OSHP
LEADS Data Centers
Preventative Maintenance Recommendations
Report

The Ohio State Highway Patrol

At

Lancaster - Post 23
Alum Creek Facility
Shipley Building
EMS Center

Prepared For:

State of Ohio

Department of Public Safety/Facility Management

Ohio State Highway Patrol
Col. John Born, Superintendent

Ohio State Highway Patrol - Office of Facility Management
1970 W. Broad Street, 5th Floor
Columbus, Ohio 43223

Prepared By:

Karpinski Engineering
8720 Orion Place, Suite 120
Columbus, Ohio 43240
PM: Mr. Michael Hunter
Telephone: 614-430-9820
Fax Number: 614-430-9825
E-mail: mhunter@karpinskieng.com

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karpinski
ENGINEERING
8720 ORION PLACE
SUITE 120
COLUMBUS, OHIO 43240
P 614.430.9820
F 614.430.9825
W karpinskieng.com

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PART 1 - BASIC RECOMMENDATIONS

1.1 MAINTAINING REDUNDANCY

A. Maintenance shall be performed on one system component at a time on all redundant systems.

B. Before any component is turned off for maintenance, its corresponding redundant component shall be verified that it is operational and free of any operational deficiencies or alarms.

C. Service shall be completed entirely and restored to normal operation before proceeding with service to redundant components.

1.2 RESTORATION DURING EMERGENCY

A. Back out procedures shall be established prior to undertaking service on any non-redundant component which if failure of the primary source would cause loss of service and loss of IT equipment operation.

    1. Generator and transfer switch maintenance service shall be performed in intervals such that the operation can be restored in time not exceeding UPS system battery backup time.

1.3 SITE READINESS

A. All systems shall be returned to normal operating service prior to service personnel leaving site on a daily basis. No equipment shall be left unattended when in a non-operational state.

B. Care shall be taken to assure any PM procedure which could cause activation of the VESDA Smoke detection system, EPO activation, Gaseous Fire Suppression activation, Fire Alarm system activations or other detrimental actions, such as creation of dust particles, smoke, gasses or other agents which could cause tripping of such systems. All contractors performing any activities which could pose such risks shall notify the owner prior to undertaking the action, shall secure all site emergency system in a inhibited or disarmed mode and restore all systems upon completion and prior to leaving the site.

C. VESDA system shall be placed in the inhibited mode prior to any equipment service involving utilization of compressed air, testing of smoke detection systems, service on fire protection systems, involving practices which could cause smoke, disturb dust or cause related VESDA activation.

1.4 GENERAL QUALIFICATIONS

A. All work shall be performed by qualified maintenance personnel who are factory trained on the maintenance and service of the equipment involved and licensed in the State of Ohio to perform such services.

B. All electrical maintenance and IR scans shall be performed by licensed electricians, licensed in the State of Ohio to perform such services.

C. All legally required PM procedures and intervals on legally required systems such as fire protective and suppression systems, fire alarm systems, VESDA system, emergency generator, transfer switch and other life safety systems, shall be performed as part of those systems PM procedures in accordance with all applicable sections of NFPA, state and local code requirements. This document shall not act to supersede or over rule any legally required PM procedure or interval.

D. **Refer to and comply with requirements of Publications referenced in Section 8 – Additional Referenced Standards.**

1.5 PM REPORTS

A. All service personnel shall maintain daily logs documenting the following minimum observations:

1. Time of arrival onsite and time of departure.

2. Identify all persons performing such activities on-site.

3. Identify equipment to be serviced and/or reason for service.

4. Status condition of equipment to be serviced, noting any alarms, off normal operating conditions, leaks or damage observed.

5. Status condition of any other equipment conditions observed which appear to have alarms, off normal operating conditions, leaks or damage observed.

6. Status condition of serviced equipment at the time service personnel left the site.

PART 2 - HVAC EQUIPMENT PREVENTATIVE MAINTENANCE

2.1 CRAC UNITS

A. All PM services shall be performed by a factory trained service technician, certified by Emerson –Liebert in service on model units to be serviced.

B. Document actual space conditions prior to performing any PM services, at each PM inspection/service interval, as follows:

    1. Room temperature reading

    2. Inlet air temperature to front of IT equipment rack (max)

    3. Unit return air temperature reading

    4. Unit Humidity reading

    5. Unit in operation

C. Perform quarterly (4 times per year) unit maintenance per Emerson – Liebert recommended PM procedures and intervals, refer to attached 8.1and 8.2 Liebert CRAC Unit Maintenance Guides.

D. Perform specific PM procedures at intervals, per the following minimum requirements.

E. FILTERS

    1. Air filters shall be checked for obstructions and dirt accumulation every 3 months.

    2. Air filters shall be changed every 6 months, remove old filter and replace with new. (Adjust frequency of replacement to suit local operating conditions with owner's prior approval).

F. CONDENSATE PUMP

    1. Condensate pump shall be checked for obstruction and cleaned every 3 months.

    2. Inspect condensate line for accumulation of mold and dirt debris in line, traps and pans. Clean as required.

    3. Clean condensate pump sump, remove scale, flush with clean water.

G. HUMIDIFIER

    1. Inspect and clean humidifier pan every 3 months. Remove scaling from float switch and pan as recommended.

H. FANS

1. Lubricate blower motor per manufacturer's recommendations every 5 years. Inspect belt tension and adjust.

I. ICOM CONTROLS

1. Verify at each PM inspection, the unit controls are in the following condition:

a. Automatic Operation – Teamwork Mode 1.

b. 78 degree F return air temperature setpoint (adjustable to produce a maximum inlet air temperature to IT equipment racks at front of rack of 78 degrees F.

2.2 DRYCOOLERS

A. All PM services shall be performed by a factory trained service technician, certified by Emerson –Liebert in service on model units to be serviced.

B. Perform unit maintenance per Emerson – Liebert recommended PM procedures and intervals, refer to attached 8.1 and 8.2 Liebert CRAC Unit Maintenance Guides. Perform specific PM procedures at intervals, per the following minimum requirements.

C. COILS

1. Inspect coils for dirt debris every 3 months.

2. Clean coils by flushing with water hose at no more than city water pressure once per year.

D. EXPANSION TANK

1. Check expansion tank charge every 6 months.

E. FANS

1. Check fan controls, aqua stat settings every 6 months.

2.3 GLYCOL PUMPS

A. All PM services shall be performed by a factory trained service technician, certified by Emerson –Liebert in service on model units to be serviced.

B. Perform unit maintenance per Emerson – Liebert recommended

PM procedures and intervals, refer to attached 8.1 and 8.2 Liebert CRAC Unit Maintenance Guides. Perform specific PM procedures at intervals, per the following minimum requirements.

C. Inspect glycol water pressure readings on suction and discharge sides of pump monthly.

D. PUMP MOTORS

1. Inspect pump motor bearings every 6 months.

2.4 GLYCOL FLUID MAINTENANCE

A. GENERAL

1. Check glycol solution level every 3 months.

2. Vent system, adjust fluid levels every 3 months.

3. Inspect glycol water pressure readings on suction and discharge sides of pump monthly.

4. Drain system, flush and refill with new solution every 5 years or as recommended by testing agency.

B. TESTING

1. Take glycol sample and perform specific gravity test every 6 months. Perform a glycol fluid chemical analysis every 1-year.

2. Propylene glycol (Dowfrost) 50 percent concentration:

a. Specific gravity @ 60 degree F = 1.050-1.060

b. PH = 9.0-10.0

c. Reserve Alkalinity (min.) = 10.0 ml

d. Freezing Point = (-28.3) F

2.5 VALVES

A. Inspect valves for proper position and signs of leaks or corrosion, clean as required, quarterly.

B. Cycle all glycol system valves by operating from full open to full closed, no less than once per year. Cycle valves only with system shut down while redundant system is in operation. Do not drain any fluids during valve operations.

PART 3 - PLUMBING EQUIPMENT PREVENTATIVE MAINTENANCE

3.1 DOMESTIC COLD WATER BACKFLOW PREVENTER

A. Inspect for proper operation one yearly.

B. Perform PM Service cleaning, adjustment and spring/seal replacement every 5 years.

3.2 GAS METER AND SUPPLY PIPING

A. Visually inspect gas lines and regulator installation for proper condition and signs of leaks once per year.

3.3 CONDENSATE DRAINS

A. Condensate drains shall be checked for obstruction every 3 months. Inspect condensate line for accumulation of mold and dirt debris in line, traps and pans. Clean as required. Flush with clean water.

PART 4 - FIRE PROTECTION EQUIPMENT

4.1 CLEAN AGENT GASEOUS FIRE SUPPRESSION SYSTEM

A. GENERAL MAINTENANCE SERVICE

1. Perform maintenance in accordance with NFPA 2001-2013.

B. Control units and devices shall be inspected semi-annually and tested annually.

C. Batteries shall be inspected and tested semi-annually.

D. Supervisory signals and flow devices shall be inspected once every 3 months.

4.2 VESDA SMOKE DETECTION SYSTEM

A. GENERAL MAINTENANCE SERVICE

1. Perform maintenance in accordance with NFPA 72-2013.

B. Refer to attached 7.3 VESDA Maintenance Guide.

C. Units shall be inspected, tested and serviced at least once annually.

D. Batteries shall be inspected and tested semi-annually.

E. FILTER

1. Replace cartridge filters on each VESDA unit every 3-5 years or as recommended by service personnel where units are exposed to heavy dust or air born contamination.

F. DE-ACTIVATION DURING SERVICE OPERATIONS

1. VESDA system shall be placed in the inhibited mode prior to any equipment service involving utilization of compressed air, testing of smoke detection systems, service on fire protection systems, involving practices which could cause smoke, disturb dust or cause related VESDA activation.

4.3 PRE-ACTION DRY PIPE SPRINKLER SYSTEM (ALUM CREEK ONLY)

A. GENERAL MAINTENANCE SERVICE

1. Perform maintenance in accordance with NFPA 13-2013.

B. Control units and devices shall be inspected semi-annually and tested annually.

C. Batteries shall be inspected and tested semi-annually.

D. Supervisory signals and flow devices shall be inspected once every 3 months.

4.4 FIRE ALARM PANEL (Lancaster - Post 23 Only)

A. GENERAL MAINTENANCE SERVICE

1. Perform maintenance in accordance with NFPA 72-2013.

B. Control units and devices shall be inspected semi-annually and tested annually.

C. Batteries shall be inspected and tested semi-annually.

D. Supervisory signals and water flow devices shall be inspected once every 3 months.

PART 5 - ELECTRICAL EQUIPMENT

5.1 DISTRIBUTION PANELS

A. IR SCAN

1. Every 5 years, Perform Infrared imaging photographic scan of all incoming terminations, main bus area, circuit breakers and load terminations with panels operating under normal load.

B. BREAKER OPERATION

1. Manufacturers recommend circuit breakers be operated (cycled on-off) at least once per year to verify operation and exercise the operator. In data center operations power loss is a primary concern and breakers are difficult to cycle on-off as this would cause loss of power to the load and there-fore discouraged.

2. Scheduled maintenance and operation of breakers should occur any time IT equipment systems are planned to be shut down. Record breaker operations during all maintenance and installation procedures, with date of operation.

3. All breakers should be operated at least once every 2 years, either through ongoing operations or through planned breaker operation maintenance schedules.

4. Breakers can be cycled for equipment in standby mode and the primary equipment has been verified for proper operating condition. Record breaker operations with date of operation.

5. All Breakers downstream of the UPS should be cycled maintaining A/B topography to each individual load. Verify prior to cycling breaker that corresponding alternate source is operational before cycling. Record breaker operations with date of operation.

C. METERING EQUIPMENT

1. Document each meters voltage, frequency, ampere, KW, KVA and PF readings 4 times per year.

2. Verify systems are in normal operating condition.

5.2 SERVICE DISCONNECTS

A. IR SCAN

1. Every 5 years, Perform Infrared imaging photographic scan of all incoming terminations, main bus area, circuit breakers and load terminations with panels operating under normal load.

5.3 EMERGENCY POWER OFF (EPO) SYSTEM

A. DE-ACTIVATION DURING SERVICE OPERATIONS

1. EPO system shall be placed in the inhibited mode prior to any equipment service involving utilization of compressed air, testing of smoke detection systems, service on fire protection systems, involving practices which could cause smoke, disturb dust or cause related EPO activation.

2. Every 2 years, place system in inhibit mode and test operation. Clean control panel interior with compressed air to remove dust accumulations (inhibit VESDA System before performing this procedure.).

5.4 AUTOMATIC TRANSFER SWITCH (LANCASTER POST 23 ONLY)

A. MAINTENANCE

1. Transfer switches shall have manufacturers recommended preventative maintenance (Minor) performed every 3 months and annual preventative service (Major) performed annually.

B. IR SCAN

1. Every 5 years, Perform Infrared imaging photographic scan of all incoming terminations, main bus area, circuit breakers and load terminations with panels operating under normal load.

C. TRANSFER TESTS

1. Transfer switches shall be tested and operated under building load once monthly.

5.5 GENERATOR (LANCASTER POST 23 ONLY)

A. All PM services shall be performed by a factory trained service technician, certified by Kohler in service on model units to be serviced.

B. Perform unit maintenance per Kohler recommended PM procedures and intervals, refer to attached 7.2 Kohler PM guide. Perform quarterly inspections and maintenance. Perform specific PM procedures at intervals, per the following minimum requirements.

C. LOAD TESTS

1. Generators shall be exercised and tested under load once

monthly for a minimum of 30 minutes, as follows:

a. Loading that maintains the minimum exhaust gas temperatures as recommended by the manufacturer, or

b. Under operating temperature conditions and at not less than 30 percent of rated load. (37.5 KW)

D. BATTERY SYSTEM

1. Starting batteries shall be inspected and tested monthly. Recording of battery condition shall be maintained on-site.

2. Replace starting batteries every 4-years.

E. FLUID CHANGES

1. Change engine oil and filters annually. Change air filters annually.

2. Test engine coolant annually.

3. Replace engine coolant every 3 years or as recommended by service technician.

5.6 GROUNDING SYSTEMS

A. GROUND BAR

1. Visually inspect systems components, conductors and installation annually. Tighten all bolted connections. Repair any corroded or damaged grounding conductors.

2. Perform ground resistance test every 5 years.

5.7 LIGHTNING PROTECTION SYSTEM

A. Visually inspect lightning protection systems components, conductors and installation annually. Tighten all bolted connections. Repair any corroded or damaged conductors or air terminals.

B. Perform ground resistance test every 5 years.

C. Renew the UL Master Label every 5 years.

PART 6 - REFERENCED EQUIPMENT

6.1 OSHP LEADS DATA CENTER – LANCASTER POST 23

A. CRAC UNITS

1. LIEBERT DS UNITS Model Number: DS053KDC0EI

    a. Quantity: 2

B. DRYCOOLERS

1. LIEBERT Model Number: DSO491Y32

    a. Quantity: 2

C. GLYCOL PUMPS

1. LIEBERT Single Pump Model Number: S3Y

    a. Quantity: 2

D. GLYCOL FLUID

1. DOW DOWFROST Inhibited Propylene Glycol Fluid

E. DOMESTIC COLD WATER BACKFLOW PREVENTER

1. WATTS Series 9D Dual Check Valve with Intermediate Atmospheric Vent, 3/4” Model M2

F. CLEAN AGENT GASEOUS FIRE SUPPRESSION SYSTEM

1. 3M NOVEC 1230 Engineered Fire Suppression System

G. VESDA SMOKE DETECTION SYSTEM

1. XTRALIS VESDA VLP DETECTOR

    a. Quantity: 2

H. FIRE ALARM PANEL

1. FENWAL – FENWALNET 6000 Fire Alarm/Suppression System Control Unit

2. FENWAL – Model RDCM Remote Display/Control Module

I. DISTRIBUTION PANELS

1. GENERAL ELECTRIC Type AQP
2. GENERAL ELECTRIC Type AQ

J. SERVICE DISCONNECTS

1. GENERAL ELECTRIC Type 400AF N1 DS TH3325

K. EMERGENCY POWER OFF (EPO) SYSTEM

1. DARWELLIT TRIPMASTER XL

L. AUTOMATIC TRANSFER SWITCH

1. KOHLER MODEL KCT-ACVA-06008

M. GENERATOR

1. KOHLER MODEL 125REZGB

N. LIGHTNING PROTECTION SYSTEM

1. INDEPENDENT PROTECTION CO, INC. ULE10913 PROJECT # 10394

6.2 OSHP LEADS DATA CENTER – ALUM CREEK FACILITY

A. CRAC UNITS

1. LIEBERT DS UNITS Model Number: DS053KDA0EI
    a. Quantity: 2

B. DRYCOOLERS

1. LIEBERT Model Number: DSO491A32
    a. Quantity: 2

C. GLYCOL PUMPS

1. LIEBERT Single Pump Model Number: S3A
    a. Quantity: 2

D. GLYCOL FLUID

1. DOW DOWFROST Inhibited Propylene Glycol Fluid

E. DOMESTIC COLD WATER BACKFLOW PREVENTER

1. WATTS Series 9D Dual Check Valve with Intermediate Atmospheric Vent, 3/4” Model M2

F. CLEAN AGENT GASEOUS FIRE SUPPRESSION SYSTEM

1. 3M NOVEC 1230 Engineered Fire Suppression System
2. FENWAL 732 Fire Alarm -Suppression Control Unit

G. VESDA SMOKE DETECTION SYSTEM

1. XTRALIS VESDA VLP DETECTOR
    a. Quantity: 2

H. PRE-ACTION DRY PIPE SPRINKLER SYSTEM

1. GENTRY FIRE PROTECTION COMPANY # 55312C

I. FIRE ALARM PANEL

1. NOT INCLUDED

J. DISTRIBUTION PANELS

1. SCHNEIDER ELECTRIC I-LINE PANELBOARD
2. SCHNEIDER ELECTRIC NQ PANELBOARD
3. LIEBERT ACCUVAR TVSS MODEL ACV277Y111RK
4. LIEBERT ACCUVAR TVSS MODEL ACV120Y111RK

K. EMERGENCY POWER OFF (EPO) SYSTEM

1. DARWELLIT TRIPMASTER XL

6.3 OSHP DATA CENTER – SHIPLEY BUILDING

A. CRAC UNITS

1. LIEBERT DS DX UNITS Model Number: DS105AUA0EI
    a. Quantity: 2
2. LIEBERT DELUXE SYSTEM 3 GLYCOL UNITS Model Number: FH192GUAAM0415, serial numbers 340415-005, 340415-006 and 340415-007.

a. Quantity: 3

3. LIEBERT DELUXE SYSTEM 3 GLYCOL UNITS Model Number: FH110GUAAM0415, serial numbers 340415-008 and 340415-009.

   a. Quantity: 2

4. LIEBERT DELUXE SYSTEM 3 DX UNITS Model Number: UH125AUAAM0415, serial number 340415-004

   a. Quantity: 1

5. LIEBERT CHALLENGER UNIT GLYCOL Model Number: BU046WGAAM0415, serial number 340415-003

   a. Quantity: 1

6. LIEBERT CHALLENGER UNIT DX Model Number: BU042AAAM0415, serial numbers 340415-001 and 340415-002.

   a. Quantity: 2

7. LIEBERT MINI-MATE UNIT DX Model Number: MME036E-XH1, serial numbers 93155, 93159, 93167, 93168, 93204 and 93205.

   a. Quantity: 6

B. DRYCOOLERS

1. LIEBERT DX CONDENSER Model Number: TCDV415A

   a. Quantity: 2

2. LIEBERT GLYCOL DRYCOOLER Model Number: DDNT350A, serial numbers 97030224, 97030225, 97030226.

   a. Quantity: 3

3. LIEBERT DX CONDENSER Model Number: DCSF083LZ , serial numbers 97030181 and 97030232

   a. Quantity: 2

4. LIEBERT DX CONDENSER Model Number: DCDF165LA , serial number 97030297

   a. Quantity: 1

5. LIEBERT DX CONDENSER Model Number: PFC037A-YL0, serial numbers D042758, D042759, D042762, D042763, D042776 and D042777.

    a. Quantity: 6

C. GLYCOL PUMPS

1. LIEBERT DUPLEX PUMP PACKAGE Model Number: 018-0551, serial number 0896-L2236/896-L2237.

    a. Quantity: 1

6.4 OSHP DATA CENTER – EMA FACILITY

A. CRAC UNITS

1. LIEBERT CHALLENGER UNIT CHILLED WATER upflow unit Model Number: BU102C-CDEI626A, serial number N12M740191

    a. Quantity: 1

2. LIEBERT CHALLENGER UNIT CHILLED WATER down flow unit Model Number: BF102C-CDEI756A, serial number N12K740050

    a. Quantity: 2

PART 7 - INTERVAL MATRIX

PREVENTATIVE MAINTENANCE INTERVAL MATRIX

OSHP - DATA CENTERS - PM RECOMMENDATIONS MATRIX

			INSPECT				CLEAN				REPLACE				SERVICE				TEST				
PART	ITEM	SUB ITEM	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	REMARKS
2.1	CRAC UNITS																						
2.1.B		DOCUMENT EXISTING SPACE CONDITIONS	X																				
2.1.C		LIEBERT RECOMMENDED PM PROCEDURES														X							
2.1.E		AIR FILTERS		X										6-MO									
2.1.F		CONDENSATE PUMP		X				X								X							
2.1.G		HUMIDIFIER		X				X								X							
2.1.H		FANS		X												X							
2.1.I		ICOM CONTROLS		X												X							
2.2	DRYCOOLERS																						
2.2.B		LIEBERT RECOMMENDED PM PROCEDURES		X												X							
2.2.C		COILS		X					X							X							
2.2.D		EXPANSION TANK				6-MO												6-MO					
2.2.E		FANS				6-MO												6-MO					
2.3	GLYCOL PUMPS																						
2.3.B		LIEBERT RECOMMENDED PM PROCEDURES		x												x							
2.3.C		WATER PRESSURE READINGS	X																				
2.3.D		PUMP MOTOR				6-MO												6-MO					
2.4	GLYCOL FLUID																						
2.4.A.1		CHECK FLUID LEVEL		X												X							
2.4.A.2		VENT, ADJUST LEVEL		X												X							
2.4.A.3		DOCUMENT PRSSSURE READINGS	X																				
2.4.A.4		DRAIN, FLUSH AND REPLACE FLUID								5-YRS				5-YRS				5-YRS					
2.4.B.1		TEST SOLUTION				6-MO																6-MO	
2.5	VALVES																						
																	X						
2.5.A		INSPECT		X				X								X							
2.5.B		CYCLE ALL VALVES															X						
3.1	BACKFLOW PREVENTER																						
3.1.A		INSPECT			X												X						
3.1.B		SERVICE/SEAL REPLACEMENT								5-YR				5-YR				5-YR					
3.2	GAS METER AND PIPING																						
3.2.A		VISUAL INSPECTION			X																		
3.3	CONDENSATE DRAINS																						
3.3.A		INSPECT/CLEAN/FLUSH		X				X								X							

OSHP - DATA CENTERS - PM RECOMMENDATIONS MATRIX

			INSPECT				CLEAN				REPLACE				SERVICE				TEST				
PART	ITEM	SUB ITEM	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	REMARKS
4.1	CLEAN AGENT SYSTEM																						
4.1.A.1		PREFORMED REQUIRED PM SERVICES																				PER NFPA 2001-2013	
4.1.B		CONTROL UNITS/DEVICES				6-MO												6-MO			X		
4.1.C		BATTERIES				6-MO												6-MO				6-MO	
4.1.D		SUPERVISORY SIGNALS/FLOW DEVICES		X												X				X			
4.2	VESDA SMOKE DETECTION																						
4.2.A.1		PREFORMED REQUIRED PM SERVICES																				PER NFPA 72-2013	
4.2.B		VESDA MAINTENANCE			X				X								X						
4.2.C		CONTROL UNITS/DEVICES				6-MO											X				X		
4.2.D		BATTERIES				6-MO												6-MO				6-MO	
4.2.E.1		FILTER			X									3-YRS			X						
4.3	PRE-ACTION DRY PIPE SYS																						
4.3.A.1		PREFORMED REQUIRED PM SERVICES																				PER NFPA 13-2013	
4.3.B		CONTROL UNITS/DEVICES				6-MO											X				X		
4.3.C		BATTERIES				6-MO												6-MO				6-MO	
4.3.D		SUPERVISORY SIGNALS/FLOW DEVICES		X												X				X			
4.4	FIRE ALARM PANEL																						
4.4.A.1		PREFORMED REQUIRED PM SERVICES																				PER NFPA 72-2013	
4.4.B		CONTROL UNITS/DEVICES				6-MO											X				X		
4.4.C		BATTERIES				6-MO												6-MO				6-MO	
4.4.D		SUPERVISORY SIGNALS/FLOW DEVICES		X												X				X			
5.1	DISTRIBUTION PANELS																						
5.1.A.1		IR SCAN				5-YR																5-YR	
5.1.B		BREAKER OPERATION				2-YR																2-YR	
5.1C		METER READINGS		X																			
5.2	SERVICE DISCONNECTS																						
5.2.A		IR SCAN				5-YR																5-YR	
5.3	EPO SYSTEM																						
5.3.A.2		TEST SYSTEM OPERATION				2-YR																2-YR	

OSHP - DATA CENTERS - PM RECOMMENDATIONS MATRIX

			INSPECT				CLEAN				REPLACE				SERVICE				TEST				
PART	ITEM	SUB ITEM	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	MO	QTR	AN	OTHER	REMARKS
5.4	ATS	(LANCASTER)																					
5.4.A.1		PREFORMED REQUIRED PM SERVICES		X				X								MINOR	MAJOR			X			
5.4.B.A		IR SCAN				5-YR																5-YR	
5.4.C.1		TRANSFER TEST	X																X				BUILDING LOAD TEST
5.5	GENERATOR	(LANCASTER)																					
5.5.B		PREFORMED REQUIRED PM SERVICES		x				x								x							
5.5.C		LOAD TESTS	X																X				
5.5.D.1		BATTERIES	x												X				X				
5.5.D.2		REPLACE STARTING BATTERY												4-YR									
5.5.E.1		FLUID CHANGE			X								X				X						
5.5.E.2		REPLACE ENGINE COOLANT			X									3-YR							X		
5.6	GROUNDING SYSTEM																						
5.6.A.1		GROUND BAR			X												X						
5.6.A.2		GROUND RESISTANCE TEST				5-YR																5-YR	
5.7	LIGHTNING PROTECTION																						
5.7.A		INSPECT AND TIGHTEN BOLTS			X												X						
5.7.B		GROUND RESISTANCE TEST				5-YR																5-YR	
5.7.C		RENEW UL MASTER LABEL				5-YR												5-YR				5-YR	

PART 8 - ATTACHMENTS

8.1 Liebert DS CRAC Unit PM Recommendations

13.0 MAINTENANCE

WARNING

Risk of electric shock. Can cause injury or death.

Disconnect local and remote power supplies before working within.

Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.

Follow all local codes.

WARNING

Risk of improper wiring, piping, moving, lifting and handling. Can cause equipment damage, injury or death.

Only qualified service personnel should work on this equipment.

Read all installation, operating and safety instructions before proceeding.

Read and follow all warnings in this manual

NOTICE

Risk of improper operation. Can cause damage to equipment.

Do not change Advanced Menu parameter settings in the Liebert iCOM without first getting permission from Emerson Network Power Liebert Service.

Lowering this parameter to less than 100% will cause the coil to freeze on DX units, will overheat the reheat components on any unit and cause condensation problems on any unit equipped with a humidifier.

The Liebert DS product is a single component in the facility heat removal system. The system includes air distribution (raised floors, duct systems), outdoor heat rejection (condensers, pumps, drycoolers, cooling towers, piping, heat rejection fluid, ambient temperature, etc.) and indoor cooling and humidity loads (equipment load, location, outside air infiltration). Proper application and maintenance of the entire system is critical to the life and reliability of the Liebert DS.

- Good maintenance practices are essential to minimizing operation costs and maximizing product life.
- Read and follow monthly and semi-annual maintenance schedules included in this manual. These MINIMUM maintenance intervals may need to be more frequent based on site-specific conditions.
- See the Liebert iCOM user manual, SL-18835, for instructions on how to utilize the unit controller to predict some service maintenance intervals.
- Emerson recommends the use of trained and authorized service personnel, extended service contracts and factory-specified replacement parts. Contact your local Emerson representative.

13.1 Filters

NOTICE

Risk of improper filter installation and filter collapse. Can cause equipment damage.

Pleat direction is non-standard. Use only short-pleat filters (see **Figure 98**). Long-pleat filters are subject to collapse at high airflows.

To maximize the performance and reliability of Liebert DS equipment, use only Liebert filters. Contact your local Emerson representative to order replacement filters.

Table 58 Filter quantities

	028	035	042	053	070	077	105
Downflow Models							
Quantity	3	3	3	4	4	4	4
Nominal Size, inches	2 @ 25x20 1 @ 25x16	2 @ 25x20 1 @ 25x16	2 @ 25x20 1 @ 25x16	4 @ 25x20	4 @ 25x20	4 @ 25x20	2 @ 25x20 4 @ 25x16
Upflow Models (Front & Rear return) Filters located in separate filter box on rear return, located on lower unit panel							
Quantity	4	4	4	6	6	6	8
Nominal Size, inches	25x20	25x20	25x20	25x20	25x20	25x20	25x20

Disposable Type - Nominal Sizes and Quantities, Standard MERV 8 or Optional MERV 11; (filter types cannot be mixed, must be all MERV 8 or all MERV 11)

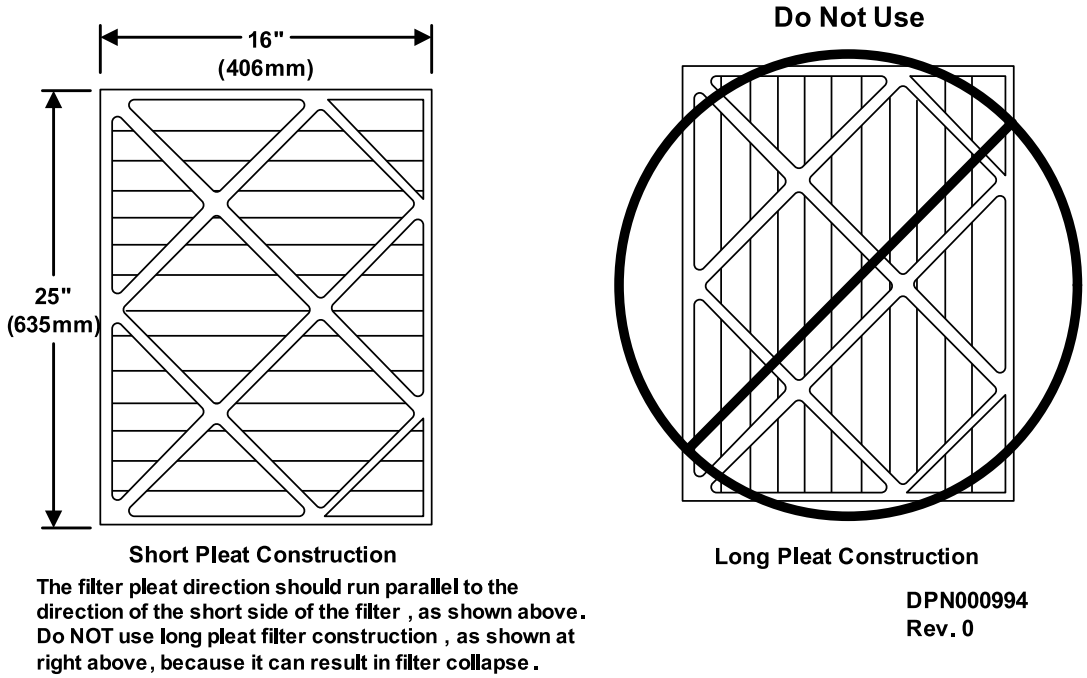
13.1.1 Filter Replacement Procedure—Downflow Units

1. Disconnect power from the Liebert DS.
2. Using a stepladder, remove filters from the top of the unit.
   The optional downflow return air plenum includes a filter access door.
3. Replace with new filters—install the filters in the proper direction of the airflow (see **Figure 98**).
4. Test the operation of the filter clog switch.
   The unit panels must be in place and closed to find this point.
5. Start the blower and turn the switch counterclockwise until the alarm is energized.
6. Turn the adjusting knob one turn clockwise or to the desired filter change point.

13.1.2 Filter Replacement Procedure—Upflow Units

1. Disconnect power from the Liebert DS.
2. Remove the lower front access panel and remove the filters.
   For upflow front return units, remove the lower front access panels, lift filters to the top of the filter rack and tilt forward for removal.
   For upflow rear return units, remove filters using filter access door in rear return filter box.
3. Replace with new filters—install the filters in the proper direction of the airflow (see **Figure 98**).
4. Test the operation of the filter clog switch.
   The unit panels must be in place and closed to find this point.
5. Start the blower and turn the switch counterclockwise until the alarm is energized.
6. Turn the adjusting knob one turn clockwise or to the desired filter change point.

Figure 98 Proper filter pleat direction



13.2 Blower Drive System—Centrifugal Fans

Blower drive system components that are part of the maintenance schedule include the blower wheel(s) drive shaft, bearings, pulley, belts, sheave, motor auto-tension base and motor. See **Blower Section on page 152**.

WARNING

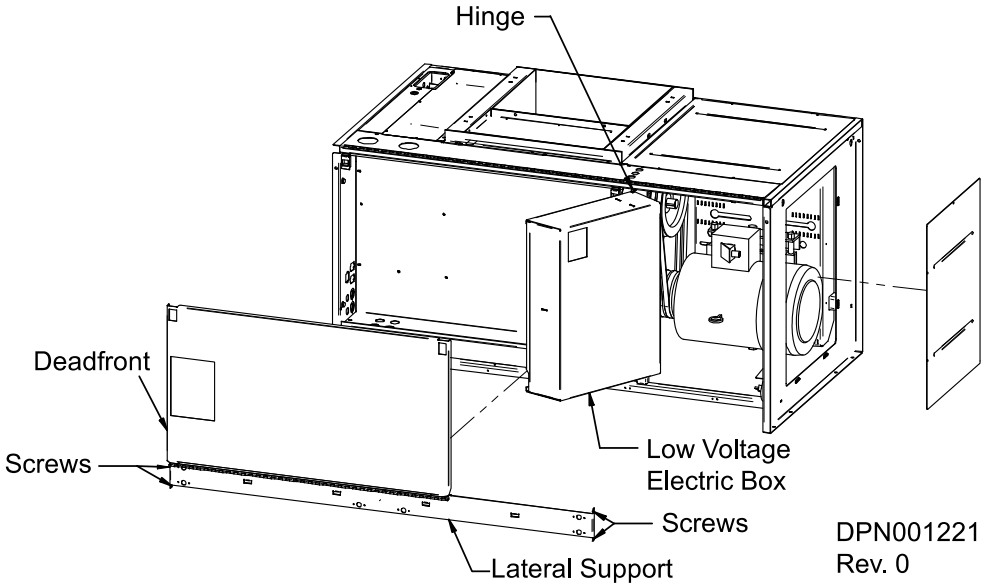
Risk of crushing and pinching action from spring-loaded motor base. Can cause serious injury to hands and fingers.

Improper drive belt removal may cause the motor base to slam down suddenly. Read the directions in this manual and on the unit instruction labels before servicing the belts, motors or pulleys. Follow all directions when servicing the unit.

13.2.1 Upflow Motor Access

1. Remove the lateral support (sheet metal channel) under electric box by removing two screws at each end.
2. Removed the hinged deadfront panel (30-ton units have open access to the motor).
3. Remove two screws on the right side of the low-voltage electric box that secure the low volt electric box to the sheet metal shoulder.
4. Swing open low-voltage electric box to gain access to the motor.

Figure 99 Upflow motor access



13.2.2 Belt Removal

1. Disconnect power to unit.

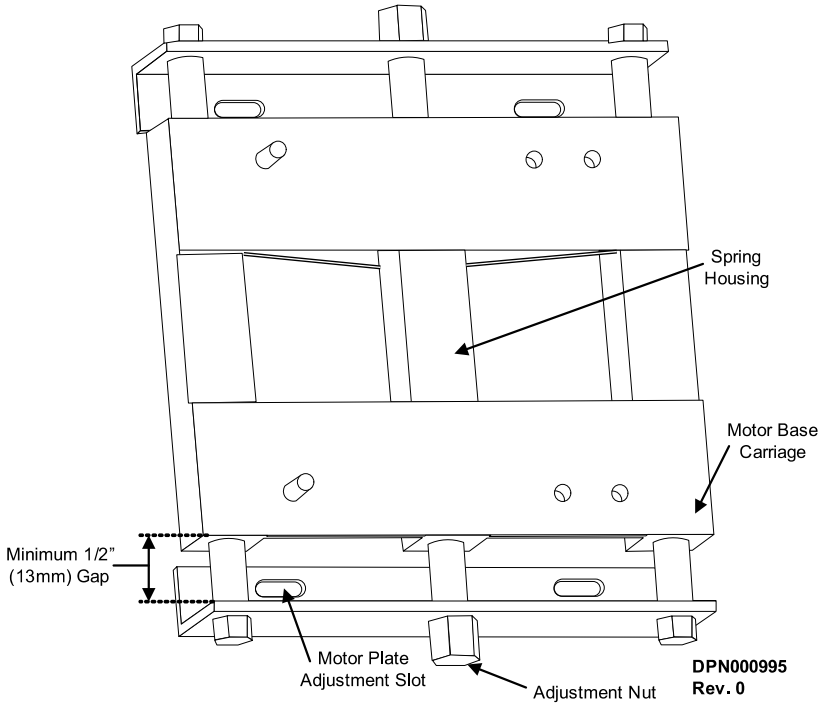
   Do not pry the belts off sheave or pulley.
2. Refer to instruction labels on unit near motor base.
3. Turn adjustment nut (see **Figure 100**) counterclockwise (left) to loosen belts and bring motor base internal spring out of compression.
4. Remove belts.

13.2.3 Belt Installation and Tensioning

1. Select the appropriate replacement of belts (matched set) and position on drive package.

   To maximize performance and reliability of Liebert DS equipment, use only Liebert belts. Contact your local Emerson representative for replacement belts.
2. Ensure pulley grooves are properly aligned. If adjustment is required, loosen (do not remove) four nuts in adjustment slots (see **Figure 100**) holding motor base to unit frame and slide motor base assembly into alignment.
3. Tension belts by turning adjustment nut clockwise (right) **until motor base carriage stops moving downward.**
4. Ensure minimum 1/2" (12.7mm) clearance exists from motor base carriage to base front flange (see **Figure 100**). If the clearance is less than 1/2" (12.7mm), select shorter belts.
5. Mark the adjustment nut and rotate clockwise (right) five additional full turns. This sets internal spring for proper belt tension, no readjustments necessary.

Figure 100 Auto-belt tensioning motor base



Blower Bearing Maintenance

- Field lubrication is NOT required for the life of the bearing.
- Bearings are permanently sealed and self-lubricating and cannot be greased.

Blower Bearing Inspection

1. Disconnect power to unit.
2. Remove drive belts (see **13.2.2 - Belt Removal**).
3. Inspect bearing for tightness of set screws and mounting bolts.
4. Rotate fan wheel by hand.
5. Listen for *unusual* noise and look for signs of *unusual* play.

Blower Bearing Replacement

1. To maximize performance and reliability of Liebert DS equipment, use only SealMaster® Reduced Maintenance pillow block bearing with tapered lands race and double lock set screws. Contact local Emerson representative to order replacement bearings.
2. Properly mount and align bearings on shaft. Tighten set-screws in proper sequence and to proper torque using a torque wrench in accordance with the manufacturer's instructions.

Blower Motor

Inspect motor at regular intervals. Keep motor clean and ventilation openings clear of dust, dirt and other debris.

Blower Motor Lubrication

- Motor comes pre-lubricated from factory and does NOT require initial lubrication.
- Emerson recommends a 5-year lubrication interval for motor bearings that have grease fittings.
- Greases of different bases may not be compatible when mixed.
- Contact specific motor manufacturer to determine type of grease to be used.

Blower Wheel

Check to see if wheel(s) are tightly mounted on fan shaft. Rotate wheel(s) and make sure they do not rub against fan housing. The wheel(s) should be periodically cleaned of dirt and debris.

13.2.4 Electronic Variable Speed Drive - Inverter

On Liebert DS models with digital scroll, an optional, variable speed drive is available. This packaged unit is factory-set and should not require field adjustment.

Removing VSD from Liebert DS

1. Turn off power at the unit disconnect.
2. Remove the front right panel.
3. Remove the VSD subassembly from the unit shoulder (downflow) or from the unit floor (upflow). To find the inverter in downflow units, see **Figure 1**; refer to **Figure 2** for the inverter's location in upflow units.
4. Remove the VSD sheet metal cover from the VSD subassembly.
5. Label the wires from the VSD, then disconnect the wires from the VSD junction box.
6. Remove the VSD from the sheet metal bracket.
7. Install the new VSD on the sheet metal bracket.
8. Reconnect wires to the VSD.
9. Reinstall the VSD sheet metal cover.
10. Re-mount the VSD on the unit shoulder or on the unit floor.
11. Reinstall the right panel.
12. Engage power to the unit disconnect.

13.3 Blower Drive System—EC Fans

13.3.1 Fan Impellers and Bearings

Fan impellers should be periodically inspected and any debris removed. Check to ensure that the impellers can rotate freely and that the fan guards are still properly mounted for sufficient protection against accidentally contacting the impeller. Bearings used on the units are maintenance-free. Consult the factory for more information.

13.3.2 Protective Features

Monitoring functions protect the motor against overtemperature of electronics, overtemperature of motor and incorrect rotor position detection. With any of these failures, an alarm will display through the Liebert iCOM and the motor stops electronically. There is no automatic restart. The power must be switched off for a minimum of 20 seconds once the motor is at a standstill.

The motor also provides locked rotor protection, undervoltage/phase failure detection and motor current limitation. These conditions will display an alarm through the Liebert iCOM.

WARNING

Risk of electric shock. Can cause injury or death.

Disconnect all local and remote electrical power supplies before working within the unit.

When connecting the motor to input power, dangerous voltages occur. Do not open the motor within the first 5 minutes after disconnection of all phases.

WARNING

Risk of electric shock. Can cause injury or death.

Dangerous external voltages can be present at main fan terminal KL2 even after the motor has been turned off.

WARNING

Risk of improper handling. Can cause injury.

Use proper skin protection when touching the electronics housing or allow time for the housing to cool before replacing parts.

The electronics housing can get hot and can cause severe burns

CAUTION

Risk of improper moving, lifting and handling. Can cause equipment damage or injury.

Only properly trained and qualified personnel should work on this equipment. Fan modules weigh in excess of 100lb. (45kg) each. Take precautions to avoid back injury and dropping during removal.

NOTICE

Risk of improper installation. Can cause equipment damage.

Only a properly trained and qualified technician should install or open this motor.

Use 60/75°C copper wire only. Use Class 1 wires only.

13.4 Humidifier—Infrared

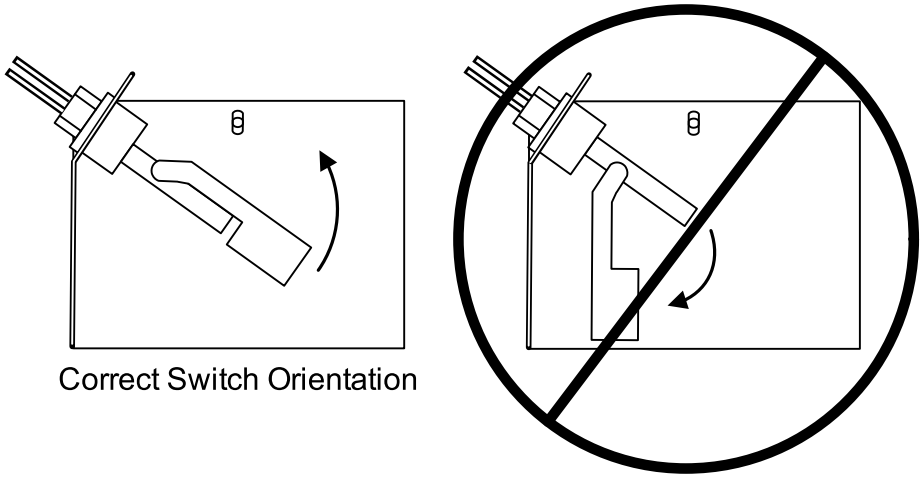
During normal humidifier operation, deposits of mineral solids will collect in humidifier pan and on the float switch. These must be cleaned periodically to ensure proper operation. Frequency of cleaning must be locally established since it is dependant on humidifier usage and local water quality. A spare pan is recommended to reduce maintenance time at unit. The Liebert autoflush system can greatly increase the time between cleanings, but does not eliminate the need for periodic checks and maintenance (see Liebert iCOM user manual SL-18835 for autoflush setup). To help reduce excessive scaling in locations with difficult water quality, the use of Vapure™ is recommended (contact your local Emerson representative).

13.4.1 Cleaning Humidifier Pan and Float Switch

Before turning off unit:

1. With unit operating, remove call for humidification at the Liebert iCOM control.
2. Let the blower operate 5 minutes to allow the humidifier and water to cool.
3. If unit has a condensate pump, turn unit OFF at Liebert iCOM control.
4. Pull out the humidifier standpipe in pan.
5. Inspect the O-ring (replace if necessary).
6. Let the pan drain and condensate pump operate (if applicable).
7. Disconnect power from the unit.
8. Disconnect the drain coupling from the bottom of the pan.
9. Remove the thermostat from the bottom of the pan and the retaining screws from the sides of the pan.
10. Slide the pan out.
11. Loosen scale on side and bottom of pan with a stiff nylon brush or plastic scraper.
12. Flush with water.
13. Carefully clean scale off float switch (make sure to reinstall correctly (see **Figure 101**).
14. Reinstall the pan, thermostat, standpipe, drain coupling and screws into the humidifier.
15. Operate the humidifier and check for leaks.

Figure 101 Correct orientation of float switch



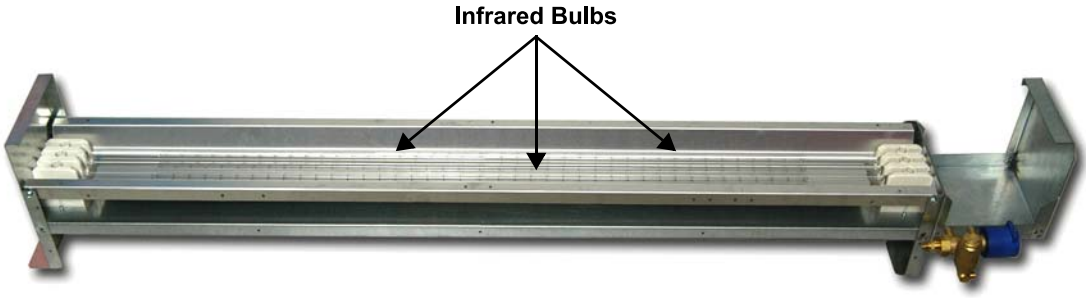
13.4.2 Changing Humidifier Lamps

NOTE

Touching quartz lamps with bare hands will severely shorten bulb life. Skin oils create hot spots on lamp surface. Wear clean cotton gloves when handling lamps.

1. Remove humidifier pan (see **13.4.1 - Cleaning Humidifier Pan and Float Switch**, **Steps 1** through **10**).
2. Disconnect power from unit.
3. At humidifier, remove screws and cover from high-voltage compartment.
4. Disconnect one end of purple jumper wires.
5. Using a continuity meter, locate burned out lamp.
6. Remove lamp brackets under lamps.
7. Loosen two screws securing lamp lead wires to junction block.
8. Pull bulb straight down and discard.
9. Wrap lead wires once around new lamp's metal ends. This will support lamp and allow for thermal expansion. Insert lead wires into junction block and torque screws to 30 in-lb.
10. Reassemble by reversing **Steps 1** through **9**.

Figure 102 Infrared humidifier lamps



13.5 Humidifier—Steam Generating

The humidifier drains and refills to maintain a current setpoint and alert the operator when the humidifier canister needs to be replaced.

Figure 103 Steam generating humidifier canister

13.5.1 Replacing the Steam Generating Humidifier Canister

WARNING

Risk of electric shock. Can cause injury or death.

Disconnect local and remote power supplies before working within.

Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.

Follow all local codes.

WARNING

Risk of improper wiring, piping, moving, lifting and handling. Can cause equipment damage, injury or death.

Only properly trained and qualified service personnel should work on this equipment.

Read all installation, operating and safety instructions before proceeding.

Read and follow all warnings in this manual.

WARNING

Risk of fire. Can cause equipment damage, injury or death.

Do not ignore humidifier problem alarms. Resetting humidifier without addressing cause may result in fire or damage due to leaking water. See **Table 60**, for alarm corrective actions.

After an extended period of operation, in accordance with life expectancy information, the cylinder is completely used as indicated by the amber high water sensor light illuminated on the cabinet. When this condition is reached, a new replacement cylinder is to be installed.

NOTE

The amber high water sensor light may come on during initial startup but this instance does not indicate that the cylinder should be replaced.

The steam cylinder is disposable and must be replaced at the end of the cylinder's life. Cylinder life will vary according to water supply conditions and humidifier usage.

WARNING

Risk of humidifier canister meltdown, smoke and fire. Can cause fire suppression system activation, fire and smoke alarm activation, serious equipment and building damage, injury and death.

Using a humidifier canister that has reached the end of it's service life can be extremely hazardous. If the canister cannot be replaced immediately at the end of life condition, turn Off the power and water supply to the humidifier and remove the canister until a replacement canister can be installed.

Table 59 Humidifier canister part numbers

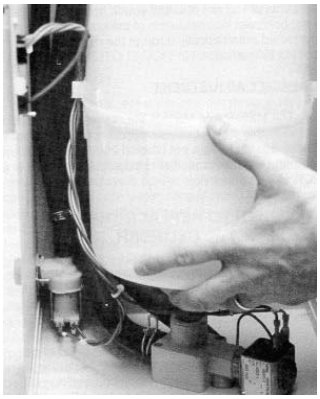
Unit Model	200V, 208V, 230V	380/415V, 460V, 575V	Humidifier Model
DS 028-042	163814P1	163814P4	MES 10
DS 053-105	163814P1	163814P2	MES 20

Removing the Old Canister

To replace a used-up humidifier cylinder, refer to **Figure 104** and perform these steps:

1. Turn off the water supply to unit.
2. The old cylinder must be drained completely before removing. This is done by pushing the auto on/off/drain switch to the Drain position.
3. When completely drained, push the auto on/off/drain switch to the Off position.
4. Open the main electrical disconnect during the entire cylinder change operation.
5. The power wires to the cylinder are attached by cylinder plugs to the electrode pins on top of the cylinder. Pull up to remove the plugs from the pins.
6. Use slotted screwdriver to loosen the steam hose clamp(s)
7. Disconnect the steam hose by pulling it straight up.
8. Loosen reversible cylinder zip tie.
9. The cylinder is now ready to be lifted out of the unit.

Figure 104 Removing the old canister



Mandatory Cleaning of the Drain Valve

Always clean the drain valve before installing a new cylinder. **Figure 105** shows an exploded view of the drain valve for reference to clean it.

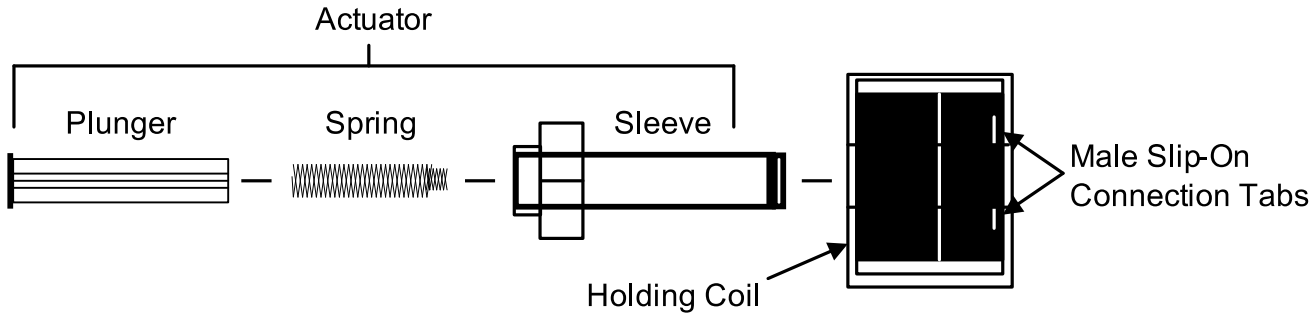
1. Remove old cylinder as previously described.
2. Note that the ring terminal for the drain valve green ground wire is sandwiched between the drain valve and the drain pan.
3. Remove the two screws securing the drain valve body to the drain pan.
4. Remove the hose clip and hose connection from the drain valve body.
5. Drain valve assembly is now free to be taken to a sink for disassembly and cleaning.
6. Remove the snap fit red cap from the coil assembly and slide the coil off the actuator.
7. Loosen actuator using a wrench and unscrew from the plastic body.
8. Clean the exposed core, spring and plastic drain valve pot
9. Reinstall in the reverse order.

NOTE

Be cautious when putting the spring back into the plunger, the taper end of the spring must be installed toward the solenoid.

10. Hand tighten the actuator back into place, then secure it by using a wrench to turn it a quarter of a turn.
11. Clean out the end of the hose, then reconnect it to the drain valve body with the clamp.
12. Fit mounting screws back through the drain valve body, one through ring terminal on the green wire.

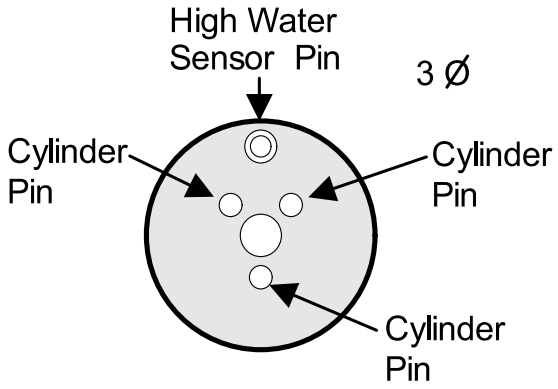
Figure 105 Drain valve assembly



Installing the New Canister

1. The reverse procedure should be followed to install a new cylinder. The main electrical disconnect is to be left open until the cylinder is completely installed and reconnected.
2. The blue sensor plug on all units is for the high water sensor pin, which always goes on the single pin with collar offset from the others. See **Figure 106**.
3. Ensure that cylinder plugs are snug on the pins. Replace any loose fitting plugs as these may result in hazardous operation.

Figure 106 Canister plugs



WARNING

Risk of humidifier canister meltdown, smoke and fire. Can cause fire suppression system activation, fire and smoke alarm activation, equipment or serious building damage, injury and death.

Check steam generating humidifier electrode plugs to ensure that they are pressed firmly onto pins. Loose connections will cause overheating of cylinder and plugs.

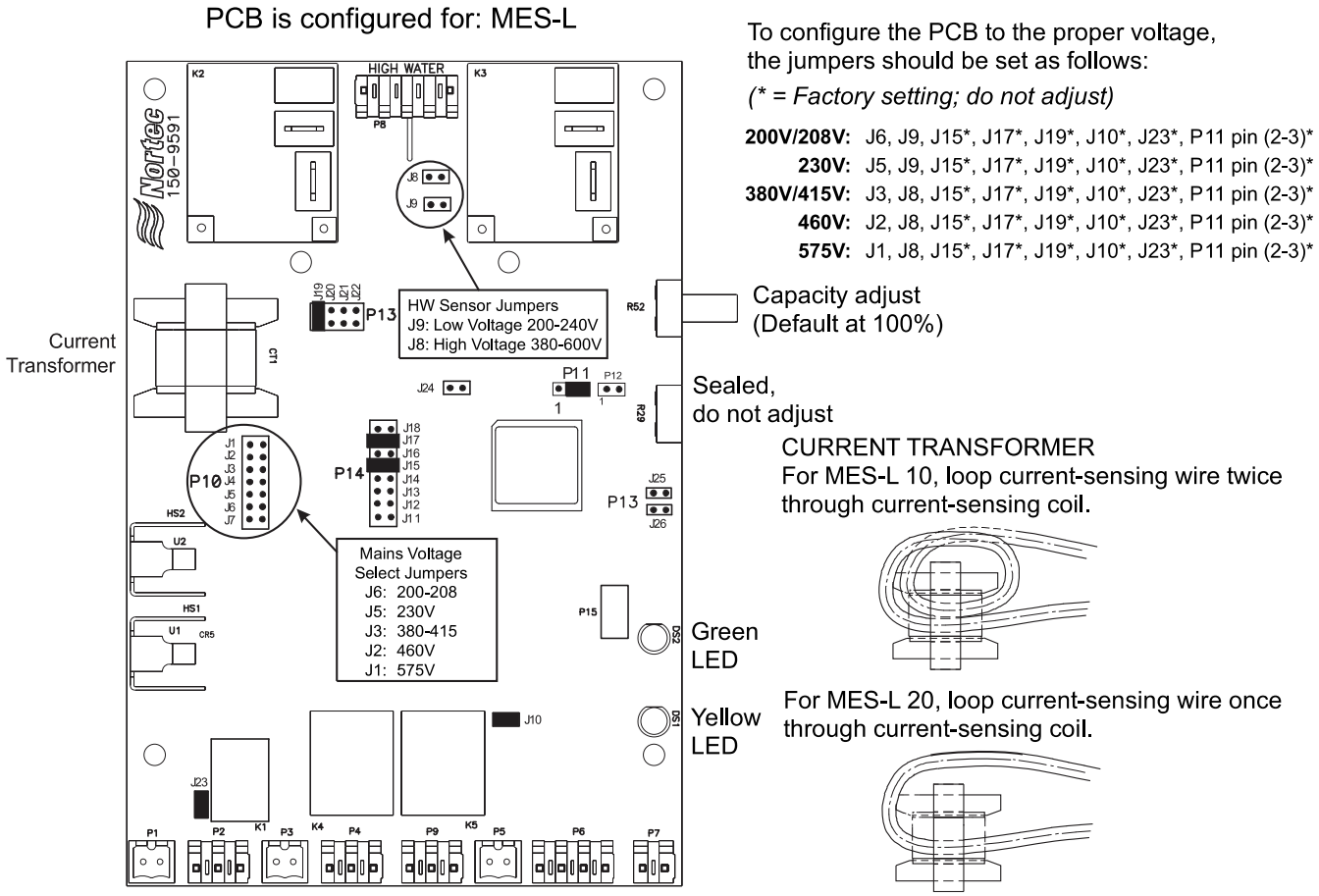
Table 60 Steam generating humidifier status lamps: causes, corrective action

Unit Status Lamp		Symptom	Corrective Actions
Yellow	Green		
On	On	Maximum water level inside cylinder.	This usually happens on initial startup after replacing the cylinder (normal). Water is concentrated with minerals inside the cylinder. Let unit run, yellow light will disappear when the unit is at full output. This may take a day or two.
Off	Off	No power to the board.	Check for main power supply fault. Turn power switch to DRAIN position. If drain valve is activated (sound of solenoid), check connection to the board or board itself. When no sound present, check fuse (replace with 3A, if needed), transformer (voltage should be present between fuse holder and ground screw).
One flash sequence	Off	Excess current. Operating amperage exceeded 130% of rated amps. Water is drained from the cylinder (drain valve on for 10 min.).	Check drain valve operation, drain time, possible drain restrictions. Check if fill valve leaks (not holding supply water). Back-pressure may also cause very conductive water conditions. Check for short cycling. Water conductivity too high.
Two flashes in sequence	Off	No current detection for 30 minutes with continuous call for humidity.	Check water level in the cylinder - should be more than one-quarter full. If it is not, check the fill rate, 24VAC voltage on fill valve terminals (unit must be on with call for humidity - green light steady on). Verify fresh water supply to the humidifier. Leaking drain valve can be at fault (minerals blocking the plunger). If cylinder is more than ¼ full, check primary power, connections to the cylinder, continuity of wires to cylinder. Are power wires connected to proper terminals on the cylinder? (Color coding) Low water conductivity.
Three flashes in sequence	Off	No current detected with high water sensor activated.	Check L1 to ensure that power is properly connected. Check that L1 wire runs through CT of main PCB. Cylinder may be defective, check for conductivity between powered pins and H.W.S. (should be an opened circuit). Ensure all legs are drawing similar current. Low water conductivity. Are power wires connected to proper terminals on the cylinder? (Color coding). Foaming.
Four flashes in sequence	Off	End of cylinder life; change cylinder.	Check water level in the cylinder; it should be about three-fourths full. Check for foaming if water level lower or cylinder life shorter than expected. Change cylinder, clean drain valve.

Table 61 Steam generating humidifier troubleshooting guide

Symptom	Possible Cause	Check or Remedy
Unit in call for humidification, humidifier will not operate	Humidifier not receiving power	Verify ON/OFF/DRAIN switch is in ON position.
		Check fuses or CB's and replace or reset if necessary.
Humidifier Contactor pulled in, but no water enters canister	No water available to unit	Check external water shut-off valves.
	Clogged fill line strainer	Clean or replaced fill line strainer
Excessive arcing in canister	Drain valve clogged or defective	Verify that drain valve operates freely when activated. Clean valve and replace if defective. Flush canister several times and replace if arcing persists.
	Improper water supply	If water is commercially softened, reconnect humidifier to raw water supply, drain canister and restart. If connected to hot water supply, reconnect to cold water.
	Insufficient drain rate	Verify that drain valve operates freely when activated. Clean valve and replace if defective. Flush canister several times and replace if arcing persists.
	Excessive mineral content in water	Analyze mineral content of water. If mineral content is excessive contact Liebert service.

Figure 107 Circuit board diagram



13.6 Condensate Drain and Condensate Pump Systems

13.6.1 Condensate Drain

Check and clear obstructions in tubing during routine maintenance.

13.6.2 Condensate Pump

- Disconnect power to unit using disconnect switch.

WARNING

Risk of electric shock. Can cause injury or death.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the "Unit Off" mode. Some internal components require and receive power even during the "unit off" mode of the Liebert iCOM control.

Disconnect local and remote power supplies before working within.

- Check and clear obstructions in gravity lines leading to condensate pump.
- Remove sump and clean with a stiff nylon brush and flush with water.
- Inspect and clear clogs in discharge check valve and float mechanism.
- Reassemble and check for leaks.

13.7 Air-Cooled Condenser and Drycoolers

- Clear coil surface of all debris that will inhibit airflow.
- Check for bent or damaged coil fins and correct.
- Do not permit snow to accumulate around or under outdoor unit.
- Periodically consider commercial cleaning of coil surface
- Inspect fans, motors and controls for proper operation.
- Check all piping and capillaries for proper support.
- Inspect for leaks.

13.8 Reheat—Electric Reheat (Three-Stage and SCR)

- Inspect and clean reheat elements.
- Inspect and tighten support hardware.

13.9 Thermostatic Expansion Valve

The Thermostatic Expansion Valve (TEV) performs one function: It keeps the evaporator supplied with enough refrigerant to satisfy load conditions. It does not effect compressor operation.

Proper valve operation can be determined by measuring superheat. The correct superheat setting is between 10 and 20°F (-12 and -6°C). If too little refrigerant is being fed to the evaporator, the superheat will be high; if too much refrigerant is being supplied, the superheat will be low.

13.9.1 Determine Suction Superheat

To determine superheat:

1. Measure the temperature of the suction line at the point the TEV bulb is clamped.
2. Obtain the gauge pressure at the compressor suction valve.
3. Add the estimated pressure drop between the bulb's location and the suction valve.
4. Convert the sum of the two pressures to the equivalent temperature.
5. Subtract this temperature from the actual suction line temperature. The difference is superheat.

13.9.2 Adjust Superheat Setting with the TEV

To adjust the superheat setting:

1. Remove the valve cap at the bottom of the valve.
2. Turn the adjusting stem counterclockwise to lower the superheat.
3. Turn the adjusting stem clockwise to increase the superheat.

NOTE

Make no more than one turn of the stem at a time. As long as thirty minutes may be required for the new balance to take place.

13.10 Compressor

13.10.1Compressor Oil

NOTICE

Risk of improper compressor lubrication. Can cause compressor and refrigerant system damage.

Failure to use oil types, viscosities and quantities recommended by the compressor manufacturer may reduce compressor life and void the compressor warranty. See oil types specified in **Table 62**.

- Do NOT mix polyolester (POE) and mineral-based oils.
- Do NOT mix oils of different viscosities.

Consult Emerson or the compressor manufacturer if you have questions.

Table 62 Compressor oil types

Compressor Type	Refrigerant Type
	R-407c
Carlyle Semi-Hermetic	POE Oil - ISO 68 Viscosity [1]
Copeland Scroll and Digital Scroll	POE Oil - ISO 32 Viscosity [2]

1. Use Carlyle POE Oil Totaline P903-1001, Castrol SW68 or other Carlyle-approved oils.
2. Use Copeland POE Oil ULTRA 32-3MAF or other Copeland-approved oils.

13.10.2Semi-Hermetic Compressors

Oil level can be viewed at the sight glass on semi-hermetic compressors. Normal operating oil level is 1/4 to 3/4 up the sight glass.

After a compressor has been idle for an extended length of time, foaming will usually be present when compressor first starts. Wait until compressor has been operating for at least five minutes before viewing the oil level.

If oil level is low, the cause must be corrected and oil level returned to its proper level.

13.10.3Scroll and Digital Scroll Compressors

Hermetic scroll and digital scroll compressors do not have an oil sight glass.

NOTE

*Refer to **9.2.2 - Scroll and Digital Scroll—Additional Oil Requirements** for approved oil types and additional oil required based on the system's refrigerant charge.*

13.11 Compressor Replacement

Replacement compressors are available through your local Emerson office. Compressors are shipped in reusable packaging. If unit is under warranty, complete and include Liebert Service Credit Application (LSCA) with the compressor that is being returned. The original compressor should be returned in the same packaging.

13.11.1Compressor Motor Burnout

If a burnout has occurred, a full system clean-out is required; if not, compressor and system problems will continue.

For clean-out warnings and procedures, see Copeland Application Engineering Bulletin 24-1105 "Principles of Cleaning Refrigeration Systems" or Carlyle Service Guide, Literature # 020-611.

13.11.2Digital Compressor Unloading Solenoid(s)

Models 028, 035 and 042

When replacing a digital scroll compressor, digital solenoid valve and coil must be replaced. Compressor and valve kit are shipped separately. Valve kit must be field-brazed to top of compressor in proper orientation and supported with original factory bracket.

Models 053, 070 and 077

When replacing a digital scroll compressor, digital solenoid coil must be replaced. Compressor and coil kit are shipped separately.

13.11.3Compressor Replacement Procedure

1. Disconnect power and follow all warnings at front of this manual.
2. Attach suction and discharge gauges to access fittings.
3. Front-seat service valves to isolate the compressor. Reclaim charge from compressor.
4. Remove marked pressure transducer and discharge pressure switch. Disconnect all electrical connections.
5. Detach service valves from compressor.
6. Remove failed compressor.
7. If required, follow compressor manufacturer's suggested clean-out procedures.
8. Install replacement compressor and make all connections. Replace gaskets or seals on service valves. Replace unloading solenoid.
9. Evacuate, charge and operate per **9.3 - Dehydration/Leak Test and Charging Procedures for R-407C**.
10. Semi-hermetic only: see **5.3 - Semi-Hermetic Compressor Spring Isolation System** for compressor spring adjustment.

NOTICE

Risk of improper component reinstallation. Can cause equipment damage.

Identify and mark location of suction pressure transducer and discharge pressure switch. These devices look similar and they must be reinstalled in their original location.

13.12 Facility Fluid and Piping Maintenance

Facility water and glycol quality remain a requirement throughout the life of the piping system. Fluid and piping system maintenance schedules must be established and performed. A local fluid maintenance program must be established that will evaluate fluid chemistry and apply necessary treatment. A periodic leak inspection of facility and unit fluid piping is recommended. Refer to **9.1.4 - Requirements of Systems Using Water or Glycol**.

13.13 Paradenser—Water-Cooled Condenser

During normal Paradenser operation, deposits will collect on inside wall of condenser tubes. It must be cleaned periodically to ensure proper operation. Frequency of cleaning must be locally established because it varies according to Paradenser usage and local fluid quality. See **13.12 - Facility Fluid and Piping Maintenance**.

13.13.1 Cleaning Instructions

Refer to **Figure 1 - Downflow model component locations**.

1. Disconnect power to unit.
2. Close field-installed isolation valves to isolate this unit's condenser system from facility water or glycol circuit.
3. Remove access panel from front of compressor section.
4. Locate the 1/2" NPT drain plugs located at lower front of compressor section and provide means to collect fluid drained from system
5. Remove the 1/2" drain plugs using two wrenches to prevent damage to drain lines.
6. Locate and remove the 3" diameter clean out plugs on top of shell assemblies (use Craftsman™ 1-3/16" drag link socket, Sears item # 00944514000 or similar).
7. Brush and flush each of the nominal 5/8" inner diameter, rifled copper tubes. Recommend using John R. Robinson, Inc. or similar:
   - Motorized Tube Cleaner, Model JR3800-1200
   - Nylon brush 9/16" diameter, Model JRRB211N-916
   - Flexible shaft, Model JRRFS702-25
8. Reinstall 1/2" drain plugs 6 to 7 turns using Loctite 567 PST Thread Sealant as instructed by the manufacturer.
9. Wipe clean the machine threads and sealing surfaces of 3" diameter clean out plugs.
10. Remove and install new O-rings (Liebert part number 180750P1) on the 3" diameter clean out plugs. (Do not use thread sealant).
11. Hand tighten 3" diameter clean out plugs and torque using drag link socket to 25 ft-lb.
12. Leak check fluid system (refer to **Leak Checking of Unit and Field Piping on page 87**).
13. Bleed system using Schrader ports near the top of the Paradenser.
14. Ensure that condensing fluid isolation valves are fully open.
15. Unit is ready to be put on-line.

13.14 Water/Glycol Control Valves

13.14.1 Regulating Valves – Semi Hermetic and Standard Scroll Compressors

The water regulating valves automatically regulate the amount of fluid necessary to remove the heat from the refrigeration system, permitting more water to flow when load conditions are high and less fluid to flow when load conditions are low. The valve consists of a brass body, balance spring, valve seat, valve disc holders, capillary tube to discharge pressure, and adjusting screw.

Adjustment—Johnson Controls Valves

The valves may be adjusted with a standard refrigeration service valve wrench or screwdriver.

Table 63 Recommended refrigerant pressures

System Design	PSIG (kPa)
Water-Cooled	
65 to 75°F water (18 to 24°C)	210 (1450)
85°F water (29°C)	225 (1550)
Glycol-Cooled	295 (2035)
Maximum	330 (2275)
High Pressure Cut-out	400 (2859)

To lower the head pressure setting, turn the square adjusting screw clockwise until the high pressure gauge indicates the desired setting. To raise the head pressure setting, turn the adjusting screw counterclockwise until the desired setting is obtained. Consult the factory if your unit is equipped with valves from other manufacturers.

Testing Function of Valve

First, turn off the refrigeration system. When the refrigeration system has been off for approximately 10 to 15 minutes, the water flow should stop. If the water continues to flow, the valve is either improperly adjusted (with head pressure too low) or the pressure-sensing capillary is not connected properly to the condenser.

Location

The water regulating valves are located in the condenser fluid supply line.

13.14.2Motor Ball Valve—Digital Scroll Compressors

On digital scroll units discharge pressure is controlled by a motorized ball valve. During unloaded operation, the pressure changes during each digital cycle could result in excessive repositions with a pressure operated water regulating valve. The control algorithm for the motorized ball valve uses an intelligent sampling rate and adjustable pressure thresholds to reduce valve repositions. The valve assembly consists of the brass valve, linkage and actuator.

Control

The valve actuator operates on 24VAC power and is controlled by a 2-10VDC proportional control signal. The valve full open to full close time is 60 seconds. At 2VDC the valve is closed; at 10VDC the valve is fully open. There is a 20-second delay to position the motorized ball valve before starting the compressor.

Control Method

The control utilizes an upper and lower pressure threshold with a 35 PSI (241 kPa) deadband to reduce valve movement. If the liquid pressure is between the upper and lower threshold the valve remains at the current position. If the liquid pressure exceeds the upper threshold the valve opens, and if the pressure falls below the lower threshold the valve closes. There are multiple adjustment bands to ease discharge pressure back into control range.

Adjustment

Both pressure thresholds can be shifted simultaneously over a 50 PSI (345 kPa) range (the 35 PSI [241 kPa] differential remains constant). The ball valve setpoint offset parameter in the Service menu can be adjusted from 0 to 50 PSI (345 kPa) to raise or lower the control band similar to the pressure adjustment on a water regulating valve. Changing the setpoint offset will adjust the pressure thresholds for both circuits. Units are factory set at a 30 PSI (207 kPa) setpoint offset (30 PSI [207 kPa] above minimum). This results in a 220 PSIA (1517 kPa) lower threshold and a 255 PSIA (1758 kPa) upper threshold pressure.

Startup

The setpoint offset is adjusted to the minimum value during startup, then transitions to the set value once the compressor reaches normal operating pressures. Due to the control dead band it is possible for each circuit to stabilize at different pressures within the dead band. Additionally changes in fluid temperature could cause pressure changes that do not result in valve movement within the dead band. Fan cycling stats should be set to prevent continuous fluid temperature swings greater than 10°F (5.6°C) (see **13.14.3 - Drycooler Settings**).

Location

The motorized ball valves are located in the condenser fluid return line. Three-way valves are piped in a mixing arrangement with the common port at the valve outlet.

Manual Control

The valve can be manually set by disconnecting AC power, depressing the manual override button on the valve actuator, and adjusting the valve position with the handle. Motorized ball valves may be controlled through the Service menu using manual mode to override the normal control.

13.14.3Drycooler Settings

Applications with the Optional Stat Setting require field piping to be insulated to prevent condensation. **Table 64** shows acceptable applications where stats must be adjusted to Optional Setting. Aquastats must be field-adjusted to Optional Setting for:

- GLYCOOL/Dual Cool applications
- Single Drycooler loops with motor ball valve flow controls (motor ball valves are used on all Liebert DS units with digital compressors). These units have a "D" or "G" in the seventh character: DS/VS/xxxx**D** or DS/VS/xxxx**G**.

Table 64 Water/glycol system conditions requiring optional settings for aquastats

Cooling Type	Glycool				Glycol			
Flow Control	MBV		WRV		MBV		WRV	
Drycoolers in Loop	1	Multiple	1	Multiple	1	Multiple	1	Multiple
Stat Setting*	Optional	Optional	Optional	Optional	Optional	Factory	Factory	Factory
Insulate Field Piping	Yes	Yes	Yes	Yes	Yes	No	No	No

* See **Tables 65** through **67**
MBV = motor ball valve; WRV = water regulating valve

Table 65 Aquastat settings—two-fan through four-fan drycoolers

Dial Setting (Stat Open Temp) Set for Mid Differential 8°F (4.4°C) Rise to Close			
Aquastat #	Fans	Factory Setting (Glycol) (see Notes 1 and 2)	Optional Setting (GLYCOOL) (see Note 3)
AQ1	F1	65°F (18.3°C)	35°F (1.7°C)
AQ2	F2 & F3	75°F (23.9°C)	45°F (7.2°C)
AQ3	F4	70°F (21.1°C)	40°F (4.4°C)

Table 66 Aquastat settings—six-fan drycoolers

Dial Setting (Stat Open Temp) Set for Mid Differential 8°F (4.4°C) Rise to Close				
Aquastat #	Fans	Stat Location Cabinet	Factory Setting (Glycol) (see Notes 1 and 2)	Optional Setting (GLYCOOL) (see Note 3)
AQ1	F1	Main	65°F (18.3°C)	35°F (1.7°C)
AQ2	F2	Main	70°F (21.1°C)	40°F (4.4°C)
AQ3	F3 & F4	Auxiliary	73°F (22.8°C)	43°F (6.1°C)
AQ4	F5 & F6	Auxiliary	75°F (23.9°C)	45°F (7.2°C)

Table 67 Aquastat settings—eight-fan drycoolers

Dial Setting (Stat Open Temp) Set for Mid Differential 8°F (4.4°C) Rise to Close				
Aquastat #	Fans	Stat Location Cabinet	Factory Setting (Glycol) (see Notes 1 and 2)	Optional Setting (GLYCOOL) (see Note 3)
AQ1	F1	Main	65°F (18.3°C)	35°F (1.7°C)
AQ2	F2	Main	70°F (21.1°C)	40°F (4.4°C)
AQ3	F3 & F4	Auxiliary	73°F (22.8°C)	43°F (6.1°C)
AQ4	F5 & F6	Auxiliary	75°F (23.9°C)	45°F (7.2°C)
AQ5	F7 & F8	Main	78°F (25.6°C)	48°F (8.9°C)

NOTE

1. *All drycoolers are shipped at Factory Setting.*
2. *Factory Setting is used for all glycol applications, except single drycooler loops with motor ball valve controls.*
3. *Stats must be field-adjusted to Optional Setting for GLYCOOL/Dual Cool applications and all single drycooler loops using motor ball valve flow controls.*

14.0 HVAC MAINTENANCE CHECKLIST

Inspection Date		Job Name	
Indoor Unit Model #		Indoor Unit Serial Number #	
Condenser/Drycooler Model #		Condenser/Drycooler Serial #	
Room Temperature/Humidity	° %	Ambient Temperature	°

Filters

___ 1. Check/replace filters
___ 2. Grille area unrestricted
___ 3. Wipe section clean
___ 4. Coil clean

Blower Section

___ 1. Blower wheels free of debris
___ 2. Check belt tension and condition on centrifugal fans (replace if needed)
___ 3. Check/lube bearings
___ 4. Check sheave/pulley on centrifugal fans (replace if worn)
___ 5. Check motor mount
___ 6. Motor amp draw L1_____ L2 _____ L3_____
____ Compare to nameplate amps

Reheat

___ 1. Inspect elements
___ 2. Check wire connections (inside reheat box)
___ 3. Reheat amp draw
___ a. #1
___ a. #2
___ a. #3

Steam Generating Humidifier

___ 1. Check drain valve/drain lines/trap for clogs
___ 2. Check water make-up valve and all hoses for leaks
___ 3. Clean the fill strainer
___ 4. Replace humidifier bottle if necessary
___ 5. Check operation of humidifier
___ 6. Humidifier amp draw L1 _____ L2 _____L3_____

Infrared Humidifier

___ 1. Check drain lines and trap for clogs
___ 2. Check/clean pan for mineral deposits
___ 3. Clean reflector
___ 4. Check water make-up valve for leaks
___ 5. Check humidifier lamps (replace if burnt out)
___ 6. Check wire connections (inside humidifier box)
___ 7. Humidifier amp draw L1 _____ L2 _____L3_____

Condensate Pump

___ 1. Check for debris in sump

___ 2. Check operation of float(s) (free movement)

Refrigeration Piping

___ 1. Check refrigerant lines (clamps secure/no rubbing/no leaks)

___ 2. Check for moisture (sight glass)

Water-Cooled Condensers

___ 1. Check water regulating valve operation

___ 2. Cap tubes (not rubbing)

___ 3. Check for water/glycol leaks

___ 4. Entering water temperature _____ °

___ 5. Leaving water

Drain Piping

___ 1. Check for free running drain system

___ 2. Clear out obstructions and material buildup on tubing walls

___ 3. Check for leaks

___ 4. Check for tubing kinks or damage

Compressor Section

___ 1. Check oil level

___ 2. Check for oil leaks

___ 3. Check compressor mounts (springs/bushings)

___ 4. Cap tubes (not rubbing)

___ 5. Check wire connections (inside compressor box)

___ 6. Compressor operation (vibration/noise)

___ 7. Suction Pressure Circuit #1 _____ Circuit #2 _____

___ 8. Discharge Pressure Circuit #1 _____ Circuit #2 _____

___ 9. Superheat Circuit #1 _____ Circuit #2 _____

___ 10. Low pressure switch cut out Circuit #1 _____ Circuit #2 _____

___ 11. Low pressure cut in Circuit #1 _____ Circuit #2 _____

___ 12. High pressure cut out Circuit #1 _____ Circuit #2 _____

___ 13. Amp draw

____ Circuit #1

___ a. L1 L2 L3

____ Circuit #2

___ a. L1 L2 L3

Electrical Panel

___ 1. Check fuses

___ 2. Check contactors for pitting

___ 3. Check wire connections

Controls

___ 1. Check/Verify Control Operation (Sequence)
___ 2. Check humidifier high water alarm operation
___ 3. Check operation of the air safety switch
___ 4. Check setting/operation of the filter clog switch
___ 5. Check/test changeover device(s)
___ 6. Check/test water detection device(s)

Air-Cooled Condenser / Drycooler

___ 1. Coil surfaces and fans free of debris (clean, wash and straighten fins as needed)
___ 2. Fan motors securely mounted
___ 3. Motor bearings in good condition
___ 4. Check all piping and capillaries for vibration isolation; support and secure as necessary
___ 5. Check fuses
___ 6. Check contactors for pitting
___ 7. Check wire connections
___ 8. Fan speed control operation
___ 9. Check operational sequence/thermostat setpoints
___ 10. Check refrigerant/glycol lines for signs of leaks/repair leaks as found
___ 11. Check refrigerant level in each Liebert Lee-Temp receiver
___ 12. Glycol level
___ 13. Glycol solution_____ %
___ 14. Motor amp draw

#1	L1	_____	L2	_____	L3	_____
		(L1 and L2 on Fan Speed Control Motor)				
#2	L1	_____	L2	_____	L3	_____
#3	L1	_____	L2	_____	L3	_____
#4	L1	_____	L2	_____	L3	_____
#5	L1	_____	L2	_____	L3	_____
#6	L1	_____	L2	_____	L3	_____
#7	L1	_____	L2	_____	L3	_____
#8	L1	_____	L2	_____	L3	_____

Glycol Pump

___ 1. Check pump rotation
___ 2. Check for glycol leaks
___ 3. Pump pressures

#1	Suction	_____	Discharge	_____
#2	Suction	_____	Discharge	_____

___ 4. Amp Draw

#1	L1	_____	L2	_____	L3	_____
#2	L1	_____	L2	_____	L3	_____

___ 5. Pump changeover (if multiple pumps)

EMERSON
Network Power

PRECISION COOLING SERVICES
(FLOORMOUNT, CEILING, WALLMOUNT & HEAT REJECTION)
SCOPE OF WORK

Y1 – ESSENTIAL FULL SERVICE (4 PM'S)

- Guaranteed 4-hour on-site emergency response, 7 days/week, 24 hours/day, within 150 miles of a Liebert Services' Service city.
- Includes (4) PM inspections scheduled by the customer between 8am- 5pm, Monday-Friday, (excluding national holidays).
- Includes 1-800-LIEBERT Customer Response Center.
- Includes 100% labor and travel coverage for emergency service 7 days/week, 24 hours/day (within the 48 contiguous states).
- Includes 100% parts coverage (excluding piping external from the unit, replacement of outdoor condensing unit, components showing physical damage, component failure due to irregular voltage conditions, pumps external to the unit, fire suppression system, unit control upgrades, network panels external to the unit, and leak detection panels) Rental of temporary spot coolers is also excluded.
- Includes access to Liebert Customer Services Network On-Line Internet portal.
- Performed by Liebert Factory Trained Technicians.
- Prior to acceptance of full service contract, all applicable equipment must be inspected and brought up to a minimum service level. This work is completed outside the full service contract and is performed on a time and material basis.
- Subject to all Terms & Conditions as noted in the Liebert Services Terms & Conditions.

SERVICE PERFORMED

Maintenance Includes:

Filters

1. Check for restricted airflow.
2. Replace air filters as needed
3. Examine filter switch.
4. Wipe entire section clean.

Blower Section

1. Verify that impellers are free of debris and move freely.
2. Check belt for condition and proper tension.
3. Replace belts as needed.
4. Verify that the bearings are in good condition.
5. Check the fan safety switch for proper operation.
6. Check the pulleys and motor mounts for tightness and proper alignment.

Air Cooled Condenser (If Applicable)

1. Verify condenser coil cleanliness
2. Brush clean and spray using hose and nozzle connected to local water source (if local water source is available)
3. Chemical cleaning of outdoor condensing unit is excluded from normal scheduled maintenance and can be performed on a time and material basis.
4. Examine motor mounts for tightness. Tighten if necessary.
5. Verify that the bearings are in good working order.
6. Confirm that the refrigerant lines are properly supported.

Water/Glycol Condenser (If Applicable)

1. Check cleanliness of copper tubing.
2. Confirm that the water regulating valves are functioning properly.
3. Check the glycol solution level.
4. Check glycol freeze protection level
5. Check for water/glycol leaks.

Glycol Pump

1. Examine for any glycol leaks.
2. Determine proper pump operation.

Steam Generating Humidifier (If Applicable)

1. Examine the water make-up valve for any leaks.
2. Check the condition of all steam hoses.
3. Check the canister for any deposits.
4. Check and adjust potentiometers for optimal performance

Infrared Humidifier (If Applicable)

1. Check the pan drain for any type of blockage.
2. Examine the humidifier lamps for proper operation.
3. Check the pan for any type of mineral deposits.

Refrigerant Cycle/Section

1. Examine refrigerant lines for leaks or damage.
2. Using the sight glass, check lines for moisture.
3. Monitor suction pressure.
4. Monitor head pressure.
5. Monitor discharge pressure.
6. Check superheat.

Electric Panel, Controls, and Ancillary Items

1. Check fuses
2. Check electrical connections
3. Check contactors for pitting
4. Using microprocessor controls, ensure proper operation of the unit components
5. Inspect leak detection cabling (if connected to unit)

Chilled water units - additional checks (if Applicable):

1. Inspect chilled water valve and actuator for proper operation.
2. Adjust/ tighten linkage if necessary.
3. Inspect internal chilled water piping and coil for leaks.

8.2 Liebert CHALLENGER CRAC Unit PM Recommendations

7.0 Component Operation and Maintenance

7.1 System Testing

7.1.1 Environmental Control Functions

The performance of all control circuits can be tested by actuating each of the main functions. This is done by temporarily changing the setpoints.

Cooling

To test the cooling function, set the setpoint for a temperature of 10°F (5°C) below room temperature. A call for cooling should be seen and the equipment should begin to cool. A high temperature alarm may come On. Disregard it. Return setpoint to the desired temperature.

Heating

Reheat may be tested by setting the setpoint for 10°F (5°C) above room temperature. A call for heating should be seen and the heating coils should begin to heat. Disregard the temperature alarm and return the setpoint to the desired temperature.

Humidification

To check humidification, set the humidity setpoint for an RH 10% above the room humidity reading. For infrared humidifiers, the infrared element should come On. Steam generating humidifiers should click immediately as it energizes. After a short delay, the canister will fill with water. The water will heat and steam will be produced. Return the humidity setpoint to the desired humidity.

Dehumidification

Dehumidification can be checked by setting the humidity setpoint for an RH 10% below room relative humidity. The compressor should come On. Return humidity setpoint to the desired humidity.

Electric Panel

The electric panel should be inspected for any loose electrical connections.

WARNING

Risk of electric shock. Can cause injury or death.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the "Unit Off" mode. Some internal components require and receive power even during the "Unit Off" mode of Liebert iCOM control.

The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.

Be sure that all power has been disconnected from the unit before attempting to tighten any fittings or connections.

Control Transformer and Fuses

The control system is divided into four separate circuits. The control voltage circuits are individually protected by fuses located on the transformer/fuse board. If any of the fuses are blown, first eliminate shorts, then use spare fuses supplied with unit. Use only type and size of fuse specified for your unit.

The small isolation transformer on the board supplies 24 volts to the main control board. The transformer is internally protected. If the internal protector opens, the transformer/fuse board must be replaced. Also check the control voltage fuse on the main control board before replacing the transformer/fuse board.

Fan Safety Switch

The Fan Safety Switch is located in the low voltage compartment and consists of a diaphragm switch and interconnecting tubing to the blower scroll. The Fan Safety switch is wired directly to the control circuit to activate the alarm system if the airflow is interrupted

High-Temp Sensor

The optional high-temp sensor is a bimetal-operated sensing device with a normally closed switch. This device will shut down the entire unit when the inlet air temperature exceeds a preset point. It is connected between Terminals 1 and 2 at Plug P39.

Smoke Detector

The optional smoke detector power supply is located on the base of the upflow units, and at the top of downflow units. It is constantly sampling return air through a tube. No adjustments are required.

Water Detection Sensor

WARNING

Risk of fire or explosion. Can cause injury or death.

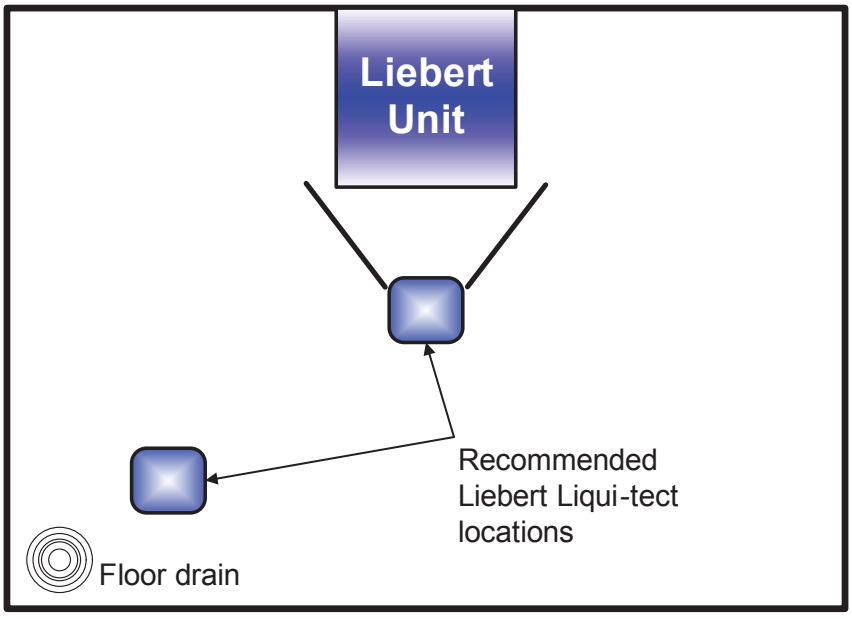
Do not use near flammable liquids or for flammable liquid detection.

The optional water detection devices available are a point leak detection sensor and a zone leak detection kit.

Figure 21 Liebert leak detection units

The point leak detection sensor provides leak detection at a critical point. A simple two-wire connection signals the alarms at a Liebert environmental unit or at a monitoring panel. Run wires to the Liebert unit and connect them to terminals 24 and 51, 55 or 56. Use NEC Class 2, 24V wiring. The sensor contains a solid state switch that closes when water is detected by the twin sensor probes. The sensor is hermetically sealed in all thread PVC nipple and is to be mounted where water problems may occur. The sensor should be located 6-8 feet (2-2.5m) from the environmental control unit in a wet trap or near a floor drain. It should not be mounted directly under the unit.

Figure 22 Recommended liquid sensor locations



The zone leak detection kit provides leak detection for a defined zone. This kit is ideal for perimeter sensing or serpentine coverage of small areas. A simple, two-wire connection signals the alarms at a Liebert environmental unit or at a monitoring panel. Run wires to the Liebert unit and connect them to terminals 24 and 51, 55 or 56. The sensor utilizes Liebert's LT500Y leak detection cable. The kit is offered with five different lengths of cable sized specifically for the type of Liebert Environmental unit (see matrix below). Refer to matrix below for the recommended location of leak detection cable.

Table 4 Zone leak detection kit installation scenarios

	Scenarios			
	Upflow Unit Detection around entire unit  2-ft clearance in front	Upflow Unit Detection on sides and in front of unit  2-ft clearance in front	Downflow Unit Detection around entire unit  6-ft clearance in front	Downflow Unit Detection on sides and in front of unit  6-ft clearance in front
	Distance From Unit, feet (m)			
In back	2 (0.6)	No cable behind	1 (0.3)	No cable behind
On sides	2 (0.6)	2 (0.6)	1 (0.3)	1 (0.3)
In front	2 (0.6)	2 (0.6)	6 (1.8)	6 (1.8)
Unit (footprint-in.)	Part Number			
Liebert Challenger 3000 and Liebert Challenger ITR (32.5 x 32.5)	LT460-Z30	LT460-Z20	LT460-Z30	LT460-Z25

Remote Shutdown

A connection point is provided for customer supplied remote shutdown devices. This terminal strip is located at the top of upflow units, and at the base of downflow units. Terminals 37 and 38 on the terminal strip are jumpered when no remote shutdown device is installed.

7.2 Filters

Filters are usually the most neglected item in an environmental control system. To maintain efficient operation, they should be checked monthly and changed as required. Because replacement intervals vary with environmental condition and filter type, each unit is equipped with a filter clog switch. This warns of restricted airflow through the filter compartment by activating the Change Filter alarm.

Turn power Off before replacing filters.

Liebert Challenger 3000 Liebert and Challenger ITR filters are 28-1/2" by 29-1/2", either 2" or 4" thick, plus an optional 2" thick pre-filter. The filter is replaced from the front of the unit. On upflow units, the filter is vertical, in front of the lower compartment. Pull the filter out toward you to remove it. On downflow units, the filter is horizontal, above the electrical panel. Slide the filter out toward you to remove it.

After replacing the filter(s), test the operation of the filter clog switch. Turn the adjusting screw counter clockwise to trip the switch — this will energize the Change Filter alarm. To adjust the switch proceed as follows: With the fan running, set the switch to energize the light with clean filters. The unit panels must all be in place and closed to accurately find this point. Then turn the adjusting knob one turn clockwise, or to the desired filter change point.

7.3 Blower Package

Periodic checks of the blower package include: belt, motor mounts, fan bearings, and impellers.

7.3.1 Fan Impellers and Bearings

Fan impellers should be periodically inspected and any debris removed. Check to see if they are tightly mounted on the fan shaft. Rotate the impellers and make sure they do not rub against the fan housing.

Bearings used on the units are permanently sealed and self-lubricating. They should be inspected for signs of wear when the belt is adjusted. Shake the pulley and look for movement in the fan shaft. If any excessive movement is noticed, bearings should be replaced. However, the cause of the wear must be determined and corrected before returning the unit to operation.

7.3.2 Belt

The drive belt should be checked monthly for signs of wear and proper tension. Pressing in on belts midway between the sheave and pulley should produce from 1/2" to 1" (12 to 25 mm) of movement. Belts that are too tight can cause excessive bearing wear.

Belt tension can be adjusted by raising or lowering the fan motor base. Loosen nut above motor mounting plate to remove belt. Turn nut below motor mounting plate to adjust belt tension. If belt appears cracked or worn, it should be replaced with a matched belt (identically sized). With proper care, a belt should last several years.

NOTICE

Risk of improper adjustment. Can cause equipment damage.

After adjusting or changing the belt, check to ensure that the motor base nuts are tightened. The bottom adjustment nut should be finger tight. The top locking nut should be tightened with a wrench.

7.3.3 Air Distribution

All unit models are designed for constant volume air delivery. Therefore any unusual restrictions within the air circuit must be avoided. For downflow models operating on a raised floor, refer to the following table for recommended free area for proper air flow.

Table 5 Recommended free area ft^2 (m^2) for grilles or perforated panels at output velocities of 550 and 600 fpm (2.8 and 3.1 m/s)

Model	550 FPM (2.8 m/s)	600 FPM (3.1 m/s)
60 Hz Units		
3 Ton	3.3 (0.31)	3.0 (0.28)
5 Ton	5.1 (0.41)	4.7 (0.44)
50 Hz Units		
3 Ton	3.3 (0.31)	3.0 (0.28)
5 Ton	4.7 (0.44)	4.3 (0.40)

Grilles used in raised floors vary in size, the largest being 18" x 6" (46 cm x 15 cm). This type of grille has approximately 56 in^2 (361 cm^2) of free area. Perforated Panels are usually 2' x 2' (61 cm x 61 cm) and have a nominal free area of approximately 108 to 144 in^2 (697 to 929 cm^2).

NOTICE

Risk of airflow restriction. Can cause inefficient operation and equipment overheating.

In raised-floor use, all under-floor restrictions, such as clusters of cables or piping, must be avoided because they may form barriers to airflow. Whenever possible, cables and pipes should be run parallel to the airflow. Never stack cables or piping.

7.4 Refrigeration System

Each month, the components of the refrigeration system should be inspected for proper function and signs of wear. Since, in most cases, evidence of malfunction is present prior to component failure, periodic inspections can be a major factor in the prevention of most system failures.

Refrigerant lines must be properly supported and not allowed to vibrate against ceilings, floors or the unit frame. Inspect all refrigerant lines every six months for signs of wear and proper support. Also inspect capillary and equalizer lines from the expansion valve and support as necessary.

Each liquid line has a sight glass that indicates liquid refrigerant flow and the presence of moisture. Bubbles in the sight glass indicate a shortage of refrigerant or a restriction in the liquid line. The moisture indicator changes from green to yellow when moisture is present in the system.

7.4.1 Suction Pressure

Suction pressure will vary with load conditions. The low pressure switch will shut the compressor down if suction pressure falls below the cut-out setting. High suction pressure reduces the ability of the refrigerant to cool compressor components and can result in compressor damage. Minimum (pressure switch cut-out setting) and maximum (design operating) suction pressures are in **Table 6**.

Table 6 Suction pressures - R407c

System	Minimum PSIG (kPa)	Maximum PSIG (kPa)
Air w/FSC (Fan Speed Control)	15 (103)	95 (654)
Air w/Lee-Temp Control (Floodback head pressure control)	20 (137)	95 (654)
Water-Cooled	20 (137)	95 (654)
Glycol-Cooled	20 (137)	95 (654)

7.4.2 Discharge Pressure

Discharge Pressure can be increased or decreased by load conditions or condenser efficiency. The high pressure switch will shut the compressor down at its cut-out setting. Refer to **Table 7**, below.

Table 7 Discharge pressures

System Design		Discharge Pressure PSIG (kPa)
Air-Cooled		260 (1795)
Water/Glycol-Cooled	65-75°F (18-24°C) fluid	210 (1450)
	85°F (29°C) fluid	225 (1550)
	115°F (46°C) fluid	295 (2035)
Maximum		330 (2275)
High Pressure Cut-Out		360 (2482)

7.4.3 Superheat

Superheat can be adjusted by the Thermostatic Expansion Value (TEV). To determine superheat:

1. Measure the temperature of the suction line at the point the TEV bulb is clamped.
2. Obtain the gauge pressure at the compressor suction valve.
3. Add the estimated pressure drop between bulb location and suction valve.
4. Convert the sum of the two pressures to the equivalent temperature.
5. Subtract this temperature from the actual suction line temperature. The difference is superheat.

7.4.4 Thermostatic Expansion Valve

Operation

The thermostatic expansion valve performs one function. It keeps the evaporator supplied with enough refrigerant to satisfy load conditions. It does not effect compressor operation.

Proper valve operation can be determined by measuring superheat. If too little refrigerant is being fed to the evaporator, the superheat will be high; if too much refrigerant is being supplied, the superheat will be low. The correct superheat setting is between 10 and 15°F (5.6 and 8.3°C).

Adjustment

To adjust the superheat setting:

1. Remove the valve cap at the bottom of the valve.
2. Turn the adjusting stem counterclockwise to lower the superheat.
3. Turn the adjusting stem clockwise to increase the superheat.

NOTE

Make no more than one turn of the stem at a time. As long as 30 minutes may be required for the new balance to take place.

7.4.5 Hot Gas Bypass Valve—Not Available on Digital Scroll Units

Operation—Self-Contained Units

The hot gas bypass is inserted between the compressor discharge line and the leaving side of the expansion valve through the side outlet distributor. The system, with normal operation when the evaporator is under full load, will maintain enough pressure on the leaving side of the hot gas valve to keep the valve port closed.

If the load on the evaporator decreases, the evaporator will get colder. When the coil is too cold, the internal pressure in the evaporator drops and allows the hot gas bypass valve to open. Hot gas then mixes with the liquid coolant on the discharge side of the expansion valve raising the temperature and pressure in the evaporator. The net result is a reduction in the cooling capacity of the unit to match the load.

To aid in lubricating the compressor, the hot gas bypass solenoid is delayed for 30 seconds on the initial call for cooling and de-energized for 30 seconds during every 60 minutes of continuous operation.

NOTE

These procedures are not applicable to condensing units. For condensing unit information, refer to Liebert's condensing unit manual, SL-10059, available at the Liebert Web site, ***www.liebert.com***

Adjustment

Upon deciding what evaporator temperature is desired, the following procedure should be used to adjust the hot gas bypass valve:

1. Install the suction and discharge pressure gauge.
2. Adjust the temperature setpoint to call for cooling so that the refrigeration compressor will run.
3. Remove the TOP adjusting nut from the valve.
4. Insert an Allen wrench in the brass hole at top of the valve in adjusting port, and turn CLOCKWISE if a higher evaporator temperature is required.
5. After obtaining the suction pressure required, reinstall the cap tightly making sure there are no leaks.
6. Let the evaporator operate for approximately 10 to 15 minutes to make sure the suction pressure is within the desired range.
7. There will be a fluctuation of approximately 3 to 6 PSIG (21 to 41 kPa) on the evaporator due to the differential on the hot gas bypass.
8. Return the temperature setpoint to desired number.

7.4.6 Air-Cooled Condenser

Restricted airflow through the condenser coil will reduce the operating efficiency of the unit and can result in high compressor head pressure and loss of cooling.

Clean the condenser coil of all debris that will inhibit air flow. This can be done with compressed air or commercial coil cleaner. Check for bent or damaged coil fins and repair as necessary. In winter, do not permit snow to accumulate around the sides or underneath the condenser.

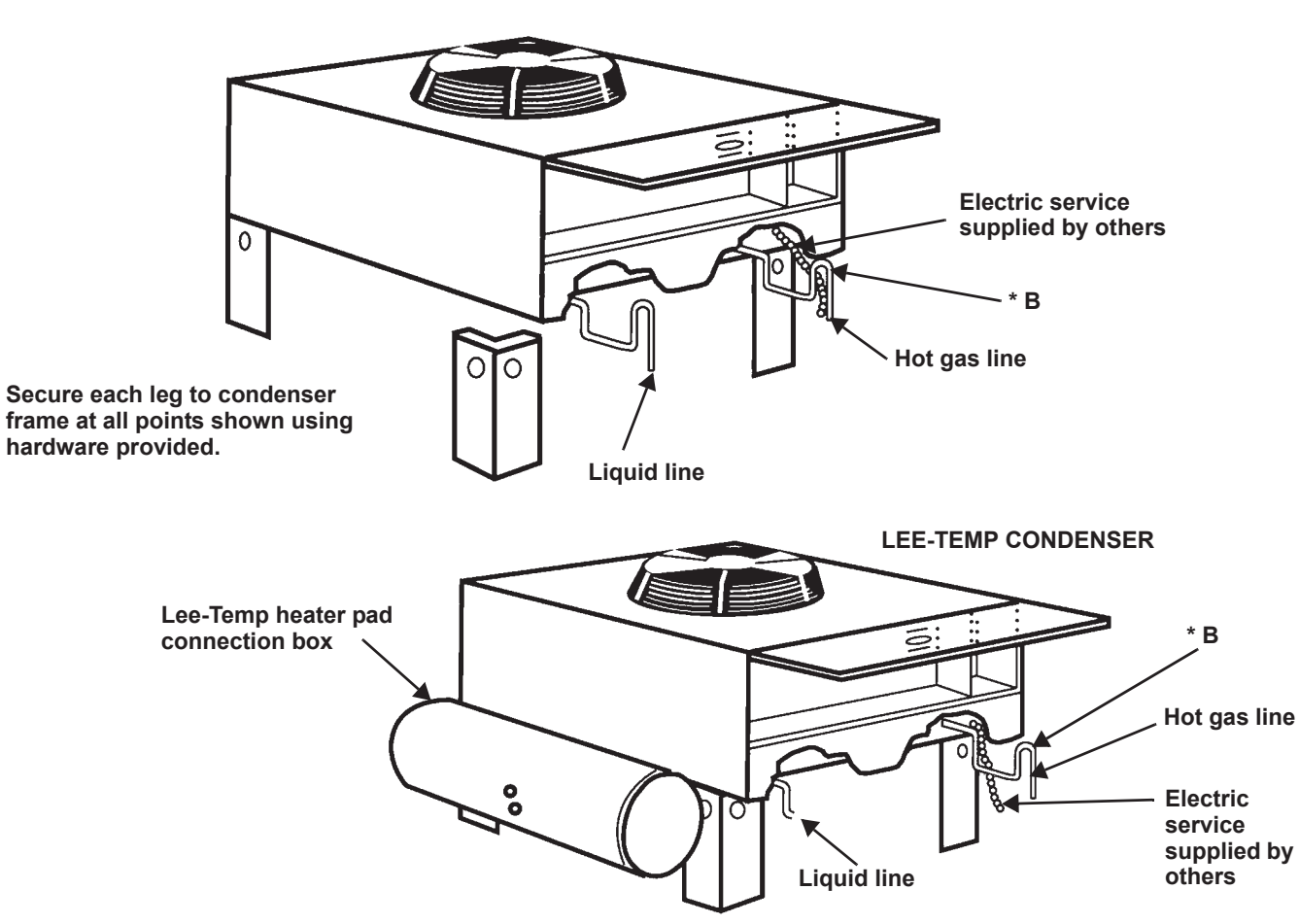
Check all refrigerant lines and capillaries for vibration isolation. Support as necessary. Visually inspect all refrigerant lines for signs of oil leaks.

Checking Refrigerant Charge (Lee–Temp/Flood Back Head Pressure Control)

The system refrigerant level must be checked periodically. To do so:

1. Adjust temperature setpoint in the unit so that the compressor will run continuously.
2. The refrigerant level is visible through two sight glasses on the receiver and will vary with ambient temperature.
   a. 40°F (4.4°C) and lower — Midway on the bottom sight glass.
   b. 40 to 60°F (4.4 to 15.6°C) — Bottom sight glass should be clear with liquid.
   c. 60°F (15.6°C) and above — Midway on the top sight glass.
3. Return temperature setpoint to desired number.

Figure 23 Outdoor fan/condenser configuration



***B - Inverted traps are to be field-supplied and installed (typical). When installing traps, provide clearance for swing end of access door. Traps are to extend above base of coil by a minimum of 7-1/2" (190 mm).**

7.4.7 Water/Glycol-Cooled Condensers

Coaxial Condenser

Each water- or glycol-cooled module has a coaxial condenser that consists of a steel outside tube and a copper inside tube.

Coaxial condensers do not normally require maintenance or replacement if the water supply is clean. If your system operates at high head pressure with reduced capacity, and all other causes have been eliminated, the coaxial condenser may be obstructed and needs to be replaced.

7.4.8 Motorized Ball Valve—Digital Scroll Compressor

On water-cooled and glycol-cooled digital scroll units, the discharge pressure is controlled by a motorized ball valve. During unloaded operation, the pressure changes during each digital cycle could result in excessive repositions with a pressure operated water regulating valve. The control algorithm for the motorized ball valve uses an intelligent sampling rate and adjustable pressure thresholds to reduce valve repositions. The valve assembly consists of the brass valve, linkage and actuator.

Control

The valve actuator operates on 24VAC power and is controlled by a 2-10VDC proportional control signal. The valve full open to full close time is 60 seconds. At 2VDC the valve is closed; at 10VDC the valve is fully open. There is a 20-second delay to position the motorized ball valve before starting the compressor.

Control Method

The control utilizes an upper and lower pressure threshold with a 35 PSI (241 kPa) deadband to reduce valve movement. If the liquid pressure is between the upper and lower threshold the valve remains at the current position. If the liquid pressure exceeds the upper threshold the valve opens, and if the pressure falls below the lower threshold the valve closes. There are multiple adjustment bands to ease discharge pressure back into control range.

Adjustment

Both pressure thresholds can be shifted simultaneously over a 50 PSI (345 kPa) range (the 35 PSI [241 kPa] differential remains constant). The ball valve setpoint offset parameter in the Service menu can be adjusted from 0 to 50 PSI (345 kPa) to raise or lower the control band similar to the pressure adjustment on a water regulating valve. Units are factory set at a 30 PSI (207 kPa) setpoint offset (30 PSI [207 kPa] above minimum). This results in a 220 PSIA (1517 kPa) lower threshold and a 255 PSIA (1758 kPa) upper threshold pressure.

Startup

The setpoint offset is adjusted to the minimum value during startup, then transitions to the set value once the compressor reaches normal operating pressures. Additionally changes in fluid temperature could cause pressure changes that do not result in valve movement within the dead band on drycoolers. Fan cycling stats should be set to prevent continuous fluid temperature swings greater than 10°F (5.6°C) (see **7.4.10 - Drycooler Settings**).

Location

The motorized ball valves are located in the condenser fluid return line. The three-way valve is piped in a mixing arrangement with the common port at the valve outlet.

Manual Control

The valve can be manually set by disconnecting AC power, depressing the manual override button on the valve actuator, and adjusting the valve position with the handle. You also have the option to control the motorized ball valves through the Service menu using manual mode to override the normal control.

7.4.9 Regulating Valve—Scroll Compressor

The water regulating valve automatically regulates the amount of fluid necessary to remove the heat from the refrigeration system, permitting more fluid to flow when load conditions are high and less fluid to flow when load conditions are low. The valve consists of a brass body, balance spring, valve seat, valve disc holders, capillary tube to discharge pressure, and adjusting screw.

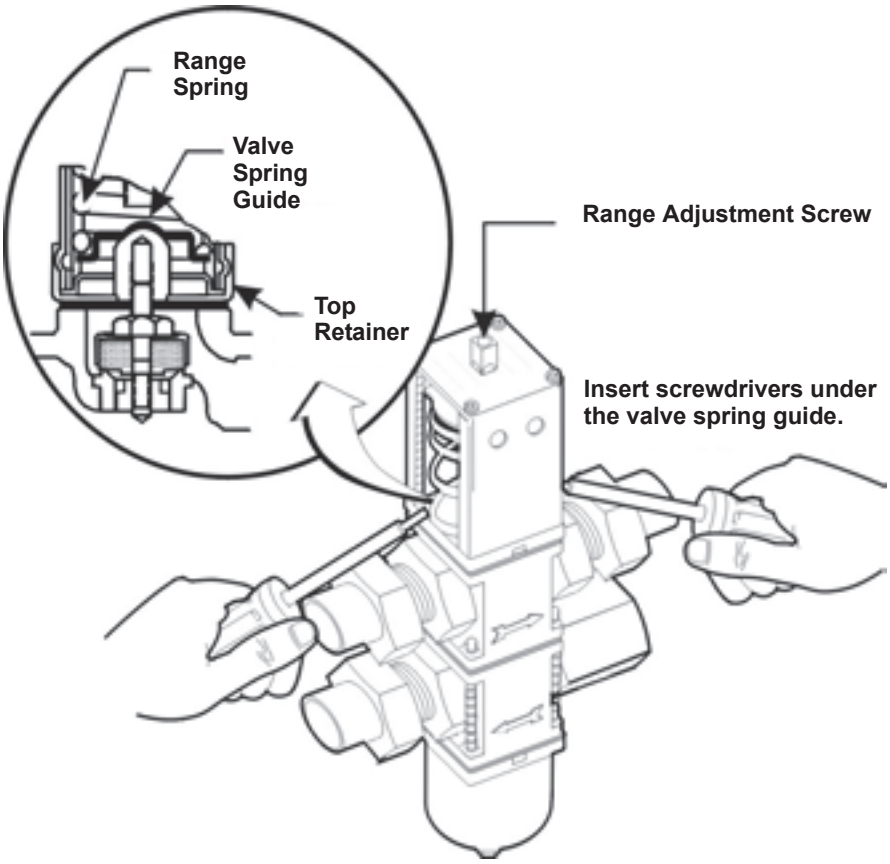
Standard Valve - 150 psig (1034 kPa) system for 3 & 5 ton units (Johnson Controls Valve) High Pressure Valve - 350 psig (2413 kPa) system for 5 ton units (Johnson Controls Valve)

Adjustment—The valve may be adjusted with a standard refrigeration service valve wrench or screw driver. Refer to **Table 7** for recommended refrigerant pressures.

To lower the head pressure setting, turn the square adjusting screw clockwise until the high pressure gauge indicates the desired setting.

To raise the head pressure setting, turn the adjusting screw counterclockwise until the desired setting is obtained.

Figure 24 Johnson Controls valve adjustment



Manual Flushing—The valve may be flushed by inserting a screwdriver or similar tool under the two sides of the main spring and lifting. This action will open the valve seat and flush any dirt particles from the seat. If this fails, it will be necessary to disassemble the valve and clean the seat.

High Pressure Valve - 350 PSIG System (2413 kPa) for 3 Ton Units (Metrex Valve)

Adjustment—The valve may be adjusted using a 1/8" diameter rod. Turn adjusting collar nut counterclockwise to raise head pressure. Turn it clockwise to lower head pressure. Rotation directions are as viewed from top of valve spring housing.

Figure 25 Metrex valve adjustment

Manual Flushing—The valve may be flushed by rotating the socket head screw clockwise. This screw must be in the OUT position (counterclockwise) for normal valve operation.

Valve Disassembly

1. Shut off the water supply by using isolating valves.
2. Relieve the tension on the main spring by turning the adjusting screw (or collar) as far as it will go (provide a container to catch water below the valve).
3. Remove four screws extending through the main spring housing.
4. Remove the center assembly screws for access to all internal parts.
5. Clean the seat if possible. If the seat is pitted or damaged, replace the valve rubber disc and valve seat.
6. After valve is reassembled check for leaks.
7. Readjust head pressure control.

Testing Function of Valve—When the refrigeration system has been Off for approximately 10 to 15 minutes, the water flow should stop.

If the water continues to flow, the valve is either improperly adjusted (with head pressure too low) or the pressure sensing capillary is not connected properly to the condenser.

7.4.10 Drycooler Settings

Applications with the Optional Stat Setting require field piping to be insulated to prevent condensation. **Table 8** shows acceptable applications where stats must be adjusted to Optional Setting. Aquastats must be field-adjusted to Optional Setting for:

- GLYCOOL/Dual Cool applications
- Single Drycooler loops with motor ball valve flow controls (motor ball valves are used on all Liebert Challenger 3000 and ITR units with digital compressors).

Table 8 Water/glycol system conditions requiring optional settings for aquastats

Cooling Type	Glycool				Glycol			
Flow Control	MBV		WRV		MBV		WRV	
Drycoolers in Loop	1	Multiple	1	Multiple	1	Multiple	1	Multiple
Stat Setting [1]	Optional	Optional	Optional	Optional	Optional	Factory	Factory	Factory
Insulate Field Piping	Yes	Yes	Yes	Yes	Yes	No	No	No

1. See **Table 9**.
2. MBV=motor ball valve; WRV=water regulating valve

Table 9 Aquastat settings—two-fan through four-fan drycoolers

Dial Setting (Stat Open Temp) Set for Mid Differential 8°F (4.4°C) Rise to Close			
Aquastat #	Fans	Factory Setting (Glycol) (see Notes 1 and 2)	Optional Setting (GLYCOOL) (see Note 3)
AQ1	F1	65°F (18.3°C)	35°F (1.7°C)
AQ2	F2 & F3	75°F (23.9°C)	45°F (7.2°C)
AQ3	F4	70°F (21.1°C)	40°F (4.4°C)

NOTE

1. *All drycoolers are shipped at Factory Setting.*
2. *Factory Setting is used for all glycol applications, except single drycooler loops with motor ball valve controls.*
3. *Stats must be field-adjusted to Optional Setting for GLYCOOL/Dual Cool applications and all single drycooler loops using motor ball valve flow controls.*

7.4.11 Compressor Oil

NOTICE

Risk of improper compressor lubrication. Can cause compressor and refrigerant system damage.

Failure to use oil types, viscosities and quantities recommended by the compressor manufacturer may reduce compressor life and void the compressor warranty. See oil types specified in **Table 10**.

- Do NOT mix polyol ester (POE) and mineral-based oils.
- Do NOT mix oils of different viscosities.

Consult Emerson or the compressor manufacturer if you have questions.

Table 10 Compressor oil types

Compressor Type	R-407c
Copeland Scroll and Digital Scroll	POE Oil - ISO 22 Viscosity [1]

1. Use Copeland POE Oil ULTRA 22CC, Mobil EAL Arctic 22CC or other Copeland-approved oils.

7.5 Compressor Replacement

Replacement compressors are available through your local Emerson office. Compressors are shipped in reusable packaging. If unit is under warranty, complete and include Liebert Service Credit Application (LSCA) with the compressor that is being returned. The original compressor should be returned in the same packaging.

Before Replacing or Returning a Compressor

Be certain that the compressor is actually defective. At a minimum, recheck a compressor returned from the field in the shop or depot for Hipot, winding resistance and ability to start before returning it. More than one-third of compressors returned for warranty analysis are determined to have nothing wrong. They were misdiagnosed in the field as being defective. Replacing working compressors unnecessarily costs everyone.

7.5.1 Compressor Functional Check

The following diagnostic procedure should be used to evaluate whether the compressor is working properly.

1. Proper voltage to the unit should be verified.
2. The normal checks of motor winding continuity and short to ground should be made to determine if the inherent overload motor protector has opened or if an internal motor short or ground fault has developed. If the protector has opened, the compressor must be allowed to cool sufficiently to allow it to reset.
3. Proper indoor and outdoor blower/fan operation should be verified. Condenser glycol flow should be verified.
4. With service gauges connected to suction and discharge pressure fittings, turn On the compressor. If suction pressure falls below normal levels, either the system charge is low on or there is a flow blockage in the system.
5. If suction pressure does not drop and discharge pressure does not rise to normal levels, reverse any two of the compressor power leads and reapply power to make sure compressor was not wired to run in reverse direction. If pressures still do not move to normal values, system is properly charged and solenoid valves function, the compressor is faulty. Reconnect the compressor leads as originally configured and use normal diagnostic procedures to check operation of the reversing valve.
6. To test if the compressor is pumping properly, the compressor current draw must be compared to published compressor performance curves using the operating pressures and voltage of the system. If the measured average current deviates more than ±15% from published values, a faulty compressor may be indicated. A current imbalance exceeding 15% of the average on the three phases should be investigated further.

7.5.2 Standard Scroll Compressor Replacement

Infrequently a fault in the motor insulation may result in a motor burn, but burnouts rarely occur in a properly installed system. Of those that do, most are the effects of mechanical or lubrication failures, resulting in the burnout as a secondary consequence.

If problems that can cause compressor failures are detected and corrected early, a large percentage can be prevented. Periodic maintenance inspections by alert service personnel on the lookout for abnormal operation can be a major factor in reducing maintenance costs. It is easier and far less costly to take the steps necessary to ensure proper system operation than it is to allow a compressor to fail and require replacement.

When troubleshooting a compressor, check all electrical components for proper operation.

1. Check all fuses and circuit breakers.
2. Check Hi-Lo Pressure switch operation.
3. If a compressor failure has occurred, determine whether it is an electrical or mechanical failure.

Mechanical Failure

A mechanical compressor failure will be not be indicated by a burned odor. The motor will attempt to run. If you have determined that a mechanical failure has occurred, the compressor must be replaced.

If a burnout occurs, correct the problem that caused the burnout and clean the system. It is important to note that successive burnouts of the same system are usually caused by improper cleaning.

Electrical Failure

An electrical failure will be indicated by a distinct pungent odor. If a severe burnout has occurred, the oil will be black and acidic.

In the event that there is an electrical failure and a complete burnout of the refrigeration compressor motor, the proper procedures must be performed in order to clean the system to remove any acids that would cause a future failure.

For clean-out warnings and procedures, see Copeland Application Engineering Bulletin 24-1105 “Principles of Cleaning Refrigeration Systems” or Carlyle Service Guide, Literature # 020-611.

WARNING

Risk of explosive discharge from high-pressure refrigerant. Can cause injury or death.

This unit contains fluids and gases under high pressure. Relieve pressure before working with piping. Do not loosen any refrigeration or electrical connections before relieving pressure.

CAUTION

Risk of contact with hot substances or surfaces. Can cause injury.

Avoid touching or contacting the gas and oils with exposed skin. Severe burns will result. Use long rubber gloves in handling contaminated parts. Use extreme caution and wear protective gloves and arm protection when working on or near hot compressors, discharge lines, humidifiers and reheats.

NOTE

Release of refrigerant to the atmosphere is harmful to the environment and is unlawful. Refrigerant must be recycled or discarded in accordance with federal, state, and local regulations.

NOTICE

Damage to a replacement compressor caused by improper system cleaning constitutes abuse under the terms of the warranty, and the warranty will be void.

NOTICE

Risk of improper scroll compressor installation. Could cause poor performance and compressor damage.

Three-phase power must be connected to the unit line voltage terminals in the proper sequence so that the scroll compressor rotates in the proper direction. Rotation in the wrong direction will result in poor performance and compressor damage.

Record compressor motor connections when removing a failed compressor. Wire the replacement compressor motor the same way to maintain proper rotation direction.

7.5.3 Digital Scroll Compressor Replacement Procedure

1. Disconnect power and follow all warnings at front of this manual.
2. Attach suction and discharge gauges to access fittings.
3. Front-seat service valves to isolate the compressor. Reclaim charge from compressor.
4. Remove marked pressure transducer and discharge pressure switch. Disconnect all electrical connections.
5. Detach service valves from compressor.
6. Remove failed compressor.
7. If required, follow compressor manufacturer's suggested clean-out procedures.
8. Install replacement compressor and make all connections. Replace gaskets or seals on service valves. Replace unloading solenoid.
9. Evacuate and charge as detailed in the user manual, SL-11962.

NOTICE

Risk of improper component reinstallation. Can cause equipment damage.

Identify and mark location of suction pressure transducer and discharge pressure switch. These devices look similar and they must be reinstalled in their original location.

Digital Compressor Unloading Solenoid(s)—Models 040, 042, 047, 049, 061 and 072

When replacing a digital scroll compressor, digital solenoid valve and coil must be replaced. Compressor and valve kit are shipped separately. Valve kit must be field-brazed to top of compressor in proper orientation and supported with original factory bracket.

7.6 Facility Fluid and Piping Maintenance for Water and Glycol Systems

Facility water and glycol quality remain a requirement throughout the life of the piping system. Fluid and piping system maintenance schedules must be established and performed. A local fluid maintenance program must be established that will evaluate fluid chemistry and apply necessary treatment. A periodic leak inspection of facility and unit fluid piping is recommended.

Glycol Solution Maintenance

It is difficult to establish a specific schedule of inhibitor maintenance since the rate of inhibitor depletion depends upon local water conditions. Analysis of water samples at time of installation and every six months should help to establish a pattern of depletion. A visual inspection of the solution and filter residue is often helpful in judging whether or not active corrosion is occurring.

The complexity of water caused problems and their correction makes it important to obtain the advice of a water treatment specialist and follow a regularly scheduled maintenance program. It is important to note that improper use of water treatment chemicals can cause problems more serious than using none.

Proper inhibitor maintenance must be performed in order to prevent corrosion of the glycol system. Consult glycol manufacturer for testing and maintenance of inhibitors. Do not mix products from different manufacturers. For further details, refer to filling instructions in the installation manual, Liebert part number SL-11925, available at the Liebert Web site, **www.liebert.com**

7.7 Humidifier

7.7.1 Infrared Humidifier

During normal humidifier operation, deposits of mineral solids will collect in the humidifier pan. This should be cleaned out periodically to ensure efficient operation. Each water supply has different characteristics, so the time interval between cleanings must be determined locally. A monthly check (and cleaning if necessary) is recommended.

Removing the Pan

To remove humidifier pan, first open disconnect switch and open front panel. Allow time for pan and water to cool. Unlatch front retainer clip (or remove screw from bracket on some units). Pull pan forward. Remove stand pipe to allow pan to drain. Disconnect drain line. Pull pan forward to remove it.

WARNING

Risk of electric shock and contact with hot liquids. Can cause injury or death.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the "Unit Off" mode. Some internal components require and receive power even during the "Unit Off" mode of Liebert iCOM control.

The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.

Before removing pan, be sure power is disconnected from the unit and water in the humidifier pan is no hotter than lukewarm.

Cleaning the Pan

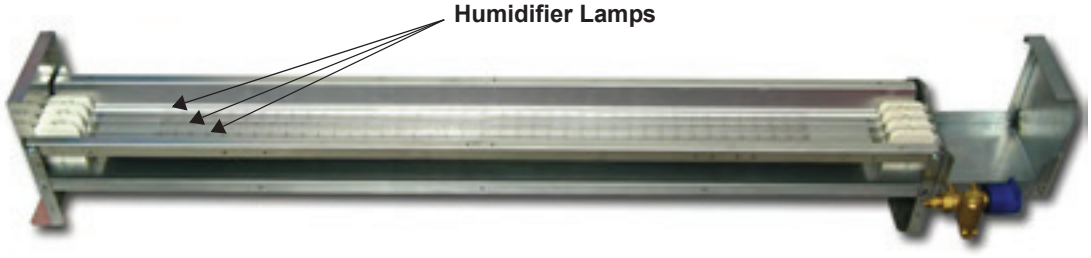
An autoflush system can greatly increase the time between cleanings but does not eliminate the need for periodic checks and maintenance.

Scale on the side and bottom can be loosened with a stiff brush. Flush with water and replace pan in humidifier.

Changing Humidifier Lamps

1. Open disconnect switch.
2. Open front panel.
3. Remove screws securing line voltage compartment cover, then remove the cover.
4. In line voltage compartment, disconnect one end of the purple jumpers, then locate the burned out bulb with a continuity meter.
5. Remove humidifier pan. Refer to **Removing the Pan on page 50**.
6. Remove lamp brackets (2) under lamps.

Figure 26 Infrared humidifier lamps



7. Loosen two screws securing bulb wires to junction block.
8. Pull bulb straight down.
9. Replace bulb. Wrap wires once loosely around bulb. This will support the bulb and also allow for thermal expansion. Make sure lamp wires are secure in the junction block.

NOTICE

Risk of oily deposits. Can shorten component life.

Do not touch the quartz lamps with your bare hands. Oily deposits such as fingerprints will severely shorten bulb life. Use clean cotton gloves at all times.

10. Reverse **Steps 1** through **6** to reassemble.

Autoflush Infrared Humidifier Cleaning System

NOTICE

Risk of improper water pressure. Can cause improper component operation.

To operate properly, the Autoflush Humidifier requires a water source that can deliver at least 1 gpm (0.063 l/s) with a minimum pressure of 20 psig (138 kPa).

The autoflush system will periodically flush the humidifier pan with water to prevent the buildup of water minerals due to saturation. Because water conditions vary, the amount of water flushing through the system may be programmed to match local needs.

Water amounts between 110% and 500% of the amount needed for humidification may be selected. Operation of the flushing system is then automatic and no further adjustments need to be made.

Autoflush Operation

The operation of the autoflush is divided into four steps, beginning with a call for humidification.

1. If the humidifier has not been activated for over 30 hours, the autoflush will flow water into the pan for about 30 seconds. This will provide a minimum amount of water in the pan and prevent heat damage to the humidifier pan. Humidifier lamps are Off.
2. If the humidifier has been activated within the last 30 hours, **Step 1** is bypassed. The autoflush will flow water into the pan for about 4 minutes. The humidifier lamps are On and the humidifier is operational during this period. When the pan is filled (the fill cycle has timed out), the water make-up valve is closed.
3. The water make-up valve remains Off and the humidifier lamps are On for a maximum of 9-1/2 minutes.
4. After the 9-1/2 minute delay, the autoflush adds water to the pan to replenish the water used in humidification and flush the pan of mineral solids. This amount of water is adjustable from 110% to 500% in increments of 10%. At the end of this cycle, the make-up valve is closed. **Steps 3** and **4** repeat as long as humidification is required.

Autoflush Controls

Use the LCD display, menu, and keys on the front control panel to program the autoflush controls.

7.7.2 Steam Generating Humidifier

Steam generating humidifiers are designed to operate in voltage ranges from 200 to 575 volts and generate 11 pounds (5 kg) of steam per hour. These humidifiers operate efficiently over a wide range of water quality conditions and automatically adjust to changes in the conductivity of water. The humidifiers drain and refill to maintain an amperage setpoint and alert the operator when the humidifier canister needs to be replaced. The humidifier is in the lower section of upflow units; it is in the middle section of downflow units.

Figure 27 Steam generating humidifier

Operation

1. During startup, when the humidity control calls for humidification, the fill valve opens and allows water to enter the canister. When the water level reaches the electrodes, current flows and the water begins to warm. The canister fills until the amperage reaches the setpoint and the fill valve closes. As the water warms, its conductivity increases and the current flow, in turn, rises. If the amperage reaches 115% of the normal operating amperage, the drain valve opens and flushes some of the water out of the canister. This reduces electrode contact with the water and lowers the current flow to the amperage setpoint. Boiling soon commences, and the canister operates normally.
2. If the conductivity of the water is low, the canister fills and the water level reaches the canister full electrode before the amperage setpoint is reached. The humidifier stops filling to prevent overflow. Boiling should commence in time. As water is boiled off, the mineral concentration in the canister increases and current flow also increases. The canister eventually reaches full output and goes to normal operation. No drain is permitted until then.
3. When full output is reached the circuit board starts a time cycle which is factory set at 60 seconds. During this repeating time cycle, the fill valve will open periodically to replenish the water being boiled off and maintain a “steady state” output at the set point. The amperage variance will depend on the conductivity of the water.
4. After a period of time, the mineral concentration in the canister becomes too high. When this occurs, the water boils too quickly. As the water quickly boils off and less of the electrode is exposed, the current flow decreases. When the current crosses the low threshold point (factory set at 90%) before the end of the time cycle, the drain valve opens, draining the mineral laden water out and replacing it with fresh water. This lowers the mineral concentration and returns the canister to “steady state” operation and prolongs canister life. The frequency of drains depends on water conductivity.
5. Over a period of time, the electrode surface will become coated with a layer of insulating material, which causes a drop in current flow. As this happens, the water level in the canister will slowly rise exposing new electrode surface to the water to maintain normal output. Eventually, the steady state water level will reach the canister full electrode and indicate so by activating the canister full alarm. At this point, all of electrode surface has been used up and the canister should be replaced.
6. After the entire electrode surface has been coated, the output will slowly begin to fall off. This usually occurs in the last several hours of electrode life and should allow enough time to schedule maintenance. During these last hours, the mineral concentration can increase. If the mineral concentration is too high, arcing can occur. If the electrodes start to arc, turn Off the humidifier immediately and replace the canister with the identical part.

Controls

The humidifier RUN/DRAIN switch is located at the upper right of the humidifier assembly. This switch should be in the RUN position when the humidifier is in normal operation, and in the DRAIN position when a manual drain sequence is required. The electronic control board for the humidifier is located on the right side of the humidifier assembly. When the main unit is energized, power is available to the humidifier circuits.

Replacing the Canister

Over a period of operation, the humidifier electrodes become coated with mineral solids. This coating insulates the electrodes and decreases the current flow. To maintain humidifier capacity, the water level slowly rises to expose fresh electrode. Eventually, the entire electrode becomes coated and the water level reaches the top. At this point, the canister full alarm is activated and the output begins to fall. When this happens, it is necessary to replace the full canister.

To replace the canister:

1. Turn the humidifier Off by lowering the humidity setpoint below the ambient humidity level. Record the original setpoint.
2. Place the RUN/DRAIN switch in the DRAIN position to drain the water from the canister.
3. Return the RUN/DRAIN switch to the RUN position after the canister has drained.

WARNING

Risk of electric shock. Can cause injury or death.

To avoid a shock hazard, all power to the unit must be disconnected before proceeding with the canister replacement procedure.

4. Turn Off the power at the main unit.
5. Remove the cover from the humidifier cabinet.

CAUTION

Risk of contact with hot surfaces. Can cause injury.

The canister and steam hose may be hot. Allow sufficient time for them to cool before working within the unit cabinet. Use extreme caution and wear protective gloves and arm protection when working on or near the canister or steam hose.

6. Locate the power wires to the steam canister. They are connected to the canister with 1/4" quick connects. Make note of the wiring configuration before removing any wires. Refer to the schematic on the unit. Slide the rubber boot back to expose the connections. Remove the three power wires and the two canister full wires. Do not loosen the screws that secure the electrodes.
7. Loosen the steam outlet hose clamp and slide the steam hose away from the canister top fitting.
8. The canister is now ready to be removed. Pull the canister straight up and out of the cabinet toward you.
9. Replace the canister with the part indicated in **Table 11**.

Table 11 Humidifier canister part numbers

Part Number	Voltage	Capacity lb/hr (kg/hr)
136798P1	200-460*	11 (5)
136798P2	380-575	11 (5)

* Can operate on 575V unit with transformer

10. Replace the canister by reversing the above procedure. Make special note of the following:

NOTE

When replacing the canister:

1. *Make sure the two "O" rings are lubricated and properly seated on the bottom neck.*
2. *Always check the fill and drain solenoids for proper operation.*

NOTE

When replacing the wiring, connect the red wire from Terminal #1 on the interface to the red top terminal on the canister. It is in the middle of a group of three terminals. The black wire from Terminal #2 on the interface connects to the power terminal farthest from the red terminal/wire. The power wire to this terminal is routed through the current sensing coil.

Circuit Board Adjustments

WARNING

Risk of electric shock. Can cause injury or death.

The Liebert iCOM microprocessor does not isolate power from the unit, even in the "Unit Off" mode. The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.

Only properly trained and qualified personnel should perform adjustment of the circuit board. Hazardous voltages are present in the equipment throughout the procedure. Disconnect all power from the unit before working within the cabinet.

Humidifier operation is governed by the humidifier control board. This board is located on the right side of the humidifier compartment. There are three potentiometers mounted on the board. These pots can be used to adjust for extreme water conductivity conditions and capacity.

The "%" pot controls the amperage at which the drain will energize. The pot is clearly marked in percentages. This adjustment is factory set at 90%, which indicates that the unit will drain when the amperage falls off to 90% of the capacity setpoint. Raising the value increases the frequency of drain cycles. Lowering the value decreases the frequency of drain cycles. The frequency should be increased for highly conductive water and decreased for less conductive water. If adjustment is necessary, and a change of three to four percent in either direction does not permit normal operation of the unit, consult your Liebert supplier.

The pot marked "SEC" controls the duration of the drain cycle. The pot is clearly marked in seconds. This adjustment is factory set at 60 seconds and should not be readjusted without consulting your Liebert supplier.

The pot marked "CAP ADJ" is factory set at 100%. The maximum capacity is determined by a fixed resistor (R4) which is factory selected based on unit voltage.

Drain Tempering Feature

All units are equipped with a drain tempering feature which mixes cold fill water with hot drain water to protect drain piping. This feature can lower drain water temperature to as low as 140°F (60°C), depending on water pressure. To deactivate this feature, remove the diode from socket CR18 on the circuit board (lower left, above LED).

8.3 Kohler Generator PM Recommendations

CERTIFIED STATIONARY ENGINE MAINTENANCE REQUIREMENTS

Perform the following maintenance on the engine at the hours indicated and at equivalent hour intervals thereafter.

	Interval Hours									
	Daily	1000	1500	2000	2500	3000	3500	4000	4500	5000
General Maintenance Section										
Visual check for fluid leaks	X									
Check engine oil level	X									
Check coolant level	X									
Change engine oil and filter	**Every 150 hours or 120 days of operation**									
Check LPG system for leaks	Prior to any service or maintenance activity									
Inspect accessory drive belts for cracks, breaks, splits or glazing		X		X		X		X		X
Inspect electrical system wiring for cuts, abrasions or corrosion				X				X		
Replace crankcase breather element - 8.1L Engine	**Every 150 hours or 120 days of operation**									
Inspect all vacuum lines and fittings for cracks, breaks or hardening				X				X		
Engine Coolant Section										
Clean debris from radiator core	**Every 100 hours or 60 days of operation**									
Change coolant[1]										X
Inspect coolant hoses for cracks, swelling or deterioration		X		X		X		X		X
Engine Ignition System		X		X		X		X		X
Replace spark plugs			X			X				
Clean secondary ignition coil tower		X		X		X		X		X
Check spark plug wires for cuts abrasions or hardening		X								
Replace distributor cap and rotor				X				X		
Replace spark plug wires				X				X		
Fuel System Maintenance										
Inspect air cleaner	**Every 200 hours, or every 100 hours in dusty environment**									
Replace filter element	Annually, or as required in dusty environments									
Replace fuel filter		X		X		X		X		X
Inspect Shut-off Valve for leaks and closing				X				X		
Leak check fuel lines				X				X		
Check air induction for leaks		X		X		X		X		X
Check manifold for vacuum leaks		X		X		X		X		X
Drain Vaporizer oil build up	**Every 2500 hrs**									
Engine Exhaust System										
Inspect exhaust manifold for leaks				X				X		
Inspect exhaust piping for leaks				X				X		
Check HEGO sensor(s) connector and wires for burns, cuts or damage				X				X		
Inspect catalyst for mechanical damage				X				X		

SPECIAL NOTES SECTION

Note 1 = PSI requires the use of coolant meeting GM specification GM6277M. When used, this coolant change interval is 5,000 hours or 5 years (whichever occurs first). Changing of coolant types (typically indicated by color) and mixing of coolants is not allowed as this can result in a loss of coolant protection during the engine life. Consult the OEM for the correct replacement interval if you use coolant other than GM6277M

3.3 Service Schedule

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
Fuel System						
Day tank level	X	X				Weekly
Flexible lines and connections	X		R			Weekly
Fuel level switch	X				X	Weekly
Main tank supply level		X				Weekly
Solenoid valve operation	X				X	Weekly
Transfer pump operation	X				X	Weekly
Water in system, remove		●		●		Weekly
Filter(s)			●			Quarterly
Gasoline supply			R			Six Months
Fuel piping	X					Yearly
Tank vents and return lines for obstructions		X				Yearly
Lubrication System						
Oil level	●	●				Weekly
Crankcase breather	●		●			Quarterly
Change oil			●			First 50 Hrs., Then Every 250 Hrs.
Replace filter(s)*			●			
Cooling System						
Air cleaner to room/enclosure		X				Weekly
Block heater operation		X				Weekly
Coolant level	●	●				Weekly
Flexible hoses and connectors	X	X				Weekly
Water pump(s)	●					Weekly
Fan and alternator belts	●	●	R			Monthly
Coolant temperature protection level					●	Six Months
Air ducts, louvers		X		X		Yearly
Coolant			●			Yearly
Heat exchanger				X		Yearly
Louver motors and controls	X			X	X	Yearly
Radiator exterior				X		Yearly
Water supply to heat exchanger		X				Yearly
Exhaust System						
Drain condensate trap		X				Weekly
Leakage	X	X				Weekly
Insulation, fire hazards	X					Quarterly
Flexible connector(s)	X					Six Months
Excessive back pressure					X	Yearly
Hangers and supports	X					Yearly
DC Electrical System						
Battery charger operation, charge rate	X					Monthly
Battery electrolyte level		X				Monthly
Battery specific gravity, charge state					X	Monthly
Recharge after engine start		X				Monthly
Remove corrosion, clean and dry battery and rack	X			X		Monthly
Clean and tighten battery terminals	X	X				Quarterly
Tighten DC electrical connections		X				Six Months

● Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual. If not indicated, follow this service schedule. Some items may not apply to all generator sets.
R Replace as necessary.
X Action
* Service more frequently if operated in dusty areas.

Service Schedule, continued

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
AC Electrical System						
Controller lamp test	X				R	Weekly
General Inspection	X					Weekly
Circuit breakers, fuses†	X	X	R	X	X	Monthly
Wire abrasions where subject to motion	X	X				Quarterly
Safety and alarm operation		X			X	Six Months
Tighten control and power wiring connections		X				Yearly
Transfer switch main contacts†	X			X		Yearly
Voltage-sensing device/relay adjustment†		●			●	Yearly
Wire-cable insulation breakdown	X				X	3 Years or 500 Hrs.
Engine and Mounting						
General inspection	●					Weekly
Governor operation, lubricate moving parts	●	●				Monthly
Air cleaner service		●	●			Six Months
Choke, carburetor adjustment		●				Six Months
Governor oil (mechanical governor only)		●				Yearly
Ignition components	●			●		Yearly
Injector pump and injector flow rate, pressure, spray pattern		●			●	Yearly
Valve clearance		●				3 Years or 500 Hrs.
Bolt torque		●			●	3 Years or 500 Hrs.
Remote Control System, etc.						
Compartment condition	X			X		Weekly
Remote control					X	Monthly
Run generator set					X	Monthly
Alternator						
General inspection	X					Weekly
Rotor and stator	X			X		Yearly
Bearing condition	X	X	R			Yearly
Exciter	X	X		X		Yearly
Voltage regulator	X	X		X		Yearly
Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier disconnected)					X	Yearly
Blow dust out of alternator*	X			●		2 Years or 300 Hrs.
General Condition of Equipment						
Any condition of vibration, leakage, noise, temperature, or deterioration	X	X		X		Weekly
Ensure that system is set for automatic operation	X					Weekly
Interior of equipment room or outdoor weather housing	X			X		Weekly

● Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual. If not indicated, follow this service schedule. Some items may not apply to all generator sets.
R Replace as necessary.
X Action.
* Service more frequently if operated in dusty areas.
† Do not break manufacturer's seals or internally inspect these devices.

Megger® is a registered trademark of Biddle Instruments.

8.4 VESDA Maintenance Guide

Xtralis VESDA Maintenance Guide

Document Number: 10256_08
Part Number: 30010

xtralis
VESDA

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i. in the case of services, the cost of having the services supplied again; or
ii. in the case of goods, the lowest cost of replacing the goods, acquiring equivalent goods or having the goods repaired.

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Document Conventions

The following typographic conventions are used in this document:

Convention	Description
Bold	**Used to denote:** emphasis Used for names of menus, menu options, toolbar buttons
Italics	**Used to denote:** references to other parts of this document or other documents. Used for the result of an action.

The following icons are used in this document:

Convention	Description
	**Caution:** This icon is used to indicate that there is a danger to equipment. The danger could be loss of data, physical damage, or permanent corruption of configuration details.
	**Warning:** This icon is used to indicate that there is a danger of electric shock. This may lead to death or permanent injury.
	**Warning:** This icon is used to indicate that there is a danger of inhaling dangerous substances. This may lead to death or permanent injury.

Contact Us

The Americas	+1 781 740 2223
Asia	+8 52 2297 2438
Australia and New Zealand	+61 3 9936 7000
Continental Europe	+41 55 285 99 99
UK and the Middle East	+44 1442 242 330
www.xtralis.com	

Codes and Standards Information for Air Sampling Smoke Detection

We strongly recommend that this document is read in conjunction with the appropriate local codes and standards for smoke detection and electrical connections. This document contains generic product information and some sections may not comply with all local codes and standards. In these cases, the local codes and standards must take precedence. The information below was correct at time of printing but may now be out of date, check with your local codes, standards and listings for the current restrictions.

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, the user is encouraged to try to correct the interference by one or more of the following measures; re-orientate or relocate the receiving antenna, increase the separation between the equipment and receiver, connect the equipment to a power outlet which is on a different power circuit to the receiver or consult the dealer or an experienced radio/television technician for help.

FDA

This VESDA product incorporates a laser device and is classified as a Class 1 laser product that complies with FDA regulations 21 CFR 1040.10. The laser is housed in a sealed detector chamber and contains no serviceable parts. The laser emits invisible light and can be hazardous if viewed with the naked eye. Under no circumstances should the detector chamber be opened.

FM Hazardous Applications

3611 Hazardous Approval Warning: Exposure to some chemicals may degrade the sealing of relays used on the detector. Relays used on the detector are marked “TX2-5V”, “G6S-2-5V” or “EC2-5NU”.

VESDA detectors must not be connected or disconnected to a PC while the equipment is powered in an FM Division 2 hazardous (classified) location (defined by FM 3611).

FM Approved Applications

The product must be powered from VPS-100US-120, VPS-100US-220 or VPS-220 only.

ONORM F3014

ONORM F3014, transport times for all tubes (including capillaries) must not exceed 60 seconds from any hole. This means that the pre-designed pipe networks that include capillaries cannot be used.

AS1603.8

The performance of this product is dependent upon the configuration of the pipe network. Any extensions or modifications to the pipe network may cause the product to stop working correctly. You must check that ASPIRE2 approves alterations before making any changes. ASPIRE2 is available from your VESDA ASD distributor.

AS1851.1 2005

Maintenance Standards. Wherever this document and the AS1851.1 differ, AS1851.1 should be followed in preference to this document.

European Installations

The product must use a power supply conforming to EN54: Part 4.

Table of Contents

1 Introduction

1.1 Scope

This Maintenance Guide provides essential information for service personnel maintaining Xtralis VESDA systems. It includes suggestions for a maintenance schedule and instructions on servicing the different Xtralis VESDA detector components.

Knowledge about local fire regulations, electrical codes and standards is assumed. Anyone responsible for maintenance should possess this knowledge.

Note: Important Note: Xtralis strongly recommends that all persons who install, commission, service and/or maintain Xtralis VESDA systems attend the Xtralis VESDA accreditation training. Please contact your local Xtralis office for more information.

1.2 Brief Outline

The information presented in this Maintenance Guide is arranged into the following sections:

- Section 2 - describes how to determine an appropriate maintenance schedule and maintenance procedures for Xtralis VESDA detectors.
- Section 3 - describes how to maintain the power supply.
- Section 4 - describes how to maintain the sampling pipe network.
- Section 5 - provides information on post-maintenance testing.
- Section 6 - provides information on annual testing.
- Section 7 - describes the procedures for replacing parts on the range of Xtralis VESDA detectors
- Appendix A: provides a list of part numbers.
- Appendix B: provides application specific information on determining an appropriate maintenance schedule.
- Appendix C: provides a sample maintenance log, which should be completed as part of each maintenance visit.

1.3 Maintenance Overview - Who and When?

To maintain the Xtralis VESDA system at its peak performance level, the suggested maintenance schedule should be followed. Maintenance can be conducted by the original installer, an Xtralis VESDA distributor or a service contractor. The optimum operation of an Xtralis VESDA system requires that the equipment is supported by a well designed and maintained sampling pipe network. The site conditions and the local codes & standards may require more regular maintenance than that recommended by Xtralis.

Maintenance frequency must be increased in industrial applications such as coal-fired power stations, factories, distribution facilities and warehousing with high vehicular traffic loads since these applications commonly have high levels of background pollution.

Note: Xtralis have adopted the fire industry term 'Disable' for the Xtralis VESDA VLF and all future products. The Xtralis VESDA VLP, Xtralis VESDA VLS and Xtralis VESDA VLC continue to use the term 'Isolate'. Both terms are used throughout this document and have the same meaning.

Note: Xtralis have adopted the fire industry term 'Address' instead of the formerly used term ‘Zone’ for the VLF and all future products. The VLP, VLS and VLC continue to use the term 'Zone'. Both terms are used throughout this document and have the same meaning.

1.4 Important pre-maintenance preparations

All maintenance procedures require the Xtralis VESDA system to be isolated during maintenance and testing. Failure to isolate the system, may lead to unwanted alarms and initiation of fire response systems. When an Xtralis VESDA system has to be isolated, alarms will be displayed but no relays will be tripped. Prior to isolating an Xtralis VESDA system for maintenance, you must do the following:

1. Inform the appropriate supervising authority about the risk associated with isolating a Xtralis VESDA Address.
2. Ensure that any ancillary devices, dependent on the detector, are appropriately isolated. When a detector is isolated, a fault is signalled at the monitoring system. This is acknowledged either by wiring the isolate relay in series with the fault relay (VLP and VLS) or by configuring the fault relay (fault number 3) to trigger an isolate.

1.5 Maintenance Schedule Summary

Table 1 contains a summary of the suggested maintenance schedule.

Table 1-1: VESDA maintenance schedule summary

Maintenance Task	Every Visit	Monthly	Six Monthly	Annual	Every Two Years
Check Detector & Filter	See Recommended Xtralis VESDA Maintenance Period & Filter Cartridge Replacement Frequency (Appendix B).				
Check Power Supply			•		
Inspect Pipe Network			•		
Check Air flow (per pipe)	•				
Perform System Integrity Smoke Test				•	
Clean Sampling Points					•
Flush Pipe Network					•

Notes:

- The above table only applies to clean environments.
- If local codes and standards for the site require more frequent maintenance, their guidelines must override those suggested in this Maintenance Guide.
- Maintenance schedules may also vary according to operating conditions.
- Sampling pipe flushing and the cleaning of sampling holes should be conducted as frequently as required by the detector type and environment.

2 Detector Maintenance

2.1 Maintenance Considerations

Before beginning system maintenance, the important considerations are as follows:

- What will the maintenance schedule be?
- What maintenance procedures will be required?
- What unscheduled maintenance needs may arise?

2.2 Equipment Required

In order to properly maintain the Xtralis VESDA system, you will require the following equipment:

- Phillips head screwdriver "1" (length 90 mm minimum) - for filter replacement.
- Phillips head screwdriver "2" - for removing all detector covers.
- PC with Xtralis VSC and a High Level Interface (HLI), HLI model number VHX-0200 or VHX-0210. Xtralis recommends the use of Xtralis VSC and a HLI. However, a hand-held programmer could also be used for this purpose.
- Vacuum cleaner.
- Air compressor.
- Spare parts (refer to Appendix A).
- Records for commissioning and a maintenance history.
- Maintenance logs or record sheets.
- The original ASPIRE2 design file and commissioning history (optional).

2.3 Determining a Maintenance Schedule

The background smoke readings, recorded in the Xtralis VESDA detector event log, provide a representative value for the protected environment. Use of these logs allows the recommended filter replacement frequency to be calculated, a maintenance program developed and a maintenance schedule determined.

Xtralis VSC can be used to access the event log to determine the average background smoke level. Average smoke levels over a 15-minute period (minimum), where conditions should reflect the typical operating area, provide enough data to determine the environment type. For clean environments, the significant smoke change will need to be set to 0.005%obs/m (0.0015%obs/ ft) for the test period. Remember to return this setting to its original value, once the test is completed.

Note: The following steps do not represent a complete list of instructions. You must also refer to the sections, of this manual, specific to the various types of Xtralis VESDA detector.

To determine an appropriate maintenance schedule, follow the instructions listed below:

1. Ensure that detectors are isolated from the monitoring panel and suppression systems.
2. Notify the relevant authorities about the work to be performed and the risks associated with isolating a VESDA address.
3. If a filter fault is displayed, the current filter is older than the recommended filter replacement frequency. Replace the filter, according to the detector's guidelines, making sure that you write the date of replacement on the label and take measures to order stock (VSP-005) for the next replacement date. For detector specific filter replacement instructions, refer to Replacing VLP and VLS filter cartridges on page 15, Replacing the VLC filter cartridge on page 16 and Replacing the VLF filter cartridge on page . The color codes for the dates of filter manufacture are given in Table 2-1.

Color	Date
Brown	July 2008
Yellow	July 2006
Green	July 2004
Orange	July 2000
Blue	July 1997

Table 2-1: Color codes for filter date of manufacture

4. Check for and record any detector faults.
5. Prior to downloading the smoke event log, use Xtralis VSC to check the significant smoke change setting. If it is still at the factory default value of 0.02%obs/m (0.0063%obs/ft) or some other value, record it then change it to 0.005%obs/m (0.0015%obs/ft).
6. Run the detector for 15 minutes minimum (longer is recommended in very stable or clean environments).
7. Download and save the event log for comparison of smoke readings during normal operation.
8. Determine the detector's background smoke level and estimate the average recorded level, for typical operation, during the test period.
9. Compare the results with Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29 to determine your system's environment class.
10. Based on your system's environment class, establish an appropriate detector and filter maintenance schedule.
11. Using Xtralis VSC, set the filter service timer to the value, in days, given in Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29.
12. Using Xtralis VSC, return the significant smoke change setting to its original value.
13. Proceed to the next section or, if your system is showing no faults, return it to its normal operating mode.

2.4 Maintenance Procedures

This section provides instructions for the regular maintenance of detectors. If you need to address faults, refer to the Troubleshooting Guide for a list of VESDAnet faults. Should you need to address the 10 instant fault finder faults, on the VLF detector, refer to its Product Guide.

Further information on maintenance, part replacement and recommended filter cartridge replacement frequency are provided throughout the remainder of this document.

Note: Xtralis recommends that you record all work you perform in a maintenance log such as that in Appendix C: Example Of A Typical Maintenance Log on page 31.

If you do not need to determine a maintenance schedule, continue with the instructions listed below:

1. Ensure that the detectors are isolated from the monitoring panel and suppression systems.
2. Notify the relevant authorities about the work to be performed and the risks associated with isolating a VESDA address.
3. Check for and record any detector faults.
4. If a filter fault is displayed, the current filter is older than the recommended filter replacement frequency. Replace the filter, according to the detector's guidelines, making sure that you write the date of replacement on the label and take measures to order stock (VSP-005) for the next replacement date. For detector specific filter replacement instructions, refer to Replacing VLP and VLS filter cartridges on page 15, Replacing the VLC filter cartridge on page 16 and Replacing the VLF filter cartridge on page . The color codes for the dates of filter manufacture are given in Table 2-1 above.
5. Download and save the event log for comparison of smoke readings during normal operation.
6. Record the current airflow (% and raw values) for before and after comparison.
7. Disconnect power to the detector.
8. Remove dust from around the pipe inlets.
9. Disconnect all pipes from the detector inlet(s) and exhausts then cover them to ensure that no unwanted material can enter the detector.

10. Optional - proceed with this step if there is a low flow fault, a noisy aspirator, excessive or noticeable dust around the exhaust. Remove the detector aspirator (refer to Replacing VLP and VLS aspirators on page 20 or Replacing the VLC aspirator on page 22) and blow it out with compressed air. Make sure that it is cleaned well away from the detector. The aspirator can collect a significant amount of material in dusty environments, cleaning with compressed air (400 KPa) may produce a large quantity of dust.
11. Remove the filter and clean any visible dust around it.
12. Reconnect all pipes.
13. Re-assemble the detector aspirator and filter.
14. Turn the power supply back on.
15. Allow the detector to operate for 15 minutes (still in isolate/disable mode).
16. View any faults present and take the appropriate action to fix them.
17. After allowing the detector to operate in a stable and correct state for 15 minutes, review the event log to monitor the background smoke level.
18. Check this value against the Environment Class (Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29) to determine the next scheduled maintenance period.
19. Set the filter timer to reflect the correct environment.
20. Compare the background smoke level with that recorded during previous maintenance visits. While the background smoke level should be the same, it may be different if your environment has changed. If a difference in background smoke level cannot be explained by a change in your environment, you should do one or all of the following: clean the detector, clean the sampling pipe network and/or change the filter. If you do any or all of these, you should re-check the background smoke level before proceeding.
21. Compare the before maintenance and after maintenance flow rates. Ideally, the flow rate should be close to 100% for each used pipe. If this is not the case, check the sampling pipe network for loose connections or obstructions.
22. If necessary, clean the detector and sampling pipe network (refer to Sampling Pipe Network maintenance on page 10).
23. If the sampling pipe network is OK, review the event log. If the event log does not show any unexpected flow faults, normalize the raw airflow.
24. Once the detector and sampling pipe network have been serviced, cleaned, tested (for testing instructions, refer to Post-maintenance testing on page 13), and are operating fault-free, return the system to its normal operating mode.

2.5 Unscheduled Maintenance

There will be occasions where unscheduled detector maintenance is required. Such instances are often the result of fault conditions. Faults can range from minor, "minor low airflow pipe 2", to urgent and must be dealt with by trained and qualified personnel. A full investigation of any reported fault must be conducted, taking into account all possible causes of the fault.

For further information, refer to the Xtralis VESDA Troubleshooting Guide in the System Design Manual or visit www.xtralis.com/vesda.

2.6 Checking Airflow

Every time you visit a site, it is recommended that you check and record the airflow in each sampling pipe. The current percentage airflow readings indicate any changes in airflow percentage since the last airflow normalization. These readings may not indicate the absolute increase or decrease in airflow through the sampling pipe network. Airflow changes could be a result of one of the following:

- Blockages - within sampling pipes, at sampling holes or in capillary tubes.
- Leaks - in sampling pipes or at pipe junctions.
- Airflow changes - introduced by building ventilation systems, changes in sampling pipe network layout or pipe length etc.
- Aspirator degradation.
- Detector contamination.

Check the airflow in each sampling pipe by following the instructions below:

1. Check the recent airflow data recorded in the event log. Look for flow faults that endured for a considerable period of time or frequent normalizations. If there are repeated flow faults or detector normalizations in the event log, detector and system cleaning may be required.
2. Fix any problems from the list above, blockages for example. If there are no obvious problems, use Xtralis VSC to check the raw airflow through the detector (VLP, VLS and VLC only).
3. Compare the raw airflow against previous historical data.

Notes:

- Progressive decreases in the raw airflow readings may indicate a blockage developing inside the sampling pipe network. An unexpected reduction of airflow over an extended period of time may indicate that pipe cleaning is urgently required.
- Record separate raw airflow results for each sampling pipe. When comparing successive raw airflows, ensure that the values compared are for the same sampling pipes and check that the pipe network has not changed recently.
- The VLF measures flow in liters per minute, not raw airflow, unless it has a VESDAnet card in which case it displays a value that when divided by 100 equates to an airflow in liters per minute.

Refer to the Xtralis VSC online help for information on how to obtain current raw airflow data for VLP, VLS and VLC products.

2.7 Checking the Filter

When checking the filter, compare the date of installation on the filter label with the recommendations in Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29. If in doubt, replace the filter with a new one and record the date on its label.

Note: Serious smoke events, such as those indicated by Fire level alarms, can also affect the life expectancy of filter cartridges. Filter cartridges should be replaced after all actual fire events.

3 Power Supply Maintenance

The Xtralis VESDA system power supply should be checked, at least, every six months or as required by local codes and standards. Xtralis VESDA products are designed to operate between 18 VDC and 30 VDC. We recommend, as an absolute minimum, that you check the following:

- Input voltage - from DC power supply to detector.
- Output voltage - from detector to other devices.
- Backup battery voltage - 24 VDC.
- Charging backup battery voltage - typically 27.6 VDC.

4 Sampling Pipe Network Maintenance

4.1 Important Pre-maintenance Preparations

Every six months, you should perform a visual check for any damaged sampling pipes or pipe junctions and do repairs as necessary. If damaged or blocked sampling pipes go unrepaired, detector flow faults can occur.

Prior to isolating an Xtralis VESDA system for maintenance, the following important steps must be taken:

1. Inform appropriate supervising authorities about the risk associated with isolating a VESDA Address.
2. Ensure that any ancillary devices, dependent on the detector, are appropriately isolated.

Warning: Inhalation of dust is hazardous to health. Dust build up may contain potentially dangerous toxic materials. All cleaning processes must be suitably modified in such instances to negate the risk from toxic materials. Adequate precautions must be taken to comply with local health and safety regulations.

4.2 Cleaning Sampling Pipes

For environment classes 1 & 2, it is recommended that the sampling pipe network be checked every two years. However, your system's environment will affect this so refer to Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29. The scheduled period should be reduced to suit harsh site environments.

Note: Local code guidelines may require more frequent inspections for all classes.

Where possible, sampling pipes and their connections should be checked to ensure that the pipe runs are intact and that the network is free of dirt and dust.

Follow the instructions below to clean your sampling pipe network:

1. Ensure that detectors are isolated from the monitoring panel and fire suppression systems.
2. Notify the relevant authorities that the work is being performed.
3. Check and record the current airflow for before and after comparison.
4. Disconnect the detector power supply.
5. Remove all pipes from the detector inlet(s) and exhausts then cover them to ensure that no further dust can enter the detector.
6. Ensure that end caps are set firmly in place.
7. Connect a vacuum cleaner to the detector end of each pipe in turn. When turned on, it will extract dust and contaminants that have built up inside the pipes.
8. Alternatively, introduce compressed air (400 KPa for 2 minutes) at the detector end of each pipe in turn to blow dust and contaminants out through the sampling holes.
9. Take precautions to ensure that dust is not blown into undesired areas. Ensure that end caps are still set firmly in place.
10. Compare the before and after flow rates. Ideally, the flow should be close to 100% for each used pipe. If this is not the case, the capillaries and detector may need closer inspection. If the sampling pipe network appears to be OK, continue with the remainder of this section to determine the cause of the reduced airflow.
11. Once the system has been serviced, cleaned, tested and is operating fault-free, return it to its normal operating mode.

Sites with dirty environments, which require very regular sampling and exhaust pipe cleaning, should consider installing automated equipment to assist with regular cleaning schedules.

For more information, refer to Xtralis's Application Note - VESDA Air Sampling for Ducts available on our website at www.xtralis.com.

Note: For in-duct sampling remove the pipe(s) from the duct and follow the cleaning process. Once cleaning is complete, return the pipe(s) to their original angle (usually 45° to the airflow).

4.3 Cleaning Sampling Holes

We suggest that sampling holes are cleaned, at least, once every two years. This is a recommended interval for environment classes 1 & 2 but your environment will have an effect on how often sampling holes require cleaning, refer to Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29. The scheduled period should be reduced to suit harsh site environments. Cleaning is required to remove any dust build up and to ensure that the in-pipe sampling holes are not blocked.

To clean in-pipe sampling holes, follow the instructions below:

1. Ensure that detectors are isolated from the monitoring panel and fire suppression systems.
2. Notify the relevant authorities that work is being performed.
3. Check and record the current airflow for before and after comparison.
4. Disconnect the detector power supply.
5. Remove all pipes from the detector inlet(s) and exhausts then cover them to ensure that no further dust can enter the detector.
6. Connect a vacuum cleaner to each in-pipe sampling hole in turn to extract dust and contaminants that have built up.
7. Alternatively, introduce compressed air (400 KPa for 2 minutes) at the detector end of the pipe to blow dust and contaminants out of the sampling holes. Take precautions to ensure that dust is not blown into undesired areas.
8. Visually check that the in-pipe sampling holes have a clear air path.
9. Compare the before and after flow rates. Ideally, the flow should be close to 100% for each used pipe. If this is not the case, the capillaries and detector may need closer inspection.
10. If the sampling pipe network appears to be OK, continue with the remainder of this section to determine the cause of reduced airflow.
11. Once the system has been serviced, cleaned, tested and is operating fault-free, return it to its normal operating mode.

Note: Sites with dirty environments, which require very regular sampling pipe and sampling hole cleaning, should consider installing automated equipment to assist with regular cleaning schedules.

4.4 Cleaning Capillary Tubes

We suggest that capillary tubes be cleaned, at least, once every two years. This is a recommended interval for environment classes 1 & 2 but your system environment will have an effect on how often capillary tubes require cleaning, refer to Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29. The scheduled period should be reduced to suit harsh site environments. Cleaning may be required to remove any dust build up and to ensure that the capillary tubes are not blocked.

To clean capillary tubes, follow the instructions below:

1. Ensure that detectors are isolated from the monitoring panel and fire suppression systems.
2. Notify the relevant authorities that work is being performed.
3. Check and record the current airflow for before and after comparison.
4. Disconnect the detector power supply.
5. Remove all pipes from the detector inlet(s) and exhausts then cover them to ensure that no further dust can enter the detector.
6. Remove the capillary tubes from the sampling pipe and unscrew the sampling end pieces, if applicable.

7. Clean out the capillary tubes and sampling end pieces with a vacuum cleaner or compressed air source.
8. Visually check that each part has a clear air path.
9. Reassemble the sampling end pieces, if applicable, and connect them to the capillary tubes.
10. Reconnect the capillary tubes to the sampling pipe network, ensuring that there are no kinks. If the sampling pipe network is also to be flushed, do not reconnect the capillary tubes until this has occurred.
11. Compare the before and after flow rates. Ideally, the flow should be close to 100% for each used pipe. If this is not the case, the pipe network and detector may need closer inspection.
12. If the sampling pipe network appears to be OK, continue with any remaining maintenance tasks to determine the cause of reduced airflow.
13. Once the system has been serviced, cleaned, tested and is operating fault-free, return it to its normal operating mode.

Sites with dirty environments, which require very regular capillary tube cleaning, should consider installing automated equipment to assist with regular cleaning schedules.

5 Post-maintenance testing

Post-maintenance tests should be performed, after a maintenance visit, to determine whether the system is functional. Take the appropriate measures to ensure that this testing does not result in unwanted intervention from response systems, for example, suppression.

Consult your local code guidelines to establish the following:

- The minimum testing required per sampling pipe.
- The appropriate alarm threshold per sampling pipe.

Here are some examples of possible tests:

- You could create a fault to ensure that it is registered by the detector and monitoring system (for example, remove a pipe to create a high airflow fault).
- You could inject smoke into the last sampling hole to see whether it is detected.
- Likewise, you could inject smoke into critical sampling holes to see whether it is detected.
- More specifically, you could inject smoke into sampling holes only in sections of the pipe network where maintenance has been performed. to check the effectiveness of that maintenance.

With all smoke injections, you need to record transport time, ensure that a significant amount of smoke is registered and that alarm(s) are generated. The alarm thresholds and amount of smoke injected may have an impact on the results. You should compare times with the ASPIRE2 design files, commissioning tests and service history.

Note: Transport time is the time taken (in seconds) for the smoke to travel to the detector. Typically, allowing for small variations, the result should be approximately the same as the ASPIRE2 calculations.

In the event that there is a wide variation between the ASPIRE2 results and the actual smoke test results, you must investigate the following:

1. Check that the sampling pipe network matches your ASPIRE2 design.
2. Check that the aspirator speed matches your ASPIRE2 design (VLP and VLS only).
3. Check for any preset alarm delays.
4. Check the sampling pipe network for leaks and blockages.

Xtralis does not recommend the use of canned smoke to perform post-maintenance tests. However, if you do use canned smoke, you should ensure that you do the following:

- Read and carefully follow all instructions on the canned smoke product.
- Take all necessary health and safety precautions.
- Avoid inhaling the fumes.
- Avoid spraying the canned smoke directly into the detector or the pipe inlets.
- Avoid prolonged bursts - use in short bursts of less than 2 seconds.

Prolonged use of canned smoke can damage plastic components and the detector itself, thereby, invalidating the detector's warranty.

6 Annual Testing

Local code guidelines may state that system and detector tests be conducted on a regular basis. Xtralis recommends that such tests be conducted, at least, annually. However, there are some environments in which it is necessary to conduct maintenance and testing more frequently, refer to Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29.

Notes:

- A sample maintenance and testing log is provided in Appendix C: Example Of A Typical Maintenance Log on page 31.
- Xtralis strongly recommends that all persons who install, commission, service and maintain Xtralis VESDA systems attend the Xtralis VESDA accreditation training. Please contact your local Xtralis office for more information.

6.1 Detector Tests

Check the following items to ensure that performance is still satisfactory:

1. Recorded faults - If any faults are present, record and rectify them before beginning any maintenance.
2. Power supply - Ensure that the input voltage is within the operating requirements.
3. Backup battery (if installed) - Check that the batteries are fully charged and the charging voltage is functioning correctly.
4. Airflow - Check the airflow for each sampling pipe in use. Compare to previous site visit data to ensure that there is no degradation in performance due to pipe blockages, leaks, breaks or contamination.
5. Smoke test - Inject an appropriate level of smoke into the required sampling holes.
6. Record Transport Time - This figure should be consistent with your previous maintenance visit or your original commissioning documentation. Refer to your local standards for allowable variations.
7. Local detector display - Ensure that the detector's front panel display responds appropriately to any faults and smoke levels, within the time specified in your local code guidelines.
8. Relay performance - Ensure that the detector's fire and fault relays are functioning correctly.
9. Remote detector display - Ensure that any associated remote detector displays (if installed) respond appropriately to any faults and smoke levels, within the time specified in your local code guidelines.
10. Record results - Xtralis recommends that you photocopy the sample maintenance log in Appendix C: Example Of A Typical Maintenance Log on page 31 and record all results on the copy. Store the log in an appropriate known location on-site.
11. Compare all results to previous recorded tests - Ensure that there is no degradation in performance. If a noticeable change is observed, maintenance of the detector and/or sampling pipe network may be necessary.
12. Schedule next visit - Determine the appropriate time for the next site visit by referring to Appendix B: Recommended frequencies for general maintenance and filter cartridge replacement on page 29.

6.2 System Fire Panel Notification Tests

Your detector alarm and fault tests should register on the monitoring system, within a time frame consistent with local standards. System notification results should be recorded in the detector maintenance log.

7 Replacing Detector Components

7.1 Replacing VLP and VLS Filter Cartridges

The service interval of an air filter depends upon the environment. You can use the LCD Programmer or Xtalis VESDA PC Software guides to change the service interval for filters. The system will generate a minor fault when the filter has reached 80% and an urgent fault when it reaches 120% of its capacity. We recommend that the installation date and replacement date be written on the air filter cartridge label as a physical reminder of when the next service is expected.

Note: Important Note: The detector must have the power turned on while the air filter cartridge is being replaced.

The procedure and diagrams outlined below provide the steps to be followed when replacing the air filter cartridge in the VLP and VLS detectors:

1. Slide down and remove the air filter cover (A) in Figure 1 below.
2. Unscrew the recessed phillips head screw (B) in Figure 1 below.

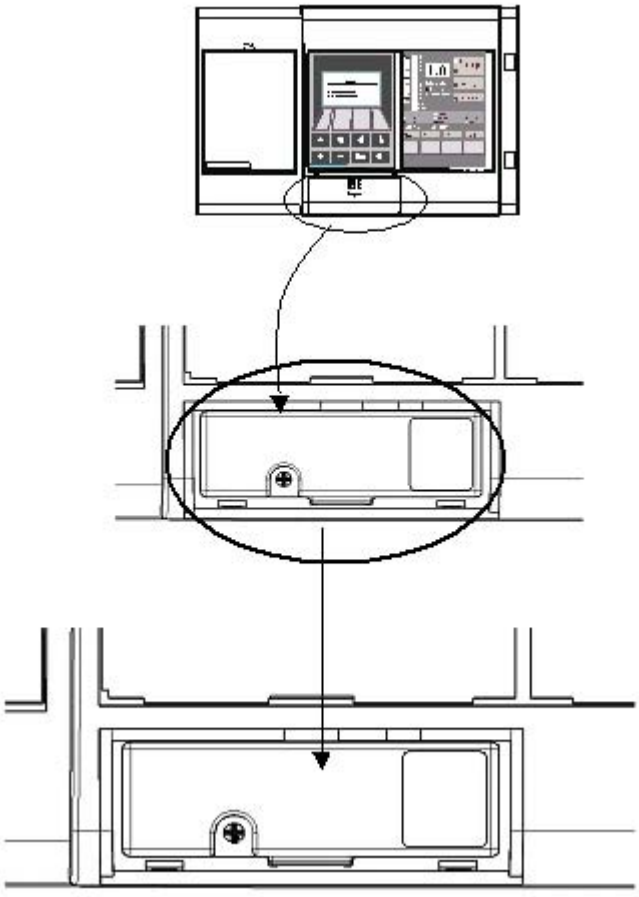


Figure 7-1: Replacing air filters in VLP and VLS detectors

3. Pull out the air filter cartridge (C) in Figure 1 above. This will stop the aspirator. If the aspirator does not stop, replace the filter switch.
4. Insert the replacement air filter cartridge (VSP-005).
5. Tighten the filter screw.
6. Replace the air filter cover.
7. Reset the filter counter using either the LCD Programmer or a PC running Xtralis VSC or Xtralis VSM4.

7.2 Replacing the VLC Filter Cartridge

The service interval of an air filter depends upon the environment. You can use the LCD Programmer or Xtralis VESDA PC Software guides to change the service interval for filters. The system will generate a minor fault when the filter has reached 80% and an urgent fault when it reaches 120% of its capacity. We recommend that the installation date and replacement date are written on the air filter cartridge label as a physical reminder of when the next service is expected.

Note: The detector must have the power turned on when the air filter cartridge is being replaced.

The procedure and diagrams outlined below provide the steps to be followed when replacing the air filter cartridge in the VLC detector:

1. Open the front cover
2. Locate the air filter cartridge (A), inside the detector compartment, as indicated in Figure 2 below.
3. Undo the recessed phillips head filter screw (B) in Figure 2 below.
4. Lift out the air filter cartridge.

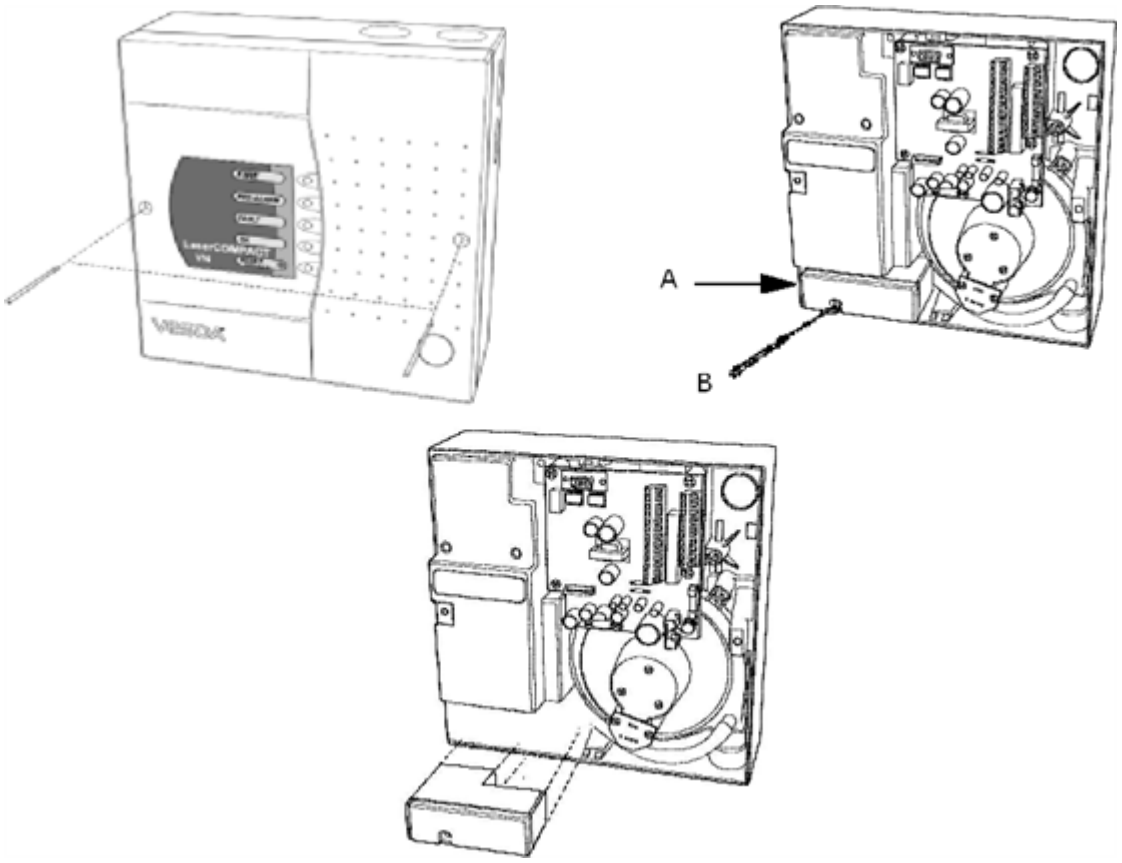


Figure 7-2: Replacing the air filter cartridge in VLC detectors

5. Insert a new air filter cartridge (A) in Figure 2 above.
6. Tighten the filter screw (B) in Figure 2 above.
7. Reset the filter counter by connecting a LCD programmer or a PC with VSC software to the programming socket.
8. Using a PC only (applicable to RO version) or a PC with a PC-Link HLI (Applicable to VN version only), reset the filter by entering your user level and PIN number to Log ON to the detector then Initiate the Reset Filter Settings command located under the device menu.
9. Close up the detector.

7.3 Replacing the VLF Fitler Cartridge

The VLF detector uses a disposable dual stage air filter cartridge. This filter removes dust contamination from sampled air and provides a clean air bleed to preserve the detector chamber optics. The detector constantly monitors filter efficiency. To maintain the operational integrity of the smoke detector, it is recommended that the filter be replaced every 2 years or when a filter fault occurs. More frequent filter replacement is necessary in environments where there are high levels of contamination.

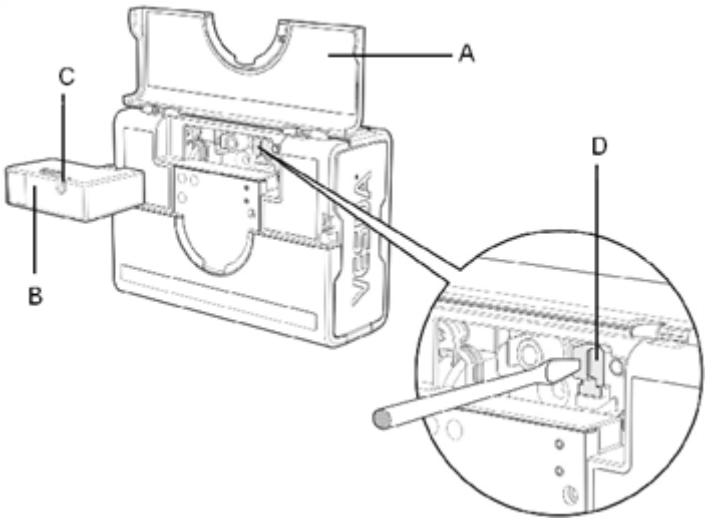
A fault is raised on the detector, when the filter needs to be replaced. During the replacement process, the detector must be told that a new filter has been installed.

Notes:

- Prior to any work or maintenance being carried out on the VLF, take the necessary steps to advise the monitoring authority that power may be removed and that the system will be disabled.
- Ensure that the area surrounding the filter is clear of dirt and debris, prior to replacement.
- The filter is for single use only, it cannot be cleaned and re-used.
- Ensure that the detector remains powered up during filter replacement and that a new filter cartridge is available:

The procedure and diagrams outlined below provide the steps to be followed when replacing the air filter cartridge in the VLF detector:

1. Push in the security tab and lift up the field service access door (A) in Figure 7-3 below.
2. Set the detector to 'Standby' mode by pressing the Disable button for 6 seconds. The Disabled LED begins to flash rapidly. After releasing the Disable button the disabled LED will flash more slowly.
3. Undo the recessed retaining screw (C) and pull out the old filter (B) in Figure 7-3 below.



Legend	
A	Field service access door
B	Air filter cartridge
C	Retaining screw
D	Filter switch

Figure 7-3: Replacing the air filter cartridge in a VLF detector

3. Using your finger, firmly press the filter switch (D), in the filter recess of the detector, 5 times within 5 seconds to confirm with the detector that a new filter is about to be installed (see inset). A LED next to the serial interface will flash each time you push the filter switch, and will continue flashing once you have successfully pressed the switch 5 times in 5 seconds.
4. Insert the new filter (VSP-005) and tighten the retaining screw.
5. Press the Disable button for 6 seconds to return the detector to normal operating mode.
6. Record the filter replacement date on the filter.
7. Close the field service access door.

7.4 Replacing VLP and VLS Chassis

You must disassemble the VLP or VLS detectors, before replacing their chassis, as follows:

1. Isolate the detector by pressing the isolate button on the zone configured display or by selecting "Isolate Zone" from the "Zone" menu in VSC or VSM4. This isolates the output from the detector to a fire alarm panel or monitoring system.
2. Save Node Configuration by using Xtralis VSC or Xtralis VSM4, highlight the detector in the device tree window and select "Save Node Configuration" from the "Device" menu.
3. Turn off the power by disconnecting the power cables.
4. Remove the front panel by first opening the cover plate and screw covers, then unscrewing the cover plate screws as shown in Figure 7-4 below.

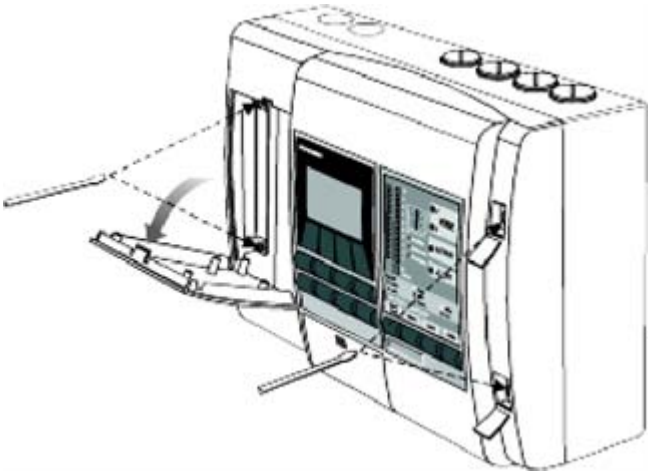


Figure 7-4: Removing the VLP or VLS front cover for chassis replacement

5. Disconnect the data cables that connect the chassis assembly to the termination card. These include the front panel modules (if fitted) and manifold (behind chassis). Refer to Figure 7-5.

Note: Performing this step with live power can result in lost detector calibration data. Should this occur, detector warranties shall be void and service charges will be incurred.

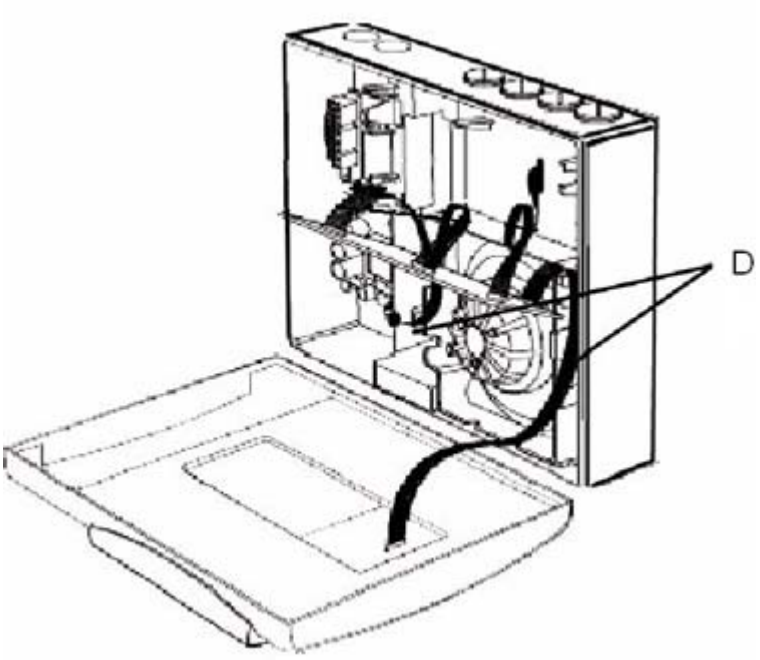


Figure 7-5: Removing data cables for VLP or VLS chassis replacement

6. Unscrew the 2 recessed retaining screws (D) in the Figure 7-5 above.
7. Remove the chassis, holding the chassis by the aspirator assembly. Release the two lower locking tabs by lifting the chassis upward and pulling outward. Use a screwdriver to assist with tab release if necessary. Refer to Figure 7-6 below.

Note: The part number for the VLP chassis is VSP-006; for the VLS chassis, the part number is VSP-009.

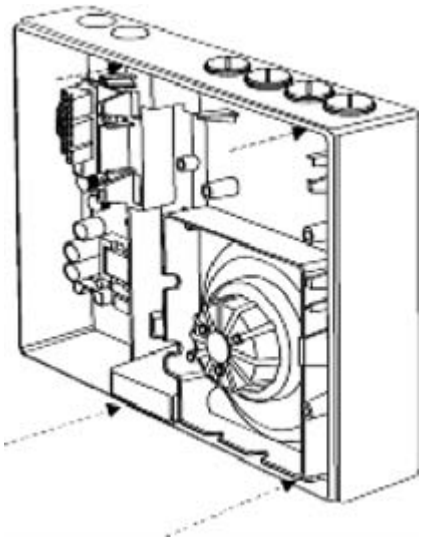


Figure 7-6: Removing the VLP or VLS chassis

Caution: Care must be taken not to damage the cable running to the manifold.

Note: The detection chamber, head processor card and flow sensors are factory calibrated as a matched set. Separating the set and replacing it with components from another set may cause the Detector to malfunction, requiring re-calibration at the factory.

8. Disconnect the flow sensor lead.
9. Unscrew the manifold retaining screws.
10. Remove the Manifold by sliding it downward, away from the pipe network as shown in Figure 7-7.

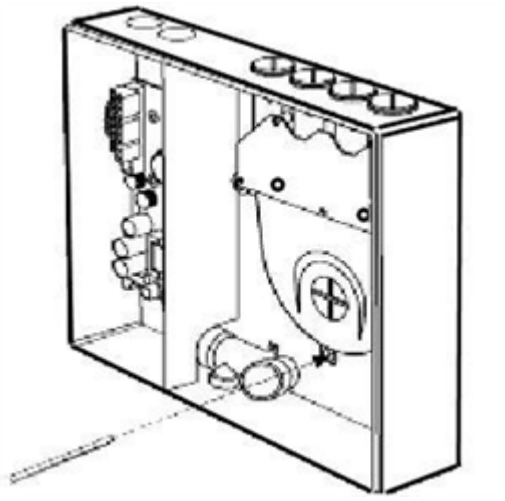


Figure 7-7: Removing Pipe Inlet Manifold during VLP and VLS chassis replacement

11. Attach the replacement Manifold and Chassis by reversing the procedure above.

Note: Ensure that power is turned off before reconnecting Data cables. All Data cables must be connected properly before power is turned on. Failure to observe this requirement may cause data corruption that requires factory re-calibration.

12. Configure the Node using Xtralis VSC or Xtralis VSM4 by highlighting the Detector in the Device Tree Window and highlighting "Restore Node Configuration" from the Device Menu, or reprogram the detector using the LCD Programmer.

7.5 Replacing VLP and VLS Aspirators

When replacing the VLP or VLS detector aspirators, follow the instructions below:

1. Isolate and power down the detector.
2. Open the front cover.
3. Locate and unplug the cable loom that connects from the head processor card (HPC) to one of the modules located on the front panel. Mark out this connector position, if unsure about the cabling.
4. Remove the air filter cartridge. Refer to Figure 7-8.

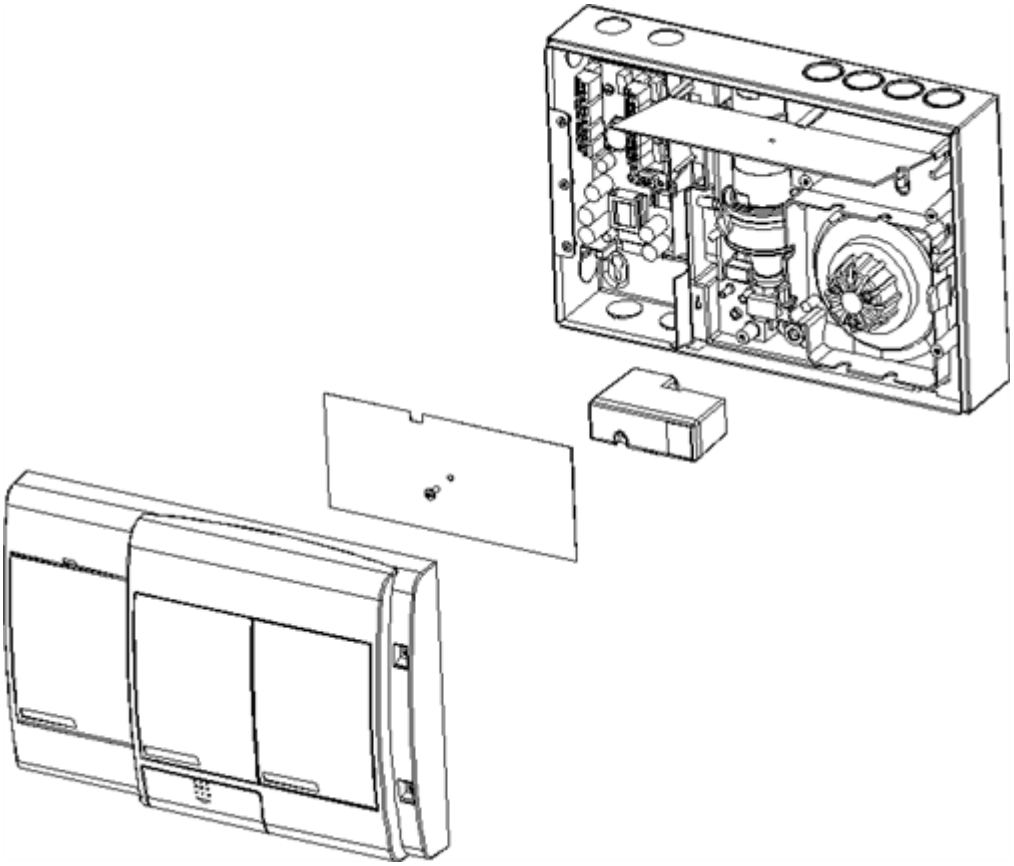
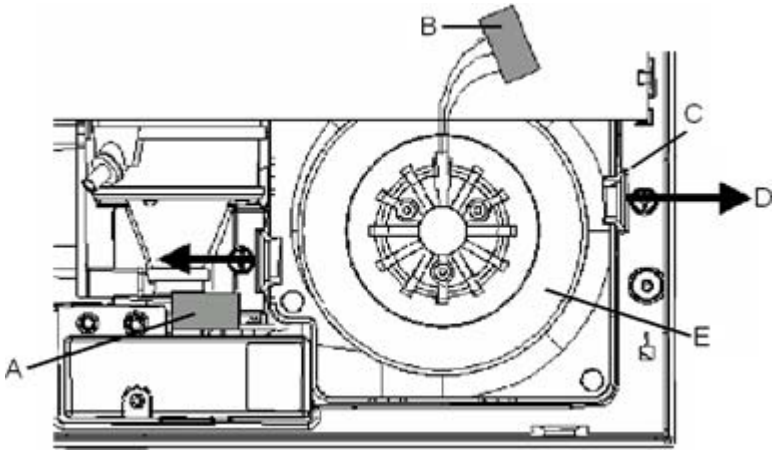


Figure 7-8: Removing the Air Filter Cartridge for VLP or VLS aspirator replacement

5. Remove the HPCs securing screw.

Warning: Hold the HPC at the edges. Static charges may damage it.

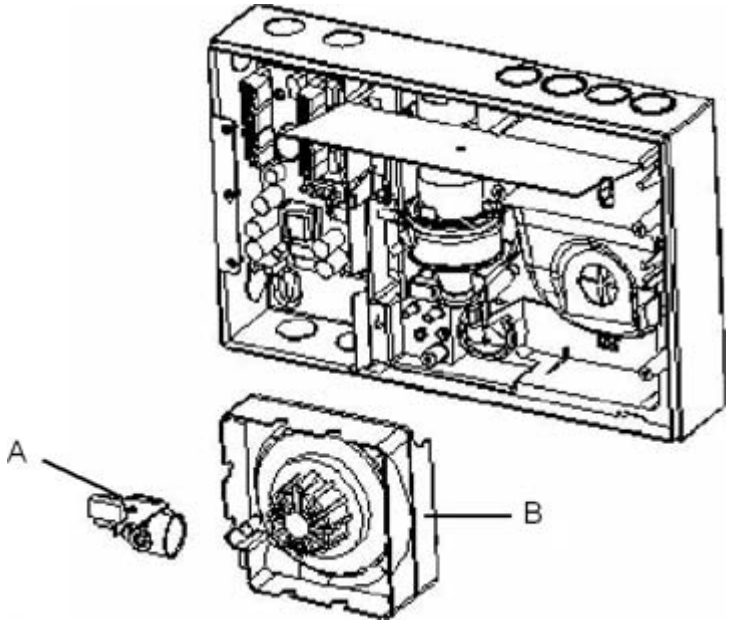
6. Remove the brown insulating sheet and lift up the HPC.
7. Locate the aspirator cable loom (red, white and blue wires) and disconnect the connector from the HPC.



Legend	
A	Filter switch connector socket
B	Aspirator loom connector
C	Aspirator locking fingers
D	Move both locking fingers outwards
E	Aspirator (lift upwards)

Figure 7-9: Removing the HPC and Disconnecting the aspirator cable loom

8. Locate the two plastic fingers securing the aspirator to the chassis (D) in Figure 9 above.
9. Push fingers outwards (E) and lift the aspirator out.
10. Remove the exhaust pipe elbow and filter card assembly (A) from the aspirator (B) as shown in Figure 7-10.



Legend	
A	Exhaust pipe elbow with filter card switch
B	Aspirator

Figure 7-10: Removing the Exhaust Pipe Elbow and Aspirator

11. Reattach the exhaust pipe elbow and filter card assembly (A) to the aspirator (B) exhaust outlet as shown in Figure 7-10 above.
12. Wipe the manifold outlet flange surface if dirty.
13. Slide the aspirator between the fingers until fingers lock over aspirator. Check that the aspirator does not come off when lifted.
14. Reconnect the aspirator cable loom to the cable socket on the HPC.
15. Secure the HPC to the chassis, ensuring that the card locks under the plastic fingers.
16. Place the insulating sheet over the HPC and secure it with the screw.
17. Re-attach the air filter cartridge.
18. Re-connect the cable loom to the module on the front panel.
19. Check that all wires are secured to the connectors or terminals.
20. Power up the detector and check the aspirator is running.
21. Close the detector. Refer to Figure 7-4

7.6 Replacing the VLC Aspirator

Aspirators, in VLC detectors are replaced as follows:

1. Isolate and power down the detector.
2. Remove the four screws securing the termination card.
3. Disconnect the aspirator cable loom from the connector on the aspirator.
4. Gently pull the termination card out, away from the interface card (connected behind). Take care not to dislodge any wires connected to the termination card and leave it suspended by these wires.
5. Remove the air hose from the aspirator pipe by pulling.
6. Undo the three Phillips head screws securing the aspirator; these screws are captive.
7. Turn the aspirator anti-clockwise, using the exhaust port as the pivot point.
8. Push the aspirator upward to remove it.

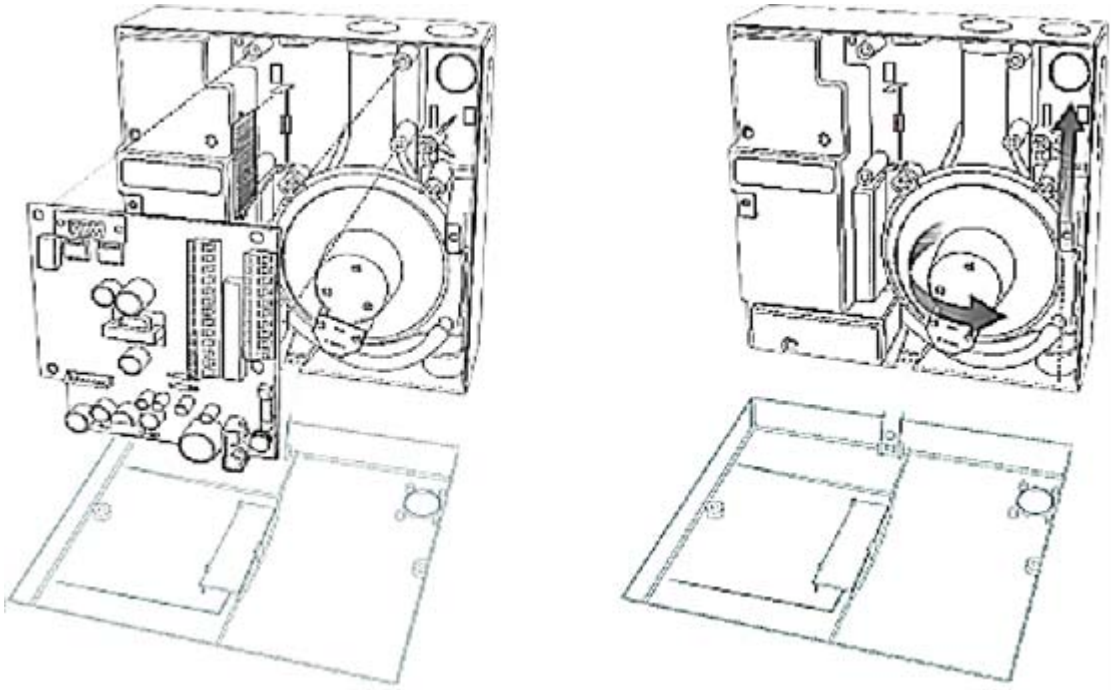


Figure 7-11: Replacing the Aspirator in a VLC detector

9. Check that the new aspirator has a gasket on the inlet flange and three attached screws.
10. Wipe the manifold outlet flange surface.
11. Secure the aspirator with the three screws.
12. Reconnect the previously removed air hose to the pipe on the aspirator. Ensure a tight fit over the pipe.
13. Reinsert the termination card into the interface card.
14. Secure the termination card with the four screws.
15. Connect the aspirator cable connector to the socket on the aspirator; the connector is keyed and can only be inserted one way.
16. Check that all wires are secured to their connectors or terminals.
17. Power up the detector and check that the aspirator is running.
18. Resolve all Fault conditions.
19. Close the detector.
20. Reset Isolate to normal conditions and check that the airflow % has returned to the level it was at before Disassembly.

7.7 Replacing the VLF Aspirator

Note: Prior to replacing the aspirator, advise the monitoring authority that power is to be removed and the system disabled.

Caution: Electrostatic discharge precautions need to be taken, prior to removing the front cover from the detector, otherwise damage may occur.

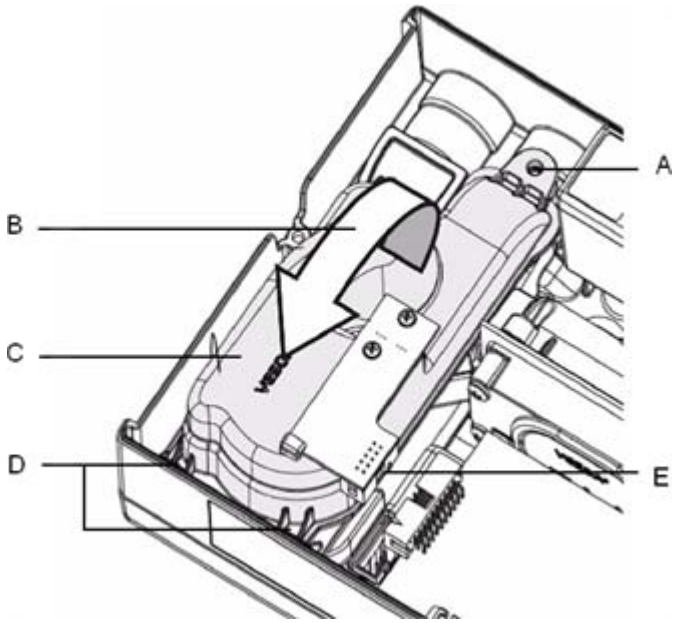
The following Aspirator removal instructions assume normal mounting, refer to Figure 12 below:

1. Disconnect power to the detector.
2. Push in the security tab and lift up the field service access door.
3. Unscrew the two front cover retaining screws, lift and swing down the front cover.
4. Only disconnect the fan wiring loom from the connection point (E) at the aspirator.
5. Undo the retaining screw on the aspirator (A).
6. Swing the aspirator out then lift and remove it from the detector.

Notes:

- Any time the aspirator is removed ensure that the area surrounding it is clear of dirt and debris before it is replace.
- Care must be taken, during aspirator replacement. The aspirator must be correctly seated; this is essential to ensure that gaskets are not damaged or dislodged from the underside of the aspirator.

7. Clip the aspirator (VSP-715 for VLF-500 or VSP-722 for VLF-250) into the retaining clip (D) and swing it back into the detector.
8. Tighten the retaining screw (A) but do not over tighten.
9. Reconnect the fan loom to the aspirator (E).
10. Replace the front cover and screw it into place.
11. Close the field service access door.
12. Reconnect the power to the detector.



Legend	
A	Aspirator securing screw
B	Swing aspirator out to remove
C	Retaining clip points
D	Fan loom connector **must** be disconnected here

Figure 7-12: Replacing the aspirator in a VLF detector

7.8 Replacing VLP and VLS Termination Cards

Note: Disconnect the detector power supply before commencing replacement of the termination card. Only reconnect the 24 VDC power supply once the replacement termination card is secured.

Follow the instructions below to replace the VLP or VLS termination cards.

1. Mark out the wire positions on each terminal socket before removing them.
2. Remove all terminal plugs (C) from sockets, leaving the wires attached to the plugs, refer to Figure 13 below.
3. Remove the 10 wire and 13 wire cable looms from their socket (B) in Figure 13 below.
4. Remove the five Phillips head screws (A) in Figure 13 below.
5. Remove the termination card.
6. Attach the Termination Card with five Phillips head screws (A).
7. Reattach the 10 wire and 13 wire cable looms to the sockets. (B) The connectors can only be inserted into the socket one way. Turn the connector around if the connector does not fit into its socket.
8. Reconnect the terminal plugs to their sockets, ensuring the plugs are connected to their correct socket (C).

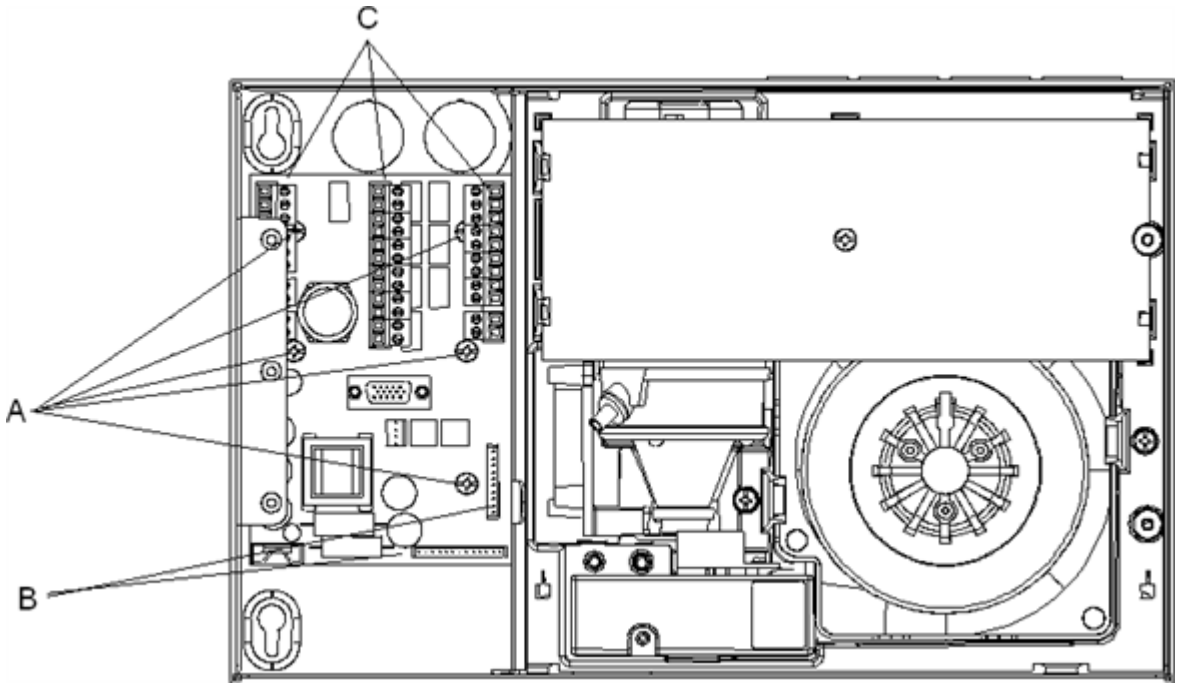


Figure 7-13: Replacing VLP/VLS head termination cards

7.9 Replacing the VLC Termination Card

Follow the instructions below to replace the VLC detector termination card:

1. Remove the front cover of the detector (refer to Figure 2, “Replacing the air filter cartridge in VLC detectors,” on page 16).
2. Isolate and power down the detector before you begin.
3. Record all wiring connections to the termination card so that you can connect the replacement card properly.
4. Disconnect the wiring for power, communications and relays from the 45 deg screw terminals.
5. Remove the four screws securing the termination card.
6. Disconnect the 3-way aspirator cable loom from the connector on the termination card.
7. Disconnect the 5-way front panel LED cable from the termination card.
8. Gently pull the termination card away from the interface card (connected behind).

9. Secure the replacement termination card with the four screws.
10. Reconnect the 3-way aspirator cable loom to the connector on the termination card.
11. Reconnect the 5-way front panel LED cable to the termination card.

Note: Both the 3-way aspirator cable and the 5-way front panel LED cable are keyed so that they can only be connected in one orientation.

12. Reconnect the wiring for power, communications and relays to the 45 deg screw terminals.
13. Check that all wires are secured to their correct terminals.
14. Power up the detector and check that the aspirator is running.
15. Resolve all Fault conditions.
16. Close the detector.
17. Reset Isolate to normal conditions and check that the airflow % has returned to the level it was at before disassembly.

7.10 Replacing VLP and VLS Detector Modules

Note: Important Note: Isolate and power down the detector before you begin.

Follow the instructions below to replace VLP and VLS detector modules:

1. Insert a screwdriver at the top between the Module and the Front Cover (refer to Figure 4, “Removing the VLP or VLS front cover for chassis replacement,” on page 18),
2. Gently remove the module from the front cover by levering the screwdriver.
3. Disconnect the wire loom from the module processor card.
4. Connect the wire loom to the respective 10 or 11 way connector(s) on the module processor card.
5. Secure the modules to the front cover by gently snapping the module into place ensuring that none of the EMC Screening is trapped.
6. Power up the detector.

7.11 Inspecting and Cleaning VLS Valves

The VLS has four valves that open and close to allow the detector to draw air from one sampling pipe at a time. Since the air that reaches the valves has not been filtered, it may contain dust, dirt, and background pollution such as soot or coal dust.

To inspect and clean VLS valves, follow the instructions below:

1. Remove the pipes leading into the VLS detector.
2. Press, and hold down, the Silence/Scan button on the front of your VLS detector. The valve scan test will start. If your VLS does not have a Silence/Scan button, use your PC and Xtralis VSC to start the valve scan test (step 3 to 6).
3. Logon to Xtralis VSC
4. Select the VLS detector from the Device Tree
5. Select Device from the Main Menu
6. Select Start Manual Scan Test. A dialogue box confirms that you wish to proceed with the test. Select Yes to continue.
7. Once the valve scan test is complete, look inside the inlet ports to see that the valves are periodically opening and closing. Also look for evidence of a build-up of dirt.
8. If dirt is found, you will need to remove the chassis before flushing the valves. Refer to Replacing VLP and VLS chassis on page 18 for details.
9. Remove the air inlet manifold and clean it with compressed air. The manifold is sensitive so do not clean with more than 87 KPa (6 bar) compressed air.
10. Once clean, reassemble the detector and perform a test to ensure system integrity.

A Parts List

Category	Part number	Description
VLP	VSP-000	Blank plate, non-EMC painted, with VESDA logo
	VSP-001	Programmer Module
	VSP-002	Display Module
	VSP-005	Filter Cartridge
	VSP-006	VLP Detector Chassis Assembly complete with Manifold
	VSP-013	Detector Cover Assembly complete with EMC shields
	VSP-014	7-relay Head Termination Card (HTC7)
	VSP-015	VLP Detector Aspirator Assembly
	VSP-019	Filter Cover
	VSP-021	Imperial Pipe Adaptors (25 mm to 27 mm) (4 off) (US only)
	VSP-100	Blank plate with FIRE 1 & OK LEDs, non-EMC painted, with VESDAlogo
	VSP-101	Blank plate with French FIRE 1 & Fault (FF) LEDs, non-EMC painted, with Printed logo
	VSP-200	Blank plate, EMC painted, without VESDA logo
	VSP-540	Exhaust Deflector (black)
VLS	VSP-000	Blank plate, non-EMC painted, with VESDA logo
	VSP-001	Programmer Module
	VSP-004	Scanner Display Module
	VSP-005	Filter Cartridge
	VSP-009	Scanner Chassis Assembly complete with Manifold
	VSP-013	Detector Cover Assembly complete with EMC shields
	VSP-014	7-relay Head Termination Card (HTC7)
	VSP-015	VLP Detector Aspirator Assembly
	VSP-016	12-relay Head Termination Card (HTC12)
	VSP-019	Filter Cover
	VSP-021	Imperial Pipe Adaptors (25 mm to 27 mm) (4 off) (US only)
	VSP-100	Blank plate with FIRE 1 & OK LEDs, non-EMC painted, with VESDAlogo
	VSP-101	Blank plate with French FIRE 1 & Fault (FF) LEDs, non-EMCpainted, with Printed logo
	VSP-200	Blank plate, EMC painted, without VESDA logo
	VSP-540	Exhaust Deflector (black)
VLC	VSP-005	Filter Cartridge
	VSP-021	Imperial Pipe Adaptors (25 mm to 27 mm) (4 off) (US only)
	VSP-501	VLC Aspirator
	VSP-502	VLC VN Remote Display Module
	VSP-509	VESDAlink™ RS232 9-pin to 9-pin Serial Cable
	VSP-510	VLC RO Termination Card (CTC-RO)
	VSP-515	VLC VN Termination Card (CTC-VN)
	VSP-540	Exhaust Deflector (black)
VLF	VSP-005	Filter Cartridge

Category	Part number	Description
VLP	VSP-000	Blank plate, non-EMC painted, with VESDA logo
	VSP-021	Imperial Pipe Adaptors (25 mm to 27 mm) (4 off) (US only)
	VSP-540	Exhaust Deflector (black)
	VSP-702	VLF Remote Display Module
	VSP-715	VLF-500 Aspirator
	VSP-722	VLF-250 Aspirator
Modules	VSP-001	Programmer Module
	VSP-002	Display Module
	VSP-004	Scanner Display Module
	VSP-007	0-relay Remote termination card (RTC0)
	VSP-008	7-relay Remote termination card (RTC7)
	VSP-016	12-relay Head Termination Card (HTC12)
	VSP-200	Blank plate, EMC painted, without VESDA logo
	VSP-208	12-relay Remote termination card (RTC12)
	VSP-300	Blank plate, non-EMC painted, without VESDA logo
Accessories	VSP-003	VESDAnet Socket Kit
	VSP-102	Detector Relay Processor Module (Blank + DRP)
	VSP-103	Scanner Relay Processor Module (Blank + DRP)
	VSP-200	Blank plate, EMC painted, without VESDA logo
	VSP-300	Blank plate, non-EMC painted, without VESDA logo

B Recommended Frequences for General Maintenance and Filter Cartridge Replacement

Environment Class	Typical Application	Background Smoke Level	Recommended Filter Replacement Frequency	Recommended Maintenance Period	Factors that may affect filter replacement frequency. Recommendations of use
1	Fully enclosed, and strictly no leakage, fully air-conditioned, usually with HEPA filters fitted, strictly maintained to high standards of cleanliness such as Clean Room classification 1, 10,100 in accordance with US Federal Standard 209D, computer rooms with restricted access, medical facilities with positive pressure, installations within medical and semiconductor equipment etc.	Usually less than 0.006% obs/m (average) {<0.002% obs/ft} (average)	At least every 60 months	At least every 24 months (code requirements typically call for 12 month Service Intervals	Higher clean room classification, protection of other areas such as wet bench, subject to contamination due to frequent access or minor building leakage
2	Fully enclosed and usually air-conditioned with some filters fitted, high airflow extraction systems or standalone AHU, routinely maintained to acceptable health recommendations for occupants. Frequent access. May be multi-function facility. General office building, telecommunication base station, equipment switch rooms, shopping mall, heritage building, churches, document storage and general warehouse type building (including cold storages) with high ceiling.	Usually between 0.006-0.009% obs/m {0.002-0.003% obs/ft}	At least every 36 months	At least every 24 months (code requirements typically call for 12 month Service Intervals)	Frequent access and/or excessive building leakage/doors connected to a highly polluted ambient environment, infrequent HVAC maintenance, high relative humidity, activities such as cooking, production, dusty spaces like ceiling void, suspension floor, regular wash downs.
3	Similar to Environment Class 2 in countries with high levels of pollution and no filtration of outside air. Facilities with light industrial sites, manufacturing and processing without noticeable airborne particles, prison cells, etc.	Usually less than 0.015% obs/m {<0.005% obs/ft}	At least every 24 months	At least every 12 months	Low ceiling, higher airborne particles level, high relative humidity. May require water trap in high humidity climate.

Environment Class	Typical Application	Background Smoke Level	Recommended Filter Replacement Frequency	Recommended Maintenance Period	Factors that may affect filter replacement frequency. Recommendations of use
4	Partially enclosed, no air-conditioning but may use extraction system from time to time.Usually industrial sites with noticeable air pollution, loading bays, dusty production, underground platform, equipment rooms, facilities using natural air ventilation.	Usually less than 0.03% obs/m {<0.01% obs/ft}	At least every 18 months	At least every 12 months	High relative humidity, frequent wash-down.May require water-trap in high humidity climate.
5	Open environments, airborne particle clearly visible, sometime require wash-down to maintain acceptable health standard for occupants. May use extensive stage smoke or fog.Applications like amusement park rides, coal fired power station, fertiliser factory, waste-treatment, tunnels, bus terminals, etc.	Usually above 0.03% obs/m {>0.01% obs/ft}	At least every 12 months	At least every 6 months	Refer to Class 6 (Special Case). May require water-trap in high humidity climate.
6(Special Cases)	Usually fits within "High" and "Extreme" definitions. Regular fumigation (such as tobacco storage), corrosive, radiative, irregular process, high level of fine dusty environment such ascement, textile, welding, oily, steamy, etc.	Varied	Closely monitor for the first 3 to 6 months to develop a filter replacement guideline	Closely monitor for the first 3 to 6 months to develop a maintenance schedule	Consult with Risk Manager, refer to local codes, standards and regulations to ensure compliance.Regular smoke tests are required. May require water-trap in high humidity climate.

C Example of a Typical Maintenance Log

Customer:		Date of visit:	
Site:		Technician's name:	
Service company name:		Address:	
		Phone number:	
Visit type:	scheduled / fault call out / annual test (circle appropriate visit)		

Before you record any more information:	
1. Record airflow	use table below
2. Download and save event log via VSC	Yes / No
3. Download and save configuration file via VSC	Yes / No
4. Give a copy of event log and configuration file to site manager	Yes / No

Flow (before):	%	actual	Flow (after):	%	actual
Pipe 1			Pipe 1		
Pipe 2			Pipe 2		
Pipe 3			Pipe 3		
Pipe 4			Pipe 4		

Detector faults present:	Actions to fix:

Parts replaced:		Clean pipes:	
filter	Yes / No	pipe flush	Yes / No
others		in-pipe sampling holes	Yes / No
	capillaries	Yes / No	

Have you done the following?		Comments
reviewed service history	Yes / No	
checked power supply/UPS	Yes / No	
checked battery backup	Yes / No	
checked battery charging	Yes / No	
tested fire alarm and fault notification at detector	Yes / No	
tested fire alarm and fault notification at monitoring system	Yes / No	
compared current results to commissioning data	Yes / No	
returned the system to normal operation mode	Yes / No	

Record any other activities undertaken:

Circle the detector's environment class:	1	2	3	4	5	6
Record filter replacement frequency:		months	Exp. Date			
Record detector maintenance period:		months	Next visit:			

Signatures:	
Technician:	Site Manager:
Date:	Date:

PART 9 - LIST OF ADDITIONAL REFERENCED STANDARDS

9.1 NFPA 13 – 2013 Standard for the Installation of Sprinkler Systems

9.2 NFPA 2001- 2012 Standard on Clean Agent Fire Extinguishing Systems.

9.3 NFPA 70B- 2013 Standard for Electrical Equipment Maintenance.

9.4 NFPA 72- 2013 National Fire Alarm and Signaling Code - Inspection, Testing and Maintenance, including Tables 14.3.1 and 14.4.3.2.

9.5 NFPA 75-2013 Standard for the Fire Protection of Information Technology Equipment

9.6 NFPA 110-2013 Standard for Emergency and Standby Power Systems.

9.7 NFPA 780-2014 Standards for the Installation of Lightning Protection Systems, including Annex D – Inspection and Maintenance of Lightning Protection Systems.

9.8 BICSI – 002-2011 Data Center Design and Implementation Best Practices, including Chapter 17.

9.9 IEEE 1188 Maintenance, Testing and Replacement of Stationary Valve-regulated Lead Acid (VRLA) Batteries for Stationary Applications

Table 14.3.1 Visual Inspection

	Component	Initial Acceptance	Periodic Frequency	Method	Reference
1.	All equipment	X	Annual	Ensure there are no changes that affect equipment performance. Inspect for building modifications, occupancy changes, changes in environmental conditions, device location, physical obstructions, device orientation, physical damage, and degree of cleanliness.	14.3.4
2.	Control equipment:				
	(a) Fire alarm systems monitored for alarm, supervisory, and trouble signals			Verify a system normal condition.	
	(1) Fuses	X	Annual		
	(2) Interfaced equipment	X	Annual		
	(3) Lamps and LEDs	X	Annual		
	(4) Primary (main) power supply	X	Annual		
	(5) Trouble signals	X	Semiannual		
	(b) Fire alarm systems unmonitored for alarm, supervisory, and trouble signals			Verify a system normal condition.	
	(1) Fuses	X	Weekly		
	(2) Interfaced equipment	X	Weekly		
	(3) Lamps and LEDs	X	Weekly		
	(4) Primary (main) power supply	X	Weekly		
	(5) Trouble signals	X	Weekly		
3.	Reserved				
4.	Supervising station alarm systems — transmitters			Verify location, physical condition, and a system normal condition.	
	(a) Digital alarm communicator transmitter (DACT)	X	Annual		
	(b) Digital alarm radio transmitter (DART)	X	Annual		
	(c) McCulloh	X	Annual		
	(d) Radio alarm transmitter (RAT)	X	Annual		
	(e) All other types of communicators	X	Annual		
5.	In-building fire emergency voice/alarm communications equipment	X	Semiannual	Verify location and condition.	
6.	Reserved				
7.	Reserved				
8.	Reserved				
9.	Batteries			Inspect for corrosion or leakage. Verify tightness of connections. Verify marking of the month/year of manufacture (all types).	10.6.10
	(a) Lead-acid	X	Monthly	Visually inspect electrolyte level.	
	(b) Nickel-cadmium	X	Semiannual		
	(c) Primary (dry cell)	X	Monthly		
	(d) Sealed lead-acid	X	Semiannual		
10.	Reserved				

(continues)

Table 14.3.1 *Continued*

	Component	Initial Acceptance	Periodic Frequency	Method	Reference
11.	Remote annunciators	X	Semiannual	Verify location and condition.	
12.	Notification appliance circuit power extenders	X	Annual	Verify proper fuse ratings, if any. Verify that lamps and LEDs indicate normal operating status of the equipment.	10.6
13.	Remote power supplies	X	Annual	Verify proper fuse ratings, if any. Verify that lamps and LEDs indicate normal operating status of the equipment.	10.6
14.	Transient suppressors	X	Semiannual	Verify location and condition.	
15.	Reserved				
16.	Fiber-optic cable connections	X	Annual	Verify location and condition.	
17.	Initiating devices			Verify location and condition (all devices).	
	(a) Air sampling				
	(1) General	X	Semiannual	Verify that in-line filters, if any, are clean.	17.7.3.6
	(2) Sampling system piping and sampling ports	X		Verify that sampling system piping and fittings are installed properly, appear airtight, and are permanently fixed. Confirm that sampling pipe is conspicuously identified. Verify that sample ports or points are not obstructed.	17.7.3.6
	(b) Duct detectors				
	(1) General	X	Semiannual	Verify that detector is rigidly mounted. Confirm that no penetrations in a return air duct exist in the vicinity of the detector. Confirm the detector is installed so as to sample the airstream at the proper location in the duct.	17.7.5.5
	(2) Sampling tube	X		Verify proper orientation. Confirm the sampling tube protrudes into the duct in accordance with system design.	17.7.5.5
	(c) Electromechanical releasing devices	X	Semiannual		
	(d) Fire extinguishing system(s) or suppression system(s) switches	X	Semiannual		
	(e) Manual fire alarm boxes	X	Semiannual		
	(f) Heat detectors	X	Semiannual		
	(g) Radiant energy fire detectors	X	Quarterly	Verify no point requiring detection is obstructed or outside the detector's field of view.	17.8
	(h) Video image smoke and fire detectors	X	Quarterly	Verify no point requiring detection is obstructed or outside the detector's field of view.	17.7.7; 17.11.5
	(i) Smoke detectors (excluding one- and two-family dwellings)	X	Semiannual		
	(j) Projected beam smoke detectors	X	Semiannual	Verify beam path is unobstructed.	
	(k) Supervisory signal devices	X	Quarterly		
	(l) Waterflow devices	X	Quarterly		
18.	Reserved				

Table 14.3.1 *Continued*

	Component	Initial Acceptance	Periodic Frequency	Method	Reference
19.	Combination systems			Verify location and condition (all types).	
	(a) Fire extinguisher electronic monitoring device/systems	X	Semiannual		
	(b) Carbon monoxide detectors/systems	X	Semiannual		
20.	Fire alarm control interface and emergency control function interface	X	Semiannual	Verify location and condition.	
21.	Guard's tour equipment	X	Semiannual	Verify location and condition.	
22.	Notification appliances			Verify location and condition (all appliances).	
	(a) Audible appliances	X	Semiannual		
	(b) Audible textual notification appliances	X	Semiannual		
	(c) Visible appliances				
	(1) General	X	Semiannual		18.5.5
	(2) Candela rating	X		Verify that the candela rating marking agrees with the approved drawings.	18.5.5
23.	Exit marking audible notification appliances	X	Semiannual	Verify location and condition.	
24.	Reserved				
25.	Area of refuge two-way communication system	X	Annual	Verify location and condition.	
26.	Reserved				
27.	Supervising station alarm systems — receivers				
	(a) Signal receipt	X	Daily	Verify receipt of signal.	
	(b) Receivers	X	Annual	Verify location and normal condition.	
28.	Public emergency alarm reporting system transmission equipment			Verify location and condition.	
	(a) Publicly accessible alarm box	X	Semiannual		
	(b) Auxiliary box	X	Annual		
	(c) Master box				
	(1) Manual operation	X	Semiannual		
	(2) Auxiliary operation	X	Annual		
29.	Reserved				
30.	Mass notification system				
	(a) Monitored for integrity			Verify a system normal condition.	
	(1) Control equipment				
	(i) Fuses	X	Annual		
	(ii) Interfaces	X	Annual		
	(iii) Lamps/LED	X	Annual		
	(iv) Primary (main) power supply	X	Annual		
	(2) Secondary power batteries	X	Annual		
	(3) Initiating devices	X	Annual		
	(4) Notification appliances	X	Annual		

(continues)

Table 14.3.1 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method	Reference
30. Mass notification system *(continued)*				
(b) Not monitored for integrity; installed prior to adoption of the 2010 edition			Verify a system normal condition.	
(1) Control equipment				
(i) Fuses	X	Semiannual		
(ii) Interfaces	X	Semiannual		
(iii) Lamps/LED	X	Semiannual		
(iv) Primary (main) power supply	X	Semiannual		
(2) Secondary power batteries	X	Semiannual		
(3) Initiating devices	X	Semiannual		
(4) Notification appliances	X	Semiannual		
(c) Antenna	X	Annual	Verify location and condition.	
(d) Transceivers	X	Annual	Verify location and condition.	

14.3.2 Devices or equipment that is inaccessible for safety considerations (e.g., continuous process operations, energized electrical equipment, radiation, and excessive height) shall be permitted to be inspected during scheduled shutdowns if approved by the authority having jurisdiction.

14.3.3 Extended intervals shall not exceed 18 months.

14.3.4 The visual inspection shall be made to ensure that there are no changes that affect equipment performance.

14.4 Testing.

14.4.1 Initial Acceptance Testing.

14.4.1.1 All new systems shall be inspected and tested in accordance with the requirements of Chapter 14.

14.4.1.2 The authority having jurisdiction shall be notified prior to the initial acceptance test.

14.4.2* Reacceptance Testing.

14.4.2.1 When an initiating device, notification appliance, or control relay is added, it shall be functionally tested.

14.4.2.2 When an initiating device, notification appliance, or control relay is deleted, another device, appliance, or control relay on the circuit shall be operated.

14.4.2.3 When modifications or repairs to control equipment hardware are made, the control equipment shall be tested in accordance with Table 14.4.3.2, items 1(a) and 1(d).

14.4.2.4 When changes are made to site-specific software, the following shall apply:

(1) All functions known to be affected by the change, or identified by a means that indicates changes, shall be 100 percent tested.
(2) In addition, 10 percent of initiating devices that are not directly affected by the change, up to a maximum of 50 devices, also shall be tested and correct system operation shall be verified.
(3) A revised record of completion in accordance with 7.5.6 shall be prepared to reflect these changes.

14.4.2.5 Changes to the system executive software shall require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify critical system functions such as notification appliances, control functions, and off-premises reporting.

14.4.3* Test Methods.

14.4.3.1* At the request of the authority having jurisdiction, the central station facility installation shall be inspected for complete information regarding the central station system, including specifications, wiring diagrams, and floor plans that have been submitted for approval prior to installation of equipment and wiring.

14.4.3.2* Systems and associated equipment shall be tested according to Table 14.4.3.2.

Table 14.4.3.2 was revised by tentative interim amendments (TIAs). See page 1.

Table 14.4.3.2 Testing

	Component	Initial Acceptance	Periodic Frequency	Method
1.	All equipment	X		See Table 14.3.1.
2.	Control equipment and transponder			
	(a) Functions	X	Annually	Verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
	(b) Fuses	X	Annually	Verify rating and supervision.
	(c) Interfaced equipment	X	Annually	Verify integrity of single or multiple circuits providing interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.
	(d) Lamps and LEDs	X	Annually	Illuminate lamps and LEDs.
	(e) Primary (main) power supply	X	Annually	Disconnect and test all secondary (standby) power under maximum load, including all alarm appliances requiring simultaneous operation. Reconnect all secondary (standby) power at end of test. Test redundant power supplies separately.
3.	Fire alarm control unit trouble signals			
	(a) Audible and visual	X	Annually	Verify operation of control unit trouble signals. Verify ring-back feature for systems using a trouble-silencing switch that requires resetting.
	(b) Disconnect switches	X	Annually	If control unit has disconnect or isolating switches, verify performance of intended function of each switch. Verify receipt of trouble signal when a supervised function is disconnected.
	(c) Ground-fault monitoring circuit	X	Annually	If the system has a ground detection feature, verify the occurrence of ground-fault indication whenever any installation conductor is grounded.
	(d) Transmission of signals to off-premises location	X	Annually	Actuate an initiating device and verify receipt of alarm signal at the off-premises location. Create a trouble condition and verify receipt of a trouble signal at the off-premises location. Actuate a supervisory device and verify receipt of a supervisory signal at the off-premises location. If a transmission carrier is capable of operation under a single- or multiple-fault condition, activate an initiating device during such fault condition and verify receipt of an alarm signal and a trouble signal at the off-premises location.
4.	Supervising station alarm systems — transmission Equipment			
	(a) All equipment	X	Annually	"Test all system functions and features in accordance with the equipment manufacturer's published instructions for correct operation in conformance with the applicable sections of Chapter 26. Except for DACT, actuate initiating device and verify receipt of the correct initiating device signal at the supervising station within 90 seconds. Upon completion of the test, restore the system to its functional operating condition. If test jacks are used, conduct the first and last tests without the use of the test jack.
	(b) Digital alarm communicator transmitter (DACT)	X	Annually	Except for DACTs installed prior to adoption of the 2013 edition of NFPA 72 that are connected to a telephone line (number) that is also supervised for adverse conditions by a derived local channel, ensure connection of the DACT to two separate means of transmission. Test DACT for line seizure capability by initiating a signal while using the telephone line (primary line for DACTs using two telephone lines) for a telephone call. Ensure that the call is interrupted and that the communicator connects to the digital alarm receiver. Verify receipt of the correct signal at the supervising station. Verify each transmission attempt is completed within 90 seconds from going off-hook to on-hook.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
4. Supervising station alarm systems — transmission Equipment			
(b) Digital alarm communicator transmitter (DACT) *(continued)*			Disconnect the telephone line (primary line for DACTs using two telephone lines) from the DACT. Verify indication of the DACT trouble signal occurs at the premises fire alarm control unit within 4 minutes of detection of the fault. Verify receipt of the telephone line trouble signal at the supervising station. Restore the telephone line (primary line for DACTs using two telephone lines), reset the fire alarm control unit, and verify that the telephone line fault trouble signal returns to normal. Verify that the supervising station receives the restoral signal from the DACT. Disconnect the secondary means of transmission from the DACT. Verify indication of the DACT trouble signal occurs at the premises fire alarm control unit within 4 minutes of detection of the fault. Verify receipt of the secondarey means trouble signal at the supervising station. Restore the secondary means of transmission, reset the fire alarm control unit, and verify that the trouble signal returns to normal. Verify that the supervising station receives the restoral signal from the secondary transmitter. Cause the DACT to transmit a signal to the DACR while a fault in the telephone line (number) (primary line for DACTs using two telephone lines) is simulated. Verify utilization of the secondary communication path by the DACT to complete the transmission to the DACR.
(c) Digital alarm radio transmitter (DART)	X	Annually	Disconnect the primary telephone line. Verify transmission of a trouble signal to the supervising station by the DART occurs within 4 minutes.
(d) McCulloh transmitter	X	Annually	Actuate initiating device. Verify production of not less than three complete rounds of not less than three signal impulses each by the McCulloh transmitter. If end-to-end metallic continuity is present and with a balanced circuit, cause each of the following four transmission channel fault conditions in turn, and verify receipt of correct signals at the supervising station: (1) Open (2) Ground (3) Wire-to-wire short (4) Open and ground If end-to-end metallic continuity is not present and with a properly balanced circuit, cause each of the following three transmission channel fault conditions in turn, and verify receipt of correct signals at the supervising station: (1) Open (2) Ground (3) Wire-to-wire short
(e) Radio alarm transmitter (RAT)	X	Annually	Cause a fault between elements of the transmitting equipment. Verify indication of the fault at the protected premises, or transmission of trouble signal to the supervising station.
(f) Performance-based technologies	X	Annually	Perform tests to ensure the monitoring of integrity of the transmission technology and technology path. Where a single communications path is used, disconnect the communication path. Manually initiate an alarm signal transmission or allow the check-in (handshake) signal to be transmitted automatically.[b] Verify the premises unit annunciates the failure within 200 seconds of the transmission failure. Restore the communication path. Where multiple communication paths are used, disconnect both communication paths. Manually initiate an alarm signal transmission. Verify the premises control unit annunciates the failure within 200 seconds of the transmission failure. Restore both communication paths.
5. Emergency communications equipment			
(a) Amplifier/tone generators	X	Annually	Verify correct switching and operation of backup equipment.
(b) Call-in signal silence	X	Annually	Operate/function and verify receipt of correct visual and audible signals at control unit.
(c) Off-hook indicator (ring down)	X	Annually	Install phone set or remove phone from hook and verify receipt of signal at control unit.
(d) Phone jacks	X	Annually	Visually inspect phone jack and initiate communications path through jack.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(e) Phone set	X	Annually	Activate each phone set and verify correct operation.
(f) System performance	X	Annually	Operate the system with a minimum of any five handsets simultaneously. Verify voice quality and clarity.
6. Engine-driven generator	X	Monthly	If an engine-driven generator dedicated to the system is used as a required power source, verify operation of the generator in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, by the building owner.
7. Secondary (standby) power supply[c]	X	Annually	Disconnect all primary (main) power supplies and verify the occurrence of required trouble indication for loss of primary power. Measure or verify the system's standby and alarm current demand and verify the ability of batteries to meet standby and alarm requirements using manufacturer's data. Operate general alarm systems a minimum of 5 minutes and emergency voice communications systems for a minimum of 15 minutes. Reconnect primary (main) power supply at end of test.
8. Uninterruptible power supply (UPS)	X	Annually	If a UPS system dedicated to the system is used as a required power source, verify by the building owner operation of the UPS system in accordance with NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.
9. Battery tests			Prior to conducting any battery testing, verify by the person conducting the test, that all system software stored in volatile memory is protected from loss.
(a) Lead-acid type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the battery does not fall below 2.05 volts per cell under load.
(5) Specific gravity	X	Semiannually	Measure as required the specific gravity of the liquid in the pilot cell or all of the cells. Verify the specific gravity is within the range specified by the manufacturer. Although the specified specific gravity varies from manufacturer to manufacturer, a range of 1.205–1.220 is typical for regular lead-acid batteries, while 1.240–1.260 is typical for high-performance batteries. Do not use a hydrometer that shows only a pass or fail condition of the battery and does not indicate the specific gravity, because such a reading does not give a true indication of the battery condition.
(b) Nickel-cadmium type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test[d]	X	Annually	With the batteries fully charged and connected to the charger, place an ampere meter in series with the battery under charge. Verify the charging current is in accordance with the manufacturer's recommendations for the type of battery used. In the absence of specific information, use 1/30 to 1/25 of the battery rating.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery. Verify the float voltage for the entire battery is 1.42 volts per cell, nominal, under load. If possible, measure cells individually.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
9. Battery tests *(continued)*			
(c) Sealed lead-acid type			
(1) Battery replacement	X	Annually	Replace batteries in accordance with the recommendations of the alarm equipment manufacturer or when the recharged battery voltage or current falls below the manufacturer's recommendations.
(2) Charger test	X	Annually	With the batteries fully charged and connected to the charger, measure the voltage across the batteries with a voltmeter. Verify the voltage is 2.30 volts per cell ±0.02 volts at 77°F (25°C) or as specified by the equipment manufacturer.
(3) Discharge test	X	Annually	With the battery charger disconnected, load test the batteries following the manufacturer's recommendations. Verify the voltage level does not fall below the levels specified. Load testing can be by means of an artificial load equal to the full fire alarm load connected to the battery.
(4) Load voltage test	X	Semiannually	Verify the battery performs under load, in accordance with the battery manufacturer's specifications.
10. Public emergency alarm reporting system — wired system	X	Daily	Manual tests of the power supply for public reporting circuits shall be made and recorded at least once during each 24-hour period. Such tests shall include the following: (1) Current strength of each circuit. Changes in current of any circuit exceeding 10 percent shall be investigated immediately. (2) Voltage across terminals of each circuit inside of terminals of protective devices. Changes in voltage of any circuit exceeding 10 percent shall be investigated immediately. (3)[a] Voltage between ground and circuits. If this test shows a reading in excess of 50 percent of that shown in the test specified in (2), the trouble shall be immediately located and cleared. Readings in excess of 25 percent shall be given early attention. These readings shall be taken with a calibrated voltmeter of not more than 100 ohms resistance per volt. Systems in which each circuit is supplied by an independent current source (Forms 3 and 4) require tests between ground and each side of each circuit. Common current source systems (Form 2) require voltage tests between ground and each terminal of each battery and other current source. (4) Ground current reading shall be permitted in lieu of (3). If this method of testing is used, all grounds showing a current reading in excess of 5 percent of the supplied line current shall be given immediate attention. (5) Voltage across terminals of common battery on switchboard side of fuses. (6) Voltage between common battery terminals and ground. Abnormal ground readings shall be investigated immediately. Tests specified in (5) and (6) shall apply only to those systems using a common battery. If more than one common battery is used, each common battery shall be tested.
11. Remote annunciators	X	Annually	Verify the correct operation and identification of annunciators. If provided, verify the correct operation of annunciator under a fault condition.
12. Reserved			
13. Reserved			
14. Reserved			
15. Conductors — metallic			
(a) Stray voltage	X	N/A	Test all installation conductors with a volt/ohmmeter to verify that there are no stray (unwanted) voltages between installation conductors or between installation conductors and ground. Verify the maximum allowable stray voltage does not exceed 1 volt ac/dc, unless a different threshold is specified in the published manufacturer's instructions for the installed equipment.
(b) Ground faults	X	N/A	Test all installation conductors, other than those intentionally and permanently grounded, for isolation from ground per the installed equipment manufacturer's published instructions.
(c) Short-circuit faults	X	N/A	Test all installation conductors, other than those intentionally connected together, for conductor-to-conductor isolation per the published manufacturer's instructions for the installed equipment. Also test these same circuits conductor-to-ground.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(d) Loop resistance	X	N/A	With each initiating and indicating circuit installation conductor pair short-circuited at the far end, measure and record the resistance of each circuit. Verify that the loop resistance does not exceed the limits specified in the published manufacturer's instructions for the installed equipment.
(e) Circuit integrity	X	N/A	For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
	N/A	Annually	For periodic testing, test each initiating device circuit, notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
16. Conductors — nonmetallic			
(a) Fiber optics	X	N/A	Test the fiber-optic transmission line by the use of an optical power meter or by an optical time domain reflectometer used to measure the relative power loss of the line. Test result data must meet or exceed ANSI/TIA 568-C.3, *Optical Fiber Cabling Components Standard*, related to fiber-optic lines and connection/splice losses and the control unit manufacturer's published specifications.
(b) Circuit integrity	X	N/A	For initial and reacceptance testing, confirm the introduction of a fault in any circuit monitored for integrity results in a trouble indication at the fire alarm control unit. Open one connection at not less than 10 percent of the initiating devices, notification appliances, and controlled devices on every initiating device circuit, notification appliance circuit, and signaling line circuit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
	N/A	Annually	For periodic testing, test each initiating device circuit, notification appliance circuit, and signaling line circuit for correct indication at the control unit. Confirm all circuits perform as indicated in Sections 23.5, 23.6, and 23.7.
17. Initiating devices[f]			
(a) Electromechanical releasing device			
(1) Nonrestorable-type link	X	Annually	Verify correct operation by removal of the fusible link and operation of the associated device. Lubricate any moving parts as necessary.
(2) Restorable-type link[g]	X	Annually	Verify correct operation by removal of the fusible link and operation of the associated device. Lubricate any moving parts as necessary.
(b) Fire extinguishing system(s) or suppression system(s) alarm switch	X	Annually	Operate the switch mechanically or electrically and verify receipt of signal by the fire alarm control unit.
(c) Fire–gas and other detectors	X	Annually	Test fire–gas detectors and other fire detectors as prescribed by the manufacturer and as necessary for the application.
(d) Heat detectors			
(1) Fixed-temperature, rate-of-rise, rate of compensation, restorable line, spot type (excluding pneumatic tube type)	X	Annually (see 14.4.4.5)	Perform heat test with a listed and labeled heat source or in accordance with the manufacturer's published instructions. Assure that the test method for the installed equipment does not damage the nonrestorable fixed-temperature element of a combination rate-of-rise/fixed-temperature element detector.
(2) Fixed-temperature, nonrestorable line type	X	Annually	Do not perform heat test. Test functionality mechanically and electrically. Measure and record loop resistance. Investigate changes from acceptance test.
(3) Fixed-temperature, nonrestorable spot type	X	See Method	After 15 years from initial installation, replace all devices or have 2 detectors per 100 laboratory tested. Replace the 2 detectors with new devices. If a failure occurs on any of the detectors removed, remove and test additional detectors to determine either a general problem involving faulty detectors or a localized problem involving 1 or 2 defective detectors. If detectors are tested instead of replaced, repeat tests at intervals of 5 years.
(4) Nonrestorable (general)	X	Annually	Do not perform heat tests. Test functionality mechanically and electrically.
(5) Restorable line type, pneumatic tube only	X	Annually	Perform heat tests (where test chambers are in circuit), with a listed and labeled heat source or in accordance with the manufacturer's published instructions of the detector or conduct a test with pressure pump.

(continues)

Table 14.4.3.2 ***Continued***

Component	Initial Acceptance	Periodic Frequency	Method
17. Initiating devices[f]			
(d) Heat detectors *(continued)*			
(6) Single- and multiple-station heat alarms	X	Annually	Conduct functional tests according to manufacturer's published instructions. Do not test nonrestorable heat detectors with heat.
(e) Manual fire alarm boxes	X	Annually	Operate manual fire alarm boxes per the manufacturer's published instructions. Test both key-operated presignal and general alarm manual fire alarm boxes.
(f) Radiant energy fire detectors	X	Semiannually	Test flame detectors and spark/ember detectors in accordance with the manufacturer's published instructions to determine that each detector is operative. Determine flame detector and spark/ember detector sensitivity using any of the following: (1) Calibrated test method (2) Manufacturer's calibrated sensitivity test instrument (3) Listed control unit arranged for the purpose (4) Other approved calibrated sensitivity test method that is directly proportional to the input signal from a fire, consistent with the detector listing or approval If designed to be field adjustable, replace detectors found to be outside of the approved range of sensitivity or adjust to bring them into the approved range. Do not determine flame detector and spark/ember detector sensitivity using a light source that administers an unmeasured quantity of radiation at an undefined distance from the detector.
(g) Smoke detectors — functional test			
(1) In other than one- and two-family dwellings, system detectors	X	Annually	[h]Test smoke detectors in place to ensure smoke entry into the sensing chamber and an alarm response. Use smoke or a listed and labeled product acceptable to the manufacturer or in accordance with their published instructions. Other methods listed in the manufacturer's published instructions that ensure smoke entry from the protected area, through the vents, into the sensing chamber can be used.
(2) Single- and multiple-station smoke alarms connected to protected premises systems	X	Annually	Perform a functional test on all single- and multiple-station smoke alarms connected to a protected premises fire alarm system by putting the smoke alarm into an alarm condition and verifying that the protected premises system receives a supervisory signal and does not cause a fire alarm signal.
(3) System smoke detectors used in one- and two-family dwellings	X	Annually	Conduct functional tests according to manufacturer's published instructions.
(4) Air sampling	X	Annually	Test with smoke or a listed and labeled product acceptable to the manufacturer or in accordance with their published instructions. Test from the end sampling port or point on each pipe run. Verify airflow through all other ports or points.
(5) Duct type	X	Annually	In addition to the testing required in Table 14.4.3.2(g)(1) and Table 14.4.3.2(h), test duct smoke detectors that use sampling tubes to ensure that they will properly sample the airstream in the duct using a method acceptable to the manufacturer or in accordance with their published instructions.
(6) Projected beam type	X	Annually	Test the detector by introducing smoke, other aerosol, or an optical filter into the beam path.
(7) Smoke detector with built-in thermal element	X	Annually	Operate both portions of the detector independently as described for the respective devices.
(8) Smoke detectors with control output functions	X	Annually	Verify that the control capability remains operable even if all of the initiating devices connected to the same initiating device circuit or signaling line circuit are in an alarm state.
(h) Smoke detectors — sensitivity testing			
In other than one- and two-family dwellings, system detectors	N/A	See 14.4.4.3	[i]Perform any of the following tests to ensure that each smoke detector is within its listed and marked sensitivity range: (1) Calibrated test method (2) Manufacturer's calibrated sensitivity test instrument (3) Listed control equipment arranged for the purpose

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
			(4) Smoke detector/control unit arrangement whereby the detector causes a signal at the control unit when its sensitivity is outside its listed sensitivity range (5) Other calibrated sensitivity test method approved by the authority having jurisdiction
(i) Carbon monoxide detectors/carbon monoxide alarms for the purposes of fire detection	X	Annually	Test the devices in place to ensure CO entry to the sensing chamber by introduction through the vents, to the sensing chamber of listed and labeled product acceptable to the manufacturer or in accordance with their published instructions.
(j) Initiating devices, supervisory			
(1) Control valve switch	X	Annually	Operate valve and verify signal receipt to be within the first two revolutions of the handwheel or within one-fifth of the travel distance, or per the manufacturer's published instructions.
(2) High- or low-air pressure switch	X	Annually	Operate switch and verify receipt of signal is obtained where the required pressure is increased or decreased a maximum 10 psi (70 kPa) from the required pressure level.
(3) Room temperature switch	X	Annually	Operate switch and verify receipt of signal to indicate the decrease in room temperature to 40°F (4.4°C) and its restoration to above 40°F (4.4°C).
(4) Water level switch	X	Annually	Operate switch and verify receipt of signal indicating the water level raised or lowered a maximum 3 in. (70 mm) from the required level within a pressure tank, or a maximum 12 in. (300 mm) from the required level of a nonpressure tank. Also verify its restoral to required level.
(5) Water temperature switch	X	Annually	Operate switch and verify receipt of signal to indicate the decrease in water temperature to 40°F (4.4°C) and its restoration to above 40°F (4.4°C).
(k) Mechanical, electrosonic, or pressure-type waterflow device	X	Semiannually	Water shall be flowed through an inspector's test connection indicating the flow of water equal to that from a single sprinkler of the smallest orifice size installed in the system for wet-pipe systems, or an alarm test bypass connection for dry-pipe, pre-action, or deluge systems in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*
(l) Multi-sensor fire detector or multi-criteria fire detector or combination fire detector	X	Annually	Test each of the detection principles present within the detector (e.g., smoke/heat/CO, etc.) independently for the specific detection principle, regardless of the configuration status at the time of testing. Also test each detector in accordance with the published manufacturer's instructions. Test individual sensors together if the technology allows individual sensor responses to be verified. Perform tests as described for the respective devices by introduction of the physical phenomena to the sensing chamber of element, and an electronic check (magnets, analogue values, etc.) is not sufficient to comply with this requirement. Confirm the result of each sensor test through indication at the detector or control unit. Where individual sensors cannot be tested individually, test the primary sensor.[j] Record all tests and results.
18. Special hazard equipment			
(a) Abort switch (dead-man type)	X	Annually	Operate abort switch and verify correct sequence and operation.
(b) Abort switch (recycle type)	X	Annually	Operate abort switch and verify development of correct matrix with each sensor operated.
(c) Abort switch (special type)	X	Annually	Operate abort switch and verify correct sequence and operation in accordance with authority having jurisdiction. Observe sequencing as specified on as-built drawings or in system owner's manual.
(d) Cross-zone detection circuit	X	Annually	Operate one sensor or detector on each zone. Verify occurrence of correct sequence with operation of first zone and then with operation of second zone.
(e) Matrix-type circuit	X	Annually	Operate all sensors in system. Verify development of correct matrix with each sensor operated.
(f) Release solenoid circuit[k]	X	Annually	Verify operation of solenoid.
(g) Squibb release circuit	X	Annually	Use AGI flashbulb or other test light approved by the manufacturer. Verify operation of flashbulb or light.
(h) Verified, sequential, or counting zone circuit	X	Annually	Operate required sensors at a minimum of four locations in circuit. Verify correct sequence with both the first and second detector in alarm.
(i) All above devices or circuits or combinations thereof	X	Annually	Verify supervision of circuits by creating an open circuit.

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
19. Combination systems			
(a) Fire extinguisher electronic monitoring device/system	X	Annually	Test communication between the device connecting the fire extinguisher electronic monitoring device/system and the fire alarm control unit to ensure proper signals are received at the fire alarm control unit and remote annunciator(s) if applicable.
(b) Carbon monoxide[l] device/system	X	Annually	Test communication between the device connecting the carbon monoxide device/system and the fire alarm control unit to ensure proper signals are received at the fire alarm control unit and remote annunciator(s) if applicable.
20. Interface equipment[m]	X	See 14.4.4.4	Test interface equipment connections by operating or simulating the equipment being supervised. Verify signals required to be transmitted are received at the control unit. Test frequency for interface equipment is the same as the frequency required by the applicable NFPA standard(s) for the equipment being supervised.
21. Guard's tour equipment	X	Annually	Test the device in accordance with the manufacturer's published instructions.
22. Alarm notification appliances			
(a) Audible[n]	X	N/A	For initial and reacceptance testing, measure sound pressure levels for signals with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters*, Type 2 requirements. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with Chapter 18. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST).
	N/A	Annually	[o]For periodic testing, verify the operation of the notification appliances.
(b) Audible textual notification appliances (speakers and other appliances to convey voice messages)	X	N/A	For initial and reacceptance testing, measure sound pressure levels for signals with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters*, Type 2 requirements. Measure sound pressure levels throughout the protected area to confirm that they are in compliance with Chapter 18. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST). Verify audible information to be distinguishable and understandable and in compliance with 14.4.11.
	N/A	Annually	[o]For periodic testing, verify the operation of the notification appliances.
(c) Visible	X	N/A	Perform initial and reacceptance testing in accordance with the manufacturer's published instructions. Verify appliance locations to be per approved layout and confirm that no floor plan changes affect the approved layout. Verify that the candela rating marking agrees with the approved drawing. Confirm that each appliance flashes.
	N/A	Annually	For periodic testing, verify that each appliance flashes.
23. Exit marking audible notification appliance	X	Annually	Perform tests in accordance with manufacturer's published instructions.
24. Emergency control functions[p]	X	Annually	For initial, reacceptance, and periodic testing, verify emergency control function interface device activation. Where an emergency control function interface device is disabled or disconnected during initiating device testing, verify that the disabled or disconnected emergency control function interface device has been properly restored. [
25. Area of refuge two-way communication system	X	Annually	At a minimum, test the two-way communication system to verify operation and receipt of visual and audible signals at the transmitting and receiving unit respectively. Operate systems with more than five stations with a minimum of five stations operating simultaneously. Verify voice quality and clarity.
26. Special procedures			
(a) Alarm verification	X	Annually	Verify time delay and alarm response for smoke detector circuits identified as having alarm verification.
(b) Multiplex systems	X	Annually	Verify communications between sending and receiving units under both primary and secondary power. Verify communications between sending and receiving units under open-circuit and short-circuit trouble conditions.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
			Verify communications between sending and receiving units in all directions where multiple communications pathways are provided. If redundant central control equipment is provided, verify switchover and all required functions and operations of secondary control equipment. Verify all system functions and features in accordance with manufacturer's published instructions.
27. Supervising station alarm systems — receiving equipment			
(a) All equipment	X	Monthly	Perform tests on all system functions and features in accordance with the equipment manufacturer's published instructions for correct operation in conformance with the applicable sections of Chapter 26. Actuate initiating device and verify receipt of the correct initiating device signal at the supervising station within 90 seconds. Upon completion of the test, restore the system to its functional operating condition. If test jacks are used, perform the first and last tests without the use of the test jack.
(b) Digital alarm communicator receiver (DACR)	X	Monthly	Disconnect each transmission means in turn from the DACR, and verify audible and visual annunciation of a trouble signal in the supervising station. Cause a signal to be transmitted on each individual incoming DACR line (path) at least once every 6 hours (24 hours for DACTs installed prior to adoption of the 2013 edition of *NFPA 72*). Verify receipt of these signals.
(c) Digital alarm radio receiver (DARR)	X	Monthly	Cause the following conditions of all DARRs on all subsidiary and repeater station receiving equipment. Verify receipt at the supervising station of correct signals for each of the following conditions: (1) AC power failure of the radio equipment (2) Receiver malfunction (3) Antenna and interconnecting cable failure (4) Indication of automatic switchover of the DARR (5) Data transmission line failure between the DARR and the supervising or subsidiary station
(d) McCulloh systems	X	Monthly	Test and record the current on each circuit at each supervising and subsidiary station under the following conditions: (1) During functional operation (2) On each side of the circuit with the receiving equipment conditioned for an open circuit Cause a single break or ground condition on each transmission channel. If such a fault prevents the functioning of the circuit, verify receipt of a trouble signal. Cause each of the following conditions at each of the supervising or subsidiary stations and all repeater station radio transmitting and receiving equipment; verify receipt of correct signals at the supervising station: (1) RF transmitter in use (radiating) (2) AC power failure supplying the radio equipment (3) RF receiver malfunction (4) Indication of automatic switchover
(e) Radio alarm supervising station receiver (RASSR) and radio alarm repeater station receiver (RARSR)	X	Monthly	Cause each of the following conditions at each of the supervising or subsidiary stations and all repeater station radio transmitting and receiving equipment; verify receipt of correct signals at the supervising station: (1) AC power failure supplying the radio equipment (2) RF receiver malfunction (3) Indication of automatic switchover, if applicable
(f) Private microwave radio systems	X	Monthly	Cause each of the following conditions at each of the supervising or subsidiary stations and all repeater station radio transmitting and receiving equipment; verify receipt of correct signals at the supervising station: (1) RF transmitter in use (radiating) (2) AC power failure supplying the radio equipment (3) RF receiver malfunction (4) Indication of automatic switchover

(continues)

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
27. Supervising station alarm systems — receiving equipment *(continued)*			
(g) Performance-based technologies	X	Monthly	Perform tests to ensure the monitoring of integrity of the transmission technology and technology path. Where a single communications path is used, disconnect the communication path. Verify that failure of the path is annunciated at the supervising station within 60 minutes of the failure (within 5 minutes for communication equipment installed prior to adoption of the 2013 edition of *NFPA 72*). Restore the communication path. Where multiple communication paths are used, disconnect both communication paths and confirm that failure of the path is annunciated at the supervising station within not more than 6 hours of the failure (within 24 hours for communication equipment installed prior to adoption of the 2013 edition of *NFPA 72*). Restore both communication paths.
28. Public emergency alarm reporting system transmission equipment			
(a) Publicly accessible alarm box	X	Semiannually	Actuate publicly accessible initiating device(s) and verify receipt of not less than three complete rounds of signal impulses. Perform this test under normal circuit conditions. If the device is equipped for open circuit operation (ground return), test it in this condition as one of the semiannual tests.
(b) Auxiliary box	X	Annually	Test each initiating circuit of the auxiliary box by actuation of a protected premises initiating device connected to that circuit. Verify receipt of not less than three complete rounds of signal impulses.
(c) Master box			
(1) Manual operation	X	Semiannually	Perform the tests prescribed for 28(a).
(2) Auxiliary operation	X	Annually	Perform the tests prescribed for 28(b).
29. Low-power radio (wireless systems)	X	N/A	The following procedures describe additional acceptance and reacceptance test methods to verify wireless protection system operation: (1) Use the manufacturer's published instructions and the as-built drawings provided by the system supplier to verify correct operation after the initial testing phase has been performed by the supplier or by the supplier's designated representative. (2) Starting from the functional operating condition, initialize the system in accordance with the manufacturer's published instructions. Confirm the alternative communications path exists between the wireless control unit and peripheral devices used to establish initiation, indication, control, and annunciation. Test the system for both alarm and trouble conditions. (3) Check batteries for all components in the system monthly unless the control unit checks all batteries and all components daily.
30. Mass notification systems			
(a) Functions	X	Annually	At a minimum, test control equipment to verify correct receipt of alarm, supervisory, and trouble signals (inputs); operation of evacuation signals and auxiliary functions (outputs); circuit supervision, including detection of open circuits and ground faults; and power supply supervision for detection of loss of ac power and disconnection of secondary batteries.
(b) Fuses	X	Annually	Verify the rating and supervision.
(c) Interfaced equipment	X	Annually	Verify integrity of single or multiple circuits providing interface between two or more control units. Test interfaced equipment connections by operating or simulating operation of the equipment being supervised. Verify signals required to be transmitted at the control unit.
(d) Lamps and LEDs	X	Annually	Illuminate lamps and LEDs.
(e) Primary (main) power supply	X	Annually	Disconnect all secondary (standby) power and test under maximum load, including all alarm appliances requiring simultaneous operation. Reconnect all secondary (standby) power at end of test. For redundant power supplies, test each separately.
(f) Audible textual notification appliances (speakers and other appliances to convey voice messages)	X	Annually	Measure sound pressure level with a sound level meter meeting ANSI S1.4a, *Specifications for Sound Level Meters*, Type 2 requirements. Measure and record levels throughout protected area. Set the sound level meter in accordance with ANSI S3.41, *American National Standard Audible Evacuation Signal*, using the time-weighted characteristic F (FAST). Record the maximum output when the audible emergency evacuation signal is on. Verify audible information to be distinguishable and understandable.

Table 14.4.3.2 *Continued*

Component	Initial Acceptance	Periodic Frequency	Method
(g) Visible	X	Annually	Perform test in accordance with manufacturer's published instructions. Verify appliance locations to be per approved layout and confirm that no floor plan changes affect the approved layout. Verify that the candela rating marking agrees with the approved drawing. Confirm that each appliance flashes.
(h) Control unit functions and no diagnostic failures are indicated	X	Annually	Review event log file and verify that the correct events were logged. Review system diagnostic log file; correct deficiencies noted in file. Delete unneeded log files. Delete unneeded error files. Verify that sufficient free disk space is available. Verify unobstructed flow of cooling air is available. Change/clean filters, cooling fans, and intake vents.
(i) Control unit reset	X	Annually	Power down the central control unit computer and restart it.
(j) Control unit security	X	Annually	If remote control software is loaded onto the system, verify that it is disabled to prevent unauthorized system access.
(k) Audible/visible functional test	X	Annually	Send out an alert to a diverse set of predesignated receiving devices and confirm receipt. Include at least one of each type of receiving device.
(l) Software backup	X	Annually	Make full system software backup. Rotate backups based on accepted practice at site.
(m) Secondary power test	X	Annually	Disconnect ac power. Verify the ac power failure alarm status on central control equipment. With ac power disconnected, verify battery voltage under load.
(n) Wireless signals	X	Annually	Check forward/reflected radio power is within specifications.
(o) Antenna	X	Annually	Check forward/reflected radio power is within specifications. Verify solid electrical connections with no observable corrosion.
(p) Transceivers	X	Annually	Verify proper operation and mounting is not compromised.

[a]Some transmission equipment (such as but not limited to cable modems, fiber-optic interface nodes, and VoIP interfaces) are typically powered by the building's electrical system using a standby power supply that does not meet the requirements of this Code. This is intended to ensure that the testing authority verifies full standby power as required by Chapter 10. Additionally, refer to Table 14.4.3.2, Items 7 through 9 for secondary power supply testing.

[b]The automatic transmission of the check-in (handshake) signal can take up to 60 minutes to occur.

[c]See Table 14.4.3.2, Item 4(a) for the testing of transmission equipment.

[d]Example: 4000 mAh × 1/25 = 160 mA charging current at 77°F (25°C).

[e]The voltmeter sensitivity has been changed from 1000 ohms per volt to 100 ohms per volt so that the false ground readings (caused by induced voltages) are minimized.

[f]Initiating devices such as smoke detectors used for elevator recall, closing dampers, or releasing doors held in the open position that are permitted by the Code *(see* NFPA *101, Life Safety Code, 9.6.3)* to initiate supervisory signals at the fire alarm control unit (FACU) should be tested at the same frequency (annual) as those devices when they are generating an alarm signal. They are not supervisory devices, but they initiate a supervisory signal at the FACU.

[g]Fusible thermal link detectors are commonly used to close fire doors and fire dampers. They are actuated by the presence of external heat, which causes a solder element in the link to fuse, or by an electric thermal device, which, when energized, generates heat within the body of the link, causing the link to fuse and separate.

[h]Note, it is customary for the manufacturer of the smoke detector to test a particular product from an aerosol provider to determine acceptability for use in smoke entry testing of their smoke detector/ smoke alarm. Magnets are not acceptable for smoke entry tests.

[i] There are some detectors that use magnets as a manufacturer's calibrated sensitivity test instrument.

[j]For example, it might not be possible to individually test the heat sensor in a thermally enhanced smoke detector.

[k]Manufacturer's instructions should be consulted to ensure a proper operational test. No suppression gas or agent is expected to be discharged during the test of the solenoid. See Test Plan of 14.2.10.

[l]Testing of CO device should be done to the requirements of NFPA 720, *Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment.*

[m]A monitor module installed on an interface device is not considered a supervisory device and therefore not subject to the quarterly testing frequency requirement. Test frequencies for interface devices should be in accordance with the applicable standard. For example, fire pump controller alarms such as phase reversal are required to be tested annually. If a monitor module is installed to identify phase reversal on the fire alarm control panel, it is not necessary to test for phase reversal four times a year.

[n]Chapter 18 would require 15 dB over average ambient sound for public mode spaces. Sometimes the ambient sound levels are different from what the design was based upon. Private operating mode would require 10 dB over average ambient at the location of the device.

[o]Where building, system, or occupancy changes have been observed, the owner should be notified of the changes. New devices might need to be installed and tested per the initial acceptance testing criteria.

[p]See A.14.4.3.2, and Table 14.4.3.2, Item 24.