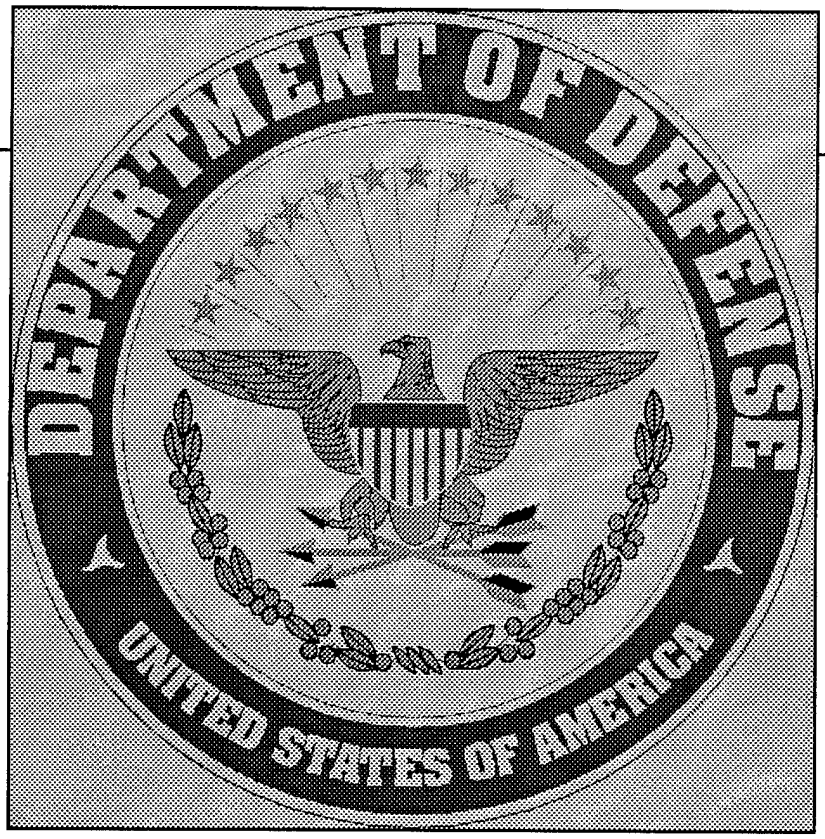

CAIS STANDARD MANUAL

SYSTEM NO. 8
BUILDING
MECHANICAL

CAS PROJECT
CAIS MANUAL

Issued April 28, 1995

DTIC QUALITY INSPECTED 1

8 Mar 96

MEMORANDUM FOR DTIC-OCP
ATTN: Ms. Lue Lynch
8725 John J. Kingman Road, Suite 0944
Fort Belvoir, VA 22060-6218

FROM: AL/EQ (STINFO)
139 Barnes Drive. Suite 2
Tyndall AFB FL 32403-5323

SUBJECT: Transmision of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive. Suite 2
Tyndall AFB, FL 32403-5323

2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.

LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

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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 D. 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 Building Mechanical System.

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 building mechanical systems consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. 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. There are very few Level II inspections for Building Mechanical Systems, since most defects are readily apparent from a Level I. The majority are inspections triggered by a grinding noise coming from a pump, fan or blower.

To perform detailed analysis on a boiler, the inspector and Facility Manager must be in close contact with a certified boiler operator assigned to that facility. Specialized knowledge of boiler operation is required to assure safe and proper inspections.

Note: The CAS survey is not designed to take the place of inspections requiring certified or licensed boiler inspectors.

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 08-A provides the breakdown from system through component for the Building Mechanical System. 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

08 BUILDING MECHANICAL

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. 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 Building Mechanical System 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 Building Mechanical System 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, two sections of 6" DIA steam pipe extend the length of a 20' wall within a

08 BUILDING MECHANICAL

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 6" DIA steam pipe in the room of 40 LF.

- Chiller, Condenser, Compressor, etc. - The IU for singularly defined items such as these is 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
Pocket knife or ice pick
Refrigerant gauges
Electronic leak detector
Scraper
Wire brush
Dye penetrant
Hammer
Calipers
Measuring scales

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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.

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.

The following is a list of the Level III Inspection Methods that are not flagged at the observation level in the DOD CAS Manual, but are available to the Facility Manager:

1. Checking boiler efficiency (performance).
2. Investigation of worn bearings, seals and impellers of pumps.
3. Checking the windings of electric motors for open circuits, grounds or deteriorated insulation.
4. Sampling of oil or refrigeration to determine the oil degradation, contamination and machine wear.
5. Checking of the tubes in the condenser, evaporators and heat recovery units for refrigerant leaks or detect deterioration which could lead to tube failure..
6. Disassembly of the compressor for inspection.
7. Inspection for accumulation of deposits on the humidifier pan.
8. Checking of the HVAC system control interlocks to insure that the safeties and sequences are intact and as designed.
9. Operational check of control indicators, transmitters and sensors.
10. Ultrasonic thickness testing of piping, fittings and valves.
11. Flow rate efficiency check of distribution systems.

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12. Checking the balance of an air distribution system.

There exists break points where it is more cost effective to replace equipment or components rather than expend the cost to perform a Level III inspection. It is recommended that the Facility Manager review the base replacement records for equipment and components. A sizing guide can be developed to establish the most cost effective approach of either initiating a Level III inspection or replacement of equipment or components.

It is recommendation that the sizes of equipment listed below be the criteria for the lower limit for which a Level III inspection is considered.

Pumps	40 GPM
Motors	60 HP
Blowers	24 Inch Diameter
Air Conditioners	10 Ton

The Facility Manager is not limited by these sizing guides, he can authorize any Level III inspection he feels necessary for specialized equipment or components.

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 Building Mechanical.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Building Mechanical.

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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 08-A. WORK BREAKDOWN STRUCTURE

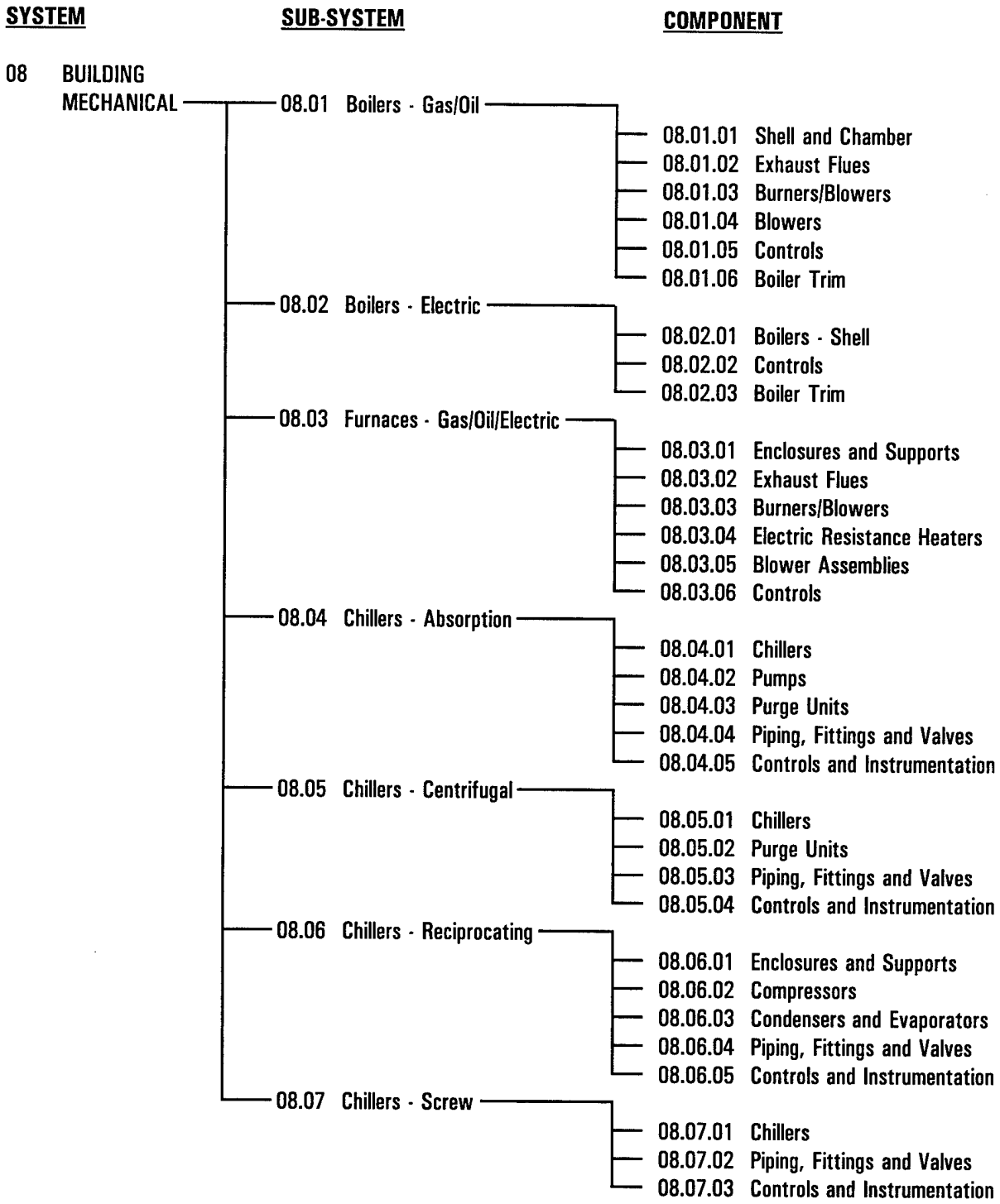

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Figure 08-A. WORK BREAKDOWN STRUCTURE (Continued)

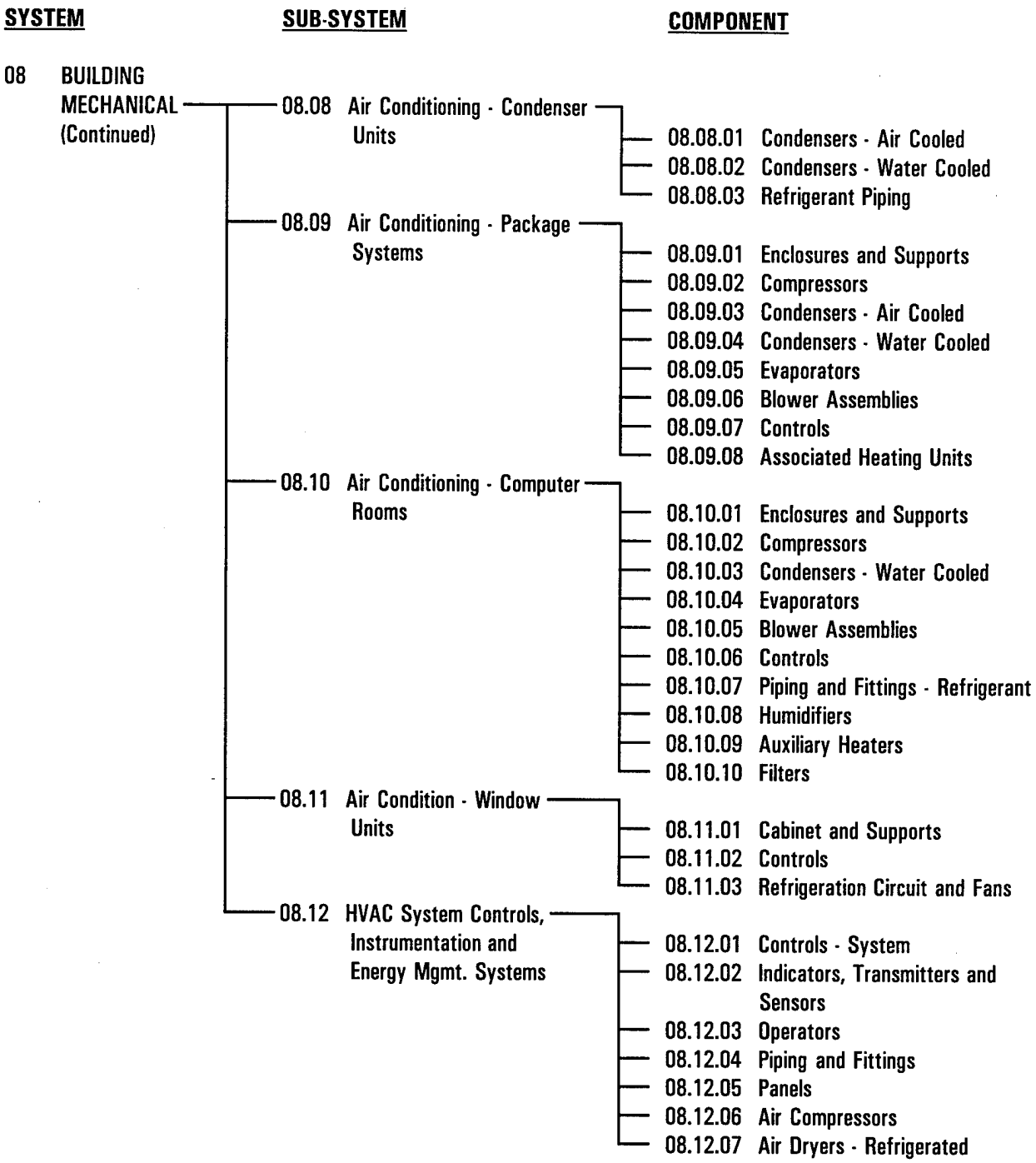

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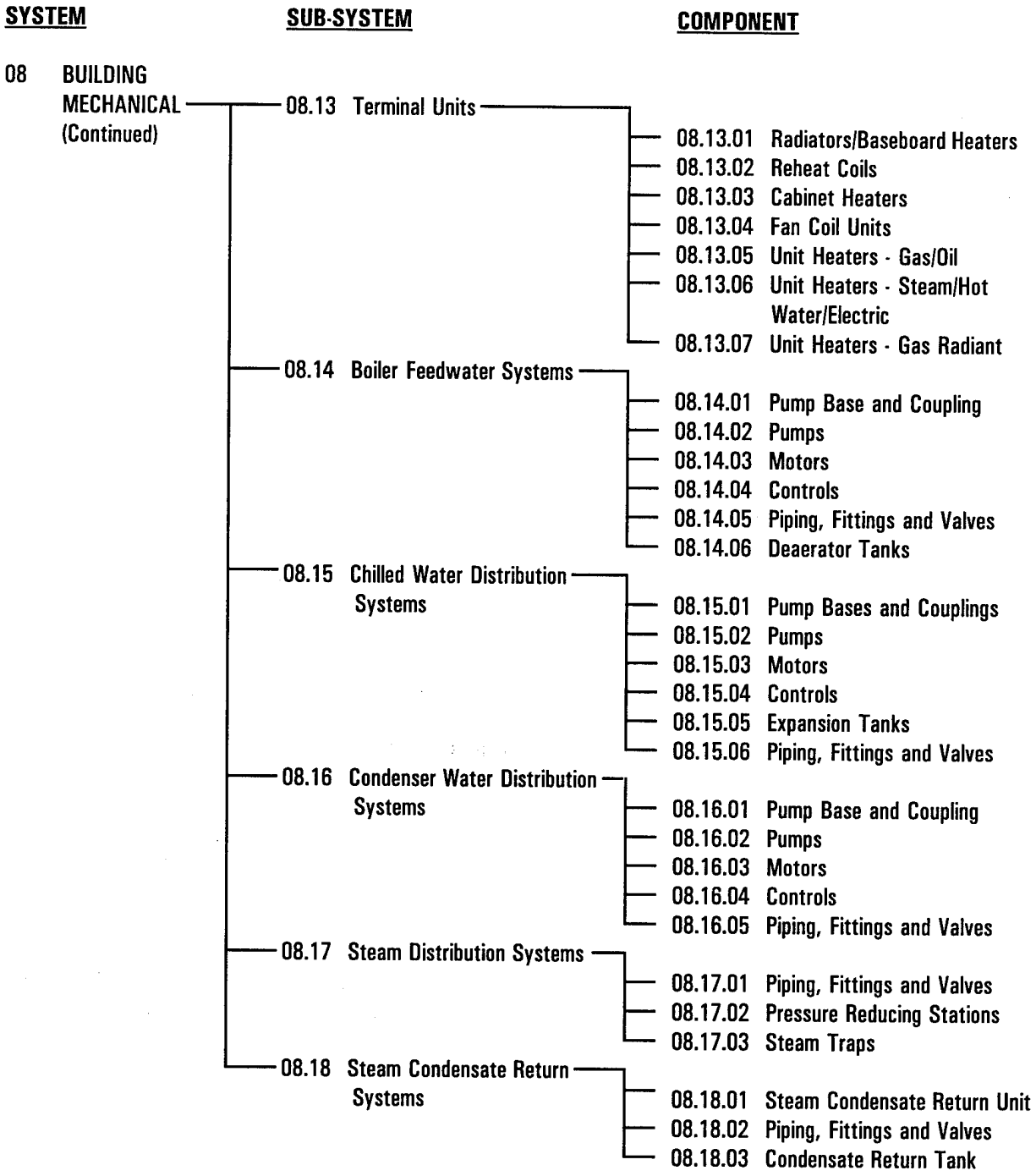
Figure 08-A. WORK BREAKDOWN STRUCTURE (Continued)



08 BUILDING MECHANICAL

Figure 08-A. WORK BREAKDOWN STRUCTURE (Continued)

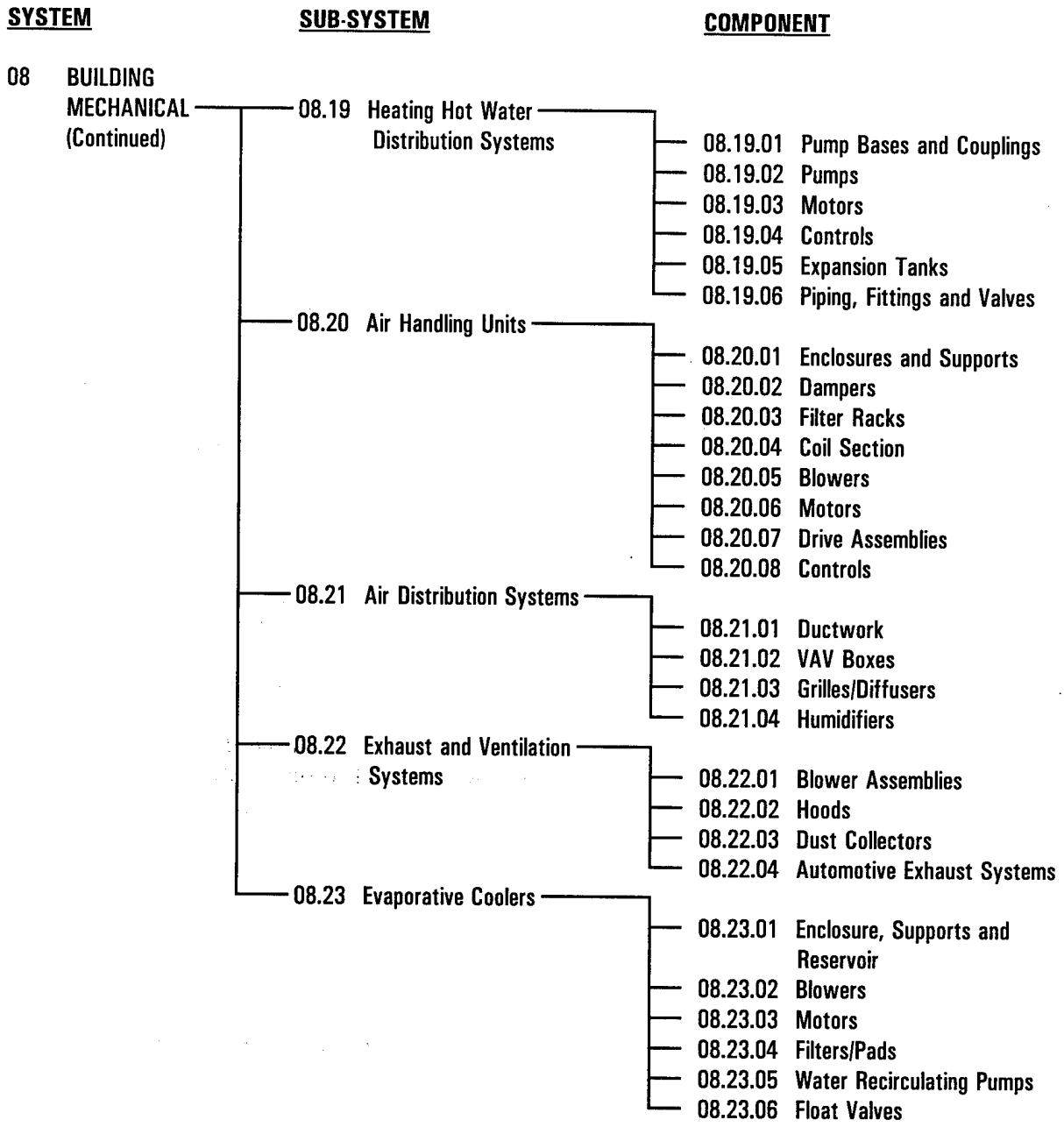


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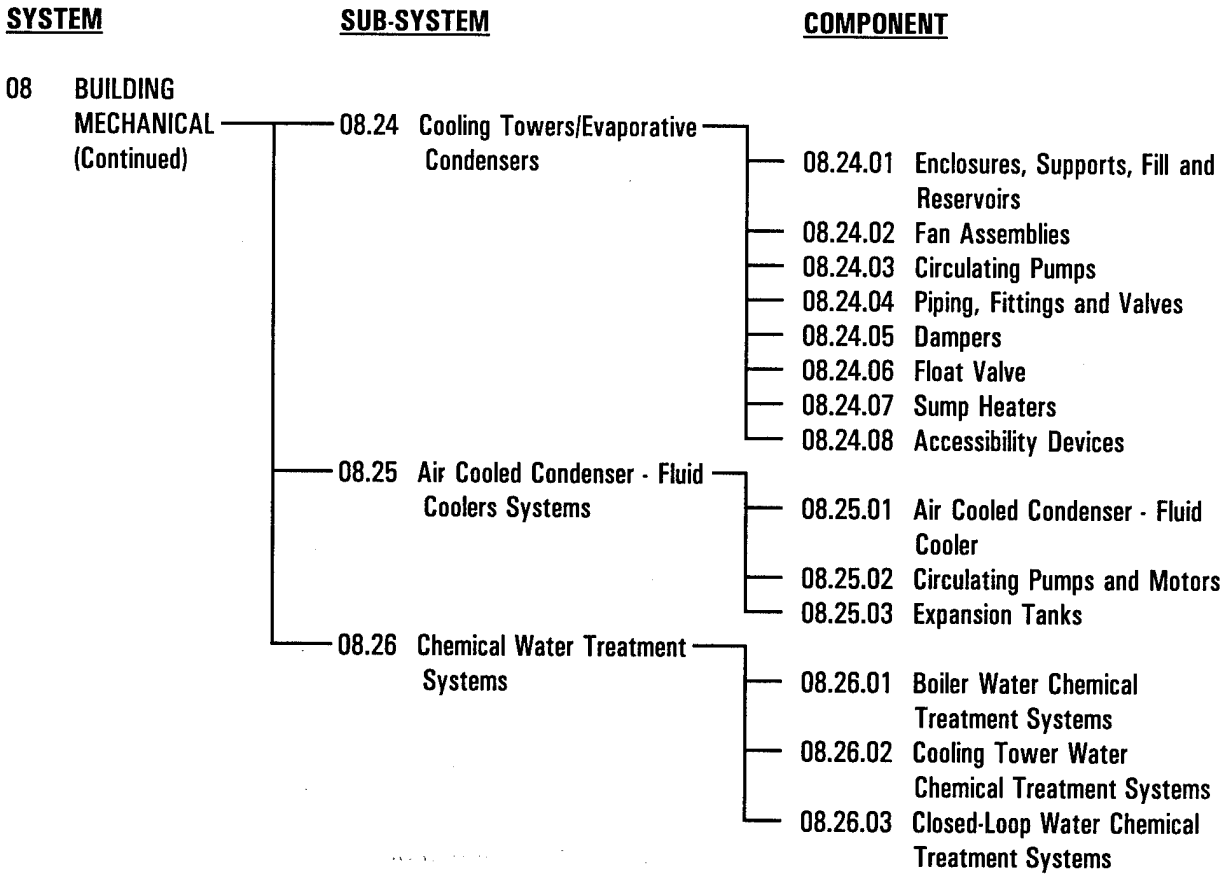
Figure 08-A. WORK BREAKDOWN STRUCTURE (Continued)



08.01 HEATING BOILERS - GAS/OIL

DESCRIPTION

Heating Boilers - Gas/Oil is a subsystem of the Building Mechanical System. 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 fired boilers.

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

COMPONENT LIST

- 08.01.01 SHELL AND CHAMBER
- 08.01.02 EXHAUST FLUES
- 08.01.03 BURNERS/BLOWERS
- 08.01.04 BLOWERS
- 08.01.05 CONTROLS
- 08.01.06 BOILER TRIM

RELATED SUBSYSTEMS

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

08.02	HEATING BOILERS - ELECTRIC
08.14	BOILER FEEDWATER SYSTEMS
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS
08.26	CHEMICAL WATER TREATMENT SYSTEMS

08.01 HEATING BOILERS - GAS/OIL

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 Field CAIS.

The inspection of Heating Boilers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized boiler applications.

COMPONENTS

◆ 08.01.01 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. The casing is the metal covering over the insulation or lagging.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective casing.**			
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 plate or door.	EA		2
*** {Severity H}			
*** 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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.01 SHELL AND CHAMBER (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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.02 EXHAUST FLUES

Exhaust Flues are 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. Damaged/disconnected flue damper.	EA		
*** {Severity H}			
d. Damaged or missing insulation or lagging.	SF		
*** {Severity M}			
*** 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, or 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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.03 BURNERS/BLOWERS

The burner is an assembly where fuel and air ignite 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 blower motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise or vibration at blower 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 blower motor mounting hardware.**			
Observation:			
a. Loose base-tiedown bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Damaged blower.**			
Observation:			
a. Loose, missing or damaged housing.	EA		
*** {Severity M}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ **08.01.03 BURNERS/BLOWERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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		
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	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}			
*** 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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.04 BLOWERS

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

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged blower motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Excessive noise or vibration at blower 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 blower 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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.04 BLOWERS

*** Excessive noise or vibration at blower.**

Observation:

a. Rattling noise. EA
*** {Severity M}

b. Grinding noise indicating metal to metal contact. EA
*** {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}

*** Defective electrical connectors.**

Observation:

a. Loose conduit or connectors. EA
*** {Severity M}

b. Exposed wires or missing cover plates. EA
*** {Severity H}

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.05 CONTROLS

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		
*** {Severity M}			
b. Electrical arcing noise.	EA		
*** {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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ **08.01.05 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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.06 BOILER TRIM

Boiler trim consists of water column, valves, fuel oil pump, steam safety valves, hot 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. Damaged cutout isolation valve.	EA		
*** {Severity H}			
*** Damaged safety/relief valve.**			
Observation:			
a. Missing or broken lift handle.	EA		
*** {Severity M}			
b. Leaking safety/relief 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}			
*** Damaged fuel oil pump.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity H}			
b. Leaking fuel oil pump.	EA		
*** {Severity H}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ 08.01.06 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. Defective 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}			

08.01 HEATING BOILERS - GAS/OIL

COMPONENTS (Continued)

◆ **08.01.06 BOILER TRIM (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}			

08.01 HEATING BOILERS - GAS/OIL

REFERENCES

1. NAVFAC MO-322 Vol. II, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, 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 Pressure Vessels, 1992

08.01 HEATING BOILERS - GAS/OIL

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.01.01-1
2	GS-III 08.01.01-2
3*	GS-III 08.01.01-3*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 08.01.01-1

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 lockout 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 determine 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. Remove tags and lockout on 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. Scrapper
3. Grinders
4. Ice Pick
5. Chipping Hammer & Chisel
6. Dust Masks
7. Extension Cord with Light

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 08.01.01-1

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 Standards, Roger W. Liska, P.E., AIC, 1988
3. NAVFAC MO-324 Inspection of Boilers and Unfired Pressure Vessels, 1992

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 08.01.01-2

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 lockout 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 determine 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 lockout on disconnect.
8. 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. Scrapper
3. Ice Pick
4. Dust Masks
5. Extension Cord with Light
6. Dye Penetrant

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 08.01.01-2

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 Standards, Roger W. Liska, P.E., AIC, 1988

3. NAVFAC MO-324 Inspection and certification of Boilers and Unfired Pressure Vessels, 1993

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 08.01.01-3*

Application

This guide applies to checking boiler efficiency (performance).

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. Always have one person standing by outside when someone is working inside a confined space.

Inspection Actions

1. Review records of maintenance, operation log sheets, steam flow charts and feedwater treatment records.
2. Check the flue gas temperature and flue-gas oxygen content to determine the combustion efficiency.
3. Check the temperatures of the internal metal components, the furnace gases and the water and/or steam.
4. Check the pressures of the internal furnace gases and the water and/or steam.
5. Check for refractory or insulation breakdown.
6. Check for blocked water passages or scale buildup.
7. Check for hot gas leaks or valve leakage.
8. Document any problems and report results.
9. Notify appropriate facility personnel for permission to place unit back in service.

Special Tools and Equipment

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

1. Infrared Temperature Tester
2. Gas Analyzer
3. Audio Leak Detector

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: SHELL AND CHAMBER
CONTROL NUMBER: GS-III 08.01.01-3*

References

1. ASME Performance Test Codes - PTC 4.1, Steam Generating Units

2. The Locomotive Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn., Vol. 66 Fall 1988, No. 3; Vol. 66 Summer 1991, No. 6

08.02 HEATING BOILERS - ELECTRIC

DESCRIPTION

Heating Boilers - Electric is a subsystem of the Building Mechanical System. Heating boilers - electric are heat generating systems which use electric resistance heaters to directly convert electricity into low temperature hot water or into steam at pressures not exceeding 15 psi.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Boilers - Electric Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

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

COMPONENT LIST

- 08.02.01 BOILERS - SHELL
- 08.02.02 CONTROLS
- 08.02.03 BOILER TRIM

RELATED SUBSYSTEMS

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

08.01	HEATING BOILERS - GAS/OIL
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS
08.26	CHEMICAL WATER TREATMENT SYSTEMS

08.02 HEATING BOILERS - ELECTRIC

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 Field CAIS.

The inspection of Heating Boilers will be scheduled when the equipment is in operation.

COMPONENTS

◆ 08.02.01 BOILERS - SHELL

The boiler shell contains the heated fluid and electric heating elements.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged casing.**			
Observation:			
a. Loose casing panel.	SF		
*** {Severity L}			
b. Missing or damaged casing.	SF		
*** {Severity M}			
*** Water or steam leakage.**			
Observation:			
a. Water or steam dripping from shell, door or heating element seals.	EA		1
*** {Severity H}			
*** Defective exterior insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing 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}			

08.02 HEATING BOILERS - ELECTRIC

COMPONENTS (Continued)

◆ 08.02.02 CONTROLS

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		
*** {Severity M}			
b. Electrical arcing noise.	EA		
*** {Severity H}			
*** Defective sensors.**			
Observation:			
a. Disconnected.	EA		
*** {Severity H}			
b. Missing.	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}			

08.02 HEATING BOILERS - ELECTRIC

COMPONENTS (Continued)

◆ **08.02.02 CONTROLS (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}			

08.02 HEATING BOILERS - ELECTRIC

COMPONENTS (Continued)

◆ 08.02.03 BOILER TRIM

Boiler trim consists of water column, valves, steam safety valves, hot 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. Damaged cutout isolation valve.	EA		
*** {Severity H}			
*** Damaged safety/relief valve.**			
Observation:			
a. Missing or broken lift handle.	EA		
*** {Severity M}			
b. Leaking safety/relief 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}			

08.02 HEATING BOILERS - ELECTRIC

COMPONENTS (Continued)

◆ **08.02.03 BOILER TRIM (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective gauge.**			
Observation:			
a. Broken, missing, or dirty gauge lens.	EA		
*** {Severity L}			
b. Defective 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}			
*** 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}			

08.02 HEATING BOILERS - ELECTRIC

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993

2. Means Facilities Maintenance Standards, Roger W. Liska, PE, 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 Pressure Vessels, 1992

08.02 HEATING BOILERS - ELECTRIC

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.02.01-1

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: BOILERS - SHELL
CONTROL NUMBER: GS-III 08.02.01-1

Application

This guide applies to the investigation of water or steam leaking from boiler shell, door or heating element seals.

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 lockout disconnects.
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. Check heating element seals for deterioration.
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 that all parts, guards and covers have been reinstalled.
9. 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, required to perform the inspection of the boiler.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: BOILERS - SHELL
CONTROL NUMBER: GS-III 08.02.01-1

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 Standards

08.03 FURNACES - GAS/OIL/ELECTRIC

DESCRIPTION

Furnaces - Gas/Oil/Electric is a subsystem of the Building Mechanical System. The furnace converts gas, fuel oil or electric power into heat and transfers this heat to the air passing through the furnace.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Furnaces - Gas/Oil/Electric Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Furnaces - Gas/Oil/Electric Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 08.03.01 ENCLOSURES AND SUPPORTS
- 08.03.02 EXHAUST FLUES
- 08.03.03 BURNERS/BLOWERS
- 08.03.04 ELECTRIC RESISTANCE HEATERS
- 08.03.05 BLOWER ASSEMBLIES
- 08.03.06 CONTROLS

RELATED SUBSYSTEMS

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

08.01	HEATING BOILERS - GAS/OIL
08.02	HEATING BOILERS - ELECTRIC

08.03 FURNACES - GAS/OIL/ELECTRIC

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 Field CAIS.

The inspection of Furnaces will be scheduled when the equipment is in operation.

COMPONENTS

◆ 08.03.01 ENCLOSURES AND SUPPORTS

The enclosure is the housing for the heating units and blowers. Supports are the structural members that support the furnace components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Missing or damaged enclosure panel.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Enclosure 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}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ 08.03.02 EXHAUST FLUES

Exhaust Flues are an airtight conduit which conveys the products of combustion from the furnace to the atmosphere or to a chimney stack.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective exhaust flue.**			
Observation:			
a. Loose or missing flue.	LF		
*** {Severity H}			
b. Damaged or missing insulation.	LF		
*** {Severity M}			
*** Damaged exhaust flue hangers, guides and supports.**			
Observation:			
a. Loose exhaust flue hangers, guides or supports.	EA		
*** {Severity M}			
b. Broken or missing exhaust flue hangers, or guides.	EA		
*** {Severity H}			
*** Corroded flue.**			
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}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ 08.03.03 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 line 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}			
*** Defective blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ **08.03.03 BURNERS/BLOWERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration at blower.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA		
*** {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}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** Severity F}			
*** 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}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ 08.03.04 ELECTRIC RESISTANCE HEATERS

The electric resistance heaters consist of a resistor, insulated supports, and terminals for connecting the resistor to electric power.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors on electric heating elements.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
c. No heat.	EA		
*** {Severity H}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ 08.03.05 BLOWER ASSEMBLIES

Blowers move air through the furnace heat exchanger and the air distribution systems. The blower assembly consists of a blower, motor and drive unit (direct or belt drive) and can be for supply and return air.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration at blower.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
*** Defective blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {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}			
*** Excessive noise or vibration at blower 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}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ **08.03.05 BLOWER ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged blower motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
c. Motor does not work.	EA		
*** {Severity H}			
*** 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 electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** Defective fan belts.**			
Observation:			
a. Loose fan belt.	EA		
*** {Severity F}			
b. Missing or broken fan belt.	EA		
*** {Severity F}			

08.03 FURNACES - GAS/OIL/ELECTRIC

COMPONENTS (Continued)

◆ 08.03.06 CONTROLS

Controls govern the operation of the furnace and consist of switches, relays and disconnects.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

08.03 FURNACES - GAS/OIL/ELECTRIC

REFERENCES

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

2. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

08.03 FURNACES - GAS/OIL/ELECTRIC

LEVEL II KEY **GUIDE SHEET CONTROL NUMBER**

N/A

LEVEL III KEY **GUIDE SHEET CONTROL NUMBER**

N/A

08.04 CHILLERS - ABSORPTION

DESCRIPTION

Chillers - Absorption is a subsystem of the Building Mechanical Systems. An absorption chiller uses water as the primary refrigerant and employs an absorbent as a secondary fluid. Unlike the centrifugal, reciprocating or screw units, it uses a physio-chemical process and employs little mechanical energy.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Absorption Chillers, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

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

COMPONENT LIST

- 08.04.01 CHILLERS
- 08.04.02 PUMPS
- 08.04.03 PURGE UNITS
- 08.04.04 PIPING, FITTINGS AND VALVES
- 08.04.05 CONTROLS AND INSTRUMENTATION

RELATED SUBSYSTEMS

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

08.12	HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS
08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.16	CONDENSER WATER DISTRIBUTION SYSTEMS
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS

08.04 CHILLERS - ABSORPTION

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 Field CAIS.

The inspection of Absorption Chillers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized chiller applications.

COMPONENTS

◆ 08.04.01 CHILLERS

The chiller consists of a water cooled condenser, an absorber, an evaporator and a generator (concentrator). The latent heat of evaporation is provided by an external heat source or by direct fired gas or oil burners.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise and vibration at the burner/blower.**			
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}			
*** Leakage.**			
Observation:			
a. Evidence of water or absorbent leakage.	EA		
*** {Severity M}			
b. Evidence of fuel leakage.	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}			

08.04 CHILLERS - ABSORPTION

COMPONENTS (Continued)

◆ **08.04.01 CHILLERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective assembly hardware.**			
Observation:			
a. Loose assembly bolts.	EA		
*** {Severity M}			
b. Broken/missing assembly bolts.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts.	EA		
*** {Severity H}			
*** 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}			

08.04 CHILLERS - ABSORPTION

COMPONENTS (Continued)

◆ 08.04.02 PUMPS

Pumps are used to cycle the refrigerant from the evaporator catch basin to spray nozzles in the evaporator and to send solution from the generator to the absorber spray nozzles.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective pump.**			
Observation:			
a. Leaking at pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity H}			
*** Excessive noise and vibration in pump.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
*** Defective pump motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
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}			

08.04 CHILLERS - ABSORPTION

COMPONENTS (Continued)

◆ 08.04.03 PURGE UNITS

The purge unit removes the non-condensable gases that enter the refrigerant system through charging or through leaks during normal low pressure operations.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of absorbent leakage.	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}			
*** Defective mounting bolts.**			
Observation:			
a. Loose mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing mounting bolts.	EA		
*** {Severity H}			

08.04 CHILLERS - ABSORPTION

COMPONENTS (Continued)

◆ 08.04.04 PIPING, FITTINGS AND VALVES

Piping, fittings and valves, that are part of an absorption chiller, pertain to the refrigerant and lubricating oil circuits.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Absorbent leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Absorbent leaking.	LF		
*** {Severity H}			
*** Leaking/damaged 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 insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Missing or damaged insulation.	LF		
*** {Severity H}			

08.04 CHILLERS - ABSORPTION

COMPONENTS (Continued)

◆ **08.04.04 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded piping, fittings and valves.**			
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}			

08.04 CHILLERS - ABSORPTION

COMPONENTS (Continued)

◆ 08.04.05 CONTROLS AND INSTRUMENTATION

Controls govern the operation of the chiller and instrumentation shows the status of the chiller components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged control/instrument panel.**			
Observation:			
a. Physically damaged panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Defective control/instrument.**			
Observation:			
a. Broken/physically damaged control.	EA		
*** {Severity M}			
b. Disconnected control.	EA		
*** {Severity H}			
*** Damaged mounting hardware or supports.**			
Observation:			
a. Loose mounting hardware or supports.	EA		
*** {Severity M}			
b. Broken or missing hardware or supports.	EA		
*** {Severity H}			

08.04 CHILLERS - ABSORPTION

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993

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

3. TRANE ABDL-M-1, Operation/Maintenance, Direct-Fired Absorption Chiller

4. CARRIER 1992/1993, Products and Systems Master Catalog

5. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems Equipment

6. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982

7. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.04 CHILLERS - ABSORPTION

LEVEL II KEYS GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEYS GUIDE SHEET CONTROL NUMBER

1*	GS-III 08.04.01-1*
2*	GS-III 08.04.01-2*
3*	GS-III 08.04.02-3*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.04.01-1*

Application

This guide applies to sampling of lithium bromide for presence of corrosion products and to determine chemical balance of solution inhibitors. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

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

Inspection Actions

1. Acquire a 50 ML sample of the lithium bromide.
2. Perform analysis of the sample to determine presence of corrosion products and chemical balance of solution inhibitors.

Special Tools and Equipment

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

1. 50 ML container

Recommended Inspection Frequency

Annually

References

1. The Locomotive, Hartford Steam Boiler Inspection and Insurance Co., Vol. 66, Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.04.01-2*

Application

This guide applies to checking of tubes in the condenser, evaporator and absorber to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller tag and lock out disconnect.
2. Drain evaporator, absorber and condenser water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions.
4. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
5. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
6. Ensure all 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 the requirements listed in the Standard Tool Section.

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.04.01-2*

References

1. TRANE ABDL-M-1, Operation/Maintenance, Direct-Fired Absorption Chiller

2. NASA Facilities Maintenance handbook, NHB08831,2, December 1991

3. The Locomotive, Hartford Steam Boiler Inspection and Insurance Co., Vol.66, Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.04.02-3*

Application

This guide applies to the investigation of worn bearings, seals and impellers of the solution pumps. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down pump, tag and lock out disconnect.
2. Isolate pump by securing shutoff valves.
3. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
4. Check coupling for wear, damage, loose fasteners.
5. Check impellers for wear, erosion/corrosion, physical damage, distortion.
6. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
7. Document the problem and contact appropriate facility personnel for further instructions and reassemble pump, if directed.
8. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
9. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

Special Tools and Equipment

No special tools are needed for the performance of the Level III inspection beyond the requirements listed in the Standard Tools Section.

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions, otherwise every 3 years.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.04.02-3*

References

1. The Locomotive, Hartford Steam Boiler Inspection and Insurance Co., Vol. 66, Spring 1988

08.05 CHILLERS - CENTRIFUGAL

DESCRIPTION

Chillers - Centrifugal is a subsystem of the Building Mechanical System. A centrifugal chiller compresses gaseous refrigerant using centrifugal force and produces cooling via water, through a shell and tube evaporator.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Centrifugal Chillers, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

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

COMPONENT LIST

- 08.05.01 CHILLERS
- 08.05.02 PURGE UNITS
- 08.05.03 PIPING, FITTINGS AND VALVES
- 08.05.04 CONTROLS AND INSTRUMENTATION

RELATED SUBSYSTEMS

08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.16	CONDENSER WATER DISTRIBUTION SYSTEMS

08.05 CHILLERS - CENTRIFUGAL

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 Field CAIS.

The inspection of Centrifugal Chillers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized chiller applications.

COMPONENTS

◆ 08.05.01 CHILLERS

The chiller consists of a centrifugal compressor, cooled compressor motor, water cooled condenser, economizer, heat recovery unit, evaporator and lubrication system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise and vibration at the compressor.**			
Observation:			
a. Rattling noise.	EA		1
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA		1
*** {Severity H}			
*** Excessive noise and vibration at the motor.**			
Observation:			
a. Rattling noise.	EA		2
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA		2
*** {Severity H}			

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ 08.05.01 CHILLERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage at condenser.	EA		
*** {Severity M}			
b. Evidence of water leakage at evaporator.	EA		
*** {Severity M}			
c. Evidence of refrigerant leakage. at compressor.	EA		
*** {Severity H}			
d. Evidence of refrigerant leakage. at condenser.	EA		
*** {Severity H}			
e. Evidence of refrigerant leakage. at evaporator.	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}			
*** Defective assembly hardware.**			
Observation:			
a. Loose assembly bolts.	EA		
*** {Severity M}			
b. Broken/missing assembly bolts.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts.	EA		
*** {Severity H}			

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ 08.05.01 CHILLERS (Continued)

*** Defective insulation.**

Observation:

a. Loose insulation. SF
*** {Severity L}

b. Missing or damaged insulation. SF
*** {Severity H}

*** Corrosion at compressor.**

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}

*** Corrosion compressor motor.**

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}

*** Corrosion at condenser.**

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}

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ **08.05.01 CHILLERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion at evaporator.**			
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}			

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ 08.05.02 PURGE UNITS

The purge unit removes the non-condensable gases that enter the refrigerant system through charging or leaks during normal low pressure operation.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of refrigerant leakage.	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}			
*** Defective mounting bolts.**			
Observation:			
a. Loose mounting bolts.	EA		
*** {Severity M}			
b. Broken or missing mounting bolts.	EA		
*** {Severity H}			

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ 08.05.03 PIPING, FITTINGS AND VALVES

Piping, fittings and valves, that are part of the centrifugal chiller, pertain to the refrigerant and lubricating oil circuits.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Evidence of oil/refrigerant leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Evidence of oil/refrigerant leaking.	LF		
*** {Severity H}			
*** Leaking/damaged valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Evidence of oil/refrigerant leaking.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ **08.05.03 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded piping, fittings and valves.**			
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}			

08.05 CHILLERS - CENTRIFUGAL

COMPONENTS (Continued)

◆ 08.05.04 CONTROLS AND INSTRUMENTATION

Controls govern the operation of the chiller and instrumentation shows the status of the chiller components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged control/instrument panel.**			
Observation:			
a. Physically damaged panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Defective control/instrument.**			
Observation:			
a. Broken/physically damaged.	EA		
*** {Severity M}			
b. Disconnected/missing.	EA		
*** {Severity H}			
*** Damaged mounting hardware or supports.**			
Observation:			
a. Loose mounting hardware or supports.	EA		
*** {Severity M}			
b. Broken or missing hardware or supports.	EA		
*** {Severity H}			

08.05 CHILLERS - CENTRIFUGAL

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. TRANE CVHB0M05A, Operation/Maintenance Centrifugal Chiller
4. CARRIER 1992/1993, Products and Systems Master Catalog
5. Operation and Maintenance of Centrifugal Units by Garth Denison CMS
6. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment.
7. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982
8. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983.

08.05 CHILLERS - CENTRIFUGAL

LEVEL II KEYS GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEYS GUIDE SHEET CONTROL NUMBER

1	GS-III 08.05.01-1
2	GS-III 08.05.01-2
3*	GS-III 08.05.01-3*
4*	GS-III 08.05.01-4*
5*	GS-III 08.05.01-5*
6*	GS-III 08.05.01-6*
7*	GS-III 08.05.01-7*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-1

Application

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

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 compressor operation and determine possible source of noise.
2. Perform vibration analysis on compressor bearings.
3. Shut down compressor, tag and lock out disconnect.
4. Isolate unit mechanically by pumping down system and securing valves on associated components.
5. Open and inspect compressor interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas with dye penetrant.
6. Check interior shafting for signs of fatigue.
7. Check compressor shafting for damage from packing/mechanical seal.
8. Check impellers for erosion/corrosion, physical damage, distortion.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Check clearances between impeller and wear rings; compare with manufacturer's specifications.
11. Close compressor.
12. Rotate (cycle) compressor to check for binding.
13. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
14. Check coupling for wear, damage, loose fasteners.
15. Check coupling for misalignment.
16. Ensure that all seals and covers have been reinstalled.
17. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
18. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
19. Restore valves to normal position.
20. Remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-1

Special Tools and Equipment

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

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant
4. Refrigerant Gauges

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection 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, PE, AIC 1988
3. TRANE CVHB0M05A, Operation/Maintenance Centrifugal Chiller

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-2

Application

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

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Isolate unit mechanically by pumping down system and securing valves on associated components.
5. Rotate (cycle) motor to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
8. Check interior shafting for signs of fatigue or wear.
9. Rotate (cycle) shafting and check for distortion.
10. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
11. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
12. Ensure all guards and covers have been installed; evacuate air from system and recharge, 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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-2

Recommended Inspection Frequency

Perform inspection when triggered by a Level I inspection 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, Virginia

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-3*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation. Do not duplicate this effort is it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Large electrical equipment such as motors above 500 HP usually have sufficient capacitance to store a dangerous amount of energy from the test current. Make sure this capacitance is discharged after each test and before handling the test leads.
3. Do not use the megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-3*

Recommended Inspection Frequency

Annually

References

1. The Locomotive, Vol. 69, spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985), and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, Mg 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-4*

Application

This guide applies to the sampling of the chiller oil to determine the oil degradation, oil contamination and machine wear. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

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

Inspection Actions

1. Acquire a 50 ML sample of the chiller oil.
2. Perform a spectrochemical analysis of the oil sample to determine the oil degradation, oil contamination and machine wear.

Special Tools and Equipment

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

1. 50 ML container

Recommended Inspection Frequency

Annually

References

1. Jennings Laboratories 1118 Cypress Ave., Virginia Beach, VA
2. Operation and Maintenance of Centrifugal Units by Garth Denison CMS
3. The Locomotive, Hartford Steam Boiler Inspection & Insurance Co. Hartford, Conn., Vol. 66, Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-5*

Application

This guide applies to the checking of the tubes in the condenser and heat recovery units for refrigerant leaks. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate unit mechanically by pumping down system and securing valves on associated components.
3. Open end covers and inspect condition of tubes, check for refrigerant leaks using a dye penetrant on suspicious areas.
4. Replace end covers.
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. Restore valves to normal position.
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 the requirements listed in the Standard Tool Section.

1. Dye Penetrant
2. Refrigerant Gauges

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-5*

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. TRANE CVHB0M05A, Operation/Maintenance Centrifugal Chiller
4. Operation and Maintenance of Centrifugal Units by Garth Denison CMS

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-6*

Application

This guide applies to the disassembly of the compressor for inspection. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate compressor mechanically by pumping down system and securing valves on associated components.
3. Perform a nondestructive test of the internal parts of the compressor, according to the manufacturers recommendations.
4. Re-assemble the compressor.
5. Document any problems and contact appropriate facility personnel for further instructions.
6. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
7. Restore valves to normal position.
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 the requirements listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant
4. Refrigerant Gauges

Recommended Inspection Frequency

Every 5 years or 40,000 hours of operation

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-6*

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. CARRIER CORP, Catalogs 19.011, Forms 19EB-3SSM
4. TRANE CVHB0M05A, Operation/Maintenance Centrifugal Chiller
5. Operation and Maintenance of Centrifugal Units by Garth Denison CMS

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-7*

Application

This guide applies to checking tubes in the condenser and evaporator to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down condenser, tag and lock out disconnect.
2. Drain evaporator and condenser water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions.
4. Document the problem and contact appropriate facility personnel for further instructions, if defects found are not critical to continued function.
5. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
6. Ensure all covers have been installed; remove tags, disconnect and restore unit to service.

Special Tools and Equipment

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

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.05.01-7*

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. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company, Inc.
4. The Locomotive, The Hartford Steam Boiler Inspection and Insurance Co., Spring 1988, Vol. 66

08.06 CHILLERS - RECIPROCATING

DESCRIPTION

Chillers - Reciprocating is a subsystem of the Building Mechanical Systems. A reciprocating chiller compresses gaseous refrigerant using a reciprocating piston force and produces cooling via water, through a shell and tube evaporator.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Reciprocating Chillers, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

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

COMPONENT LIST

- 08.06.01 ENCLOSURES AND SUPPORTS
- 08.06.02 COMPRESSORS
- 08.06.03 CONDENSERS AND EVAPORATORS
- 08.06.04 PIPING, FITTINGS AND VALVES
- 08.06.05 CONTROLS AND INSTRUMENTATION

RELATED SUBSYSTEMS

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

08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.16	CONDENSER WATER DISTRIBUTION SYSTEMS
10.08	MOTOR CONTROL CENTERS

08.06 CHILLERS - RECIPROCATING

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 Field CAIS.

The inspection of Reciprocating Chillers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized chiller applications.

COMPONENTS

◆ 08.06.01 ENCLOSURES AND SUPPORTS

The enclosure is the housing for reciprocating chillers. Supports are the structural members that support the main chiller components.

Defect:	UOM	LEVEL II KEY	LEVEL II KEY
*** Damaged enclosure panels.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Missing or damaged enclosure panel.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Corroded enclosure panels.**			
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}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ **08.06.01 ENCLOSURES AND SUPPORTS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded 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}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ 08.06.02 COMPRESSORS

The compressor normally consists of crankshaft with one or more pistons driven by a motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Excessive noise or vibration at compressor.**			
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}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts or isolators.	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}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ 08.06.03 CONDENSERS AND EVAPORATORS

The water cooled condensers and evaporators consist of shell and tube heat exchangers. The evaporators serve to cool circulating water for the building while condensers serve to liquify the high pressure refrigerant gas. The air condensers consist of propeller fans and fin-tube coils.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of refrigerant leakage at condenser.	EA		
*** {Severity H}			
b. Evidence of refrigerant leakage at evaporator.	EA		
*** {Severity H}			
c. Evidence of water leakage at condenser.	EA		
*** {Severity H}			
d. Evidence of water leakage at evaporator.	EA		
*** {Severity H}			
*** Deteriorated/clogged air cooled condenser coils.**			
Observation:			
a. Damaged coils.	SF		
*** {Severity H}			
b. Dust/debris accumulation on coils.	SF		
*** {Severity F}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ 08.06.03 CONDENSERS AND EVAPORATORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration in fan motor.**			
Observation:			
a. Clicking or rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Fan blade hitting metal housing.	EA		
*** {Severity M}			
d. Cracked or damaged fan blades.	EA		
*** {Severity H}			
e. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Corroded air cooled condenser coil.**			
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}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	SF		
*** {Severity M}			
c. Missing insulation.	SF		
*** {Severity H}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ **08.06.03 CONDENSERS AND EVAPORATORS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded water cooled condenser.**			
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}			
*** Corroded water cooled evaporator.**			
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}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ 08.06.04 PIPING, FITTINGS AND VALVES

Piping, fittings and valves, that are part of the reciprocating chiller, pertain to the refrigerant and lubricating oil circuits.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Evidence of oil/refrigerant leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Evidence of oil/refrigerant leaking.	LF		
*** {Severity H}			
*** Leaking/damaged valves.**			
Observation:			
a. Broken or missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Cracked valve body.	EA		
*** {Severity H}			
d. Evidence of oil/refrigerant leaking.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ **08.06.04 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded piping, fittings and valves.**			
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}			

08.06 CHILLERS - RECIPROCATING

COMPONENTS (Continued)

◆ 08.06.05 CONTROLS AND INSTRUMENTATION

Controls govern the operation of the chiller and instrumentation shows the status of the chiller components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged control/instrument panel.**			
Observation:			
a. Physically damaged panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Defective control/instrument.**			
Observation:			
a. Broken/physically damaged.	EA		
*** {Severity M}			
b. Disconnected or missing.	EA		
*** {Severity H}			
*** Damaged mounting hardware or supports.**			
Observation:			
a. Loose mounting hardware or supports.	EA		
*** {Severity M}			
b. Broken or missing hardware or supports.	EA		
*** {Severity H}			

08.06 CHILLERS - RECIPROCATING

REFERENCES

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993

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

3. TRANE CGWC-10M-3, Installation, Operation, Maintenance, Reciprocating Chiller

4. CARRIER 30GB075-200 Flotronic Reciprocating Liquid Chillers

5. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment

6. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982

7. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.06 CHILLERS - RECIPROCATING

LEVEL II KEYS GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEYS GUIDE SHEET CONTROL NUMBER

1	GS-III 08.06.02-1
2*	GS-III 08.06.02-2*
3*	GS-III 08.06.02-3*
4*	GS-III 08.06.02-4*
5*	GS-III 08.06.02-5*
6*	GS-III 08.06.03-6*
7*	GS-III 08.06.03-7*
8*	GS-III 08.06.03-8*
9*	GS-III 08.06.03-9*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-1

Application

This guide applies to the investigation of rattling or grinding noise from compressors.

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 compressor operation and determine possible source of noise.
2. Carefully check compressor supports for loose, damaged or missing fasteners.
3. Check compressor electrical current draw.
4. Check for correct suction and discharge pressure.
5. Document the problem 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 the requirements listed in the Standard Tool Section.

1. Ammeter
2. Refrigerant gauges

Recommended Inspection Frequency

Perform inspection when triggered by Level I 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, PE, AIC, 1988
3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-2*

Application

This guide applies to sampling compressor oil to determine oil degradation, contamination and machine wear. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

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

Inspection Actions

1. Acquire a 50 ML sample of the chiller oil.
2. Perform a spectrochemical analysis of the oil sample to determine the oil degradation, oil contamination and machine wear.

Special Tools and Equipment

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

1. 50 ML container

Recommended Inspection Frequency

Annually

References

1. Jennings Laboratories 1118 Cypress Ave., Virginia Beach, VA

2. The Locomotive Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn., Vol. 66 Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-3*

Application

This guide applies to the partial disassembly of the compressor for inspection. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program. This inspection should be coordinated with Guide Sheet GS-III 08.06.02-4.

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. Shut down, tag chiller and lock out disconnect.
2. Isolate compressor mechanically by pumping down system and securing valves on associated components.
3. Remove cylinder heads for examination of suction and discharge valves, valve springs and upper cylinder areas.
4. Remove crankcase cover plate and inspect the crankcase for metal particles which would indicate bearing wear.
5. Re-assemble the compressor.
6. Document any problems and contact appropriate facility personnel for further instructions.
7. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
8. Restore valves to normal position.
9. 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 the requirements listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Refrigerant Gauges

Recommended Inspection Frequency

Every 2 years or 10,000 hours of operation

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-3*

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. CARRIER CORP, Catalogs 19.011, Forms 19EB-3SSM
4. TRANE CGWC-10M-3, Installation, Operation, Maintenance, Reciprocating Chiller
5. The Locomotive, The Hartford Steam Boiler Inspection and Insurance Co., Vol. 66, Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-4*

Application

This guide applies to the disassembly of the compressor for inspection of the connecting rod and piston assemblies. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program. This inspection to be coordinated with Guide Sheet GS-III 08.06.02-3.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate compressor mechanically by pumping down system and securing valves on associated components.
3. Remove connecting rod and piston assemblies to:
   a. Check piston rings for wear.
   b. Check connecting rod bearing surfaces for wear.
   c. Check connecting rod yokes, caps and bolts with dye penetrant.
   d. Check crankpin diameter for wear.
   e. Check oil pump for wear.
4. Re-assemble the compressor.
5. Document any problems and contact appropriate facility personnel for further instructions.
6. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
7. Restore valves to normal position.
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 the requirements listed in the Standard Tool Section.

1. Alignment Tools
2. Vibration Tester
3. Dye Penetrant
4. Refrigerant Gauges

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-4*

Recommended Inspection Frequency

Every 4 years or 20,000 hours of operation

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. CARRIER CORP, Catalogs 19.011, Forms 19EB-3SSM
4. TRANE CGWC-10M-3, Installation, Operation, Maintenance, Reciprocating Chiller
5. The Locomotive, The Hartford Steam Boiler Inspection and Insurance Co., Spring 1988, Vol. 66, No.1

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5*

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-5*

Application

This guide applies to the checking the windings of electric motors for open circuits, grounds or deteriorated insulation. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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.
2. Do not use the Megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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 the requirements listed in the Standard Tool Section.

1. Megohmmeter

Recommended Inspection Frequency

Every 2 years

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5* (Continued)

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.06.02-5*

References

1. The locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-6*

Application

This guide applies to the checking of the tubes in the condenser for refrigerant leaks. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate unit mechanically by pumping down system and securing valves on associated components.
3. Open end covers and inspect condition of tubes, check for refrigerant leaks using a dye penetrant on suspicious areas.
4. Replace end covers.
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. Restore valves to normal position.
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 the requirements listed in the Standard Tool Section.

1. Dye Penetrant
2. Refrigerant Gauges

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6* (Continued)

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-6*

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. TRANE CGWC-10M-3, Installation, Operation, Maintenance, Reciprocating Chiller

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-7*

Application

This guide applies to the checking of the tubes in the condenser to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down condenser, tag and lock out disconnect.
2. Drain condenser water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions.
4. Document the problem and contact appropriate facility personnel for further instructions, if defects found are not critical to continued function.
5. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
6. Ensure all covers have been installed; remove tags, disconnect and restore unit to service.

Special Tools and Equipment

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

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-7*

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. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company, Inc.

4. The Locomotive, The Hartford Steam Boiler Inspection and insurance Co., spring 1988, Vol. 66

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8*

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-8*

Application

This guide applies to the checking of the tubes in the evaporator for refrigerant leaks. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate unit mechanically by pumping down system and securing valves on associated components.
3. Open end covers and inspect condition of tubes, check for refrigerant leaks using a dye penetrant on suspicious areas.
4. Replace end covers.
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. Restore valves to normal position.
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 the requirements listed in the Standard Tool Section.

1. Dye Penetrant
2. Refrigerant Gauges

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8* (Continued)

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-8*

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. TRANE CGWC-10M-3, Installation, Operation, Maintenance, Reciprocating Chiller

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9*

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-9*

Application

This guide applies to the checking of the tubes in the evaporator to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down condenser, tag and lock out disconnect.
2. Drain evaporator water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions.
4. Document the problem and contact appropriate facility personnel for further instructions, if defects found are not critical to continued function.
5. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
6. Ensure all covers have been installed; remove tags, disconnect and restore unit to service.

Special Tools and Equipment

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

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 9* (Continued)

COMPONENT: CONDENSERS AND EVAPORATORS
CONTROL NUMBER: GS-III 08.06.03-9*

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. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company, Inc.
4. The Locomotive, The Hartford Steam Boiler Inspection and insurance Co., spring 1988, Vol. 66

08.07 CHILLERS - SCREW

DESCRIPTION

Chillers - Screw is a subsystem of the Building Mechanical Systems. A screw chiller compresses gaseous refrigerant using helical rotors and produces cooling via water, through a shell and tube evaporator.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Screw Chillers, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

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

COMPONENT LIST

- 08.07.01 CHILLERS
- 08.07.02 PIPING, FITTINGS AND VALVES
- 08.07.03 CONTROLS AND INSTRUMENTATION

RELATED SUBSYSTEMS

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

08.12	HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS
08.15	CHILLED WATER DISTRIBUTION SYSTEM
08.16	CONDENSER WATER DISTRIBUTION SYSTEM
10.08	MOTOR CONTROL CENTERS

08.07 CHILLERS - SCREW

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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Screw Chillers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized chiller applications.

COMPONENTS

◆ 08.07.01 CHILLERS

The chiller consists of a screw compressor, compressor motor, water cooled condenser, evaporator and lubrication system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise and vibration at the compressor.**			
Observation:			
a. Rattling noise.	EA		1
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA		1
*** {Severity H}			
*** Excessive noise and vibration at the motor.**			
Observation:			
a. Rattling noise.	EA	1	2
*** {Severity M}			
b. Grinding noise indicating metal to metal contact.	EA	1	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			

08.07 CHILLERS - SCREW

COMPONENTS (Continued)

◆ **08.07.01 CHILLERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage at condenser.	EA		
*** {Severity M}			
b. Evidence of water leakage at evaporator.	EA		
*** {Severity M}			
c. Evidence of refrigerant leakage. at compressor.	EA		
*** {Severity H}			
d. Evidence of refrigerant leakage. at condenser.	EA		
*** {Severity H}			
e. Evidence of refrigerant leakage. at evaporator.	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}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Missing or damaged insulation.	SF		
*** {Severity H}			

08.07 CHILLERS - SCREW

COMPONENTS (Continued)

◆ **08.07.01 CHILLERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion at compressor.**			
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}			
*** Corrosion compressor motor.**			
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}			
*** Corrosion at condenser.**			
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}			

08.07 CHILLERS - SCREW

COMPONENTS (Continued)

◆ **08.07.01 CHILLERS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion at evaporator.**			
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}			

08.07 CHILLERS - SCREW

COMPONENTS (Continued)

◆ 08.07.02 PIPING, FITTINGS AND VALVES

Piping, fittings and valves, that are part of the screw chiller, pertain to the refrigerant and lubricating oil circuits.

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

08.07 CHILLERS - SCREW

COMPONENTS (Continued)

◆ **08.07.02 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded piping, fittings and valves.**			
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}			

08.07 CHILLERS - SCREW

COMPONENTS (Continued)

◆ 08.07.03 CONTROLS AND INSTRUMENTATION

Controls govern the operation of the chiller and instrumentation shows the status of the chiller components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physically damaged control/instrument panel.**			
Observation:			
a. Physically damaged panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Panel blocked, not accessible for inspection.	EA		
*** {Severity S}			
*** Defective control/instrument.**			
Observation:			
a. Broken/physically damaged.	EA		
*** {Severity M}			
b. Disconnected or missing.	EA		
*** {Severity H}			
*** Damaged mounting hardware or supports.**			
Observation:			
a. Loose mounting hardware or supports.	EA		
*** {Severity M}			
b. Broken or missing hardware or supports.	EA		
*** {Severity H}			

08.07 CHILLERS - SCREW

REFERENCES

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993

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

3. TRANE Air Conditioning Clinic Booklet, Helical Rotary Water Chillers

4. TRANE RTHA-IOM-IA, Operation/Maintenance, Rotary Liquid Chillers

5. CARRIER 1992/1993, Products and Systems Master Catalog

6. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment

7. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982

8. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.07 CHILLERS - SCREW

LEVEL II KEYS	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.07.01-1

LEVEL III KEYS	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.07.01-1
2	GS-III 08.07.01-2
3	GS-III 08.07.01-3
4*	GS-III 08.07.01-4*
5*	GS-III 08.07.01-5*
6*	GS-III 08.07.01-6*
7*	GS-III 08.07.01-7*
8*	GS-III 08.07.01-8*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: CHILLERS
CONTROL NUMBER: GS-II 08.07.01-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the chiller motor, if 60 HP or greater in size.

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.

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: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-1

Application

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

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 compressor operation and determine possible source of noise.
2. Perform vibration analysis on compressor bearings.
3. Shut down compressor, tag and lock out disconnect.
4. Isolate unit mechanically by pumping down system and securing valves on associated components.
5. Open and inspect compressor interior housing for cracks, fatigue, erosion, and corrosion, check suspicious areas with dye penetrant.
6. Check interior shafting for signs of fatigue.
7. Check compressor shafting for damage from packing/mechanical seal.
8. Check rotors for erosion/corrosion, physical damage, distortion.
9. Rotate (cycle) shafting and check for distortion in shaft.
10. Check clearances between rotors; compare with manufacturer's specifications.
11. Close compressor.
12. Rotate (cycle) compressor to check for binding.
13. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
14. Ensure that all seals and covers have been reinstalled.
15. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Restore valves to normal position.
18. Remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-1

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
4. Refrigerant Gauges

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 Standards, Roger W. Liska, PE, AIC 1988
3. TRANE RTHA-IOM-IA, Operation/Maintenance Rotary Liquid Chillers

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the chiller motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Isolate unit mechanically by pumping down system and securing valves on associated components.
5. Rotate (cycle) motor to check for binding.
6. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
7. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
8. Check interior shafting for signs of fatigue or wear.
9. Rotate (cycle) shafting and check for distortion.
10. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
11. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
12. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-2
Special Tools and Equipment

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. Electric Motor & Contracting Co. Inc., Chesapeake, Va.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-3

Application

This guide applies to the investigation of electrical arcing noise from the chiller motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lockout disconnect.
8. Isolate unit mechanically by pumping down system and securing valves on associated components.
9. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
10. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
12. Check commutator/slip rings for loose parts, physical damage, wear.
13. Check brushes for wear, proper tension.
14. Check bearings for lube leakage into motor.
15. Check motor shafting for wear.
16. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
17. Notify appropriate personnel for permission to place unit back in service if defect is not critical to continued function.
18. Ensure all guards and covers have been installed; evacuate air from system and recharge, remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-3

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
6. Dye Penetrant
7. Refrigerant gauges

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. Electric Motor & Contracting Co. Inc., Chesapeake, Va.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Large electrical equipment such as motors above 500 HP usually have sufficient capacitance to store a dangerous amount of energy from the test current. Make sure this capacitance is discharged after each test and before handling the test leads.
3. Do not use the Megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-4*

Recommended Inspection Frequency

Annually

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-5*

Application

This guide applies to sampling chiller oil to determine oil degradation, contamination and machine wear. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

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

Inspection Actions

1. Acquire a 50 ML sample of the chiller oil.
2. Perform a spectrochemical analysis of the oil sample to determine the oil degradation, oil contamination and machine wear.

Special Tools and Equipment

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

1. 50 ML container

Recommended Inspection Frequency

Annually

References

1. Jennings Laboratories 1118 Cypress Ave., Virginia Beach, VA

2. The Locomotive, Hartford Steam Boiler Inspection & Insurance Co., Hartford Conn., Vol. 66, Spring 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-6*

Application

This guide applies to the checking of the tubes in the condenser and heat recovery units for refrigerant leaks. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate unit mechanically by pumping down system and securing valves on associated components.
3. Open end covers and inspect condition of tubes, check for refrigerant leaks using a dye penetrant on suspicious areas.
4. Replace end covers.
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. Restore valves to normal position.
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. Dye Penetrant
2. Refrigerant Gauges

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-6*

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. TRANE RTHA-IOM-IA, Operation/Maintenance Rotary Liquid Chillers

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-7*

Application

This guide applies to the disassembly of the compressor for inspection. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down chiller, tag and lock out disconnect.
2. Isolate compressor mechanically by pumping down system and securing valves on associated components.
3. Perform nondestructive tests of the internal parts of the compressor, according to the manufacturer's recommendations.
4. Re-assemble the compressor.
5. Document any problems and contact appropriate facility personnel for further instructions.
6. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
7. Restore valves to normal position.
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. Alignment Tools
2. Vibration Tester
3. Dye Penetrant
4. Refrigerant Gauges

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-7*

Recommended Inspection Frequency

Every 4 years or 20,000 hours of operation

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. CARRIER CORP, Catalogs 19.011, Forms 19EB-3SSM

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8*

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-8*

Application

This guide applies to the checking of the tubes in the condenser and evaporator to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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. Shut down condenser, tag and lock out disconnect.
2. Drain condenser and evaporator water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions.
4. Document the problem and contact appropriate facility personnel for further instructions, if defects found are not critical to continued function.
5. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
6. Ensure all covers have been installed; remove tags, disconnect and restore unit to service.

Special Tools and Equipment

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

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 8* (Continued)

COMPONENT: CHILLERS
CONTROL NUMBER: GS-III 08.07.01-8*

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. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company, Inc.

4. The Locomotive, The Hartford Steam Boiler Inspection and insurance Co., spring 1988, Vol. 66

08.08 AIR CONDITIONING - CONDENSER UNITS

DESCRIPTION

Air Conditioning - Condenser Units a subsystem of the Building Mechanical System. Split system air conditioning systems normally consist of an external condensing unit, a air handling unit located within the facility and refrigerant lines interconnecting the two pieces of equipment. This subsystem covers the condenser units and external refrigerant lines. Refer to 08.20 for Air Handling Units.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Air Conditioning Condensing Units, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Air Conditioning Condensing Units, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 08.08.01 CONDENSERS - AIR COOLED
- 08.08.02 CONDENSERS - WATER COOLED
- 08.08.03 REFRIGERANT PIPING

RELATED SUBSYSTEMS

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

08.20 AIR HANDLING UNITS
08.21 AIR DISTRIBUTION SYSTEMS

08.08 AIR CONDITIONING - CONDENSER UNITS

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 Field CAIS.

The inspection of Air Conditioning Condensers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized condenser unit applications.

COMPONENTS

◆ 08.08.01 CONDENSERS - AIR COOLED

Air cooled condenser units are heat exchangers which transfer heat to the surrounding air and consist of one or more power-driven compressors, fan motors, condenser coils, liquid receivers and control accessories.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration in compressors.**			
Observation:			
a. Rattling noise.	EA		1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		1
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Deteriorated/clogged coils.**			
Observation:			
a. Damaged coils.	SF		
*** {Severity H}			
b. Dust/debris accumulation on coils.	SF		
*** {Severity F}			

08.08 AIR CONDITIONING - CONDENSER UNITS

COMPONENTS (Continued)

◆ **08.08.01 CONDENSERS - AIR COOLED (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration in fan motor.**			
Observation:			
a. Clicking or rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Fan blade hitting housing.	EA		
*** {Severity M}			
d. Cracked or damaged fan blades.	EA		
*** {Severity H}			
e. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing covers.	EA		
*** {Severity F}			
*** Corroded compressor.**			
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}			

08.08 AIR CONDITIONING - CONDENSER UNITS

COMPONENTS (Continued)

◆ **08.08.01 CONDENSERS - AIR COOLED (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded enclosure.**			
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}			

08.08 AIR CONDITIONING - CONDENSER UNITS

COMPONENTS (Continued)

◆ 08.08.02 CONDENSERS - WATER COOLED

Water cooled condensers are heat exchangers which are designed to transfer heat from hot gaseous refrigerant to water.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration in compressors.**			
Observation:			
a. Rattling noise.	EA		2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		2
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Evidence of water leakage.	EA		
*** {Severity M}			
b. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Damaged enclosure panels.**			
Observation:			
a. Loose enclosure panels.	EA		
*** {Severity L}			
b. Missing or damaged enclosure panel.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose hardware.	EA		
*** {Severity L}			
b. Missing or damaged hardware.	EA		
*** {Severity H}			

08.08 AIR CONDITIONING - CONDENSER UNITS

COMPONENTS (Continued)

◆ 08.08.02 CONDENSERS - WATER COOLED (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded compressor.**			
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}			
*** Corroded water cooled condenser.**			
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}			
*** Corroded enclosure.**			
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}			

08.08 AIR CONDITIONING - CONDENSER UNITS

COMPONENTS (Continued)

◆ 08.08.03 REFRIGERANT PIPING

Refrigerant piping conveys the refrigerant liquid from the condenser to the evaporator and the refrigerant gas from the evaporator to the compressor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or deformed pipe.	LF		
*** {Severity L}			
b. Evidence of refrigerant leakage.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	LF		
*** {Severity M}			
c. Missing insulation.	LF		
*** {Severity H}			

08.08 AIR CONDITIONING - CONDENSER UNITS

REFERENCES

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993

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

3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

4. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment

5. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982

6. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.08 AIR CONDITIONING - CONDENSER UNITS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.08.01-1
2	GS-III 08.08.02-2
3*	GS-III 08.08.02-3*
4*	GS-III 08.08.02-4*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: CONDENSERS - AIR COOLED
CONTROL NUMBER: GS-III 08.08.01-1

Application

This guide applies to the investigation of rattling or grinding noise from compressors, if 10 HP or greater in size.

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 compressor operation and determine possible source of noise.
2. Carefully check compressor supports for loose, damaged or missing fasteners.
3. Check compressor electrical current draw.
4. Check for correct suction and discharge pressure.
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.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the compressor.

1. Ammeter
2. Refrigerant Gauges

Recommended Inspection Frequency

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CONDENSERS - AIR COOLED
CONTROL NUMBER: GS-III 08.08.01-1

References

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.
3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: CONDENSERS - WATER COOLED
CONTROL NUMBER: GS-III 08.08.02-2

Application

This guide applies to the investigation of rattling or grinding noise from compressors, if 10 HP or greater in size.

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 compressor operation and determine possible source of noise.
2. Carefully check compressor supports for loose, damaged or missing fasteners.
3. Check compressor electrical current draw.
4. Check for correct suction and discharge pressure.
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.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the compressor.

1. Ammeter
2. Refrigerant Gauges

Recommended Inspection Frequency

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CONDENSERS - WATER COOLED
CONTROL NUMBER: GS-III 08.08.02-2

References

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.
3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: CONDENSER - WATER COOLED
CONTROL NUMBER: GS-III 08.08.02-3*

Application

This guide applies to the checking of the tubes in the condenser for refrigerant leaks. Do not duplicate this effort if it is being performed under an existing base PM or reoccurring maintenance program.

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. Shut down condenser and lock out disconnect.
2. Isolate unit mechanically by pumping down system and securing valves on associated components.
3. Open end covers and inspect condition of tubes, check for refrigerant leaks using a dye penetrant on suspicious areas.
4. Replace end covers.
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. Restore valves to normal position.
8. Remove lockout on disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the condenser.

1. Dye Penetrant
2. Refrigerant Gauges

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CONDENSER - WATER COOLED
CONTROL NUMBER: GS-III 08.08.02-3*

References

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988.
3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: CONDENSER - WATER COOLED
CONTROL NUMBER: GS-III 08.08.02-4*

Application

This guide applies to checking tubes in the condenser, evaporator and absorber to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or reoccurring maintenance program.

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. Shut down condenser, lock out and tag disconnect.
2. Drain evaporator, absorber and condenser water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions..
4. Document the problem and contact appropriate facility personnel for further instructions, if defects found are not critical to continued function.
5. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
6. Ensure all covers have been installed; remove tags, disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the condenser.

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: CONDENSER - WATER COOLED
CONTROL NUMBER: GS-III 08.08.02-4*

References

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993

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

3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc

4. The Locomotive, The Hartford Steam Boiler Inspection and Insurance Co., Spring 1988, Vol. 66, No.1

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

DESCRIPTION

Air Conditioning - Package Systems is a subsystem of the Building Mechanical Systems. A package air conditioning system is a self contained air conditioning system. The units are normally air cooled or water cooled with remote fluid coolers or cooling towers.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Air Conditioning Package Units, beyond the requirements listed in the Standard Tools 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 Air Conditioning - Package Systems:

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

COMPONENT LIST

- 08.09.01 ENCLOSURES AND SUPPORTS
- 08.09.02 COMPRESSORS
- 08.09.03 CONDENSERS - AIR COOLED
- 08.09.04 CONDENSERS - WATER COOLED
- 08.09.05 EVAPORATORS
- 08.09.06 BLOWERS ASSEMBLIES
- 08.09.07 CONTROLS
- 08.09.08 ASSOCIATED HEATING UNITS

RELATED SUBSYSTEMS

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

08.08	AIR CONDITIONING - CONDENSER UNITS
08.20	AIR HANDLING UNITS
08.21	AIR DISTRIBUTION SYSTEMS
08.24	COOLING TOWERS/EVAPORATIVE CONDENSERS
08.25	AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

08.09 AIR CONDITIONING - PACKAGE 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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Package Air Conditioning Units will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized package air conditioning applications.

COMPONENTS

◆ 08.09.01 ENCLOSURES AND SUPPORTS

The enclosure is the housing for all components contained within the package air conditioning unit. Supports are the structural members that support the package air conditioning components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ **08.09.01 ENCLOSURES AND SUPPORTS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **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.	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}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.02 COMPRESSORS

The compressor consists of a motor driven compressor unit that compresses the refrigerant.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration.**			
Observation:			
a. Rattling or knocking noise.	EA		1
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	EA		1
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose supports or isolators.	EA		
*** {Severity M}			
b. Damaged or missing supports or isolators.	EA		
*** {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}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.03 CONDENSERS - AIR COOLED

An air cooled condenser is a heat exchanger which transfers heat to surrounding air and consist of propeller fans and fin-tube heat exchangers. The condenser serve to liquify the high pressure refrigerant gas.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Deteriorated/clogged coils.**			
Observation:			
a. Damaged coils.	SF		
*** {Severity H}			
b. Dust/debris accumulation on coils.	SF		
*** {Severity F}			
*** Excessive noise or vibration in fan motor.**			
Observation:			
a. Clicking or rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
*** Defective fan blade.**			
Observation:			
a. Fan blade hitting metal housing.	EA		
*** {Severity M}			
b. Cracked or damaged fan blades.	EA		
*** {Severity H}			
*** Defective fan motor mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ **08.09.03 CONDENSERS - AIR COOLED (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corroded condenser coil.**			
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}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.04 CONDENSERS - WATER COOLED

Water cooled condensers are of two types: tube within a tube and shell and tube heat exchangers. The condensers serve to liquify the high pressure refrigerant gas.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage.	EA		
*** {Severity M}			
b. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts.	EA		
*** {Severity H}			
*** Corroded water cooled condenser.**			
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}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.05 EVAPORATORS

The evaporator is that part of the refrigeration system in which refrigerant is vaporized; thereby taking up external heat and producing cooling, and consists of a fin-tube heat exchanger.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage from clogged condensate drain line.	EA		
*** {Severity M}			
b. Evidence of refrigerant, steam or water leakage.	EA		
*** {Severity H}			
*** Clogged/dirty coils.**			
Observation:			
a. Dust/dirt accumulation on coils.	SF		
*** {Severity F}			
*** 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}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	SF		
*** {Severity M}			
c. Missing insulation.	SF		
*** {Severity H}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.06 BLOWER ASSEMBLIES

Blower assemblies move air through the evaporator and air distribution systems. The blowers consists of a blower, motor and drive assembly and can be for supply and return air.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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 blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			
*** Defective blower intake dampers.**			
Observation:			
a. Inoperable dampers.	EA		
*** {Severity M}			
b. Missing dampers.	EA		
*** {Severity H}			
*** Defective mounting blower hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ **08.09.06 BLOWER ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration at motor.**			
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}			
*** Damaged motors.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** 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 electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ **08.09.06 BLOWER ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
c. Damaged coupling.	EA		
*** {Severity H}			
*** Defective belt/coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged belt/coupling guard.	EA		
*** {Severity S}			
*** Defective fan belts.**			
Observation:			
a. Loose fan belt.	EA		
*** {Severity F}			
b. Missing or broken fan belt.	EA		
*** {Severity F}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.07 CONTROLS

Controls govern the operation of the air condition system and include the starting protection devices for the blower assemblies.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		
*** {Severity M}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible.	EA		
*** {Severity S}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ 08.09.08 ASSOCIATED HEATING UNITS

The heating units provide heat to the air being circulated by the blower assembly.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective supports or hangers.**			
Observation:			
a. Loose gas piping/exhaust flue hangers or supports.	EA		
*** {Severity M}			
b. Broken, missing gas piping/exhaust flue, hangers or supports.	EA		
*** {Severity H}			
*** Defective exhaust flue.**			
Observation:			
a. Physically damaged flue, no penetrations.	SF		
*** {Severity M}			
b. Missing or damaged flue, with penetrations.	SF		
*** {Severity H}			
*** Flue 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}			
*** Burner 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}			

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

COMPONENTS (Continued)

◆ **08.09.08 ASSOCIATED HEATING UNITS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors on electric heat elements.**			
Observation:			
a. Loose, burnt or disconnected electrical connections.	EA		
*** {Severity H}			

08.09 AIR CONDITIONING - PACKAGE 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. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

4. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment

5. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982

6. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.09.06-1
2	GS-II 08.09.06-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.09.02-1
2*	GS-III 08.09.02-2*
3*	GS-III 08.09.04-3*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-II 08.09.06-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the fans/blowers, if 60 HP or greater in size.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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 blading for foreign objects and deposit buildup.
6. Inspect blading 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 inspection or other local factors such as problematic conditions.

References

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

2. Maintenance and Operations of Ventilation Systems, NAVFAC MO-114, Vol. III, 1993

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-II 08.09.06-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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.

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: COMPRESSORS
CONTROL NUMBER: GS-III 08.09.02-1

Application

This guide applies to the investigation of rattling, or grinding noise from compressors, if 10 HP or greater in size.

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 compressor operation and determine possible source of noise.
2. Carefully check compressor supports for loose, damaged or missing fasteners.
3. Check compressor electrical current draw.
4. Check for correct suction and discharge pressure.
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.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the compressor.

1. Ammeter
2. Refrigerant gauges

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 Standards, Roger W. Liska, PE, AIC, 1988

3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.09.02-2*

Application

This guide applies to the sampling and analysis of the compressor oil to determine degradation, contamination and machine wear. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

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

Inspection Actions

1. Acquire a 50 ML sample of the chiller oil.
2. Perform a spectrochemical analysis of the oil sample to determine the oil degradation, oil contamination and machine wear.

Special Tools and Equipment

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

1. 50 ML container

Recommended Inspection Frequency

Annually

References

1. Jennings Laboratories 1118 Cypress Ave., Virginia Beach, VA

2. The locomotive, The Hartford Steam Boiler Inspection and Insurance Co., spring 1988, Vol. 66 #1

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: CONDENSERS - WATER COOLED
CONTROL NUMBER: GS-III 08.09.04-3*

Application

This guide applies to checking tubes in the condenser, evaporator and absorber to detect deterioration which could lead to tube failure. Do not duplicate this effort if it is being performed under an existing base PM or reoccurring maintenance program.

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. Shut down condenser, tag and lockout disconnect.
2. Drain evaporator, absorber and condenser water sides.
3. Open end covers, perform eddy current tests in tubes and chart tube conditions..
4. Document the problem and contact appropriate facility personnel for further instructions, if defects found are not critical to continued function.
5. Notify appropriate facility personnel for permission to place unit back in service if defects found are not critical to continued function.
6. Ensure all covers have been installed; remove tags, disconnect and restore unit to service.

Special Tools and Equipment

The following is a list of special tools and equipment, beyond the requirements listed in the Standard Tool Section, required to perform the inspection of the condenser.

1. Multi-frequency signal generator
2. Cathode ray tube
3. Oscilloscope
4. Strip chart recorder
5. Eddy current probe

Recommended Inspection Frequency

Every 3 years.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CONDENSER - WATER COOLED
CONTROL NUMBER: GS-III 08.09.04-3*

References

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993

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

3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

4. The Locomotive, The Hartford Steam Boiler Inspection and Insurance Co., Spring 1988, Vol. 66, No.1

08.10 AIR CONDITIONING - COMPUTER ROOMS

DESCRIPTION

Air Conditioning - Computer Rooms is a subsystem of the Building Mechanical System. Computer room air conditioning systems consist of self-contained units located in the computer room space. The units normally employ remote air cooled fluid coolers or evaporative condensers.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Air Conditioning Package Units, beyond the requirements listed in the Standard Tools 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 Air Conditioning - Computer Rooms Systems.

1. Inspectors should utilize the installations notification procedure to secure safe access to the computer room units.

COMPONENT LIST

- 08.10.01 ENCLOSURES AND SUPPORTS
- 08.10.02 COMPRESSORS
- 08.10.03 CONDENSERS - WATER COOLED
- 08.10.04 EVAPORATORS
- 08.10.05 BLOWERS ASSEMBLIES
- 08.10.06 CONTROLS
- 08.10.07 PIPING AND FITTINGS - REFRIGERANT
- 08.10.08 HUMIDIFIERS
- 08.10.09 AUXILIARY HEATERS
- 08.10.10 FILTERS

RELATED SUBSYSTEMS

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

08.08	AIR CONDITIONING - CONDENSER UNITS
08.20	AIR HANDLING UNITS
08.24	COOLING TOWERS/EVAPORATIVE CONDENSERS
08.25	AIR COOLED CONDENSER - FLUID COOLER

08.10 AIR CONDITIONING - COMPUTER ROOMS

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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Computer Room Air Conditioning Units will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized computer room air conditioning applications.

COMPONENTS

◆ 08.10.01 ENCLOSURES AND SUPPORTS

The enclosure is the housing for all components contained within the computer rooms air conditioning units. Supports are the structural members that support the computer rooms air conditioning components.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ **08.10.01 ENCLOSURES AND SUPPORTS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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.	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}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.02 COMPRESSORS

The compressor consists of a motor driven compressor unit that compresses the refrigerant.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration.**			
Observation:			
a. Rattling noise.	EA		1
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	EA		1
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Evidence of oil/refrigerant leakage.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose supports or isolators.	EA		
*** {Severity M}			
b. Damaged or missing supports or isolators.	EA		
*** {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}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.03 CONDENSERS - WATER COOLED

A water cooled condenser consists of a shell and tube heat exchanger. The condenser serves to liquify the high pressure refrigerant gas.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage.	EA		
*** {Severity M}			
b. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing or damaged base tie-down bolts.	EA		
*** {Severity H}			
*** Corroded water cooled condenser.**			
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}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.04 EVAPORATORS

The evaporator is part of the refrigeration system in which refrigerant is vaporized thereby taking up external heat and producing a cooling effect and consists of a fin-tube heat exchanger.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage from clogged condensate drain line.	EA		
*** {Severity M}			
b. Evidence of refrigerant, steam or water leakage.	EA		
*** {Severity H}			
*** Clogged/dirty coils.**			
Observation:			
a. Dust/dirt accumulation on coils.	SF		
*** {Severity F}			
*** 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}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	SF		
*** {Severity M}			
c. Missing insulation.	SF		
*** {Severity H}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.05 BLOWER ASSEMBLIES

Blowers move air over the evaporator and out into the area being cooled.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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 blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			
*** Defective blower intake dampers.**			
Observation:			
a. Inoperable dampers.	EA		
*** {Severity M}			
b. Missing dampers.	EA		
*** {Severity H}			
*** Defective blower mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.05 BLOWER ASSEMBLIES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **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}			
* **Damaged motors.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
* **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 electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
* **Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.	EA		
*** {Severity H}			
c. Damaged coupling.	EA		
*** {Severity H}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ **08.10.05 BLOWER ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged coupling guard.	EA		
*** {Severity S}			
*** Defective fan belts.**			
Observation:			
a. Loose fan belt.	EA		
*** {Severity F}			
b. Missing or broken fan belt.	EA		
*** {Severity F}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.06 CONTROLS

The controls govern the operation of the air condition system including starting and protective devices.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		
*** {Severity M}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible.	EA		
*** {Severity S}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.07 PIPING AND FITTINGS - REFRIGERANT

Refrigerant piping conveys the refrigerant liquid from the remote condenser to the evaporator and the refrigerant gas from the evaporator to the remote compressor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or deformed pipe.	LF		
*** {Severity L}			
b. Evidence of refrigerant leakage.	LF		
*** {Severity H}			
*** Loose/missing supports or hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken or missing supports or hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or deteriorated insulation.	LF		
*** {Severity M}			
c. Missing insulation.	LF		
*** {Severity H}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.08 HUMIDIFIERS

A humidifier adds moisture to the air moving through the distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	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}			
*** Defective humidifier.**			
Observation:			
a. Damaged enclosure.	EA		
*** {Severity L}			
b. Inoperable humidifier.	EA		
*** {Severity H}			
c. Missing humidifier.	EA		
*** {Severity H}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.09 AUXILIARY HEATERS

Auxiliary heaters provide heat from electrical resistance units to the air being circulated to the computer room.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors on electric heat elements.**			
Observation:			
a. Loose, burnt or disconnected electrical connections.	EA		
*** {Severity F}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

COMPONENTS (Continued)

◆ 08.10.10 FILTERS

Filters clean the air circulated throughout the computer rooms.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective filter rack.**			
Observation:			
a. Loose filter rack housing.	EA		
*** {Severity L}			
b. Dirty filter media.	SF		
*** {Severity F}			
c. Missing filter media.	SF		
*** {Severity F}			

08.10 AIR CONDITIONING - COMPUTER ROOMS

REFERENCES

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993

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

3. Liebert Deluxe Systems/3 Operation and Maintenance Manual

4. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment

5. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982

6. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.10 AIR CONDITIONING - COMPUTER ROOMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.10.05-1

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.10.02-1
2*	GS-III 08.10.02-2*
3*	GS-III 08.10.08-3*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

08.10 AIR CONDITIONING - COMPUTER ROOMS

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BLOWERS ASSEMBLIES
CONTROL NUMBER: GS-II 08.10.05-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the fans/blowers, if 60 HP or greater in size.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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 blading for foreign objects and deposit buildup.
6. Inspect blading 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

2. Maintenance and Operations of Ventilation Systems, NAVFAC MO-114, Vol. III, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.10.02-1

Application

This guide applies to the investigation of rattling, or grinding noise from compressors if 10 HP or greater in size.

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 compressor operation and determine possible source of noise.
2. Carefully check compressor supports for loose, damaged or missing fasteners.
3. Check compressor electrical current draw.
4. Check for correct suction and discharge pressure.
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.

Special Tools and Equipment

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

1. Ammeter
2. Refrigerant gauges

Recommended Inspection Frequency

Perform inspection when triggered by a Level I 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, PE, AIC, 1988

3. Modern Refrigeration and Air Conditioning, The Goodheart-Wilcox Company Inc.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: COMPRESSORS
CONTROL NUMBER: GS-III 08.10.02-2*

Application

This guide applies to the sampling/analysis of the compressor oil to determine degradation, contamination and machine wear. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

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

Inspection Actions

1. Acquire a 50 ML sample of the chiller oil.
2. Perform a spectrochemical analysis of the oil sample to determine the oil degradation, oil contamination and machine wear.

Special Tools and Equipment

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

1. 50 ML container

Recommended Inspection Frequency

Annually

References

1. Jennings Laboratories 1118 Cypress Ave., Virginia Beach, VA

2. The Locomotive, The Hartford Steam Boiler Inspection and Insurance Co. Spring, 1988, Vol. 66

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: HUMIDIFIERS
CONTROL NUMBER: GS-III 08.10.08-3*

Application

This guide applies to the inspection for accumulation of deposits on the humidifier pan. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

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.
2. Avoid contact with hot water in the humidifier pan.

Inspection Actions

1. Open disconnect switch, tag and lock out disconnect.
2. Remove access panel.
3. Investigate leaking pans and for water overflow.
4. Investigate deposits on sides and bottom of humidifier pan.
5. Replace access plate.
6. Notify affected personnel and obtain permission to place unit back in service.
7. Remove tags lockout on disconnect and restore unit to service.

Special Tools and Equipment

No special tools are needed for the performance of the Level III inspection beyond the requirements listed in the Standard Tools Section.

Recommended Inspection Frequency

Semi-annual

References

1. Liebert Deluxe Systems/3, Operation and Maintenance Manual

08.11 AIR CONDITIONING - WINDOW UNITS

DESCRIPTION

Air Conditioning - Window Units is a subsystem of the Building Mechanical Systems. Window unit air conditioners have all components assembled within the unit cabinet and is normally installed in a window or wall opening.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Air Conditioning - Window Units Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following is a list of special safety requirements are needed for the inspection of Air Conditioning - Window Units Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section:

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

COMPONENT LIST

- 08.11.01 CABINET AND SUPPORTS
- 08.11.02 CONTROLS
- 08.11.03 REFRIGERATION CIRCUIT AND FANS

RELATED SUBSYSTEMS

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

08.09 AIR CONDITIONING - PACKAGE SYSTEMS
08.21 AIR DISTRIBUTION SYSTEMS

08.11 AIR CONDITIONING - WINDOW UNITS

STANDARD INSPECTION PROCEDURE

This subsystem requires Level I inspections as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the Field CAIS.

COMPONENTS

◆ 08.11.01 CABINET AND SUPPORTS

The cabinet houses the compressor, fans, motors, coils and controls of window units.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			
*** Damaged cabinet.**			
Observation:			
a. Physically damaged cabinet.	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}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			

08.11 AIR CONDITIONING - WINDOW UNITS

COMPONENTS (Continued)

◆ 08.11.01 CABINET AND SUPPORTS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged grill panels.**			
Observation:			
a. Loose grill panels.	EA		
*** {Severity L}			
b. Missing or damaged grill panels.	EA		
*** {Severity H}			
*** Defective control panel.**			
Observation:			
a. Loose panels.	EA		
*** {Severity M}			
b. Broken or missing panels.	EA		
*** {Severity H}			
*** Defective side panels.**			
Observation:			
a. Loose side panels.	EA		
*** {Severity L}			
b. Missing or damaged side panels.	EA		
*** {Severity H}			

08.11 AIR CONDITIONING - WINDOW UNITS

COMPONENTS (Continued)

◆ 08.11.02 CONTROLS

The controls are used to operate the window units. They consist of switches, thermostats and vent operators.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective controls.**			
Observation:			
a. Broken, missing or damaged switch.	EA		
*** {Severity H}			
b. Broken, missing or damaged thermostat.	EA		
*** {Severity H}			
*** Defective control knobs.**			
Observation:			
a. Broken, missing or damaged control knobs.	EA		
*** {Severity F}			

08.11 AIR CONDITIONING - WINDOW UNITS

COMPONENTS (Continued)

◆ 08.11.03 REFRIGERATION CIRCUIT AND FANS

The refrigeration circuit includes compressors, fans, coils, refrigeration piping and drain pans.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective compressor.**			
Observation:			
a. Inoperable compressor.	EA		
*** {Severity H}			
*** Excessive compressor noise or vibration.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
*** Refrigerant leakage.**			
Observation:			
a. Evidence of oil/refrigerant leakage.	EA		
*** {Severity H}			
*** Deteriorated/clogged coils.**			
Observation:			
a. Damaged coils.	SF		
*** {Severity H}			
b. Dust/debris accumulation on coils.	SF		
*** {Severity F}			
*** Defective fan motor.**			
Observation:			
a. Inoperable fan motor.	EA		
*** {Severity H}			
*** Excessive noise or vibration in fan motor.**			
Observation:			
a. Clicking or rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			

08.11 AIR CONDITIONING - WINDOW UNITS

COMPONENTS (Continued)

◆ 08.11.03 REFRIGERATION CIRCUIT AND FANS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fan blade.**			
Observation:			
a. Fan blade hitting metal housing.	EA		
*** {Severity M}			
b. Cracked or damaged fan blades.	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}			
*** Defective drains, drain piping or supports.**			
Observation:			
a. Loose drain pipe or supports.	EA		
*** {Severity M}			
b. Broken drain, drain piping or supports.	EA		
*** {Severity H}			

08.11 AIR CONDITIONING - WINDOW UNITS

REFERENCES

1. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment
4. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc. 1982
5. Electricity for Refrigeration, Heating, and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.11 AIR CONDITIONING - WINDOW UNITS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
N/A	

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

DESCRIPTION

HVAC Controls, Instrumentation and Energy Management Systems is a subsystem of the Building Mechanical Systems. The System includes devices, equipment, piping and wiring that automatically control the operation of the building mechanical system to provide conditioning of the spaces as required.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of HVAC Controls, Instrumentation and Energy Management Systems, beyond the requirements listed in the Standard Tools 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 HVAC Controls, Instrumentation and Energy Management Systems.

1. Inspectors should utilize the installations notification procedure to secure safe access to the HVAC Controls, Instrumentation and Energy Management Systems.

COMPONENT LIST

- 08.12.01 CONTROLS - SYSTEM
- 08.12.02 INDICATORS, TRANSMITTERS AND SENSORS
- 08.12.03 OPERATORS
- 08.12.04 PIPING AND FITTINGS
- 08.12.05 PANELS
- 08.12.06 AIR COMPRESSORS
- 08.12.07 AIR DRYERS - REFRIGERATED

RELATED SUBSYSTEMS

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

08.08	AIR CONDITIONING - CONDENSER UNITS
08.09	AIR CONDITIONING - PACKAGE SYSTEMS
08.10	AIR CONDITIONING - COMPUTER ROOMS
08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.16	CONDENSER WATER DISTRIBUTION SYSTEMS
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

RELATED SUBSYSTEMS (Continued)

08.20	AIR HANDLING UNITS
08.21	AIR DISTRIBUTION SYSTEMS
08.22	EXHAUST AND VENTILATION SYSTEMS

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT 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 Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized pump and motor applications.

COMPONENTS

◆ 08.12.01 CONTROLS - SYSTEM

Controls are the automatic devices in the panels used to stop, start and/or regulate heating, ventilating and air conditioning systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
Defective controls.			
Observation:			
a. Broken/physically damaged.	EA		
*** {Severity M}			
b. Disconnected or missing.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Evidence of air leakage.	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}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing hardware or supports.	EA		
*** {Severity H}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.02 INDICATORS, TRANSMITTERS AND SENSORS

Indicators, transmitters and sensors are those devices that are used to monitor or record temperature, humidity, pressure, flow, fluid levels and transmit a signal to the control panel.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Inoperable or missing.**			
Observation:			
a. Failed/non-registering mechanism.	EA		
*** {Severity H}			
b. Missing mechanism.	EA		
*** {Severity H}			
*** Damaged or illegible.**			
Observation:			
a. Bent/deformed mechanism.	EA		
*** {Severity M}			
b. Cracked/broken indicator glass.	EA		
*** {Severity H}			
c. Illegible scale.	EA		
*** {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}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.03 OPERATORS

Operators are those devices that automatically trigger mechanisms such as dampers and valves.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective operator.**			
Observation:			
a. Broken/physically damaged.	EA		
*** {Severity M}			
b. Disconnected or missing.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Evidence of air leakage.	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}			
*** Defective assembly hardware.**			
Observation:			
a. Loose assembly hardware.	EA		
*** {Severity M}			
b. Broken/missing assembly hardware.	EA		
*** {Severity H}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.04 PIPING AND FITTINGS

Piping and fittings provide the distribution network for the pneumatic control system. Typical systems are installed with copper pipe. Variations use steel pipe.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Fitting leaking air.	EA		
*** {Severity H}			
*** Defective pipe.**			
Observation:			
a. Bent pipe, not leaking.	LF		
*** {Severity L}			
b. Pipe leaking air.	LF		
*** {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}			
*** Defective pipe labeling/color coding.**			
Observation:			
a. Damaged or missing labels.	EA		
*** {Severity L}			
b. Damaged or missing color coding.	LF		
*** {Severity L}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.04 PIPING AND FITTINGS

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}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.05 PANELS

Panels are the enclosures that house the automatic controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Damaged enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Missing or damaged enclosure panel.	EA		
*** {Severity H}			
*** Defective assembly hardware.**			
Observation:			
a. Loose assembly bolts.	EA		
*** {Severity M}			
b. Broken or missing assembly bolts.	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}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.06 AIR COMPRESSORS

An air compressor is a device that stores and maintains air pressure for operation of HVAC system controls.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Leaking tank, piping, fittings and valves.**			
Observation:			
a. Leaking valve packing glands/seals, evidenced by leaking air.	EA		
*** {Severity M}			
b. Damaged piping, fittings, or valves.	EA		
*** {Severity H}			
c. Stress cracks in tank, evidenced by leaking air.	EA		
*** {Severity H}			
* **Broken/loose assembly bolts.**			
Observation:			
a. Loose compressor or motor assembly bolts.	EA		
*** {Severity M}			
b. Broken or missing compressor or motor assembly bolts.	EA		
*** {Severity H}			
* **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}			
* **Defective pressure gauge.**			
Observation:			
a. Broken gauge or gauge lens.	EA		
*** {Severity L}			
b. Leaking pressure gauge.	EA		
*** {Severity M}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.06 AIR COMPRESSORS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damaged electric equipment.**			
Observation:			
a. Damaged pressure controls.	EA		
*** {Severity H}			
b. Damaged or loose conduit and wiring.	EA		
*** {Severity H}			
*** Corrosion on tank.**			
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}			
*** Inoperable air compressor.**			
Observation:			
a. Broken/missing fan belt.	EA		
*** {Severity F}			
b. Loose fan belt.	EA		
*** {Severity F}			
*** Loose/missing belt guard.**			
Observation:			
a. Loose belt guard.	EA		
*** {Severity S}			
b. Missing belt guard.	EA		
*** {Severity S}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.12.07 AIR DRYERS - REFRIGERATED

Dryers are installed in the distribution line to remove oil and moisture from the air. The most common dryer is a small refrigerated unit employing a hermetic compressor, a shell and tube evaporator and fan-cooled condenser.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective or missing dryer.**			
Observation:			
a. Loose electrical dryer connections.	EA		
*** {Severity L}			
b. Loose, damaged, missing mount fasteners.	EA		
*** {Severity M}			
c. Disconnected dryer.	EA		3
*** {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}			

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

REFERENCES

1. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
2. NAVFAC MO-322, Vol. II Inspection of Shore Facilities, 1993
3. Modern Refrigeration and Air Conditioning; Althouse, Turnquist and Bracciano
4. Honeywell Inc. 77-9367, General Maintenance of Pneumatic Control Systems
5. Robertshaw Controls Co. Product Data Sheets
6. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc., 1982
7. Electricity for Refrigeration, Heating and Air-Conditioning, Second Edition, Russell E. Smith, Breton Publishers, 1983

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1*	GS-III 08.12.01-1*
2*	GS-III 08.12.02-2*
3	GS-III 08.12.07-3

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1*

COMPONENT: CONTROLS - SYSTEM
CONTROL NUMBER: GS-III 08.12.01-1*

Application

This guide applies to the checking of the control interlocks to insure that the safeties and sequences of the HVAC systems are intact and as designed.

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. Review system design and sequence of operation.
2. Perform complete shut-down and start-up sequence.
3. Induce faults in 5% of the controls to check safeties and operation of system lockouts.
4. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
5. Notify affected facility personnel for permission to place unit back in service if defect is not critical to continued function.

Special Tools and Equipment

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

1. Mechanics Tool Set
2. Ammeter
3. Voltmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CONTROLS - SYSTEM
CONTROL NUMBER: GS-III 08.12.01-1*

References

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

2. U.S. Coast Guard Support Center, Elizabeth City, NC, Specification SMD 0028, March 1992, Boiler and Pressure Vessel Inspection and Testing Services

3. NAVFAC MO-324, Inspection and Certification of Boilers and Unfired Pressure Vessels, 1992

4. TRANE CVHB0M05A, Operation/Maintenance Centrifugal Chiller

5. CARRIER 1992/1993, Products and Systems Master Catalog

6. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems Equipment

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: INDICATORS, TRANSMITTERS AND SENSORS
CONTROL NUMBER: GS-III 08.12.02-2*

Application

This guide applies to the performing a check of the operation of the control indicators, transmitters and sensors.

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 system out of service.

Inspection Actions

1. Check with the affected facility personnel for problems with the control system.
2. Check the calibration and operation of 10% of the control indicators, transmitters and sensors.
3. Check 5% of the actuators and operators for proper operation, based upon manufacturer specifications..
4. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
5. Notify affected facility personnel for permission to place unit back in service if defect is not critical to continued function.

Special Tools and Equipment

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

1. Mechanics Tool Set
2. Ammeter
3. Voltmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: INDICATORS, TRANSMITTERS AND SENSORS
CONTROL NUMBER: GS-III 08.12.02-2*

References

1. NAVFAC MO-322, Vol. 2, Inspection of Shore Facilities, 1993

2. U.S. Coast Guard Support Center, Elizabeth City, NC, Specification SMD 0028, March 1992, Boiler and Pressure Vessel Inspection and Testing Services

3. NAVFAC MO-324, Inspection and Certification of Boilers and Unfired Pressure Vessels, 1992

4. TRANE CVHB0M05A, Operation/Maintenance Centrifugal Chiller

5. CARRIER 1992/1993, Products and Systems Master Catalog

6. 1992 ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems Equipment

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: DRYERS - REFRIGERATED
CONTROL NUMBER: GS-III 08.12.07-3

Application

This guide applies to the investigation of defective refrigerated air dryer compressors, evaporators and condensers.

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

Prior to Shutdown:

1. Perform leak test on pressurized air/gas systems using bubble test and gas leak detectors.
2. Monitor discharge head, evaporator temperature and discharge humidity and compare against rating data.

Unit Shutdown:

3. Turn off unit and lock out disconnect.
4. Tag out all electrical devices.
5. Isolate unit mechanically.
6. Tag out all secured valves.
7. Open drain valves and remove air pressure from system.

Shutdown Inspection:

8. Open and inspect moisture trap. Check for worn or loose discs and guide assemblies, worn seats; note any corrosion buildup that could interfere with trap operation.
9. Open and inspect system controls. Check contact for pitting, burning; check wiring for fraying, loose fasteners.
10. Cycle isolation valves to check for proper operation; not binding; proper seating.

Return to Service:

13. Ensure that all tools, equipment and materials used for inspection have been removed from the unit.
14. Ensure that all guards and covers have been reinstalled.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: DRYERS - REFRIGERATED
CONTROL NUMBER: GS-III 08.12.07-3

Return to Service: (Continued)

15. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
16. Notify affected facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Restore valves to normal position.
18. Remove lockout on disconnect and restore unit to service.
19. Remove tags from all devices.

Special Tools and Equipment

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

1. Mechanics Tool Set
2. Calipers
3. Ammeter
4. Voltmeter
5. Bubble test detector
6. Gas leak detector

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. 2, Inspection of Shore Facilities, 1993

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

08.13 TERMINAL UNITS

DESCRIPTION

Terminal Units is a subsystem of the Building Mechanical System. Terminal units are devices that provide cooling and/or heating of the air to an area. The source of cooling/heating to the units is provided by chilled water, hot water, steam, electrical, gas, or oil distribution systems.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Terminal Unit Systems, beyond the requirements listed in the Standard Tools 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 Terminal Units Systems.

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

COMPONENT LIST

- 08.13.01 RADIATORS/BASEBOARD HEATERS
- 08.13.02 REHEAT COILS
- 08.13.03 CABINET HEATERS
- 08.13.04 FAN COIL UNITS
- 08.13.05 UNIT HEATERS - GAS/OIL
- 08.13.06 UNIT HEATERS - STEAM/HOT WATER/ELECTRIC
- 08.13.07 UNIT HEATERS - GAS RADIANT

RELATED SUBSYSTEMS

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

08.12	HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS
08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS

08.13 TERMINAL UNITS

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 Field CAIS.

The inspection of Terminal Units will be scheduled when the equipment is in operation.

COMPONENTS

◆ 08.13.01 RADIATORS/BASEBOARD HEATERS

Radiators are normally cast iron heating units located under windows in the rooms or spaces to be heated. Typically, radiators are covered by some type of enclosures. Baseboard heaters are normally enclosed fin and tube heating units located horizontally at the base of walls in the rooms or spaces to be heated. The source of heat for baseboard heaters is steam, hot water or electricity.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective heating elements.**			
Observation:			
a. Physically damaged.	LF		
*** {Severity H}			
b. Leaking water or steam.	EA		
*** {Severity H}			
c. Broken electric element.	LF		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			
*** Defective enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	EA		
*** {Severity H}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.01 RADIATORS/BASEBOARD HEATERS (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}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.02 REHEAT COILS

Reheat coils are installed in air supply ducts to reheat the air being supplied to individual spaces or a group of spaces, as needed, to control the temperature. The source of heat for the reheat coils is steam, hot water or electricity.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coil.**			
Observation:			
a. Physically damaged.	SF		
*** {Severity H}			
b. Leaking water or steam.	EA		
*** {Severity H}			
c. Broken electric element.	SF		
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** 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}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.03 CABINET HEATERS

A cabinet heater is a metal housing enclosing a heating element with openings to facilitate air flow. The heater frequently contains a fan for controlling the air flow. The source of heat for the cabinet heaters is from the hot water, steam or electric distribution systems. Cabinet heaters are usually located under windows and secured to the walls in the spaces they serve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective heating elements.**			
Observation:			
a. Physically damaged.	LF		
*** {Severity H}			
b. Leaking water or steam.	EA		
*** {Severity H}			
c. Broken electric element.	LF		
*** {Severity H}			
*** Defective motor/fan.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Disconnected motor.	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}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.03 CABINET HEATERS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	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}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.04 FAN COIL UNITS

A fan coil unit includes a cooling and heating coil, fan, filter, metal enclosures and drain pan. It operates by moving air through an opening in the unit and across the coil. The source of cooling/heating is from chilled water and hot water heating or steam distribution systems. Fan coil units are usually secured to the walls or suspended from the ceiling in the spaces they serve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coil.**			
Observation:			
a. Physically damaged.	SF		
*** {Severity H}			
b. Leaking water or steam.	EA		
*** {Severity H}			
c. Inoperable coil.	SF		
*** {Severity H}			
*** Defective motor/fan.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Inoperable fan.	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}			
c. Damaged or missing controls	EA		
*** {Severity L}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ **08.13.04 FAN COIL UNITS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			
*** Defective enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	EA		
*** {Severity H}			
c. Missing filter.	SF		
*** {Severity H}			
d. Water leaking from condensate drain or pan connection.	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}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.05 UNIT HEATERS - GAS/OIL

A gas or oil unit heater includes a heating element, burner, fan motor and metal enclosures. The unit heater produces heat by combustion of the fuel in the burner and then forces air across the heated element. The source of fuel is from a gas or oil distribution systems. These unit heaters are usually hung from the wall or ceiling in the space they serve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective burner.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Rattling or grinding noise.	EA		
*** {Severity M}			
c. Evidence of leaking fuel.	EA		
*** {Severity H}			
*** Defective combustion chamber.**			
Observation:			
a. Physically damaged.	EA		
*** {Severity H}			
*** Defective exhaust flue.**			
Observation:			
a. Physically damaged flue, no penetrations.	SF		
*** {Severity M}			
b. Physically damaged flue, with penetrations.	SF		
*** {Severity H}			
c. Disconnected flue damper.	EA		
*** {Severity H}			
*** Defective motor/fan.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.05 UNIT HEATERS - GAS/OIL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			
*** Defective enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	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}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.06 UNIT HEATERS - STEAM/HOT WATER/ELECTRIC

A steam, hot water or electric unit heater includes a heating element, fan, motor and metal enclosures. The unit heater operates by forcing air across the heating element. Hot water, steam or electricity is supplied to the heating element by the respective distribution systems. These unit heaters are usually hung from the walls or ceilings in the spaces they serve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective heating elements.**			
Observation:			
a. Physically damaged.	LF		
*** {Severity H}			
b. Leaking water or steam.	EA		
*** {Severity H}			
c. Broken electric element.	LF		
*** {Severity H}			
*** Defective motor/fan.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity H}			
b. Grinding noise, indicating metal to metal contact.	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}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ **08.13.06 UNIT HEATERS - STEAM/HOT WATER/ELECTRIC (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Physically damaged or missing enclosure.	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}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.07 UNIT HEATERS - GAS RADIANT

A gas radiant unit heater includes a heating element, burner, reflector and metal enclosure. Heat is radiated from the heating element and reflected by the reflector. These unit heaters are usually hung from the walls or ceilings in the spaces they serve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective burner.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Rattling or grinding noise.	EA		
*** {Severity M}			
c. Evidence of leaking fuel.	EA		
*** {Severity H}			
*** Defective heating elements.**			
Observation:			
a. Physically damaged heating element, not leaking exhaust fumes.	LF		
*** {Severity M}			
b. Damaged or missing heating element, leaking exhaust fumes.	LF		
*** {Severity H}			
*** Defective exhaust flue.**			
Observation:			
a. Physically damaged flue, no penetrations.	SF		
*** {Severity M}			
b. Physically damaged flue, with penetrations.	SF		
*** {Severity H}			
c. Disconnected flue damper.	EA		
*** {Severity H}			

08.13 TERMINAL UNITS

COMPONENTS (Continued)

◆ 08.13.07 UNIT HEATERS - GAS RADIANT (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			
*** Defective reflector.**			
Observation:			
a. Loose reflector.	EA		
*** {Severity M}			
b. Physically damaged or missing reflector.	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}			

08.13 TERMINAL UNITS

REFERENCES

1. NAVFAC MO-322, Vol. II, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. Means Illustrated Construction Dictionary, 1991
4. W. W. Grainger, Inc., Catalog No. 375
5. McMaster - Carr Supply Co. Catalog No. 94

08.13 TERMINAL UNITS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER

N/A

08.14 BOILER FEEDWATER SYSTEMS

DESCRIPTION

Boiler Feedwater Systems is a subsystem of the Building Mechanical Systems. 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

- 08.14.01 PUMP BASE AND COUPLING
- 08.14.02 PUMPS
- 08.14.03 MOTORS
- 08.14.04 CONTROLS
- 08.14.05 PIPING, FITTINGS AND VALVES
- 08.14.06 DEAERATOR TANKS

RELATED SUBSYSTEMS

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

08.01 HEATING BOILERS - GAS/OIL
08.18 STEAM CONDENSATE RETURN SYSTEMS

08.14 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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Boiler Feedwater System will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.14.01 PUMP BASE AND COUPLING

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}			
*** 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.01 PUMP BASE AND COUPLING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

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

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.03 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.04 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.05 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.05 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.06 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}			

08.14 BOILER FEEDWATER SYSTEMS

COMPONENTS (Continued)

◆ 08.14.06 DEAERATOR TANKS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* **Defective float/hardware.**			
Observation:			
a. Loose, deformed, binding linkage.	EA		
*** {Severity H}			
b. Float system inoperable.	EA		
*** {Severity H}			
c. Float alarm inoperable.	EA		
*** {Severity H}			
* **Physical tank damage.**			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Impact damage, dents.	SF		
*** {Severity M}			
* **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}			

08.14 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

08.14 BOILER FEEDWATER SYSTEMS

LEVEL II KEYS	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.14.02-1

LEVEL III KEYS	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.14.02-1

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 08.14.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.

References

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

2. NAVFAC M0-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 08.14.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.
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.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 08.14.02-1

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

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

DESCRIPTION

Chilled Water Distribution Systems is a subsystem of the Building Mechanical System. The typical chilled water distribution system circulates chilled water from the generating equipment or from the exterior chilled water distribution system to equipment that provides conditioned air throughout the building.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

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

COMPONENT LIST

- 08.15.01 PUMP BASES AND COUPLINGS
- 08.15.02 PUMPS
- 08.15.03 MOTORS
- 08.15.04 CONTROLS
- 08.15.05 EXPANSION TANKS
- 08.15.06 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.

08.04	CHILLERS - ABSORPTION
08.05	CHILLERS - CENTRIFUGAL
08.06	CHILLERS - RECIPROCATING
08.07	CHILLERS - SCREW
23.05	CHILLED WATER DISTRIBUTION SYSTEMS

08.15 CHILLED 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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Chilled Water Distribution System will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.15.01 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}			
*** Defective mounting hardware.**			
Observation:			
a. Loose base tie-down bolts.	EA		
*** {Severity M}			
b. Missing base tie-down bolts or isolators.	EA		
*** {Severity H}			
*** Defective coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing coupling guard.	EA		
*** {Severity H}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.01 PUMP BASES AND COUPLINGS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.		EA	
*** {Severity H}			
*** Corrosion (base).**			
Observations:			
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}			
*** Abandoned pump assembly (disconnected).**			
Observation:			
a. Inactive pump abandoned, requiring proper disposal.	EA		
*** {Severity L}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.02 PUMPS

Pumps provide for chilled 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.**			
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. Missing or damaged insulation.	SF		
*** {Severity H}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **08.15.02 PUMPS (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}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.03 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	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.04 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		5
*** {Severity H}			
*** Physically damaged 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}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.05 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.**			
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. Missing or damaged insulation.	SF		
*** {Severity H}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.05 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}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.06 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the chilled water system. Valves are installed to control the water supply, isolate system 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 Guides or anchors.**			
Observation:			
a. Loose guides or anchors.	EA		
*** {Severity L}			
b. Broken or missing guides or anchors.	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}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **08.15.06 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 M}			
*** 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}			

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.15.06 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective pipe labeling.**			
Observation:			
a. Damaged/missing labels.	EA		
*** {Severity L}			

08.15 CHILLED 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

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.15.02-1
2	GS-II 08.15.03-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.15.02-1
2	GS-III 08.15.03-2
3	GS-III 08.15.03-3
4*	GS-III 08.15.03-4*
5	GS-III 08.15.04-5
6*	GS-III 08.15.06-6*
7*	GS-III 08.15.06-7*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 08.15.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.

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 08.15.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.

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 08.15.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.
15. Notify appropriate 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.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 08.15.02-1

Special Tools and Equipment

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

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: MOTORS
CONTROL NUMBER: GS-III 08.15.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
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.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.15.03-2

Recommended Inspection Frequency

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

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.15.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.15.03-3

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
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.

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.15.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.15.03-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc..

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 08.15.04-5

Application

This guide applies to the investigation of electrical arcing noise from the controls, if motor is 60 HP or greater in size.

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 lockout 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

Recommended Inspection Frequency

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

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 08.15.04-5

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.15.06-6*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

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

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.15.06-7*

Application

This guide applies to performing an efficiency check of the flow rate of the chilled water distribution system.

Special Safety Requirements

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

Inspection Actions

1. Review the design specifications of the distribution system to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

DESCRIPTION

Condenser Water Distribution Systems is a subsystem of the Building Mechanical Systems. The condenser water distribution system circulates treated water between the cooling generating equipment and the cooling tower for the purpose of heat dissipation.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

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

COMPONENT LIST

- 08.16.01 PUMP BASE AND COUPLING
- 08.16.02 PUMPS
- 08.16.03 MOTORS
- 08.16.04 CONTROLS
- 08.16.05 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.

08.04	CHILLERS - ABSORPTION
08.05	CHILLERS - CENTRIFUGAL
08.06	CHILLERS - RECIPROCATING
08.07	CHILLERS - SCREW
08.08	AIR CONDITIONING - SPLIT SYSTEMS
08.09	AIR CONDITIONING - PACKAGE SYSTEMS
08.24	COOLING TOWERS/EVAPORATIVE CONDENSERS

08.16 CONDENSER 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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Condenser Water Distribution Systems will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.16.01 PUMP BASE AND COUPLING.

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}			
*** 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}			

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.16.01 PUMP BASE AND COUPLING (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Loose/damaged 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}			

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.16.02 PUMPS

Pumps provide for condenser 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 H}			
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 M}			
*** 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}			

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.16.03 MOTORS

Electric motors are used to drive the circulating pumps. In-line circulator 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	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.16.04 CONTROLS

Controls govern the operation of the pump equipment and consist of disconnects, starters and controllers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		5
*** {Severity H}			
*** Physically damaged 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}			

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.16.05 PIPING, FITTINGS AND VALVES

Piping and fittings provide the distribution network for the condenser water distribution system. Valves are installed to isolate or divert portions of the 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 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}			
*** Loose/missing supports/hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken/missing supports/hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged/missing insulation.	LF		
*** {Severity M}			

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **08.16.05 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/missing labels.	EA		
*** {Severity L}			

08.16 CONDENSER 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. NAVFAC MO-209, Maintenance of Steam, Hot Water and Compressed Air Distribution Systems, 1989

4. NAVFAC P-717.0, Department of Defense, Engineered Performance Standards for Real Property Maintenance Activities

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.16.02-1
2	GS-II 08.16.03-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.16.02-1
2	GS-III 08.16.03-2
3	GS-III 08.16.03-3
4*	GS-III 08.16.03-4*
5	GS-III 08.16.04-5
6*	GS-III 08.16.06-6*
7*	GS-III 08.16.06-7*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 08.16.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.

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 08.16.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.

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 08.16.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.
15. Notify appropriate 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.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 08.16.02-1

Special Tools and Equipment

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

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: MOTORS
CONTROL NUMBER: GS-III 08.16.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
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.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.16.03-2

Recommended Inspection Frequency

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

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.16.03-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.16.03-3

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
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.

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.16.03-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.16.03-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc..

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 08.16.04-5

Application

This guide applies to the investigation of electrical arcing noise from the controls, if the motor is 60 HP or greater in size.

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 lockout 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

Recommended Inspection Frequency

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

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5 (Continued)

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 08.16.04-5

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.16.06-6*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

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

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.16.06-7*

Application

This guide applies to performing an efficiency check of the flow rate of the condenser water distribution system.

Special Safety Requirements

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

Inspection Actions

1. Review the design specifications of the distribution system to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

08.17 STEAM DISTRIBUTION SYSTEMS

DESCRIPTION

Steam Distribution Systems is a subsystem of the Building Mechanical System. The steam distribution system provides steam circulation between the steam generating equipment or the exterior steam distribution system and the facility steam devices.

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

- 08.17.01 PIPING, FITTINGS AND VALVES
- 08.17.02 PRESSURE REDUCING STATIONS
- 08.17.03 STEAM TRAPS

RELATED SUBSYSTEMS

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

08.01	HEATING BOILERS - GAS/OIL
08.02	HEATING BOILERS - ELECTRIC
08.18	STEAM CONDENSATE RETURN SYSTEMS
23.07	STEAM DISTRIBUTION SYSTEMS
23.08	STEAM CONDENSATE RETURN SYSTEMS

08.17 STEAM DISTRIBUTION 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 Field CAIS.

The inspection of Steam Distribution System will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.17.01 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}			
*** Damaged/defective strainer.**			
Observation:			
a. Cracked strainer, not leaking.	EA		
*** {Severity M}			
b. Cracked strainer, steam leaking.	EA		
*** {Severity H}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **08.17.01 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Loose/missing supports/hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken/missing supports/hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			
*** Defective valve.**			
Observation:			
a. Broken/missing valve handle.	EA		
*** {Severity L}			
b. Bent stem.	EA		
*** {Severity M}			
c. Leaking valve.	EA		
*** {Severity M}			
d. Cracked valve body.	EA		
*** {Severity H}			
e. Inoperable valve.	EA		
*** {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}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ **08.17.01 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.17.02 PRESSURE REDUCING STATIONS

Pressure reducing stations are used to reduce the pressure of a steam source to a 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}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.17.02 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 F}			
c. Leaking gauge.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity M}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.17.02 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}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.17.03 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.	EA		3
*** {Severity H}			
b. Broken/damaged steam trap.	EA		3
*** {Severity H}			
*** Continuously discharging condensate.**			
Observation:			
a. Trap is not sized correctly.	EA		
*** {Severity M}			
b. Damaged/defective trap.	EA		3
*** {Severity H}			
*** Cold trap - no discharge.**			
Observation:			
a. No condensate/steam coming to trap.	EA		4
*** {Severity M}			
b. Pipe line/fittings plugged.	EA		4
*** {Severity M}			
c. Strainer plugged.	EA		4
*** {Severity M}			
d. Broken/damaged steam trap.	EA		3
*** {Severity H}			
e. Broken valve in line to trap.	EA		
*** {Severity H}			

08.17 STEAM DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.17.03 STEAM TRAPS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Hot trap - no discharge.**			
Observation:			
a. No condensate coming to trap.	EA		
*** {Severity M}			
b. Improper installation, trap installed above leaking by-pass valve.	EA		
*** {Severity M}			
c. Broken/damaged steam trap.	EA		3
*** {Severity H}			
d. Noisy high pitch sound.	EA		3
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion (no pitting evident).	EA		
*** {Severity L}			
b. Surface corrosion evident by pitting or blistering.	EA		
*** {Severity M}			
c. Surface corrosion evident by holes or loss of base metal.	EA		
*** {Severity H}			

08.17 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

08.17 STEAM DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.17.01-1
2*	GS-III 08.17.01-2*
3	GS-III 08.17.03-3
4	GS-III 08.17.03-4

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.17.01-1

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.2, 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, 1988

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.17.01-2*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

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

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: STEAM TRAPS
CONTROL NUMBER: GS-III 08.17.03-3

Application

This guide applies to the investigation of the proper operation of a steam trap using a 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. Thermo-dynamic 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

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

1. Audio amplifier

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: STEAM TRAPS
CONTROL NUMBER: GS-III 08.17.03-3

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.2, 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. 4

COMPONENT: STEAM TRAPS
CONTROL NUMBER: GS-III 08.17.03-4

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 20 degrees F, 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.2, 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

08.18 STEAM CONDENSATE RETURN SYSTEMS

DESCRIPTION

Steam Condensate Return Systems is a subsystem of the Building Mechanical System. The steam condensate return system collects steam condensate and delivers it to the "condensate return tank" in facilities that have their own heating boiler. condensate is delivered to the "condensate return unit" if the steam to the facility is supplied by an exterior distribution system.

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 Steam Condensate Return Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 08.18.01 STEAM CONDENSATE RETURN UNIT
- 08.18.02 PIPING, FITTINGS AND VALVES
- 08.18.03 CONDENSATE RETURN TANK

RELATED SUBSYSTEMS

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

08.14	BOILER FEEDWATER SYSTEMS
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
23.07	STEAM DISTRIBUTION SYSTEMS
23.08	STEAM CONDENSATE RETURN SYSTEMS

08.18 STEAM CONDENSATE RETURN 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 Field CAIS.

The inspection of Steam Condensate Return System will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.18.01 STEAM CONDENSATE RETURN UNIT

The steam condensate return unit collects and delivers condensate to the exterior steam condensate return system. This component is not applicable for facilities that have their own boilers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage at tank.**			
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}			
*** Physical tank damage.**			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Impact damage, dents.	SF		
*** {Severity M}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 08.18.01 STEAM CONDENSATE RETURN UNIT (Continued)

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

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 08.18.01 STEAM CONDENSATE RETURN UNIT (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise and vibration at motor.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
*** Physically damaged controls.**			
Observation:			
a. Missing or damaged level switches.	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}			
*** Corrosion at tank.**			
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}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 08.18.02 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.	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}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ **08.18.02 PIPING, FITTINGS AND VALVES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Missing or damaged 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}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 08.18.02 PIPING, FITTINGS AND VALVES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 08.18.03 CONDENSATE RETURN TANK

The Condensate return tank provides a collection point for returned steam condensate. This component is not applicable if condensate is delivered to an exterior steam condensate return system.

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}			
*** Physical tank damage.**			
Observation:			
a. Impact damage, dents.	SF		
*** {Severity M}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Missing or damaged insulation.	SF		
*** {Severity H}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

COMPONENTS (Continued)

◆ 08.18.03 CONDENSATE RETURN TANK

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}			

08.18 STEAM CONDENSATE RETURN SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. 2, 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

08.18 STEAM CONDENSATE RETURN SYSTEMS

LEVEL II KEYS	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1 *	GS-III 08.18.02-1 *

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

08.18 STEAM CONDENSATE RETURN SYSTEMS

LEVEL III GUIDE SHEET - KEY NO. 1*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.18.02-1*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

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

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facility Maintenance & Repair Cost Data 1994

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

DESCRIPTION

Heating Hot Water Distribution Systems is a subsystem of the Building Mechanical System. The Heating Hot Water Distribution System circulates hot water between the hot water generating equipment or the exterior hot water distribution system 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 Heating Hot Water Distribution Systems, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 08.19.01 PUMP BASES AND COUPLINGS
- 08.19.02 PUMPS
- 08.19.03 MOTORS
- 08.19.04 CONTROLS
- 08.19.05 EXPANSION TANKS
- 08.19.06 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.

08.01	HEATING BOILERS - GAS/OIL
08.02	HEATING BOILERS - ELECTRIC
23.09	HEATING HOT WATER DISTRIBUTION SYSTEMS

08.19 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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Hot Water Heating Distribution System will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.19.01 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 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}			
*** 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.01 PUMP BASES AND COUPLINGS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.02 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.03 MOTORS

Electric motors are used to drive the circulating pumps. In-line circulating pumps are typically driven via spring-coupled motors, pedestal-mounted pumps re 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	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.04 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.05 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.05 EXPANSION TANKS (Continued)

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

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.06 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.19.06 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}			

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol. 2, 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.

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

LEVEL II KEYS	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.19.02-1
2	GS-II 08.19.03-2

LEVEL III KEYS	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.19.02-1
2	GS-III 08.19.04-2
3	GS-III 08.19.03-3
4	GS-III 08.19.03-4
5*	GS-III 08.19.03-5*
6*	GS-III 08.19.06-6*
7*	GS-III 08.19.06-7*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: PUMPS
CONTROL NUMBER: GS-II 08.19.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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.

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 08.19.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.

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 08.19.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the pump, if 40 GPM or greater in size.

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 by securing air or water lines.
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.
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.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: PUMPS
CONTROL NUMBER: GS-III 08.19.02-1

Special Tools and Equipment

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

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 08.19.04-2

Application

This guide applies to the investigation of electrical arcing noise from the controls, if the motor is 60 HP or greater in size.

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

Recommended Inspection Frequency

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: CONTROLS
CONTROL NUMBER: GS-III 08.19.04-2

References

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

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.19.03-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
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.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.19.03-3

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. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.19.03-4

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.19.03-4

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
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.

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.19.03-5*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 5* (Continued)

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.19.03-5*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc..

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 6*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.19.06-6*

Application

This guide applies to the use of an ultrasonic thickness gauge to determine sediment buildup or detect internal flaws and corrosion of the walls in piping, fittings and valves.

Special Safety Requirements

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

Inspection Actions

1. Use the ultrasonic thickness testing device to measure the wall thickness of the suspected area.
2. Document the readings and compare to wall thickness of piping in ASTM manual to determine if piping/fittings and defective or damaged.

Special Tools and Equipment

1. Ultrasonic Thickness Gauge

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523
2. Means Facility Maintenance & Repair Cost Data 1994

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 7*

COMPONENT: PIPING, FITTINGS AND VALVES
CONTROL NUMBER: GS-III 08.19.06-7*

Application

This guide applies to performing an efficiency check of the flow rate of the chilled water distribution system.

Special Safety Requirements

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

Inspection Actions

1. Review the design specifications of the distribution system to determine the flow rate, the total dynamic head and the design amperes of the pumps and pump motor.
2. Determine the existing flow conditions.
3. Document the readings, compare to the design specifications and report results to the facility personnel.

Special Tools and Equipment

1. Ultrasonic Flow Meter
2. Infrared Temperature Tester
3. Ammeter
4. Voltmeter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a five year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

08.20 AIR HANDLING UNITS

DESCRIPTION

Air Handling Units is a subsystem of the Building Mechanical Systems. Air Handling Units are the packaged assembly of components (coil section, blower, etc.) which provide for the moving and treatment of air through the air distribution system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Air Handling Units Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Air Handling Units Systems.

1. Inspectors should utilize the installation's notification procedure to secure safe access to the air handlers.

COMPONENT LIST

- 08.20.01 ENCLOSURES AND SUPPORTS
- 08.20.02 DAMPERS
- 08.20.03 FILTER RACKS
- 08.20.04 COIL SECTION
- 08.20.05 BLOWERS
- 08.20.06 MOTORS
- 08.20.07 DRIVE ASSEMBLIES
- 08.20.08 CONTROLS

RELATED SUBSYSTEMS

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

08.12	HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS
08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.17	STEAM DISTRIBUTION SYSTEMS
08.18	STEAM CONDENSATE RETURN SYSTEMS
08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS
08.21	AIR DISTRIBUTION SYSTEMS

08.20 AIR HANDLING UNITS

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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Air Handling Units will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.20.01 ENCLOSURES AND SUPPORTS

The enclosure is the housing for all components contained within the air handling units. Supports are the structural members that support the air handling units.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking.**			
Observation:			
a. Air leaking at enclosure joints or openings.	EA		
*** {Severity L}			
b. Water leaking from base or enclosure.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
B. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Damaged enclosure.**			
Observation:			
a. Loose enclosure panel.	EA		
*** {Severity L}			
b. Missing or damaged enclosure panel.	EA		
*** {Severity H}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.01 ENCLOSURES AND SUPPORTS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.02 DAMPERS

Dampers are 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.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective dampers.**			
Observation:			
a. Loose operator or damper linkage.	EA		
*** {Severity M}			
b. Broken or missing dampers.	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}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.03 FILTER RACKS

Filter racks are frames that support filters within the air handler.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective filter rack.**			
Observation:			
a. Loose filter rack housing.	EA		
*** {Severity L}			
b. Missing filter rack drive.	EA		
*** {Severity H}			
c. Missing filter rack.	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}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.04 COIL SECTION

The coil section is a contained fin-tube heat exchanger, in which steam, hot water, cold water or refrigeration passes to condition the air.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage.**			
Observation:			
a. Evidence of water leakage from clogged condensate drain line.	EA		
*** {Severity M}			
b. Evidence of refrigerant, steam or water leakage.	EA		
*** {Severity H}			
*** Clogged/dirty coils.**			
Observation:			
a. Dust/dirt accumulation on coils.	SF		
*** {Severity F}			
*** 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}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.05 BLOWERS

The blower moves the air through the evaporator and air distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration.**			
Observation:			
a. Rattling noise.	EA	1	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	
*** {Severity H}			
*** Defective blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ **08.20.05 BLOWERS (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}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.06 MOTORS

Electric motors are used to drive the blowers in an air handling unit.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration.**			
Observation:			
a. Rattling noise.	EA	2	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	1
*** {Severity H}			
c. Electrical arcing noise.	EA		2
*** {Severity H}			
*** Defective motor.**			
Observation:			
a. Cracked or damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	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}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.07 DRIVE ASSEMBLIES

The drive assembly is the mechanical connection between the blower and motor.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.		EA	
*** {Severity H}			
*** Defective belt/coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged belt/coupling guard.	EA		
*** {Severity S}			
*** Defective fan belts.**			
Observation:			
a. Loose fan belt.	EA		
*** {Severity F}			
b. Missing or broken fan belt.		EA	
*** {Severity F}			

08.20 AIR HANDLING UNITS

COMPONENTS (Continued)

◆ 08.20.08 CONTROLS

Controls govern the operation of the air handling unit and consist of switches, relays, disconnects and protection devices for the electric motors.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise.**			
Observation:			
a. Electrical arcing noise.	EA		
*** {Severity M}			
*** Physically damaged control panel.**			
Observation:			
a. Physically damaged control panel.	EA		
*** {Severity M}			
b. Burned out pilot lamps.	EA		
*** {Severity F}			
c. Control panel blocked, not accessible.	EA		
*** {Severity S}			

08.20 AIR HANDLING UNITS

REFERENCES

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

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

3. Means Mechanical Cost Data, 16th Annual Edition, 1993

4. Richardson Engineering Services General Construction Estimating Standards, Vol. 3

5. Refrigeration and Air-Conditioning, Second Edition, Billy C. Langley, Reston Publishing Company, Inc., 1982

6. Electricity for Refrigeration, Heating and Air-Conditioning, Second Edition, Russel E. Smith, Breton Publishers, 1983

08.20 AIR HANDLING UNITS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.20.05-1
2	GS-II 08.20.06-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.20.06-1
2	GS-II 08,20.06-2
3*	GS-II 08.20.06-3*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BLOWERS
CONTROL NUMBER: GS-II 08.20.05-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the blowers, if 24" in diameter or greater.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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 blading for foreign objects and deposit buildup.
6. Inspect blading 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

2. NAVFAC MO-114, Vol. 3, Maintenance and Operations of Ventilation Systems

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 08.20.06-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.

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: MOTORS
CONTROL NUMBER: GS-III 08.20.06-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
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.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.20.06-1

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. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.20.06-2

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.20.06-2

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
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.

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.20.06-3*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: MOTORS
CONTROL NUMBER: GS-III 08.20.06-3*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc..

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

08.21 AIR DISTRIBUTION SYSTEMS

DESCRIPTION

Air Distribution Systems is a subsystem of the Building Mechanical Systems. The air is distributed throughout the building via ducts, VAV boxes, grilles and diffusers.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

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

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Air Distribution Systems.

1. Inspectors should utilize the installations notification procedure to secure safe access to the air distribution system.

COMPONENT LIST

- 08.21.01 DUCTWORK
- 08.21.02 VAV BOXES
- 08.21.03 GRILLES/DIFFUSERS
- 08.21.04 HUMIDIFIERS

RELATED SUBSYSTEMS

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

08.20 AIR HANDLING UNITS

08.21 AIR DISTRIBUTION 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 Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.21.01 DUCTWORK

Ductwork is the distribution network for the air distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective ductwork.**			
Observation:			
a. Loose ductwork.	SF		
*** {Severity L}			
b. Damaged ductwork.	SF		
*** {Severity M}			
c. Missing ductwork.	SF		
*** {Severity H}			
*** Leaking.**			
Observation:			
a. Air leaking at joint in ductwork.	EA		
*** {Severity L}			
b. Torn or deteriorated flexible connector at fan or air handling unit.	LF		
*** {Severity H}			
c. Water dripping from ductwork.	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}			

08.21 AIR DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.21.01 DUCTWORK (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective insulation.**			
Observation:			
a. Loose insulation.	SF		
*** {Severity L}			
b. Damaged or missing insulation.	SF		
*** {Severity H}			
*** Defective hangers or supports.**			
Observation:			
a. Loose hangers or supports.	EA		
*** {Severity M}			
b. Broken or missing hangers or supports.	EA		
*** {Severity H}			
*** Dirty ductwork.**			
Observation:			
a. Dust on grille.	EA		
*** {Severity L}			
b. Dirt caked on grille or adjacent ceiling tiles.	EA		1
*** {Severity M}			

08.21 AIR DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.21.02 VAV BOXES

The VAV box is a device integrated into an air distribution system that varies the volume of air (at constant temperature) to meet individual or changing cooling load needs. The device is either tied into the diffusers or located to service remote diffusers by flexible ducts. Most VAV boxes are complete factory assembled units.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective Dampers.**			
Observation:			
a. Loose operator or damper linkage.	EA		
*** {Severity M}			
b. Broken or missing linkage.	EA		
*** {Severity H}			
c. Broken or missing controllers.	EA		
*** {Severity H}			
*** Leaking control tubing.**			
Observation:			
a. Air leaking at fittings.	EA		
*** {Severity H}			
*** Defective control wiring (external).**			
Observation:			
a. Loose connections.	EA		
*** {Severity M}			
b. Dirty contacts.	EA		
*** {Severity M}			
*** 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}			

08.21 AIR DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.21.03 GRILLES/DIFFUSERS

Grilles and diffusers are outlets and inlets that regulate the air movement in air distribution systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective grille/diffuser.**			
Observation:			
a. Loose grille/diffuser.	EA		
*** {Severity L}			
b. Missing or damaged grille/diffuser.	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}			

08.21 AIR DISTRIBUTION SYSTEMS

COMPONENTS (Continued)

◆ 08.21.04 HUMIDIFIERS

A humidifier adds moisture to the air moved through the air distribution system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	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}			
*** Defective humidifier.**			
Observation:			
a. Damaged enclosure.	EA		
*** {Severity L}			
b. Disconnected humidifier.	EA		
*** {Severity H}			

08.21 AIR DISTRIBUTION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

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

3. NAVFAC MO-114, Vol.3, Maintenance and Operations of Ventilation Systems, 1989

08.21 AIR DISTRIBUTION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.21.01-1
2*	GS-III 08.21.01-2*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: DUCTWORK
CONTROL NUMBER: GS-III 08.21.01-1

Application

This guide applies to the investigation of dirty ductwork.

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. Remove a 10 percent sample of ceiling or wall grilles.
2. Investigate the inside of ductwork for dirt accumulation.
3. Replace removed ceiling or wall grilles.

Special Tools and Equipment

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

1. Scraper
2. Brush
3. Ladder

Recommended Inspection Frequency

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

References

1. NAVFAC MO-322, Vol. 2 Inspection of Shore Facilities, 1993.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: DUCTWORK
CONTROL NUMBER: GS-III 08.21.01-2*

Application

This guide applies to the checking the balance of an air distribution system.

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. Review the design drawings or specifications to determine the criteria for the room air requirements.
2. Sample the air supply in 10 percent of the rooms and compare the results to the design criteria.
3. Document the results and submit a recommendation to the facility manager.

Special Tools and Equipment

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

1. Air Volume Meter

Recommended Inspection Frequency

This inspection should be performed at the direction of the facility manager on a ten year cycle or other periodic basis when the desired degree of reliability justifies the procedure.

References

1. NAVFAC MO-322, Vol. 2 Inspection of Shore Facilities, 1993.

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

08.22 EXHAUST AND VENTILATION SYSTEMS

DESCRIPTION

Exhaust and Ventilation Systems is a subsystem of the Building Mechanical Systems. Exhaust and ventilation systems supply fresh air and remove heat, dust, toxic, gases, fumes and odors. Exhaust and ventilation systems normally are roof or wall type ventilators, with or without ducts.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Exhaust and Ventilation Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Section, are necessary to perform the inspection of Exhaust and Ventilation Systems.

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

COMPONENT LIST

- 08.22.01 BLOWER ASSEMBLIES
- 08.22.02 HOODS
- 08.22.03 DUST COLLECTORS
- 08.22.04 AUTOMOTIVE EXHAUST SYSTEMS

RELATED SUBSYSTEMS

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

08.21 AIR DISTRIBUTION SYSTEMS

08.22 EXHAUST AND VENTILATION 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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Exhaust and Ventilation Systems will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.22.01 BLOWER ASSEMBLIES

Blower assemblies consists of a blower, motor and drive assembly and can be used in exhaust or ventilation systems.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** 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 blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			
*** Defective blower intake dampers.**			
Observation:			
a. Inoperative dampers.	EA		
*** {Severity M}			
b. Missing dampers.	EA		
*** {Severity H}			

08.22 EXHAUST AND VENTILATION SYSTEMS

COMPONENTS (Continued)

◆ **08.22.01 BLOWER ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting blower hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Excessive noise or vibration at motor.**			
Observation:			
a. Rattling noise.	EA	2	1
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	1
*** {Severity H}			
c. Electrical arcing noise.	EA		2
*** {Severity H}			
*** Damaged motors.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	EA		
*** {Severity H}			
*** 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}			

08.22 EXHAUST AND VENTILATION SYSTEMS

COMPONENTS (Continued)

◆ **08.22.01 BLOWER ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.		EA	
*** {Severity H}			
c. Damaged coupling.	EA		
*** {Severity H}			
*** Defective belt/coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged belt/coupling guard.	EA		
*** {Severity S}			
*** Defective fan belts.**			
Observation:			
a. Loose fan belt.	EA		
*** {Severity F}			
b. Missing or broken fan belt.		EA	
*** {Severity F}			

08.22 EXHAUST AND VENTILATION SYSTEMS

COMPONENTS

◆ 08.22.02 HOODS

Hoods receive and contain emitted contaminant at the source of generation. They are normally connected to an exhaust system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Defective hood.**			
Observation:			
a. Excessive deposits (soot, dirt and grease).	EA		
*** {Severity F}			
*** Defective filter.**			
Observation:			
a. Damaged or missing filter.	EA		
*** {Severity F}			
*** 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}			

08.22 EXHAUST AND VENTILATION SYSTEMS

COMPONENTS

◆ 08.22.03 DUST COLLECTORS

Dust collectors are devices that collect contaminants from industrial processes.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			
*** Defective filter.**			
Observation:			
a. Damaged or missing filter.	EA		
*** {Severity F}			
b. Leaking, torn or missing collector bags.	EA		
*** {Severity F}			
*** 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}			

08.22 EXHAUST AND VENTILATION SYSTEMS

COMPONENTS

◆ 08.22.04 AUTOMOTIVE EXHAUST SYSTEMS

Automotive exhaust systems consist of underfloor or overhead ducts for the removal of automotive exhaust fumes.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fan.**			
Observation:			
a. Excessive fan noise or vibration.	EA		
*** {Severity H}			
b. Missing or broken fan belt.		EA	
*** {Severity F}			
*** Defective duct.**			
Observation:			
a. Inoperative or broken flexible tube hoisting apparatus.	EA		
*** {Severity M}			
b. Damaged or missing dampers.	EA		
*** {Severity M}			
c. Disconnected or missing flexible duct.	EA		
*** {Severity H}			
d. Torn or rotten flexible connector.	EA		
*** {Severity H}			
e. Broken or missing hangers or 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}			

08.22 EXHAUST AND VENTILATION SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993

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

3. NAVFAC MO-114, Vol.3, Maintenance and Operations of Ventilation Systems, 1989

4. Ammerman Engineering Handbook for Automotive and Truck Exhaust Systems, 1990

08.22 EXHAUST AND VENTILATION SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.22.01-1
2	GS-II 08.22.01-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.22.01-1
2	GS-II 08.22.01.2
3*	GS-II 08.22.01-3*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-II 08.22.01-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the blowers, if 24" in diameter or greater.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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 blading for foreign objects and deposit buildup.
6. Inspect blading 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

2. NAVFAC MO-114, Vol. 3, Maintenance and Operations of Ventilation Systems

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-II 08.22.01-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.

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: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-III 08.22.01-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
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.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-III 08.22.01-1

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. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-III 08.22.01-2

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-III 08.22.01-2

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
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.

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3*

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-III 08.22.01-3*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: BLOWER ASSEMBLIES
CONTROL NUMBER: GS-III 08.22.01-3*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc.,

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

08.23 EVAPORATIVE COOLERS

DESCRIPTION

Evaporative Coolers is a subsystem of the Building Mechanical System. Evaporative coolers utilize the natural cooling process of evaporation to provide an efficient, economical alternative to air conditioning in areas where the average relative humidity is less than 50 percent. The system includes a fan to draw outside air through a rotating pad wetted by a water reservoir or fixed pads wetted by a small pump and drip tube. The reservoir is equipped with a float level valve to maintain water level and the unit housing is usually metal with louvered sides.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Evaporative Coolers, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

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

COMPONENT LIST

- 08.23.01 ENCLOSURE, SUPPORTS AND RESERVOIR
- 08.23.02 BLOWERS
- 08.23.03 MOTORS
- 08.23.04 FILTERS/PADS
- 08.23.05 WATER RECIRCULATING PUMPS
- 08.23.06 FLOAT VALVES

RELATED SUBSYSTEMS

There are no related subsystems.

08.23 EVAPORATIVE COOLERS

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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Evaporative Coolers will be scheduled when the equipment is in operation.

COMPONENTS

◆ 08.23.01 ENCLOSURE, SUPPORTS AND RESERVOIR

The enclosure provides protection and structural support for the various interior components and provides louvered areas for the direction of air flow to the fan/blower. A reservoir is normally a metal or plastic container holding water for distribution to the filter/pad by a small pump and drip tube or by an emersed roll filter/pad system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective enclosure panels.**			
Observation:			
a. Damaged or missing panels.	SF		
*** {Severity H}			
*** Clogged reservoir drain.**			
Observation:			
a. Clogged overflow drain.	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}			

08.23 EVAPORATIVE COOLERS

COMPONENTS (Continued)

◆ 08.23.02 BLOWERS

The blower draws outside air through the saturated filter material and discharges it directly into the conditioned space or into a duct system for distribution.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration.**			
Observation:			
a. Rattling noise.	EA	1	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	1	
*** {Severity H}			
c. Clicking or slapping noise.	EA	1	
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged or missing hardware or supports.	EA		
*** {Severity H}			
*** Defective blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Missing or broken belt.	EA		
*** {Severity F}			
*** 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}			

08.23 EVAPORATIVE COOLERS

COMPONENTS (Continued)

◆ 08.23.03 MOTORS

The blower motor is usually a moisture protected, variable speed electric motor with thermal overload protection. This motor drives the fan.

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 or 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 F}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity F}			

08.23 EVAPORATIVE COOLERS

COMPONENTS (Continued)

◆ 08.23.04 FILTERS/PADS

The filter/pad is a porous material, fixed in racks or on a continuous roll, saturated with water. Fixed filter/pads are usually located on all non-ducted sides of the unit, while the continuous roll filter/pad is located on one side. The fixed pads are saturated with water from a small pump and drip tube and the continuous roll pad is run through a reservoir by a mechanical drive system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective filter/pad racks and mechanisms.**			
Observation:			
a. Loose filter/pad rack or holding frame.	EA		
*** {Severity H}			
b. Missing or damaged filter rack or drive mechanism.	EA		
*** {Severity H}			
*** Defective filter/pad.**			
Observation:			
a. Mineral/dirt build-up on filter/pad	EA		
*** {Severity M}			
b. Missing or damaged filter/pad.	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. Corroded evidenced by holes or loss of base metal.	SF		
*** {Severity H}			

08.23 EVAPORATIVE COOLERS

COMPONENTS (Continued)

◆ 08.23.05 WATER RECIRCULATING PUMPS

The water recirculating pump is a small enclosed pump which pumps water from the reservoir to the drip tube. This allows the water to trickle through the filter/pad to be evaporated or drain back into the reservoir.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective water circulating pump.**			
Observation:			
a. Mineral build-up over pump but still operable.	EA		
*** {Severity L}			
b. Clogged intake screen or opening.	EA		
*** {Severity H}			
c. Inoperable, missing or damaged beyond repair.	EA		
*** {Severity H}			

08.23 EVAPORATIVE COOLERS

COMPONENTS (Continued)

◆ 08.23.06 FLOAT VALVES

The float valve is installed in the reservoir to replenish and regulate the water level. It consists of a float actuator and water supply valve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective float valve.**			
Observation:			
a. Mineral build-up on the float or valve, still operable.	EA		
*** {Severity L}			
b. Float bulb leaking and/or submerged.	EA		
*** {Severity H}			
c. Valve leaking, water flowing in overflow.	EA		
*** {Severity H}			
d. Valve inoperable, reservoir dry.	EA		
*** {Severity H}			

08.23 EVAPORATIVE COOLERS

REFERENCES

1. Means Mechanical Cost Data, Edition 15, 1992

2. TRANE Air Conditioning Manual, 1983

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

4. Grainger Industrial and Commercial Equipment and Supplies, 1993

08.23 EVAPORATIVE COOLERS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.23.02-1
2	GS-II 08.23.03-2

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: BLOWERS
CONTROL NUMBER: GS-II 08.23.02-1

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the blowers, if 24" in diameter or greater.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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 blading for foreign objects and deposit buildup.
6. Inspect blading 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

2. NAVFAC MO-114, Vol.3, Maintenance and Operations of Ventilation Systems

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: MOTORS
CONTROL NUMBER: GS-II 08.23.03-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

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.
2. Always have one person standing by outside when someone is working inside a walk-in unit.

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.

References

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

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

DESCRIPTION

Cooling Towers/Evaporative Condensers is a subsystem of the Building Mechanical System. A cooling tower is a device which operates on the principle of reducing water temperature by evaporation of water in air. Water is cooled to the wet bulb temperature of the air. The water is then pumped to a remote condenser. An evaporative condenser is similar to a cooling tower except that the condenser is contained within the tower and the cooled water flows over the condenser.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

The following of special tools and equipment, beyond the requirements listed in the Standard Tool Section, are required to perform the inspection of the Cooling Towers/Evaporative Condensers:

1. Paintbrush
2. Dye penetrant and developer
3. Scraper
4. Wire brush
5. Calipers
6. Measuring scales
7. Hammer
8. Ice pick or pocket knife

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Cooling Towers/Evaporative Condensers, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 08.24.01 ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS
- 08.24.02 FAN ASSEMBLIES
- 08.24.03 CIRCULATING PUMPS
- 08.24.04 PIPING, FITTINGS AND VALVES
- 08.24.05 DAMPERS
- 08.24.06 FLOAT VALVE
- 08.24.07 SUMP HEATERS
- 08.24.08 ACCESSIBILITY DEVICES

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

RELATED SUBSYSTEMS

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

08.04	CHILLERS - ABSORPTION
08.05	CHILLERS - CENTRIFUGAL
08.06	CHILLERS - RECIPROCATING
08.07	CHILLERS - SCREW
08.08	AIR CONDITIONING - SPLIT SYSTEMS
08.09	AIR CONDITIONING - PACKAGE SYSTEMS
08.10	AIR CONDITIONING - COMPUTER ROOMS
08.16	CONDENSER WATER DISTRIBUTION SYSTEMS

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

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. Associated defects and observations, for each major component, are listed in the Field CAIS.

The inspection of Cooling Towers/Evaporative Condensers will be scheduled when the equipment is in operation.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.24.01 ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS

The enclosure is the housing for all components of the cooling tower and evaporative condenser. The supports are the structural members that support the cooling tower and evaporative condensers. The fill is the wet deck and drift eliminator. The reservoir is the cold deck at the bottom of the water tower or evaporative condenser.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective supports.**			
Observation:			
a. Deformation, twisting, or bending.	LF		
*** {Severity H}			
b. Physically damaged member.	LF		
*** {Severity H}			
c. Stress or fatigue cracks.	LF	1	
*** {Severity H}			
*** Corrosion of supports.**			
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}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ **08.24.01 ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective support connections/anchorage.**			
Observation:			
a. Loose bolts, rivets or mechanical fasteners.	EA		
*** {Severity M}			
b. Cracked or broken welds.	LF	1	
*** {Severity H}			
*** Defective enclosure panels.**			
Observation:			
a. Damaged or bent seams, no obvious water leaking.	LF		
*** {Severity L}			
b. Damaged or open seam/lap, obvious water leaking.	LF		
*** {Severity H}			
c. Loose panels.	EA		
*** {Severity H}			
d. Cracks, holes or punctures in panel, obvious water penetration.	SF		
*** {Severity H}			
e. Missing or loose panels.	SF		
*** {Severity H}			
*** Defective air intake screens.**			
Observation:			
a. Loose or bent screens.	EA		
*** {Severity L}			
b. Missing or damaged screens.	SF		
*** {Severity H}			
*** Defective panel or screen fasteners.**			
Observation:			
a. Loose fasteners	EA		
*** {Severity M}			
b. Missing or broken fasteners	EA		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.01 ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion at enclosure panels or screens.**			
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}			
*** Defective reservoir.**			
Observation:			
a. Damaged or bent seams, no obvious water leaking.	LF		
*** {Severity L}			
b. Damaged or open seam/lap, obvious water leaking.	LF		
*** {Severity H}			
*** Corrosion at metal reservoir.**			
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}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.01 ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective wood members.**			
Observation:			
a. Wood member rotted, cross section loss less than 25 percent original area.	SF		1
*** {Severity M}			
b. Wood member rotted, cross section loss greater than 25 percent original area.	SF		1
*** {Severity H}			
*** Defective fill.**			
Observation:			
a. Broken or cracked fill (ceramic, PVC, or fiberglass) not effecting flow.	SF		
*** {Severity L}			
b. Broken or cracked fill (ceramic, PVC, or fiberglass) restricting or channeling flow.	SF		
*** {Severity M}			
c. Wood fill rotted, cross section loss 25 percent original area.	SF		
*** {Severity M}			
d. Wood fill rotted, cross section loss over 25 percent original area.	SF		
*** {Severity H}			
*** Biological fouling or scaling.**			
Observation:			
a. Film of algae or slime.	SF		
*** {Severity L}			
b. Sludge of algae or slime.	SF		
*** {Severity M}			
c. Magnesium and calcium salts deposits.	SF		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.02 FAN ASSEMBLIES

Fan assemblies are normally used on cooling towers and evaporative condensers to increase the rate of evaporation, thereby increasing the efficiency of the unit. The fan assembly normally consists of a blower or fan, motor and drive assembly.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration at fan/blower.**			
Observation:			
a. Rattling noise.	EA	2	
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	2	
*** {Severity H}			
c. Axial fan blade bent, damaged or vibrating.	EA		
*** {Severity H}			
*** Defective fan/blower.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			
*** Defective fan/blower intake dampers.**			
Observation:			
a. Inoperative dampers.	EA		
*** {Severity M}			
b. Missing dampers.	EA		
*** {Severity H}			
*** Defective mounting fan/blower hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	EA		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.02 FAN ASSEMBLIES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise or vibration at motor.**			
Observation:			
a. Rattling noise.	EA	3	2
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA	3	2
*** {Severity H}			
c. Electrical arcing noise.	EA		3
*** {Severity H}			
*** Damaged motors.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	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 electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			
*** Defective coupling.**			
Observation:			
a. Loose set screws.	EA		
*** {Severity M}			
b. Missing set screws.		EA	
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ **08.24.02 FAN ASSEMBLIES (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective belt/coupling guard.**			
Observation:			
a. Loose coupling guard.	EA		
*** {Severity L}			
b. Missing or damaged belt/coupling guard.	EA		
*** {Severity S}			
*** Defective fan belts.**			
Observation:			
a. Loose fan belt.	EA		
*** {Severity F}			
b. Missing or broken fan belt.		EA	
*** {Severity F}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.03 CIRCULATING PUMPS

The evaporative condenser has a circulation pump to lift water from the reservoir (sump) in the bottom of the unit and deliver it to the distribution system of headers and nozzles at the top of the unit.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise at pump.	EA		
*** {Severity M}			
b. Grinding noise at pump, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Electrical arcing noise (motor).	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity M}			
*** Damaged motor/pump.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken base.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing mounting bolts.	EA		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ **08.24.03 CIRCULATING PUMPS (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.04 PIPING, FITTINGS AND VALVES

Piping, fittings and valves that are part of the evaporative condensers, pertain to the water lifting system from the reservoir to the headers and nozzles.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leaking/damaged fittings.**			
Observation:			
a. Bent or cracked fitting, not leaking.	EA		
*** {Severity L}			
b. Water leaking.	EA		
*** {Severity H}			
*** Leaking/damaged pipe.**			
Observation:			
a. Bent or cracked pipe, not leaking.	LF		
*** {Severity L}			
b. Water leaking.	LF		
*** {Severity H}			
*** Leaking/damaged 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}			
*** Loose/missing supports/hangers.**			
Observation:			
a. Loose supports or hangers.	EA		
*** {Severity L}			
b. Broken/missing supports/hangers.	EA		
*** {Severity H}			
*** Defective insulation.**			
Observation:			
a. Loose insulation.	LF		
*** {Severity L}			
b. Damaged or missing insulation.	LF		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ **08.24.04 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/missing labels.	EA		
*** {Severity L}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.05 DAMPERS

Installations requiring close temperature controls employ a centrifugal fan equipped with capacity control dampers. The damper is a single air foil blade located in the fan discharge and may be manual or connected with a standard electric control package.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Damper binding or hanging up.**			
Observation:			
a. Damper loaded up with dirt.	SF		
*** {Severity L}			
b. Damper/control linkage bent or damaged.	EA		
*** {Severity H}			
c. Broken or missing damper.	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}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.06 FLOAT VALVE

The float valve is installed in the reservoir to replenish and regulate the water level. It consist of a float actuator and water supply valve.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective float valve.**			
Observation:			
a. Mineral build-up on the float or valve, still operable.	EA		
*** {Severity L}			
b. Float bulb leaking and/or submerged.	EA		
*** {Severity H}			
c. Valve leaking, water flowing in overflow.	EA		
*** {Severity H}			
d. Valve inoperable, reservoir dry.	EA		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.07 SUMP HEATERS

Sump heaters are provided to prevent the reservoir water from freezing.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electric heating element.**			
Observation:			
a. Disconnected.	EA		
*** {Severity H}			
b. Missing.	EA		
*** {Severity H}			
*** Defective steam modulating valve.**			
Observation:			
a. Disconnected or missing modulating valve sensor.	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}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.08 ACCESSIBILITY DEVICES

Stairways, ladders and walkways are provided for access to the interior and the fan deck. These can be wood or metal to complement the construction material. Ladders for towers with the fan deck 20' or more above the basin curb will be furnished with a metal safety cage. The fan deck walkways are guarded by railings.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective connections, anchorage or supports.**			
Observation:			
a. Missing or loose belts/fasteners.	EA		
*** {Severity H}			
b. Loose, rotten, broken or split (wood).	EA		
*** {Severity H}			
c. Brackets corroded beyond repair.	EA		
*** {Severity H}			
d. Impact damage, broken brackets.	EA		
*** {Severity H}			
*** Cracking or buckling of frame (metal).**			
Observation:			
a. Deformation, twisting, or bending.	LF		
*** {Severity H}			
b. Physically damaged member.	LF		
*** {Severity H}			
c. Stress or fatigue cracks.	LF	4	
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			
*** Split, cracked or broken members (wood).**			
Observation:			
a. Surface fibers separated, less than 25 percent of thickness affected.	LF		
*** {Severity M}			
b. Surface fibers separated, greater than 25 percent of thickness affected.	LF		
*** {Severity H}			
c. Physically damaged, broken or deflected.	LF		
*** {Severity H}			
d. Missing rungs.	EA		
*** {Severity H}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

COMPONENTS (Continued)

◆ 08.24.08 ACCESSIBILITY DEVICES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Rot, fungus or decay (wood).**			
Observation:			
a. Moist stained area.	SF		
*** {Severity M}			
b. Discolored, soft or crushed area.	SF	5	
*** {Severity H}			
*** Corrosion (metal).**			
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}			

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

REFERENCES

1. TRANE Air Conditioning Manual, 67th Printing Nov. 93, McGill Graphic Arts
2. Architectural Graphic Standards, Seventh Edition, Ramsey/Sleeper, 1981
3. Building Design and Construction Handbook, Fourth Edition, McGraw-Hill, 1982
4. Handbook of Fundamentals, ASHRAE, 1985
5. NAVFAC MO-144, Vol. 3, Maintenance and Operation of Ventilation Systems, 1989

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
1	GS-II 08.24.01-1
2	GS-II 08.24.02-2
3	GS-II 08.24.02-3
4	GS-II 08.24.08-4
5	GS-II 08.24.08-5

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1	GS-III 08.24.01-1
2	GS-III 08.24.02-2
3	GS-III 08.24.02-3
4*	GS-III 08.24.02-4*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS
CONTROL NUMBER: GS-II 08.24.01-1

Application

This guide applies to the investigation of cracks or cracked welds in exterior metal enclosures, supports and reservoirs.

Special Safety Requirements

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

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Annually

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 2

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-II 08.24.02-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the blowers, if 24" in diameter or greater.

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 covers.
4. Check assembly for wear, damage or loose fasteners.
5. Visually inspect blading for foreign objects and deposit buildup.
6. Inspect blading 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

2. NAVFAC MO-114, Vol.3, Maintenance and Operations of Ventilation Systems, 1989

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 3

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-II 08.24.02-3

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the fan motor, if 60 HP or greater in size.

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.

References

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

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 4

COMPONENT: ACCESSIBILITY DEVICES
CONTROL NUMBER: GS-II 08.24.08-4

Application

This guide applies to the investigation of cracks or cracked welds in metal ladders, stairways, and railings.

Special Safety Requirements

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

Inspection Actions

1. Clean area (wire brush) to bare metal.
2. Apply dye, allow to penetrate, remove excess.
3. Apply developer, this draws the dye out and defines the extent and size of surface flaws.

Recommended Inspection Frequency

Annually

References

1. Architectural Graphic Standards, Seventh Edition, Rampsey/Sleeper, 1981

LEVEL II INSPECTION METHOD GUIDE SHEET

LEVEL II GUIDE SHEET - KEY NO. 5

COMPONENT: ACCESSIBILITY DEVICES
CONTROL NUMBER: GS-II 08.24.08-5

Application

This guide applies to the investigation of deterioration of wood handrails, stairways, walkways and ladders due to insect infestation, rot, or fungi damage.

Special Safety Requirements

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

Inspection Actions

1. Clean affected area using scraper and brush.
2. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
3. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
4. Probe with ice pick or pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.

Recommended Inspection Frequency

Annually

References

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

2. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS
CONTROL NUMBER: GS-III 08.24.01-1

Application

This guide applies to the investigation of deterioration of wood members due to insect infestation, rot or fungi damage.

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. Shut down unit, tag and lock out disconnect. Drain reservoir.
2. Clean affected area using scraper and brush.
3. Utilize calipers and scales to determine an approximation of the area that has been lost due to deterioration.
4. Tap with hammer in order to detect loss of interior material, evidenced by a hollow sound.
5. Probe with ice pick or pocket knife to determine extent of damage due to insect infestation, rot or fungi damage.
6. Document the problem and contact appropriate facility personnel for further instructions, if defect is major.
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. Scraper
2. Brush
3. Calipers
4. Hammer

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: ENCLOSURES, SUPPORTS, FILL AND RESERVOIRS
CONTROL NUMBER: GS-III 08.24.01-1

References

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

2. NAVFAC MO-312, Wood Protection, 1990

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-III 08.24.02-2

Application

This guide applies to the investigation of rattling and grinding (metal to metal) noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Perform vibration analysis on motor bearings.
3. Shut down motor, tag and lock out disconnect.
4. Rotate (cycle) motor to check for binding.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specifications.
6. Open and inspect motor interior housing for cracks, fatigue, erosion and corrosion, check suspicious areas with dye penetrant.
7. Check interior shafting for signs of fatigue or wear.
8. Rotate (cycle) shafting and check for distortion.
9. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
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.

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

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-III 08.24.02-2

Recommended Inspection Frequency

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

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-III 08.24.02-3

Application

This guide applies to the investigation of electrical arcing noise from the motor, if 60 HP or greater in size.

Special Safety Requirements

The following is a list of special 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. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated equipment.
3. Perform vibration analysis on the motor.
4. Rotate motor shaft and check for binding, rubbing.
5. Measure run-out play in bearings due to wear; compare with manufacturer's specification.
6. Check alignment.
7. Shut down motor, tag and lock out disconnect.
8. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage, check suspicious areas with dye penetrant.
9. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
11. Check commutator/slip rings for loose parts, physical damage, wear.
12. Check brushes for wear, proper tension.
13. Check bearings for lube leakage into motor.
14. Check motor shafting for wear.
15. Document the problem and contact appropriate facility personnel for further instructions and reassemble motor, if directed.
16. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
17. Ensure all guards and covers have been installed; remove tags, lockout on disconnect and restore unit to service.

LEVEL III INSPECTION METHOD GUIDE SHEET

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

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-III 08.24.02-3

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. Infrared Temperature Tester
4. Ammeter
5. Voltmeter
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.

References

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

2. Electric Motor & Contracting Co. Inc., Chesapeake, VA

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4*

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-III 08.24.02-4*

Application

This guide applies to checking the windings of electric motors for open circuits, grounds or deteriorated insulation, if 60 HP or greater in size. Do not duplicate this effort if it is being performed under an existing base PM or recurring maintenance program.

Special Safety Requirements

The following is a list of special 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.
2. Do not use megohmmeter in an explosive atmosphere.

Inspection Actions

1. Check line voltage and ampere load for proper balance.
2. Shut down motor, tag and lockout disconnect.
3. Remove the three phase leads (load conductors) at the motor terminals or at the starter. If leads are removed at the motor, tape conductor ends. Mark leads.
4. Perform grounding and dielectric resistance test on motor windings. Values below 50 Megohms at an ambient temperature of 85 degrees F or less may indicate the presence of moisture in the winding insulation.
5. Document readings and contact appropriate facility personnel if the readings indicate a suspected problem.
6. Notify appropriate facility personnel for permission to place unit back in service if defect is not critical to continued function.
7. Make sure that leads are connected 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. Megohmmeter

Recommended Inspection Frequency

Annually

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4* (Continued)

COMPONENT: FAN ASSEMBLIES
CONTROL NUMBER: GS-III 08.24.02-4*

References

1. The Locomotive, Vol. 69, Spring 1994, The Hartford Steam Boiler Inspection and Insurance Co., Inc..

2. Institute of Electrical and Electronic Engineers (IEEE), Specifications 112 (1984), 113 (1985) and 115 (1983)

3. National Electrical Manufactures' Association (NEMA) Book, MG 1-987, Part 12 (1987)

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

DESCRIPTION

Air Cooled Condenser - Fluid Cooler Systems is a subsystem of the Building Mechanical Systems. Air cooled condenser DX systems, normally consist of an air cooled condenser coil and fans. Fluid cooler systems, for water or glycol systems, normally consist of an air cooled condenser coil, fans, dampers, a pump and an expansion tank.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Air Cooled Condenser - Fluid Cooler Systems, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the performance of the Level II inspections beyond those listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- 08.25.01 AIR COOLED CONDENSER - FLUID COOLER
- 08.25.02 CIRCULATING PUMPS AND MOTORS
- 08.25.03 EXPANSION TANKS

RELATED SUBSYSTEMS

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

08.09	AIR CONDITIONING - PACKAGE SYSTEMS
08.10	AIR CONDITIONING - COMPUTER ROOM

08.25 AIR COOLED CONDENSER - FLUID COOLER 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 Field CAIS.

The inspection of Fluid Cooler will be scheduled when the equipment is in operation.

COMPONENTS

◆ 08.25.01 AIR COOLED CONDENSER - FLUID COOLER

The air cooled condenser removes the heat from the high pressure refrigeration gas. The fluid cooler removes heat from the high temperature condenser water or glycol. The units contain fin tube coils, fans and dampers.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Leakage at coil.**			
Observation:			
a. Evidence of refrigerant leakage.	EA		
*** {Severity H}			
b. Evidence of water or glycol leakage.	EA		
*** {Severity H}			
*** Deteriorated/clogged coils.**			
Observation:			
a. Damaged/eroded coils.	SF		
*** {Severity H}			
b. Dust/debris accumulation on coils.	SF		
*** {Severity F}			
*** Excessive noise or vibration at fan.**			
Observation:			
a. Rattling noise.	EA		
*** {Severity M}			
b. Grinding noise, indicating metal to metal contact.	EA		
*** {Severity H}			
c. Axial fan blade bent, damaged or vibrating.	EA		
*** {Severity H}			

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

COMPONENTS (Continued)

◆ **08.25.01 AIR COOLED CONDENSER - FLUID COOLER (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective fan.**			
Observation:			
a. Cracked or damaged housing.	EA		
*** {Severity M}			
b. Cracked or damaged blades.	EA		
*** {Severity H}			
*** Defective fan mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Missing or damaged hardware or supports.	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}			
*** Damaged motors.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity M}			
b. Broken motor base.	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}			

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

COMPONENTS (Continued)

◆ 08.25.01 AIR COOLED CONDENSER - FLUID COOLER (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Defective electrical connectors.**			
Observation:			
a. Loose conduit or connectors.	EA		
*** {Severity M}			
b. Exposed wires or missing cover plates.	EA		
*** {Severity H}			
*** Defective Dampers.**			
Observation:			
a. Loose operator or damper linkage.	EA		
*** {Severity M}			
b. Broken or missing dampers.	SF		
*** {Severity H}			
*** Damaged enclosures.**			
Observation:			
a. Loose enclosure panels.	EA		
*** {Severity L}			
b. Missing or damaged enclosure panels.	SF		
*** {Severity H}			
*** Corrosion at dampers.**			
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}			

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

COMPONENTS (Continued)

◆ **08.25.01 AIR COOLED CONDENSER - FLUID COOLER (Continued)**

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Corrosion at enclosure.**			
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}			

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

COMPONENTS (Continued)

◆ 08.25.02 CIRCULATING PUMPS AND MOTORS

Pumps provide for fluid circulation throughout the fluid cooling system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Excessive noise and vibration.**			
Observation:			
a. Rattling noise at pump.	EA		
*** {Severity M}			
b. Grinding noise at pump, indicating metal to metal contact.	EA		
*** {Severity H}			
*** Leakage.**			
Observation:			
a. Leaking pump, fittings or seals.	EA		
*** {Severity M}			
b. Cracked or damaged pump housing.	EA		
*** {Severity M}			
*** Damaged motor.**			
Observation:			
a. Cracked/damaged housing or end bells.	EA		
*** {Severity H}			
b. Broken base.	EA		
*** {Severity H}			
*** Defective mounting hardware.**			
Observation:			
a. Loose mounting bolts.	EA		
*** {Severity L}			
b. Broken or missing mounting bolts.	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}			

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

COMPONENTS (Continued)

◆ 08.25.03 EXPANSION TANKS

Expansion tanks are closed steel containers that are used to compensate for the change in liquid volume caused by the system temperature variation. Expansion tanks are normally installed at the highest point in the system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
*** Physical damage.**			
Observation:			
a. Abrasions.	SF		
*** {Severity L}			
b. Impact damage, dents.	SF		
*** {Severity M}			
*** Leakage.**			
Observation:			
a. Liquid dripping from tank fitting.	EA		
*** {Severity L}			
b. Leakage at tank seams.	EA		
*** {Severity H}			
*** Defective mounting hardware or supports.**			
Observation:			
a. Loose hardware or supports.	EA		
*** {Severity L}			
b. Damaged hardware or supports.	EA		
*** {Severity M}			
c. Missing hardware or supports.	EA		
*** {Severity H}			
*** Corrosion.**			
Observation:			
a. Surface corrosion no pitting evident.	SF		
*** {Severity L}			
b. Corrosion evident by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evident by holes or loss of base metal.	SF		
*** {Severity H}			

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

REFERENCES

1. NAVFAC MO-322, Vol.2, Inspection of Shore Facilities, 1993
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. Liebert Corporation, Heat Rejection, General Data - Bulletin No. SL-10055, 1986
4. Liebert Corporation, Air Cooled Condensers - Bulletin No. SL-10057, 1988
5. Liebert Corporation, Dry Coolers - Bulletin No. SL-10058, 1987

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
N/A	

08.26 CHEMICAL WATER TREATMENT SYSTEMS

DESCRIPTION

Chemical Water Treatment Systems is a subsystem of the Building Mechanical Systems. Chemical water treatment systems inhibit the development of scale, corrosion and biological growth within the boilers, cooling towers, hot and chilled water distribution systems. The typical system consists of 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

- ◆ 08.26.01 BOILER WATER CHEMICAL TREATMENT SYSTEMS
- ◆ 08.26.02 COOLING TOWER WATER CHEMICAL TREATMENT SYSTEMS
- ◆ 08.26.03 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.

08.01	HEATING BOILERS - GAS/OIL
08.14	BOILERS FEEDWATER SYSTEMS
08.15	CHILLED WATER DISTRIBUTION SYSTEMS
08.16	CONDENSER WATER DISTRIBUTION SYSTEMS
08.19	HEATING HOT WATER DISTRIBUTION SYSTEMS

08.26 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 Field CAIS.

The Facility Manager will authorize any Level III inspection he feels necessary for specialized equipment applications.

COMPONENTS

◆ 08.26.01 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}			

08.26 CHEMICAL WATER TREATMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.26.02 COOLING TOWER WATER CHEMICAL TREATMENT SYSTEMS

Cooling tower water chemical treatment systems inhibit corrosion and deposit build-up within the open recirculating system. Water treatment also controls chemical and biological surface attack on condenser tubes and cooling tower wood in flooded portions of the tower.

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 pumps.**			
Observation:			
a. Deposit build-up.	EA		
*** {Severity M}			
b. Excessive corrosion.	EA		
*** {Severity H}			
c. Leaking pump.	EA		
*** {Severity H}			
* **Defective controller.**			
Observation:			
a. Broken glass panel on controller door.	EA		
*** {Severity M}			
b. Controller disconnected or missing.	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}			

08.26 CHEMICAL WATER TREATMENT SYSTEMS

COMPONENTS (Continued)

◆ 08.26.03 CLOSED-LOOP WATER CHEMICAL TREATMENT SYSTEMS

Chemical treatment of closed-loop systems inhibit corrosion and deposit build-up caused by appreciable make-up water being added to replace 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}			

08.26 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. Baltimore Aircoil Company, Baltimore, MD, 21227
5. NAVFAC MO-225, Industrial Water Treatment, 1990

08.26 CHEMICAL WATER TREATMENT SYSTEMS

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
N/A	

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
1*	GS-III 08.26.01-1*
2*	GS-III 08.26.02-2*

* Indicates guide sheets which are not directly referenced by a Key. These Level III Inspection Methods can be implemented, by the Facility Manager, based on an analysis of equipment operating time, equipment age, suspected hidden problems or repeated service calls that indicate a problem exists.

08.26 CHEMICAL WATER TREATMENT SYSTEMS

LEVEL III GUIDE SHEET - KEY NO. 1*

COMPONENT: BOILER WATER CHEMICAL TREATMENT SYSTEM
CONTROL NUMBER: GS-III 08.26.01-1*

Application

This guide applies to the checking the timer/sequencer operation to insure that the water treatment system is operating. .

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. Review system design and sequence of operation.
2. Perform complete shut-down and start-up sequence.
3. Induce a fault in PH setting of the controls to check operation of system.
4. Reset system.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify affected facility personnel for permission to place unit back in service if defect is not critical to continued function.

Special Tools and Equipment

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

1. Mechanics Tool Set

Recommended Inspection Frequency

Annually

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

08.26 CHEMICAL WATER TREATMENT SYSTEMS

LEVEL III GUIDE SHEET - KEY NO. 2*

COMPONENT: COOLING TOWER CHEMICAL TREATMENT SYSTEM
CONTROL NUMBER: GS-III 08.26.02-2*

Application

This guide applies to the checking the timer/sequencer operation to insure that the water treatment system is operating. .

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. Review system design and sequence of operation.
2. Perform complete shut-down and start-up sequence.
3. Induce a fault in PH setting of the controls to check operation of system.
4. Reset system.
5. Document the problem and contact appropriate facility personnel for further instructions, if defect cannot be determined or is major.
6. Notify affected facility personnel for permission to place unit back in service if defect is not critical to continued function.

Special Tools and Equipment

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

1. Mechanics Tool Set

Recommended Inspection Frequency

Annually

References

1. EPD Technology Corporation, 12 W. Main Street, Elmsford, New York 10523

2. Means Facility Maintenance & Repair Cost Data 1994

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
BTU	British Thermal Unit
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
CFM	Cubic Feet Per Minute
DCD	Data Collection Device
DIA	Diameter
DX	Direct Expansion
EA	Each
FT	Foot
GS	Guide Sheet
HRS	Hours
HP	Horse Power
IU	Inspection Unit
KW	Kilo-Watt
LF	Linear Foot
MBH	Thousands of BTU's per Hour
MCFM	Thousands of Cubic Feet per Minute
ML	Milliliter
N/A	Not Applicable
NAVFAC-MO	Naval Facilities Maintenance and Operations

APPENDIX A

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
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

APPENDIX A

· Times or By

x Times or By

APPENDIX B

GLOSSARY

Accessible	Having access thereto but which first may require the removal of an access panel, door or similar obstruction.
Air Conditioner	Device used to control temperature, humidity, cleanliness, and movement of air in a conditioned space.
Air Conditioning: Computer Rooms	Computer room air conditioning systems consist of self-contained units located in the computer room space. The units normally employ remote fluid coolers or evaporative condensers.
Air Conditioning: Package System	A package air conditioning system is a self-contained air conditioning system. The units are normally air cooled or water cooled with remote fluid coolers or cooling towers.
Air Conditioning: Split System	Split air conditioning systems normally place the condensing unit outside or remote from the air handling unit and interconnected with refrigerant lines.
Air Conditioning: Window Unit	Window unit air conditioners have all components assembled within the unit cabinet and are normally installed in a window or wall opening.
Air Diffuser	A circular, square, or rectangular, air distribution outlet, generally located in the ceiling and comprised of deflecting members to discharge supply air in various directions.
Air Grille	A covering over an air outlet or inlet with openings that regulate the air movement in air distribution systems.
Air Handling Units	The equipment which contains a fan or fans for moving air through a building which has a forced air system. Fans may be shut down by the fire protection system during an alarm.
Air Return	Air returned from the conditioned or refrigerated space.
Air Vent	Valve installed at the high points in a hot water system to permit the elimination of air from the system.
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.

APPENDIX B

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.
Axial	Of, pertaining to, or along an axis. In a fan, one whose housing confines the gas flow to the direction along the rotating shaft at both the inlet and outlet.
Axial Fans	Fans that produce pressure from a change in velocity passing through the impeller, with no pressure being produced by centrifugal force.
Backflow Preventer	A device used to keep water from being drawn into a potable water system.
Baseboard Heaters	Baseboard heaters are normally enclosed fin and tube heating units located horizontally at the base of walls in the rooms or spaces to be heated.
Bearings	The support for a shaft, axle, or trunnion used to mediate friction; usually in conjunction with a lubricant.
Bells (Housing)	A hollow metal cylinder closed at one end and flared at the other; used to protect the operator and internal parts and to contain lubrication. A conical device that seals the top of a blast furnace or other mechanical device;
Biological Deposits	Deposits composed of either microscopic organisms, such as algae, or macroscopic organisms, such as barnacles.
Blowdown	Water discharged from the system to control the concentration of salts or other impurities in the circulating water.
Blow-off	A release of steam, water, etc.; a valve for effecting this. An outlet designed to permit the discharge of water to remove built-up deposits of impurities and chemicals.
Blower	A fan, usually one for heavy-duty application, e.g. a fan that forces fresh air through a duct system.
Boiler	Closed vessel in which water is heated, steam is generated, steam is superheated, or any combination thereof, under pressure or vacuum by the direct application of heat.

APPENDIX B

Boiler Horsepower	The equivalent evaporation of 34.5 pounds of water per hour from and at 212°F. This is equal to a heat output of 970.3x34.5 = 33,475 BTU/hr.
British Thermal Unit	A quantity of heat required to raise the temperature of 1 lb. (0.45 kg) of water 1°F.(0.56°C).
Bucket Steam Trap	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.
Buildup	To apply in successive layers to form a thicker mass.
Burner	The part of a boiler or furnace in which combustion takes place.
Butterfly Valve	A device which regulates the flow of a liquid by a plate which pivots in the waterway.
Cabinet Heater	A metal housing enclosing a heating element with openings to facilitate air flow. The heater frequently contains a fan for controlling the air flow. The source of heat for the cabinet heaters is from the hot water heating, steam or electric distribution systems. Cabinet heaters are usually located under windows and secured to the walls in the spaces they serve.
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).
Centrifugal Fan	A fan within a scroll-type housing, which receives air perpendicular to the axis of rotation and discharges it radially; by pushing it away from the center of rotation; may be either belt driven or connected directly to a motor.
Centrifugal Pump	A pump in which the pressure is imparted to the fluid by centrifugal force provided by a rotating impeller.
Check Valve	A device which permits a liquid or gas to flow in one direction only.
Chiller:Absorption	An absorption chiller uses water as the primary refrigerant and employs an absorbent as a secondary fluid. Unlike the centrifugal, reciprocating or screw units, it uses a physio-chemical process and employs little mechanical energy.

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Chiller: Centrifugal	Compresses gaseous refrigerant using centrifugal force and produces cooling via water, through a shell and tube evaporator.
Chiller: Screw	Compresses gaseous refrigerant using helical rotors and produces cooling via water, through a shell and tube evaporator.
Coil	A term applied to a heat exchanger that uses connected pipes or tubing in rows, layers, or windings, as in steam heating, water heating, and refrigeration condensers and evaporators.
Combustion	The act or process of burning.
Combustion Chamber	The portion of an appliance within which combustion normally occurs.
Compressor	A machine for compressing air or other gases.
Compressor: Hermetic	Compressor in which the driving motor is sealed in the same dome or housing that contains the compressor.
Compressor: Open-type	Compressor in which the crankshaft extends through the crankcase and is driven by an outside motor.
Compressor: Reciprocating	Compressor which uses a piston and cylinder mechanism to provide pumping action.
Commutator	That part of a direct-current motor or generator which serves the dual function, in combination with brushes, of providing an electrical connection between the rotating armature winding and the stationary terminals, and of permitting reversal of the current in the armature windings.
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 a surface, by condensation of the natural natural moisture content of the air flow.
Condensate Pump	Device used to remove fluid condensate that collects beneath an evaporator.

APPENDIX B

Condensate: Steam	Water which forms by condensation of steam.
Condenser	The heat exchanger in a refrigeration system that removes heat from the hot high-pressure refrigerant gas and transforms it into a liquid.
Condenser: Air Cooled	A heat exchanger which transfers heat to surrounding air.
Condenser:Tube-within-a-tube	A water-cooled condensing unit in which a small tube is placed inside a larger tube. Hot refrigerant passes through one tube, water through the other; thereby removing excess heat.
Condenser: Water Cooled	Heat exchanger which is designed to transfer heat from hot gaseous refrigerant to water.
Conduit	A tube or pipe used to protect electric wiring. A tube or pipe used for conveying fluid.
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.
Contaminate	To make impure, infected, corrupt, radioactive, etc. by contact with or addition of something; pollute; taint.
Control	Automatic or manual device used to stop, start, and/or regulate flow of gas, liquid, and/or electricity.
Convector	A terminal unit surrounded on all sides by an enclosure having an air outlet at the top or upper front and bottom. The air being heated rises and creates a current which brings cool air to the heat source. The natural flow of heated air circulates to heat the space.
Cooling Tower	A device for lowering temperature by evaporation. A natural draft cooling tower is one where the air flow through the tower is due to its natural draft or chimney effect. A mechanical draft tower employs fans to force or induce a draft.
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.

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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 metal plate at the fireplace throat, i.e. between fireplace and smoke chamber, or in a flue; to regulate draft.
Degradation	To lower or corrupt in quality, value, etc.. The lowering of land surfaces by erosion. To convert an organic compound into a simpler compound by removal of one or more parts of a molecule.
Dehumidifier	Device used to remove moisture from air in an enclosed space.
Dielectric	A nonconductor of electricity; an insulator or insulating material.
Direct Expansion Evaporator	An evaporator coil using either an automatic expansion valve or a thermostatic expansion valve for refrigerant control.
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.
Drip Pan	Pan-shaped panel or trough used to collect condensate from evaporator coil.
Economizer	A forced-flow once-through, convection-heat-transfer tube bank in which feedwater is raised in temperature on its way to the evaporating section of a steam boiler, thus lowering flue gas temperature, improving boiler efficiency, and saving fuel.

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Eddy Current Test	A non-destructive test that involves the observation of the interaction between electromagnetic fields and metals. A coil containing a high-frequency electric current is used to generate a magnetic field in the specimen; this generates eddy currents in the specimen. The impedance caused by a change in the uniformity of the specimen's structure will signal the presence of a flaw in the metal. Useful for detecting cracks, pitting, corrosion or other flaws that inhibit the flow of electric current.
Egress	The act of going out or forth; emergence.
Electric Heating Element	A unit assembly consisting of a resistor, insulated supports, and terminals for connecting the resistor to electric power.
End Bell	End structure of electric motor which usually holds motor bearings.
Erosion	The deterioration brought about by the abrasive action of fluids or solids in motion.
Evaporator	The heat exchanger in a refrigeration system that removes heat from the media being cooled (air or chilled water). It takes low-pressure, low-temperature refrigerant liquid and transforms it into a gas. The two types of evaporators in which refrigerant liquid is vaporized are direct expansion coils and shell and tube water chillers.Any of many devices in which liquid is changed to vapor state by the addition of heat, for example, distiller, still, dryer, water purifier, or refrigeration system element where evaporation proceeds at low pressure and consequent low temperature.
Evaporative Cooler	Cooling is achieved by the evaporation of water in air, thus increasing humidity and decreasing dry-bulb temperature.
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 Tank	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 mechanical rooms.
Fan	A radial or axial flow device used for moving or producing artificial currents of air.

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Fan: Axial	A fan that produces pressure from the velocity of air passing through the impeller, with no pressure being produced by centrifugal force.
Fan: Centrifugal	A fan within a scroll-type housing, which receives air perpendicular to the axis of rotation and discharges it radially; by pushing it away from the center of rotation; may be either belt driven or connected directly to a motor.
Fan: Propeller	An axial fan using a propeller or disc-type wheel within a mounting ring or plate including driving mechanism supports for either belt drive or direct connection.
Fan Coil Unit	Normally includes a cooling and heating coil, fan, filter and drain pan. It operates by moving air through an opening in the unit and across the coil. The source of cooling/heating is from chilled water, hot water heating, or steam distribution systems. Fan coil units are usually secured to the walls or suspended from the ceiling in the spaces they serve.
Fatigue	The tendency of a metal or other material to crack and fail under repeated applications of stress.
Filter	A device to separate solids, such as dust, from air. A device to separate solids from liquids; using a porous article or material for separating suspended particulate matter from liquids by passing the liquid through the pores of the filter and sieving out the solids.
Fin	An extended surface to increase the heat transfer area, as metal sheets attached to tubes.
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.
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.
Frass	A powdery residue in holes bored in wood by insects, usually by powder-post beetles.

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Furnace	That part of a warm air heating system in which combustion takes place.
Fusible Links	A metal chain link made of a low-melting point alloy; in case of fire, the chain breaks, thereby closing a damper, door, or the like.
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.
Gate Valve	A valve designed in such a way that the opening for flow (when the valve is fully open) is essentially the same as the pipe and the direction of flow through the valve is in a straight line. This is accomplished by a disk which is raised and lowered straight up out of the pipe into a bonnet or housing.
Gauge	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.
Generate	To originate or produce by a physical or chemical process.
Heat Exchanger	Any device, such as an automobile radiator, that transfers heat from one fluid to another or to the environment.
Hermetic	Completely sealed by fusion, soldering, etc. so as to keep air or gas from getting in or out; airtight.
Hermetic System	Refrigeration system which has a compressor driven by a motor contained in the compressor dome or housing.
Horsepower	The unit of power in the British engineering system, equal to 550 foot-pounds per second, approximately 745.7 watts.
High Temperature Hot Water	A hot water heating system operating at design water temperatures of greater than 350°.
Humidifiers	Device used to add to and control the humidity in a confined space.
Humidity	Moisture; dampness. Relative humidity is a quantity ratio of vapor present in the air to the greatest amount possible at a given temperature.

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Illegible	Very difficult or impossible to read because it is badly written or printed, faded, obscured by age, etc.
Impulse Steam Trap	Impulse traps have a piston in a conical cylinder and are intermittent in operation . A bleed hole through the piston allows flow from the inlet to the outlet even when the trap is closed.
Impellers	The rotating member of a fan, turbine, blower, axial or centrifugal pump, or mixing apparatus. Also known as a rotor.
Inspection	Visual and mechanical checking of the condition of facilities, usually performed on a regularly scheduled basis, to determine the extent of the maintenance and repair work required, and to ensure the proper operation of the systems being checked.
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.
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.
Kilopascal	The metric equivalent of the foot pound. A unit of pressure equal to the pressure resulting from a force which will impart an acceleration of one meter per second squared to a kilogram mass when the force is acting uniformly over an area of one square meter.
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.
Lithium Bromide	A chemical compound (salt) with the ability to absorb water and cool it by evaporation.
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.

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Low Temperature Water	A hot water heating system operating at design water temperatures of 250° or less and a maximum working pressure of 160 psi.
Lubricate	To reduce friction by providing a smooth film as a covering over parts that move against each other. To make slippery or smooth, to apply a lubricant.
Medium Temperature Water	A hot water system operating at temperatures of 350° or less, with pressures not exceeding 150 psi.
Mobilization	To put into motion, to bring into readiness for immediate active service; to organize (people, resources, etc.) for active service or use.
Ohmmeter	An instrument for measuring electric resistance; the scale may be graduated in ohms or megohms (the unit of electrical resistance of a conductor such that a constant current of one ampere in it produces a decrease in voltage across it of one volt.
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 Lamp	A low-wattage light used to indicate that an electric circuit, control, or device is active.
Pilot Light	A small flame which is used to ignite the gas at the main burner.
Plumb	Exactly Vertical.
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.
Purge	To evacuate air or gas from a duct line, pipeline, container, space or furnace; to blow out gas from a refrigerant containing vessel (now illegal because of regulations controlling the use of chlorofluorocarbons).

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Radiator	Cast iron heating units located under windows in the rooms or spaces to be heated. Due to their poor aesthetic appeal, many radiators are covered by some type of enclosure.
Reciprocate	Moving alternately back and forth; interchange position.
Refractory	A material, usually nonmetallic used to withstand high temperatures.
Refrigerant	A substance that by undergoing a change in phase (liquid to gas, gas to liquid) releases or absorbs a large latent heat in relation to its volume, and thus effects a considerable cooling effect. Examples are ammonia, sulfur dioxide, lithium bromide,and the fluorocarbons, such as Freon.
Register	Combination grille and damper assembly covering on an air opening or end of an air duct.
Reheat Coils	Installed in air supply ducts to reheat the air being supplied to individual spaces or a group of spaces, as needed, to control the temperature. The source of heat for the reheat coils is from hot water, steam, or electricity.
Residual	What is left at the end of a process; something remaining. What is left over after part or most is taken away.
Rotor	The rotating member of an electrical machine or device such as the rotating armature of a motor or generator or the rotating plates of a variable capacitor.
Run-out Play	The measurement of wear or erosion of a bearing or shaft.
Seals	A tight closure as against the passing of air and water, something that closes or fastens tightly or securely.
Sensors	The generic name for a device that senses either the absolute value or a change in a physical quantity such as temperature, pressure, flow rate, or pH, or the intensity of light, sound, or radio-waves and converts that change into a useful input signal for an information-gathering system.
Shaft	A bar or cylinder supporting or transmitting motion to a mechanical part.
Shell, Boiler: Electric	The boiler shell contains the heated fluid and the heating elements.

APPENDIX B

Shell and Chamber: Boiler Gas	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.
Specifications	An organized listing of basic components for materials of construction, product compositions, dimensions, or test conditions. A quantitative description of the required characteristics of a device or machine.
Spectrochemical	The branch of chemistry dealing with the analysis of the spectra of substances.
Stator	A fixed part forming the pivot or housing for a revolving part (rotor), as in a motor, dynamo.
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 a thermostatic 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: Thermostatic	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.
Suction	The production of a vacuum or partial vacuum in a cavity or over a surface so that the external atmospheric pressure forces the surrounding fluid into the cavity or causes something to adhere to the surface.
Thermometer	Device for measuring temperatures.

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Ton of Refrigeration	Refrigerating effect equal to the melting of one ton of ice in 24 hours. These may be expressed as follows: 288,000 BTU\24 hr, 12,000BTU\1hr, 200BTU\min.
Trim, Boiler	Piping or tubing close to or attached to a boiler for connecting controls, gages, or other instrumentation.
Tube-within-a-tube:	A water-cooled condensing unit in which a small tube is placed inside a larger unit. Refrigerant passes through one tube; water through the other.
Unit Heater	This term applies to a terminal unit designed to heat a given space. It consists of a fan and motor, a heating element, and an enclosure.
V-Belt	Type of belt that is commonly used in mechanical equipment. It has a contact surface which is in the shape of the letter "V".
Valve: Butterfly	A device which regulates the flow of a liquid by a plate which pivots in the waterway.
Valve: Check	A device which permits a liquid or gas to flow in one direction only.
Valve: Gate	A valve designed in such a way that the opening for flow (when the valve is fully open) is essentially the same as the pipe and the direction of flow through the valve is in a straight line.
Valve: OS&Y	A valve configuration where the valve stem, with exposed external threads supported by a yoke, indicates the open or closed position of the valve, (OS&Y = Outside Stem and Yoke).
Ventilation	The introduction of outdoor air into a building by mechanical means.
Vibration Tester	Instrument that measures the displacement, velocity or acceleration of a vibrating body.
Voltmeter	Instrument for measuring voltage in electrical circuit.
Water Heater	A closed vessel in which water is heated by the combustion of fuels, electricity, or any other source, and withdrawn for use external to the system at pressures not exceeding 160 psig (1100kPa gauge), and shall include the apparatus by which heat is generated and all controls and devices necessary to prevent water temperatures from exceeding 210°F (99°C).

APPENDIX B

APPENDIX C

LIFE CYCLES

08 BUILDING MECHANICAL

08.01 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

08.02 HEATING BOILERS - ELECTRIC

Electric Boilers	15 Years

Source:
Means Estimating Handbook, 1990

08.03 FURNACES - GAS/OIL/ELECTRIC

Furnaces - Gas/Oil	20 Years
Furnaces - Electric	15 Years

Source:
Means Estimating Handbook, 1990

08.04 CHILLERS - ABSORPTION

Chillers - Absorption	23 Years

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

08.05 CHILLERS - CENTRIFUGAL

Chillers - Centrifugal	23 Years

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

APPENDIX C

08.06 CHILLERS - RECIPROCATING

Chillers - Reciprocating 20 Years

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

08.07 CHILLERS - SCREW

Chillers - Screw 20 Years

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

08.08 AIR CONDITIONING - SPLIT SYSTEMS

Air Conditioning - Split Systems 15 Years

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

08.09 AIR CONDITIONING - PACKAGE SYSTEMS

Air Conditioning - Package Systems 15 Years

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

08.10 AIR CONDITIONING - COMPUTER ROOMS

Air Conditioning - Computer Rooms 15 Years

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

08.11 AIR CONDITIONING - WINDOW UNITS

Air Conditioning - Window Units 10 Years

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

APPENDIX C

08.12 HVAC SYSTEM CONTROLS, INSTRUMENTATION AND ENERGY MANAGEMENT SYSTEMS

Controls - system, electric	16 Years
Controls - system, pneumatic	20 Years
Indicators, transmitters, and sensors, electric	16 Years
Indicators, transmitters, and sensors, pneumatic	20 Years
Operators, electric	16 Years
Operators, pneumatic	20 Years
Piping and fittings	20 Years
Panels	15 Years
Air tanks	30 Years
Air compressors	15 Years
Motors	18 Years
Valves	20 Years
Controls - air compressor	17 Years
Dryers	15 Years
Pressure regulators and fitters	15 Years

Source:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
Means Estimating Handbook, R.S.Means Company, Inc., 1990

08.13 TERMINAL UNITS

Radiators	25 Years
Baseboard Heaters	25 Years
Cabinet Heaters	20 Years
Fan Coil Units	20 Years
Unit Heaters - Gas/Oil/Electric	13 Years
Unit Heaters - Steam/Hot Water	20 Years
Unit Heaters - Gas Radiant	13 Years

Source:

Means Estimating Handbook, R.S.Means Company, Inc., 1990
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

APPENDIX C

08.14 BOILER FEEDWATER SYSTEMS

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

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

08.15 CHILLED WATER DISTRIBUTION SYSTEMS

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

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

08.16 CONDENSER WATER DISTRIBUTION SYSTEMS

Pumps	15 Years
Motors	15 Years
Controls	15 Years
Piping And Fittings	30 Years
Valves	15 Years

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

08.17 STEAM DISTRIBUTION SYSTEMS

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

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

APPENDIX C

08.18 STEAM CONDENSATE RETURN SYSTEMS

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

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

08.19 HEATING HOT WATER DISTRIBUTION SYSTEMS

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

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

08.20 AIR HANDLING UNITS

Enclosures and supports	20 Years
Dampers	20 Years
Filters, permanent	5 Years
Coils	20 Years
Fans/blowers	20 Years
Motors	18 Years
Drive Assemblies	18 Years
Controls	15 Years

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

APPENDIX C

08.21 AIR DISTRIBUTION SYSTEMS

Ductwork	30 Years
VAV boxes	20 Years
Grilles/diffusers	27 Years
Humidifiers	17 Years

Sources:

Means Estimating Handbook, R.S. Means Company, Inc., 1990
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

08.22 EXHAUST AND VENTILATION SYSTEMS

Exhaust and Ventilation Systems	20 Years

Source:

Means Estimating Handbook, R.S.Means Company, Inc., 1990
Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

08.23 EVAPORATIVE COOLERS

Life Cycle:	10 Years

Source:

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

08.24 COOLING TOWERS/EVAPORATIVE CONDENSERS

Enclosures, Fill, Frame - Wood (redwood treated)	20 YRS
Enclosures, Fill, Frame - Metal (aluminum, Galvanized steel)	20 YRS
Enclosures, Fill, Frame - Fiberglass	15 YRS
Enclosures, Fill, Frame - Ceramic	34 YRS
Enclosures, Fill, Frame - PVC	15 YRS
Fans/Blowers/Drive Assemblies	18 YRS
Pumps	20 YRS
Motors	18 YRS
Condensing Coil	20 YRS
Dampers	20 YRS
Metal Ladders, Stairways, Railing	20 YRS

Source:

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

APPENDIX C

08.25 AIR COOLED CONDENSER - FLUID COOLER SYSTEMS

Air Cooled Condensers	15 Years
Fluid Coolers	15 Years

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

08.26 CHEMICAL WATER TREATMENT SYSTEMS

Chemical Water Treatment System	15 Years

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