FPT

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-AHU-1A**
Service:	VIVARIUM	System:	Air Side
Location:	ROOF		Table of Contents

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-AHU-1A**
Service:	VIVARIUM	System:	Air Side
Location:	ROOF	Test:	1 of 4

Test   AHU - Hardwired safeties

Description   Safety device(s) shutdown shall be hardwired and independent of DDC system controls.

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate an alarm condition	1. Unit shuts down		

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Reset controls to normal operating mode	1. Unit returns to pretest mode of operation		

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-AHU-1A**
Service:	VIVARIUM	System:	Air Side
Location:	ROOF	Test:	2 of 4

Test   AHU - Duct static pressure control

Description   DDC monitors supply duct static pressure and regulates fan VFD speed to maintain duct static pressure set point

Date of Test

Test Procedure A	Expected Results	Pass/Fail	Notes
1. Adjust duct static pressure set point to 20% above normal	1. Supply fan VFD modulates to maintain duct static pressure set point	☐	

Test Procedure B	Expected Results	Pass/Fail	Notes
1. Adjust duct static pressure set point to 20% below normal	1. Supply fan VFD modulates to maintain duct static pressure set point	☐	

Test Procedure C	Expected Results	Pass/Fail	Notes
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-AHU-1A**
Service:	VIVARIUM	System:	Air Side
Location:	ROOF	Test:	3 of 4

Test	AHU - Supply air temperature reset
Description	DDC monitors all zone cooling demands. Reset supply air temperature set point between 65 Deg.F and 55 Deg.F as follows every 15 minutes, based on the zone with the highest cooling demand: Demand above 90% decrease set point by 1 Deg.F; 66%-89% no change; under 65% increase set point by 1 Deg.F.

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust one VAV damper above 90% and all others to 75%	1. At 15 minute intervals supply air temperature set point is reduced by 1 degF		

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust all VAV dampers to 75%	1. After 15 minutes there is no change to the supply air temperature set point		

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust one VAV damper below 65% and all others to 75%	1. At 15 minute intervals supply air temperature set point is increased by 1 degF		

Test Procedure D	*Expected Results*	*Pass/Fail*	*Notes*
1. Repeat procedures A, B, and C for each VAV box so that every box is verified to effect SAT reset	1. All results from procedures A, B, and C passed for each VAV box		

Test Procedure E	*Expected Results*	*Pass/Fail*	*Notes*
1. Release all overrides	1. Unit returns to pretest mode of operation		

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-AHU-1A**
Service:	VIVARIUM	System:	Air Side
Location:	ROOF	Test:	4 of 4

Test	**AHU Zone Control - Unoccupied Heating and Cooling**
Description	(Heating) If at least 60% of the zone controllers signal a night heating requirement, the AHU fan will start. The system will be controlled as in occupied mode. (Cooling) If at least 25% of the zone controllers signal a night cooling requirement, the AHU fan system will be cycled on. The supply fan will be controlled as in the occupied mode. Recommend AHU remain off during heating.

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Heating - Adjust schedule to switch unit to unoccupied mode	1. Supply fan off	☐	
	2. Return air damper 100% open	☐	
	3. Economizer OSA damper 0% open	☐	
	4. Electric heat disabled	☐	
	5. Chilled water valve 0% open	☐	

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Heating - Override OSA temp below heating lockout setpoint	1. Supply fan on	☐	
2. Adjust 60% of the terminal units NSB heating setpoints to 10°F above current space temps	2. Mixed air dampers modulate to maintain minimum OSA	☐	
	3. At min OSA heating is enabled to maintain setpoint	☐	

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Test Procedure D	*Expected Results*	*Pass/Fail*	*Notes*
1. Cooling - Adjust schedule to switch unit to unoccupied mode	1. Supply fan off	☐	
	2. Return air damper 100% open	☐	
	3. Economizer OSA damper 0% open	☐	
	4. Electric heat disabled	☐	
	5. Chilled water valve 0% open	☐	

Test Procedure E	*Expected Results*	*Pass/Fail*	*Notes*
1. Cooling - Override OSA temp to 62°F	1. Supply fan on	☐	
2. Adjust 25% of terminal unit's NSB cooling setpoints lower	2. Mixed air dampers modulate to maintain setpoint	☐	
	3. At 100% OSA chilled water	☐	

Functional Performance Testing

Project:	VAPA - Research VMU		Unit ID:	**710-AHU-1A**
Service:	VIVARIUM		System:	Air Side
Location:	ROOF		Test:	4 of 4

than current space temp	valve modulates to maintain setpoint		

Test Procedure F	*Expected Results*	*Pass/Fail*	*Notes*
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

End of Functional Performance Testing for 710-AHU-1A

Comments

Tested By:		Witnessed By:	
Representing:		Representing:	

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-FC-1-01**
Service:	FAN COIL UNIT	System:	Air Side
Location:			Table of Contents

Test	FPT ID	FPT Name	Tested By	Date	%
1	FCU COOL	Fan Coil Unit - Cooling Only			0

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-FC-1-01**
Service:	FAN COIL UNIT	System:	Air Side
Location:		Test:	1 of 1

Test   Fan Coil Unit - Cooling Only

Description   In occupied mode, the outside air damper opens the fan runs continuously, and in unoccupied mode the fan cycles with cooling demand. On fall in room temperature the cooling coil valve modulates open to maintain zone temperature set point.

Date of Test

Test Procedure A	Expected Results	Pass/Fail	Notes
1. Adjust schedule to put unit into occupied mode. 2. Adjust setpoints to force unit into deadband mode.	1. Supply fan on 2. Chilled water valve 0% open	☐ ☐	

Test Procedure B	Expected Results	Pass/Fail	Notes
1. Adjust setpoints to force unit into cooling mode.	1. Supply fan on 2. Chilled water valve modulates to maintain temperature set point	☐ ☐	

Test Procedure C	Expected Results	Pass/Fail	Notes
1. Adjust schedule to switch unit to unoccupied mode 2. Adjust setpoints to force Room Terminal Unit into deadband mode.	1. Supply fan off 2. Chilled water valve 0% open	☐ ☐	

Test Procedure D	Expected Results	Pass/Fail	Notes
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project: VAPA - Research VMU

Service: FAN COIL UNIT

Location:

Unit ID: **710-FC-1-01**

System: Air Side

Signature Page

End of Functional Performance Testing for 710-FC-1-01

<u>Comments</u>

Tested By:

Representing:

Witnessed By:

Representing:

Functional Performance Testing

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-HS-1A**
Service:	STEAM HUMIDIFIER	System:	Air Side
Location:	710-AHU-1A	Test:	1 of 1

Test   Humidifier Operation

Description   The humidifier valve modulates the steam into the air flow to maintain the Relative Humidity (RH) set point at the sensor.

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoint to call for an increase in RH	1. Steam valve modulates steam output to maintain RH setpoint	☐	

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoint to call for a decrease in RH	1. Steam valve modulates steam output to maintain RH setpoint	☐	

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate a fan failure by disconnecting power to the fan or manually stopping the VFD	1. Humifier shuts down	☐	

Test Procedure D	*Expected Results*	*Pass/Fail*	*Notes*
1. Reset controls to normal operating mode	1. Humidifier modulates steam output to maintain RH setpoint	☐	

Test Procedure E	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate a high humidity in the duct, greater than 85%RH	1. Humifier valve throttles back to maintain humidity high limit setpoint in the duct	☐	

Test Procedure F	*Expected Results*	*Pass/Fail*	*Notes*
1. Reset controls to normal operating mode	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project: VAPA - Research VMU   Unit ID: **710-HS-1A**
Service: STEAM HUMIDIFIER   System: Air Side
Location: 710-AHU-1A   Signature Page

End of Functional Performance Testing for 710-HS-1A

Comments

Tested By:		Witnessed By:	
Representing:		Representing:	

HDR

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-SS-1-01**
Service:	DX SPLIT SYSTEM	System:	Air Side
Location:			Table of Contents

Test	FPT ID	FPT Name	Tested By	Date	%
1	AC SS OPER	Split-System AC unit cooling operation			0
2	AC SS Alarms	Split System AC Alarms			0

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-SS-1-01**
Service:	DX SPLIT SYSTEM	System:	Air Side
Location:		Test:	1 of 2

Test	Split-System AC unit cooling operation
Description	On a call for cooling evaporator fan starts (if not already running in continuous fan mode); condensing unit fan and compressor start. Supply air temperature drops and stabilizes at nominal level for proper cooling effect.
	On removal of cooling call, condensing unit fan and compressor stop; evaporator fan stops (unless set in continuous fan mode).

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoints to force unit into cooling mode. 2. Adjust sepoints to end call for pump operation 3. Adjust RH setpoint to 55%RH 4. new one	1. Supply fan on 2. Condenser fan and compressor are operating	☐ ☐	

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoints to force unit into deadband mode.	1. Supply fan off 2. Condenser fan and compressor are off	☐ ☐	

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-SS-1-01**
Service:	DX SPLIT SYSTEM	System:	Air Side
Location:		Test:	2 of 2

Test | Split System AC Alarms

Description DDC shall monitor Temperature and Humidity in space served by AC unit.

If Temperature rises above high limit temperature set point, an alarm is generated at DDC panel.

If Humidity rises above the high humidity alarm set point, an alarm is generated at DDC panel.

If Humidity drops below the low humidity alarm set point, an alarm is generated at DDC panel.

All alarms clear when space temperature or humidity recover from alarm condition.

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate a high space temperature	1. Alarm is displayed at DDC operator workstation	☐	

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate a high space humidity	1. Alarm is displayed at DDC operator workstation	☐	

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate a low space humidity	1. Alarm is displayed at DDC operator workstation	☐	

Test Procedure D	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoint back to it's original setpoint	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-SS-1-01**
Service:	DX SPLIT SYSTEM	System:	Air Side
Location:			Signature Page

End of Functional Performance Testing for 710-SS-1-01

<u>Comments</u>

Tested By: _____   Witnessed By: _____

Representing: _____   Representing: _____

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-TU-01-01**
Service:	1-221 / 1-223	System:	Air Side
Location:			Table of Contents

Test	FPT ID	FPT Name	Tested By	Date	%
1	VAVRH-OCC	VAV with reheat temperature control occupied mode			0
2	VAVRH-UNOCC	VAV with reheat - unoccupied mode			0

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-TU-01-01**
Service:	1-221 / 1-223	System:	Air Side
Location:		Test:	1 of 2

Test	VAV with reheat temperature control occupied mode
Description	In dead band primary air is at minimum and heat is off. On rise in room temperature primary valve modulates open to maintain zone temperature. On a drop in temperature primary valve is set to minimum position and heat cycles to maintain zone temperature.

Date of Test

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoints to force unit into cooling mode.	1. Primary air valve modulates open to maintain zone temperature	☐	
	2. Heat is disabled	☐	

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Adjust setpoints to force unit into heating mode.	1. Primary air valve is at minimum position	☐	
	2. Heat modulates to maintain setpoint	☐	

Test Procedure D	*Expected Results*	*Pass/Fail*	*Notes*
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**710-TU-01-01**
Service:	1-221 / 1-223	System:	Air Side
Location:		Test:	2 of 2

Test   VAV with reheat - unoccupied mode

Description   In dead band primary air valve is closed. On rise in room temperature primary valve modulates open to maintain zone temperature (if primary air is available). On a drop in temperature primary valve is closed and electric heat cycles to maintain zone temperature.   In unoccupied mode the heating and cooling set points are adjusted to increase the dead band.

Date of Test

Test Procedure A	Expected Results	Pass/Fail	Notes
1. Adjust schedule to switch unit to unoccupied mode	1. Primary air damper is fully closed	☐	
2. Adjust setpoints to force unit into deadband mode.	2. Supply fan off	☐	
	3. Heat is disabled	☐	

Test Procedure B	Expected Results	Pass/Fail	Notes
1. Adjust setpoints to force unit into cooling mode.	1. Primary air valve modulates open to maintain zone temperature	☐	
	2. Supply fan off	☐	
	3. Heat is disabled	☐	
	4. Unit controls to maintain NSB set points	☐	

Test Procedure C	Expected Results	Pass/Fail	Notes
1. Adjust setpoints to force unit into heating mode.	1. Primary air damper is fully closed	☐	
	2. Supply fan on	☐	
	3. Supply fan cycles as first stage heat to maintain temperature setpoint	☐	
	4. On further call for heat, with supply fan on, heat cycles to maintain temperature setpoint	☐	
	5. Unit controls to maintain NSB set points	☐	

Test Procedure D	Expected Results	Pass/Fail	Notes
1. Release all overrides	1. Unit returns to pretest mode of operation	☐	

Functional Performance Testing

Project: VAPA - Research VMU
Service: 1-221 / 1-223
Location:

Unit ID: **710-TU-01-01**
System: Air Side
Signature Page

End of Functional Performance Testing for 710-TU-01-01

<u>Comments</u>

Tested By: Witnessed By:

Representing: Representing:

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**ATS-A**
Service:	AUTOMATIC XFER SWITCH	System:	Electrical System
Location:			Table of Contents

Test	FPT ID	FPT Name	Tested By	Date	%
1	ATS	Automatic Transfer Switch Operation			0

Functional Performance Testing

Project:	VAPA - Research VMU	Unit ID:	**ATS-A**
Service:	AUTOMATIC XFER SWITCH	System:	Electrical System
Location:		Test:	1 of 1

Test   Automatic Transfer Switch Operation

Description   Upon sensing a loss of normal power, for the programmed time interval, the ATS signals the generator to start. When emergency power has been available for the programmed time interval, the ATS transfers load to emergency power. When normal power has been available for the programmed time interval, the ATS transfers load to normal power. After the programmed cool-down time delay, the ATS signals the generator to stop.

While on emergency power, if the generator fails and normal power is available the ATS will transfer back to normal power immediately. If neither power source is available the ATS moves to the open position of both busses. Upon return of either power source the ATS will switch to the available source after the programmed time interval.

Date of Test

Test Procedure A	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate loss of normal power	1. ATS signals generator to start	☐	
	2. ATS switches to emergency power when available and after proper time interval	☐	

Test Procedure B	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate loss of normal power 2. Simulate loss of emergency power	1. ATS switches to the open position between both busses	☐	

Test Procedure C	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate loss of normal power 2. Simulate return of emergency power	1. ATS switches to emergency power when available and after proper time interval	☐	

Test Procedure D	*Expected Results*	*Pass/Fail*	*Notes*
1. Simulate return of normal power	1. ATS switches to normal power after proper time interval	☐	
	2. ATS signals the generator to stop after proper cool-down time delay	☐	

Functional Performance Testing

Project: VAPA - Research VMU

Service: AUTOMATIC XFER SWITCH

Location:

Unit ID: **ATS-A**

System: Electrical System

Signature Page

End of Functional Performance Testing for ATS-A

Comments

Tested By: _____

Representing: _____

Witnessed By: _____

Representing: _____