

2012-11-09

Use this Section to specify the chemical cleaning and treatment of steam boiler systems. Refer to Section 23 25 02 for a complete list of sections related to Chemical Cleaning and Treatment of Mechanical Systems.

This Master Specification Section contains:

- .1 This Cover Sheet
- .2 Data Sheet - Reference Standards
- .2 Data Sheet - Guidelines for Renovated Systems
- .3 Specification Section Text:
 - 1. General**
 - 1.1 Intent
 - 1.2 Related Requirements
 - 1.3 Reference Documents
 - 1.4 Performance Requirements
 - 1.5 Submittals
 - 2. Products**
 - 2.1 Cleaning Chemicals
 - 2.2 Chemical Treatment Materials
 - 2.3 Water Test Equipment
 - 3. Execution**
 - 3.1 Equipment Installation
 - 3.2 Cleaning - General
 - 3.3 Pre-Boiler Equipment Cleaning Procedure
 - 3.4 Boiler Cleaning Procedure
 - 3.5 Deposit Removal Procedure
 - 3.6 Cleaning Direct Steam Culinary Boilers and Sterilizers
 - 3.7 Operation Maintenance until Interim Acceptance
 - 3.8 Waste Water and Material Disposal
 - 3.9 Chemical Cleaning and Treatment Schedule for Renovated Systems

2012-11-09

1. When any of the following work has been performed, no cleaning is required but loose deposits must be flushed out before flooding with system water.
 - .1 A minor amount of new piping is added to the system when compared with the entire system.
 - .2 Converter is re-tubed.
 - .3 Less than approximately 50% of the tubes are replaced in a fire-tube or water-tube boiler.

2. New piping which **can** be isolated from the rest of the system:
 - .1 Clean piping using the chemical cleaner and procedure specified in 2.1.3 and 3.4.
 - .2 Chemically treat the entire system with a corrosion inhibitor specified in 2.2 and 3.7.

3. New piping which **can not** be isolated from the rest of the system:
 - .1 Clean the deposits from the entire pre-boiler system as specified in 2.1.3 and 3.5.
 - .2 Clean the entire system with the chemical cleaner and procedure specified in 2.1.1 and 3.3 and 3.4.
 - .3 Chemically treat the entire system with a corrosion inhibitor specified in 2.2 and 3.7.

4. Fire-tube boilers where more than approximately 50% of the tubes in a fire-tube boiler are re-placed:
 - .1 Isolate the boiler from the rest of the system.
 - .2 Clean the deposits from the boiler as specified in 2.1.3 and 3.5.
 - .3 Clean the boiler with the chemical cleaner and procedure specified in 2.1.1 and 3.3 and 3.4.
 - .4 Chemically treat the boiler with a corrosion and scale inhibitor specified in 2.2 and 3.7.

5. Removal of deposits from system/boiler where no new piping is added or re-tubing is done:
 - .1 Clean the deposits from the system/boiler as specified in 2.1.3 and 3.5.
 - .2 Chemically treat the system/boiler with a corrosion inhibitor specified in 2.2 and 3.7.

END OF DATA SHEET

Plan No:
Project ID:

1. General

1.1 INTENT

- .1 This Section specifies services and material required for onsite, cleaning and chemical treatment of a multi-metal, steam boiler system.
- .2 Do not clean and chemically treat direct contact culinary steam boilers and steam sterilizers.
- .3 Do not soften feed water to culinary steam boilers and steam sterilizers.

1.2 RELATED REQUIREMENTS

- .1 Mechanical Spare Parts and Maintenance Materials: Section 20 00 23.
- .2 Chemical Treatment and Cleaning Equipment: Section 23 25 01.
- .3 Chemical Treatment and Cleaning - General Requirements Section 23 25 02.

1.3 REFERENCE DOCUMENTS

- .1 [Alberta Infrastructure Water Treatment Program Manual](#)

1.4 PERFORMANCE REQUIREMENTS

- .1 Clean system to remove oil, grease, silt, and rust and leave metal surfaces well passivated.

Plan No:
Project ID:

- .2 Chemically treat and maintain system water to meet following standards:

Parameter	Control Limits
Boiler Water:	
pH:	10.5-11.5
TDS, $\mu\text{S}/\text{cm}$:	2000-4000 neutralized sample
OH alkalinity, mg/L CaCO_3 :	150-300
M alkalinity, mg/L CaCO_3 :	<700
sulphite, mg/L SO_3 :	30-60
phosphate, mg/L PO_4 :	40-80
Boiler Feedwater:	
hardness, mg/L CaCO_3 :	<2
Softener Outlet:	
hardness, mg/L CaCO_3 :	<2
Boiler Condensate:	
pH (for systems not used for humidity control):	8.5-9.5
pH (for systems used for humidity control):	8.0-8.5
TDS, $\mu\text{S}/\text{cm}$:	<50
hardness, mg/L CaCO_3 :	<2

1.5 SUBMITTALS

- .1 In addition to submittal requirements specified in Section 23 25 02, submit a written report of actual cleaning activities including:
- .1 Times.
 - .2 System status.
 - .3 Problems encountered.
 - .4 Actions taken.
 - .5 Composition of cleaning & spent cleaning solutions.
 - .6 Inspection results.

Plan No:
Project ID:

- .7 Final boiler water:
 - .1 pH level.
 - .2 TDS concentration.
 - .3 Sulphite concentration.
 - .4 OH and M Alkalinity concentration.
 - .5 phosphate concentration.
- .8 Final condensate:
 - .1 pH level.
 - .2 TDS concentration.
 - .3 Hardness mg/L CaCO₃

2. Products

2.1 CLEANING CHEMICALS

SPEC NOTE: If the steam boiler system does not have a pre-boiler system, the “Cleaning Solution for Preboiler System” is not required.

- .1 Cleaning Solution for Pre-boiler System: neutral pH cleaning solution at an acceptable concentration which is capable of removing oil, grease, and rust from metal surfaces of system and passivating cleaned metal surfaces of system. Cleaning solution shall include:
 - .1 Low foaming non-ionic surfactant for penetrating oil and grease deposits.
 - .2 Solvent for dissolving oil and grease.
 - .3 Dispersant for dissolving rust.
 - .4 Reducing agent for corrosion control.
 - .5 Ferrous and non-ferrous metal corrosion inhibitors.
- .2 Alkaline Boil-out Cleaning Solution for Boiler System: alkaline boil-out cleaning solution at an acceptable concentration which is capable of removing oil, grease and rust from metal surfaces of boiler. Cleaning solution shall include:
 - .1 Low foaming non-ionic surfactant for penetrating oil and grease deposits.
 - .2 Phosphate and soda ash to provide alkalinity.

SPEC NOTE: Specify deposit removal cleaning solution for existing systems only.

- .3 Deposit Removal Cleaning Solution: blended neutral pH cleaning solution which is capable of removing scale and iron deposits, destroying bacteria, and passivating the metal surfaces of system.

Plan No:
Project ID:

2.2 CHEMICAL TREATMENT CHEMICALS

- .1 Chemical Treatment: corrosion and scale inhibitors which contains the following components, in the form of separate chemicals:
 - .1 Sulphite as an oxygen scavenger.
 - .2 Phosphate as a scale inhibitor.
 - .3 Caustic as an alkalinity builder.
 - .4 Neutralizing amine as a corrosion control agent.

SPEC NOTE: Neutralizing amine component of the chemical treatment is not required if the steam boiler system does not have a condensate system.

2.3 WATER TEST EQUIPMENT

- .1 Supply one of each of the following water test kits specified in Section 23 25 02:
 - .1 pH test kit.
 - .2 Sulphite test kit.
 - .3 P&M Alkalinity test kit.
 - .4 Phosphate test kit.
 - .5 TDS or Conductivity Meter.

3. Execution

3.1 EQUIPMENT INSTALLATION

- .1 Prior to performing chemical treatment work ensure following work specified in Section 23 25 01 has been completed:
 - .1 Sample cooler.
 - .2 Chemical metering system.
 - .3 Softener system.

3.2 CLEANING - GENERAL

- .1 Maintain following conditions during cleaning process:
 - .1 Manual and automatic valves are in full open position.
 - .2 By-pass valves are operated to ensure full flow through entire system.
 - .3 Safety devices, including pressure relief valves, flow switches, and pressure switches are functioning.

Plan No:
Project ID:

- .4 Temporary fine mesh strainers for system pump and control valve strainer baskets are installed and cleaned as required.

SPEC NOTE: *If the steam boiler has a pre-boiler system, perform cleaning procedures for pre-boiler and boiler immediately one after the other.*

3.3 PRE-BOILER EQUIPMENT CLEANING PROCEDURE

- .1 Step 1: Fill system with domestic water, establish circulation, and heat system contents to a temperature of 60°C.
- .2 Step 2: After two hours of circulation, collect water samples from at least three different locations in system. If these samples contain suspended solids, clean out strainer baskets, drain system, and repeat steps 1 & 2.
- .3 Step 3: Blend in prepared concentrated pre-boiler equipment cleaning solution at acceptable concentration, establish circulation, and maintain system temperature at 60°C for at least three days.
- .4 Step 4: Dump spent cleaning solution to disposal, fill system with domestic water, circulate system contents for at least two hours, and dump spent rinse water to disposal.
- .5 Step 5: Fill system with domestic water and repeat step 4 until water samples collected from system are free of oil, grease, and suspended solids.
- .6 Step 6: Drain system completely, including all system low points and perform visual inspections of metal surfaces at three different locations.
- .7 Complete steps 4, 5 & 6 within a 24 hour period.
- .8 If metal surfaces contain oil, grease or silt, fill system with domestic water and repeat steps 3, 4, 5 & 6.

3.4 BOILER CLEANING PROCEDURE

- .1 To empty boiler, blend in concentrated alkaline boil-out cleaning solution at an acceptable concentration proportionally with softened water make-up to fill boiler to normal operating level.
- .2 Fire boiler and slowly increase pressure to its normal operating pressure.
- .3 Hold pressure for four hours, remove heat and allow to sit for 15 minutes, blow-out all boiler connections for 10-15 seconds, re-fill boiler with alkaline boil-out cleaning solution treated softened water, apply heat, and raise pressure. Hold pressure for one hour and repeat blowdown, treated water re-fill, heat and pressure sequence.

Plan No:
Project ID:

- .4 Maintain boil-out conditions (i.e. blowdown, make-up, chemical levels and pressure) for a period of at least 48 hours. The best guide for determining when to end the boil-out is the condition and appearance of water blown from the boiler. A leveling off of the oil and grease, suspended solids, dissolved solids concentrations, and colour indicate that maximum capacity of alkaline boil-out cleaning solution is attained.
- .5 At end of boil-out period, deconcentrate alkaline boil-out chemical cleaning solution concentration in boiler by alternately blowing down 1/2 gauge glass and make-up with softened make-up water containing no alkaline boil-out chemical cleaning solution.
- .6 When boiler water phosphate concentration has been reduced to 10 mg/L as PO₄, relieve boiler pressure and drain boiler by opening bottom drains.
- .7 When completely drained, open boiler for inspection. If wetted surfaces or boiler are free of oil and grease, boil-out is complete, but if a film of oil and grease are present, repeat boiler cleaning procedure.
- .8 If operation of steam boiler is not imminent, flood pre-boiler and boiler with sulphite and caustic treated softened water such that final sulphite concentration of at least 200 mg/L as SO₃ and final hydroxide alkalinity concentration of 200 mg/L as CaCO₃ are maintained.
- .9 If operation of steam boiler system is imminent, fill system with chemically treated softened water so that concentrations of control parameters are maintained within control limits specified under "Performance Requirements".

SPEC NOTE: *Specify deposit removal procedure for cleaning of existing systems.*

3.5 DEPOSIT REMOVAL PROCEDURE

- .1 Step 1: Fill system with domestic water, establish circulation, and heat system contents to a temperature of 60°C;
- .2 Step 2: Blend in prepared concentrated cleaning solution for removal of deposits etc., establish circulation, and maintain system temperature at 60°C until total iron concentration stabilizes;
- .3 Step 3: Dump spent cleaning solution to disposal, fill system with domestic water, circulate system contents for at least two hours, and drain spent rinse water from various locations in system to disposal;
- .4 Step 4: Fill system with domestic water and repeat step 3 until water samples collected from system are free of suspended material;

Plan No:
Project ID:

- .5 Step 5: Drain system and perform visual inspections of metal surfaces at three different locations;
- .6 Complete steps 3, 4, & 5 within a 24 hour period.
- .7 Step 6: If metal surfaces contain scale or iron deposits and are not passivated, fill system with domestic water and repeat steps 2, 3, 4 & 5.

3.6 CLEANING DIRECT STEAM CULINARY BOILERS AND STERILIZERS

- .1 Manually flush system thoroughly to remove debris.

3.7 OPERATION MAINTENANCE UNTIL INTERIM ACCEPTANCE

- .1 Perform following minimum routine maintenance until Interim Acceptance of the Work:
 - .1 Maintain control limits specified under "Performance Requirements". Add chemicals as required.
 - .2 Blow down boiler as required.
 - .3 Maintain operation of softener system.
 - .4 Test water samples of system once per day for following:
 - .1 Boiler Water:
 - .1 pH
 - .2 TDS, $\mu\text{S}/\text{cm}$
 - .3 OH alkalinity, mg/L CaCO_3
 - .4 M alkalinity, mg/L CaCO_3
 - .5 Sulphite, mg/L SO_3
 - .6 Phosphate, mg/L PO_4
 - .2 Boiler Feedwater:
 - .1 Hardness, mg/L CaCO_3
 - .3 Softener Outlet:
 - .1 Hardness, mg/L CaCO_3
 - .4 Boiler Condensate:
 - .1 pH
 - .2 TDS, $\mu\text{S}/\text{cm}$
 - .3 Hardness, mg/L CaCO_3

Plan No:
Project ID:

- .2 Document water analyses results, quantities and dates chemicals added, make-up water used and blowdown adjustments on a chemical treatment report form.

3.8 WASTE WATER DISPOSAL

- .1 Wastewater discharged into a municipal sanitary sewer system from existing or new systems shall be within the limits established by local authorities. Where no local limits have been established, stay within limits specified in “Alberta Infrastructure Water Treatment Program Manual, Section I - Environmental Guideline”.

3.9 CHEMICAL CLEANING AND TREATMENT SCHEDULE FOR RENOVATED SYSTEMS

SPEC NOTE: Schedule cleaning requirements for renovated steam boiler systems based on the guidelines on Page 01.

- .1 Clean and treat renovated steam boiler systems as follows:
 - .1 Re-tubed fin-tube boiler:
 - .1 Flush out loose deposits before flooding with system water.
 - .2 New piping - isolated from rest of system:
 - .1 Chemically clean piping.
 - .2 Chemically treat entire system with corrosion inhibitor.
 - .3 []:
 - .1 []

END OF SECTION