small amount of sediment, whereas the condensate and softener samples must be clear and colorless with no sediment.
8. File all documentation pertaining to system activities and test results for future reference.

### **3.0 Closed Chilled Water Cooling System**

#### **3.1 Description**

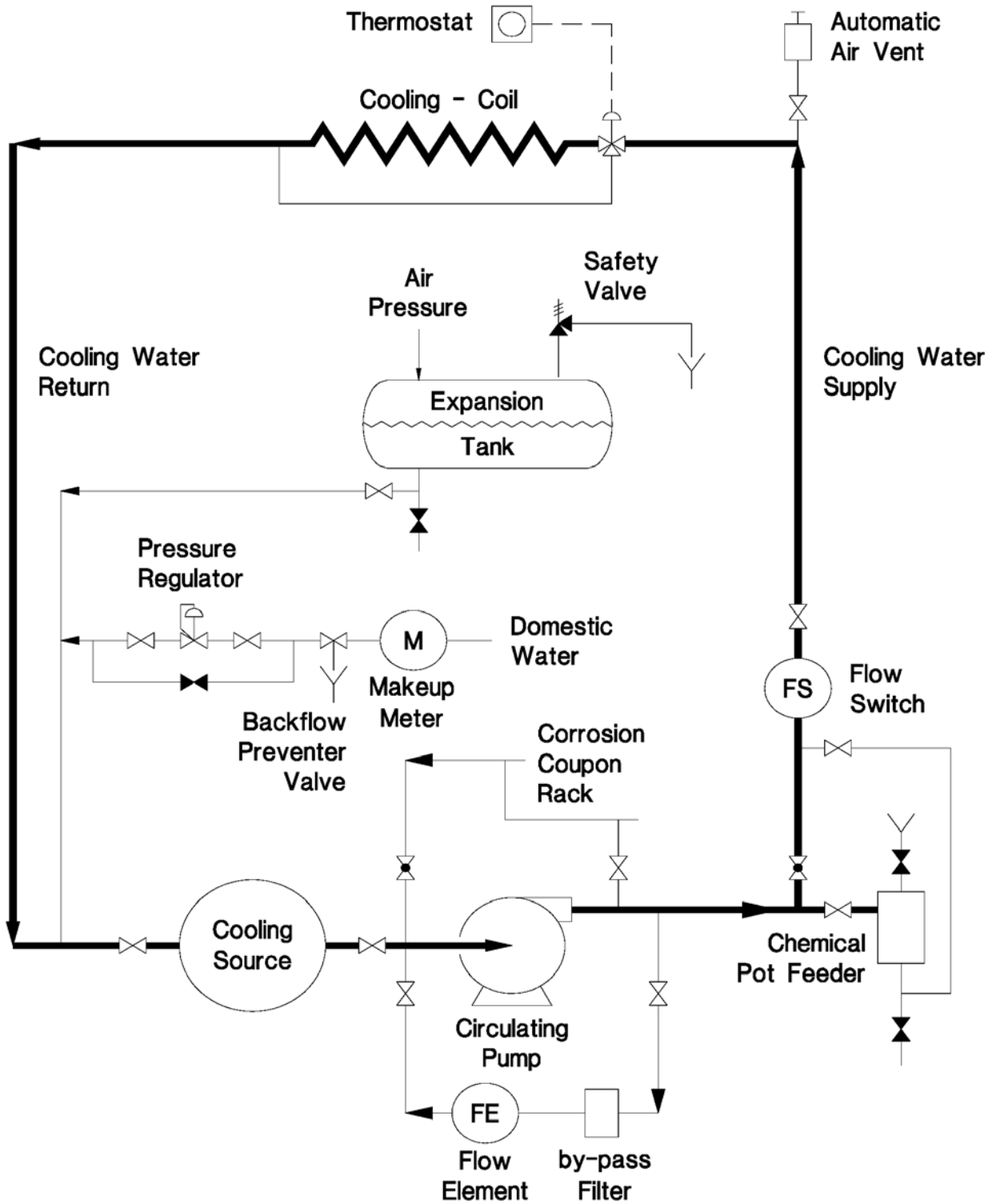
A closed chilled water cooling system, a typical schematic diagram of which is included, is a cooling system where cool water is circulated to fan coil units throughout the building or through cooling coils in an HVAC system to provide space cooling.

The principal components of a chilled water cooling system include:

- a cooling source (e.g. chiller, of the absorption or the compression type, or a cooling tower in a free cooling system)
- automatic air vents
- circulating pumps
- pressurized expansion tank
- heat exchangers
- low-temperature cut-out switch, flow switch
- chemical pot feeder
- by-pass filter with flow element
- corrosion coupon rack
- water make-up meter
- backflow prevention device
- pressure regulator



3.2 Typical Schematic Drawing



### 3.3 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:

1. Limit the amount of make-up water as follows:
  - a. Install water meter(s) in the water make-up line(s)
  - b. Locate and repair system leaks immediately
  - c. Adjust pump seals with packing so that there is minimum leakage
  - d. Ensure that pumps with mechanical seals have zero leakage
  - e. Do not drain and fill these systems seasonally unless freeze protection is required. If maintenance or inspection is required, only those portions of the system that are affected should be drained
  - f. Ensure that the safety valves have zero leakage
  - g. Minimize the amount of water lost from the system during water sampling, safety valve testing, and filter cartridge replacement activities.

2. 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:

$$\text{Imperial Formula: } P = (H/2.31) + 5$$

$$\text{Metric Formula: } P = [(9.81 \times H) + 34.5]$$

Where P: system pressure at the circulating pumps with the pumps shutoff, psig (kPa):

Where H: elevation of the system piping above the circulating pumps, feet (meters)

3. Ensure that there is a water level in the expansion tank at all times.
4. Replace faulty automatic vents as required.
5. Confirm the operation of the make-up water meter by noting the changes in its reading before and after such activities as water sampling, safety valve testing and filter cartridge replacement.
6. Bacteria contamination of the system is minimized by the following operational type methods:
  - a. Drain the expansion tank at the beginning and 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. The flushing process is important, since any remaining glycol could serve as a nutrient source for bacteria.

### 3.4 Water Treatment

When a new system is filled with domestic water for the first time, the dissolved oxygen is consumed by uniform corrosion, thus leaving only inert nitrogen in the system. In this perfectly closed state, the water in the system will not cause further corrosion.

However, since the system cannot be a perfectly closed one in reality, sodium sulphite is added as an oxygen scavenger such that a residual sulphite concentration of 50 - 100 ppm  $\text{SO}_3$  is maintained (80 - 160 ppm  $\text{Na}_2\text{SO}_3$ ), and sodium hydroxide (caustic) is added as required in order to elevate the pH level to within its control range of 8.5 - 9.5.

NOTE:

Corrosion of copper material is excessive at pH levels greater than 9.5.

Corrosion of iron material is excessive at pH levels less than 8.5.

In addition to being an oxygen scavenger, the sodium sulphite will react with iron and copper in the system to form black iron magnetite and cupric oxide, respectively. These two materials will offer moderate corrosion protection for the system, but if air is constantly entering the system, they will be sacrificed, the underlying metal will corrode, and the sulphite consumption will increase, thus causing the TDS concentration to increase and the water in the system to become corrosive.

Chemical treatment cannot correct the problems associated with continuous air ingress into the system. Chemical treatment can only provide a certain amount of temporary insurance against the effects of this contaminant should it temporarily gain entrance to the system. Therefore, under normal operations, if the operations and maintenance activities referred to previously are diligently carried out, only a very small amount of chemicals, or maybe none at all, are required in order to maintain their residual concentrations after the initial charge has been added.

Based on a generally acceptable maximum make-up water rate of 0.1% of the system capacity per day, the 'rule of thumb' maximum acceptable sodium sulphite addition rate in grams/month is equivalent to 2% of the system capacity in Imperial gallons. For example, if the system capacity were 1,000 Imperial gallons, the maximum acceptable sodium sulphite addition rate would be 20 grams/month. If the sulphite consumption is greater than this amount, excessive air is entering the system via, either the make-up water or air ingress.

If excessive amounts of caustic or sodium sulphite have been added to the system, its pH level will rise above 9.5 and the TDS concentration will gradually increase, possibly surpassing its limit of 2000 ppm (or 2500  $\mu\text{S}/\text{cm}$ ). Therefore, in order to prevent corrosion of the copper materials, due to the high pH level, and corrosion of iron material, due to the high TDS concentration, the system must be partially drained, fresh make-up water must be added, and sodium sulphite must be added such that its concentration is maintained at 50 - 100 ppm  $\text{SO}_3$  (80 - 160 ppm  $\text{Na}_2\text{SO}_3$ ). Also, the source of air ingress into the system must be located and the appropriate corrective actions must be taken.

If, as a result of testing using the dip slide method, bacteria are detected in the system, an appropriate biocide must be added to the system according to the specifications of the manufacturer.

### 3.5 Control Tests

In order to minimize scaling and/or corrosion of these systems, the following control tests must be performed, and all water test results must be documented on a dedicated record sheet (see typical record sheet in Section G).

1. Document the make-up water meter reading at least once per month.  
It must be negligible.
2. Determine and document the sulphite concentration of the water in the system at least once per month.  
It must be 50 - 100 ppm SO<sub>3</sub> (80 - 160 ppm Na<sub>2</sub>SO<sub>3</sub>). Do NOT blowdown if it is high.
3. Determine and document the pH level of the water in the system at least once per month.  
It must be 8.5 - 9.5 pH.  
Add caustic if it is low; blowdown if it is high.
4. Determine and document the TDS (or conductivity) level of the water in the system at least once every three (3) months.  
It must be less than 2000 ppm or less than 2500 µS/cm; blowdown if it is high.
5. Determine and document the visual appearance of the water in the system at least once per month.  
It must be clear and colorless.
6. Determine and log the bacteria concentration of the water in the system at least once per month.  
It must be less than 10<sup>3</sup> cfu/ml (i.e. colony forming units/ml).
7. Replace the by-pass filter cartridge when the flow indicator shows a reduced flow and document this activity.
8. If present, replace the iron and copper corrosion coupons with fresh coupons once every six months and determine the respective corrosion rates.  
The iron corrosion rate must be less than 0.5 mpy (i.e. mils per year), and the copper corrosion rate must be less than 0.2 mpy.
9. File all documentation pertaining to system activities and test results for future reference.

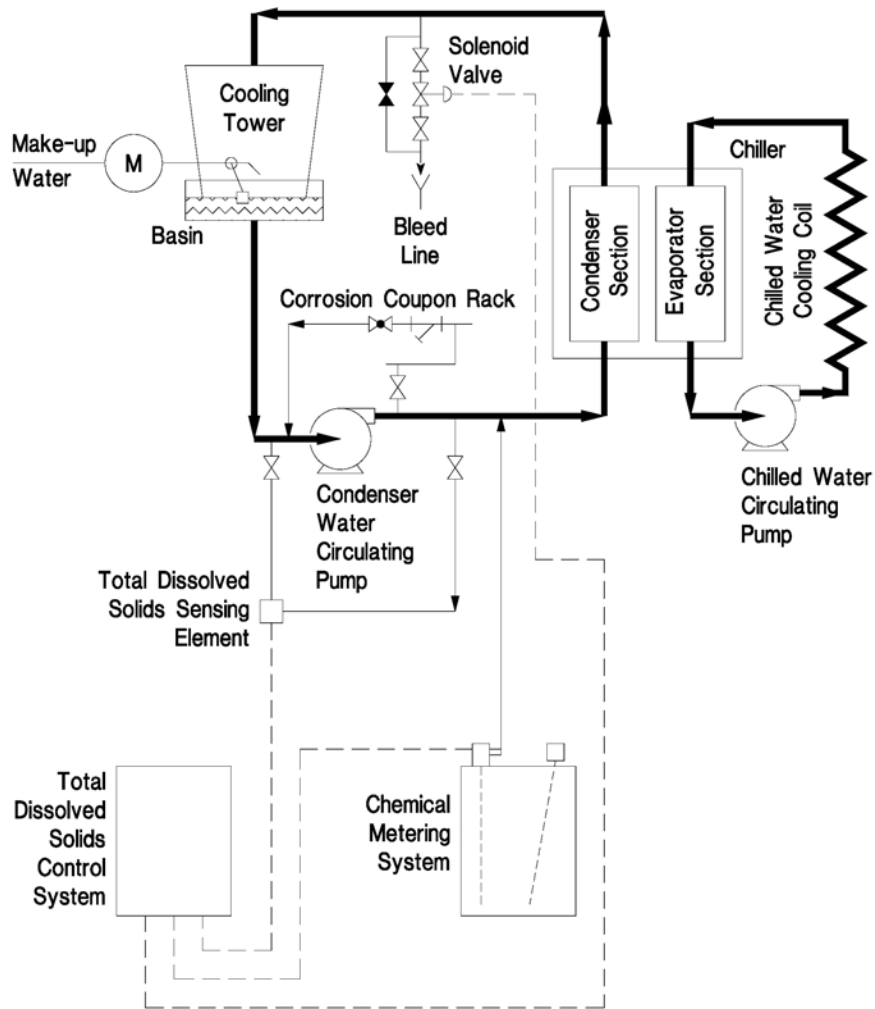
#### 4.0 Open Cooling Water System

#### 4.1 Description

An open cooling water system or condenser water system, a typical schematic diagram of which is included, is a system that normally provides cooling water for the condenser section of a chiller unit. However, in a 'free cooling' system, the condenser water system provides either direct or indirect cooling, via a heat exchanger, to the coils of a chilled water system when the chiller unit is by-passed.

The principal components of these systems include a cooling tower, circulating pump, cooling coils, heat exchanger, continuous bleed-off valve, TDS control system, chemical feed system, corrosion coupon rack, and metered make-up water with float valve or conductivity probes with a solenoid valve. If there is not adequate air space between the condensing water level and the point of make-up water a backflow prevention device must be installed.

#### 4.2 Typical Schematic Drawing



NOTE: The corrosion coupon rack must be lower than the water level in the basin of the cooling tower so that the coupon rack is flooded at all times.

### **4.3 Operation and Maintenance**

The fresh make-up water to these systems contains 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. Ensure that the locations of chemical injection; chemical controller probe and continuous blowdown are not interfering with one another's correct operation.

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

1. Adjust the setting of the TDS controller such that scaling and corrosion are prevented.
2. Log the make-up water meter reading at least once per week.
3. Provide screens on the slats of the cooling tower if airborne debris is gaining access to the cooling tower.
4. Inspect the cooling tower at least once per week to detect scaling, corrosion, or slime growths.
5. Inspect the chiller condenser coils and chilled water coils when maintenance is being carried out on these units.

#### 4.4 Water Treatment

Since the water within these systems is continuously aerated and exposed to the atmosphere, the prevention of corrosion due to dissolved oxygen, scale formation due to hardness salts, and fouling due to bacteria **cannot** be accomplished by operational techniques alone. Therefore, chemical treatment must be used to provide protection against these contaminants.

The following recommendations are made with respect to the water treatment for the majority of these systems.

1. Whether the system is treated with proprietary or non-proprietary chemical methods depends on such factors as the make-up water quality, the size of the system, and the operating time of the system. An economic evaluation of these methods may be obtained from the Water Treatment Consultant.
2. If the economic evaluation shows that the proprietary chemical treatment is preferred, the chemical supplier will establish its concentration as well as the concentration of solids in the system. However, in most cases the total dissolved solids concentration will be set to control the calcium hardness at 500 ppm as CaCO<sub>3</sub> maximum.
3. If the economic evaluation shows that generic chemical treatment is preferred, the following recommendations are made:
  - a. The make-up water must consist of fresh domestic water and softened domestic water, blended so that that combined total hardness concentration of 25 - 50 ppm CaCO<sub>3</sub> is maintained in the circulating water.
  - b. Sodium hexameta phosphate must be added such that a residual poly phosphate concentration of 10 - 20 ppm PO<sub>4</sub> is maintained in the circulating water.
4. Add sodium hypochlorite (liquid bleach) as required to control microbiological growths. If the microbiological growth proliferates beyond normal control, a proprietary biocide treatment may be required. The maximum bacteria population is 10<sup>3</sup> colony forming units/mL (cfu/ml).

Note: Excessive chlorine concentrations are corrosive.

#### 4.5 Control Tests

In order to minimize scaling, corrosion, and fouling of these systems, the following control tests must be performed, and all water test results must be documented on a dedicated record sheet (see typical record sheet in Section G).

1. Document the make-up water meter reading at least once per week.
2. Determine and log the TDS concentration of the water in the system three (3) times per week. Contact the Water Treatment Consultant for the TDS control limits.
3. Determine and log the pH of the water in the system three (3) times per week.
4. Determine and log the total hardness of the water in the system three (3) times per week. It must be 25 - 50 ppm CaCO<sub>3</sub> if generic treatment is being used.
5. Determine and log the poly phosphate concentration (generic treatment) or inhibitor concentration (proprietary treatment) of the water in the system three (3) times per week. It must be 10 - 20 ppm PO<sub>4</sub> or chemical suppliers recommend inhibitor concentration.
6. Determine and log the bacteria concentration of the water in the system at least once per month. It must be less than 10<sup>3</sup> cfu/ml (i.e. colony forming units/mL).
7. Remove the iron and copper corrosion coupons, and replace them with fresh coupons every 30 - 60 days. The maximum iron corrosion rate is 2 mpy (i.e. mils per year). The maximum copper corrosion rate is 0.2 mpy. If the chilled water system is part of a direct free cooling system (i.e. Mixing of condenser and chilled water) to reduce energy costs related to mechanical cooling, the corrosion rates of the system maybe greater than the limits indicated above and the system must be treated with a proprietary scale and corrosion inhibitor.
8. Determine and document the visual appearance of the water in the system at least once per month. It must be clear and colorless.
9. To control microbiological growth a biocide will have to be added. Add sodium hypochlorite (liquid bleach) to maintain a free chlorine residual of 0.2 - 0.8 ppm, and for shock treatment 1.0 - 2.0 ppm is allowed. These treatment limits must be maintained, since excessive chlorine concentrations are corrosive.

File all documentation pertaining to system activities and test results for future reference.



## 5.0 Air Washer Humidifier System

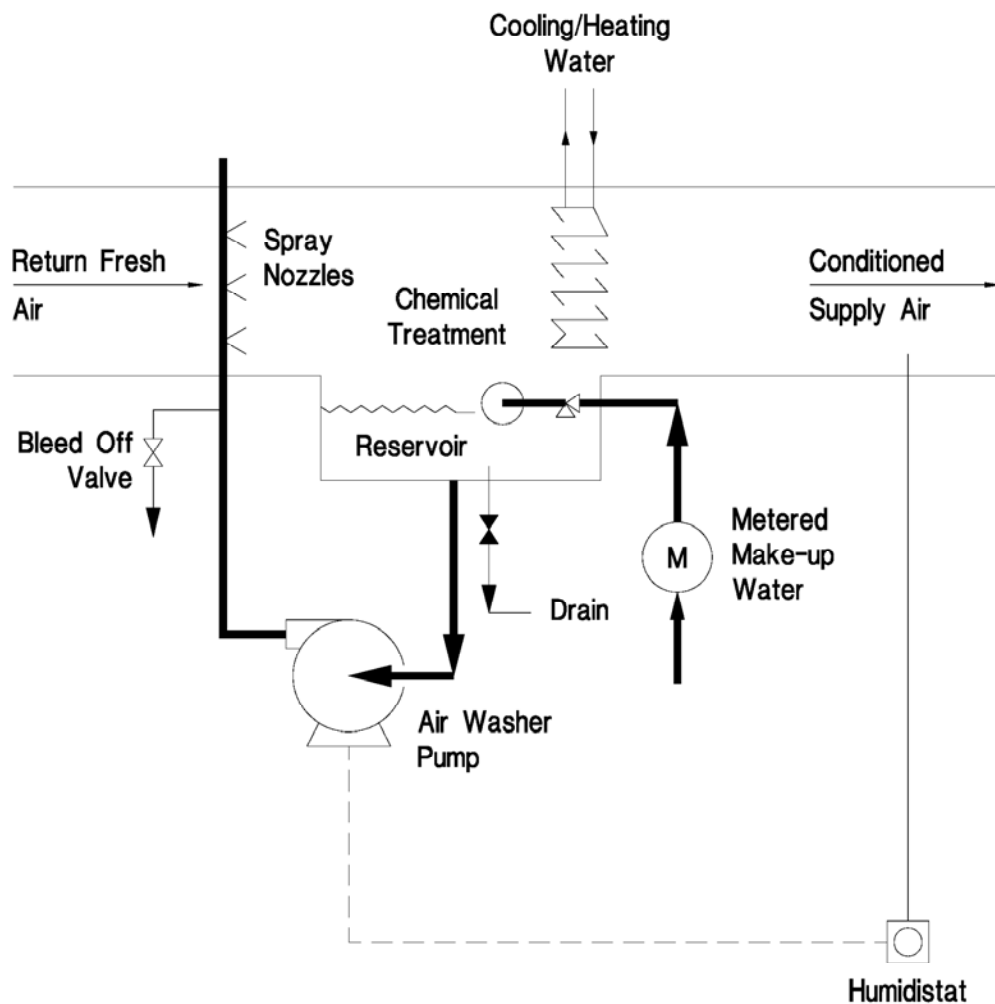
### 5.1 Description

A re-circulating air washer humidifier system, a typical schematic diagram of which is included, is a system, which cleans, humidifies, and cools the air by re-circulating water through spray nozzles from a reservoir within the ductwork of an HVAC system.

The principal components of these systems consist of an air washer re-circulating pump, spray nozzles, continuous bleed-off valve, humidistat, cooling/heating coils or media, reservoir, and metered make-up water with a float valve.

A once through air washer humidifier system performs the same functions as the re-circulating type. However, in the once through type of air washer humidifier system instead of re-circulating the water through the system, fresh water is evenly distributed at the top of the media and allowed to flow down over the media and out to drain.

### 5.2 Typical Schematic Drawing



### **5.3 Operation and Maintenance**

The fresh make-up water to these systems contains hardness salts, dissolved oxygen, and dissolved solids. If these contaminants as well as microbiological contaminants and airborne 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.

1. Adjust the setting of the bleed valve such that scaling and corrosion are prevented.
2. Log the make-up water meter reading at least once per week.
3. Inspect the nozzles, reservoir and baffle surfaces at least once per week to detect scaling, corrosion, or slime growths.
4. Clean the nozzles and ductwork as required.

#### 5.4 Water Treatment

Since the water within these systems is continuously aerated and exposed to the atmosphere, the prevention of corrosion due to dissolved oxygen, scale formation due to hardness salts, and fouling due to bacteria cannot be accomplished by operational techniques alone. Therefore, chemical treatment must be used to provide protection against these contaminants.

The following recommendations are made with respect to the water treatment for the majority of these systems.

1. Whether the system is treated with proprietary or non-proprietary chemical methods depends on such factors as the make-up water quality, the size of the system, and the operating time of the system. An economic evaluation of these methods may be obtained from the Water Treatment Consultant.
2. If the economic evaluation shows that the proprietary chemical treatment is preferred, the chemical supplier will establish the inhibitor concentration as well as the concentration of total dissolved solids in the system.
3. If the economic evaluation shows that generic chemical treatment is preferred, the following recommendations are made:
  - a. The make-up water must consist of fresh **un-softened** domestic water.
  - b. Sodium hexameta phosphate must be added such that a residual poly phosphate concentration of 10 - 20 ppm PO<sub>4</sub> is maintained in the circulating water.
4. Add sodium hypochlorite (liquid bleach) as required to control microbiological growths. If the microbiological growth proliferates beyond normal control, a proprietary biocide treatment may be required. The maximum bacteria population is 10<sup>3</sup> colony forming units/ml.

Note: Excessive chlorine concentrations are corrosive.

## 5.5 Control Tests

In order to minimize scaling, corrosion, and fouling of these systems, the following control tests are recommended, and all water test results must be documented on a dedicated record sheet. (see typical record sheet in Section G).

- \* 1. Log the make-up water meter reading at least once per week.
- 2. Determine and log the TDS concentration of the water in the system, and adjust the continuous blowdown controller as required, three (3) times per week. Contact the Water Treatment Consultant or your Chemical Supplier for the TDS control limits.
- 3. Determine and log the pH of the water in the system three (3) times per week.
- 4. Determine and log the poly phosphate or inhibitor concentration of the water in the system three (3) times per week.  
It must be 10 - 20 ppm PO<sub>4</sub> or chemical suppliers recommend inhibitor concentration.
- \* 5. Determine and log the bacteria concentration of the water in the system at least once per month.  
It must be less than 10<sup>3</sup> cfu/mL (i.e. colony forming units/ml).
- 6. Determine and document the visual appearance of the water in the system at least once per month.  
It must be clear and colorless.
- \* 7. To control microbiological growth a biocide will have to be added. Add sodium hypochlorite (liquid bleach) to maintain a free chlorine residual of 0.2 - 0.8 ppm, and for shock treatment 1.0 - 2.0 ppm is allowed. These treatment limits must be maintained, since excessive chlorine concentrations are corrosive.
- \* 8. File all documentation pertaining to system activities and test results for future reference.

**\*Note** For a once through system, these are the only tests required.  
For a Gas-Fired Direct Steam system, follow manufacturer's operating and maintenance procedures.

## **6.0 Glycol System**

### **6.1 Description**

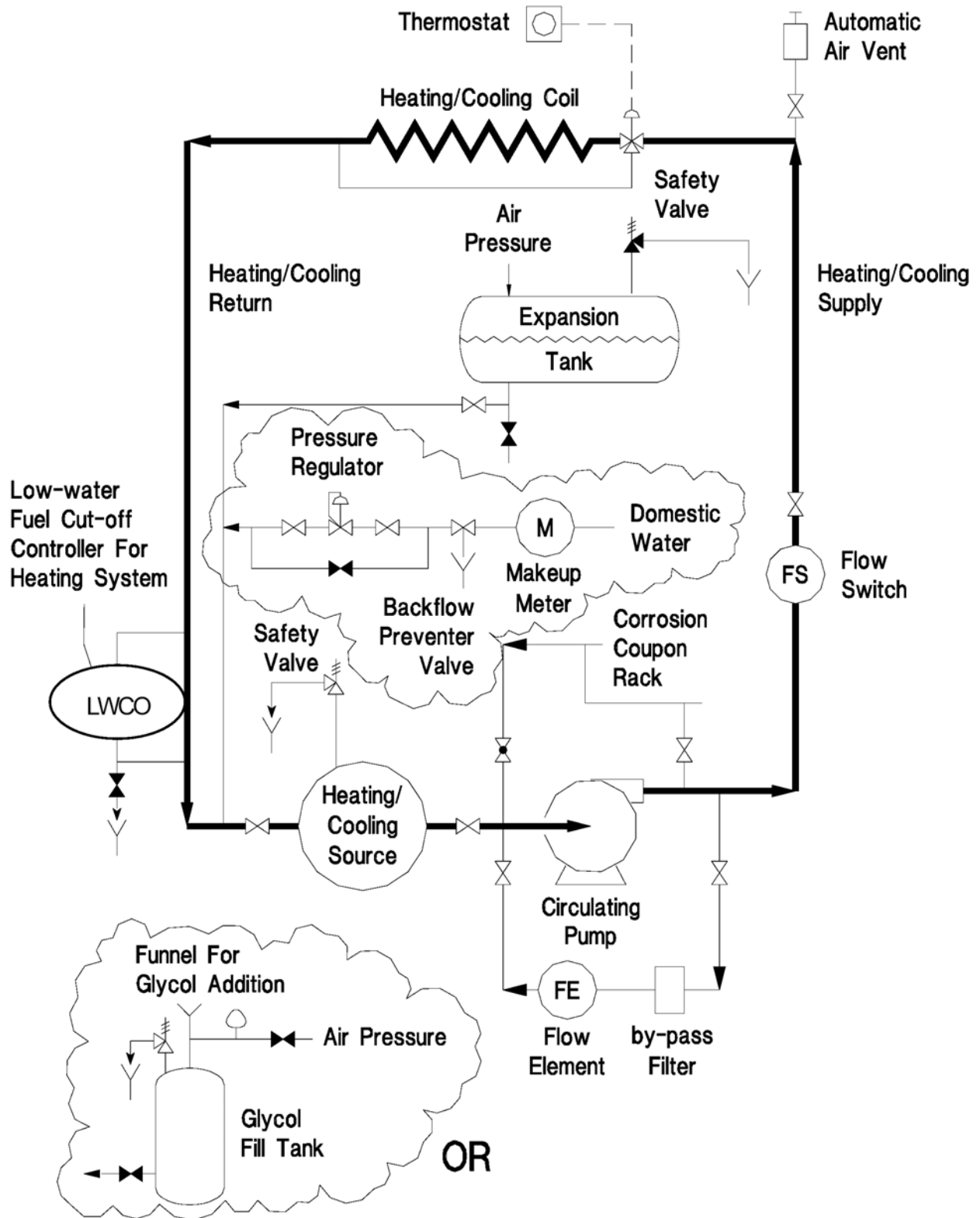
NOTE: Glycol systems for emergency generator diesel engines, which utilize automotive grade glycol in accordance with the supplier recommendations, are not included in this Section.

A glycol system, a typical schematic diagram of which is included, is a heating/cooling system in which an ethylene or propylene glycol-water solution is circulated to fan coil units throughout the building or through heating/cooling coils in an HVAC system in order to provide space heating/cooling without the inherent risk of freeze damage.

The heat source may be converters, fired heaters, or fired boilers. The cooling source is a chiller.

The principal components of these systems include a heating/cooling source, automatic air vents, circulating pumps, flow switch, expansion tank, heat exchangers, a pumping system to introduce the glycol-water solution into the system, safety valves, low-water fuel cut-off controller, bypass filter with flow element, and corrosion coupon rack. In order to prevent undetected dilution of the glycol concentration in the system, a water make-up connection is not recommended for these systems, however, if a make-up connection is provided, it must contain a water meter, backflow prevention device and pressure regulator.

6.2 Typical Schematic Drawing



### 6.3 Operation and Maintenance

Industrial grade glycol is composed of 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 glycol should be used because of its low oral toxicity, otherwise an industrial grade ethylene glycol is the preferred choice.

*NOTE: In order to accurately measure the glycol concentration in the system, ethylene and propylene glycol must not be mixed together in the same system.*

Since dissolved oxygen in the system will decompose glycol into an organic acid, particularly at elevated temperatures, thus causing corrosion and fouling, both types of glycol contain a corrosion inhibitor, typically dipotassium hydrogen phosphate.

The water, which is used to mix with concentrated glycol, must be of the highest possible quality (i.e. softened, de-mineralized, de-ionized, boiler condensate), otherwise the hardness and corrosive salts in most domestic water supplies will deplete the corrosion 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 below.

1. A water connection is not recommended. However, if a water connection is provided, limit the amount of make-up water as follows:
  - a. Install a water meter in the water make-up line, and confirm its operation by noting the changes in its reading before and after such activities as water sampling, low-water fuel cut-off controller blowdown, safety valve testing and filter cartridge replacement activities. Document the make-up water meter reading at least once per month.
  - b. Locate and repair system leaks immediately.
  - c. Adjust pump seals with packing so that there is minimum leakage.
  - d. Ensure that pumps with mechanical seals have zero leakage.
  - e. Do NOT drain and fill the system seasonally. If maintenance or inspections are required, only those portions of the system that are affected should be drained.
  - f. Ensure that safety valves have zero leakage.
  - g. Minimize loss from the system during glycol sampling, low-water fuel cut-off controller blowdown, safety valve testing and filter cartridge replacement activities.

### 6.3 Operation and Maintenance (continued)

2. 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.

Imperial Formula:  $P = (H/2.31) + 5$

Metric Formula:  $P = [(9.81 \times SG \times H)/2.31] + 34.5$

Where P: system pressure at the circulating pumps with the pumps shutoff, psig (kPa)

Where H: elevation of the system piping above the circulating pumps, feet (meters)

Where SG: specific gravity

3. Ensure that there is a glycol-water solution level in the expansion tank at all times.
4. Replace faulty automatic vents as required.
5. 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)



## 6.4 Chemical Treatment

In order to provide freeze protection (i.e. a glycol concentration which is sufficient to prevent the formation of ice crystals and thus remain pumpable at the lowest temperature experienced by the fluid) down to at least -34 °C, the acceptable glycol concentration range for cooling systems which are operational year round and for heating systems is 48 - 87 vol. % for ethylene glycol systems and 50 vol. % minimum for propylene glycol systems. However, for economic reasons, the preferred glycol concentration range is 48 - 52 vol. % with a corresponding freeze point range of -34 °C to -40 °C for ethylene glycol systems and 50 - 54 vol. % with a corresponding freeze point range of -34 °C to -40 °C for propylene glycol systems. Other than causing higher energy consumption, a high glycol concentration is acceptable; therefore, dilution is not required unless the ethylene glycol concentration is greater than 87 vol. %.

In order to provide burst protection (i.e. a glycol concentration which is high enough to prevent bursting of pipes and other mechanical damage, but not necessarily high enough to keep the fluid pumpable) down to less than -50 °C the acceptable glycol concentration is 30 - 85 vol. % for ethylene glycol cooling systems which are operational only during the summer months. However, for economic reasons, the preferred glycol concentration range is 30 - 35 vol. % with a corresponding freeze point range of -16 °C to -19 °C. Similarly the preferred range is 35 - 40 vol. % with a corresponding freeze point range of -16 °C to -19 °C for burst protection down to less than -40 °C. Other than causing higher energy consumption a high glycol concentration is acceptable, therefore dilution is not required.

It must be stated again that these lower glycol concentrations are in place only if the cooling fluid is not exposed to outside temperatures during the winter months.

Since glycol concentrations less than 20 vol. % are a nutrient source for bacteria, the glycol concentration must be greater than 20 vol. %.

The following equation may be used to calculate the approximate amount of glycol required to increase the glycol concentration in a system.

$$G = V \times (CD - CP) / (100 - CP)$$

Where G: volume of present glycol solution to be drained from the system and volume of fresh concentrated glycol to be added to the system, liters.

Where CD: desired glycol concentration, vol. %

Where CP: present glycol concentration, vol. %

Where V: volume of the system, liters

In order to provide adequate corrosion protection of the glycol system, the reserve alkalinity based on a glycol concentration of 100% (i.e. RA [100%]), which is an indication of the corrosion inhibitor level, must be maintained at a level of at least 9.0 for all glycol concentrations by corrosion inhibitor additions as required.

If the RA (100%) value is less than 9.0, the following equation may be used to calculate the first estimate for the amount of corrosion inhibitor addition that is required.

$$I = 1.75 \times V / 100$$

Where I: volume of inhibitor, liters

Where V: volume of the system, liters

## 6.5 Control Tests

In order to minimize fouling and / or corrosion of glycol systems, the following control tests must be performed. Due to the more sophisticated nature of the chemical tests for glycol systems, (glycol concentration, pH and reserve alkalinity levels) should be performed by a commercial laboratory.

1. Document the make-up water meter reading at least once per month. It must be negligible.
2. Determine and document the glycol concentration in the system at least once per year. The following control limits must be maintained.
  - a. For ethylene glycol cooling systems that are operational year round and for ethylene glycol heating systems, the glycol concentration must be 48 - 52 vol. % with a corresponding freeze temperature of -34 °C to -40 °C and a burst temperature of less than -50 °C.
  - b. For propylene glycol cooling systems that are operational year round and for propylene glycol heating systems, the glycol concentration must be 50 - 54 vol. % with a corresponding freeze temperature of -34 °C to -40 °C and a burst temperature of less than -40 °C.
  - c. For ethylene glycol cooling systems that are operational only during the cooling season, the glycol concentration must be 30 - 35 vol. % with a corresponding freeze temperature of -16 °C to -19 °C and a burst temperature of less than -50 °C.
  - d. For propylene glycol cooling systems that are operational only during the cooling season, the glycol concentration must be 35 - 40 vol. % with a corresponding freeze temperature of -16 °C to -19 °C and a burst temperature of less than -40 °C.
3. Determine and document the pH level in the system at least once per year. It must be greater than 8.5.
4. Determine and document the reserve alkalinity level in the system at least once per year. The RA (100%) level must be greater than 9.0.
5. Replace the by-pass filter cartridge when the flow indicator shows a reduced flow and document this activity.
6. If present, replace the iron and copper corrosion coupons with fresh coupons once every six months and determine the respective corrosion rates. The iron corrosion rate must be less than 0.5 mpy (i.e. mils per year), and the copper corrosion rate must be less than 0.2 mpy.
7. File all documentation pertaining to system activities and test results for future reference.
8. Sample size required for glycol testing is 125ml.

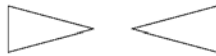
**7.0 CONTACT STEAM COOKING SYSTEM**

**7.1 Description**

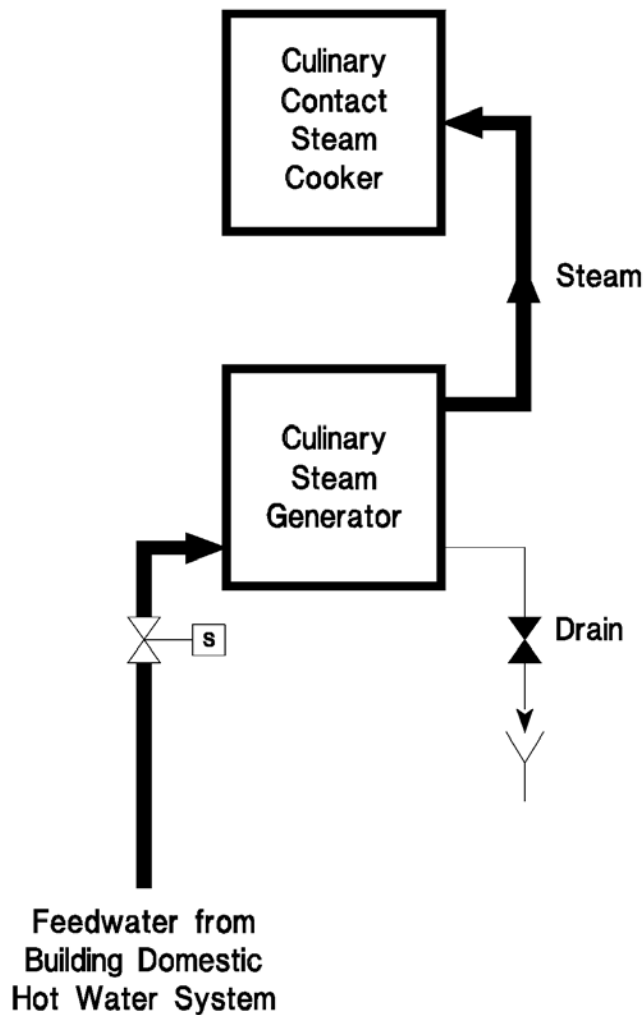
A contact steam cooking system, a typical schematic diagram of which is included, is the only acceptable system that provides steam for direct contact cooking of cafeteria type food.

The principal components of these systems include a culinary steam generator and a culinary steam cooker. However, if the culinary steam generator is a gas-fired unit, an exhaust fan should also be provided in order to exhaust the products of combustion.

**7.2 Typical Schematic Drawing**



**Exhaust Fan for Gas Fired Culinary Steam Generators**



### 7.3 Operation and Maintenance

Since the steam produced by these systems comes into direct contact with food, there can be no chemical treatment of the water and steam in these systems, and the feedwater to these systems must be un-softened domestic water. Therefore, the corrosive and scaling tendencies of oxygenated water can only be minimized by the following operational and maintenance activities:

1. Ensure that the feedwater to the culinary steam generator is **un-softened** domestic water from the building domestic hot water system.
2. Drain and refill the culinary steam generator with fresh hot water at the end of each cooking period.

Note: This activity can be performed automatically every time the unit is shut off by connecting the drain and fill solenoid valves to the on/off switch or it can be performed manually.

3. In those cases where daily draining of the culinary steam generator does not alleviate scaling sufficiently, the cleaning procedure indicated below shall be used.

#### **Cleaning Procedure for Culinary Steam Generator**

1. Required equipment and material includes a plastic mixing tank, a plastic circulating pump, plastic supply and return lines, safety eye goggles, pH paper, metric scale, sulfamic acid, soda ash, and an inhibitor like the Dow A-120 must be used.
2. Disconnect the feed and drain lines of the culinary generator, and connect these to the circulating pump discharge line and the return line to the mixing tank.
3. Prepare the acid solution by adding sufficient sulfamic acid to warm water in the mixing tank such that a pH of 4 – 5 is obtained. Then add 0.2 grams of inhibitor for every 100 grams of acid added.
4. Circulate this solution through the culinary generator until the foaming action stops, and then drain the spent acid from the culinary generator and the mixing tank into a holding tank.
5. Prepare a neutralizing solution by adding 5 grams of soda ash for each liter of warm water in the mixing tank. Circulate it through the culinary generator for at least one hour, and then drain the culinary generator and the mixing tank into the holding tank for disposal to the sanitary sewer system.
6. Flush out the culinary generator using warm water until the pH of the rinse water is the same as the domestic water.
7. Reconnect the feed and drain lines of the culinary generator and return it to service.

## **8.0 POTABLE WATER SYSTEM**

### **8.1 Description**

A potable water system, a typical schematic diagram of which is included, provides potable water for general domestic use. It does not include municipal potable water systems or other potable water systems, which are licensed, operated and monitored by Alberta Environment.

The principal components of a potable water system include a water source (i.e. well, cistern, reservoir) supply pump, pressure tank and pressure switch. It may also include a water conditioner (i.e. filter, softener, iron filter, reverse osmosis unit, ultra-violet sterilizer unit) and/or chlorine injection equipment (i.e. mixing tank, mixer, metering pump, controller).

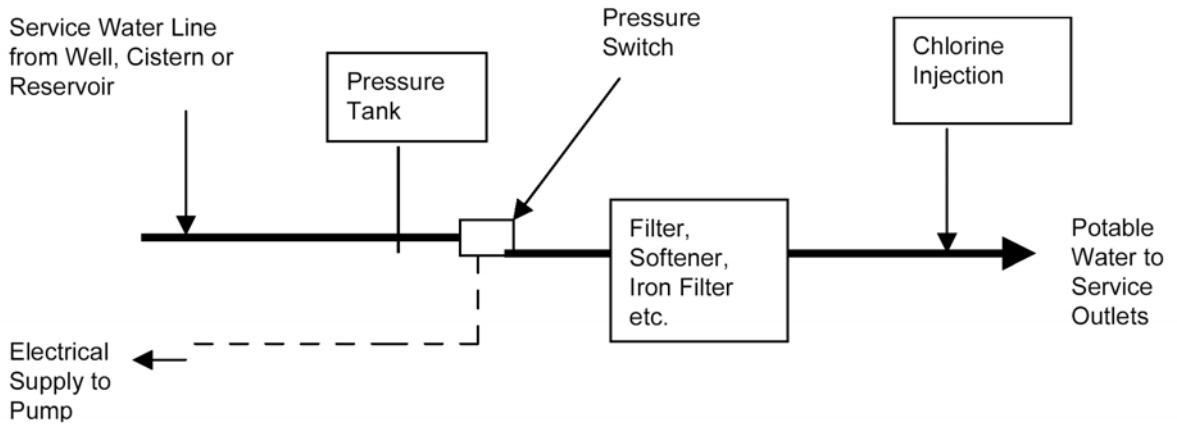
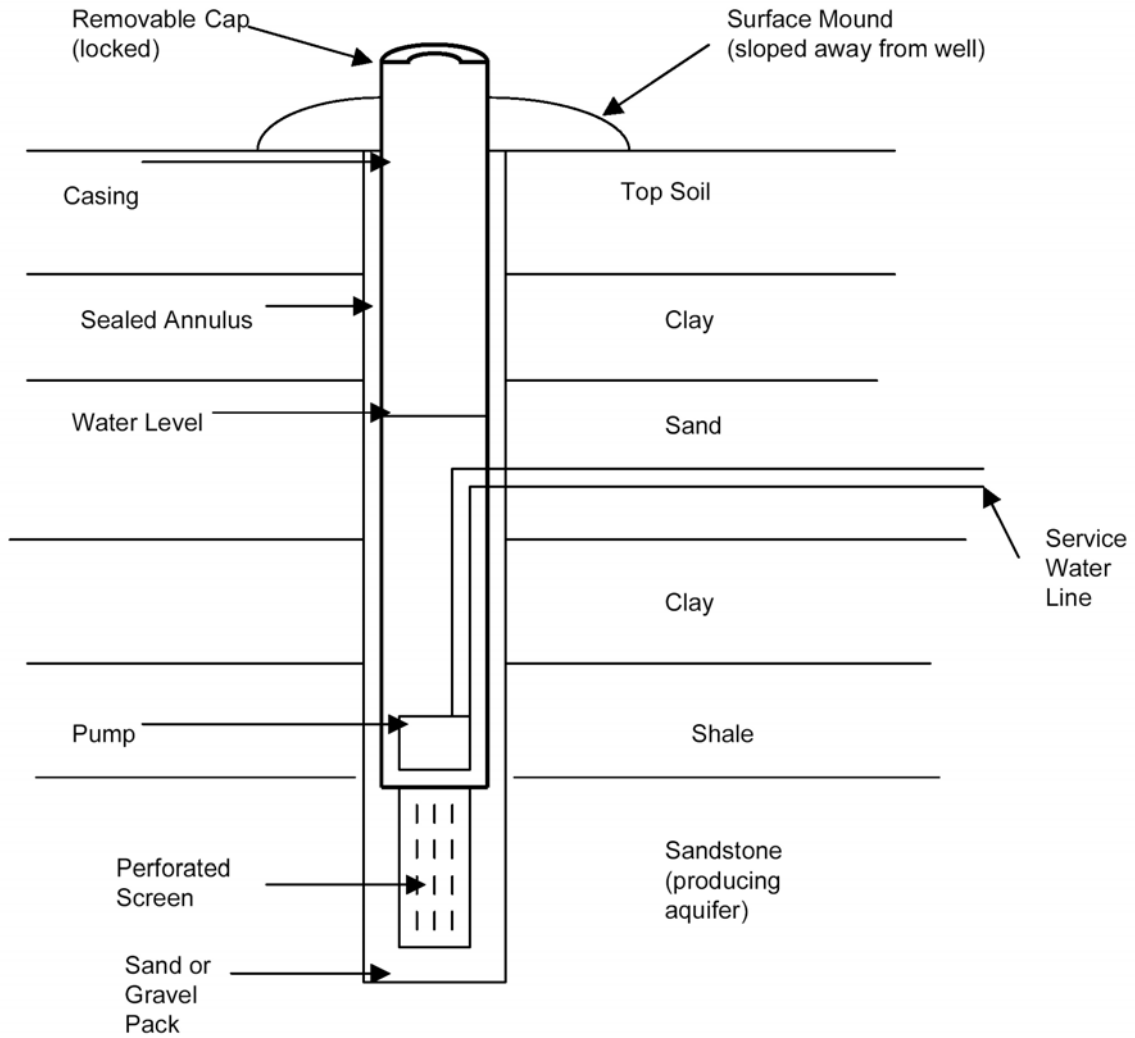
If the source water is a cistern or reservoir, the fill water must be originally drawn from a water source that is approved and licensed by Alberta Environment. Furthermore, Alberta Environment must license the tanker truck that is used to transport the water.

If the water source is a creek, river, lake, or if the water is a well under the influence of a creek, river or lake, approval and licensing must be obtained from Alberta Environment.

Although water from a dugout or lagoon may be used for general service water (i.e. washing floors, flushing toilets, etc.) this water source must NOT be directly or indirectly connected to a potable water system.

A water system that has been tested and proven to contain water that is unfit for human consumption shall have the appropriate official signage (i.e. faucet, water drop and drinking glass with a red encircled line through it) affixed to the wall in clear view above all faucets and outlets in the water system until such time that this same water is properly treated, tested and approved for human consumption.

**8.2 Typical Schematic Drawing**



### 8.3 Operation and Maintenance

A standard bacteriological analysis determines total coliform and faecal coliform bacteria concentrations in the water sample. The total coliform and faecal coliform bacteria are indicator organisms for the potential presence of pathogenic (i.e. disease causing) bacteria. The presence of *Escherichia coli* (i.e. *E. coli*), one species of the faecal coliform group, is a definite indicator of faeces (i.e. animal and human waste). Other species of the faecal coliform group (i.e. *Klebsiella*, *pneumoniae*, *Enterobacter*, *cloacae*) are not restricted to faeces but occur naturally on vegetation and in soils. The maximum acceptable concentration for coliform bacteria - both total and faecal - must be less than that indicated in the latest editions of the following standards:

1. Guidelines for Canadian Drinking Water Quality
2. Alberta Environment Standard

Note that a standard bacteriological analysis does NOT determine the non-pathogenic (i.e. non-disease causing) bacteria such as iron bacteria or sulphate reducing bacteria, nor does it determine viruses or protozoa (*Giardia*).

Similarly, a routine (i.e. pH, turbidity, TDS, nitrate/nitrite, etc) and possibly a non-routine (i.e. pesticides, etc) potable water chemicals analysis must be performed on water samples, and the maximum acceptable concentrations for each of these parameters must be less than that indicated in the latest editions of the following standards:

1. Guidelines for Canadian Drinking Water Quality
2. Alberta Environment Standard

#### 8.4 Water Treatment

The need for water treatment of these systems (i.e. chlorination, filtration) is specified by Alberta Health and Wellness or Alberta Environment.

Depending on the source of the water, treatment may be required to ensure the water is microbiologically safe and palatable. Groundwater usually does not contain harmful microorganisms, but depending on the aquifer and well system, can be contaminated through surface infiltration, surface water contamination (groundwater under influence), and abandoned wells. Surface water has a greater potential of being contaminated by disease causing bacteria. As a result, proper disinfection is needed for all surface water supplies. The ideal system is a multi-barrier approach to treating surface water consisting of watershed protection, filtration and disinfection.

The minimum treatment for a groundwater source is disinfection.

The minimum treatment for a surface water source is filtration followed by disinfection.

No water should enter a communal distribution system unless it has been disinfected with a residual disinfectant.

The minimum concentration of free chlorine and chloramines that must be maintained in the distribution system is:

1. 0.2 mg/L for groundwater
2. 0.5 mg/L for groundwater under the influence of surface water.



## 8.5 Control Tests

In order to minimize the health risks associated with these systems, the following control tests must be performed, and all test results must be documented on a dedicated record sheet (see typical record sheet in Section G)

1. If chlorination is specified, determine and document the free chlorine residual or combined chlorine residual concentration of the water in the system at least once per week. (This frequency may change at the discretion of the Local Health Inspector) The chlorine residual must be 0.2 - 0.5 mg/L. If the chlorine concentration is high, reduce the chlorine concentration by reducing the amount of chlorine being added into the system. If the chlorine residual is low, increase the chlorine concentration by increasing the amount of chlorine being added into the system.
2. Obtain a sample bottle, sampling procedure and sample requisition form for bacteriological analysis either from the Provincial Laboratories in Edmonton or Calgary, or from your Local Regional Health Authority Office; and submit a water sample of the system for bacteriological analysis to any one of these locations at the frequency approved by the Local Health Inspector. If the results are unsatisfactory, Alberta Public Health, Alberta Environment or your Local Health Inspector will contact you immediately and will specify and verify the appropriate corrective actions to be taken.
3. Obtain a sample bottle, sampling procedures and sample requisition form for a routine chemical analysis to verify its drinking water quality. These are obtained from the Provincial Laboratories in Edmonton or Calgary, or your Local Regional Health Authority Office. Submit a water sample of the system to any one of these locations once per year for cistern and reservoir systems, and once every two years for well water systems. (This frequency may change at the discretion of the Local Public Health Inspector) If the results are unsatisfactory, Alberta Public Health, Alberta Environment or your Local Health Inspector will contact you immediately and will specify and verify the appropriate corrective actions to be taken.

Detailed information on microbial indicators, sampling protocol, interpretation of results, site investigation, communication and action protocol one can refer to "Environmental Public Health Field Manual for Private, Public and Communal Drinking Water Systems in Alberta: Second Edition" published by Alberta Health and Wellness. This document can be obtained on the web at the following address:

[http://www.health.gov.ab.ca/resources/publications/Environmental\\_drinking\\_water\\_manual.pdf](http://www.health.gov.ab.ca/resources/publications/Environmental_drinking_water_manual.pdf)

**1.0 General**

Water circulating in a boiler or cooling system must be constantly corrected to prevent problems and to insure proper operation. Regular, accurate water testing is needed to control impurities, treatment levels, corrosion and deposits.

Water used in potable water systems; depending on the source of the water, treatment and testing may be required to ensure that the water is microbiologically safe and palatable.

Various methods of water testing include titration, color comparison, electronic metering and indicator paper tests.

## 1.1 Sample Collection

The goal of sampling is to obtain for analysis a portion of the main body of water that is truly representative. The most critical factors necessary to achieve this are:

- point(s) of sampling
- time of sampling
- frequency of sampling
- maintenance or integrity of the sample prior to analysis

Sample points should be remote from excessive amounts of particulate matter, incoming feed or make-up water, and chemical feed points.

Samples should be collected during normal operation prior to system blowdown and chemical dosing if these are batch operations.

The frequency of sampling is determined by the amount of deviation of the control parameters from their control points.

Before collecting a sample, establish a flow of less than 500 ml/minute for a minimum purge period of 10 - 15 seconds for every foot of sample line.

*NOTE: When collecting samples for analysis, allow the bottle to overflow at least five (5) times its volume, then rinse the cap with the sample, place it tightly on the bottle, and identify the sample.*

## 1.2 Sample Analysis

Samples should be analyzed as quickly as possible after collection, provided that they have been cooled to room temperature.

The abridged water test procedures are indicated overleaf. However, these reduced procedures should not be used until an understanding of the detailed procedures is obtained. The Operator must be familiar with the specific test procedures provided by the chemical supplier. The Water Treatment Consultant can provide additional advice as required.

This section provides descriptions of the methods used for testing system parameters. There are new testing technologies available that may follow different principles than those described.

More information is available from the following reference material:

1. Annual Book of ASTM Standards  
American Society for Testing Materials
2. Methods for Chemical Analysis of Water and Wastes  
U.S. Environmental Protection Agency
3. Standard Methods for the Examination of Water and Wastewater  
American Water Works Association
4. Methods Manual for Chemical Analysis of Water and Wastes  
Alberta Environmental Centre, Vegreville

Typical water test record sheets are included in the Section G.

## ABRIDGED WATER TEST PROCEDURES

### P & M Alkalinities (as ppm CaCO<sub>3</sub>)

- 20 ml sample
- 2-3 drops P Ind. Phenolphthalein Solution
- titrate to clear with Sulphuric Acid, 0.02 N
- **P = ml X 50**
- 2-3 drops M Ind. Mixed Indicator Solution
- continue titration until purple/grey with Sulphuric Acid, 0.02 N until
- **M = total ml X 50**
- **OH = (2 x P) - M**

### Total Hardness, Low [<10 ppm ] (as ppm CaCO<sub>3</sub>)

- 100 ml sample
- 1.0 ml Hardness Buffer Solution
- 0.05 g H Ind. Hardness Indicator
- titrate to blue with EDTA, 0.001M
- **TH-L = ml X 1**

### Sulphite (as ppm SO<sub>3</sub>)

- 50 ml sample
- 1 ml Hydrochloric Acid, 50%
- 3 drops S Ind. Starch Indicator
- titrate to blue/grey with Potassium Iodide-Iodate, 0.0125M
- **SO<sub>3</sub> = ml X 10**

### Phosphate, ortho (HACH TEST KIT) (as ppm PO<sub>4</sub>)

- rinse tube with de-mineralized water
- fill dropper with 0.5 ml of boiler water and add to viewing tube
- add de-mineralized water to the 5.0 ml mark and swirl to mix
- add 1 PhoVer 3 reagent powder pillow to the 5 ml sample. Swirl to mix. Place in right top opening
- fill other viewing tube to 5 ml mark with de-mineralized water. Place in left opening
- allow at least 1 minute but no more than 5 minutes for color development
- **read mg/L Phosphate from scale window**

**Note: If PO<sub>4</sub> is above 50 ppm then use ½ the drops of 0.5 ml boiler water and multiply results by 2.**

### Hydroxide Alkalinity (as ppm CaCO<sub>3</sub>)

- 20 ml sample
- 0.2 g Barium Chloride
- 2-3 drops P Ind. Phenolphthalein Solution
- titrate to clear with Sulphuric Acid, 0.02 N
- **OH = ml X 50**

### Total Hardness, High [>10 ppm ] (as ppm CaCO<sub>3</sub>)

- 50 ml sample
- 0.5 ml Hardness Buffer Solution
- 0.2 g Hardness Indicator
- titrate to blue with EDTA, 0.01M
- **TH-H = ml X 20**

### pH (as pH units)

- use pH pen or paper

### TDS (ppm) & Conductivity (µS/cm)

#### **Steam Boiler Water:**

- 2-3 drops P Ind. Phenolphthalein Solution
- add Gallic Acid to clear
- Conductivity Meter:  
Conductivity (in µS/cm) or conductivity X 0.65 = TDS in ppm
- TDS Meter: Reading as TDS in ppm

#### **Other Waters:**

- Conductivity (in µS/cm) or conductivity X 0.80 = TDS in ppm

- |               |    |  |
|---------------|----|--|
| <b>NOTES:</b> | 1. | Sulphite increases SO <sub>3</sub> and TDS.  |
|               | 2. | Caustic increases pH, OH Alkalinity and TDS  |
|               | 3. | Hexameta phosphate increases TDS and PO <sub>4</sub> , but decreases pH and OH Alkalinity. |
|               | 4. | Tri-sodium phosphate increases TDS, PO <sub>4</sub> , pH and OH Alkalinity.                |
|               | 5. | Morpholine increases TDS, pH and OH Alkalinity of the condensate return.                   |

## 2.0 Determination of Total Dissolved Solids (TDS)

### 2.1 Principles of Test

The conductivity of the sample is measured and a specific factor is applied to determine the total dissolved solids concentration.

Different ions increase the conductivity by different amounts, but in most cases there is sufficient similarity in the composition of the water so that a direct relationship can be used. This is especially true if the high conductivity acid or hydroxide ions are neutralized.

### 2.2 Reagents Required

<u>NAME</u>	<u>QUANTITY</u>
Gallic Acid	see procedure
Phenolphthalein Solution (P Ind)	2 – 3 drops
Standard Solution, (ex. 1000 $\mu$ S/cm)	see procedure

### 2.3 Equipment Used

TDS Meter or Conductivity Meter  
Casserole, porcelain, white, 210 ml

### 2.4 Procedure using a TDS Meter for Steam Boilers

1. Calibrate the TDS Meter using a 1000 micromhos/cm standard solution (i.e. with a conversion factor of 0.8, adjust the meter reading to show 800 ppm when using the 1000  $\mu$ S/cm standard solution).
2. If a steam boiler water sample is being tested, add 2-3 drops of Phenolphthalein Solution then add Gallic Acid until the pink color disappears.
3. Add the neutralized steam boiler water sample, or the fresh water sample to the cup of the TDS Meter and note the reading.

Note: As this is a dissolved solids test, shaking of the sample is not required.

### 2.5 Procedure using a Conductivity Meter for Steam Boilers

1. Calibrate the Conductivity Meter using a 1000  $\mu$ S/cm standard solution.
2. If a steam boiler water sample is being tested, add 2-3 drops of Phenolphthalein Solution then add Gallic Acid until the pink color disappears.
3. Pour the neutralized steam boiler water sample, or the fresh water sample over the probe of the Conductivity Meter, making sure that the proper range is selected, and note the reading.

Note: As this is a dissolved solids test, shaking of the sample is not required.

### 2.6 Calculation of Results

Using a Dissolved Solids Meter (TDS Meter)  
ppm TDS = reading

Using a Conductivity Meter:

For steam boiler waters: ppm TDS = 0.65 x reading  
For other waters: ppm TDS = 0.80 x reading

**DISSOLVED SOLIDS (PPM)  
vs.  
SPECIFIC CONDUCTANCE ( $\mu\text{S}/\text{cm}$ ) OF WATER**

Dissolved Solids (ppm)	Specific Conductance ( $\mu\text{S}/\text{cm}$ )	Dissolved Solids (ppm)	Specific Conductance ( $\mu\text{S}/\text{cm}$ )
5	10	375	700
10	20	400	730
15	32	450	785
20	45	500	840
30	65	550	895
40	85	600	950
50	105	650	1000
60	120	700	1050
70	140	750	1100
80	160	800	1150
90	180	850	1220
100	200	900	1290
110	220	950	1370
120	240	1000	1440
130	255	1200	1720
140	275	1400	2000
150	295	1600	2290
160	315	1800	2580
170	335	2000	2850
180	355	2200	3120
190	375	2400	3390
200	395	2600	3660
210	415	2800	3930
220	430	3000	4200
230	450	3200	4480
240	470	3400	4760
250	490	3600	5040
260	510	3800	5330
270	530	4000	5600
280	545	4200	5880
290	565	4400	6160
300	580	4600	6440
325	625	4800	6720
350	665	5000	7000

Calibration: is based on standard KCl solutions as described in *Standard Methods for the Examination of Water and Wastewater, 12<sup>th</sup> Edition, 1965*.

Specific Conductance: is defined as  $\mu\text{S}/\text{cm}$  at 77 °F (25 °C).

### 3.0 Determination of P, M, and OH Alkalinity

#### 3.1 Principles of Test

A water sample containing alkalinity is titrated with standardized sulphuric acid. 0.02 N titrant.

The end-point for the titration of phenolphthalein alkalinity (P Alkalinity), which is a measure of that alkalinity fraction contributed by the hydroxide and one-half of the carbonate alkalinities, is indicated by a change in sample color from pink to colorless in the presence of the phenolphthalein indicator (i.e. a pH of 8.3)

The total alkalinity (M Alkalinity) is a measure of that alkalinity contributed by the hydroxide, carbonate, and bicarbonate alkalinities and is determined by the continued titration past the phenolphthalein end-point to the mixed indicator end-point (i.e. a pH of 4.6), which is a purple/grey color in the present of mixed indicator.

#### 3.2 Reagents Required

<u>NAME</u>	<u>QUANTITY</u>
Sulphuric Acid, 0.02 N	titrant
Phenolphthalein Solution (P Ind.)	2 - 3 drops
Mixed Indicator Solution (M Ind.)	2 - 3 drops

#### 3.3 Equipment Used

<u>NAME</u>
Burette, automatic, clear bottle, 10 ml
Casserole, porcelain, white, 210 ml
Cylinder, graduated, glass, 50 ml
Stirring rod, glass, 5 inch

#### 3.4 Procedure

1. Without shaking the sample bottle excessively, add 20 ml of sample into a clean 210 ml casserole.
2. Add 2 - 3 drops of Phenolphthalein Solution (P Ind.).

If the sample does not turn pink, there is no phenolphthalein alkalinity. Proceed to Step 5.

3. Titrate with Sulphuric Acid, 0.02N, while stirring the sample until the sample changes color from pink to colorless.
4. Record the volume of titrant used as: " A = \_\_\_\_\_ ml "
5. Add 2 - 3 drops of Mixed Indicator Solution (M Ind.) to the same sample in which the phenolphthalein alkalinity has been determined.
6. Continue the titration with the Sulphuric Acid, 0.02N while stirring the sample, until the sample changes color from green to purple/grey.
7. Record the total volume of titrant used, including the volume used to the phenolphthalein end-point, as: " B = \_\_\_\_\_ ml "

#### 3.5 Calculation of Results

P Alkalinity	as ppm CaCO <sub>3</sub> = 50 x A ml
M Alkalinity	as ppm CaCO <sub>3</sub> = 50 x B ml
OH Alkalinity	as ppm CaCO <sub>3</sub> = (2 x P) - M

#### 4.0 Determination of Hydroxide Alkalinity

#### 4.1 Principles of Test

Barium chloride is added to a sample containing hydroxide alkalinity in order to precipitate alkalinity due to carbonates and phosphates. The free hydroxide alkalinity is then titrated with sulphuric acid, 0.02 N to the phenolphthalein end-point.

#### 4.2 Reagents Required

<u>NAME</u>	<u>QUANTITY</u>
Sulphuric Acid, 0.02 N	titrant
Barium Chloride	0.2 g
Phenolphthalein Solution (P Ind.)	2 - 3 drops

#### 4.3 Equipment Used

<u>NAME</u>
Burette, automatic, clear bottle, 10 ml
Casserole, porcelain, white, 210 ml
Cylinder, graduated, glass, 50 ml
Measuring Spoon, 0.2 g
Stirring rod, glass, 5 inch

#### 4.4 Procedure

1. Without shaking the sample bottle excessively, add 20 ml of sample into a clean 210 ml casserole.
2. Add 0.2 g Barium Chloride and stir the sample. A white precipitate will be formed.
3. Add 2 - 3 drops of Phenolphthalein Solution (P Ind.). If the sample does not turn pink, there is no hydroxide alkalinity.
4. Titrate with Sulphuric Acid, 0.02 N while stirring the sample, until the pink color disappears.
5. Record the volume of titrant used.

#### 4.5 Calculation of Results

Hydroxide Alkalinity as ppm  $\text{CaCO}_3$  = 50 x ml of Sulphuric Acid



## 5.0 Determination of Sulphite

### 5.1 Principles of Test

The water sample, containing sulphite, is acidified and titrated with a standardized potassium iodide-iodate, 0.0125M titrant. Free iodine is released when the sulphite has been completely oxidized, resulting in the formation of a persistent blue/grey color in the presence of a starch indicator.

### 5.2 Reagents Required

<u>NAME</u>	<u>QUANTITY</u>
Potassium Iodide-Iodate, 0.0125M	titrant
Hydrochloric Acid, 50%	1 ml
Starch Solution	3 drops

### 5.3 Equipment Used

<u>NAME</u>
Burette, automatic, clear bottle, 10 ml
Casserole, porcelain, white, 210 ml
Cylinder, graduated, glass, 50 ml
Stirring rod, glass, 5 inch

### 5.4 Procedure

1. Add 50 ml of unfiltered sample into a clean 210 ml casserole.
2. Add 1 ml hydrochloric acid, 50%.
3. Add 3 drops of starch solution (S Ind.) and stir sample.
4. Immediately titrate with Potassium Iodide-Iodate, 0.0125M while stirring sample until the first persistent blue/grey color appears in the sample.
5. Record the volume of titrant used.

### 5.5 Calculation of Results

Sulphite as ppm  $\text{SO}_3 = 10 \times \text{ml of Potassium Iodide-Iodate}$

## 6.0 Determination of Total Hardness, High

### 6.1 Principles of Test

This test should be used for hardness determination greater than 10 ppm as CaCO<sub>3</sub>.

The water sample, containing calcium and magnesium hardness, is buffered to a pH of 10.0 and titrated with a standardized hardness titrant (Sodium Salt of EDTA, 0.01M). When the hardness is fully complexed (combined with the EDTA), the sample turns from wine red to blue in the present of Eriochrome Black T indicator.

Total hardness consists of calcium, magnesium, strontium, iron, aluminum, zinc, and manganese ions however, in most applications of this test, calcium and magnesium constitute the major portion of these ions. Therefore, this test is referred to as being a total hardness test even though only the calcium and magnesium concentrations are actually determined.

### 6.2 Reagents Required

<u>NAME</u>	<u>QUANTITY</u>
EDTA, 0.01M	titrant
Hardness Buffer Solution	0.5 ml
Hardness Indicator	0.2 g

### 6.3 Equipment Used

<u>NAME</u>
Burette, automatic, clear bottle, 10 ml
Casserole, porcelain, white, 210 ml
Cylinder, graduated, glass, 50 ml
Measuring Spoon, 0.2 g
Stirring rod, glass, 5 inch

### 6.4 Procedure

1. Add 50 ml of unfiltered sample into a clean 210 ml casserole.
2. Add 0.5 ml Hardness Buffer Solution and stir the sample
3. Add 0.2 g of Hardness Indicator (H Ind.) and stir sample.
4. Immediately titrate, preferably under a fluorescent lamp, with EDTA 0.01M, while stirring the sample, until the sample color changes from wine red to blue. The time between the first addition of buffer in Step 2 and completion of titration in Step 4 must be less than 5 minutes in order to prevent precipitation.
5. Record the volume of EDTA used.

### 6.5 Calculation of Results

Total Hardness as ppm CaCO<sub>3</sub> = 20 x ml of EDTA

## 7.0 Determination of Phosphate, Ortho

### 7.1 Principles of Test

There are two principal types of phosphates, namely the ortho and the poly types. This test covers the analysis of the ortho phosphates such as tri-sodium phosphate and di-sodium phosphate. Poly phosphates such as hexameta phosphate are responsive to this test only after they have been converted to the ortho phosphate form upon heating (i.e. in a steam boiler, a hot water boiler, a hot plate, etc.).

The test procedure described is using a HACH Phosphate Test Kit (Model PO-23/PO-23A). The addition of one PhosVer 3 Phosphate Reagent Powder Pillow to a clear sample containing ortho phosphate forms a characteristic blue-violet color. This blue color's intensity is proportional to the phosphate present in the sample. The ortho phosphate concentration is read directly from the color comparator.

### 7.2 Reagents Required

<u>NAME</u>	<u>QUANTITY</u>
Demineralized Water	10 ml
PhosVer 3 Phosphate Powder Pillow	1 package

### 7.3 Equipment Used

Model PO-23/PO-23A	Hach Test Kit
--------------------	---------------

### 7.4 Procedure

1. Filter the sample.
2. Rinse a color viewing tube with demineralized water. Rinse the plastic dropper several times with the water to be tested.
3. Fill the dropper to the 0.5 mL mark with water to be tested. Discharge the contents of the dropper into the rinsed color viewing tube.
4. Add demineralized water to the 5 mL mark and swirl to mix.
5. Open one PhosVer 3 Phosphate Reagent Powder Pillow for 5 mL sample. Add the contents of the pillow to the tube and swirl to mix. Allow at least one minute but no longer than five minutes for color development. If phosphate is present, a blue-violet color will develop.
6. Insert the tube of the prepared sample in the right top opening of the color comparator.
7. Fill the other viewing tube to the 5 mL mark with demineralized water. Insert that tube into the left top opening of the color comparator.
8. Hold the comparator up to a light source such as the sky, a window or lamp and view through the openings in front. Rotate the disc to obtain a color match. Read the mg/L phosphate ( $\text{PO}_4$ ) from the scale window.

### 7.5 Calculation of Results

Ortho-Phosphate as ppm  $\text{PO}_4$  = comparator slide reading

## 8.0 Determination of pH

### 8.1 Principals of Test

The pH is the negative logarithm of the hydrogen-ion concentration, a measure of the acidity or alkalinity, of a water solution. The pH scale ranges from 0 – 14. A pH of less than 7 means that a solution is acidic, a pH greater than 7 means the solution is alkaline and a pH of 7 means the solution is neutral.

To prevent acidic corrosion in a water system the pH is usually kept above 8.5 for all systems. Specific limits are set for different systems.

### 8.2 Reagents Required

None

### 8.3 Equipment Used

pH Paper or pH Selective Electrode

#### 1. Procedure

Dip into the sample solution either the pH paper or a selective electrode combined with a handheld or stationary meter.

### 8.4 Calculation of Results

pH = pH paper color comparison or reading on meter

## **9.0 Determination of Bacteria (Dipslide Test)**

### **9.1 Principals of Test**

Bacteria, yeasts and fungi will grow in a media, which supplies them with water and nutrients. This media is called an 'Agar'. The dipslide is a plastic support material, which is holding two different agars, one on each side, to promote the growth of aerobic bacteria and yeast and fungi respectively. Determined is colony density, which is the number of colonies formed, and not their size.

### **9.2 Reagents Required**

Nil

### **9.3 Equipment Used**

Dipslides for Bacteria / Fungal Counts  
**Sterile Dilution Water**

### **9.4 Procedure**

1. Unscrew the tube and withdraw the slide without touching the agar surfaces.
2. Dip the slide into the water to be sampled or wet the slide by spraying or holding it under the stream of water sample. If the fluid is under pressure, the slide must be handled carefully so that the agar is not dislodged from it or place the sample in a container and dip the slide into it. Both agar surfaces must be completely wet. The slide must be in contact with the fluid for about 5 - 10 seconds.
3. Allow excess fluid to drain off the slide. (Do not shake the slide)
4. Blot the lower edge of the slide on clean absorbent paper without touching the agar.
5. Screw the slide tightly back into the tube. Fill in the label and affix it to the tube.
6. Place the tube upright in an incubator at 27 - 32 °C. After incubating for 24 hours the total bacterial count (TTC) can be read. Confirm the results at 48 hours after incubation. Yeast and fungi will show on the pink agar (Rose Bengal) after about 3 days incubation. If an incubator cannot be used, let the tube sit at room temperature/. Total bacterial counts can be read after 2 days and yeast fungi can be read at 4 - 5 days. It is recommended to keep the dipslides for 5 days and to confirm the initial results at the end of that period.
7. After incubation, remove the slide from the tube. Compare the density of the colonies growing on the medium with the model density charts supplied with the dipslides. (It is not necessary to actually count the colonies) Determine the growth level based on the drawing most closely matching the density of colonies on the dipslide.

## **10.0 Determination of Total & Free Chlorine**

### **10.1 Principles of Test**

Chlorine can be present in water as free available chlorine and as combined available chlorine. Both forms can exist in the same water and be determined together as the total available chlorine. Free chlorine is present as hypochlorous and/or hypochlorite ions. Combined chlorine exists as monochloramine, dichloramine, nitrogen trichloride and other chloro derivatives.

The free available chlorine reacts immediately with DPD (N,N,-diethyl-p-phenylenediamine) indicator to form a magenta color, which is proportional to the chlorine concentration. This test determines the Free Available Chlorine concentration. The combined chlorine oxidizes added iodide to iodine, which then reacts along with the free chlorine and DPD. This test determines the Total Available Chlorine concentration. The Combined Available Chlorine concentration is then calculated by subtracting the Free Available Chlorine Test results from the Total Available Chlorine results.

### **10.2 Reagents Required**

Nil

### **10.3 Equipment Used**

Chlorine Test Kit  
Water Quality Test Strips for Total and Free Chlorine

### **10.4 Procedure**

1. Chlorine Test Kit:  
Follow the manufacture's instructions that are supplied with your Chlorine Test Kit.
2. Water Quality Test Strips:
  - a. Dip the strip into water being tested and move back and forth for 30 seconds or hold strip pads under a water stream for 10 seconds.
  - b. Compare the Total Chlorine and Free Chlorine pads to the color chart on the container and estimate results if the color on the test pad falls between two colors blocks.

1.0 Field Testing Schedules

System		Frequency					Tests
		Daily	3 X per week	Weekly	Monthly	Annually	
1. Steam Boiler Water	Power Boilers	✓					pH, PO <sub>4</sub> , SO <sub>3</sub> , OH, TDS P Alkalinity, M Alkalinity
	Process Heating Boilers	✓					
	Closed Heating Boilers		✓				
	Humidification Boilers			✓			
2. Steam Boiler Feed Water	Power Boilers	✓					Total Hardness
	Process Heating Boilers	✓					
	Closed Heating Boilers		✓				
	Humidification Boilers			✓			
3. Condensate Water	Power Boilers	✓					pH, TDS
	Process Heating Boilers	✓					
	Closed Heating Boilers		✓				
	Humidification Boilers			✓			
4. Hot Water Heating Closed Chilled Water Closed Chilled Water					✓		pH, SO <sub>3</sub> , TDS  Total Bacteria Count
					✓		
					✓		
5. Open Cooling Tower Water	Auto Blowdown		✓				PO <sub>4</sub> (Meta), TDS, pH Total Bacteria Count
	Manual Blowdown		✓				
6. Glycol						✓	% Glycol, RA (100%), Freeze Point, SG, pH
7. Air Washer / Humidifier			✓				PO <sub>4</sub> (Meta), TDS, pH Total Bacteria Count
						✓	
8. Open Cooling Tower Water			✓				Free & Total Chlorine Bacteriological Analysis Routine Chem. Analysis
					✓		
						✓	

**2.0 Monitoring Sampling Schedule**

System		Frequency						
		Daily	Every 2 Days	Weekly	Monthly	Semi-Annually	Annually	Anytime As Required
1.	Boiler Steam Hot Water Heating					✓		
2.	Condensate                      From Steam System					✓		
3.	Chilled Water						✓	
4.	Open Cooling Water						✓	
5.	Feed to Cooling Tower						✓	
6.	Glycol						✓	
7.	Corrosion Coupons                      Hot Water Heating System Closed Chilled Water System Condenser System Glycol System					✓	✓	
						✓	✓	
					✓			
						✓	✓	
8.	Problem Samples Deposits Resins							✓
								✓
								✓
9.	Air Washer						✓	

NOTE: Proper identification of samples is required if submitting them for duplicate testing to the Water Treatment Coordinator or the Water Treatment Consultant.



**1.0 General**

Ensure there is a current, up-to-date WHMIS binder on site. This should include all chemicals and testing reagents used for water treatment. The binder must be kept current with the latest chemical data sheets. The maximum age of MSDS is four (4) years from the date of print.

All individuals handling chemicals must be competent in the proper handling procedures.

Follow all safe-handling procedures as outlined on the chemical data sheets. Chemical packaging must be labeled as per WHMIS regulations.

When handling chemicals, wear eye and mouth shields, rubber gloves, rubber apron, and follow instructions as outlined on the chemical data sheets.

If an accident happens, follow the instructions on the data sheets. Complete an incident report, and contact a physician if required. When any chemical contacts the eyes, skin, or clothing, it must be washed off immediately with warm water. If irritation develops, call a physician. No chemical should be taken internally.

Do not mix different chemicals together. Dry chemicals should not be handled in areas of air turbulence.

Clean up all chemical spills immediately.

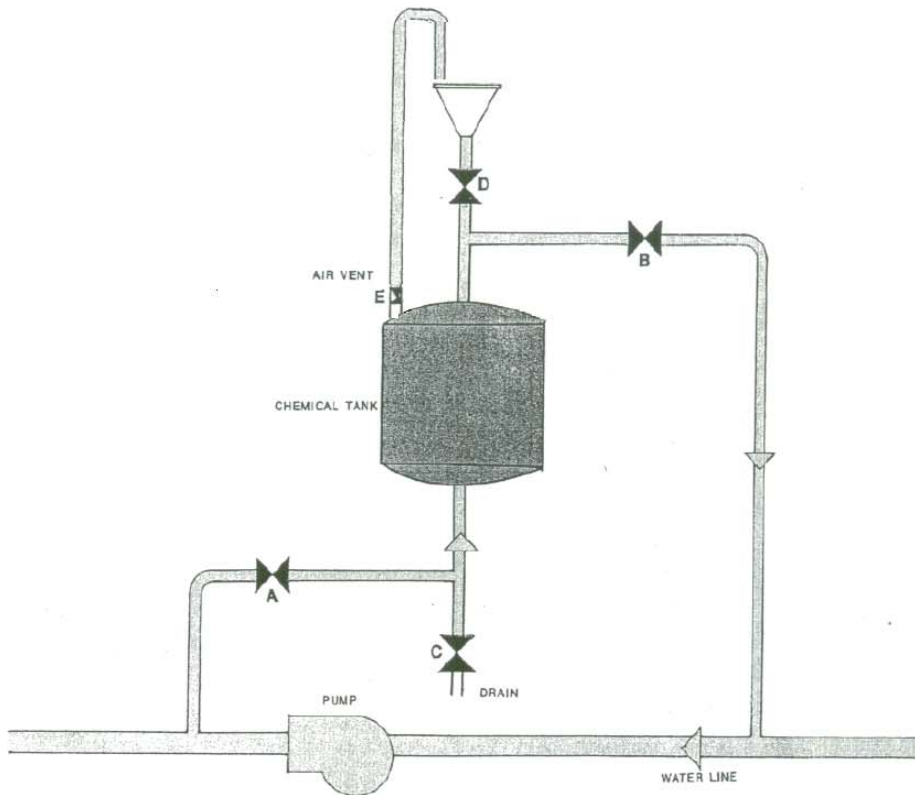
Store chemicals in a dry and well ventilated location. All containers must be labeled and the area kept clean.

Dispose of old and outdated chemicals by following the Environmental Guidelines Section I of the Water Treatment Program Manual.

Ensure all test equipment is in sound working condition and free of any defects.

Such activities as storage at room temperature, away from light and humidity, and replacement when their purity is suspected to be at fault, will ensure reasonable shelf life for most chemicals.

Ensure expiry dates of all reagents have not surpassed.



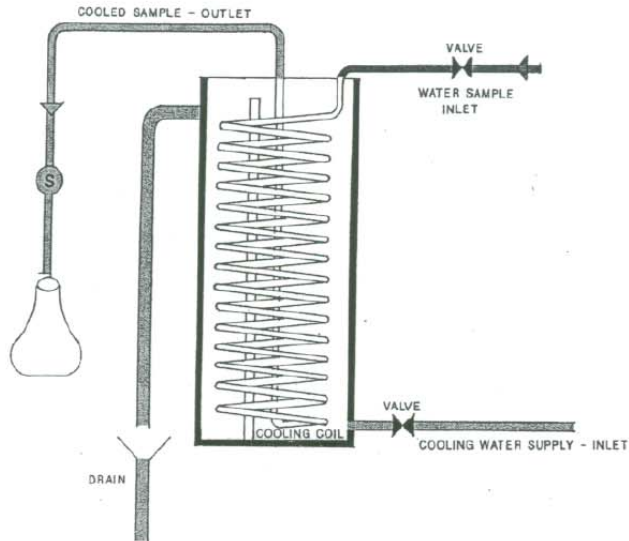
## CHEMICAL POT FEEDER INSTALLED ACROSS A PUMP OPERATION

TO ADD WATER TREATMENT TO THE SYSTEM ENSURE:

1. SYSTEM VALVES A AND B ARE CLOSED.
2. OPEN DRAIN VALVE C, FILL VALVE D AND AIR VENT VALVE E.
3. WHEN CHEMICAL TANK IS DRAINED, CLOSE DRAIN VALVE C.
4. POUR DISSOLVED CHEMICALS CAUTIOUSLY INTO FILL FUNNEL.
5. ADD MORE WATER TO COMPLETELY FILL CHEMICAL TANK.
6. CLOSE AIR VENT VALVE E AND FILL VALVE D.
7. OPEN SYSTEM VALVES A AND B. ALLOW SYSTEM TO CIRCULATE.

**NOTE:** PLEASE TAKE ALL NECESSARY SAFETY PRECAUTIONS TO PREVENT CHEMICAL INJURY.  
SYSTEM CAN BE LEFT WITH SYSTEM VALVES A AND B EITHER OPEN OR CLOSED.  
OPERATOR'S CHOICE.

## SAMPLE COOLING COIL



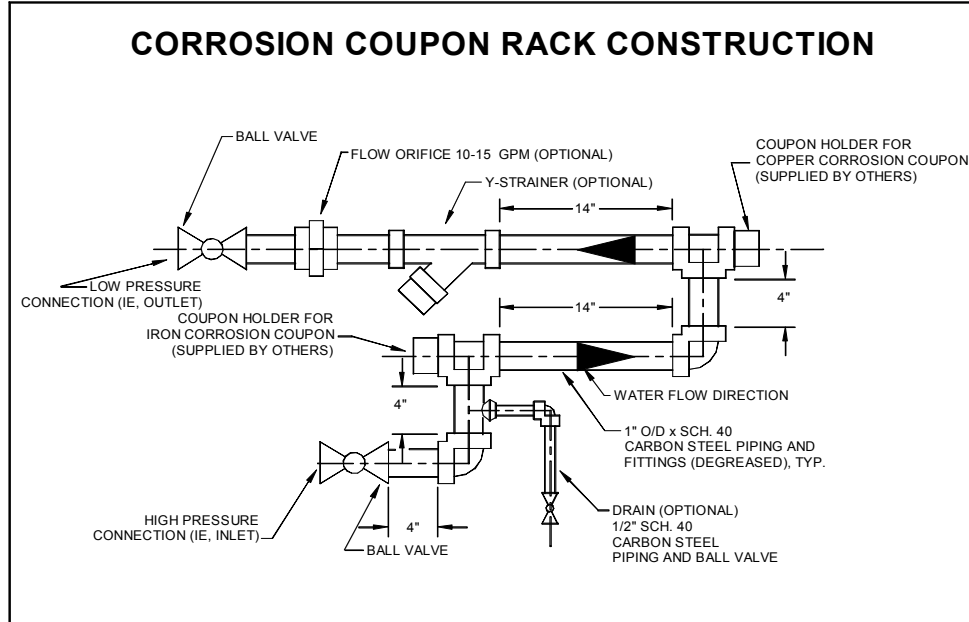
### USE OF A COOLING COIL AT SAMPLE SITE

1. PREVENTS FLASHING.
2. PROTECTS YOU FROM BEING SCALDED.
3. ELIMINATES CONCENTRATION OF SAMPLE.
4. PROVIDES A MORE ACCURATE SAMPLE.
5. SAVES TIME AND TROUBLE.

### WHEN TAKING A SAMPLE

1. FLUSH COOLING COIL WELL BEFORE AND AFTER.
2. WHEN NO COOLING COIL IS PRESENT FLUSH THE LINE THOROUGHLY BEFOREHAND.
3. RINSE CONTAINER WITH SAMPLE WATER.
4. TAKE MORE SAMPLE THAN NEEDED FOR ALL THE TESTS.

## Corrosion Coupon Rack



### Corrosion Coupon Rack Installation Notes

1. The corrosion coupon rack should be piped to valved connections (1/2" minimum) in the inlet & outlet piping of the system circulating pumps or to existing connections in parallel with the bypass filter, with due regard to the water flow direction - see above drawing;
2. The corrosion coupon rack must be located at operating level, away from any electrical devices, and adequately supported;
3. Access must be provided so that the coupon holders and attached corrosion coupons may be easily removed from the corrosion coupon rack;
4. The piping to & from the corrosion coupon rack may be copper or iron (1/2" minimum), but the corrosion coupon rack itself must be fabricated in accordance with the above drawing.

## COUPON INSTALLATION PROCEDURE

1. Maintain the corrosion coupon in its zip locked bag until it is installed, and handle it carefully, since it is pre-weighed to the nearest 0.1 mg;
2. Attach the coupon onto the coupon holder with the nylon nut, bolt & washer.
3. Wrap the threads of the coupon holder with teflon tape.
4. Wipe the iron coupon with tissue, as it is coated with a protective oil film;
5. Install the coupon holder, with attached coupon, into the coupon rack (note 1: the iron coupon is installed first in the direction of water flow.
6. Tighten the coupon holder until the line marker on the face of the coupon holder is either parallel or perpendicular with the plane of the coupon rack;
7. Adjust the **inlet** valve on the coupon rack to the fully open position and the **outlet** valve to the 25-50% open position;
8. Record the installation date;
9. Replace the coupon with a fresh coupon after 6 months of continuous wetted service for closed systems, and 30-60 days for condenser water systems;
10. Record the removal date;
11. Air dry the used coupon, wrap it in tissue, and forward it to the Consultant. Shipping instructions can be obtained from the Facilities Managers, Water Treatment Coordinators, or the Consultant

The information contained in the following table must be included with each coupon.

### Corrosion Coupon Information

Building Location		
Building Name		
Type of System		
Coupon Number	Iron:	Copper:
Coupon Installation Date	Iron:	Copper:
Coupon Removal Date	Iron:	Copper:

## 1.0 Introduction

The Water Treatment Program in place within Alberta Government Buildings generates waste material that could possibly have effects on the environment. The purpose of Environmental Guidelines is to provide an acceptable procedure for the disposal of this waste material. It is the operator's responsibility to ensure compliance with the municipal by-laws, environmental regulations governing chemical disposal and accidental spills.

The sewer service bylaws for the cities of Calgary and Edmonton have been revised to restrict the limits for waste material that is directed to their sewer systems. These bylaws can be found at:

[http://www.calgary.ca/portal/server.pt/gateway/PTARGS\\_0\\_2\\_373072\\_0\\_0\\_18/24m96.pdf](http://www.calgary.ca/portal/server.pt/gateway/PTARGS_0_2_373072_0_0_18/24m96.pdf)  
[www.Edmonton.ca/bylaws/C9676.doc](http://www.Edmonton.ca/bylaws/C9676.doc)

The sewer service bylaws for less populated municipalities such as Red Deer and Lethbridge currently have less restrictive limits, but they are either in the process of following the lead of Calgary and Edmonton, or they are expected to be doing so in the near future. These bylaws can be found at:

[www.city.red-deer.ab.ca/bylaws](http://www.city.red-deer.ab.ca/bylaws) (click utility bylaw 3215-98)  
<http://www.lethbridge.ca/NR/rdonlyres/AA5D6CDD-8D8E-413E-BD30-A83AB0453323/0/SewerageBylaw3250.pdf>

Smaller municipalities do not have documented sewer service bylaws at this point in time, but they are expected to have them in the near future.

## 2.0 Compliance with Other Laws

Nothing in this Environmental Guideline relieves any building operator from complying with any provision of any Federal, Provincial, or Municipal legislation.

## 3.0 Disposal of Waste Material

1. Empty paper containers of inhibitors and biocides shall be disposed of at an approved landfill site.
2. Empty plastic and metal containers of inhibitors, biocides and water test reagents shall be preferably returned to the supplier, otherwise they shall either be recycled for other uses or be disposed of at an approved landfill site.
3. Scale and corrosion products, in solid form, shall be disposed of at an approved landfill site.
4. Concentrated or diluted inhibitors, biocides and water test reagents shall not be discharged to a watercourse, storm sewer system, or a landfill site.
5. Waste fluid or cleaning waste shall not be discharged to a watercourse, storm sewer system, or landfill site.
6. Waste fluid associated with water system operational sampling, water testing, bleed-off and blowdown shall be discharged to the waste sewer system.

7. Waste fluid containing biocides and/or the following inhibitors, as indicated on Material Safety Data Sheets, shall be discharged to the waste sewer systems, provided that the system water is within the general parameters and the disposal limits for restricted inhibitors as indicated in the table below.
  - a) all organic
  - b) molybdenum
  - c) nitrite (without boron or molybdenum)
  - d) phosphate
  - e) phosphonate (without zinc)
  - f) silicate (without boron)
  - g) sulphite
  
8. Waste fluid containing restricted inhibitors, as indicated on Material Safety Data Sheets, shall be diluted with building waste water and discharged to the waste sewer system such that the concentration of the restricted inhibitor and the concentrations of the general parameters at the site test point are in compliance with the limits indicated.
  
9. Cleaning Waste and expired water test reagents shall be diluted with building waste water and discharged to the waste sewer system such that their concentrations at the site test point are in compliance with the general parameter limits indicated.

**LIMITS FOR THE DISPOSAL OF RESTRICTED INHIBITOR WASTE (Cleaning Waste, Expired Water Test Reagents to MUNICIPAL WASTE (Sanitary) SEWER SYSTEMS**

<u>PARAMETERS</u>	<u>CONTROL LIMITS *</u>
General Parameters	pH of 6.0 minimum pH of 10.0 maximum temperature of 65°C maximum suspended solids of 200 ppm maximum copper of 0.5 ppm Cu maximum iron of 50 ppm Fe maximum oil & grease of 100 ppm maximum BOD (biochemical oxygen demand) of 200 ppm maximum
Restricted Inhibitors	
Glycol (Ethylene, Propylene)	BOD (biochemical oxygen demand) of 200 ppm maximum
Molybdenum / Molybdate	Molybdenum of 5.0 ppm Mo maximum Boron of 1.0 ppm B maximum
Nitrite	Molybdenum of 5.0 ppm Mo maximum Boron of 1.0 ppm B maximum
Silicate	Boron of 1.0 ppm B maximum
Phosphonate	Zinc of 1.0 ppm Zn maximum

\*Note 1. Dilution with domestic water for the sole purpose of meeting these limits is prohibited

\*Note 2. Where possible, glycol shall be reclaimed using an approved commercial waste disposal firm

#### **4.0 Accidental Disposal of Waste Material**

A building operator who causes or permits the accidental disposal of waste fluid containing restricted inhibitors or cleaning waste to a sewer system such that their concentrations and/or the concentrations of the general parameters at the test site point are greater than the limits indicated in the above chart shall immediately report the incident to the Owner's Manager and to the local Waste Treatment Plant providing the following information:

- a) Name of Owner's Manager and telephone number where he/she may be contacted
- b) Location where the release occurred
- c) Time and date of the release
- d) Type of waste material released and any known associated hazards
- e) Volume of waste material released
- f) Corrective action being taken, or anticipated to be taken, in order to prevent future accidental releases

#### **5.0 Definitions**

Approved Landfill Site:	municipal landfill site
Cleaning waste:	unwanted cleaning solution within the water system
Owner:	the Province of Alberta
Site Test Point:	a sample location where the total wastewater from the building/site enters the waste sewer system
Storm Sewer System:	a municipal sewer system for the collection and transmission of storm run-off water
Waste Sewer System:	a municipal sewer system for the collection and transmission of waste water
Waste Fluid:	unwanted operational solution that is discharged from a water system
Waste Material:	unwanted material associated with the Water Treatment Program
Waste Water:	unwanted solution resulting from the normal business activity within a building
Water Course:	a lake, river, or creek

#### **6.0 Summary**

Additional and updated information can be obtained from the web address listed at the beginning of this section. If you are unsure of the proper procedures to be practiced contact your Local Municipality, Manager, Water Treatment Coordinator or the Water Treatment Consultant.



**1.0 Scale Control**

1. If you don't give the boiler water proper treatment, your boiler will suffer from carryover, sludging, scale and corrosion.
2. Long before the boiler fails, water-related problems will cause:
  - growing safety hazard
  - increased maintenance cost
  - higher energy costs
  - lower boiler efficiency
3. Scale is any hard water-formed deposit on the waterside surfaces of the boiler. Most scale is a buildup of water hardness particles deposited on the boiler tube walls and other heated surfaces.
4. Sludge is the mud-like residue from the chemical treatment of hardness in the water and should be expected as the normal by-product of water treatment.
5. Scale buildup can reduce boiler water circulation, cause overheating, tube failure, and waste fuel.
6. One sure way to prevent boiler scale buildup is to follow a regular schedule of water testing and treatment application.
7. For scale control in boilers, water tests usually run are TDS, OH, and Phosphate. These tests are all closely tied together and are all affected by blowdown, therefore, before interpreting any of these tests individually, run all of them.
8. There is a direct relationship between the amount of TDS in the boiler and scale control, foaming and carryover. Therefore, the boiler water TDS should be kept within a practical working range.
9. High TDS in boiler water indicates not enough continuous blowdown and on the other hand low TDS indicates too much continuous blowdown.
10. The major function of 'OH' alkalinity in the boiler water is to create proper conditions for scale control reactions. If the OH is below established control limits, the jobs of converting and precipitating the scaling impurities won't be fully accomplished.
11. Corrective actions should not be taken until all your water tests are run and you have interpreted your reading.

## 2.0 Water Chemistry Terms

Acid	An acid is a substance that furnishes hydrogen ions in an aqueous solution. It reacts with a pH indicator to give a reading below a pH of 7.0
Algae	A simple form of aquatic plant life, which multiply by division and requires sunlight for survival
Alkali	A chemical compound that furnishes hydroxide ions in an aqueous solution. It reacts with a pH indicator to give a reading above a pH of 7.0
Analysis	The examination of a water sample to determine its chemical composition and characteristics
AST	Advanced Sulphite Treatment (AST) incorporating sulphite as the oxygen scavenger, a buffer system to maintain the specified pH limits, and a specific corrosion inhibitor for yellow metals
Bacteria	A single cell organism without a nucleus, usually in the shape of rods, spheres, or spirals, and is sub-divided into aerobic bacteria (bacteria which require oxygen to survive), and anaerobic bacteria (bacteria which survive in the absence of oxygen)
Biocide	A toxic material such as chlorine which is used to kill living bacteria
Bleed-off	A term applied to the portion of re-circulating water that is drawn from the water system, either continuously or intermittently, in order to de-concentrate the dissolved and/or suspended solids concentration in water
Blow down	A term applied to the portion of boiler water that is drawn from the boiler, either continuously or intermittently, in order to de-concentrate the dissolved and / or suspended solids concentration in the boiler water, and thus diminish the potential for scale formation
Boiler Water Sample	A representative sample of the circulating boiler water
Buffer	A substance that tends to resist changes in the pH of a solution
Buffer Standard	A buffer solution that is used to calibrate pH meters prior to pH testing
Burette	A long narrow titrating column that has been accurately calibrated to indicate the exact volume of liquid dispenses in the test procedure
Carry-over	The entrainment of small droplets of boiler water and associated dissolved solids in the steam leaving the boiler
Caustic	This refers to caustic soda that is sodium hydroxide
Chlorine	A disinfecting oxidizing agent, which is most widely used in water treatment
Chlorine, Combined Available	The chlorine residual, which exists in water systems as a chemical combination with ammonia or organic matter after the chlorine, has been satisfied
Chlorine Demand	The amount of chlorine consumed by organize matter and bacteria in water systems

## 2.0 Water Chemistry Terms (continued)

Chlorine, Free Available	The hypochlorous ions (OCI), hypochlorous acid (HOCl), or any combination thereof present in water (the portion of chlorine in water systems that is available for the immediate oxidation [killing] of bacteria and organic matter)
Chlorine, Residual	The total amount of free and combined chlorine remaining in water systems after its chlorine demand has been satisfied
Chlorine, Total	The sum of free and combined chlorine
Color Standard	A hermetically sealed glass tube containing a stable solution equivalent in color to the color developed when an indicator is added to a sample solution to determine the concentration of a chemical
Colorimetric	A name, which is given to a chemical test method where the results of the test are determined by the amount or shade of color that is developed
Comparator	The device for holding color standards and a test sample in adjacent positions so that the colors of each may be easily compared with one another
Comparator Unit	A device for holding color standards and a test sample in adjacent positions so that the colors of each may be easily compared with one another
Concentration	The amount of a substance per unit volume
Conductivity	The ability of an aqueous solution to conduct an electrical current, expressed as micromhos/cm ( $\mu\text{S}/\text{cm}$ )
Corrosion	A process of deterioration where loss of metal occurs due to chemical reactions at the inter-phase of metal surface and solution
Corrosion Coupon	A pre-weighed metal specimen that is inserted into a liquid stream in order to determine the corrosiveness of the liquid
De-alkalized Water	A process, which is used for the reduction of alkalinity in water (e.g. a chloride form anion dealkalizer)
De-aeration	The process of removing or drastically reducing the dissolved gasses (usually oxygen) in water by passing steam upwards through the water within a closed vessel called a de-aerator
De-mineralized Water	Water which has had most of its salts removed by ion exchange
Dissolved Oxygen	The amount of oxygen dissolved in water
Endpoint	The point in a titration procedure where a color change in the sample takes place
Filtration	The separating of a liquid from suspended matter in it by passing the liquid through a filter paper

## 2.0 Water Chemistry Terms (continued)

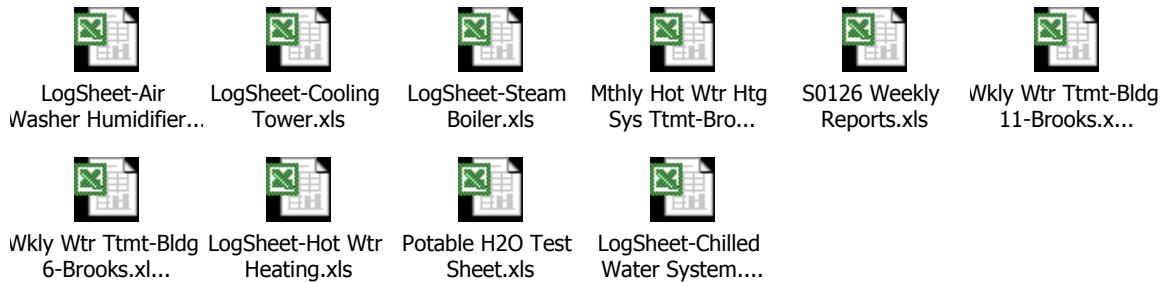
Generic Chemical	A chemical, which is identified with a chemical name and not a proprietary one. It is usually composed of only one chemical
Hard Water	Water that has a high calcium or magnesium content
Hardness, Total	The sum of the calcium hardness plus the magnesium hardness
Indicator	A chemical reagent added to a test sample to bring about a color reaction
Inhibitor	A chemical that interferes with a chemical reaction to reduce or eliminate corrosion
Meniscus	The curved surface of a liquid within a container
Magnesium Hardness	The amount of magnesium, which is present in the sample
MIL (Milliliter or mL)	One-thousandth part of a liter (which equals 1 cm <sup>3</sup> )
Monitoring	The regular sampling, measuring, recording, and/or signaling of the characteristics of water or waterborne material
Mpy	A measure of corrosion penetration rate expressed as 'mils per year'
Neutral	A water sample is neutral if it has a pH reading of 7.0
PPM	Parts per million. A unit of measurement used in chemical testing which indicates the parts by weight in relation to one million parts of water
pH	This is a scale based on the hydrogen ion concentration by which water and other substances are measured to determine if they are acid, neutral or alkaline
pH Scale	Numerical scale used to measure the strength of acids and bases
Pipette	A 'dropper' device that is usually calibrated for measuring small amounts of liquid
Precipitate	An insoluble compound formed by chemical action between two or more soluble compounds in solution
Proprietary Chemical	A chemical, which is usually identified with a supplier specific name and product number. It is usually composed of more than one chemical
Reagent	A chemical material in liquid, powder or tablet form that has been especially prepared for use in chemical testing

## 2.0 Water Chemistry Terms (continued)

Reserve Alkalinity	A measure of the buffer capacity of glycol solutions, determined by titrating the sample with standard hydrochloric acid. The buffer acts as a corrosion inhibitor in glycol-based heat transfer fluids and the reserve alkalinity is therefore a measurement of corrosion protection
Reserve Alkalinity (100%)	The reserve alkalinity mathematically converted to 100 vol. % glycol
Residual	The amount or level of an un-reacted material present in the water
Scale	A hard, crusty deposit that may be found inside boilers, tubes, pipes, valves, etc
Shelf Life	The length of time that an analytical reagent can be stored without its chemical composition deteriorating or it undergoing some change that will make the reagent unacceptable for use
Shock Treatment	The application of extremely high concentrations of chlorine to destroy bacteria and algae in cooling tower and swimming pool systems
Sludge	A 'mud-like' residue, which is formed from the chemical treatment of hardness salts in water, and is considered to be a normal by-product of water treatment
Soft Water	Water that has a very low calcium and magnesium content.
Soluble	A substance, which is easily dissolved
Standard Solution	A solution with a precise known composition
Suspended Solids	Particles within a liquid solution, which can be removed by filtration
Test Tube	A glass or plastic tube, in which a sample of water is treated for testing purpose, also called a comparator tube, sample tube, or test cell
TDS	Total dissolved solids
Titration	A chemical test method using a reagent that is chemically keyed to the unknown factor being tested. Usually an indicator is added to the test sample and then the titrating solution is added in measured amounts. When sufficient titrating solution is added to bring about a color change in the sample (the endpoint) the amount of solution added is noted and its volume multiplied by a standard factor gives the result in ppm of the chemical compound being measured
Turbidity	A suspension of fine particles that obscures light rays but requires many days for settling out because of the small particle size
Water System (For This Manual)	Refers to hot water heating systems, chilled water systems, steam boiler systems, condenser water or cooling tower systems, air washer humidifier systems, glycol heating and cooling systems, domestic hot and cold water systems, and contact steam cooking systems

1.0 GENERAL

The following record worksheets are samples only and can be edited to suit your particular building system. The importance of proper documentation with adequate and accurate information is extremely useful when adding chemical to obtain correct concentrations, troubleshooting system problems, boiler or pump failure, etc.









# WATER TREATMENT LOG SHEET

Building Name: \_\_\_\_\_

Water System: STEAM BOILER # \_\_\_\_\_

Location: \_\_\_\_\_

Month / Year: \_\_\_\_\_

Date	Boiler Water							Condensate		Softener	Chemicals Added			
	pH	TDS	SO <sub>3</sub>	P	M	OH	PO <sub>4</sub>	pH	TDS	TH	PO <sub>4</sub>	Caustic	SO <sub>3</sub>	Amine
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														

**Control Limits:**

Parameter:	Boiler Water	Condensate	Softener
Total Hardness:	NA	2 ppm CaCO <sub>3</sub> maximum	2 ppm CaCO <sub>3</sub> maximum
pH:	10.5 - 11.5	8.5 - 9.5 (8.0 - 8.5 with humidification)	NA
TDS:	1500 - 3000 ppm (2000 - 4000 µS/cm)	40 ppm maximum (50 µS/cm maximum)	NA
Sulphite (SO <sub>3</sub> ):	30 - 60 ppm (50 - 100 ppm Na <sub>2</sub> SO <sub>3</sub> )	NA	NA
P Alkalinity:	NA	NA	NA
M Alkalinity:	700 ppm CaCO <sub>3</sub> maximum	NA	NA
OH Alkalinity:	150 - 300 ppm CaCO <sub>3</sub>	NA	NA
Phosphate (PO <sub>4</sub> ):	40 - 80 ppm	NA	NA





2002
cfw

BOILER # 1					
TDS	SO3	PALK	MALK	OH	PO4

BOILER # 2					
TDS	SO3	PALK	MALK	OH	PO4

BOILER # 3					
TDS	SO3	PALK	MALK	OH	PO4

RAW W	
HH	TDS

DEALK. W	
PALK	MALK

cfw

BOILER # 4					
TDS	SO3	PALK	MALK	OH	PO4

BOILER # 5					
TDS	SO3	PALK	MALK	OH	PO4

CONDENSATE		
pH	TDS	LH

TOWER WATER			
pH	502	TDS	Fr. Cl


BOILER CHEM.				
MOR	T.PO4	HPO4	SO3	OH

TOWER CHEM.			REG. CHEM.		
502	651	PO4	CL2	SALT	NaOH

Week Total
cfw
TOTAL
Bal. on Hand

Kg.	Kg.	Kg.	Kg.	Kg.

Pails	Litres	Kg.	Kg.	Reg	Kg.

**Boiler Limits**

TDS: 1500 - 3000  
 SO3: 30 - 60  
 OH: 150 - 300  
 Total Alkalinity: 700 max.  
 PO4: 40 - 80

**Cooling Tower :**

TDS: 1000 - 1200  
 AQUAGUARD 502: 15 - 20 ppm

**Condensate:**

pH: 8.5 - 9.5  
 Morpholine 40% (Zeotec 3301)

Remarks: \_\_\_\_\_  
 Chem. Rec'd: \_\_\_\_\_  
 Chem. to other bldg.: \_\_\_\_\_

# DEALKALIZER / SOFTENER REPORT

Week Ending: \_\_\_\_\_

## Dealkalizer

Date: 2002

Meter Reading

Total Pounds  
(Reading X 2200)


**Total For Week**


**Total For Week**

Two Week Total Pounds  
Carried Forward  
Total To Date


## Softener

Meter Reading

Carried Fwd.

Total Gallons  
(Reading X 0.8)

**Total For Week**



**Total For Week**

Two Week Total Gallonage  
Carried Forward  
Total To Date


# WATER TREATMENT LOG SHEET

Building Name: \_\_\_\_\_

Week Ending \_\_\_\_\_

	DATE	BOILER # 1						CONDENSATE		
		TDS	SO <sub>3</sub>	P ALK	M ALK	OH	PO <sub>4</sub>	pH	TDS	HH
CFW [Friday]										
Monday										
Tuesday										
Wednesday										
Thursday										
Friday										

	DATE	BOILER CHEMICALS			SALT
		T PO <sub>4</sub>	H PO <sub>4</sub>	SO <sub>3</sub>	
CFW [Friday]					
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Week Total					
CFW					
TOTAL					
Balance on Hand					
		Kg	Kg	Kg	Bags

COMMENTS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Control Limits:**

Parameter:	Boiler Water
Total Hardness:	NA
pH:	10.5 - 11.5
TDS:	1500 - 3000 ppm (2000 - 4000 µS/cm)
Sulphite (SO <sub>3</sub> ):	30 - 60 ppm (50 - 100 ppm Na <sub>2</sub> SO <sub>3</sub> )
P Alkalinity:	NA
M Alkalinity:	700 ppm CaCO <sub>3</sub> maximum
OH Alkalinity:	150 - 300 ppm CaCO <sub>3</sub>
Phosphate (PO <sub>4</sub> ):	40 - 80 ppm

Condensate
2 ppm CaCO <sub>3</sub> maximum
8.5 - 9.5 (8.0 - 8.5 with humidification)
40 ppm maximum (50 µS/cm maximum)
NA
NA
NA
NA
NA
NA

Softener
2 ppm CaCO <sub>3</sub> maximum
NA
NA
NA
NA
NA
NA

# WATER TREATMENT LOG SHEET

Building Name: \_\_\_\_\_

Week Ending \_\_\_\_\_

	BOILER # 1						BOILER # 2						BOILER # 3						CONDENSATE			TOWER WATER				
	DATE	TDS	SO3	P ALK	M ALK	OH	PO4	TDS	SO3	P ALK	M ALK	OH	PO4	TDS	SO3	P ALK	M ALK	OH	PO4	pH	TDS	HH	pH	502	TDS	
CFW [Friday]																										
Monday																										
Tuesday																										
Wednesday																										
Thursday																										
Friday																										

	DATE	BOILER CHEMICALS			TOWER CHEMICALS		SALT	COMMENTS:
		T PO4	H PO4	SO3	502	651		
CFW [Friday]								
Monday								
Tuesday								
Wednesday								
Thursday								
Friday								
Week Total								
CFW								
TOTAL								
Balance on Hand								
		Kg	Kg	Kg	Pails	Litres	Bags	

<b>Control Limits:</b>	<table border="0" style="width: 100%;"> <tr> <td style="width: 25%;"><b>Parameter:</b></td> <td><b>Boiler Water</b></td> <td><b>Condensate</b></td> <td><b>Softener</b></td> <td><b>Cooling Tower</b></td> </tr> <tr> <td><b>Total Hardness:</b></td> <td>NA</td> <td>2 ppm CaCO<sub>3</sub> maximum</td> <td>2 ppm CaCO<sub>3</sub> maximum</td> <td>25 - 50 ppm CaCO<sub>3</sub></td> </tr> <tr> <td><b>pH:</b></td> <td>10.5 - 11.5</td> <td>8.5 - 9.5 (8.0 - 8.5 with humidification)</td> <td>NA</td> <td>8.5 - 9.5</td> </tr> <tr> <td><b>TDS:</b></td> <td>1500 - 3000 ppm (2000 - 4000 µS/cm)</td> <td>40 ppm maximum (50 µS/cm maximum)</td> <td>NA</td> <td>2000 ppm maximum (2500 µS/cm)</td> </tr> <tr> <td><b>Sulphite (SO<sub>3</sub>):</b></td> <td>30 - 60 ppm (50 - 100 ppm Na<sub>2</sub> SO<sub>3</sub>)</td> <td>NA</td> <td>NA</td> <td>NA</td> </tr> <tr> <td><b>P Alkalinity:</b></td> <td>NA</td> <td>NA</td> <td>NA</td> <td>NA</td> </tr> <tr> <td><b>M Alkalinity:</b></td> <td>700 ppm CaCO<sub>3</sub> maximum</td> <td>NA</td> <td>NA</td> <td>NA</td> </tr> <tr> <td><b>OH Alkalinity:</b></td> <td>150 - 300 ppm CaCO<sub>3</sub></td> <td>NA</td> <td>NA</td> <td>NA</td> </tr> <tr> <td><b>Phosphate (PO<sub>4</sub>):</b></td> <td>40 - 80 ppm</td> <td>NA</td> <td>NA</td> <td>10 - 20 ppm</td> </tr> <tr> <td><b>Bacteria:</b></td> <td>NA</td> <td>NA</td> <td>NA</td> <td>10<sup>3</sup> cf/ml maximum</td> </tr> </table>	<b>Parameter:</b>	<b>Boiler Water</b>	<b>Condensate</b>	<b>Softener</b>	<b>Cooling Tower</b>	<b>Total Hardness:</b>	NA	2 ppm CaCO <sub>3</sub> maximum	2 ppm CaCO <sub>3</sub> maximum	25 - 50 ppm CaCO <sub>3</sub>	<b>pH:</b>	10.5 - 11.5	8.5 - 9.5 (8.0 - 8.5 with humidification)	NA	8.5 - 9.5	<b>TDS:</b>	1500 - 3000 ppm (2000 - 4000 µS/cm)	40 ppm maximum (50 µS/cm maximum)	NA	2000 ppm maximum (2500 µS/cm)	<b>Sulphite (SO<sub>3</sub>):</b>	30 - 60 ppm (50 - 100 ppm Na <sub>2</sub> SO <sub>3</sub> )	NA	NA	NA	<b>P Alkalinity:</b>	NA	NA	NA	NA	<b>M Alkalinity:</b>	700 ppm CaCO <sub>3</sub> maximum	NA	NA	NA	<b>OH Alkalinity:</b>	150 - 300 ppm CaCO <sub>3</sub>	NA	NA	NA	<b>Phosphate (PO<sub>4</sub>):</b>	40 - 80 ppm	NA	NA	10 - 20 ppm	<b>Bacteria:</b>	NA	NA	NA	10 <sup>3</sup> cf/ml maximum
<b>Parameter:</b>	<b>Boiler Water</b>	<b>Condensate</b>	<b>Softener</b>	<b>Cooling Tower</b>																																															
<b>Total Hardness:</b>	NA	2 ppm CaCO <sub>3</sub> maximum	2 ppm CaCO <sub>3</sub> maximum	25 - 50 ppm CaCO <sub>3</sub>																																															
<b>pH:</b>	10.5 - 11.5	8.5 - 9.5 (8.0 - 8.5 with humidification)	NA	8.5 - 9.5																																															
<b>TDS:</b>	1500 - 3000 ppm (2000 - 4000 µS/cm)	40 ppm maximum (50 µS/cm maximum)	NA	2000 ppm maximum (2500 µS/cm)																																															
<b>Sulphite (SO<sub>3</sub>):</b>	30 - 60 ppm (50 - 100 ppm Na <sub>2</sub> SO <sub>3</sub> )	NA	NA	NA																																															
<b>P Alkalinity:</b>	NA	NA	NA	NA																																															
<b>M Alkalinity:</b>	700 ppm CaCO <sub>3</sub> maximum	NA	NA	NA																																															
<b>OH Alkalinity:</b>	150 - 300 ppm CaCO <sub>3</sub>	NA	NA	NA																																															
<b>Phosphate (PO<sub>4</sub>):</b>	40 - 80 ppm	NA	NA	10 - 20 ppm																																															
<b>Bacteria:</b>	NA	NA	NA	10 <sup>3</sup> cf/ml maximum																																															





# WATER TREATMENT LOG SHEET

Building Name: \_\_\_\_\_

Water System: POTABLE WATER

MONTH \_\_\_\_\_

Date	Cl2		pH	Pump Reading (millivolts)	Pump Stroke Setting	Pump Millivolt Setting	Comments
	Free	Total					
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

Chlorine (Cl2): Free 0.2 -0.5 ppm minimum

