

[REDACTED]

[REDACTED]

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

**HVAC SYSTEMS, DOMESTIC HOT WATER,
AND LIGHTING CONTROLS**



**US Army Corps
of Engineers**

[REDACTED]

COMMISSIONING PLAN: October 2013

Contract Number: [REDACTED]

Warriors In Transition Small Co HQ Building
Fort [REDACTED]

CONSTRUCTION PHASE COMMISSIONING PLAN

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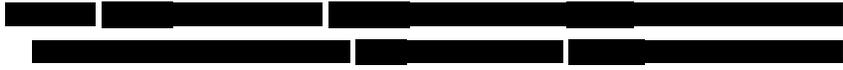
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Warriors In Transition Small Co HQ Building
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CONSTRUCTION PHASE COMMISSIONING PLAN

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**Warriors In Transition Small Co HQ Building
Fort [REDACTED]**

CONSTRUCTION PHASE COMMISSIONING PLAN

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**Warriors In Transition – Small Co HQ Building
Fort [REDACTED]**

COMMISSIONING TEAM

<u>Function</u>	<u>Name/Firm</u>
Contracting Officer	[REDACTED]
Protect Architect	[REDACTED]
Mechanical Engineer (ME)	[REDACTED]
Electrical Engineer (EE)	[REDACTED]
Construction Manager/General Contractor	[REDACTED]
Mechanical Contractor	[REDACTED]
Plumbing Contractor	[REDACTED]
Electrical Contractor	[REDACTED]
Controls Contractor, Project Manager	
TAB Contractor	
Commissioning Administrator	[REDACTED]
Commissioning Authority (CxA)	[REDACTED]
Building Envelope Commissioning Agent	[REDACTED]
Thermographer – Commissioning Agent	[REDACTED]

Abbreviations:

FCG – Facility Commissioning Group
TAB – Testing, Adjusting and Balancing

**Warriors In Transition
Small Co HQ Building
Fort ██████████**

Project Contract No. ██████████

SPECIFICATION SECTIONS 019100.0040/230800.0010

INSTRUCTIONS

Appendix A includes the Pre-Commissioning Checklists. Appendix B contains the Functional Performance Tests (FPT's). System Verification Checklists will be completed by installing contractors as a prerequisite to scheduling FPT's. Functional Performance Tests will be performed in accordance with the schedule denoted below by the entire Commissioning Team. If sufficient progress occurs during FPT's, this schedule will be accelerated to use complete morning and afternoon sessions by moving to the next scheduled test to fill out days, if possible. Systems will be tested for compliance with the Sequence of Operation indicated on contract drawings. Appendix C has a copy of the Commissioning Specifications 019100.0040 & 230800.0010, and Common Commissioning Acronyms.

Functional Performance Tests (FPT's) SCHEDULE

Pre-Commissioning Checks, Test and Balance and HVAC Controls Performance Verification Tests will be completed before starting functional performance tests.

Day 1, Morning: Domestic Hot Water, Lighting Controls **Date: ___/___/___**

Day 1, Afternoon: HVAC Systems **Date: ___/___/___**

Day 2, Morning: HVAC Systems **Date: ___/___/___**

Day 2, Afternoon: HVAC Systems **Date: ___/___/___**



Resolution Tracking Form Instructions

Project: **Warriors In Transition – Small Co HQ Building**

Date: **May 13, 2013**

Prepared by: 

- Facility Commissioning Group uses RTF's to document site observations and other issues that require follow-up and documentation of resolution.
- We do not recommend "means and methods" to contractors. Our goal is to help everyone communicate effectively and create a permanent record of issues, corrective actions and results.
- We do document the steps taken to resolve outstanding issues and results of those actions.
- Each issue is assigned a specific item number will remain on the list until it is resolved.
- Updates will be dated and listed in the update/resolution column.
- Final resolution will be shown in bracketed, bold, italicized lettering before the item is removed from the list.
- RTF's are updated as required. Therefore, they will be updated more frequently as the Temperature Controls and TAB work are completed.
- RTF photos corresponding to an RTF issue will be produced on a separate word document from the RTF excel document. The excel document will indicate the associated RTF photo which then can be found on the corresponding RTF photo document.

Please let us know if you have any questions.



*Warriors In Transition
Small Co HQ Building
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Appendix A

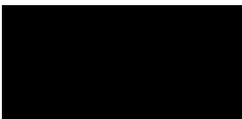
*Pre-Functional Performance Test
Checklists*



*Warriors In Transition
Small Co HQ Building
Fort [REDACTED]*

Supply Air System

*Pre-Functional Performance Test
Checklists*



Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Water-Source HP AHU**

Tag: **AHU-1**

Service: **VAV's**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Spec. 230000-2.11				MC
Installation is per manufacturers written instructions, Spec. 230000-3.2, 238147-3.1				MC
Equipment label permanently affixed, Spec. 230000-1.2.2				MC
Service access, Spec. 238147-1.9.3, 3.1.1				MC
Unit Mounted on Housekeeping Pad, M-504				MC
Vibration isolation provided for compressor, Spec. 238147-2.1.1.e				MC
MERV 8 Throwaway Filter(s) Provided, Spec. 238147-2.1.1.d				MC
Filter Differential Pressure Sensor (DP-01), M-703/Detail 1				MC
Piping				
DX Cooling Coil, M-703/Detail 1				MC
Reversing Valve, Spec. 238147-2.1.1.f				MC
Hose kits, Spec. 238147-2.1.1.h				MC
Strainer installed, Spec. 238147-2.1.1.h				MC
Blown Down Ball Valve, Spec. 238147-2.1.1.h				MC
Shut off ball valves w/ memory stops installed, Spec. 238147-2.1.1.h				MC
Flow Control Valve with Test Ports, Spec. 238147-2.1.1.h				MC
Refrigerant-to-Water Heat Exchanger, Spec. 238147-2.1.1.g				MC
Unit Drain Trap, M-501/Detail 3				MC
Fans				
Spec. 230000-2.11.2.4, M-703				MC
Louver				
Unit Connected to Louver LV-1, M-101, M-401				SM
Louver installed in accordance with manufacturer's recommendations and appropriate for wall construction, Spec. 089100-3.1.1				SM
Outside Air Louver Damper, M-101				SM

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

"This Pre-Functional Performance Test Checklist represents ██████ standard test protocol, basic functional test, and ██████ best understanding of the designed sequence of operation. This document DOES NOT define design intent, supersede contract documents, or direct means & methods."

Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: **Water-Source HP AHU**

Tag: **AHU-1**

Service: **VAV's**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Dampers				
Economizer Outside Air Damper (DA-01), M-703/Detail 1				MC
ERV Outside Air Damper (DA-02), M-703/Detail 1				MC
Mixed Return Air Damper (DA-03), M-703/Detail 1				MC
Economizer Relief Air Damper (DA-04), M-703/Detail 1				MC
Electrical				
208V AC 3 Phase Wired to Panel MDP/Correct Circuit(s), E-601				EC
60A Trip Circuit Breaker, E-601				EC
Disconnect Wired				EC
Electrical Connections Tight				EC
Grounding Connected to Unit, Spec. 262000-3.1.13				EC
Safeties Installed and Operational				EC
Controls				
Unit Controller, Spec. 238147-2.1.1.j				CC
Unit Interlocked to Emergency Shutdown, M-703				CC
Space Temperature Controls, Spec. 238147-2.1.1.k				CC
High pressure switch for compressor(s), Spec. 238147-2.1.1.e				CC
Low pressure switch for freeze protection on compressor(s), Spec. 238147-2.1.1.e				CC
Control devices and wiring have been factory wired and mounted in control panel, Spec. 238147-2.1.1.j				CC
DDC programming complete, M-703, Spec. 238147-2.12				CC
Point-to-Point Checkout Complete, M-703				CC
Supply Smoke Detector (SD-01), M-703/Detail 1, M-503/Detail 2				CC MC
VFD's (Supply and Relief Fans)				
Installation In Accordance With Recommendations of VFD Manufacturer In Installation Manual, Spec. 262923-3.1				MC
Wiring and Power for VFD				MC
Interfaced into DDC System, M-703				MC
VFD Powered (wired to controlled equipment)				EC
Drive Size Matches Motor Size				MC
Permanent Label Affixed and UL Stamp Approved				MC
Operation Checked in HAND, OFF, AUTO and Bypass				MC

Installing Contractors: **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition – Small Co HQ Building

Fort ██████████

System: **Water-To-Water Heat Pump**
 Location: **Mech. Room A106**

Tag: **WTW-1**

Service: **Geothermal Loop**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installation is per manufacturers written instructions, Spec. 230000-3.2, 238147-3.1.1				MC
Equipment label permanently affixed, Spec. 230000-1.2.2				MC
Service access, Spec. 238147-1.9.3, 3.1.1				MC
Unit Mounted on Housekeeping Pad, M-504				MC
Vibration isolation provided for compressor, Spec. 238147-2.1.2.b				MC
Sound Attenuation, Spec. 238147-2.1.2.b				MC
Piping				
Reversing Valve, Spec. 238147-2.1.2.c				MC
Hose kits, Spec. 238147-2.1.2.e, M-502/Detail 6				MC
Strainer installed, Spec. 238147-2.1.2.e				MC
Blown Down Ball Valve, Spec. 238147-2.1.2.e				MC
Shut off valves with memory stops installed, Spec. 238147-2.1.2.e				MC
Flow Switch (FS-02), M-702/Detail 1				MC
Flow Control Valve with Test Ports, Spec. 238147-2.1.2.e				MC
Refrigerant-to-Water Heat Exchanger, Spec. 238147-2.1.1.g				MC
Electrical				
Unit Wired (208V/3Ph.) to Panel RP3/Circuits 17/19/21, E-602				EC
Disconnect Wired				EC
Electric Connections Tight				EC
Grounding connected to unit, Spec. 262000-3.1.13				EC
Properly Sized Circuit Breaker (40A); Complies With Manufacturer's Recommendations, E-602				EC
Safeties Installed and Operational				EC
Controls				
Unit Controller, Spec. 238147-2.1.2.g				CC
High and low pressure switches for compressor(s), Spec. 238147-2.1.2.b				CC

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Energy Recovery Unit**

Tag: **ERV-1**

Service: **Ventilation**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installation Per Mfr. Instructions/Recommendations, Spec. 230000-3.2				MC
Permanent Equipment Labels Affixed, Spec. 2300000-1.2.2				MC
Provide an equipment pad for unit				MC
Casing condition good: no dents, leaks, door gaskets installed				MC
Access doors close tightly - no leaks				MC
Service access				MC
Ductwork				
Duct joint sealant properly installed				MC
No apparent severe duct restrictions				MC
Flexible duct connections for unit connections				MC
Supply smoke detector (SD-01), M-705				MC CC
Filter and Dampers				
MERV 8 2" Filters Provided				MC
OA Filter Switch (DP-01), M-705/Detail 1				MC
EA Filter Switch (DP-02), M-705/Detail 1				MC
Outside Air Damper installed, M-705				MC
OA Airflow Measuring Station (AFMS-01), M-705/Detail 1				MC
Exh./Relief Airflow Measuring Station (AFMS-02), M-705/Detail 1				
Exhaust Air Damper installed, M-705				MC
Dampers Interlocked to Respective Fan, M-705				CC
Electrical				
Unit Wired (208V/3Ph) to Panel RP3/Circuits 31/33/35, E-602				EC
Electrical Connections Tight				EC
Properly Sized Circuit Breaker (15A); Complies with Manufacturer's Recommendation, E-602				EC
Power disconnects located within site of the unit it controls				EC
Grounding installed for components and unit, Spec. 262000-3.1.13				EC

Installing Contractors: **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Energy Recovery Unit**

Tag: **ERV-1**

Service: **Ventilation**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Controls				
Unit Interlocked to Emergency Shutdown, M-705				CC
Energy Exchange Core, M-705				CC
DDC Programming Complete, M-705				CC
Point-to-Point Checkout Complete, M-705				CC
Temperature Monitoring by DDC, M-705				CC
Sensors				
CO2 Gas Sensor [GS-01] (In Room A138), M-705/Detail 1				CC
Entering Air Temperature Sensor (TS-03), M-705/Detail 1				CC
OA Discharge Air Temperature Sensor (TS-02), M-705/Detail 1				CC
OA Leaving Air Temperature Sensor (TS-01), M-705/Detail 1				CC
VFD (Supply Fan and Relief Fan)				
Installation In Accordance With Recommendations of VFD Manufacturer In Installation Manual, Spec. 262923-3.1				MC
Wiring and Power for VFD				MC
Interfaced into DDC System, M-705/Detail 1				MC
VFD Powered (wired to controlled equipment)				EC
Drive Size Matches Motor Size				MC
Permanent Label Affixed and UL Stamp Approved				MC
Operation Checked in HAND, OFF, AUTO and Bypass				MC
Safeties Are Active In All Modes				MC
Startup				
Written Report of Startup Results Prepared And Provided				MC
Testing, Adjusting, and Balancing (TAB)				
TAB Contractor Has Completed And Submitted TAB Report For Engineer Review				MC

<i>Notes:</i>

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

Typical VAV Terminal Units

Tag: VAV-(Unit Number)

Mechanical Contractor (MC)

- Manufacturer and Model Number
- Equipment Identification Affixed, Specification 230000-1.2.2
- Installation Per Manufacturer's Instructions/Recommendations, 230000-3.2
- Installation Is Level and Plumb
- Maintain Unit Access Clearances
- Sound Attenuation Installed, M-501/Detail 1
- Attach Flow Chart To Unit, Specification 230000-2.12.1.c

Hot Water Reheat Coil Piping

- Unions Installed, M-502/Detail 3
- PT Plugs Installed, M-502/Detail 3
- Drain Valve Installed, M-502/Detail 3
- Shutoff Valve Installed (Supply), M-502/Detail 3
- Balancing/Shutoff Valve Installed (Return), M-502/Detail 3
- 2-Way Control Valve Installed (VA-02), M-502/Detail 3, M-704/Detail 1
- Initial and Date for Each Unit

Sheet Metal Contractor (SMC)

- Volume Control Damper(s) Installed With Spin Collar for Each Grille and Diffuser, M-501/Detail 5 & 1, M-101
- VAV Terminal Box Damper (DA-04), M-704/Detail 1
- 4 Diameters Min. Straight Run of Duct Before Connecting to VAV Box, M-501/Detail 1
- Flexible Connections Used to Connect Ductwork To Unit, M-501/Detail 1
- Correct Number of Grilles and Diffusers Installed, M-101
- Initial and Date for Each Unit

Electrical Contractor (EC)

- Unit Wired To Panel RP3 and Correct Circuit, E-602
- 20A Trip Circuit Breaker, E-602
- Toggle Disconnect Switch, M-601
- Initial and Date for Each Unit

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Split System AC Unit**

Tag: **FCU-1**

Service: **Communication A102**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed in accordance with manufacturer's instructions, Spec. 230000-3.2, 238100.0020-3.1				MC
Permanent label affixed, Spec. 230000-1.2.2				MC
Casing condition good: no dents, leaks, door gaskets installed				MC
No excessive vibration or unusual Noise				MC
Access doors close tightly – no leaks				MC
Installed level and plumb, Spec. 238100.0020-3.1				MC
Unit installed to provide clearance for proper operation and maintenance, Spec. 238100.0020-3.1				MC
Refrigerant Piping Installation, Spec. 238100.0020-3.2.2				MC
FCU-1 Unit				
Drain Pan/Connection Line(s), Spec. 238100.0020-3.3				MC
Condensate Drain Extended to Floor Drain, M-102				MC
Refrigerant Shutoff Valves (Omit If Included With Unit)				MC
Filter(s), Spec. 238100.0020-2.1.7, 2.2, 3.5				MC
Strainer, Spec. 238100.0020-3.2.5				MC
Refrigerant Drier (If Not Furnished by Mfr.), Spec. 238100.0020-3.2.4				MC
Sight Glass Indicator (If Not Furnished by Mfr.), Spec. 238100.0020-3.2.4				MC
ACCU-1 Unit				
Unit Installed On Housekeeping Pad, M-102/Note 4				MC
Refrigerant Line(s) Insulated From Outdoor Unit to Indoor Unit				MC
Electrical				
Unit Wired (208V/1Ph.) wired to Panel CP1/Circuits 6/8, E-602				EC
Properly Sized Circuit Breaker (40A); Complies with Manufacturer's Recommendation, E-602				EC
Disconnect switch provided/wired				EC
Electrical connections tight				EC

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: **Hydronic Accessories**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Expansion Tank (ET-1) Service: Heating Hot Water				
Manufacturer/Model #:				MC
Equipment label affixed, Spec. 230000-1.2.2				MC
Vent & purge air from hydronic system, & ensure tank is properly charged with air to suit system Project requirements				MC
Field charge expansion tanks to required air pressure				MC
Maintenance clearance				MC
Gauge glass with petcocks, M-502/Detail 2				MC
Unions installed, M-502/Detail 2				MC
¾" Drain line with gate valve, M-502/Detail 2				MC
Gate valves installed, M-502/Detail 2				MC
Reducing valve installed, M-502/Detail 2				MC
Relief valve installed, M-502/Detail 2				MC
Check valve installed, M-502/Detail 2				MC
In-line Air Separator (AS-1) Service: Heating Hot Water				
Manufacturer/Model #:				MC
Equipment label affixed, Spec. 230000-1.2.2				MC
Install automatic air vent at high point with gate valve, M-502/Detail 2, 4				MC
Butterfly valves installed, M-502/Detail 2				MC
Drain valve installed, M-502/Detail 2				MC
Drain piping extended to nearest floor drain, M-502/Detail 2				MC
Expansion Tank (ET-2) Service: Geothermal Loop				
Manufacturer/Model #:				MC
Equipment label affixed, Spec. 230000-1.2.2				MC
Vent & purge air from hydronic system, & ensure tank is properly charged with air to suit system Project requirements				MC
Field charge expansion tanks to required air pressure				MC
Maintenance clearance				MC
Gauge glass with petcocks, M-502/Detail 2				MC
Unions installed, M-502/Detail 2				MC
¾" Drain line with gate valve, M-502/Detail 2				MC
Gate valves installed, M-502/Detail 2				MC

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Hydronic Accessories**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Expansion Tank (ET-2) Service: Geothermal Loop (continued)				
Reducing valve installed, M-502/Detail 2				MC
Relief valve installed, M-502/Detail 2				MC
Check valve installed, M-502/Detail 2				MC
In-line Air Separator (AS-2) Service: Geothermal Loop				
Manufacturer/Model #:				MC
Equipment label affixed, Spec. 230000-1.2.2				MC
Install automatic air vent at high point with gate valve, M-502/Detail 2, 4				MC
Butterfly valves installed, M-502/Detail 2				MC
Drain valve installed, M-502/Detail 2				MC
Drain piping extended to nearest floor drain, M-502/Detail 2				MC
Make-Up Water Station				
Pressure reducing valve installed, M-502/Detail 2				MC
Ball valves installed, M-502/Detail 2				MC
Unions installed, M-502/Detail 2				MC
Back flow preventer with vent, M-502/Detail 2				MC
Operational Checks				
Perform before operating system				MC
Open manual valves fully				MC
Inspect pumps for proper rotation				MC
Set makeup PRV for required pressure				MC
Inspect air vents at high points and determine if are operating freely				MC
Set temperature controls so coils are calling for full flow				MC
Inspect & set operating temperature of hydronic equipment				MC
Verify lubrication of motors & bearings				MC

<i>Notes:</i>

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Inline Pump**

Tag: **P-1**

Service: **Geothermal Loop**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installation Per Mfr. Instructions/Recommendations, Spec. 230000-3.2				MC
Permanent labels affixed, Spec. 230000-1.2.2				MC
Installed plumb and level				MC
Installed pump with access for periodic maintenance				MC
Piping				
Flange Connections, M-502/Detail 1				MC
Check valve installed (discharge), M-502/Detail 1				MC
Pressure gauge installed with ¼ Shut-Off Cocks, M-502/Detail 1				MC
Shut off/balance valve installed (discharge), M-502/Detail 1				MC
Gate Valve Installed (suction), M-502/Detail 1				MC
Electrical				
Unit Wired (208V/3Ph.) to Panel RP3/Circuit(s) 11/13/15, E-602				EC
Grounding Installed for Components and Unit, Spec. 262000-3.1.13				EC
Provide with disconnect switch				EC
Installed electrical connections for power, controls, and devices				EC
Properly Sized Circuit Breaker (20A); Complies with Manufacturer's Recommendation, E-602				EC
Controls				
DDC programming complete, M-702				CC
Point-to-Point Checkout Complete, M-702				CC

<i>Notes:</i>

Installing Contractors: **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor
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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Inline Pump**

Tag: **P-2**

Service: **Geothermal Loop**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installation Per Mfr. Instructions/Recommendations, Spec. 230000-3.2				MC
Permanent labels affixed, Spec. 230000-1.2.2				MC
Installed plumb and level				MC
Installed pump with access for periodic maintenance				MC
Piping				
Flange Connections, M-502/Detail 1				MC
Check valve installed (discharge), M-502/Detail 1				MC
Pressure gauge installed with ¼ Shut-Off Cocks, M-502/Detail 1				MC
Shut off/balance valve installed (discharge), M-502/Detail 1				MC
Gate Valve Installed (suction), M-502/Detail 1				MC
Electrical				
Unit Wired (208V/3Ph.) to Panel RP3/Circuit(s) 14/16/18, E-602				EC
Grounding Installed for Components and Unit, Spec. 262000-3.1.13				EC
Provide with disconnect switch				EC
Installed electrical connections for power, controls, and devices				EC
Properly Sized Circuit Breaker (20A); Complies with Manufacturer's Recommendation, E-602				EC
Controls				
DDC programming complete, M-702				CC
Point-to-Point Checkout Complete, M-702				CC

<i>Notes:</i>

Installing Contractors: **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor
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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Inline Pump**

Tag: **P-3**

Service: **Geothermal Loop**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installation Per Mfr. Instructions/Recommendations, Spec. 230000-3.2				MC
Permanent labels affixed, Spec. 230000-1.2.2				MC
Installed plumb and level				MC
Installed pump with access for periodic maintenance				MC
Piping				
Flange Connections, M-502/Detail 1				MC
Check valve installed (discharge), M-502/Detail 1				MC
Pressure gauge installed with ¼ Shut-Off Cocks, M-502/Detail 1				MC
Shut off/balance valve installed (discharge), M-502/Detail 1				MC
Gate Valve Installed (suction), M-502/Detail 1				MC
Electrical				
Unit Wired (208V/3Ph.) to Panel RP3/Circuit(s) 2/4/6, E-602				EC
Grounding Installed for Components and Unit, Spec. 262000-3.1.13				EC
Provide with disconnect switch				EC
Installed electrical connections for power, controls, and devices				EC
Properly Sized Circuit Breaker (15A); Complies with Manufacturer's Recommendation, E-602				EC
Controls				
DDC programming complete, M-702				CC
Point-to-Point Checkout Complete, M-702				CC

Notes:

Installing Contractors: **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor
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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Inline Pump**

Tag: **P-4**

Service: **Geothermal Loop**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installation Per Mfr. Instructions/Recommendations, Spec. 230000-3.2				MC
Permanent labels affixed, Spec. 230000-1.2.2				MC
Installed plumb and level				MC
Installed pump with access for periodic maintenance				MC
Piping				
Flange Connections, M-502/Detail 1				MC
Check valve installed (discharge), M-502/Detail 1				MC
Pressure gauge installed with ¼ Shut-Off Cocks, M-502/Detail 1				MC
Shut off/balance valve installed (discharge), M-502/Detail 1				MC
Gate Valve Installed (suction), M-502/Detail 1				MC
Electrical				
Unit Wired (208V/3Ph.) to Panel RP3/Circuit(s) 5/7/9, E-602				EC
Grounding Installed for Components and Unit, Spec. 262000-3.1.13				EC
Provide with disconnect switch				EC
Installed electrical connections for power, controls, and devices				EC
Properly Sized Circuit Breaker (15A); Complies with Manufacturer's Recommendation, E-602				EC
Controls				
DDC programming complete, M-702				CC
Point-to-Point Checkout Complete, M-702				CC

<i>Notes:</i>

Installing Contractors: **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor
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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

Typical VAV Terminal Units

Temperature Controls Contractor (TCC)

- Wall-Mounted (Space) Thermostat, M-704
- Airflow Sensor (AFS-01), M-704
- DDC Programming Complete, M-704
- Point-to-Point Checkout Complete, M-704
- 24V Control Transformer, M-601
- Initial and Date for Each Unit

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: **Electric Unit Heater** Tag: **EUH-1**
 Service: **Room A106**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed In Accordance With Manufacturer's Instructions, Spec. 230000-3.2				MC
Permanent Label Affixed, Spec. 230000-1.2.2				MC
Unit Service Access				MC
Mounting Hardware, M-601				MC
Electrical				
Unit Wired (208V/3Ph.) Wired To Panel RP1/Circuits 32,34,36, E-602				EC
Properly Sized Circuit Breaker (25A/3P); Complies With Manufacturer's Recommendation, E-602				EC
Verify Disconnect Located Within Sight Of Unit It Controls				EC
Disconnect Switch Provided/Wired				EC
Electrical Connections Tight				EC
Grounding Installed For Components And Unit, Spec. 262000-3.1.13				EC
Safeties Installed And Operational				EC
Controls				
TS-01: Integral Thermostat, M-601				CC

<i>Notes:</i>

Remarks: **IC**-Installing Contractor; **SM**-Sheet Metal Contractor; **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: **Electric Unit Heater** Tag: **EUH-2**
 Service: **Room A107**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed In Accordance With Manufacturer's Instructions, Spec. 230000-3.2				MC
Permanent Label Affixed, Spec. 230000-1.2.2				MC
Unit Service Access				MC
Mounting Hardware, M-601				MC
Electrical				
Unit Wired (208V/1Ph.) Wired To Panel RP1/Circuits 11,13, E-602				EC
Properly Sized Circuit Breaker (25A/2P); Complies With Manufacturer's Recommendation, E-602				EC
Verify Disconnect Located Within Sight Of Unit It Controls				EC
Disconnect Switch Provided/Wired				EC
Electrical Connections Tight				EC
Grounding Installed For Components And Unit, Spec. 262000-3.1.13				EC
Safeties Installed And Operational				EC
Controls				
TS-02: Integral Thermostat, M-601				CC

<i>Notes:</i>

Remarks: **IC**-Installing Contractor; **SM**-Sheet Metal Contractor; **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: **Electric Wall Heater** Tag: **EWH-1**
 Service: **Room A103**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed In Accordance With Manufacturer's Instructions, Spec. 230000-3.2				MC
Permanent Label Affixed, Spec. 230000-1.2.2				MC
Unit Service Access				MC
Mounting Hardware, M-601				MC
Electrical				
Unit Wired (208V/1Ph.) Wired To Panel RP1/Circuits 21,23, E-602				EC
Single Point Electrical Connection				EC
Properly Sized Circuit Breaker (20A/2P); Complies With Manufacturer's Recommendation, E-602				EC
Verify Disconnect Located Within Sight Of Unit It Controls				EC
Disconnect Switch Provided/Wired, M-601				EC
Electrical Connections Tight				EC
Grounding Installed For Components And Unit, Spec. 262000-3.1.13				EC
Safeties Installed And Operational				EC
Controls				
TS-03: Integral Thermostat, M-601				CC

<i>Notes:</i>

Remarks: IC -Installing Contractor; SM -Sheet Metal Contractor; MC -Mechanical Contractor; EC -Electrical Contractor; CC -Controls Contractor
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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: Electric Wall Heater Tag: EWH-2
 Service: Room A122

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed In Accordance With Manufacturer's Instructions, Spec. 230000-3.2				MC
Permanent Label Affixed, Spec. 230000-1.2.2				MC
Unit Service Access				MC
Mounting Hardware, M-601				MC
Electrical				
Unit Wired (208V/1Ph.) Wired To Panel RP1/Circuits 27,29, E-602				EC
Single Point Electrical Connection				EC
Properly Sized Circuit Breaker (20A/2P); Complies With Manufacturer's Recommendation, E-602				EC
Verify Disconnect Located Within Sight Of Unit It Controls				EC
Disconnect Switch Provided/Wired, M-601				EC
Electrical Connections Tight				EC
Grounding Installed For Components And Unit, Spec. 262000-3.1.13				EC
Safeties Installed And Operational				EC
Controls				
TS-04: Integral Thermostat, M-601				CC

<i>Notes:</i>

Remarks: **IC**-Installing Contractor; **SM**-Sheet Metal Contractor; **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

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Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort ██████████

System: **Exhaust Fan**

Tag: **EF-1**

Service: **Mechanical A106**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed in accordance with manufacturer's instructions, Spec. 230000-3.2				MC
Permanent label affixed, Spec. 230000-1.2.2				MC
Casing condition good: no dents, leaks, door gaskets installed				MC
Access doors close tightly – no leaks				MC
Connection between duct and unit tight and in good condition				MC
Unit installed to provide clearance for proper operation and maintenance				MC
Fans and Dampers				
Exhaust fan area clean				MC
Damper actuator installed				SM
Exhaust fan damper (DA-01), M-706/Detail 2				SM CC
Check all fasteners and set screws for tightness				SM
Ductwork/Louver				
Unit connected to louver LV-2, M-101, M-401				SM
Louver installed in accordance with manufacturer's recommendations and appropriate for wall construction, Spec. 089100-3.1.1				SM
Outside air louver damper (DA-02), M-706/Detail 2				SM CC
Duct joint sealant properly installed				SM
No apparent severe duct restrictions				SM
Electrical				
Unit Wired (110V/1Ph.) wired to Panel RP1/Circuit 2, E-602				EC
Properly Sized Circuit Breaker (15A); Complies with Manufacturer's Recommendation, E-602				EC
Disconnect switch provided/wired				EC
Electrical connections tight				EC
Grounding installed for components and unit, Spec. 262000-3.1.13				EC

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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*Warriors In Transition
Small Co HQ Building
Fort [REDACTED]*

Domestic Hot Water

*Pre-Functional Performance Test
Checklists*

[REDACTED]

Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

Typical Domestic Hot Water Fixtures

General Checks

- Plumbing Fixture and Other Components Assembled According to Manufacturer's Written Instructions
- Fixtures Installed Level and Plumb
- Pipe Fittings Complete and Properly Supported
- Aerators/Strainers In Place and Clean
- Installation Detail Checked Against The Drawing and Devices and Appurtenances Are In Place
- Associated Trim and Accessories Consistent With Contract Documents
- Joints Between Fixtures and Walls, Floors, and Counters Sealed
- Verify Hot and Cold Water Connections Are On Correct Side of Faucet

Installation Checks

- Cold Water Pipe Size Per Plumbing Fixture Schedule, P-601
- Hot Water Piping Size Per Plumbing Fixture Schedule, P-601
- Vent Pipe Size Per Plumbing Fixture Schedule, P-601
- Drain Pipe Size Per Plumbing Fixture Schedule, P-601
- Fixture Mounting/Height Per Plumbing Fixture Schedule, P-601
- Individual Stop Valves Installed In Each Water Supply to Fixture
- Piping Insulated
- Valves Accessible For Service
- Verify That Piping/Valves Have Been Labeled As Specified/Applicable
- Initial and Date for Each Unit

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Warriors in Transition - Small Co HQ Building
Pre-Functional Performance Test Checklist
 Fort [REDACTED]
 System: DHW Fixtures

#	Tag	Area Served	Dwg. #	General Checks					Installation Checks							
				Installation Work	Pipe Fittings	Trim & Access.	HW/CW Connections Verified	Initials & Date	Fixture Trap	Level & Plumb	Sealant	Stop Valves	Piping Access	Valves Access	Piping Labeled	Initials & Date
1	P-2	Men Restroom A103	P-101 P-401													
2	P-2A	Men Restroom A103	P-101 P-401													
3	P-7	Men Shower A104	P-101 P-401													
4	P-4	Janitors Closet A105	P-101 P-401													
5	P-7	Womens Shower A121	P-101 P-401													
7	P-2	Woman Restroom A122	P-101 P-401													
8	P-2A	Woman Restroom A122	P-101 P-401													
9	P-6	Kitchenette A131	P-101													

#	Date	Remarks
1		
2		
3		
4		
5		

Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

System: **Domestic Hot Water**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
HWH-1 Water Heater				
Manufacturer/Model #:				MC
Equipment Label Affixed, Spec. 220000-3.6.1				MC
Maintain Clearances to Facilitate Service/Access				MC
Installed Unit On Concrete Base, P-501/Detail 9				MC
Unit Installed Level and Plumb				MC
Thermometer, P-501/Detail 5				MC
Insulated Unions, P-501/Detail 5				MC
Drain Piping, P-501/Detail 5				MC
Shutoff Valve, P-501/Detail 5				MC
T&P Relief Valve; Routed To Nearest Floor Drain, P-601, P-501/Detail 5, Spec. 220000-3.2.1				MC
Unit Wired (208V/3Ph.), P-601				EC
Grounding For Components and Unit, Spec. 262000-3.1.13				EC
PP-1 DHW Recirculation Pump				
Manufacturer/Model #:				MC
Equipment Label Affixed, Spec. 220000-3.6.1				MC
Maintain Clearances to Facilitate Service/Access				MC
Check Valve, P-501/Detail 11				MC
PT Ports, P-501/Detail 11				MC
Ball Valves, P-501/Detail 11				MC
Aquastat for Pump, P-501/Detail 6				MC
Unit Wired (115V/1Ph.), P-601				EC
Grounding For Components and Unit, Spec. 262000-3.1.13				EC
DHW Thermostatic Mixing Valve (TMV-1)				
Manufacturer/Model #:				MC
Equipment Label Affixed, Spec. 220553				MC
Thermometer(s), P-501/Detail 6				MC
Ball Valves, P-501/Detail 6				MC
Balancing Valve, P-501/Detail 6				MC
Check Valve(s), P-501/Detail 6				MC
Temperature on Mixing Valve Set as Schedule 110°F, P-501/Detail 6				MC

Installing Contractors: MC-Mechanical Contractor; EC-Electrical Contractor; CC-Controls Contractor

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*Warriors In Transition
Small Co HQ Building
Fort [REDACTED]*

Lighting Controls

*Pre-Functional Performance Test
Checklists*

[REDACTED]

Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort [REDACTED]

Lighting Controls for Typical Room

Room: Room #

Electrical Contractor (EC)

Interior Lighting

- Correct Number of Occupancy Sensors Installed, E-101
- Correct Type of Occupancy Sensor Installed as indicated in Sheet Keynotes on E-101
- Occupancy Sensor Installed at The Correct Height and Position To Detect Motion, E-101 and referenced in Specification Section 265100-3.1.2
- Correct Number of Day Lighting Sensors Installed, E-101
- Correct Type of Day Lighting Sensor Installed as indicated in Sheet Keynotes on E-101
- Day Lighting Sensor Installed at The Correct Height and Position To Detect lighting levels, E-101 and referenced in Specification Section 265100-3.1.2
- Proper Wiring configuration used for Occupancy Sensor(s) and Day Lighting Sensor(s) as indicated in Details E-503 and E-504
- Correct Lighting Fixtures Installed, E-101 and Lighting Schedule E-603
- Correct number of Light Fixtures Installed, E-101
- Correct number of Emergency Light Fixtures Installed, E101
- Correct Switch(s) Installed and Wired, E-101
- Initial and Date for Each Unit

Exterior Lighting

- Fixtures mounted as indicated, E-101
- Lights Controlled by a building mounted photocell as per E-101 Sheet Keynote #18
- Correct Lighting Fixtures Installed, E-101 and E-603
- Correct Amount of Light Fixtures Installed, E-101
- Fixture(s) Connect to Correct Circuit, E-101
- Exterior Lighting circuit wired through wall mounted battery inverter as per E-101 Sheet Keynotes #19 and #19
- Initial and Date for Each Unit

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**Pre-Functional Performance Test Checklist
Warriors In Transition - Small Co HQ Building**



Fort ██████████

System: Lighting Controls

ELECTRICAL CONTRACTOR

#	Dwg. #	Area Served	Occupancy Sensor(s)			Day Lighting Sensor(s)			Wiring	Fixture Type	# of Fixtures	Emerg. Light(s)	Switch	Details	Initials & Date		
			#	Type	Wiring	Position	#	Type								Wiring	Position
Interior Lighting																	
1	E-101, E-400	Vestibule - A A101	1	Note 1 E-400			1	Note 2 E-400					LF-9 EM	4 1	4 1	\$ -----	E-506/Detail 3
2	E-101	Communication A102	2	Note 3			0	-----	-----	-----			LF-2 EM	2 1	0 1	\$ -----	E-505/Detail 5
3	E-101	Men Restroom A103	2	Note 3			0	-----	-----	-----			LF-4 LF-7 LF-8 EM	1 1 1 1	0 0 0 1	----- ----- ----- -----	E-505/Detail 5
4	E-101	Men Shower A104	1	Note 3			0	-----	-----	-----			LF-4 EM	2 1	0 1	----- -----	E-505/Detail 4
5	E-101	Janitors Closet A105	0	NA	NA	NA	0	-----	-----	-----			LF-4	1	0	\$	NA
6	E-101	Mechanical A106	0	NA	NA	NA	0	-----	-----	-----			LF-6 EM	4 2	0 2	\$ -----	NA
7	E-101	Electrical A107	0	NA	NA	NA	0	-----	-----	-----			LF-6 EM	2 1	0 1	\$. \$ -----	NA
8	E-101	Platoon Sergeant A108	1	Note 3			0	-----	-----	-----			LF-2	1	0	\$D	E-505/Detail 3
9	E-101	Platoon Sergeant A109	1	Note 3			0	-----	-----	-----			LF-2	1	0	\$D	E-505/Detail 3
10	E-101	Commander A110	1	Note 3			0	-----	-----	-----			LF-2	1	0	\$D	E-505/Detail 3
11	E-101	First Sergeant A111	1	Note 3			1	Note 4					LF-2	1	0	\$	E-506/Detail 1
12	E-101	Case Manager A112	1	Note 3			1	Note 4					LF-2	1	0	\$	E-506/Detail 1
13	E-101	Nurse Case Manager A113	1	Note 3			1	Note 4					LF-2	1	0	\$	E-506/Detail 1
14	E-101	Nurse Case Manager A114	1	Note 3			1	Note 4					LF-2	1	0	\$	E-506/Detail 1
15	E-101	Social Worker A115	1	Note 3			1	Note 4					LF-2	1	0	\$	E-506/Detail 1
16	E-101	Squad Leaders A116	1	Note 3			0	-----	-----	-----			LF-3	2	0	\$D	E-505/Detail 3
17	E-101	Squad Leaders A117	1	Note 3			0	-----	-----	-----			LF-3	2	0	\$D	E-505/Detail 3
18	E-101	Squad Leaders A118	1	Note 3			0	-----	-----	-----			LF-3	2	0	\$D	E-505/Detail 3
19	E-101	Conference Room A119	1	Note 3			0	-----	-----	-----			LF-2 LF-4 EM	2 6 1	0 0 1	\$D \$D -----	E-506/Detail 4
20	E-101	Womens Shower A121	1	Note 3			0	-----	-----	-----			LF-4 EM	2 1	0 1	----- -----	E-505/Detail 4
21	E-101	Women Restroom A122	2	Note 3			0	-----	-----	-----			LF-4 LF-7 LF-8 EM	1 1 1 1	0 0 0 1	----- ----- ----- -----	E-505/Detail 5
22	E-101	Message Center A123	1	Note 3			0	-----	-----	-----			LF-2	1	0	\$D	E-505/Detail 3
23	E101	Copier and Fax A124	1	Note 3			0	-----	-----	-----			LF-3	1	0	\$	E-505/Detail 4
24	E101	Records Room A125	1	Note 3			0	-----	-----	-----			LF-3	1	0	\$	E-505/Detail 4
25	E101	Supply Room A130	1	Note 3			0	-----	-----	-----			LF-3	1	0	\$	E-505/Detail 4
26	E-101	Kitchenette A131	1	Note 3			0	-----	-----	-----			LF-3 EM	1 1	0 1	\$ -----	E-505/Detail 4
27	E-101	Reception Waiting Room A136	2	Note 9			1	Note 10					LF-4 LF-5 EM X2	10 4 4 1	0 0 4 1	(2)\$3, \$4 ----- ----- -----	E-506/Detail 2
28	E-101	Open Office Area A137	2	Note 14			0	-----	-----	-----			LF-1 EM	8 2	0 2	(2)\$3, (2)\$4 -----	E-505/Detail 2
29	E-101	Corridor B A138 Corridor C A139 Corridor D A140	5	Note 12			0	-----	-----	-----			LF-1	13	0	(2)\$3, (2)\$4	E-505/Detail 1

ELECTRICAL CONTRACTOR

Exterior Lighting

#	Dwg. #	Area Served	Fixture Type	# of Fixture	Photocell	Emergency	Detail	Initials and Date	Remarks
1	E-101	Building Exterior	OLF-1	5	Building	5	E-506/Detail 5		
2	E-010	Site	OLF-3	5	Integral	0	-----		
			OLF-4	5	Integral	0	-----		

#	Date	Remarks

*Warriors In Transition
Small Co HQ Building
Fort [REDACTED]*

Appendix B

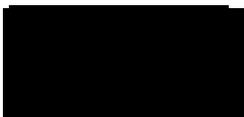
Functional Performance Tests



*Warriors In Transition
Small Co HQ Building
Fort [REDACTED]*

Supply Air System

Functional Performance Tests



Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort [REDACTED]

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Startup Report For Unit Completed And Provided			
PVT Report Completed And Provided			
TAB Complete And Provided			
Pre-Functional Performance Test Checklist Completed			
Monitoring Points			
Mixed Air Temperature (TS-01)			
Supply Air Temperature (TS-02)			
Outside Air Temperature (TS-03)			
Filter Status (DP-01)			
Return Air Relative Humidity Sensor (RH-01)			
Static Pressure Sensor (PS-01)			
Supply Fan VFD Feedback (SC-02)			
Exhaust Relief Fan VFD Feedback (SC-04)			
Building Static Pressure (DP-02)			
Return Smoke Detector (SD-01)			
Supply Fan Status (IS-01)			
Exhaust Relief Fan Status (IS-02)			
High Limit Static Pressure Switch (HPS-01)			
Supply Fan VFD Alarm (CR-02)			
Exhaust Relief Fan VFD Alarm (CR-04)			
WSHP DX Coil Control (DX-01)			
Supply Fan VFD Command (SC-01)			
Exhaust Relief Van VFD Command (SC-03)			
Economizer Outside Air Damper (DA-01)			
ERV Outside Air Damper (DA-02)			
Mixed Return Air Damper (DA-03)			
Economizer Relief Air Damper (DA-04)			
Supply Fan Command (CR-01)			
Exhaust Relief Fan Command (CR-03)			
Stop AHU-1			
Verify AHU-1 In Operating Mode			
Turn AHU-1 Off			
Supply Fan Off And VFD At 0%			
Return Fan Off And VFD At 0%			

"This Functional Performance Test document represents [REDACTED] standard test protocol, basic functional test, and [REDACTED] best understanding of the designed sequence of operation. This document DOES NOT define design intent, supersede contract documents, or direct means and methods."

Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort ██████████

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Stop AHU-1 (Continued)			
WSHP DX Coil Off			
Outside Air Damper Closed			
Return Air Damper Open			
Relief Air Damper Closed			
Safeties/Alarms			
Place AHU-1 In Occupied Mode			
Demonstrate High Static Limit Safety 3.5 In W.C.			
BAS Receives Alarm Condition			
AHU-1 Shuts Down			
Manually Reset High Static Limit Safety			
AHU-1 Returns To Occupied Mode			
Demonstrate Low Static Limit Safety 0.4 In W.C.			
BAS Receives Alarm Condition			
AHU-1 Shuts Down			
Manually Reset Low Static Limit Safety			
AHU-1 Returns To Occupied Mode			
Demonstrate Filter Status (DP-01) Alarm (0.7 High Or 0.1 Low)			0.75" WG (adj.)
BAS Receives Alarm Condition			
Reset Alarm			
Demonstrate High Limit Mixed Air Temperature (60°F)			
BAS Receives Alarm Condition			
Reset Alarm			
Demonstrate Low Limit Mixed Air Temperature (45°F)			
BAS Receives Alarm Condition			
Reset Alarm			
Demonstrate High Limit Supply Air Temperature (105°F)			
BAS Receives Alarm Condition			
Reset Alarm			
Demonstrate Low Limit Supply Air Temperature (45°F)			
BAS Receives Alarm Condition			
Reset Alarm			
Demonstrate High Limit Return Air Relative Humidity (60%)			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort ██████████

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Safeties/Alarms (Continued)			
BAS Receives Alarm Condition			
Reset Alarm			
Demonstrate Low Limit Return Air Relative Humidity (40%)			
BAS Receives Alarm Condition			
Reset Alarm			
Preliminary Control Verification			
Outside Air Damper Manually Drive 0/25/50/75/100%			
Return Air Damper Manually Drive 0/25/50/75/100%			
Relief Air Damper Manually Drive 0/25/50/75/100%			
Emergency Shut Down			
Unit Is Running In Occupied Mode			
Demonstrate Activation Of The HVAC Emergency Shut Down Button			
Supply Fan Stops			
Exh. Relief Fan Stops			
Return Air Damper Closes			
Relief/Exhaust Air Damper Closes			
Reset Emergency Shut Down			
Unit Returns To Prior Occupied State			
AHU-1 Control (Smoke Detector)			
Demonstrate Smoke Detector Status			
Supply Fan De-Energizes			
Exh. Relief Fan De-Energizes			
Return Air Damper Closes			
Smoke Detector Status Generated			
Reset Alarm			
AHU Static Pressure Control			
Verify AHU-1 Is In Occupied Mode			
Design Static Pressure Setpoint Is 1.8 " WC (Adj.)	----	----	
Record The 2/3 Static Pressure Setpoint (PS-01);	----	----	_____ " WC
Record Actual Duct Static Pressure	----	----	_____ " WC
Record SF VFD Speed	----	----	SF = _____ %
Record RF VFD Speed	----	----	RF = _____ %
Decrease Static Pressure Setpoint By _____ " WC			_____ " WC
SF VFD Decreases Fan Speed To New Setpoint			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort [REDACTED]

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
AHU Static Pressure Control (Continued)			
RF VFD Tracks With SF VFD			
Return Static Pressure Setpoint To Original Value			
SF VFD Increases Speed To Original Setpoint			
RF VFD Tracks With SF VFD			
Release Simulation			
AHU Economizer Control			
Simulate OA Temperature Equal Or Less To Economizer Cooling Setpoint Of 65°F			
WSHP DX Coil Sequences Off			
Return Damper Closes			
Outside Air/Relief Dampers Modulate To Maintain Mixed Air Temperature Setpoint 55°F			
Demonstrate Relative Humidity Setpoint Is Exceeded			
WSHP DX Coil Modulates			
Relative Humidity Setpoint Is Maintained			
WSHP DX Coil Sequences Off			
OA Temperature Greater Than Switchover Point And Economizer Disabled			
Morning Warm-Up Cycle (Winter Mode)			
The Unit Will Use An Optimal Start Algorithm For Morning Start-Up. The Algorithm Will Minimize The Unoccupied Warm-Up Or Cool-Down Period While Achieving Comfort Conditions By The Occupied Start Schedule Period			
Check Unit For Algorithm Adjustment For Schedule Start-Up To Achieve Comfort Conditions			
Demonstrate Call For Morning Warm-Up From Schedule			
VAV Boxes Open To 100%			
Outside Air Damper Closed			
Return Air Damper Open			
Relief Air Damper Closed			
Supply Fan On And VFD Modulates			
Return Fan On And VFD Modulates			
Supply Static Pressure Setpoint Maintained			
WSHP DX Coil Modulate To Heating			
Space Temperature Setpoint Maintained At 75°F			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort ██████████

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Morning Warm-Up Cycle (Winter Mode) (Continued)			
Demonstrate Temperature Falls 0.5°F Below Occupied Space Temperature Setpoint			
AHU-1 Operates In Normal Occupied Mode			
Morning Cool-Down Cycle (Summer Mode)			
The Unit Will Use An Optimal Start Algorithm For Morning Start-Up. The Algorithm Will Minimize The Unoccupied Warm-Up Or Cool-Down Period While Achieving Comfort Conditions By The Occupied Start Schedule Period			
Check Unit For Algorithm Adjustment For Schedule Start-Up To Achieve Comfort Conditions			
Demonstrate Call For Morning Cool-Down From Schedule			
Outside Air Damper Closed			
Return Air Damper Open			
Relief Air Damper Closed			
Supply Fan On And VFD Modulates			
Return Fan On And VFD Modulates			
Supply Static Pressure Setpoint Maintained			
WSHP DX Coil Modulates To Maintain Setpoint			
Space Temperature Setpoint Maintained At 68°F			
Demonstrate Temperature Rises 0.5°F Above Occupied Space Temperature Setpoint			
AHU-1 Operates In Normal Occupied Mode			
AHU Humidity Control (RH-01)			
AHU Occupied In Auto			
Simulate Relative Humidity Above Setpoint (50%; Adj.)			
WSHP DX Coil Modulates To Maintain Setpoint			
Release Relative Humidity Simulation To Auto			
Occupied Mode – Cooling Mode			
Demonstrate Space Temperature Setpoint Rises Above 75°F			
WSHP DX Coil Modulates To Maintain Setpoint			
Supply Air Temperature Setpoint Maintained			
Return Air Damper Open			
Relief Air Damper Closed			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort ██████████

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Occupied Mode – Heating Mode			
Demonstrate Space Temperature Setpoint Rises Below 68°F			
WSHP DX Coil Modulates To Maintain Setpoint			
Supply Air Temperature Setpoint Maintained			
Return Air Damper Open			
Relief Air Damper Closed			
OA Damper At Minimum Position			
Occupied Mode Mixed Air Low Limit			
Demonstrate Mixed Air Temperature < 45°F			
OA Damper Closes Below Minimum Position			
Return Air Damper Opens			
Supply Air Temperature Setpoint Maintained			
Pump Operation Verification			
Demonstrate AHU-1 Is In Operating Mode			
P-1 (Lead) Or P-2 (Lag) On			
AHU-1 Unoccupied Mode/Night Setback			
AHU Occupied In Auto			
Place AHU In Unoccupied Mode			
SF Stops			
OA Min, Economizer And EA Dampers Close			
RA Damper Opens			
WSHP DX Coil Off			
Simulate A Space Temperature Of 80°F			
AHU SF Restarts In Unoccupied Cooling Mode			
OA Min & Economizer Dampers Remain Closed			
WSHP DX Coil Modulates To Maintain Setpoint			
Setpoint Maintained			
AHU SF Stops In Unoccupied Mode			
Simulate A Space Temperature Of 60°F			
AHU SF Restarts In Unoccupied Heating Mode			
OA Min & Economizer Dampers Remain Closed			
WSHP DX Coil Modulates To Maintain Setpoint			
Release MA-T Simulation To Auto			
Release DA-T Simulation To Auto			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Air Handling Unit**

Tag: **AHU-1**

Serves: **VAV's**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____



Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Geothermal Loop**

Tag: **WTW-1**

Service: **Hot Water**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Startup report for unit completed and provided			
PVT report completed and provided			
TAB complete and provided			
Pre-functional performance test checklist(s) completed			
Monitoring Points (Drawing M-702)			
Geothermal Loop Supply Temperature (TS-01)			
Geothermal Loop Return Temperature (TS-02)			
Geothermal Loop Return Temperature (TS-03)			
Geothermal Loop Return Temperature (TS-04)			
Hot Water Differential Pressure (DP-01)			
Geothermal Pump 1 Status (IS-01)			
Geothermal Pump 2 Status (IS-02)			
HW Heat Pump 3 Status (IS-03)			
HW Heat Pump 4 Status (IS-04)			
Geothermal Loop Flow Switch (FS-01)			
Heating Hot Water Loop Flow Switch (FS-02)			
Water to Water Heat Pump Alarm (CR-08)			
Hot Water Bypass Valve Actuator (VA-01)			
Geothermal Pump 1 Command (CR-01)			
Geothermal Pump 2 Command (CR-03)			
HW Heat Pump 3 Command (CR-05)			
HW Heat Pump 4 Command (CR-06)			
Water to Water Heat Pump Command (CR-07)			
Safeties/Alarms			
Place geothermal loop in occupied mode			
Demonstrate geothermal loop supply high limit temperature (90°F; Adj.)			
BAS receives alarm condition			
Reset alarm			
Demonstrate geothermal loop supply low limit temperature (40°F; Adj.)			
BAS receives alarm condition			
Reset alarm			
Demonstrate geothermal loop return high limit temperature (85°F; Adj.)			
BAS receives alarm condition			
Reset alarm			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Geothermal Loop**

Tag: **WTW-1**

Service: **Hot Water**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Safeties/Alarms (continued)			
Demonstrate geothermal loop return low limit temperature (45°F; Adj.)			
BAS receives alarm condition			
Reset alarm			
Demonstrate high static limit hot water differential pressure (12" W.C.)			
BAS receives alarm condition			
Reset alarm			
Demonstrate Geothermal pump 1 status is in alarm status			
BAS receives alarm condition			
Reset alarm			
Demonstrate Geothermal pump 2 status is in alarm status			
BAS receives alarm condition			
Reset alarm			
Demonstrate HW heat pump 3 status is in alarm status			
BAS receives alarm condition			
Reset alarm			
Demonstrate HW heat pump 4 status is in alarm status			
BAS receives alarm condition			
Reset alarm			
Demonstrate Geothermal loop flow switch status is in alarm status			
BAS receives alarm condition			
Reset alarm			
Weekly Pump Rotation			
Demonstrate weekly rotation of lead pump P-1			
Demonstrate pump status			
Demonstrate alarm on pump failure			
Demonstrate weekly rotation of lead pump P-2			
Demonstrate pump status			
Demonstrate alarm on pump failure			
Demonstrate weekly rotation of lead pump P-3			
Demonstrate pump status			
Demonstrate alarm on pump failure			
Demonstrate weekly rotation of lead pump P-4			
Demonstrate pump status			
Demonstrate alarm on pump failure			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Geothermal Loop**

Tag: **WTW-1**

Service: **Hot Water**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Occupied Mode – Outside Air Temperature			
Place HWS operating in Operation Mode			
Demonstrate Outside Air Temperature below ____°F			
WTW-1 on			
P-4 on			
Supply water setpoint = 120°F (adjustable)			
Supply water setpoint maintained			
Demonstrate Outside Air Temperature above ____°F			
WTW-1 off			
P-3 off			
Occupied Mode – AHU-1 Occupied/Unoccupied			
Place HWS operating in Operation Mode			
Demonstrate AHU-1 in occupied mode			
WTW-1 on			
P-1 on			
Supply water setpoint = 120°F (adjustable)			
Supply water setpoint maintained			
Demonstrate AHU-1 in unoccupied mode			
WTW-1 off			
P-1 off			
P-2 off			
Operation Mode – WTW-1 Pumps Lead/Lag Operation			
Turn lead pump P-3 “OFF” at VFD			
Record delay			
Lag pump P-4 turns on “AUTO” at VFD			
Differential Pressure setpoint maintained at ____			
Turn lead pump P-3 “ON” at VFD			
P-4 turns “OFF” at VFD			
Occupied Mode – Heating			
Place WTW-1 in occupied mode			
Demonstrate loop water source flow indicated			
Lead pump P-3 on			
Pump flow verified via DP switch			
Two-way control valve open			
WTW-1 on			
Hot water temperature setpoint maintained			
Lead pump P-3 off			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Geothermal Loop**

Tag: **WTW-1**

Service: **Hot Water**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Occupied Mode – Heating (continued)			
P-4 off			
WTW-1 off			
Bypass Control			
WTW-1 is in occupied mode			
Demonstrate differential pressure has dropped below the setpoint _____			
Bypass control valve opens			
Bypass control valve modulates to maintain setpoint			
Differential pressure setpoint is maintained			
Remove call for heating			
Unoccupied Mode – Heating Mode			
Place WTW-1 in unoccupied mode			
Supply fan off			
Compressor off			
P-3 off and status verified			
Demonstrate zone temp below ____°F			
Two-way control valve opens			
P-3 on and status verified			
Supply fan on			
Compressor on			
Demonstrate thermostat setpoint satisfied			
Supply fan off			
Compressor off			
P-3 off and status verified			
P-4 off and status verified			
Two-way control valve closed			

Number	Date	Remarks
1		
2		
3		
4		
5		

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Geothermal Loop**

Tag: **WTW-1**

Service: **Hot Water**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Energy Recovery Unit** Tag: **ERV-1** Service: **Exhaust**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Test Prerequisites			
Start-Up Report Completed & Provided			
PVT Report Completed & Provided			
Pre-Functional Performance Checklist Completed, Signed, And Dated			
TAB Report Completed & Provided			
Alarms			
Demonstrate OA Filter Status Alarm (0.7 High Or 0.1 Low)			0.75" WG (adjustable)
Alarm To BAS			
Demonstrate EA Filter Status Alarm (0.7 High Or 0.1 Low)			0.75" WG (adjustable)
Alarm To BAS			
Emergency Shut Down			
Unit Is Running In Occupied Mode			
Demonstrate Activation Of The HVAC Emergency Shut Down Button			
Supply Fan Stops			
Exh. Relief Fan Stops			
Outside Air Damper Closes			
Relief/Exhaust Air Damper Closes			
Reset Emergency Shut Down			
Unit Returns To Prior Occupied State			
ERV Control Device Verification			
Drive OA Damper To 100% Open			
OA Damper Is Fully Open			
Verify OA Damper Blade Seals			
Drive EA Damper To 100% Open			
EA Damper Fully Open			
Verify EA Damper Seals			
ERV Control (Smoke Detector)			
Demonstrate Smoke Detector Status			
Supply Fan De-Energizes			
Exh. Relief Fan De-Energizes			
Outside Air Damper Closes			
Smoke Detector Status Generated			
Reset Alarm			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort ██████████

System: **Energy Recovery Unit** Tag: **ERV-1** Service: **Exhaust**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
ERV-1 Control (Minimum Outside Air)			
Outside Air Damper Modulates Open			
OA AFMS Displays Outside Air CFM At BAS			
_____ CFM Of Outside Air Maintained			
Occupied Ventilation Mode			
Schedule ERV On			
Outside Air Damper Open			
Supply And Exhaust Fans On			
Supply Fan Modulates To Maintain CO ₂ Setpoint, 700 Ppm			_____ PPM
Adjust CO ₂ Setpoint > Space Levels			
Supply Fan VFD Decreases			
Adjust CO ₂ Setpoint < Space Levels			
Alarm To BAS If Exceeds 770 Ppm			
Supply Fan VFD Increases			
Return Thermostat To Original Setpoint			
ERU VFD/AFMS Control			
Verify That AH Is In Occupied Mode			
Record The OA Air Flow Setpoint			_____ CFM
Record Actual OA Air Flow			_____ CFM
Record SF VFD Speed			_____ %
Decrease OA Flow Setpoint			
SF VFD Decreases Speed To New Setpoint			
Return Airflow Setpoint To Original Value			
Demonstrate A Alarm To BAS From AFMS-01			
Record The EA Air Flow Setpoint. Verify The Unit Maintains Minimum Exhaust Setpoint Of 1,050 CFM			_____ CFM
Record Actual EA Air Flow			_____ CFM
Record Relief EF VFD Speed			_____ %
Decrease EA Flow Setpoint			
EF VFD Decreases Speed To New Setpoint			
Return Airflow Setpoint To Original Value			
EF VFD's Increase Speed To Original Setpoint			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Energy Recovery Unit** Tag: **ERV-1** Service: **Exhaust**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
Unoccupied Mode			
Place ERU Into Unoccupied Mode			
Supply And Exh. Relief Fans Shut Down			
Outside Air Damper Closed			
Relief/Exhaust Air Damper Closed.			
ERU Operations Deactivated			
Monitored Points			
OA Supply Fan Command (CR-01)			
Exh Relief Fan Command (CR-03)			
OA Supply Fan VFD Command (SC-01)			
Exh Relief Fan VFD Command (SC-03)			
OA Supply Fan VFD Alarm (CR-02)			
Exh Relief Fan VFD Alarm (CR-04)			
Oa Supply Fan Status (Is-01)			
Exh Relief Fan Status (Is-02)			
Energy Recovery OA Discharge Temperature (TS-01)			
Energy Recovery OA Supply Temperature (TS-02)			
Energy Recovery Entering OA Temperature (TS-03)			
Supply Smoke Detector (SD-01)			
OA Filter Status (DP-01)			
EA Filter Status (DP-02)			
OA Air Flow Measuring Station (AFMS-01)			
EA Air Flow Measuring Station (AFMS-02)			
OA Supply Fan VFD Feedback (SC-02)			
Exh. Relief Fan VFD Feedback (SC-04)			
CO2 Gas Sensor (GS-01)			

Number	Date	Remark
1		
2		
3		
4		
5		

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Energy Recovery Unit** Tag: **ERV-1** Service: **Exhaust**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: Terminal Boxes

Tag: VAV-1.01

Service: Vestibule-A A101, Message Center A123

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Terminal Boxes** Tag: **VAV-1.01**
Service: **Vestibule-A A101, Message Center A123**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: Terminal Boxes

Tag: VAV-1.02

Service: Platoon Sergeant A108/A109

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

**Warriors In Transition – Small Co HQ Building
Fort [Redacted]**

System: **Terminal Boxes** Tag: **VAV-1.02**
Service: **Platoon Sergeant A108/A109**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Terminal Boxes**
Service: **Commander A110**

Tag: **VAV-1.03**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

**Warriors In Transition – Small Co HQ Building
Fort [Redacted]**

System: **Terminal Boxes**
Service: **Commander A110**

Tag: **VAV-1.03**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: Terminal Boxes Tag: VAV-1.04
Service: Rooms A111, A112, A113, A114, and A115

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Terminal Boxes** Tag: **VAV-1.04**
Service: **Rooms A111, A112, A113, A114, and A115**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____



Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Terminal Boxes**
Service: **Squad Leaders A116**

Tag: **VAV-1.05**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Terminal Boxes**
Service: **Squad Leaders A116**

Tag: **VAV-1.05**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: Terminal Boxes

Tag: VAV-1.06

Service: Squad Leaders A117/A118

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

**Warriors In Transition – Small Co HQ Building
Fort [Redacted]**

System: **Terminal Boxes**
Service: **Squad Leaders A117/A118**

Tag: **VAV-1.06**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Terminal Boxes**
Service: **Conferene Room A119**

Tag: **VAV-1.07**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Terminal Boxes**
Service: **Conferene Room A119**

Tag: **VAV-1.07**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____



Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: Terminal Boxes

Tag: VAV-1.08

Service: Supply Room A130, Kitchenette A131

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

**Warriors In Transition – Small Co HQ Building
Fort [Redacted]**

System: **Terminal Boxes** Tag: **VAV-1.08**
Service: **Supply Room A130, Kitchenette A131**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Terminal Boxes**
Service: **Copier and Fax A124**

Tag: **VAV-1.09**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

**Warriors In Transition – Small Co HQ Building
Fort [Redacted]**

System: **Terminal Boxes**
Service: **Copier and Fax A124**

Tag: **VAV-1.09**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Terminal Boxes** Tag: **VAV-1.10**
 Service: **Rooms A125, A127, A134, A128, A133, and Corridor**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Stop AHU-1			
Verify AHU in Occupied Mode and running			
Turn AHU off			
VAV Damper closes completely			
Preliminary Control Verification			
VAV Damper manual drive 0/25/50/75/100%			
Release overrides			
Monitoring Points			
Space temperature (TS-04)			
Air flow sensor VAV box (AFS-01)			
HW control valve (VA-02)			
VAV terminal box damper (DA-04)			
VAV Control (Occupied Mode)			
Place VAV in Occupied Mode			
Demonstrate rise in space temperature above 76°F setpoint			
VAV damper drives towards open			
Demonstrate further rise in space temperature			
VAV damper modulates to maximum CFM setpoint			
Max CFM setpoint maintained			
Demonstrate decrease in space temperature below 66°F setpoint			
VAV damper drives towards closed			
Demonstrate further decrease in space temperature			
VAV damper modulates to minimum CFM setpoint			
Min CFM setpoint maintained			
Demonstrate further decrease in space temperature			
Heating valve modulates open			
Discharge Air Temperature increases			
Space setpoint maintained			

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Terminal Boxes**

Tag: **VAV-1.10**

Service: **Rooms A125, A127, A134, A128, A133, and Corridor**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____



Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Split System AC Unit** Tag: **FCU-1/ACCU-1**

Service: **Communications A102**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Prerequisites			
Startup report for unit completed and provided			
PVT report completed and provided			
TAB complete and provided			
Pre-functional performance test checklist completed			
Monitoring Points			
Space air temperature (TS-01)			
Alarms			
Demonstrate high limit temperature alarm (___°F)			
Alarm generated at workstation			
Reset alarm			
Stop FCU-1			
Verify FCU-1 in Operation Mode and running			
Turn FCU-1 off via room thermostat			
Unit turns off			
Condensing Unit off (ACCU-1)			
System status monitored by DDC			
FCU-1 Control (Normal Operation)			
Place System in Normal Operation Mode			
Demonstrate call for cooling from thermostat (72°F)			
FCU-1 stages cooling on			
Condensing Unit on (ACCU-1)			
Space temperature setpoint maintained			
Return settings to normal			

Number	Remarks

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Functional Performance Test

**Warriors In Transition – Small Co HQ Building
Fort **

System: **Split System AC Unit** Tag: **FCU-1/ACCU-1** Service: **Communications A102**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Electric Unit Heater**
Service: **Room A106**

Tag: **EUH-1**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building

Fort

System: **Electric Unit Heater**
Service: **Room A107**

Tag: **EUH-2**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____



Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort

System: Electric Wall Heater Tag: EWH-1
Service: Room A103

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed In Accordance With Manufacturer's Instructions, Spec. 230000-3.2				MC
Permanent Label Affixed, Spec. 230000-1.2.2				MC
Unit Service Access				MC
Mounting Hardware, M-601				MC
Electrical				
Unit Wired (208V/1Ph.) Wired To Panel RP1/Circuits 21,23, E-602				EC
Single Point Electrical Connection				EC
Properly Sized Circuit Breaker (20A/2P); Complies With Manufacturer's Recommendation, E-602				EC
Verify Disconnect Located Within Sight Of Unit It Controls				EC
Disconnect Switch Provided/Wired, M-601				EC
Electrical Connections Tight				EC
Grounding Installed For Components And Unit, Spec. 262000-3.1.13				EC
Safeties Installed And Operational				EC
Controls				
TS-03: Integral Thermostat, M-601				CC

<i>Notes:</i>

Remarks: **IC**-Installing Contractor; **SM**-Sheet Metal Contractor; **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

"This Pre-Functional Performance Test Checklist document represents standard test protocol, basic functional test, and best understanding of the designed sequence of operation. This document DOES NOT define design intent, supersede contract documents, or direct means and methods."



Pre-Functional Performance Test Checklist

Warriors In Transition Small Co HQ Building

Fort

System: **Electric Wall Heater** Tag: **EWH-2**
 Service: **Room A122**

<i>Installation Check/Reference</i>	<i>Provided</i>	<i>Initials</i>	<i>Date</i>	<i>IC</i>
Manufacturer:				MC
Model Number:				MC
General Checks				
Installed In Accordance With Manufacturer's Instructions, Spec. 230000-3.2				MC
Permanent Label Affixed, Spec. 230000-1.2.2				MC
Unit Service Access				MC
Mounting Hardware, M-601				MC
Electrical				
Unit Wired (208V/1Ph.) Wired To Panel RP1/Circuits 27,29, E-602				EC
Single Point Electrical Connection				EC
Properly Sized Circuit Breaker (20A/2P); Complies With Manufacturer's Recommendation, E-602				EC
Verify Disconnect Located Within Sight Of Unit It Controls				EC
Disconnect Switch Provided/Wired, M-601				EC
Electrical Connections Tight				EC
Grounding Installed For Components And Unit, Spec. 262000-3.1.13				EC
Safeties Installed And Operational				EC
Controls				
TS-04: Integral Thermostat, M-601				CC

<i>Notes:</i>

Remarks: **IC**-Installing Contractor; **SM**-Sheet Metal Contractor; **MC**-Mechanical Contractor; **EC**-Electrical Contractor; **CC**-Controls Contractor

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Exhaust Air**

Tag: **EF-1**

Service: **Mechanical Rm. A106**

<i>Functional Performance Test</i>	<i>P</i>	<i>F</i>	<i>Remarks</i>
FPT Test Prerequisites			
Start-up report completed & provided			
PVT report completed & provided			
Pre-functional performance checklist completed, signed, and dated			
TAB report completed & provided			
Initial Conditions			
Power Available to Fan Motor			
Motor Cover Installed			
Point Verification			
Space Temperature (TS-01)			
Fan Status (IS-01)			
Exhaust Fan Damper (DA-01)			
Outside Air Louver Damper (DA-02)			
Exhaust Fan Command (CR-01)			
Exhaust Fan Control			
Temperature Setpoint set to ____°F (adj.)			____°F
Ventilation Deadband set to +/- 2°F			
Outside Air Ventilation Damper Opens (LV-2)			
Fan Starts			
Fan Status Reports to BAS			
Alarm Verification			
Disconnect power to fan			
Dampers close & seal			
Exhaust Fan Failure Alarm on BAS			
Restore power to fan and Alarm Clears	----	----	
Exhaust Fan Failure Alarm Clears on BAS			
Activate Emergency Shut Down Switch			
EF-1 off			
Dampers close & seal			
Reset Emergency Shut Down Switch			

Number	Date	Remark
1		
2		
3		
4		

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Exhaust Air**

Tag: **EF-1**

Service: **Mechanical Rm. A106**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing
Representative _____

Contractor's Controls Representative _____

Design Agent's Representative _____

Contracting Officer's Representative _____

Using Agency's Representative _____

Commissioning Agent _____

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*Warriors In Transition
Small Co HQ Building
Fort [REDACTED]*

Domestic Hot Water

Functional Performance Tests





Functional Performance Test

Fort Knox – Warriors In Transition – Small Co HQ Building

Fort

System: Domestic Hot Water Fixtures

<i>Functional Performance Check</i>	<i>Pass</i>	<i>Fail</i>	<i>Remarks:</i>
FPT Test Prerequisites			
SVC form(s) completed, signed, and dated			
Men Restroom A103 Lavatory (P-2)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Men Restroom A 103 Lavatory (P-2A)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Men Shower A104 Shower Trim (P-7)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Janitors Closet A105 Custodial Floor Sink (P-4)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Woman Shower A121 Shower Trim (P-7)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Woman Restroom A122 Lavatory (P-2)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Woman Restroom A122 Lavatory (P-2A)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			
Kitchenette A131 Double Bowl Sink (P-6)			
Hot water achieved when valve opened			
Hot water achieved in _____ seconds			
HW temp. does not exceed 120°F			

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Functional Performance Test

Fort Knox – Warriors In Transition – Small Co HQ Building

Fort

System: Domestic Hot Water Fixtures

Number	Remarks

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

Commissioning Agent _____

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: Water Heater

Tag: HWH-1

Service: DHW

<i>Functional Performance Test</i>	<i>Pass</i>	<i>Fail</i>	<i>Remarks</i>
FPT Test Prerequisites			
SVC forms completed and signed and dated			
Point-to-Point checks completed			
Point calibration completed			
Off Mode			
Verify HWH-1 operating occupied mode			
Turn HWH-1 off in unoccupied mode			
Two way valve closed			
Recirc pump PP-1 off			
Electric heating element off			
Occupied Mode			
HWH-1 placed in occupied mode from own internal controls			
Recirculation pump on			
Two way valve opens until 110°F leaving water temp maintained			
Two way closed			
Electric heating element on			
140°F leaving water temperature setpoint maintained			
HWH-1 off in unoccupied mode			
Recirculation pump off			
Verify TMV-1 Operation			
Record supply water temperature to building			

Number	Date	Remarks
1		
2		
3		
4		
5		

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Functional Performance Test

Warriors In Transition – Small Co HQ Building Fort

System: **Water Heater**

Tag: **HWH-1**

Service: **DHW**

Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor’s Chief Quality Control Representative _____

Contractor’s Mechanical Representative _____

Contractor’s Electrical Representative _____

Contractor’s Testing, Adjusting and Balancing Representative _____

Contractor’s Controls Representative _____

Design Agent’s Representative _____

Contracting Officer’s Representative _____

Using Agency’s Representative _____

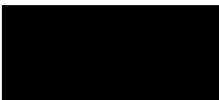
Commissioning Agent _____

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Warriors In Transition
Small Co HQ Building
Fort [REDACTED]

Lighting Controls

Functional Performance Tests



**Functional Performance Test
Warriors In Transition - Small Co HQ Building**

Fort ██████████
System: Lighting Controls



ELECTRICAL CONTRACTOR															
#	Dwg. #	Area Served	Occupancy Sensor(s)			Day Lighting Sensor(s)			Fixture Type	# of Fixtures	ON/OFF	Emerg. Light(s)	Switch	Pass/Fail	Remarks
			#	Type	Auto ON/OFF	Field of View	#	Type							
Interior Lighting															
1	E-101, E-400	Vestibule - A A101	1	Note 1 E-400			1	Note 2 E400							
									LF-9	4					
									EM	1					
2	E-101	Communication A102	2	Note 3			0	-----							
									LF-2	2					
									EM	1					
3	E-101	Men Restroom A103	2	Note 3			0	-----							
									LF-4	1					
									LF-7	1					
									LF-8	1					
									EM	1					
4	E-101	Men Shower A104	1	Note 3			0	-----							
									LF-4	2					
									EM	1					
5	E-101	Janitors Closet A105	0	-----	-----	-----	0	-----							
									LF-4	1					
6	E-101	Mechanical A106	0	-----	-----	-----	0	-----							
									LF-6	4					
									EM	2					
7	E-101	Electrical 107	0	-----	-----	-----	0	-----							
									LF-6	2					
									EM	1					
8	E-101	Platoon Sergeant A108	1	Note 3			0	-----							
									LF-2	1					
9	E-101	Platoon Sergeant A109	1	Note 3			0	-----							
									LF-2	1					
10	E-101	Commander A110	1	Note 3			0	-----							
									LF-2	1					
11	E-101	First Sergeant A111	1	Note 3			1	Note 4							
									LF-2	1					
12	E-101	Case Manager A112	1	Note 3			1	Note 4							
									LF-2	1					
13	E-101	Nurse Case Manager A113	1	Note 3			1	Note 4							
									LF-2	1					
14	E-101	Nurse Case Manager A114	1	Note 3			1	Note 4							
									LF-2	1					
15	E-101	Social Worker A115	1	Note 3			1	Note 4							
									LF-2	1					
16	E-101	Squad Leaders A116	1	Note 3			0	-----							
									LF-3	2					
17	E-101	Squad Leaders A117	1	Note 3			0	-----							
									LF-3	2					
18	E-101	Squad Leaders A118	1	Note 3			0	-----							
									LF-2	2					
									LF-4	6					
									EM	1					
19	E-101	Conference Room A119	1	Note 3			0	-----							
									LF-4	2					
									EM	1					
20	E-101	Women Shower A121	1	Note 3			0	-----							
									LF-4	1					
									EM	1					
21	E-101	Women Restroom A122	2	Note 3			0	-----							
									LF-4	1					
									LF-7	1					
									LF-8	1					
									EM	1					
22	E-101	Message Center A123	1	Note 3			0	-----							
									LF-2	1					
23	E101	Copier and Fax A124	1	Note 3			0	-----							
									LF-3	1					
24	E101	Records Room A125	1	Note 3			0	-----							
									LF-3	1					
25	E101	Supply Room A130	1	Note 3			0	-----							
									LF-3	1					
26	E-101	Kitchenette A131	1	Note 3			0	-----							
									EM	1					
									LF-4	10					
									LF-5	4					
									EM	4					
									X2	1					
27	E-101	Reception Waiting Room A136	2	Note 9			1	Note 10							
									LF-1	8					
									EM	2					
28	E-101	Open Office Area A137	2	Note 14			0	-----							
									LF-1	8					
									EM	2					
29	E-101	Corridor B A138 Corridor C A139 Corridor D A140	5	Note 12			0	-----							
									LF-1	13					

Exterior Lighting									
#	Dwg. #	Area Served	Fixture Type	# of Fixture	ON/OFF	Photocell	Emergency	Pass/Fail	Remarks
1	E-101	Building Exterior	OLF-1	5			5		
			OLF-3	5			-----		
2	E-010	Site	OLF-4	5			-----		

Warriors In Transition
Small Co HQ Building
Fort [REDACTED]

Appendix C

Commissioning Process



SECTION TABLE OF CONTENTS

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COMMISSIONING

11/12

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-- End of Section Table of Contents --

01 91 00.00 40

COMMISSIONING
11/12

PART 1 GENERAL

The requirements of this Section apply to, and are a component part of, each section of the specifications.

This Section includes:

- a. Building commissioning of the following systems:
 - (1) HVAC components and equipment
 - (2) HVAC system: interaction of cooling, heating, and comfort delivery systems
 - (3) Building Automation System (BAS): control hardware and software, sequence of operations, and integration of factory controls with BAS
 - (4) Lighting Control System and interface with daylighting
 - (5) Domestic hot water systems
 - (6) Renewable energy generation systems
- b. Building commissioning activities and documentation in support of the U.S. Green Building Council (USGBC) LEED™ rating program. Commissioning activities and documentation include the section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning" and the section on "Additional Commissioning."
- c. Building commissioning activities and documentation in support of the Building Research Establishment (BRE) Green Globes - US rating system.

The Government, Green Consultant, Architect/Engineer, or Commissioning Agent are not responsible for construction means, methods, job safety, or management function related to commissioning on the job site.

The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D6245

(2012) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation

ASTM D6345

(2010) Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air

GREEN BUILDING INITIATIVE (GBI)

Green Globes

(2004) Green Globes(tm) US Green Building Rating System

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED

(2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

LEED GBDC

(2009) LEED Reference Guide for Green Building Design and Construction

1.2 DEFINITIONS

- a. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the Project Requirements. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the Project Requirements may be included.
- b. Commissioning - Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the requirements. Commissioning during the construction, acceptance, and warranty phases intends to achieve the following specific objectives:
 - (1) Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.
 - (2) Verify and document that equipment and systems receive complete operational checkout by the installing contractors.
 - (3) Verify and document equipment and system performance.
 - (4) Verify the completeness of Operations and Maintenance materials.
 - (5) Ensure that the operating personnel are adequately trained on the operation and maintenance of the building equipment.
- c. Commissioning Agent - develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Performance Tests are performed after pre-functional checklists and startup are complete.
- d. Commissioning Plan - an overall plan that provides the structure, schedule and coordination planning for the commissioning process.
- e. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with

the Contract Documents, does not perform properly, or is not complying with the Project Requirements.

- f. Project Requirements - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the Government. It is initially the outcome of the programming and conceptual design phases.
- g. Functional Performance Test - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word.
- h. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- i. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.
- j. Pre-functional Checklist - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the Commissioning Agent to the contractor. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word "pre-functional" refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist.
- k. Seasonal Performance Tests - Functional Performance Test that are deferred until the system(s) will experience conditions closer to their design conditions.
- l. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.3 ADMINISTRATIVE REQUIREMENTS

Perform commissioning services for the system. Expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. The commissioning requires cooperation of the Contractor, subcontractors, vendors, Architect/Engineer, Commissioning Agent, Green Consultant, and Contracting Officer.

1.3.1 Coordination

Provide a Commissioning Agent for overall coordination and management of the commissioning program. The commissioning team comprises the following groups:

- a. Contractors Project Manager and Test Engineer
- b. Sub-contractor for the system being commissioned
- c. Commissioning Agents Project Manager and Project Engineers
- d. Contracting Officers Representative
- e. Green Consultant
- f. Architect/Engineer and Specialty Consultant

Coordinate with IAQ baseline evaluation in conformance with ASTM D6245, and ASTM D6345.

1.3.2 Progress Meetings

Plan and co-ordinate meetings as required to monitor construction and commissioning progress the work. Notify the Contracting Officer of construction job-site meetings to address coordination, deficiency resolution and planning issues.

1.3.3 Functional Testing Coordination

Do **not** "temporarily" start equipment for commissioning. Do not conduct functional performance testing until a pre-functional, start-up and TAB is completed for a given system. Do not functionally test the controls system and equipment it controls until all points have been calibrated and the pre-functional checklists are completed.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Commissioning Plan and Schedule

Commissioning Plan prepared in accordance with Commissioning Standard, no later than 28 days after the approval of the Commissioning Specialist.

Equipment Submittals

Provide an additional copy of all commissioned equipment to Contracting Officer for distribution to the Commissioning Authority with the Design Engineers copy.

SD-06 Test Reports

Pre-Functional Performance Tests Checklists

Submit the schedule for the Pre-Functional Performance Tests at least 14 days prior to the start of Pre-Functional Performance Testing activities. Submit completed Pre-Functional Performance Test Checklist.

Test and Balancing

Refer to Section 23 05 93 TESTING, ADJUSTING AND BALANCING for detailed requirements and procedures.

Control Drawings

Controls Sub-Contractor shall submit control drawings, sequence of operations, controls start-up test reports and Controls Performance Verification Test (PVT) to the Contracting Officer for distribution to the Commissioning Authority.

Functional Performance Tests

Submit the schedule for the Functional Performance Tests at least 14 days prior to the start of Functional Performance Test Activities. Submit complete Functional Performance Test Checklists.

Commissioning Report

No later than 14 days after completion of Functional Performance Tests.

SD-07 Certificates

Commissioning Firm

Certification of the proposed Commissioning Firm's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. Include in the documentation the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Firm or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Firm shall be described in detail.

Commissioning Specialist

Certification of the proposed Commissioning Specialist's qualifications by one of the following ACG, NEBB, or TABB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date when the current Certification expires. Any lapses in Certification of the proposed Commissioning Specialist or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Specialist shall be described in detail.

SD-11 Closeout Submittals

Final Commissioning Report

LEED™ Documentation

1.5 QUALITY CONTROL

Commissioning Agents Qualifications: Engage commissioning service personnel, that specialize in the types of inspections and tests to be performed.

Inspection and testing service agencies are members of the Building Commissioning Association (BCA) or AABC Commissioning (AABC).

1.6 DESIGN REVIEW AND DOCUMENTATION

Document basis of design and Project Requirements as they relate to environmentally responsive characteristics, including:

- a. Functionality
- b. Energy performance
- c. Water efficiency
- d. Maintainability
- e. System cost
- f. Indoor environmental quality
- g. Local environmental impacts

Review design documents to verify that each commissioned system meets the Project Requirements, including conformance with [ASTM D6245](#), [ASTM D6345](#), and [LEED GBDC](#) for new construction.

Review construction documents to verify that commissioning is adequately specified, that each commissioned system can be commissioned and is likely to meet the Project Requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 General

Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., ACG Commissioning Guideline, NEBB or TABB unless otherwise stated herein. Consider mandatory all recommendations and suggested practices contained in the Commissioning Standard. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the [Commissioning Firm](#) and Specialist and calibration of Commissioning instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the

Commissioning Standard, Commissioning procedures shall be developed by the [Commissioning Specialist](#). Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

2.1.2 LEED Commissioning

Provide documentation that meets LEED Energy & Atmosphere (EA) Prerequisite 1 and Credit 3. Obtain owner's Project Requirements and Basis of Design documents, prepared by Designer of Record, at registered project at LEED Online. Commission all systems required by LEED, including lighting controls and domestic hot water systems. Supplement/ modify appendices to this section to include all systems required to be commissioned.

2.2 TEST EQUIPMENT

Ensure instrumentation used for testing meets the following standards:

- a. Sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.
- b. Calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
- c. Maintained in good repair and operating condition throughout the duration of use on this project.

Provide all standard testing equipment required for performing startup and initial checkout and required functional performance testing for the system. Datalogging equipment or software required to test equipment will be provided by the Commissioning Agent, and not become the property of the Government.

2.2.1 Commissioning Plan

Develop a [Commissioning Plan](#) to identify how commissioning activities will be integrated into general construction and trade activities. The commissioning plan identifies how commissioning responsibilities are distributed. The intent of this plan is to evoke questions, expose issues, and resolve them with input from the entire commissioning team early in construction.

The Plan identifies who is responsible for producing the various procedures, reports, forms, and notifications. It will include the [Commissioning Schedule](#) and describe the test/acceptance procedure.

2.3 START-UP/PRE-FUNCTIONAL CHECKLISTS

Coordinate start-up plans and documentation formats, including pre-functional checklists to be completed during the startup process. Manufacturer's start-up checklists and other technical documentation guidelines can be used as the basis for pre-functional checklists.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS

The Commissioning Agent coordinates all activities. The following activities outline the commissioning tasks and the general order in which they occur.

- a. Design Review and documentation consisting of:
 - (1) Documentation of Basis of Design and Project Requirements
 - (2) Design Development Review
 - (3) Construction Document Review
- b. Commissioning Scoping Meeting
- c. Commissioning Plan
- d. Submittals Review
- e. Start-Up/Pre-Functional Checklists
- f. Functional Performance Testing
- g. Short-Term Diagnostic Testing
- h. Deficiency Report and Resolution Record
- i. Operations and Maintenance Training
- j. Record Documents Review
- k. [Final Commissioning Report](#) and LEED™ Documentation
- l. Deferred testing due to unforeseen deferred tests, seasonal testing or end of Warranty review.

3.2 FUNCTIONAL PERFORMANCE TESTING

Fully describe system test procedures identifying configuration and steps required for each test. Provide appropriate documents so that another party can repeat the tests with virtually identical results.

Submit documentation to the Contracting Officer verifying conformance with the following standards:

3.2.1 Functional Performance Test Procedures

Develop functional performance test procedures for equipment and systems. Identify specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Coordinate test procedures with the contractor for feasibility, safety, equipment and warranty protection.

Include the following information on the functional performance test forms:

- a. System and equipment or component name(s)

- b. Equipment location and ID number
- c. Date
- d. Project name
- e. Participating parties
- e. Instructions for setting up the test, including special cautions, alarm limits, etc
- f. Specific step-by-step procedures to execute the test
- g. Acceptance criteria of proper performance with a Yes / No check box
- h. Comment section

3.2.2 Test Methods

Methods for functional performance testing and verification include direct manipulation of system inputs (i.e. heating or cooling sensors), manipulation of system inputs with the building automation system (i.e. software override of sensor inputs), trend logs of system inputs and outputs using the building automation system, or short-term monitoring of system inputs and outputs using stand alone data loggers. The Commissioning Agent determines which method, or combination of methods, is most appropriate.

3.2.3 Setup

Perform each test procedure under conditions that simulate normal operating conditions as closely as possible. Where equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, have functional performance test procedures demonstrate the actual performance of safety shutoffs in a real or closely-simulated conditions of failure.

3.2.4 Sampling

The Commissioning Agent develops a sampling strategy when multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested. If, after three test attempts at testing the specified sample percentage, failures are still present, then test all remaining units at the contractors' expense.

3.2.5 Functional Performance Tests Results

Coordinate, observe and record the results of the functional performance testing. Coordinate retesting as necessary until satisfactory performance is verified. Verify the intended operation of individual components and system interactions under various conditions and modes of operation.

3.3 SHORT-TERM DIAGNOSTIC TESTING

After initial occupancy, perform short-term diagnostic testing, using the building automation system to record system operation over a three week period.

Investigate the dynamic interactions between components in the building system. Evaluate the scheduling, the interaction between heating and cooling, and the effectiveness of the HVAC system in meeting the comfort requirements.

3.4 DEFICIENCY REPORT AND RESOLUTION RECORD

Document items of non-compliance in materials, installation or operation.

3.4.1 Non-Conformance

Immediately address observed non-conformance and deficiencies in terms of notification to responsible parties, and provide recommended actions to correct deficiencies.

Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Agent. In such cases document the deficiency and resolution on the procedure form.

3.4.1.1 Identified Deficiencies Correction Procedure

If there is no dispute on the deficiency and the responsibility to correct it:

- a. The Commissioning Agent documents the deficiency and the adjustments or alterations required to correct it. The Contractor corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested.
- b. The Commissioning Agent reschedules the test and the test is repeated.

If there is a dispute about a deficiency or who is responsible:

- a. The deficiency is documented on the non-compliance form and a copy given to the Green Consultant.
- b. Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Contractor has responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by the Contracting Officer, the Architect/Engineer has responsibility for providing a design revision.
- c. The Commissioning Agent documents the resolution process.
- d. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested. The Commissioning Agent reschedules the test and the test is repeated until satisfactory performance is achieved.

The Contractor is responsible for retesting costs.

3.5 OPERATIONS AND MAINTENANCE TRAINING

Provide complete Operations and Maintenance manuals, a Training Plan and an Operations and Maintenance Database.

Coordinate and review with the Contracting Officers' representative the

training program(s) for O&M personnel.

Develop the database from the O&M manual containing the information required to start a preventative maintenance program.

Provide additional materials as necessary to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

3.6 FINAL COMMISSIONING REPORT AND LEED™ DOCUMENTATION

Compile and submit a Final [Commissioning Report](#). Summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process.

Compile and submit [LEED™ Documentation](#). Format as required by USGBC for submittal under the referenced green building rating system.

3.7 DEFERRED TESTING

3.7.1 Unforeseen Deferred Tests

If a test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon recommendation of the Commissioning Agent and the approval of the Contracting Officer. Conduct these tests in the same manner as the seasonal tests as soon as possible.

3.7.2 Deferred Tests

Schedule, coordinate, observe, and document additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the HVAC system and controls. Complete testing during the warranty period to fully test all sequences of operation.

3.7.3 End-of-Warranty Review

Conduct end of warranty review prior to the end of the warranty period. Review the current building operation with the facility maintenance staff. Include in the review all outstanding issues from original or seasonal testing. Interview facility staff to identify concerns with building operation. Provide suggestions for improvements and assist Contracting Officer in developing reports or documentation to remedy problems.

Update O&M manuals and Record Documents as necessary due to the testing.

3.8 EQUIPMENT AND SYSTEM SCHEDULE

Commission the following equipment in this project.

System	Equipment	Check
HVAC System	Air Handling Unit, AHU-1	
	Energy Recovery Unit, ERU-1	
	Variable Air Volume Units, VAV's	

System	Equipment	Check
	Exhaust Fans, EF-1 and EF-2	
	Return Fan, RF-1	
Domestic Hot Water System	Domestic Hot Water Heater HWH-1 and	
	Domestic Hot Water Pump PP-1	
	Thermostatic Mixing Valve, TMV-1	
Lighting Controls	Lighting Controls - Occupancy Sensors	
	Day Lighting Controls	

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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COMMISSIONING OF HVAC SYSTEMS

01/08

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COMMISSIONING OF HVAC SYSTEMS
01/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline (2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard (2009) Procedural Standards for Whole Building Systems Commissioning of New Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1429 (1994) HVAC Systems Commissioning Manual, 1st Edition

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and Environmental Design(tm) Green Building Rating System for New Construction (LEED-NC)

1.2 DEFINITIONS

In some instances, terminology differs between the Contract and the Commissioning Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding ACG, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	ACG	NEBB	TABB
Commissioning Standard	ACG Commissioning Guideline	Procedural Standards for Building Systems Commissioning	SMACNA HVAC Commissioning Guidelines

SIMILAR TERMS			
Contract Term	ACG	NEBB	TABB
Commissioning Specialist	ACG Certified Commissioning Agent	NEBB Qualified Commissioning Administrator	TABB Certified Commissioning Supervisor

1.3 SYSTEM DESCRIPTION

1.3.1 General

Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., [ACG Commissioning Guideline](#), [NEBB Commissioning Standard](#), or [SMACNA 1429](#) unless otherwise stated herein. Consider mandatory all recommendations and suggested practices contained in the Commissioning Standard. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the Commissioning Firm and Specialist and calibration of Commissioning instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the Commissioning Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the Commissioning Standard, Commissioning procedures shall be developed by the Commissioning Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.3.2 Energy

Formal [LEED](#) certification is not required; however, the Contractor is required to provide documentation that meets the [LEED](#) Energy & Atmosphere (EA) Prerequisite 1, Fundamental Commissioning. For New Construction and Major Revisions provide, also, documentation that meets EA Credit 3; Enhanced Commissioning. Provide documentation for as many LEED credits as possible to support LEED Silver certification of the project.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section [01 33 00](#)
SUBMITTAL PROCEDURES:

[SD-02 Shop Drawings](#)

[Commissioning Plan; G,](#)

[SD-03 Product Data](#)

[Pre-Functional Performance Test Checklists; G,](#)
[Functional Performance Tests; G,](#)

[SD-06 Test Reports](#)

Commissioning Report; G

SD-07 Certificates

Commissioning Firm; G
Commissioning Specialist; G

1.5 QUALITY ASSURANCE

1.5.1 Commissioning Firm

Submit certification of the proposed Commissioning Firm's qualifications to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. Include in the documentation the date that the Certification was initially granted and the date when the current Certification expires. The firm is either a member of ACG or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications. Any lapses in Certification of the proposed Commissioning Firm or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Firm shall be described in detail. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Firm for approval. Any firm that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections to be performed by the Commissioning Firm shall be considered invalid if the Commissioning Firm loses its certification prior to Contract completion and must be performed by an approved successor. These Commissioning services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The Commissioning Firm shall be a subcontractor of the prime Contractor and shall be financially and corporately independent of all other subContractors. The Commissioning Firm shall report to and be paid by the prime Contractor.

1.5.2 Commissioning Specialist

1.5.2.1 General

Submit certification of the proposed Commissioning Specialist's qualifications to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date when the current Certification expires. The Commissioning Specialist shall be an ACG Certified Commissioning Agent, a NEBB Qualified Commissioning Administrator, or a TABB Certified Commissioning Supervisor and shall be an employee of the approved Commissioning Firm. Any lapses in Certification of the proposed Commissioning Specialist or disciplinary action taken by ACG, NEBB, or TABB against the proposed Commissioning Specialist shall be described in detail. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Commissioning Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another Commissioning Specialist for approval. Any individual that has been the subject of disciplinary action by the ACG, the NEBB, or the TABB within the five years preceding Contract

Award is not eligible to perform any duties related to the HVAC systems, including Commissioning. All work specified in this Section and in other related Sections performed by the Commissioning Specialist shall be considered invalid if the Commissioning Specialist loses certification prior to Contract completion and must be performed by the approved successor.

1.5.2.2 Responsibilities

Perform all Commissioning work specified herein and in related sections under the direct guidance of the Commissioning Specialist. The Commissioning Specialist shall prepare, no later than 28 days after the approval of the Commissioning Specialist, the [Commissioning Plan](#) which will be a comprehensive schedule and will include all submittal requirements for procedures, notifications, reports and the Commissioning Report. After approval of the Commissioning Plan, revise the Contract NAS schedule to reflect the schedule requirements in the Commissioning Plan.

1.6 SEQUENCING AND SCHEDULING

Begin the work described in this Section only after all work required in related Sections has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Pre-Functional Performance Test Checklists shall be performed at appropriate times during the construction phase of the Contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND TEST FORMS AND CHECKLISTS

Designate Contractor team members to participate in the Pre- Functional Performance Test Checklists and the Functional Performance Tests specified herein. In addition, the Government team members will include a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency's Representative. The team members shall be as follows:

Designation	Function
A	Contractor's Commissioning Specialist
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing (TAB) Specialist
C	Contractor's Controls Representative
D	Design Agency Representative
O	Contracting Officer's Representative

Designation	Function
U	Using Agency's Representative

Appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each Pre- Functional Performance Test Checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test item shall be indicated by signature and date.

3.2 TESTS

Perform the pre-functional performance test checklists and functional performance tests in a manner that essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, establish methods which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. Provide all materials, services, and labor required to perform the pre- functional performance tests checks and functional performance tests. A functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test.

3.2.1 Pre-Functional Performance Test Checklists

Perform Pre-Functional Performance Test Checklists, for the items indicated in Appendix A, at least 28 days prior to the start of Pre-Functional Performance Test Checks. Correct and re-inspect deficiencies discovered during these checks in accordance with the applicable contract requirements. Submit the schedule for the test checks at least 14 days prior to the start of Pre-Functional Performance Test Checks.

3.2.2 Functional Performance Tests

Submit test procedures at least 28 days prior to the start of Functional Performance Tests. Submit the schedule for the tests at least 14 days prior to the start of Functional Performance Tests. Perform Functional Performance Tests for the items indicated in Appendix B. Begin Functional Performance Tests only after all Pre-Functional Performance Test Checklists have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all other relevant contract requirements. Begin Tests with equipment or components and progress through subsystems to complete systems. Upon failure of any Functional Performance Test item, correct all deficiencies in accordance with the applicable contract requirements. The item shall then be retested until it has been completed with no errors.

3.3 COMMISSIONING REPORT

Submit the Commissioning Report, no later than 14 days after completion of Functional Performance Tests, consisting of completed Pre- Functional Performance Test Checklists and completed Functional Performance Tests

organized by system and by subsystem and submitted as one package. The Commissioning Report shall also include all HVAC systems test reports, inspection reports (Preparatory, Initial and Follow-up inspections), start-up reports, TAB report, TAB verification report, Controls start-up test reports and Controls Performance Verification Test (PVT) report. The results of failed tests shall be included along with a description of the corrective action taken.

Acronyms

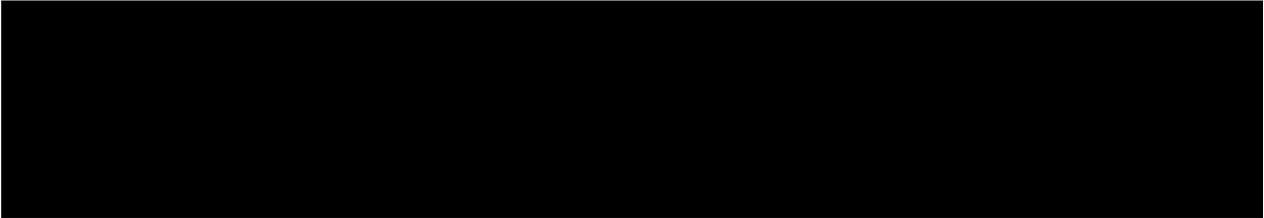
1. A Ampere
2. AABC Associated Air Balance Council
3. AC Alternating Current
4. A/C Air Conditioning
5. Ach Air changes per hour
6. ACCU Air Cooled Condensing Unit
7. ACG AABC Commissioning Group
8. A/D Analog-to-Digital
9. AE Architectural and Engineering or Architect and Engineer
10. AFMS Air Flow Monitoring Station
11. AH Air Handler
12. AHU Air Handling Unit
13. ANSI American National Standards Institute
14. AHJ Authority Having Jurisdiction
15. AHP Air Horsepower
16. AI Analog Input
17. AO Analog Output
18. AOR Architect of Record
19. ASHRAE American Society of HVACR Engineers, Inc.
20. ASME American Society of Mechanical Engineers
21. ASTM American Society for Testing and Materials
22. ATC Automatic Temperature Control
23. BACnet A data communication protocol for building automation
24. BAS Building Automation System
25. BCA Building Commissioning Association
26. BHP Brake Horsepower
27. BI Binary Input
28. BMS Boiler Management System
29. BMS Building Management System
30. BO Binary Output
31. BOD Basis of Design
32. BOD Bottom Of Duct
33. Btu British thermal unit
34. CA Commissioning Authority
35. CAD Computer-Aided design
36. CAV Constant Air Volume
37. CBF Coil Bypass Factor
38. CCC California Commissioning Collaborative
39. CD Ceiling Diffuser
40. CF Ceiling Fan
41. CFM Cubic Feet per Minute
42. cGMP current Good Manufacturing Practices
43. CH Chiller

- 44. CHW Chilled Water
- 45. CHWR..... Chilled Water Return
- 46. CHWS..... Chilled Water Supply
- 47. CMMS..... Computerized Maintenance Management System
- 48. CO Carbon Monoxide
- 49. C.O. Change Order
- 50. CO2 Carbon Dioxide
- 51. COP Coefficient of Performance
- 52. CP Commissioning Plan
- 53. CT Cooling Tower
- 54. CUH..... Cabinet Unit Heater
- 55. CUV Classroom Unit Ventilator
- 56. CWR Condenser Water Return
- 57. CWS Condenser Water Supply
- 58. Cx Commissioning
- 59. CxA ACG Certified Commissioning Authority
- 60. CxP Commissioning Plan
- 61. CxT ACG Certified Commissioning Technician
- 62. d..... Diameter
- 63. DAT Discharge Air Temperature
- 64. dB Decibel
- 65. DB (db) Dry Bulb
- 66. D-B Design-Build
- 67. DC..... Direct Current
- 68. DC..... Document Control
- 69. DDC System Direct Digital Control System
- 70. DECA..... Division of Engineering and Contract Administration
- 71. DH..... Duct Heater
- 72. DI Digital Input
- 73. DID..... Design Intent Document
- 74. DO Digital Output
- 75. DOAS..... Dedicated Outdoor Air System
- 76. DOE..... U.S. Department of Energy
- 77. DP..... Dew Point
- 78. ΔP or Delta P Differential Pressure
- 79. ΔT or Delta T..... Differential Temperature
- 80. Dx Direct Expansion
- 81. EA..... Exhaust Air
- 82. EF Exhaust Fan
- 83. EG..... Exhaust Grille
- 84. EMCS Energy Management Control System
- 85. EMS..... Energy Management System
- 86. EMT Electrical Metal Tubing
- 87. EOR..... Engineer of Record
- 88. EPA Environmental Protection Agency
- 89. ET Expansion Tank

90. FCU (FC) Fan Coil Unit
91. FF&E Furniture, Fixtures & Equipment
92. FCG Facility Commissioning Group
93. FMD Facilities Management Division
94. FPM Feet per Minute
95. FPT Functional Performance Test
96. FPT Fan Powered Terminal
97. FSE Fan Static Efficiency
98. FTP Fan Total Pressure
99. FVAV Fan Powered Variable Air Volume Terminal
100. FVP Fan Velocity Pressure
101. GPM Gallons per Minute
102. GR Grains/Grilles
103. GRD Grilles, Registers, and Diffusers
104. GRS Rigid Galvanized Steel Conduit (electrical)
105. GSF Gross Square Foot
106. h Enthalpy
107. HEPA High-Efficiency Particulate Air
108. HF Humidity Factor
109. Hp Horsepower
110. hr Hour
111. Ht Total Heat
112. HVACR Heating, Ventilation, Air Conditioning and Refrigeration
113. HWR Hot Water Return
114. HWS Hot Water Supply
115. Hx Heat Exchanger
116. Hz Hertz
117. I Current
118. IAQ Indoor Air Quality
119. IC Installing Contractor
120. IC Integrated Circuit
121. IEQ Indoor Environmental Quality
122. IMC Intermediate Metal Conduit (electrical)
123. in. W.C. Inches Water Column
124. in. W.G. Inches Water Gauge
125. IOM Installation, Operation, and Maintenance
126. IS Information Systems
127. ISO International Organization for Standardization
128. ISPE International Society of Pharmaceutical Engineers
129. IT Information Technology
130. KEF Kitchen Exhaust Fan
131. kW Kilowatt
132. LD Linear Diffuser
133. LED Light Emitting Diode
134. LEED Leadership in Energy and Environmental Design
135. LEED AP LEED Accredited Professional

- 136. L/s Liters per Second
- 137. MA Mixed Air
- 138. MBH..... Thousand Btu Per Hour
- 139. MD Manual Damper
- 140. MD Motorized Damper
- 141. MEC..... Mechanical, Electrical, Communication
- 142. MEP Mechanical, Electrical, Plumbing
- 143. MERV Minimum Efficiency Rating Value
- 144. min minute/minutes
- 145. MVD..... Manual Volume Damper
- 146. MZ Multi-Zone
- 147. NC..... Noise Criteria
- 148. NC..... Normally Closed
- 149. NEC National Electrical Code
- 150. NFPA National Fire Protection Association
- 151. NO Normally Open
- 152. OA Outside Air
- 153. OBD..... Opposed Blade Damper
- 154. O&M Operation and Maintenance
- 155. OEM Original Equipment Manufacturer
- 156. OPR..... Owner's Project Requirements
- 157. OSHA..... Occupational Safety and Health Administration
- 158. OT..... Outlet Total
- 159. OV Outlet Velocity
- 160. PBD Parallel Blade Damper
- 161. PE Professional Engineer
- 162. PF Power Factor
- 163. PID..... Proportional plus Integral plus Derivative
- 164. PM Preventative Maintenance
- 165. PR..... Pressure Range
- 166. PT Project Task(s)
- 167. PUH Propeller Unit Heater
- 168. R Resistance
- 169. RA..... Return Air
- 170. RAG..... Return Air Grille
- 171. RAM..... Random Access Memory
- 172. RAT..... Return Air Temperature
- 173. RC..... Room Criteria
- 174. RF Return Fan
- 175. RFI..... Request for Information
- 176. RFP..... Request for Proposal
- 177. RFQ Request for Qualifications
- 178. RFS..... Request for Submittal
- 179. RG Return Grille
- 180. RH..... Relative Humidity
- 181. RO Reverse Osmosis

182.	ROM	Read Only Memory
183.	RR	Return Register
184.	RTD	Resistance Temperature Detector
185.	RTF	Resolution Tracking Form
186.	RTU	Rooftop Unit
187.	RV	Relief Valve / Relief Vent
188.	s	second
189.	SA	Supply Air
190.	SAG	Supply Air Grille
191.	SCFM	Standard Cubic Feet per Minute
192.	SD	Supply Diffuser
193.	SERBCA	Southeast Region Building Commissioning Association
194.	SF	Safety Factor
195.	S.F.	Square Foot
196.	SF	Supply Fan
197.	SG	Supply Grille
198.	SHF	Sensible Heat Factor
199.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
200.	SOP	Standard Operating Procedure
201.	SP	Static Pressure
202.	SPQC	Site Progress/Quality Control
203.	Sp. Gr.	Specific Gravity
204.	SpHt	Specific Heat
205.	SPL	Sound Pressure Level
206.	SpV	Specific Volume
207.	SR	Supply Register
208.	SSTOP	System-Specific Turnover Package
209.	STP	Standard Temperature and Pressure
210.	SVC	System Verification Checklist
211.	SZ	Single Zone
212.	TAB	Testing, Adjusting and Balancing
213.	TAB	Testing and Balancing
214.	TBE	Test and Balance Engineer
215.	TCC	Temperature Control Contractor
216.	TD	Temperature Difference
217.	TDH	Total Dynamic Head
218.	TES	Thermal Energy Storage
219.	TF	Transfer Fan
220.	TG	Transfer Grille
221.	TMV	Thermostatic Mixing Value
222.	TP	Total Pressure
223.	TP	Trap Primer
224.	TR	Throttling Range
225.	TSP	Total Static Pressure
226.	UH	Unit Heater
227.	UL	Underwriter's Laboratory

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- 228. USACE Unit States Army Corps of Engineers
 - 229. USGBC United States Green Building Council
 - 230. UV Ultraviolet
 - 231. V Volt
 - 232. VA Volt-Ampere
 - 233. VAC Volts AC
 - 234. VAV Variable Air Volume
 - 235. VFD Variable Frequency Drive
 - 236. VP Velocity Pressure
 - 237. VSD Variable Speed Drive
 - 238. W Watt
 - 239. WAN Wide Area Network
 - 240. W.B. Wet Bulb
 - 241. W.C. Water Column (should use WG instead)
 - 242. W.G. Water Gauge
 - 243. WHP Water Horsepower
 - 244. Z Impedance
 - 245. °C degree Celsius
 - 246. °F degree Fahrenheit
 - 247. Ω Omega