

CAIS STANDARD MANUAL

SYSTEM NO. 28 CENTRAL HEATING PLANTS

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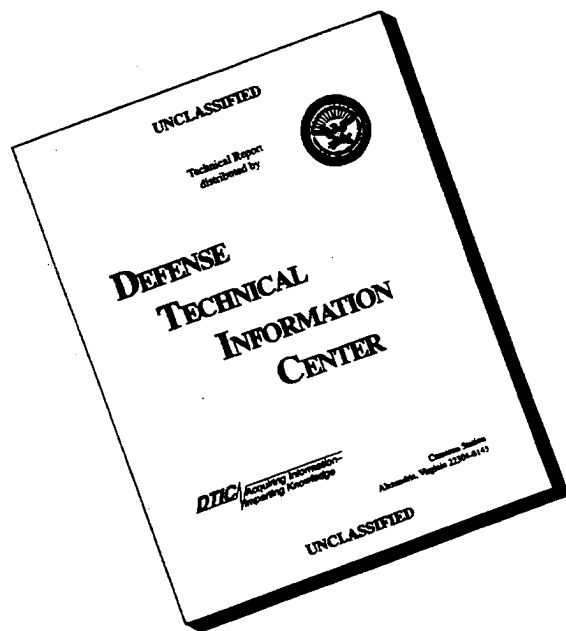
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28 CENTRAL HEATING PLANTS

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ABSTRACT**GENERAL ORGANIZATION**

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

- I. General
 - A. Level I Inspection Method Description
 - B. Level II Inspection Method Description
 - C. Level III Inspection Method Description
- II. General Inspection
 - A. Process. This section describes the process of the inspection activity.
 - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.
- III. Inspector Qualifications

This section notes the minimum qualifications for the person or persons performing the survey.
- IV. Inspection Unit

This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.
- V. Unit Costs

This section notes the nature of repair costs for this system.
- VI. Standard Safety Requirements

This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.
- VII. Standard Tools

This section lists a set of standard tools required for the general conduct of this survey.
- VIII. Special Tools and Equipment Requirements

This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys

This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys

This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost

This section describes the nature and location of replacement cost data.

XII. Appendices

Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

- * Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Central Heating Plants.

INSPECTION METHODS

Description

Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements

Lists any special tools required for this specific subsystem.

Special Safety Requirements

This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List

All components to be surveyed under this subsystem are listed here.

Related Subsystems

All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of central heating plants consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. Portions of the system may be inaccessible during the Level I inspection. Only readily accessible components need to be addressed during a Level I inspection. The survey activity is designed to be performed by a single surveyor.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. The Central Heating Plant System requires very few Level II inspections, since most defects are readily apparent from a Level I. For instance, the investigation of grinding noises in a pump may dictate that a Level II inspection be performed. Level II inspections are referenced by defect/observations through a "Level II key", which denotes a specific Guide Sheet that describes the Level II inspection activity.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 28-A provides the breakdown from system through component for the Central Heating Plants. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

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If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I and II inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building floor plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended room numbering schemes for the installation. The installation may have rooms physically identified by a numbering system or identified on floor plans. If both exist and are different, the Facility Manager will develop guidance on which numbering system takes precedence. Where numbering systems do not exist or are not complete in identifying each space, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Central Heating Plants requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Mechanical" discipline.

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. The varied configurations of the components that exist in the Central Heating Plants require that they be evaluated differently when defining the IU. Therefore, the measurement technique requires some consideration. If the inspector finds multiple defects that occur on the same IU, the inspector will quantify the observation that is considered most severe and identify the remaining quantity under the less severe observation for the discrete component. The IU's for the most common components would be defined as follows:

- Piping, fittings and valves - The IU is defined as the linear footage of the affected section of pipe containing the defect in a particular location (to include the fittings and valves along that section). For example, five sections of 2" DIA pipe extend the length of a 20' wall within a mechanical room. If the inspector were to observe 2 LF of bent pipe on one 20 LF section, the IU would be 20 LF, not the total amount of 2" DIA pipe in the room of 100 LF.

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- Pump IU, Motor IU, etc. - Singularly defined items such as these are defined as each.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 20' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pliers

VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

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All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Central Heating Plants.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Central Heating Plants.

Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

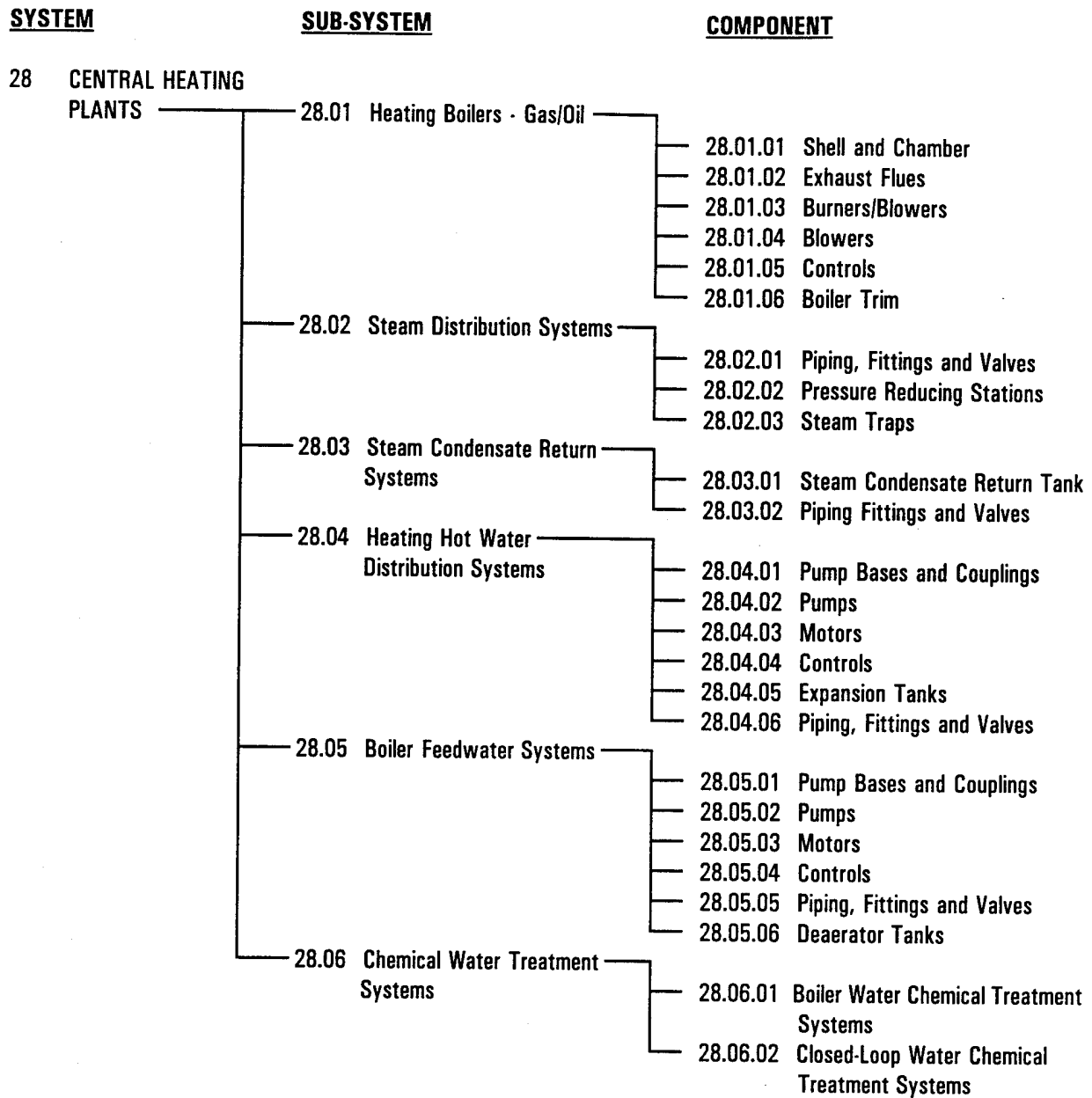
A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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Figure 28-A. WORK BREAKDOWN STRUCTURE



28.01 HEATING BOILERS - GAS/OIL

DESCRIPTION

Heating Boilers - Gas/Oil is a subsystem of the Central Heating Plant. Heating Boilers - Gas/Oil are heat generating systems which produce steam at pressures not exceeding 15 psig or low temperature hot water.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of heating boilers - gas/oil, beyond the requirements listed in the Standard Tool Section.

SPECIAL SAFETY REQUIREMENTS

The following list of special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of gas or oil fire heating boilers.

1. Inspectors should utilize the installations notification procedure to secure safe access to the boilers.

COMPONENT LIST

- ◆ 28.01.01 SHELL AND CHAMBER
- ◆ 28.01.02 EXHAUST FLUES
- ◆ 28.01.03 BURNERS/BLOWERS
- ◆ 28.01.04 BLOWERS
- ◆ 28.01.05 CONTROLS
- ◆ 28.01.06 BOILER TRIM

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- 28.02 STEAM DISTRIBUTION SYSTEMS
- 28.03 STEAM CONDENSATE RETURN SYSTEMS
- 28.04 HOT WATER DISTRIBUTION SYSTEMS
- 28.05 BOILER FEEDWATER SYSTEMS
- 28.06 CHEMICAL WATER TREATMENT SYSTEMS

28.01 HEATING BOILERS - GAS/OIL

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

- a. Use Level I inspection method if HP is less than 15.
- b. Use Level I & II inspection methods if HP is 15 to 60.
- c. Use Level I, II and/or III inspection methods if HP is 60 or greater.

For fans, burner/ blowers blower assemblies in general use, Level I & II inspection methods will apply. No Level III inspection will be required.

The Facility Manager will specify the level of inspection required for specialized motors, fans, blowers or blower assemblies.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 28.01.01 SHELL AND CHAMBER

The boiler shell contains the connecting tubes and heated fluid. The combustion chamber is the area of the boiler in which fuel is burned.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective casing panels.			
Observation:			
a. Loose casing.	SF		
*** {Severity L}			
b. Missing or damaged casing.	SF		
*** {Severity H}			
c. Blistered or buckled casing.	SF		1
*** {Severity H}			
* Water or steam leakage.			
Observation:			
a. Water or steam dripping from access	EA		2
plate or door.			
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.01 SHELL AND CHAMBER (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged inspection port.			
Observation:			
a. Cracked lens on flame inspection port.	EA		
*** {Severity H}			
* Defective exterior insulation.			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Missing or damaged insulation.	SF		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.02 EXHAUST FLUES

The Exhaust Flue is an airtight conduit which conveys the products of combustion from the boiler to the atmosphere or to a chimney stack.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective exhaust flue.			
Observation:			
a. Physically damaged flue, no penetrations.	SF		
*** {Severity M}			
b. Physically damaged flue, with penetrations.	SF		
*** {Severity H}			
c. Inoperable flue damper.	EA		
*** {Severity H}			
* Defective flue hangers, guides and supports.			
Observation:			
a. Loose exhaust flue hangers, guides or supports.	EA		
*** {Severity M}			
b. Broken or missing exhaust flue hangers, supports.	EA		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.03 BURNERS/BLOWERS

The burner is an assembly where fuel and air are ignited to produce combustion gases that heat the air indirectly. The blower provides combustion air to the burner.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Fuel Leakage.			
Observation:			
a. Leaking fuel oil lines, hoses and fittings.	EA		
*** {Severity H}			
* Damaged motors.			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
* Excessive noise or vibration at motor.			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Electrical arcing noise.	EA		
*** {Severity H}			
* Defective motor mounting hardware.			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.03 BURNERS/BLOWERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged blower.			
Observation:			
a. Loose, missing or damaged housing.	EA		
*** {Severity M}			
* Damaged blower mounting hardware or supports.			
Observation:			
a. Loose blower mounting hardware or supports.	EA		
*** {Severity M}			
b. Broken or missing blower mounting hardware or supports.	EA		
*** {Severity H}			
* Excessive noise or vibration at blower.			
Observation:			
a. Rattling noise.	EA	1	
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	
*** {Severity H}			
* Defective electrical connectors.			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			
* Burner/blower corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.04 BLOWERS

The Blowers provide combustion air to the burner and can be forced or induced draft fans.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged motor.			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
* Excessive noise and vibration.			
Observation:			
a. Rattling noise.	EA	2	
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	2	
*** {Severity H}			
c. Electrical arcing noise.	EA		
*** {Severity H}			
* Defective motor mounting hardware.			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			
* Defective blower.			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.04 BLOWERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Excessive noise or vibration at blower.			
Observation:			
a. Rattling noise.	EA	3	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	3	
*** {Severity H}			
* Defective blower mounting hardware or supports.			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity M}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.05 CONTROLS

The controls govern the operation of the boiler and consist of switches, relays and disconnects.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Physically damaged control panel.			
Observation:			
a. Impact damage, dents on enclosure panel.	EA		
*** {Severity M}			
b. Broken, missing pilot lamp lens.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
* Excessive noise.			
Observation:			
a. Rattling relay noise.	EA		3
*** {Severity M}			
b. Electrical arcing noise.	EA		3
*** {Severity H}			
* Defective sensors.			
Observation:			
a. Missing.	EA		
*** {Severity H}			
b. Disconnected.	EA		
*** {Severity H}			
* Defective electrical connectors.			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.05 CONTROLS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** (Severity M)			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.06 BOILER TRIM

The boiler trim consists of a water column, valves, fuel oil pump, steam safety valves, hot water - water relief valves, gauges and blow-off piping.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective water column.			
Observation:			
a. Residual buildup inside sight glass, poor visibility.	EA		
*** {Severity H}			
b. Cracked or broken sight glass.	EA		
*** {Severity H}			
c. Leaking seals.	EA		
*** {Severity H}			
d. Leaking cutout isolation valve.	EA		
*** {Severity H}			
e. Inoperable cutout isolation valve.	EA		
*** {Severity H}			
* Damaged safety/relief valve.			
Observation:			
a. Missing or broken lift handle.	EA		
*** {Severity M}			
b. Leaking pressure relief valve.	EA		
*** {Severity H}			
c. Broken calibration seal.	EA		
*** {Severity H}			
d. Tied-down operating lever.	EA		
*** {Severity H}			
e. Missing vent pipe.	EA		
*** {Severity H}			
f. Bent stem.	EA		
*** {Severity H}			
* Damaged fuel oil pump.			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity H}			
b. Leaking fuel oil pump.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.06 BOILER TRIM (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged fuel oil pump mounting hardware or supports.			
Observation:			
a. Loose mounting hardware or supports.	EA		
*** {Severity M}			
b. Broken or missing mounting hardware or supports.	EA		
*** {Severity H}			
* Defective gauge.			
Observation:			
a. Broken missing, or dirty gauge lens.	EA		
*** {Severity L}			
b. Inoperable gauge, no reading.	EA		
*** {Severity H}			
c. Leaking gauge.	EA		
*** {Severity H}			
d. Bent or missing pointer.	EA		
*** {Severity H}			
e. Illegible markings.	EA		
*** {Severity H}			
* Damaged valve.			
Observation:			
a. Missing or broken valve handle.	EA		
*** {Severity L}			
b. Bent stems.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity H}			
d. Cracked or damaged valve body.	EA		
*** {Severity H}			
* Damaged blow-off piping.			
Observation:			
a. Cracked or damaged blow-off piping.	EA		
*** {Severity H}			

28.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 28.01.06 BOILER TRIM (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
<ul style="list-style-type: none"> * Corrosion. Observation: a. Surface corrosion no pitting evident. EA *** {Severity L} b. Corrosion evidenced by pitting or EA blistering. *** {Severity M} c. Corrosion evidenced by holes or loss of EA base metal. *** {Severity H} 			
*** Material:	N/A		

28.01 HEATING BOILERS - GAS/OIL

REFERENCES

1. NAVFAC MO-322 Vol. II, Inspection of Shore Facilities, Jan. 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, P.E. AIC, 1988
3. Virginia Department of Labor & Industry, Boiler and Pressure Vessel Rules & Regulations
4. U.S. Coast Guard Support Center, Elizabeth City, NC, Specification SMD 0028, March 1992, Boiler and Pressure Vessel Inspection and Testing Services
5. NAVFAC MO-324: Inspection and Certification of Boilers and Unfired Pressures, 1992.

28.01 HEATING BOILERS - GAS/OIL

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

1	GS-II 28.01.03-1
2	GS-II 28.01.04-2
3	GS-II 28.01.04-3

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

1	GS-III 28.01.01-1
2	GS-III 28.01.01-2
3	GS-III 28.01.05-3

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BURNERS/BLOWERS**CONTROL NUMBER:** GS-II 28.01.03-1**Application**

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the burners/blowers.

For burners, blowers in general use, Level I and Level II inspection methods will apply. No Level III inspection will be required.

The Facility Manager will specify the level of inspection required for specialized fans, blowers or blower assemblies.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation and determine possible source of noise.
2. Shut down, tag and lock out disconnect.
3. Remove access plates.
4. Check assembly for wear, damage or loose fasteners.
5. Visually inspect blower blades for foreign objects and deposit buildup.
6. Inspect blower blades for cracks, fatigue, physical damage and corrosion.
7. Rotate shafting and check for distortion in shaft.
8. Rotate to check for binding.
9. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: BLOWERS
CONTROL NUMBER: GS-II 28.01.04-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the blower motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 15.
2. Use Level I & II inspection methods if HP is 15 to 60.
3. Use Level I, II and/or III inspection if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: BLOWERS
CONTROL NUMBER: GS-II 28.01.04-2

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: BLOWERS
CONTROL NUMBER: GS-II 28.01.04-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the blowers.

For, blowers in general use, Level I and Level II inspection methods will apply. No Level III inspection will be required.

The Facility Manager will specify the level of inspection required for specialized fans, blowers or blower assemblies.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe operation and determine possible source of noise.
2. Shut down, tag and lock out disconnect.
3. Remove access plates.
4. Check assembly for wear, damage or loose fasteners.
5. Visually inspect blower blades for foreign objects and deposit buildup.
6. Inspect blower blades for cracks, fatigue, physical damage and corrosion.
7. Rotate shafting and check for distortion in shaft.
8. Rotate to check for binding.
9. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
10. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
11. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 28.01.01-1

Application

This guide applies to the investigation of blistered or buckled enclosures.

Special Safety Requirements

The following is a list of safety requirements for the inspection beyond the requirements listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.
2. Do not enter boiler until clearance is obtained from a certified Safety Officer or Confined Space Officer.
3. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Take boiler out of service and allow to cool down.
2. Tag and lock out disconnects, steam, fuel and water valves to boiler.
3. Drain the water from the boiler.
4. Open boiler and ventilate interior.
5. Inspect boiler for water leaks.
6. Inspect refractory for signs of deteriorated surface or irregular fuel flame patterns.
7. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
8. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
9. Ensure that all parts, guards and covers have been reinstalled; remove tags and lock out or disconnect.
10. Return boiler to normal service according to the manufacturer's recommendations.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Wire Brush
2. Scraper
3. Grinders
4. Ice Pick
5. Chipping Hammer & Chisel
6. Dust Masks

LEVEL III INSPECTION METHOD GUIDE SHEET

7. Extension Cord with Light

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO.1 (Continued)

COMPONENT: SHELL AND CHAMBER**CONTROL NUMBER:** GS-III 28.01.01-1**Recommended Inspection Frequency**

Perform inspection when triggered by Level I, Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. II, Inspection of Shore Facilities 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, P.E., AIC, 1988
3. NAVFAC MO-324 Inspection of Boilers and Unfired Pressure Vessels March 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 28.01.01-2

Application

This guide applies to the investigation of water or steam leaking from boiler chamber door.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Take the boiler out of service and allow to cool down.
2. Tag and lock out disconnects, steam, fuel, and water valves to boiler.
3. Drain the water from the boiler.
4. Check boiler chamber door for wear, physical damage or signs of overheating, deteriorated seal or worn fasteners.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Remove tags and lock out or disconnect.
8. Return boiler to normal service, according to the manufacture's recommendations.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Wire Brush
2. Scraper
3. Ice Pick
4. Dust Masks
5. Extension Cord with Light
6. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: SHELL AND CHAMBER

CONTROL NUMBER: GS-III 28.01.01-2

References

1. NAVFAC MO-322 Vol. II Inspection of Shore Facilities 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, P.E., AIC, 1988
3. NAVFAC MO-324 Inspection and Certification of Boilers and Unfired Pressure Vessels, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 28.01.05-3

Application

This guide applies to the investigation of electrical arcing or rattling relay noise from the controls.

For controls in general use, Level I, II and/or III inspection methods will apply.

The Facility Manager will specify the level of inspection required for specialized control applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating. Tag and lock out disconnects.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 28.01.05-3

Recommended Inspection Frequency

Perform inspection when triggered by Level I, Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

28.02 STEAM DISTRIBUTION SYSTEMS

DESCRIPTION

Steam Distribution Systems is a subsystem of the Central Heating Plant. The Steam Distribution System provides steam circulation between the steam generating equipment and the infrastructure steam distribution system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Steam Distribution Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Steam Distribution Systems, beyond the requirements listed in the Master Plan and System Safety Section.

COMPONENT LIST

- ◆ 28.02.01 PIPING, FITTINGS AND VALVES
- ◆ 28.02.02 PRESSURE REDUCING STATIONS
- ◆ 28.02.03 STEAM TRAPS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following equipment should be reviewed for concurrent inspection activities.

- | | |
|-------|---------------------------------|
| 23.07 | STEAM DISTRIBUTION SYSTEMS |
| 23.08 | STEAM CONDENSATE RETURN SYSTEMS |
| 28.01 | HEATING BOILERS - GAS/OIL |
| 28.03 | STEAM CONDENSATE RETURN SYSTEMS |

28.02 STEAM DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level III inspections as part of the basic inspection process. Additional Level III inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 28.02.01 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the steam distribution system. Valves are installed to control the steam distribution supply and isolate system parts.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Leaking/damaged fitting.			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Steam leaking.	EA		
*** {Severity H}			
* Leaking/damaged pipe.			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Steam leaking.	LF		
*** {Severity H}			
* Plugged strainer.			
Observation:			
a. Temperature difference between inlet and outlet of strainer.	EA		1
*** {Severity H}			

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.01 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged/defective strainer.			
Observation:			
a. Cracked strainer, not leaking. *** {Severity M}	EA		
b. Cracked strainer, steam leaking. *** {Severity H}	EA		
* Loose/missing supports/hangers.			
Observation:			
a. Loose supports or hangers. *** {Severity L}	EA		
b. Broken/missing supports/hangers. *** {Severity H}	EA		
* Defective insulation.			
Observation:			
a. Loose insulation. *** {Severity L}	LF		
b. Damaged or missing insulation. *** {Severity H}	LF		
* Defective valve.			
Observation:			
a. Broken/missing valve handle. *** {Severity L}	EA		
b. Bent stem. *** {Severity M}	EA		
c. Leaking valve. *** {Severity M}	EA		
d. Cracked valve body. *** {Severity H}	EA		
e. Inoperable valve. *** {Severity H}	EA		

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.01 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Corroded piping and fittings.			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
* Corroded valves/stainers.			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
* Defective pipe labeling.			
Observation:			
a. Damaged/missing labels.	EA		
*** {Severity L}			

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.02 PRESSURE REDUCING STATIONS

Pressure reducing stations are used to reduce the pressure from the steam source to the desired operational level.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective reducing valve.			
Observation:			
a. Inoperable reducing valve, upstream and downstream gauges indicating same pressure.	EA		
*** {Severity H}			
* Damaged safety valve.			
Observation:			
a. Missing or broken lift handle.	EA		
*** {Severity M}			
b. Leaking safety valve.	EA		
*** {Severity H}			
c. Broken calibration seal.	EA		
*** {Severity H}			
d. Tied-down lift handle.	EA		
*** {Severity H}			
e. Missing vent pipe.	EA		
*** {Severity H}			
f. Bent stem.	EA		
*** {Severity H}			
* Leaking/damaged fitting.			
Observation:			
a. Bent/cracked fitting, not leaking.	EA		
*** {Severity M}			
b. Steam leaking.	EA		
*** {Severity H}			
* Leaking/damaged pipe.			
Observation:			
a. Bent/cracked pipe, not leaking.	LF		
*** {Severity M}			
b. Steam leaking.	LF		
*** {Severity H}			

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.02 PRESSURE REDUCING STATIONS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged valves.			
Observation:			
a. Broken/missing handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Inoperable valve.	EA		
*** {Severity H}			
* Defective reducing station.			
Observation:			
a. Station output pressure not maintained at plus or minus 5 PSI of tolerance.	EA		
*** {Severity M}			
* Loose/missing supports/hangers.			
Observation:			
a. Loose supports/hangers.	EA		
*** {Severity L}			
b. Broken/missing supports/hangers.	EA		
*** {Severity H}			
* Defective pressure gauges.			
Observation:			
a. Broken gauge lens.	EA		
*** {Severity L}			
b. Inoperable gauge, no reading.	EA		
*** {Severity H}			
c. Leaking gauge.	EA		
*** {Severity H}			
* Defective insulation.			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF		
*** {Severity M}			

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.02 PRESSURE REDUCING STATIONS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Corrosion.			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.03 STEAM TRAPS

Steam traps are devices for removing condensate/air from the steam heating system. If the trap is inaccessible for the Level I inspection the inspector may choose a Level III inspection method.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Steam loss.			
Observation:			
a. Trap blows live steam. *** {Severity H}	EA		2
b. Broken/damaged steam trap. *** {Severity H}	EA		2
* Continuously discharging condensate.			
Observation:			
a. Trap is not sized correctly. *** {Severity M}	EA		
b. Damaged/defective trap. *** {Severity H}	EA		2
* Cold trap - no discharge.			
Observation:			
a. No condensate/steam coming to trap. *** {Severity M}	EA		3
b. Pipe line/fittings plugged. *** {Severity M}	EA		3
c. Strainer plugged. *** {Severity M}	EA		3
d. Broken/damaged steam trap. *** {Severity H}	EA		2
e. Broken valve in line to trap. *** {Severity H}	EA		

28.02 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.02.03 STEAM TRAPS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Hot trap - no discharge.			
Observation:			
a. No condensate coming to trap. *** {Severity M}	EA		
b. Improper installation, trap installed above leaking by-pass valve. *** {Severity M}	EA		
c. Broken/damaged steam trap. *** {Severity H}	EA		2
d. Noisy high pitch sound. *** {Severity H}	EA		2
* Corrosion.			
Observation:			
a. Surface corrosion (no pitting evident). *** {Severity L}	EA		
b. Corrosion evidenced by pitting or blistering. *** {Severity M}	EA		
c. Corrosion evidenced by holes or loss of base metal. *** {Severity H}	EA		

28.02 STEAM DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

28.02 STEAM DISTRIBUTION SYSTEMS

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

1	GS-III 28.02.01-1
2	GS-III 28.02.03-2
3*	GS-III 28.02.03-3*

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 28.02.01-1

Application

This guide applies to the detection of a plugged strainer using an infrared thermometer method of testing. This method should be used when the strainer is in an inaccessible location.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Aim the infrared thermometer at the inlet and outlet of the strainer and record the temperature differential.
2. If temperature difference is 50 degrees F or greater, than it can be assumed that the strainer is not operating properly.
3. Document the reading and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared thermometer.

Recommended Inspection Frequency

Annually

References

1. NAVFAC MO-322 Vol. II, Inspection of Shore Facilities 1993
2. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
3. The Hartford Steam Boiler Inspection and Insurance Company.
4. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: STEAM TRAPS
CONTROL NUMBER: GS-III 28.02.03-2

Application

This guide applies to the investigation of the proper operation of a steam trap using an audio amplifier. Considerable experience is required for this method of testing as other noises are telegraphed along the pipe lines. When several traps are close together in the piping system, ultrasonic testers, responding only to frequencies above 35 kilohertz, are useful.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Observe steam trap operation:
2. Listen for the trap to discharge:
3. Thermostatic traps: When properly sized for the load, will discharge intermittently. Therefore, if the trap is operating properly, a loud hissing sound will be heard during discharge; no sound will be heard when trap is closed. If hissing sound continues after, the trap is leaking.
4. Bucket traps: Will operate intermittently. When the trap is working properly, a hissing noise will be heard during discharge, and when the trap closes, the sound stops.
5. Thermodynamic traps: This type of trap will open and close frequently depending on the trap load and the mechanical condition of the trap. Generally, if the trap cycles fewer than 10 times per minute, it is operating normally.
6. Impulse traps: A bleed hole is drilled through the piston allowing flow from inlet to outlet even when the trap is closed. Therefore, with the trap closed, a hissing sound will be heard. If a loud noise is heard continuously, the trap is either overloaded or stuck in the open position.
7. Float-thermostatic traps: These traps have a tendency to discharge continuously, particularly at low or moderate pressures, and modulate according to the load ahead of the trap. Under these conditions, ultrasonic testers are of no value. However, when float-thermostatic traps are used at high pressures, they tend to discharge intermittently, if the tester indicates a rhythmic intermittent discharge, the trap is working properly.

Special Tools and Equipment

1. A audio amplifier.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: STEAM TRAPS
CONTROL NUMBER: GS-III 28.02.03-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. NAVFAC MO-322 Vol. II, Inspection of Shore Facilities 1993
2. MEANS Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
3. Armstrong Steam Specialty Products, Bulletin No. M101 50M 2/87-0
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. The Hartford Steam Boiler Inspection and Insurance Company
6. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: STEAM TRAPS
CONTROL NUMBER: GS-III 28.02.03-3*

Application

This guide applies to the detection of a defective steam trap using an infrared thermometer method of testing. This method should be used when the trap is in an inaccessible location.

Special Safety Requirements

No special safety requirements are needed for the performance of the Level III inspection beyond those required in the Master Safety Plan and System Safety Section.

Inspection Actions

1. Take temperature measurements immediately adjacent, no more than 2 feet, on either side of trap.
2. If the temperature difference is less than 30 degrees F, than it can be assumed that the trap is operating properly.

Special Tools And Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared thermometer

Recommended Inspection Frequency

Annually

References

1. NAVFAC MO-322 Vol. II Inspection of Shore Facilities 1993
2. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
3. Armstrong Steam Specialty Products, Bulletin No. M101 50M 2/87-0
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. The Hartford Steam Boiler Inspection and Insurance Company
6. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

28.03 STEAM CONDENSATE RETURN SYSTEMS

DESCRIPTION

Steam Condensate Return Systems is a subsystem of the Central Heating Plants. The Steam Condensate Return System collects steam condensate and delivers it to the condensate return tank.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Steam Condensate Return Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of the Steam Condensate Return Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 28.03.01 STEAM CONDENSATE RETURN TANK
- ◆ 28.03.02 PIPING, FITTINGS AND VALVES

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- | | |
|-------|---------------------------------|
| 23.07 | STEAM DISTRIBUTION SYSTEMS |
| 23.08 | STEAM CONDENSATE RETURN SYSTEMS |
| 28.02 | STEAM DISTRIBUTION SYSTEMS |
| 28.05 | BOILER FEEDWATER SYSTEMS |

28.03 STEAM CONDENSATE RETURN SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I & II inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

- a. Use Level I inspection method if HP is less than 15.
- b. Use Level I and/or II inspection methods if HP is 15 to 60.
- c. Use Level I, II and/or III inspection methods if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized pump and motors applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 28.03.01 STEAM CONDENSATE RETURN TANK

The Condensate return tank provides a collection point for returned steam condensate.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Leakage.			
Observation:			
a. Water dripping from tank fitting.	EA		
*** {Severity L}			
b. Leakage at tank seams.	EA		
*** {Severity H}			
* Defective water column.			
Observation:			
a. Residual buildup inside sight glass, poor visibility.	EA		
*** {Severity L}			
b. Cracked or broken sight glass.	EA		
*** {Severity H}			

28.03 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 28.03.01 STEAM CONDENSATE RETURN TANK (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Physical tank damage.			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Impact damage, dents.	SF		
*** {Severity M}			
* Defective insulation.			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Missing or damaged insulation.	SF		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

28.03 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 28.03.02 PIPING, FITTINGS AND VALVES

Piping, fittings and valves provide the collection and discharge network for the steam condensate return system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective fittings.			
Observation:			
a. Bent or cracked fitting, not leaking. *** {Severity L}	EA		
b. Water leaking. *** {Severity H}	EA		
* Defective pipe.			
Observation:			
a. Bent or cracked pipe, not leaking. *** {Severity L}	LF		
b. Water leaking. *** {Severity H}	LF		
* Defective valves.			
Observation:			
a. Broken or missing valve handle. *** {Severity L}	EA		
b. Bent stem. *** {Severity M}	EA		
c. Leaking valves packing glands/gaskets. *** {Severity M}	EA		
d. Cracked valve body. *** {Severity H}	EA		
* Defective supports or hangers.			
Observation:			
a. Loose supports or hangers. *** {Severity L}	EA		
b. Broken or missing supports or hangers. *** {Severity H}	EA		
* Defective insulation.			
Observation:			
a. Loose insulation. *** {Severity L}	LF		
b. Missing or damaged insulation. *** {Severity H}	LF		

28.03 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 28.03.02 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Corroded piping and fittings.			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
* Corroded valves.			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
* Corroded hangers or supports.			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
* Defective pipe labeling.			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity L}			

28.03 STEAM CONDENSATE RETURN SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc. 6th Edition
5. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

28.03 STEAM CONDENSATE RETURN SYSTEMS

LEVEL II KEYS GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEYS GUIDE SHEET CONTROL NUMBER

N/A

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

DESCRIPTION

Heating Hot Water Distribution Systems is a subsystem of the Central Heating Plants. The Hot Water Distribution System circulates heating water between the hot water generating equipment and the facility terminal heating devices.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Heating Hot Water Distribution Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of the Heating Hot Water Distribution Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 28.04.01 PUMP BASES AND COUPLINGS
- ◆ 28.04.02 PUMPS
- ◆ 28.04.03 MOTORS
- ◆ 28.04.04 CONTROLS
- ◆ 28.04.05 EXPANSION TANKS
- ◆ 28.04.06 PIPING, FITTINGS AND VALVES

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- 23.09 HOT WATER DISTRIBUTION SYSTEMS
- 08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I & II inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

- a. Use Level I inspection method if HP is less than 15.
- b. Use Level I and/or II inspection methods if HP is 15 to 60.
- c. Use Level I, II and/or III inspection methods if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized pump and motor applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 28.04.01 PUMP BASES AND COUPLINGS

The pump base is the mounting platform for the pump and motor, the coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective pump or motor mounting bolts.			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.01 PUMP BASES AND COUPLINGS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective mounting hardware.			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			
* Defective coupling guard.			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity H}			
* Defective coupling.			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
* Abandoned pump assembly (disconnected).			
Observation:			
a. Inactive pump assembly abandoned, requiring proper disposal.	EA		
*** {Severity L}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.02 PUMPS

Pumps provide for hot water circulation throughout the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged pump.			
Observation:			
a. Cracked pump housing.	EA		
*** {Severity H}			
b. Broken pump base.	EA		
*** {Severity H}			
* Leakage.			
Observation:			
a. Leaking at pump fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
* Excessive noise and vibration at pump.			
Observation:			
a. Rattling noise.	EA	1	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	1
*** {Severity H}			
* Defective insulation.			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.03 MOTORS

Electric motors are used to drive the circulating pumps. In-line circulating pumps are typically driven via spring-coupled motors, pedestal-mounted pumps are typically driven via rigid or flex-coupled motors.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged motor.			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken motor base.	EA		
*** {Severity H}			
* Excessive noise and vibration.			
Observation:			
a. Rattling noise.	EA	2	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	
*** {Severity H}			
c. Electrical arcing noise.	EA		
*** {Severity H}			
* Defective electrical connectors.			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.04 CONTROLS

Controls govern the operation of the motor driven pump equipment. The controls normally consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Excessive noise.			
Observation:			
a. Electrical arcing noise.	EA		2
*** {Severity H}			
* Defective control panel.			
Observation:			
a. Physically damaged control panel enclosure.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.05 EXPANSION TANKS

Expansion Tanks are closed steel containers that are used to compensate for the change in water volume caused by the system temperature variation. Expansion Tanks are normally installed near the ceiling in the mechanical rooms.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Leakage.			
Observation:			
a. Water dripping from tank fitting.	EA		
*** {Severity L}			
b. Leakage at tank seams.	EA		
*** {Severity H}			
* Defective water column gauge.			
Observation:			
a. Residual buildup inside sight glass, poor visibility.	EA		
*** {Severity L}			
b. Cracked or broken sight glass.	EA		
*** {Severity H}			
* Physical tank damage.			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Impact damage, dents.	SF		
*** {Severity M}			
* Defective insulation.			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.05 EXPANSION TANKS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.06 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the domestic water system. Wherever dissimilar metals are used, dielectric unions should be provided to avoid galvanic action and prohibit corrosion. Valves are installed to control the water supply, isolate parts, and provide a means for drainage.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective fittings.			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
* Defective pipe.			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
* Defective valves.			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
* Defective supports or hangers.			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 28.04.06 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective insulation.			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			
* Corroded piping and fittings			
Observation:			
a. Surface corrosion no pitting evident.	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
* Corroded valves.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
* Corroded hangers or supports.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988
3. American Water Works Association, Manual of Water Supply Practices, M-36, 1990
4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
5. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989.

28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

LEVEL II KEYS GUIDE SHEET CONTROL NUMBER

- | | |
|---|------------------|
| 1 | GS-II 28.04.02-1 |
| 2 | GS-II 28.04.03-2 |

LEVEL III KEYS GUIDE SHEET CONTROL NUMBER

- | | |
|---|-------------------|
| 1 | GS-III 28.04.02-1 |
| 2 | GS-III 28.04.04-2 |

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 28.04.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 28.04.02-1

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988.
2. NAVFAC MO-209 Maintenance of Steam, Hot Water and Compressed Air Distribution systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 28.04.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

1. Use Level I inspection method if HP is less than 15.
2. Use Level I & II inspection methods if HP is 15 to 60.
3. Use Level I, II and/or III inspection if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized motor applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe motor operation and determine possible source of noise.
2. Shut down motor, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Visually check interior of motor housing for other physical damage, if an open motor.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 28.04.03-2

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 28.04.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.
13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 28.04.02-1

Inspection Actions (Continued)

15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section .

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Sydnor Hydrodynamics Inc., Portsmouth, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 28.04.04-2

Application

This guide applies to the investigation of electrical arcing noise from the controls.

For controls in general use, Level I, II and/or III inspection methods will apply.

The Facility Manager will specify the level of inspection required for specialized control applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe control operation and determine possible source of noise.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Open and inspect local disconnect. Check for proper tension on blade-type disconnect switch, good blade alignment, signs of overheating. Tag and lock disconnects.
4. Open and inspect motor starter. Check for contacts for pitting, good alignment, smooth action, signs of overheating.
5. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.
6. Document the problem and contact appropriate facility personnel for further instructions.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Infrared Temperature Tester
2. Ammeter
3. Voltmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 28.04.04-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I, Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC 1988
2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

28.05 BOILER FEEDWATER SYSTEMS

DESCRIPTION

Boiler Feedwater Systems is a subsystem of the Central Heating Plant. The Boiler Feedwater System collects the returned steam condensate and returns it to the boiler and also provides make-up water as required.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Boiler Feedwater Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Boiler Feedwater Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 28.05.01 PUMP BASES AND COUPLINGS
- ◆ 28.05.02 PUMPS
- ◆ 28.05.03 MOTORS
- ◆ 28.05.04 CONTROLS
- ◆ 28.05.05 PIPING, FITTINGS AND VALVES
- ◆ 28.05.06 DEAERATOR TANKS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following sub-systems should be reviewed for concurrent inspection activities.

- 23.08 STEAM CONDENSATE RETURN SYSTEMS
- 28.01 HEATING BOILERS - GAS/OIL
- 28.03 STEAM CONDENSATE RETURN SYSTEMS

28.05 BOILER FEEDWATER SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires both Level I and Level II inspection as part of the basic inspection process. Additional Level II inspections may be indicated or "triggered" by the Level I inspection observation and should be accomplished by the inspector at that time.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I & II inspection methods if GPM is 40 or greater.

For electric motors in general use, Level I, II & III inspection methods will apply in accordance with the following horsepower ranges:

- a. Use Level I inspection method if HP is less than 15.
- b. Use Level I and/or II inspection methods if HP is 15 to 60.
- c. Use Level I, II and/or III inspection methods if HP is greater than 60.

The Facility Manager will specify the level of inspection required for specialized pump and motor applications.

Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 28.05.01 PUMP BASES AND COUPLINGS

The pump base is the mounting platform for the pump and motor. The coupling is the mechanical connection between the pump and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Broken/loose mounting bolts.			
Observation:			
a. Loose pump or motor mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing pump or motor mounting bolts.	EA		
*** {Severity H}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.01 PUMP BASES AND COUPLINGS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Loose/missing mounting hardware.			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts or isolators.	EA		
*** {Severity H}			
* Loose/missing coupling guard.			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing coupling guard.	EA		
*** {Severity H}			
* Defective coupling.			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
* Abandoned pump assembly (Disconnected).			
Observation:			
a. Inactive pump assembly abandoned, requiring proper disposal.	EA		
*** {Severity L}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.02 PUMPS

Transfer pumps are used to move condensate water from the condensate return tank to the deaerator. Boiler feedwater pumps move the water from the deaerator to the boiler.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged pump.			
Observation:			
a. Cracked pump housing. *** {Severity M}	EA		
b. Broken pump base. *** {Severity H}	EA		
* Excessive noise and vibration.			
Observation:			
a. Rattling noise. *** {Severity M}	EA	1	1
b. Grinding noise, indicating metal to metal contact. *** {Severity H}	EA	1	1
* Leakage.			
Observation:			
a. Leaking pump housing gaskets. *** {Severity M}	EA		
b. Leaking or damaged pump seals. *** {Severity M}	EA		
* Broken/loose pump hardware.			
Observation:			
a. Loose pump assembly bolts. *** {Severity L}	EA		
b. Broken pump assembly bolts. *** {Severity H}	EA		
* Defective insulation.			
Observation:			
a. Loose insulation. *** {Severity L}	SF		
b. Missing or damaged insulation. *** {Severity H}	SF		

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.03 MOTORS

Electric motors are used to drive the transfer and boiler feedwater pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged motor.			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
* Excessive noise and vibration.			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Electrical arcing noise.	EA		
*** {Severity H}			
* Defective electrical connectors.			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.04 CONTROLS

The controls govern the operation of the pumps and include the starting and protective devices for the pumps.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Physically damaged control panel.			
Observation:			
a. Impact damage, dents on enclosure panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible for inspection.	EA		
*** {Severity S}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.05 PIPING, FITTINGS AND VALVES

Piping, fittings and valves provide the distribution network for the boiler feedwater system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective fitting.			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
* Defective pipe.			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
* Defective valve.			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve packing glands/gaskets.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
* Defective supports or hangers.			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.05 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective pipe, fittings and valve insulation.			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			
* Corrosion at piping and fittings.			
Observation:			
a. Surface corrosion (no pitting evident).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
* Corrosion at supports or hangers.			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			
* Defective pipe labeling.			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity L}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.06 DEAERATOR TANKS

Deaerator tanks are used to remove dissolved gases from the water for corrosion control. In particular, it is used to remove oxygen and carbon dioxide from the boiler feedwater system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective strainer.			
Observation:			
a. Cracked strainer, not leaking.	EA		
*** {Severity M}			
b. Cracked strainer, steam leaking.	EA		
*** {Severity H}			
* Damaged valves.			
Observation:			
a. Broken/missing handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Inoperable valve.	EA		
*** {Severity H}			
* Leakage.			
Observation:			
a. Water dripping from tank fitting.	EA		
*** {Severity M}			
b. Leaking gasket at manhole.	EA		
*** {Severity M}			
c. Leakage at other than manhole gasket.	EA		
*** {Severity H}			
d. Leakage at tank seams.	EA		
*** {Severity H}			
* Defective water column.			
Observation:			
a. Residual buildup inside sight glass, poor visibility.	EA		
*** {Severity M}			
b. Cracked or broken sight glass.	EA		
*** {Severity H}			

28.05 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 28.05.06 DEAERATOR TANKS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective float/hardware.			
Observation:			
a. Loose, deformed, binding linkage. *** {Severity H}	EA		
b. Float system inoperable. *** {Severity H}	EA		
c. Float alarm inoperable. *** {Severity H}	EA		
* Physical tank damage.			
Observation:			
a. Abrasions. *** {Severity L}	SF		
b. Impact damage, dents. *** {Severity M}	SF		
* Corrosion.			
Observation:			
a. Surface corrosion no pitting evident. *** {Severity L}	SF		
b. Corrosion evidenced by pitting or blistering. *** {Severity M}	SF		
c. Corrosion evidenced by holes or loss of base metal. *** {Severity H}	SF		

28.05 BOILER FEEDWATER SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities
4. Hook-up Designs for Steam & Fluid Systems, Sarco Company Inc., 6th Edition
5. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

28.05 BOILER FEEDWATER SYSTEMS

LEVEL II KEYS GUIDE SHEET CONTROL NUMBER

1 GS-II 28.05.02-1

LEVEL III KEYS GUIDE SHEET CONTROL NUMBER

1 GS-III 28.05.02-1

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 28.05.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Shut down pump, tag and lock out disconnect.
3. Check coupling for wear, damage or loose fasteners.
4. Examine drives for alignment.
5. Turn pump by hand and determine what is causing the noise.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
7. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
8. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Recommended Inspection Frequency

Perform inspection when triggered by a Level I or other local factors such as problematic conditions.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS (Continued)

CONTROL NUMBER: GS-II 28.05.02-1

References

1. Means Facilities Maintenance Standard, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-209 Maintenance of Steam, Hot Water and Compressed Air Distribution systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 28.05.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump.

For pumps in general use, Level I, II & III inspection methods will apply in accordance with the following gallon-per-minute ranges:

- a. Use Level I inspection method if GPM is less than 40.
- b. Use Level I, II and/or III inspection methods if GPM is 40 or greater.

The Facility Manager will specify the level of inspection required for specialized pump applications.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Notify affected personnel and obtain permission to take unit out of service.

Inspection Actions

1. Observe pump operation and determine possible source of noise.
2. Perform vibration analysis on pump bearings.
3. Shut down pump, tag and lock out disconnect.
4. Isolate unit mechanically.
5. Rotate (cycle) pump to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Check coupling for wear, damage, loose fasteners.
8. Check coupling for misalignment.
9. Open and inspect pump interior housing for cracks, fatigue, erosion, and corrosion; check suspicious areas.
10. Check interior shafting for signs of damage, fatigue or wear.
11. Check impellers for erosion/corrosion, physical damage, distortion.
12. Rotate (cycle) shafting and check for distortion in shaft.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 28.05.02-1

Inspection Actions (Continued)

13. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
14. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
15. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
16. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond those listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. Sydnor Hydrodynamics Inc., Portsmouth, VA

28.06 CHEMICAL WATER TREATMENT SYSTEMS

DESCRIPTION

Chemical Water Treatment Systems is a subsystem of the Central Heating Plants. Chemical Water Treatment Systems inhibit the development of scale and corrosion within the boilers, and heating water distribution systems. The typical system consists of a mixing tank, agitator, metering pump and the connecting piping, fittings, valves and instrumentation.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Chemical Water Treatment Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Chemical Water Treatment Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 28.06.01 BOILER WATER CHEMICAL TREATMENT SYSTEMS
- ◆ 28.06.02 CLOSED-LOOP WATER CHEMICAL TREATMENT SYSTEMS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- | | |
|-------|--------------------------------|
| 23.09 | HOT WATER DISTRIBUTION SYSTEMS |
| 28.01 | HEATING BOILERS - GAS/OIL |
| 28.04 | HOT WATER DISTRIBUTION SYSTEMS |
| 28.05 | BOILER FEEDWATER SYSTEMS |

28.06 CHEMICAL WATER TREATMENT SYSTEMS

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

COMPONENTS

◆ 28.06.01 BOILER WATER CHEMICAL TREATMENT SYSTEMS

The boiler water chemical treatment systems inhibit corrosion and deposit build-up within the boiler, hot water distribution systems and steam condensate return systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Defective chemical storage tanks.			
Observation:			
a. Physical damage to storage tank.	EA		
*** {Severity M}			
b. Leaking storage tank.	EA		
*** {Severity H}			
* Defective mixers.			
Observation:			
a. Deposit build-up.	EA		
*** {Severity M}			
b. Excessive corrosion.	EA		
*** {Severity H}			
* Defective pumps.			
Observation:			
a. Deposit build-up.	EA		
*** {Severity M}			
b. Excessive corrosion.	EA		
*** {Severity H}			
c. Leaking pump.	EA		
*** {Severity H}			
* Defective electrical connectors.			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

28.06 CHEMICAL WATER TREATMENT SYSTEMS

COMPONENTS (Continued)

◆ 28.06.02 CLOSED-LOOP WATER CHEMICAL TREATMENT SYSTEMS

Chemical treatment of closed-loop systems inhibit corrosion and deposit build-up caused by appreciable make-up water due to losses within the system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Shot tank corrosion.			
Observation:			
a. Surface corrosion no pitting evident.	EA		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	EA		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	EA		
*** {Severity H}			

28.06 CHEMICAL WATER TREATMENT SYSTEMS

REFERENCES

1. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company, Inc.
2. Steam/Its Generation and Use, Babcock & Wilcox
3. FSC: HVAC Water Treatment Maintenance and Repair, PWC, 1991
4. NAVFAC MO-225, Industrial Water Treatment 1990

28.06 CHEMICAL WATER TREATMENT SYSTEMS

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

N/A

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
DCD	Data Collection Device
DIA.	Diameter
EA.	Each
FT	Foot
GS	Guide Sheet
HR	Hour
IU	Inspection Unit
LF	Linear Foot
N/A	Not Applicable
NAVFAC- MO	Naval Facilities Maintenance and Operations
NDT	Non-Destructive Testing
PE	Professional Engineer
PM	Preventive Maintenance
RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual
UOM	Unit Of Measure
YRS	Years

APPENDIX A

WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Fahrenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
-	Subtract or Minus or Negative
·	Times or By
x	Times or By

APPENDIX B

GLOSSARY

Abrasions	A scraping or rubbing off, as of skin. A wearing away by rubbing or scraping, as of rock by wind and water.
Access Plates	A cover, usually small, for closing off an area which is provided through a finished construction; as into a duct or in a piece of mechanical equipment; used as a means of inspection of equipment or services housed within.
Agitator	Device used to cause motion in a confined fluid.
Alignment	An aligning or arrangement in a straight line; a ground plan , as of a field work , railroad etc.
Ammeter	An instrument for measuring the strength of an electric current (rate of flow) in terms of amperes.
Arcing	The band of sparks or incandescent light formed when an electric discharge is conducted from one electrode or conducting surface to another, characterized by relatively high current and low potential difference between electrodes.
Base Metal	The metal to be welded, soldered, or plated.
Blistering	To cause blisters (an enclosed pocket of air mixed with water or solvent vapor); or a raised area on the surface of a metallic or plastic object caused by the pressure of gases developed while the surface was in a partly molten state, or by diffusion of high-pressure gases from an inner surface.
Blower	A fan usually one for heavy-duty application, e.g. a fan that forces fresh air through a duct system.
Blow-off	The discharge of water from a system to permit emptying or removal of sediment; also the outlet for the discharge.
Boiler Shell and Chamber	The boiler shell contains the connecting tubes and heated fluid. The combustion chamber is the area of the boiler in which the fuel is burned.
Boiler Trim	Piping or tubing close to or attached to a boiler for connecting controls, gages, or other instrumentation.
Buckled	To bend, warp, or crumple, as under pressure or in intense heat.

APPENDIX B

Buildup	To apply in successive layers to form a thicker mass.
Burner	The part of a boiler or furnace in which combustion takes place.
Calibration	The act of fixing, checking, correcting, the graduations of a measuring instrument.
Centrifugal	Moving or tending to move away from a center (conveying away from a center).
Combustion	The act or process of burning.
Concrete Cracks	Hairline cracks are defined as shallow cracks that are the width of a human hair, normally occur in a random pattern and result in no loss of surface. Medium and larger cracks can be larger than a hairline size and normally follow a pattern and result in surface loss.
Condensate:Air Conditioning	Water which forms on an evaporator, by condensation of the natural moisture content of the air flow.
Condensate Pump	Device used to remove fluid condensate that collects beneath an evaporator.
Condensate: Steam	Water which forms by condensation of steam.
Conduit	A tube or pipe used to protect electric wiring. A tube or pipe used for conveying fluid.
Confined Space	An area that by design, has limited openings for entry and exit; has unfavorable natural ventilation that could contain or produce dangerous air contaminants; or a space that is not intended for continuous occupancy.
Connectors	In an electrical circuit, a device for joining two or more conductors, by a low-resistance path, without the use of a permanent splice.
Contacts	A part which is an electric conductor and which provides a low-resistance path for current flow upon mating with another conducting part with which it is designed to operate.
Control	Automatic or manual device used to stop, start, and/or regulate flow of gas, liquid, and/or electricity.

APPENDIX B

Corrosion	The deterioration of metal or of concrete by chemical or electrochemical reaction resulting from exposure to weathering, moisture, or chemicals, or other agents in the environment in which it is placed.
Coupling	A metal collar with internal threads used to connect two sections of threaded pipe. The mechanical fastening that connects shafts together for power transmission.
Current Draw	The demand of a piece of equipment which determines the flow or rate of flow of electric charge in a conductor or medium between two points having a difference in potential, generally expressed in terms of amperes.
Cycle	A period of time within which a round of regularly recurring events or phenomena is completed.
Damper	A device used to vary the volume of air passing through an air outlet, inlet, or duct; it does not significantly affect the shape of the delivery pattern. A pivoted cast-iron plate at the fireplace throat, i.e. between fireplace and smoke chamber, to regulate draft.
Deaerator	A device in which oxygen, carbon dioxide, or other non-condensable gases are removed from boiler feedwater, steam condensate, or a process stream.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Discharge	To throw off; send forth; emit; to relieve of excess pressure. To remove stored energy from a battery or capacitor. To emit waste matter; to be released.
Drainage	A system of drains; arrangement of pipes, etc. for carrying off waste matter; that which is drained off.
Dye Penetrant	A liquid with low surface tension, containing a dye or florescent chemical; which when flowed over a metal surface, is used to determine the existence and extent of cracks and other discontinuities.
End Bells	A hollow metal cylinder closed at one end and flared at the other. A conical device that seals the top of a blast furnace.

APPENDIX B

Exhaust Flues	An incombustible and heat-resistant enclosed passage in a chimney or stack, to control and carry away products of combustion from a fireplace, furnace, or boiler to the outside air.
Expansion Tanks	A vessel to control pressure in a hydraulic system by storing excess volume resulting from increased operating temperatures.
Fatigue	The tendency of a metal or other material to crack and fail under repeated applications of stress.
Feedwater	The water supplied to a boiler or still.
Fittings	A pipe part, usually standardized, such as a bend, coupling, cross, elbow, reducer, tee, union, etc.; used for joining two or more sections of pipe together. The term usually is used in the plural. An accessory such as a bushing, coupling, locknut, or other part of an electric wiring system which is intended to perform a mechanical rather than an electrical function.
Flange	A projecting collar, edge, rib, rim, or ring on a pipe, shaft or the like. Also one of the principle longitudinal components of a beam or girder which resists tension or compression.
Float	Anything which stays or causes something else to stay, on the surface of a liquid or suspended near the surface. A floating ball or device that regulates the valve controlling water level.
Flue	An incombustible and heat-resistant enclosed passage in a chimney to control and carry away products of combustion from a fireplace, furnace, or boiler to the outside air.
Gaskets	A continuous strip of resilient material attached to a panel or frame to provide a tight seal between the frame and the panel. Any ring of resilient material used as a joint to prevent leakage.
Gauges	A standard measure or scale of measurement; dimensions, capacity, thickness. Any device for measuring something as the thickness of wire, the dimensions of a machined part, the amount of liquid in a container, steam pressure, etc.
Gringing	To crush into bits or fine particles between two hard surfaces; pulverize.

APPENDIX B

Guides	Pulleys to lead a driving belt or rope in a new direction or to keep it from leaving its desired direction. Any of a number of devices used to confine or direct the movement or expansion of an assembly.
Hangers	A wire, strap, or rod attached to an overhead structure, used to support a pipe, conduit, the framework of a suspended ceiling, or the like. A "U" shaped, stirrup-like bracket used to support the end of a beam or joist at a masonry wall or girder.
High Temperature Hot Water	A hot water heating system operating at design water temperatures of greater than 350°.
Horsepower	The unit of power in the British engineering system, equal to 550 foot-pounds per second, approximately 745.7 watts.
Housing	In a pump, motor, or fan the casing or enclosure which contains the parts of the piece and acts to protect the enclosed machinery.
Illegible	Very difficult or impossible to read because it is badly written or printed, faded, obscured by age, etc.
Impact	A striking together; violent contact; collision.
Infrared Temperature Tester	An instrument that focuses and detects the infrared radiation (heat energy) emitted by an object in order to determine its temperature.
Inspection Port	A window or access hole for the critical examination of a product to determine its conformance to applicable quality standards or specifications.
Insulation	A material providing high resistance to heat flow; usually made of mineral wool, cork, asbestos, foam glass, foamed plastic, diatomaceous earth, etc. fabricated in the form of batts, blankets, blocks, boards, granular fill and loose fill.
Isolate	To set apart from others; place alone. To separate (an element or compound) in pure form from substances with which it is combined or mixed.
Isolators	A passive attenuator in which the loss in one direction is much greater than in the opposite direction; a ferrite isolator for waveguides is an example. Any device that absorbs vibration or noise, or prevents its transmission.

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Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Lock-out	To make a valve or circuit inoperative by shutting out and putting padlocks or other restrictive devices on the unit and identifying the lock-out with a card or sign.
Low Temperature Hot Water	A hot water heating system operating at design water temperatures of 250° or less and a maximum working pressure of 160 psi.
Medium Temperature Hot Water	A hot water system operating at temperatures of 350° or less, with pressures not exceeding 150 psi.
Motors	Anything that produces or imparts motion; an engine especially an internal-combustion engine. A machine for converting electrical energy to mechanical energy.
Packing Glands	Packing is the stuffing or elastic material around a shaft or valve stem or around a joint to prevent leakage. A stuffing box surrounds a shaft to prevent leakage by the use of packing; commonly used on water pumps; the packing gland is a movable part that compresses the packing in the stuffing box.
Pilot Lamps	A light which is associated with and indicative of the operation of a circuit, control, or device.
Pitting	The development of small cavities in a surface, owing to phenomena such as corrosion, cavitation, or (as in concrete) localized disintegration. The development of surface defects on a metal surface, e.g. small depressions, usually caused by electrochemical corrosion.
Plumb	Exactly vertical.
Pop-outs	A conical fragment that has broken out of the surface of the concrete leaving small holes. Generally a shattered aggregate particle will be found at the bottom of the hole, with a part of the fragment still adhering to the small end of the pop-out cone. Pop-outs are caused by reactive aggregates and high alkali cement. They are also caused by aggregates such as shale, which expand with moisture.

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Pressure	A type of stress which is exerted uniformly in all directions; its measure is the force exerted per unit area. An energy impact on a unit area; force, or thrust exerted on a surface.
Pressure Relief Valve	A device for protecting a hot water boiler (or a hot water storage tank) from excessive pressure by operating at a pre-determined pressure and discharging water or steam at a rate sufficient to prevent further build-up of pressure.
Pump	A machine that draws a fluid into itself through an entrance port and forces the fluid out through an exhaust port. A motor driven device used to mechanically circulate fluid in a system; also called a circulator.
Rattling	A quick succession of sharp short sounds.
Refractory	A material, usually nonmetallic used to withstand high temperatures.
Run-out Play	This term generally applies to the horizontal of branch circuits or the measurement of play in a bearing or shaft.
Scale	The product resulting from the corrosion of metals. A heavy oxide coating resulting from exposure to high temperatures in an oxidizing atmosphere. A weighing device.
Scaling	The gradual and continuing loss of surface mortar and aggregate over an area; due to the failure of the cement paste caused by chemical attack or freeze/thaw cycles.
Seals	A tight closure as against the passing of air and water, something that closes or fastens tightly or securely.
Seams	The joint between two sheets of material.
Sensors	A material or device which goes through a physical change or an electronic characteristic change as the conditions change, thus detecting a change in ambient conditions; used to initiate an action such as an alarm or open a valve.
Set Screws	A screw used to fix a collar, knob or other detachable part to a shaft or part of a machine.
Shaft	A bar or cylinder supporting or transmitting motion to a mechanical part.

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Sight Glass	A glass tube sealed within a fluid system, providing a means to examine (visually) the fluid within the system.
Spalling	A roughly circular or oval depression in the concrete. Spalls result from the separation and removal of a portion of the surface concrete, revealing a fracture roughly parallel to the surface. Spalls can be caused by corroding reinforcement steel and friction from thermal movement; reinforcing steel is often exposed.
Steam	Water vapor, or water in its gaseous state; the most widely used working fluid in external combustion engine cycles.
Steam Traps	A device for allowing the passage of condensate, or air and condensate from the steam heating unit, and preventing the passage of steam.
Steam Traps-Bucket	A mechanical steam trap that operates on buoyancy and is designed with an inverted or upright cup that prevents the passage of steam through the system it protects.
Steam Traps: Float/Thermostatic	A steam trap consisting of a ball float to discharge condensate and thermostatic air vent to discharge air and non-condensables from the system.
Steam Traps: Thermodynamic	Consists of a small, light weight steam trap which contains condensate discharge by operation of a disc valve.
Steam Traps: Thermodynamic	A steam trap using a thermally actuated element to expand and close a discharge port when a designed amount of steam flows through it, and to contract and allow condensate to flow through as the temperature drops; usually used on steam radiators.
Strainer	A device for withholding foreign matter from a flowing liquid or gas; a sieve.
Supports	A prop, brace, base, etc.; an object to carry or bear the weight of.
Temperature	The degree of hotness or coldness of anything, usually as measured on a thermometer. The degree of heat in the atmosphere.

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Tensions	Stress on a material produced by the pull of forces tending to cause extension. A force or combination of forces exerting such a pull against the resistance of the material. The expansive force or pressure, of a gas or vapor.
Terminal Heating Units	That part of a hydronic system in which heat is transferred from the water to the air in the air conditioned space. Common terminal units include radiators, convectors, baseboard, unit heaters, finned tube, etc. Also devices located near the conditioned space that regulate the temperature and/or volume of supply air to the space.
Ultrasonic Pulse Velocity Test	An ultrasonic detector is used either in scanning (non-contact) or in contact mode. The pulse velocity test uses the contact mode. A metal probe (transducer) supplied with the detector is stimulated by ultrasound and transmits the waves, when touched against equipment surfaces, to another detector. The velocity of this ultrasonic pulse is measured; the faster the pulse the more dense the material tested. The test can also detect and evaluate cracks, voids, delamination and other defects.
Valve	A device which regulates or controls the flow of a liquid or gas.
Ventilation	The introduction of outdoor air into a building by mechanical means.
Vent Pipe	A pipe installed to provide a flow of air to or from a drainage system or to provide a circulation of air within such a system to protect trap seals from siphonage and back pressure.
Vibration	Rapid, periodic, to-and-fro motion or oscillation of an elastic body or the particles of a fluid when displaced from the rest position or position of equilibrium, as in transmitting sound.
Voltage	Electromagnetic force, or difference in electrical potential, expressed in volts.
Volt Meter	An instrument for the measurement of potential difference between two points, in volts or in related smaller or larger units.
Volume	The amount of space occupied in three dimensions; cubic contents; a large quantity, bulk. Any of a set making up a matched set or a complete work.

APPENDIX C

LIFE CYCLES**28 CENTRAL HEATING PLANTS****28.01 HEATING BOILERS - GAS/OIL**

Steam boilers - steel	25 Years
Steam boilers - cast iron	30 Years
Hot water boilers - steel	25 Years
Hot water boilers - cast iron	35 Years

Source:

Means Estimating Handbook, R.S.Means Company, Inc., 1990

28.02 STEAM DISTRIBUTION SYSTEMS

Piping And Fittings	30 YRS
Valves	15 YRS
Pressure Reducing Stations	20 YRS
Steam Traps	5 YRS
Strainers	20 YRS

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.

28.03 STEAM CONDENSATE RETURN SYSTEMS

Pumps	15 YRS
Motors	15 YRS
Controls	15 YRS
Condensate Return Tanks	20 YRS
Piping and Fittings	30 YRS
Valves	15 YRS

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

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28.04 HEATING HOT WATER DISTRIBUTION SYSTEMS

Pumps	15 YRS
Motors	15 YRS
Controls	15 YRS
Expansion Tanks	20 YRS
Piping and Fittings	30 YRS
Valves	15 YRS

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

28.05 BOILER FEEDWATER SYSTEMS

Pumps	15 YRS
Motors	15 YRS
Controls	15 YRS
Piping and Fittings	30 YRS
Valves	15 YRS
Deaerator	20 YRS

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

28.06 CHEMICAL WATER TREATMENT SYSTEMS

Chemical Water Treatment System 15 YRS

Source:

Means Estimating Handbook, R.S.Means Company, Inc., 1990